Finance for a sustainable world

Three essays on sustainable finance

Maite Cubas Díaz

A thesis presented for the degree of

Doctor in

Quantitative Finance and Economics

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UPV EHU

Supervised by: Miguel Ángel Martínez Sedano

Universidad del País Vasco/ Euskal Herriko Unibertsitatea (UPV/EHU)

Bilbao, 2019

"Faith is taking the first step, even when you don't see the whole staircase."

"If I cannot do great things, I can do small things in a great way."

Martin Luther King

To everybody that has accompanied me during this journey, especially my family and friends.

Acknowledgements

I would like to thank many people that have helped along the whole process of creating this thesis.

Firstly, I want to express my gratitude to my supervisor Miguel Ángel Martínez Sedano for being open to investigate topics that were outside of his main area of research, and for his guidance and support throughout the process.

A huge thanks goes to my father, Luis Cosme Cubas Largacha, who has developed the databases I have used for my articles from the data I had downloaded from Datastream.

Thank you to Asbjørn Torvanger for enabling and supervising my stay in the Center for International Climate Research - Oslo (CICERO) as well as for giving me good ideas to continue and improve my research. I would also like to thank other professors and researchers that have helped me with particular issues in different chapters: Miguel Artiach Escauriaza, Javier Corral-Lage, Jon Mikel Zabala Iturriagagoitia, Casilda Lasso de la Vega, Petr Mariel, María Jesús Muñoz-Torres, Antonio Rúa Vieites and Ainhoa Zarraga Alonso. PhD and Master's colleagues that have also contributed to the development of my thesis are Jone Ascorbebeitia Bilbatua and Lorena Moldes Herrador.

More thanks goes to further scholars that have also helped to improve the different chapters of this document, such as seminar participants at the University of the Basque Country and Deusto Business School, conference participants at the AFFI and EMAN Conferences and the anonymous reviewers of the papers that have been published.

Finally, this thesis has been funded by the University of the Basque Country (grants number PIF/UPV/12/258 and MOV 16/41) and by the Spanish Ministry of Economy and Competitiveness (grant number ECO2014-51914-P).

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Introduction

The story of this thesis started with my concern about the present state of the world. We are on a path that is not sustainable, environmentally or socially, and it is my passion to help change things for the better. I thus decided to combine that passion with my previous knowledge, which is in finance. The three essays on sustainable finance included in this thesis seek to make a contribution, albeit a small one, to the well-being of our world and to society as a whole.

The first chapter that I wrote is not the one that appears first here, but the second. In my quest to find an interesting topic to write about in my thesis I came upon the paper in which Hahn and Figge (2011) presented the Value Contribution of the Resource and the Sustainable Value, measures that correct a company's profit taking into account ESG variables. I found those measures very interesting and this gave me the idea for my own first paper: creating measures that helped investors make investment decisions considering ESG factors, i.e. considering issues other than the financial profitability of their shares. And that idea led to the second chapter of this thesis, which ended up being published in the first-quartile JCR journal *Business Strategy and the Environment* on January 19, 2018.

Next came what constitutes the third chapter of this thesis. I was interested in learning whether measures such as the ones I proposed in my first article were being used by rating agencies when determining companies' credit ratings. That is, I wanted to know whether the environmental and social performance of companies is taken into consideration when determining the credit ratings because it is not possible to determine from the documents issued by the agencies whether they do so or not (to be honest, I also thought that if someone had to be the first to use the measures I had proposed, it should be me). I conducted that analysis in the article that now forms the third chapter of this thesis, which was published in the special issue on Sustainable Finance of the second-quartile JCR journal *Sustainability* on November 19, 2018.

Finally, having used data on ESG information reported by companies in my first two studies, I realised that reporting was uneven from one country and sector to another. I was also lucky enough to have access to the large, widely used Datastream database, and more specifically to its ESG part, ASSET4. I gathered as much data as possible from it and analysed the determinants of ESG reporting, including company characteristics, as in most of the previous literature, as well as country and sector variables. This made up the last chapter of this thesis to be written, but the one that appears first in this document.

The order in which the chapters appear in this thesis follows the logical development of improvements in this area within Sustainable Finance:

1. First, ESG data are needed. Companies are one of the main actors in the economy and can play a big role in the achievement (or non-achievement) of sustainability. Therefore, we need companies to report ESG information. To learn how to foster the process of improvement in ESG reporting, we need to analyse the factors that make wider reporting possible and to determine who the best performers in ESG reporting are. Thus, Chapter 1 features a hybrid panel data analysis with robust standard errors clustered by company. I find that the reporting patterns are different for environmental and social information on the one hand and governance on the other. I confirm some of the findings of previous literature, such as the positive effect of company size on ESG reporting, and add some new insights such as those derived from the separation of within and between effects in hybrid models. For instance, I conclude that becoming more profitable does not increase the quantity of environmental and social information that a company reports, but that more profitable companies do report more than less profitable ones. I also find that companies from environmentally sensitive industries tend to report more environmental and social information, but not more governance information. Moreover, South African companies report the most non-financial information, while Peruvian and Argentinian companies report the least. Companies from the Euro area report more environmental information than others, but less governance information. The same goes for companies domiciled in tax havens.

2. Second, once data are available they must be processed, because rough data are not very useful as a basis for decision-making. Therefore, Chapter 2 proposes two measures: the *Relative Sustainable Performance Measure (RSPM)* and the *Measure of Commitment-failure (MC)*, which permit sustainable decision making taking not just financial but environmental and social variables into consideration for both investors and companies themselves. This makes a triple bottom line (TBL) approach to investment decisions possible. I apply my measures to the worldwide chemical sector and validate them there. I also propose a *2D graphical sustainability analysis*, which is simple and easy for investors to understand when making investment decisions and can be used if they are concerned about environmental and social matters. It also enables companies to analyse their sustainability performance and adapt their business plans accordingly.

3. Finally, it is also important to know whether those measures are actually being used in the real world. In Chapter 3, I look at one very important indicator used by investors when they make investment decisions: the credit rating of the potential investment. I test whether credit ratings take the above-mentioned measures into account. Following the literature, I conduct a fixed-effects ordered probit analysis, using as controls the variables usually found in the related literature on credit rating analysis. The dependent variables are S&P ratings. I find that companies with higher sustainability performance levels tend to have higher credit ratings, though performing less consistently over time seems to have no effect. To check the robustness of my results, I also perform the analysis for different sectors and sub-periods. In addition, I conduct the analysis using sustainability scores provided by ASSET4 (Datastream) as an explanatory variable and using Fitch credit ratings as the explained variable.

This thesis therefore covers the process between ESG information disclosure, the use of the data reported to create measures that enable the non-financial performance of different companies to be compared and the use given to those measures to make sustainable investment decisions.

The last section of the document sets out some general conclusions.

So now let the journey begin...

1

What are the determinants of ESG reporting?

1 Introduction

Companies have been disclosing financial information about themselves for many years, given that such information has long been seen as the most important for taking investment decisions and for monitoring companies' performance. However, in the last few decades awareness of sustainability has grown and stakeholders, in particular investors, have come to demand more environmental, social and corporate governance (ESG) information from companies so as to be able to make sustainable decisions that take into consideration the non-financial performance of companies.

That shift in investor demands has also been reflected in the legislation of countries: 'once only a voluntary activity, there is a trend towards mandatory non-financial reporting. For example, in South Africa, China, Denmark, Finland, Indonesia, and most recently the European Union there are requirements in place for companies, be they large, publicly-listed or state-owned companies, to disclose ESG practices' (United Nations Global Compact, 2014).

However, although some ESG reporting regulations have existed for many years, more general sustainability regulations have been introduced only recently. For example, it was not until 2013 that the European Union issued its "Directive 2013/34/EU of the European Parliament and of the Council of 26 June 2013 on the annual financial statements, consolidated financial statements and related reports of certain types of undertaking", which obliges large companies with more than 500 employees to disclose information regarding, among others, environmental and social matters as well as issues concerning human rights and anticorruption affecting their company. This regulation did not become mandatory until fiscal year 2018.

Due to this trend, the amount of non-financial data available has increased in the last few decades (Ioannou and Serafeim, 2017; Stolowy and Paugam, 2018). In fact, the number of companies included in Datastream ASSET4, a database that includes data on ESG items reported by companies and other key performance indicators calculated from them, increased six-fold from 2002 to 2016, showing the growing interest in ESG information reporting. This increase has lead to new reporting trends such as 'integrated reporting' (IR), the creation of single reports that include both economic and ESG information about companies (Jensen and Berg, 2012; Abeysekera, 2013; Cheng et al., 2014; De Villiers et al., 2014). However, as the authors noticed when analysing non-financial data for previous studies and mentioned by Peiró-Signes et al. (2012), ESG data disclosure is uneven in different countries and sectors. This paper thus sets out to find the determinants of non-financial reporting: is it law enforcement driven or are there company, country or industry characteristics that make it more probable that a company will disclose non-financial information?

Many authors, such as Freedman and Jaggi (2005), Brammer and Pavelin (2006), Clarkson et al. (2008), Stanny and Ely (2008), Clarkson et al. (2011), D'Amico et al. (2016) and Stolowy and Paugam (2018), have studied the determinants of ESG reporting, especially environmental reporting. They analyse mainly the effect of the financial characteristics of companies on non-financial reporting, and find some matching results (e.g. the positive effect of company size) and others that are mixed (e.g. the effect of leverage). Apart from the financial determinants of non-financial reporting, D'Amico et al. (2016) include a variable related to regulation in their study and Ioannou and Serafeim (2017) study the effect of mandatory sustainability regulation on sustainability reporting.

In this paper we add to the existing literature by performing an analysis of a broad international sample of companies from different sectors dating from 2002-2017. In fact, authors such as D'Amico et al. (2016) and Stolowy and Paugam (2018) mention in their papers the interest of conducting more global analyses. Specifically, Stanny and Ely (2008) emphasise the need for this, arguing that since environmental issues are global 'it will be important to ensure appropriate disclosure across firms globally'. To do that, it is necessary to understand the incentives that lead companies to disclose environmental information. The international nature of our sample enables us to include country-related variables, which enriches our analysis and differentiates if from other research work. As far as we know, conducting our analysis with an international sample over such a long period is also a contribution. To the best of our knowledge, this is the first study that analyses the reporting patterns for environmental, social and governance data separately and also combines the information on non-financial reporting using Principal Component Analysis. Finally, we use a hybrid panel data analysis that separates the within and between effects of variables that are time-variant, which has not been done previously in reporting analysis.

Our main findings include different ESG reporting patterns for different types of information (mainly environmental and social vs. governance) and determining the best and worst performers in terms of non-financial reporting (by countries, sectors, etc.). Due to the methodology used, we also find that, depending on the variable, some within and between estimators are statistically different, which reveals different effects of those variables for a company over time and between companies that differ in terms of that variable.

The rest of the paper is organised as follows. Section Two presents our hypotheses regarding the determinants of ESG disclosure. Section Three contains the descriptive analysis of the variables used in the model estimations to test those hypotheses. Section Four presents the results of the model estimations and Section Five outlines the conclusions of the paper.

2 Hypotheses

This section presents the hypotheses tested in this paper, which are classified as *Company*, *Industry* and *Country Features*. When two or more hypotheses with the same number and different letters (e.g. 6a and 6b) are presented, they are considered as alternative hypotheses and are thus not both tested simultaneously so as to avoid multicollinearity in the estimations.

2.1 Company Features

Company features, such as financial and economic situation, size, etc. can affect decisions on whether or not to report certain non-financial information, as mentioned in the Introduction. This subsection presents the different hypothesis tested regarding these features.

Size

Prior research has included the size of the company as one of the drivers of both general and environmental disclosure, with a positive relationship being found in almost all cases between company size and disclosure. Al-Tuwaijri et al. (2004) and Helfaya and Moussa (2017) are exceptions: the former finds that the size-environmental disclosure relationship is negative and the latter that there is no such relationship.

This positive relationship hypothesis relies on the idea that bigger companies have higher public visibility and, therefore, stakeholders demand more information from them (Eleftheriadis and Anagnostopoulou, 2015). Moreover, since bigger companies benefit more from greater disclosure (Frías-Aceituno et al., 2014), they can afford to dedicate more resources to the collection and disclosure of non-financial information than smaller companies (Eleftheriadis and Anagnostopoulou, 2015).

Since this has been widely proven, our hypothesis is the following:

H1: Size has a positive effect on non-financial information disclosure.

Profitability

Stakeholder theory states more profitable companies will report environmental and social information and information on investment in social responsibility (Cho and Patten, 2007; D'Amico et al., 2016) voluntarily more often than less profitable companies, because they are more likely to invest in higher social value activities and want to spread that information. Some authors, such as Cormier and Magnan (1999), Eleftheriadis and Anagnostopoulou (2015) and Stolowy and Paugam (2018), have confirmed this theory.

At the same time, other authors defend just the opposite, i.e. that companies with worse economic performance disclose more non-financial information in order to make themselves more attractive (Andrikopoulos and Kriklani, 2013). Most authors, however, do not find any significant relationship between profitability (measured as return on assets -ROA-, return on equity -ROE- or return on investment -ROI-) and non-financial information disclosure or IR adoption.

Taking all this into account, we choose to measure profitability as the ROA of companies and state the following hypothesis:

H2: Profitability has a positive effect on non-financial information disclosure.

Financial Situation

Some authors have also considered leverage as a possible explanatory variable of non-financial reporting. However, they have obtained mixed results.

Prencipe (2004), Clarkson et al. (2008) and D'Amico et al. (2016) are among those who find a positive relationship. As Freedman and Jaggi (2005) and Gallego-Álvarez (2012) argue, greater information disclosure is likely to lead to being chosen by more investors because they can more easily 'measure the risks associated with a firm's operational activities'. Thus, companies that are more in debt tend to report more non-financial information. In fact, some lenders might require this type of information periodically (Lai et al., 2016).

Those reporting a negative relationship include Cormier and Magnan (1999, 2003), Brammer and Pavelin (2006) and Ben-Amar and McIlkenny (2015). The reason could be the fact that more indebted companies cannot afford 'the costs of producing and publishing information regarding their environmental practices' (Andrikopoulos and Kriklani, 2013). Nevertheless, most authors find no significant relationship between leverage (measured as either the debt/equity or the debt/asset ratio) and disclosure.

We choose to measure leverage as the debt/total assets ratio and test the following hypothesis:

H3: Leverage has a negative effect on non-financial information disclosure.

Capital Intensity

Capital intensity has been found to have a positive relationship with CSR/sustainability reporting by Clarkson et al. (2008), Clarkson et al. (2011) and Stolowy and Paugam (2018). The rationale behind this relationship is that 'firms with higher sustaining capital expenditures [...] are expected to have newer equipment and a better environmental performance' and, therefore, might want to disclose information about it (Clarkson et al., 2008; Borghei et al., 2018).

We measure capital intensity as the ratio of 'Property, Plant and Equipment' (PPE) to total assets, as Clarkson et al. (2011) do, and test the following hypothesis:

H4: Capital intensity has a positive effect on non-financial information disclosure.

Growth opportunities

Some studies such as Prado-Lorenzo et al. (2009a,b) and Prado-Lorenzo and García-Sánchez (2010) have found that companies with greater growth opportunities, measured in terms of market-to-book value (MTBV), tend to disclose more information voluntarily than companies with lower growth opportunities. The reason seems to be that information is needed by investors to establish trust in potential investments, so disclosure is a way of reducing information asymmetry and, thus, the cost of external financing (Frías-Aceituno et al., 2014). However, authors such as Frías-Aceituno et al. (2014), Ben-Amar and McIlkenny (2015) and Stolowy and Paugam (2018) do not find this relationship significant.

Consequently, our hypothesis is the following:

H5: Growth opportunities have a positive effect on non-financial information disclosure.

2.2 Industry Features

Sector has traditionally been considered a relevant variable when measuring the amount of information that companies report: it is argued that companies in the same sector tend to behave in similar ways when disclosing information. Accordingly, not only the amount but also the type of non-financial information reported is dependent on the sector in which companies operate. Some authors, such as Oyelere et al. (2003), Gul and Leung (2004) and Bonsón and Escobar (2004), have found the sector in which a company operates to be a variable that helps explain the amount of information that companies disclose voluntarily. However, Frías-Aceituno et al. (2014) do not find any significant relationship between sector and integrated reporting, and Al-Gamrh and Al-dhamari (2016) and Halkos and Skouloudis (2016) do not find any significant relationship between CSR disclosure and the type of industry.

A special interpretation of the influence of the sector states that it is not the sector of industry in general that explains the amount of non-financial information disclosed but the fact that some industries are considered sensitive [especially environmentally sensitive, for example high carbon impact industries (Ben-Amar and McIlkenny, 2015)]. Indeed, many scholars have recently taken this fact into account in their papers and have found mixed results. For example, Patten (2002), Halkos and Skouloudis (2016) and Stolowy and Paugam (2018) find that a company in a sensitive industry is significantly more likely to disclose sustainability information, but da Silva Monteiro and Aibar-Guzmán (2010) do not. D'Amico et al. (2016) find that companies in sensitive industries 'limit themselves to reporting environmental information of a qualitative nature'.

Other authors find that companies in certain sectors tend to disclose more non-financial information. Brammer and Pavelin (2006) find that companies in sectors with higher environmental impacts are more likely to disclose environmental information than those in lower environmental impact sectors. To name a few other examples, Eleftheriadis and Anagnostopoulou (2015) conclude that belonging to the 'Oil and Gas' sector has a significantly positive effect on the amount of climate change information disclosed, while Lai et al. (2016) find that companies in 'Basic Materials', 'Industrials', and 'Financials' are more likely to produce an integrated report than 'Oil and Gas' companies. Freedman and Jaggi (2005) find that the four sectors that they test ('Auto', 'Oil', 'Energy' and 'Chemicals') report significantly more than others and Cormier and Magnan (1999) find that 'Steel, metals and mines' companies disclose less environmental information than 'Pulp and paper' companies. Cowen et al. (1987) find that certain sectors are more likely to report certain types of information.

We hypothesise that being part of an environmentally sensitive industry increases the amount of non-financial information disclosed by companies. We follow the "sensitive industry" classification drawn up by Cho and Patten (2007) and followed by Stolowy and Paugam (2018).

All in all, we test these two alternative hypotheses:

H6a: Non-financial reporting varies from one sector to another.

H6b: Being part of a sensitive industry has a positive effect on non-financial information disclosure.

2.3 Country Features

Location can influence the quantity and type of non-financial information reported by companies. This subsection presents the different hypotheses tested regarding country features.

Country

Companies are influenced by the context in which they operate. Specifically, the quantity and type of information that they disclose depends on the culture of the country in which they are established. For example, South Africa is known as a pioneer in non-financial information disclosure and thus has a core role in studies regarding non-financial disclosure such as Stolowy and Paugam (2018).

Therefore, we test the following hypothesis:

H7a: Non-financial disclosure varies from one country to another.

Continent

In line with H7a, the continent where a company is located also influences the quantity and type of information that it discloses. For example, as can be observed in the next section, European companies report more non-financial information in relative terms than companies on other continents.

H7b: Non-financial disclosure varies from one continent to another.

Currency

Similarly, currency, which in cases such as the *Euro Area* extends across a group of countries, can also define zones with higher or lower non-financial information disclosure.

Therefore, our hypothesis is:

H7c: Non-financial disclosure varies depending on the currency of reporting.

Legislation/regulation on non-financial information disclosure

Of course, if there is regulation enforcing non-financial information disclosure, be it a law enacted by government, a requirement of a stock exchange or similar regulations, companies affected will report such information. However, if there are no such regulations in force, companies can choose whether or not to collect and disclose non-financial information. D'Amico et al. (2016) include legislation in their study of environmental disclosure by Italian companies, and find that the introduction of legislation had a positive effect only on quantitative disclosure (not on qualitative disclosure). Along the same lines, Ioannou and Serafeim (2017) find a positive effect of mandatory regulations on ESG reporting.

Here, we only test quantitative disclosure, so we hypothesise as follows:

H7d: The existence of regulations about mandatory non-financial disclosure has a positive effect on non-financial information disclosure.

Tax Havens

Very low taxes for foreigners and financial secrecy have traditionally been associated with tax havens. If financial secrecy is high and fiscal regulation is lax, then non-financial disclosure can also be expected to be lower.

Therefore, we test the following hypothesis:

H7e: The fact that the country where a company is located is a tax haven has a negative effect on non-financial information disclosure.

Human Development Index (HDI)

The HDI has been used for many years to measure the development level of countries. We believe that the development level of a country might be related to the priorities of its governments, companies and citizens. Therefore, in a country with a higher HDI there might be higher demands from citizens and investors for their companies to disclose non-financial information and, as a result, disclosure by companies might be higher. Jensen and Berg (2012) include HDI in their analysis and confirm the positive effect of higher levels on IR.

Therefore, we test the following hypothesis:

H7f: The Human Development Index for the country in which a company is located has a positive effect on non-financial information disclosure.

3 Data sampling and descriptive statistics

This section presents the data used in this paper and their sources, along with a brief analysis of the descriptive statistics for each variable included in the sample.

3.1 Sample selection

Most of the data used in this study were obtained from the ASSET4 database in Datastream. At the time of our data collection in July 2018 yearly ESG information[1] provided by companies was available for 2002 to 2017 for many sectors[2].

There were a total of 7,232 companies in the ASSET4 universe, of which 6,031 were active in July 2018. To determine whether companies were part of the ASSET4 universe throughout the period, we consider the *Equal-Weighted Rating /ESG Score* and the *ESGScore*: if Datastream gives a company either of those scores in a year, we assume that the company is part of the ASSET4 universe in that year.

In this paper we consider quantitative (not qualitative) ESG variables reported by companies along with other variables that characterise companies themselves, including financial variables. The reason for choosing only quantitative variables is that greater preparation efforts are required to report them, which shows that the company is considering and doing the calculations to report the data. For example, it is easier to report that the company is making an effort to reduce its CO_2 Emissions than to actually prepare and disclose actual figures.

We disregard all incomplete observations. We also disregard outlier observations that could distort our results using the heuristics presented in Verzani (2014), based on the boxplot function in Chambers et al. (1983):

$$LowerLimit = Q1 - k * (Q3 - Q1) \tag{1.1}$$

[1] `https://bizlib247.files.wordpress.com/2017/10/asset4_esg_data_glossary_feb2015_v1-4_external.xlsx`

[2] In July 2018, some companies had not reported their 2017 data yet, but might have reported them later.

and

$$UpperLimit = Q3 - k * (Q3 - Q1) \tag{1.2}$$

where Qs is the s-th quartile and k a scalar adjusted to eliminate observations causing problems in the estimations and keep as many non-problematic observations as possible.

To complete the sample, we obtained the values of HDI for the countries represented in the sample from the United Nations Development Program website[3]. We also created a binary variable determining whether the countries to which companies belong are tax havens or not based on the European Union (EU) grey list of tax havens[4]. We also created binary variables on non-financial mandatory disclosure regulations based on the information found in the database about sustainability reporting instruments referenced in Bartels et al. (2016)[5]. The regulations are classified as environmental/social/governance/general. For the scope of regulation we consider that those classified as, for example, "Environmental & Social" should be included in both the social and environmental categories. Moreover, we assume that the regulations came into force in the year of effect included in the database, unless otherwise stated in the text part of it. Companies from countries not in the above-mentioned database are also eliminated from our sample (less than 1% of the initial sample). Finally, with the SIC codes of the companies, we created a variable indicating whether each company operates in a sensitive industry or not, as in Stolowy and Paugam (2018); SIC codes starting with 10, 13, 26, 28, 29, 33 and 49 are considered sensitive, others are not.

We ended up with a sample of 6,578 companies from 55 different countries operating in all 10 TRBC (Thomson Reuters Business Classification[6]) sectors for 2002 to 2017. The number of companies per year is presented in Table 1.1. In total there are 47,526 company-year datapoints. Observe that the coverage of the ASSET4 database increases from 2002 to 2016. The reason for the lower number of observations in 2017 is that at the time of our data retrieval many companies had not yet reported their data.

[3] `http://hdr.undp.org/en/indicators/137506`

[4] `https://ec.europa.eu/taxation_customs/sites/taxation/files/eu_list_update_25_05_2018_en.pdf`

[5] `https://www.carrotsandsticks.net/regulations/`

[6] `http://financial.thomsonreuters.com/content/dam/openweb/documents/pdf/financial/trbc-fact-sheet.pdf`

Table 1.1: Number of companies per year

This table shows the number of companies in the sample per year.

Year	Number of companies
2002	782
2003	801
2004	1,509
2005	1,903
2006	1,949
2007	2,199
2008	2,676
2009	3,104
2010	3,705
2011	3,822
2012	3,913
2013	3,960
2014	4,073
2015	4,795
2016	5,543
2017	2,792
Total	47,526

3.2 Dependent variables

The dependent variables of the models estimated in this paper are calculated from the quantitative ESG variables obtained from ASSET4. We consider 25 environmental, 30 social and 18 corporate governance variables (see Appendix A for a full list of the ESG variables selected, along with their codes and a brief explanation). Our aim is to determine what factors affect a company's decision to report non-financial data and not to examine the values of data, so we transform those ESG variables into binary variables, assigning a value of 1 when the company reports the value of a certain variable in a certain year and 0 otherwise.

Table 1.2: Binary ESG Variables

This table shows the means of the binary ESG variables for the full period (2002-2017) and for two subperiods (2002-2007 and 2008-2017), the growth rate from one subperiod to the other and the overall mean for all of them in the last row.

Variable	Mean (2002-2017)	Mean (2002-2007)	Mean (2008-2017)	Mean Growth
Panel A: Environmental variables				
CO2EmT	0.38992	0.27250	0.46037	68.95%
CO2DirEm	0.28134	0.15358	0.35800	133.11%
CO2IndEm	0.25803	0.10909	0.34739	218.44%
FlaNG	0.00729	0.00616	0.00796	29.28%
OzDepSub	0.03486	0.02730	0.03939	44.32%
NOxEm	0.14152	0.12901	0.14902	15.51%
SOxEm	0.13392	0.11698	0.14409	23.18%
VOCEm	0.07476	0.06650	0.07972	19.88%
WasTot	0.25446	0.18339	0.29710	62.00%
NhazWas	0.12237	0.07164	0.15280	113.30%
WasRecT	0.19662	0.12476	0.23973	92.15%
HazWas	0.13412	0.09565	0.15720	64.34%
WatDis	0.07482	0.05188	0.08858	70.72%
WatPolEm	0.06320	0.04405	0.07470	69.57%
ISOEMSCP	0.11375	0.05814	0.14711	153.02%
EnvExp	0.16774	0.10902	0.20297	86.18%
EnvProv	0.08972	0.04083	0.11906	191.61%
CO2S3	0.13229	0.02050	0.19937	872.33%
CoffCre	0.02412	0.00274	0.03694	1246.67%
ENVRDExp	0.04883	0.04708	0.04987	5.92%
EnUTot	0.30960	0.18363	0.38519	109.76%
IndEnU	0.01168	0.01225	0.01134	-7.42%
WWTot	0.30248	0.23085	0.34545	49.65%
FWWTot	0.16238	0.06121	0.22309	264.49%
WatRec	0.05536	0.02169	0.07556	248.41%
Environmental Mean	0.14341	0.08962	0.17568	96.03%
Panel B: Social variables				
AlcRev	0.01047	0.01100	0.01016	-7.60%
TobRev	0.00396	0.00486	0.00342	-29.64%
FDAWLTot	0.00595	0.00834	0.00452	-45.87%
ProdDel	0.00375	0.00542	0.00275	-49.25%
NappDrug	0.00141	0.00171	0.00123	-28.14%
DonTot	0.32814	0.23661	0.38305	61.89%
PolCon	0.11825	0.08565	0.13781	60.90%
WomEmp	0.32299	0.18698	0.40460	116.39%
NwomEmp	0.06190	0.01909	0.08758	358.66%
WomMan	0.20910	0.12004	0.26254	118.71%
HRCCEqIn	0.09133	0.07189	0.10300	43.28%
DisEmp	0.07757	0.01115	0.11742	952.70%
SalWag	0.21413	0.32263	0.14903	-53.81%
Nemp	0.31233	0.17673	0.39369	122.77%
TURep	0.24681	0.13574	0.31345	130.92%
TurnEmp	0.18027	0.08658	0.23649	173.15%

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Variable	Mean (2002-2017)	Mean (2002-2007)	Mean (2008-2017)	Mean Growth
AnLay	0.08986	0.07041	0.10153	44.20%
PTEmp	0.10583	0.06087	0.13280	118.16%
EmpHSTH	0.02851	0.01546	0.03635	135.16%
TotInjR	0.16937	0.08362	0.22082	164.08%
AcciT	0.15048	0.06480	0.20189	211.53%
OcDisR	0.04364	0.01491	0.06088	308.23%
EmpFat	0.16575	0.09143	0.21034	130.05%
ConFat	0.06476	0.03899	0.08022	105.75%
LTIR	0.13567	0.07419	0.17256	132.59%
LostWD	0.08563	0.03347	0.11693	249.37%
AvTrainH	0.13310	0.06133	0.17617	187.26%
TrainCT	0.35294	0.23762	0.42214	77.66%
EmpSatP	0.04495	0.00460	0.06916	1403.95%
CSP	0.05388	0.00685	0.08209	1098.00%
Social Mean	0.12709	0.07810	0.15649	100.37%
Panel C: Corporate Governance variables				
AudCInd	0.82674	0.67774	0.91615	35.18%
AudCNEM	0.85255	0.73315	0.92419	26.06%
CompCInd	0.74346	0.61614	0.81984	33.06%
CompCNEM	0.76031	0.65650	0.82260	25.30%
NomCInd	0.66389	0.50869	0.75701	48.81%
NomCNEM	0.66133	0.52111	0.74547	43.05%
BoMeeNum	0.82179	0.77452	0.85015	9.77%
BoMeeAAv	0.62327	0.40617	0.75353	85.52%
CoMeeAAv	0.54691	0.31230	0.68767	120.20%
BoSize	0.99311	0.98619	0.99726	1.12%
BoMemReY	0.86337	0.80265	0.89980	12.10%
SELTCI	0.56470	0.30825	0.71856	133.11%
BoMeLTCI	0.31372	0.05918	0.46644	688.21%
NEBoMeTC	0.35017	0.29237	0.38485	31.63%
SETC	0.73625	0.64177	0.79294	23.56%
ESGRepSc	0.17322	0.00032	0.27695	85200.40%
VotCapP	0.74454	0.49034	0.89706	82.95%
AdvNotP	0.24010	0.00000	0.38415	100.00%
Governance Mean	0.63775	0.48819	0.72748	49.02%
Overall Mean	0.25859	0.18316	0.30385	65.89%

Table 1.2 shows the descriptives for these variables. It shows that average reporting is much higher for governance than for environmental and social variables. For example, *AudCInd* is reported in about 83% of the 47,526 company-year datapoints, while *CO2EmT* is only reported in about 39% of them. The table also reveals that the growth rate of the means from one period to the other is notable for most of the variables, with an overall average of 65.89%. However, the reporting of some variables decreases.

Instead of analysing each of the 73 binary ESG variables separately, we reduced the dimensions of the analysis by creating more agglutinative measures from them. In total we have five different combinations for the dependent variables in the estimations: three count variables and two principal components. An explanation of how they are calculated follows.

First, we calculate the number of environmental, social and/or governance variables reported by a company for a certain year. These count variables are calculated for each company and year. Their descriptive statistics year by year are shown in Panels A (environmental count variable -*ENV*-), B (social count variable -*SOC*-) and C (corporate governance count variable -*GOV*-) of Table 1.3. For example, the cross-sectional average reporting of environmental data in 2002 is 1.38 variables/items out of a maximum of 25.

The means and their trends are consistent with Table 1.2. It is, however, noteworthy that the positive trend seems to stop in 2015 for environmental and social reporting. We can find no explanation for this other than the fact that companies added to the sample in those years report less than those already in it. We can confirm in our sample that the environmental and social reporting averages are appreciably lower for companies incorporated into it from 2015 onwards.

It is interesting that the minimum is always 0 but the maximum never reaches the highest value possible for the environmental and the social combinations (25 and 30, respectively). This shows that there are companies that report no environmental and/or social data, but none that reports all data. However, for the governance combination the values are higher, even for the minimum in some years, and the maximum is at or very close to the highest value possible (18). This gives the distributions of the environmental and social combinations a positive skewness, while the governance combination is negatively skewed. The standard deviation of the variables increases over time, showing that there is greater heterogeneity in the disclosure of non-financial information in the most recent years.

In addition, to create the last two dependent variables we use Principal Component (PC) analysis on all the information for the 73 binary ESG variables. Two components are selected, following the scree plot analysis. Those components are Varimax rotated and labelled as the *environmental and social PC (PCENVSOC)* and the *governance PC (PCGOV)*. Between them they explain 29.56% of the total variance[7]. The scores for these rotated components (henceforth called PC combinations) for each company and year are obtained.

The descriptive statistics for those two PC combinations can be found in Panels D and E of Table 1.3[8]. A similar growth pattern can be observed, ending in the last years of the sample for *PCENVSOC*, but not for *PCGOV*. For the environmental and social PC combination the mean is higher than the median, showing that there are more low values than high values but that the high values are higher in absolute terms and making the distribution positively skewed. The opposite is true for the governance PC combination, leading to the distribution being negatively skewed.

[7]This might suggest that a lot of information is lost when only two components are chosen, but if it is taken into account that the number of original variables is 73, it can be seen that between them the two components selected explain about ten times what two original variables would explain. Moreover, as can be seen in Section Four, the results of the estimations for the principal components do not differ substantially from the results for the count variables.

[8]The means of the principal components are not 0 and their standard deviations are not 1, because they are obtained using the whole sample (including all years and also some company-year observations subsequently eliminated from the sample due to missing values or outliers in the financial variables) and in Panels D and E the descriptive statistics appear by year.

Table 1.3: Dependent variables: Combinations

This table shows the descriptive statistics for the combinations, calculated as the number of environmental, social or governance variables reported by each company for a certain year (Panels A, B and C) or as Varimax-rotated principal components (Panels D and E).

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
Panel A: Environmental Combination (*ENV*)								
2002	1.37852	0	0	14	2.70153	1.96	2.20	7.32
2003	1.73658	0	0	14	3.12678	1.80	1.91	5.74
2004	1.73095	0	0	17	3.11801	1.80	1.96	6.20
2005	2.24961	0	0	18	3.55063	1.58	1.65	4.97
2006	2.75936	0	0	18	3.92853	1.42	1.37	3.94
2007	3.58754	1	0	21	4.60095	1.28	1.11	3.13
2008	3.72459	1	0	21	4.83685	1.30	1.11	3.06
2009	4.18718	2	0	21	5.11713	1.22	1.03	2.92
2010	4.36410	2	0	21	5.27735	1.21	1.03	2.92
2011	4.67556	3	0	22	5.44396	1.16	0.95	2.74
2012	5.00026	3	0	22	5.54741	1.11	0.85	2.56
2013	5.00682	3	0	22	5.55604	1.11	0.82	2.48
2014	5.02357	3	0	22	5.54203	1.10	0.81	2.46
2015	4.43024	2	0	22	5.36237	1.21	0.98	2.79
2016	3.88977	1	0	22	5.19020	1.33	1.15	3.16
2017	3.61784	0	0	22	5.09787	1.41	1.28	3.54
Panel B: Social Combination (*SOC*)								
2002	1.90026	1	0	11	1.78850	0.94	1.43	5.69
2003	2.15855	2	0	11	1.94514	0.90	1.19	4.47
2004	1.91518	1	0	13	2.04575	1.07	1.54	5.65
2005	2.18024	1	0	14	2.39316	1.10	1.63	5.97
2006	2.53976	2	0	15	2.71169	1.07	1.40	4.61
2007	3.36380	2	0	16	3.27097	0.97	1.20	3.78
2008	3.67564	2	0	18	3.75644	1.02	1.25	3.76
2009	3.92622	2	0	18	3.89568	0.99	1.14	3.44
2010	4.27368	3	0	19	4.27871	1.00	1.08	3.21
2011	4.69911	3	0	20	4.57082	0.97	0.93	2.82
2012	5.23128	4	0	20	4.79657	0.92	0.82	2.60
2013	5.58308	4	0	21	4.87569	0.87	0.70	2.42
2014	5.51387	4	0	19	4.82629	0.88	0.66	2.37
2015	4.99020	3	0	21	4.74508	0.95	0.82	2.60
2016	4.58849	3	0	20	4.66578	1.02	0.94	2.79
2017	4.46454	3	0	20	4.45071	1.00	1.03	3.08
Panel C: Governance Combination (*GOV*)								
2002	7.67647	8	0	16	3.49852	0.46	-0.31	2.18
2003	8.60674	10	0	15	3.53043	0.41	-0.53	2.26
2004	8.23260	9	0	16	3.99796	0.49	-0.44	1.90
2005	8.59643	10	0	16	4.31636	0.50	-0.56	1.90
2006	9.08055	11	0	16	4.43597	0.49	-0.59	1.96
2007	10.53161	13	0	16	4.55647	0.43	-0.96	2.51
2008	11.24963	13	0	16	4.30341	0.38	-1.15	2.94
2009	11.98905	14	0	17	3.93041	0.33	-1.35	3.62

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Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
2010	12.16410	14	0	17	4.04077	0.33	-1.23	3.31
2011	12.67870	14	1	17	4.07639	0.32	-1.28	3.50
2012	13.27319	15	1	18	3.95149	0.30	-1.45	4.01
2013	13.47803	15	1	18	3.89072	0.29	-1.47	4.11
2014	13.70268	16	0	18	4.38880	0.32	-1.27	3.43
2015	13.98540	16	1	18	4.27914	0.31	-1.38	3.73
2016	13.95165	16	0	18	4.50155	0.32	-1.44	3.86
2017	14.47385	16	0	18	4.08000	0.28	-1.76	5.00
Panel D: Environmental and Social Principal Component Combination (*PCENVSOC*)								
2002	-0.49966	-0.68	-0.90	1.78224	0.43968	0.88	2.03	7.16
2003	-0.43983	-0.65	-0.90	1.58937	0.51364	1.17	1.81	5.81
2004	-0.45949	-0.68	-0.90	1.85020	0.51400	1.12	1.86	6.17
2005	-0.37665	-0.66	-0.93	2.29115	0.59446	1.58	1.62	5.28
2006	-0.28475	-0.61	-0.91	2.40017	0.67245	2.36	1.40	4.38
2007	-0.12864	-0.50	-0.91	3.12812	0.80031	6.22	1.12	3.40
2008	-0.09565	-0.53	-0.91	2.98581	0.87848	9.18	1.11	3.21
2009	-0.02952	-0.45	-0.90	3.33217	0.93288	31.60	1.05	3.06
2010	0.05618	-0.40	-0.91	3.38769	1.01114	18.00	0.99	2.89
2011	0.14336	-0.30	-0.91	3.65515	1.06390	7.42	0.91	2.70
2012	0.23603	-0.16	-0.91	3.59666	1.09614	4.64	0.79	2.48
2013	0.27734	-0.08	-0.91	3.74493	1.10913	4.00	0.72	2.37
2014	0.29146	-0.04	-0.91	3.68954	1.12085	3.85	0.71	2.35
2015	0.16476	-0.29	-0.91	3.77155	1.09795	6.66	0.85	2.56
2016	0.05378	-0.55	-0.91	3.83310	1.07846	20.05	0.99	2.80
2017	0.00161	-0.58	-0.90	3.69169	1.04319	647.01	1.10	3.07
Panel E: Governance Principal Component Combination (*PCGOV*)								
2002	-0.89111	-0.75	-3.11	0.92070	0.81299	0.91	-0.38	2.18
2003	-0.69223	-0.46	-2.76	0.74991	0.82794	1.20	-0.60	2.24
2004	-0.79370	-0.47	-2.90	0.74907	0.94257	1.19	-0.52	1.92
2005	-0.71884	-0.30	-3.12	0.90629	1.01644	1.41	-0.63	1.96
2006	-0.63168	-0.21	-3.09	0.93976	1.04129	1.65	-0.66	2.00
2007	-0.31229	0.18	-3.14	0.96465	1.08285	3.47	-1.03	2.61
2008	-0.15023	0.33	-3.09	1.15235	1.02590	6.83	-1.22	3.09
2009	0.03673	0.43	-3.15	1.23114	0.93455	25.45	-1.45	3.89
2010	0.03798	0.45	-2.77	1.29172	0.91716	24.15	-1.27	3.35
2011	0.11607	0.51	-2.59	1.28161	0.91926	7.92	-1.31	3.50
2012	0.21478	0.60	-2.71	1.37281	0.89067	4.15	-1.44	3.92
2013	0.24315	0.63	-2.58	1.34373	0.87260	3.59	-1.44	3.94
2014	0.19631	0.62	-2.83	1.33430	0.94858	4.83	-1.32	3.53
2015	0.24639	0.67	-2.98	1.31528	0.91649	3.72	-1.44	3.91
2016	0.23625	0.67	-2.98	1.37840	0.95924	4.06	-1.49	4.00
2017	0.33705	0.74	-2.98	1.28909	0.91761	2.72	-1.82	5.17

Table 1.4 shows the correlations between the different dependent variables. *ENV* and *SOC* are highly correlated and well represented in *PCENVSOC* (high correlation of *ENV* and *SOC* with the *PCENVSOC*), but they are not related to *GOV*. Also, *GOV* is highly correlated with *PCGOV* but not with *ENV*, *SOC* or *PCENVSOC*. Both principal components are very lightly

correlated.

Table 1.4: Correlations of Dependent Variables

This table shows the correlations between the dependent variables. *** and * denote that the coefficients are significantly different from zero at 0.1% and 5%, respectively.

	ENV	SOC	GOV	PCENVSOC	PCGOV
ENV	1				
SOC	0.7383***	1			
GOV	0.0329***	0.2262***	1		
PCENVSOC	0.9597***	0.8763***	0.0696***	1	
PCGOV	-0.0633***	0.2005***	0.9759***	-0.0109*	1

All in all, there are five dependent variables of two different types to be estimated separately:

1. Three reported data count variables (between 0 and the highest value possible, which is different for each of them): *ENV*, *SOC* and *GOV*
2. Two PC combinations: *PCENVSOC* and *PCGOV*

3.3 Independent variables

The regressors considered are those mentioned in Section 2. For each company and year the following are obtained:

1. Financial variables:
   (a) Size -*size*-, measured as the natural logarithm of total assets in thousands of US$[9].
   (b) Profitability -*profitability*-, measured as the ROA (return on assets).
   (c) Leverage -*leverageta*-, measured as the ratio between total debt and total assets.
   (d) Capital intensity -*ppenetta*-, measured as the ratio between net PPE and total assets.
   (e) Growth opportunities -*mtbv*-, measured as the market-to-book value.
2. Variables related to the sector of the company (according to TRBC):
   (a) Sector -*sector*-: 10 different economic sectors (see Appendix B for the list of sectors).
   (b) Sensitive Industry -*sensind*-: a dummy variable valued at 1 if the company belongs to an industry considered as sensitive (SIC Code that starts with 10, 13, 26, 28, 29, 33 and 49) and 0 otherwise.
3. Variables related to the country of the company:
   (a) Country -*country*-: the country where the company is domiciled (see list of countries in Appendix C).
   (b) Continent -*continent*-: six continents, considering North and South America separately.

[9] All total assets figures were converted to US$ when they were collected.

(c) Currency -*currency*- (see Appendix D for the list of currencies).

(d) Existence of mandatory regulations requiring non-financial disclosure -*regulation*-: a dummy variable valued at 1 if the country has such regulations in a specific year and 0 otherwise. A distinction is drawn between environmental, social, governance and general sustainability regulations, according to the sustainability pillar covered (*manenv*, *mansoc*, *mangov* or *mangen*).

(e) Tax Haven -*taxhaven*-: a dummy variable valued at 1 if the country is considered a tax haven[10] and 0 otherwise (see Appendix E for more details).

(f) Human Development Index -*hdi*- of the country to which the company belongs.

Table 1.5 shows the descriptive statistics of the financial variables and the HDI, the independent variables which are quantitative and continuous. Most of them do not vary much over the period analysed. It also emerges that the companies in the sample have total assets of between 1.4 and 3,998,567.82 millions of US$ (smallest and biggest companies in the sample over the whole period), with the average for the whole period being approximately 5,900.64 millions of US$. The values of the rest of the financial variables are reasonable and cover a wide range of companies. The average profitability is about 7%, with 25% being the average leverage, 30% the average capital intensity and 2.69 the average market-to-book value (values above 1 mean that the company has growth opportunities). The average HDI of the countries to which the companies of the sample belong is quite high.

Table 1.5: Independent Variables: Quantitative and Continuous

This table shows the descriptive statistics for the quantitative variables used in this paper as independent variables: *size*, *profitability*, *leverageta*, *ppenetta*, *mtbv* and *hdi*.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
Panel A: Size (*size*)								
2002	16.00	15.85	11.93	20.56	1.65	0.10	0.47	2.95
2003	16.14	15.98	12.47	20.96	1.67	0.10	0.55	3.06
2004	15.70	15.50	9.04	21.14	1.66	0.11	0.47	3.69
2005	15.73	15.51	10.53	21.18	1.62	0.10	0.56	3.58
2006	15.89	15.65	10.61	21.40	1.59	0.10	0.66	3.68
2007	15.97	15.75	11.59	21.80	1.58	0.10	0.69	3.71
2008	15.84	15.66	9.99	21.84	1.59	0.10	0.57	3.75
2009	15.71	15.54	10.06	21.80	1.64	0.10	0.49	3.70
2010	15.62	15.48	10.11	21.70	1.68	0.11	0.39	3.72
2011	15.65	15.53	9.63	21.75	1.68	0.11	0.39	3.68
2012	15.65	15.55	9.64	21.76	1.71	0.11	0.33	3.66
2013	15.62	15.53	8.80	21.86	1.74	0.11	0.23	3.69
2014	15.58	15.51	8.30	21.92	1.77	0.11	0.18	3.68
2015	15.40	15.32	7.25	21.95	1.76	0.11	0.25	3.70
2016	15.18	15.12	7.99	21.97	1.82	0.12	0.24	3.56
2017	15.19	15.11	8.22	22.11	1.93	0.13	0.30	3.75

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[10]According to the European Union (EU) grey list of tax havens.

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Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
Panel B: Profitability (*profitability*)								
2002	0.06	0.06	-2.02	0.63	0.16	2.72	-7.05	86.22
2003	0.07	0.07	-0.87	0.45	0.09	1.31	-2.05	21.23
2004	0.09	0.07	-0.49	0.70	0.08	0.94	0.64	9.77
2005	0.09	0.08	-0.39	0.72	0.08	0.88	0.97	9.38
2006	0.10	0.08	-2.12	0.76	0.10	1.03	-4.82	125.53
2007	0.10	0.09	-0.98	0.68	0.10	1.00	-0.69	20.92
2008	0.08	0.07	-1.76	5.07	0.16	2.13	9.95	362.89
2009	0.06	0.05	-2.17	0.88	0.12	2.10	-2.68	54.97
2010	0.08	0.07	-0.73	1.19	0.10	1.25	0.78	18.24
2011	0.08	0.07	-1.08	1.40	0.11	1.34	0.30	24.26
2012	0.07	0.06	-1.27	5.47	0.14	1.97	13.51	559.34
2013	0.06	0.06	-2.46	1.14	0.13	2.08	-5.30	83.87
2014	0.06	0.06	-4.71	2.83	0.15	2.33	-7.30	328.29
2015	0.05	0.06	-2.40	1.05	0.15	3.08	-4.51	52.61
2016	0.05	0.06	-2.74	2.66	0.17	3.36	-3.99	82.02
2017	0.06	0.06	-2.51	1.43	0.16	2.78	-5.66	82.34
Panel C: Leverage (*leverageta*)								
2002	0.27	0.26	0.00	0.90	0.16	0.61	0.44	3.19
2003	0.26	0.25	0.00	0.90	0.16	0.61	0.45	3.22
2004	0.25	0.24	0.00	0.97	0.17	0.68	0.61	3.31
2005	0.24	0.23	0.00	0.93	0.17	0.72	0.66	3.16
2006	0.24	0.22	0.00	0.95	0.17	0.72	0.68	3.20
2007	0.24	0.23	0.00	0.95	0.17	0.72	0.68	3.22
2008	0.25	0.24	0.00	0.95	0.18	0.71	0.62	3.10
2009	0.25	0.23	0.00	0.95	0.18	0.73	0.61	2.95
2010	0.24	0.22	0.00	0.97	0.18	0.75	0.68	3.18
2011	0.24	0.22	0.00	0.99	0.18	0.74	0.67	3.21
2012	0.24	0.23	0.00	0.95	0.18	0.74	0.67	3.19
2013	0.25	0.23	0.00	0.98	0.18	0.72	0.65	3.23
2014	0.25	0.24	0.00	0.99	0.18	0.70	0.62	3.18
2015	0.26	0.25	0.00	0.96	0.19	0.72	0.60	3.05
2016	0.26	0.24	0.00	0.99	0.19	0.75	0.65	3.08
2017	0.24	0.22	0.00	0.99	0.19	0.79	0.81	3.45
Panel D: Capital intensity (*ppenetta*)								
2002	0.30	0.23	0.00	0.99	0.25	0.83	0.84	2.85
2003	0.29	0.22	0.00	0.99	0.25	0.86	0.87	2.87
2004	0.31	0.25	0.00	0.99	0.26	0.84	0.78	2.64
2005	0.30	0.24	0.00	1.00	0.26	0.85	0.83	2.78
2006	0.29	0.23	0.00	0.99	0.25	0.86	0.87	2.84
2007	0.30	0.24	0.00	0.99	0.26	0.87	0.84	2.75
2008	0.32	0.26	0.00	0.99	0.27	0.84	0.69	2.39
2009	0.32	0.26	0.00	0.99	0.27	0.84	0.65	2.34
2010	0.31	0.25	0.00	1.00	0.26	0.85	0.67	2.37
2011	0.31	0.24	0.00	0.99	0.26	0.86	0.70	2.41
2012	0.31	0.24	0.00	0.99	0.27	0.86	0.68	2.35
2013	0.31	0.24	0.00	0.99	0.27	0.87	0.72	2.39

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Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
2014	0.31	0.24	0.00	0.99	0.28	0.88	0.72	2.39
2015	0.31	0.22	0.00	0.99	0.28	0.92	0.77	2.40
2016	0.29	0.20	0.00	0.99	0.28	0.96	0.85	2.53
2017	0.27	0.17	0.00	1.00	0.28	1.03	1.05	2.98
Panel E: Growth opportunities (*mtbv*)								
2002	2.59	1.92	-6.900	22.08	2.51	0.97	3.32	21.27
2003	2.98	2.31	-20.37	26.86	2.73	0.92	1.03	23.92
2004	2.97	2.22	-16.35	30.15	2.93	0.99	3.16	25.53
2005	3.12	2.43	-26.50	31.31	3.12	1.00	1.69	27.24
2006	3.27	2.55	-29.60	34.64	3.34	1.02	1.40	30.01
2007	3.19	2.33	-26.81	36.05	3.65	1.15	2.07	27.31
2008	1.82	1.32	-18.51	20.69	2.27	1.25	1.84	25.74
2009	2.43	1.79	-20.53	27.40	2.73	1.13	2.48	25.25
2010	2.69	1.93	-27.99	31.64	3.07	1.14	2.96	29.79
2011	2.21	1.53	-20.03	27.59	2.72	1.23	2.61	27.35
2012	2.35	1.63	-26.00	30.90	2.93	1.25	2.43	28.99
2013	2.71	1.81	-26.71	36.02	3.34	1.23	3.12	26.44
2014	2.70	1.80	-32.20	35.77	3.56	1.32	2.89	29.21
2015	2.85	1.82	-29.71	37.05	3.84	1.35	2.85	24.29
2016	2.81	1.93	-31.49	37.69	3.99	1.42	1.35	26.07
2017	3.08	2.04	-34.63	39.75	4.45	1.44	1.58	23.67
Panel F: Human Development Index (*hdi*)								
2002	0.88	0.89	0.61	0.92	0.02	0.03	-3.92	32.99
2003	0.88	0.89	0.62	0.92	0.02	0.03	-3.86	32.17
2004	0.88	0.89	0.63	0.93	0.02	0.03	-3.28	28.47
2005	0.89	0.89	0.65	0.93	0.02	0.02	-3.06	28.16
2006	0.89	0.89	0.66	0.93	0.02	0.02	-3.28	32.09
2007	0.89	0.90	0.56	0.94	0.03	0.04	-5.45	42.84
2008	0.88	0.90	0.56	0.94	0.06	0.06	-3.55	16.27
2009	0.88	0.90	0.49	0.94	0.06	0.07	-2.98	11.87
2010	0.87	0.90	0.50	0.94	0.08	0.09	-2.05	6.17
2011	0.87	0.91	0.51	0.94	0.08	0.10	-1.93	5.55
2012	0.87	0.90	0.51	0.94	0.09	0.10	-1.77	4.82
2013	0.87	0.91	0.52	0.95	0.08	0.10	-1.75	4.75
2014	0.87	0.91	0.53	0.95	0.08	0.09	-1.74	4.75
2015	0.88	0.92	0.53	0.95	0.08	0.09	-1.96	5.62
2016	0.89	0.92	0.54	0.95	0.07	0.08	-2.12	6.44
2017	0.90	0.93	0.54	0.96	0.07	0.07	-2.97	10.89

Table 1.6 shows the correlation coefficients between the variables described above. None of them is high enough to raise suspicions of multicollinearity problems in the estimations.

The descriptives of most of the binary and the qualitative independent variables are shown in Table 1.7. Panel A shows the distribution of the sample and of the reported data in terms of the sector. In this case the effect is not as big as in the variables described below, but it leads to the suspicion that belonging to the Financial sector is not conducive to ESG reporting and that belonging to more pollutant sectors (Industrials, Energy, Basic Materials, Utilities, etc.)

Table 1.6: Correlations of Independent Variables: Quantitative and Continuous

This table shows the correlations between the quantitative variables used in this paper as independent variables: *size*, *profitability*, *leverageta*, *ppenetta*, *mtbv* and *hdi*. *** denotes that the coefficients are significantly different from zero at 0.1%.

	size	profitability	leverageta	ppenetta	mtbv	hdi
size	1					
profitability	-0.0237***	1				
leverageta	0.1496***	-0.0821***	1			
ppenetta	-0.1169***	-0.0295***	0.2994***	1		
mtbv	-0.1773***	0.2207***	-0.0501***	-0.0961***	1	
hdi	-0.0613***	-0.0785***	-0.0158***	-0.0072	-0.0027	1

may be positive for reporting (H6a). Panel B confirms that companies from sensitive industries tend to report more than companies from non-sensitive industries. This variable can thus be expected to have a significant effect on reporting (H6b).

Regarding the country variable, Panel C only shows the values for the most and least represented countries in the sample. The most represented country is the USA, to which about 40.12% of the companies in the sample belong. However, the data reported as a percentage of the total data reported by all companies is much lower at 29.86%. To a lesser extent, the same goes for Australia. In the cases of Japan and especially the United Kingdom the situation is just the contrary. All this shows that country of origin can be a driver of the decision to report non-financial data (H7a). From Panel D it is clear that companies from North America report less than companies from other continents (35.89% reporting but 46.47% of the sample) and the opposite is true for companies from Europe. Therefore, significant differences between continents can be expected in non-financial reporting (H7b). Regarding currencies, Panel E shows that for companies which have the Euro as their main currency the reporting percentage is higher (14.74% reporting compared to 7.66% of the sample). This is probably due to the efforts of the European Union to increase non-financial reporting. Moreover, once again companies reporting in US Dollars are shown to report less non-financial data than others. This variable can thus also be expected to be significant in the regressions performed (H7c).

Panel F shows that the percentage of reporting is very similar to the proportion of the sample for which countries account when they are classed as tax havens and non-tax havens. This variable is thus unlikely to be significant in the regressions performed (unlike H7e).

Table 1.7: Independent Variables: Qualitative

This table shows the descriptive statistics for most of the binary and qualitative variables used in this paper as independent variables.

	Number of companies	% of companies	% of all reporting done by companies of each category
Panel A: Economic Sector (*sector*)			
Financials	1,424	21.65%	18.52%
Industrials	1,020	15.51%	16.30%
Cyclical Consumer Goods & Services	927	14.09%	14.08%
Basic Materials	676	10.28%	12.91%
Technology	630	9.58%	7.88%
Healthcare	531	8.07%	6.17%
Energy	495	7.53%	8.56%
Non-Cyclical Consumer Goods & Services	435	6.61%	7.11%
Utilities	267	4.06%	5.51%
Telecommunications Services	173	2.63%	2.96%
Panel B: Sensitive Industry (*sensind*)			
Yes	1,486	22.59%	27.35%
No	5,092	77.41%	72.65%
Panel C: Country (*country*)			
USA	2,639	40.12%	29.86%
Australia	505	7.68%	6.77%
Japan	454	6.90%	7.05%
United Kingdom	433	6.58%	10.73%
...			
Hungary	4	0.06%	0.12%
Morocco	3	0.05%	0.03%
Czech Republic	3	0.05%	0.05%
Others (5 countries)	5	0.08%	0.07%
Panel D: Continent (*continent*)			
North America	3,057	46.47%	35.89%
Asia	1,459	22.18%	21.16%
Europe	1,187	18.04%	31.38%
Oceania	505	7.68%	6.77%
South America	212	3.22%	2.12%
Africa	158	2.40%	2.68%
Panel E: Currency (*currency*)			
US$	2,670	40.59%	30.14%
AU$	505	7.68%	6.77%
€	504	7.66%	14.74%
...			
CK	2	0.03%	0.04%
NG	1	0.02%	0.02%
KT	1	0.02%	0.02%

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	Number of companies	% of companies	% of all reporting done by companies of each category
Panel F: Tax Haven (*taxhaven*)			
Yes	703	10.69%	10.15%
No	5,875	89.31%	89.85%

To measure the level of the relationship between the qualitative variables considered, we calculate the Cramér's V (Cramér, 1946) between them. Table 1.8 shows that all variables related to the country of companies are closely related, so they are not included in the estimations simultaneously. The same goes for the two variables related to sector. However, there is not a strong relationship between the variables related to country and those related to sector, so one of each type of variables is included in the estimations.

Table 1.8: Cramér's V of Independent Variables: Qualitative

This table shows the values for Cramér's V between most of the qualitative variables used in this paper as independent variables. *** denotes that the Chi-square test indicates that the relationship between the variables is significant at 0.1%.

	continent	country	currency	taxhaven	sector	sensind
continent	1					
country	1***	1				
currency	0.9965***	0.9839***	1			
taxhaven	0.4485***	1***	0.9745***	1		
sector	0.1167***	0.1870***	0.1746***	0.0881***	1	
sensind	0.0918***	0.2137***	0.2098***	-0.0461***	0.7955***	1

Table 1.9 shows descriptive statistics of the variables on mandatory sustainability disclosure regulations, and reveals that in most cases the percentage of companies in a country with a certain type of regulation is higher than the percentage of reporting accounted for by those companies. This might be because companies in some countries report non-financial information even though there may be no regulations of a certain type in those countries. It is also noteworthy that regulations have increased over time, with the percentages of companies in countries with regulations of most types being very high in the latest years of the sample.

Table 1.10 shows the correlation coefficients for the sustainability disclosure regulation variables. Most regulations are not highly correlated. However, the estimations do not include all regulations related to the variable to be explained if multicollinearity problems arise. For instance, in the model with *PCENVSOC* only the general sustainability reporting regulation is reported, because including *manenv* and *mansoc* simultaneously in the models causes multicollinearity.

Finally, we measure the relationship between country and regulation variables and the correlation between the latter and HDI. The relationship between regulation variables and country is close (see Table 1.11), so we do not include them simultaneously in the estimations. From the correlation coefficients between the regulation variables and HDI in Table 1.11, it can be

Table 1.9: Independent Variables: Sustainability Disclosure Regulations

This table shows the descriptive statistics for the binary variables on mandatory sustainability disclosure regulations.

Year	Environmental and mandatory (*manenv*)		Social and mandatory (*mansoc*)		Governance and mandatory (*mangov*)		General and mandatory (*mangen*)	
	% of companies in a country with such regulations	% of all environmental reporting done by companies in a country with such regulations	% of companies in a country with such regulations	% of all social reporting done by companies in a country with such regulations	% of companies in a country with such regulations	% of all governance reporting done by companies in a country with such regulations	% of companies in a country with such regulations	% of all reporting done by companies in a country with such regulations
2002	65.60%	53.62%	53.96%	42.73%	47.44%	59.02%	4.22%	3.39%
2003	65.54%	51.91%	54.31%	42.97%	47.19%	58.43%	7.12%	7.98%
2004	65.81%	63.94%	43.21%	38.27%	48.51%	63.35%	12.92%	14.44%
2005	69.36%	68.23%	41.93%	42.32%	44.67%	59.53%	15.29%	17.29%
2006	71.73%	69.71%	62.24%	49.94%	44.79%	59.37%	16.01%	18.18%
2007	72.94%	71.72%	63.03%	57.16%	44.84%	57.04%	20.51%	23.10%
2008	83.26%	82.25%	62.33%	59.26%	44.99%	55.02%	22.42%	24.94%
2009	82.06%	80.70%	62.60%	59.01%	46.36%	54.51%	25.90%	27.85%
2010	77.62%	78.09%	58.87%	56.04%	47.67%	53.59%	31.07%	34.18%
2011	76.58%	76.72%	58.11%	54.79%	48.82%	54.34%	31.92%	35.17%
2012	79.20%	78.85%	61.16%	60.12%	51.50%	56.06%	33.25%	36.36%
2013	79.22%	78.40%	65.86%	64.78%	63.81%	67.49%	42.47%	47.14%
2014	78.84%	77.04%	79.50%	78.86%	66.12%	70.21%	49.96%	54.83%
2015	81.52%	76.68%	82.69%	79.40%	88.22%	88.11%	50.57%	55.90%
2016	82.77%	75.78%	83.89%	78.56%	89.21%	90.12%	45.75%	51.66%
2017	88.36%	79.71%	89.51%	83.79%	94.02%	94.09%	44.59%	53.73%

Table 1.10: Correlations of Independent Variables: Sustainability Disclosure Regulations

This table shows the correlations between the mandatory sustainability disclosure regulation variables used in this paper as independent variables, measured as explained above. *** denotes that the coefficients are significantly different from zero at 0.1%.

	manenv	mansoc	mangov	mangen
manenv	1			
mansoc	0.645***	1		
mangov	0.246***	0.363***	1	
mangen	-0.0290***	-0.0564***	-0.165***	1

Table 1.11: Cramér's V between Country and Sustainability Disclosure Regulation Variables, and Correlation Coefficient between HDI and Sustainability Disclosure Regulation Variables

This table shows the values for Cramér's V between the Country and Sustainability disclosure regulation variables, and the correlation coefficient between HDI and Sustainability disclosure regulation variables. In the first column *** denotes that the Chi-square test indicates that the relationship between the variables is significant at 0.1%, and in the second column that the coefficients are significantly different from zero at 0.1%.

	country	hdi
manenv	0.8981***	0.2586***
mansoc	0.8344***	0.1339***
mangov	0.7832***	0.0685***
mangen	0.8507***	-0.1347***

deduced that it may be possible to include them simultaneously in the estimations. However, for the sake of consistency with the other variables, we choose not to do so. Therefore, we estimate different models for each of the five dependent variables, including country, continent, currency, regulation, tax haven or HDI variable(s) in each of them.

4 Methodology and results

This section presents the methodologies used to draw up the estimations and the results obtained.

4.1 Methodology

We estimate hybrid panel data models (Allison, 2009), which are generalised linear mixed models, with robust standard errors clustered by company, using the 'xthybrid' function in Stata by Schunck and Perales (2017). Hybrid models are less prone to produce biased estimators than random effects models. They calculate two estimators (within cluster -W- and between cluster -B-) for the time-variant independent variables, as long as the two coefficients are not proven to be equal. "Within" estimators show the effect of changes in time-variant variables for a company over the period, while "between" estimators show the effect of differences in those variables between companies. For those variables where the two estimators are equal and for time-invariant regressors the model gives the random effects estimator -R-. Time fixed-effects are included in all the models, and always have a significantly positive effect on the variable explained. As found in Schunck and Perales (2017) and adapted to our case, a general equation of the hybrid model would be the following:

$$g(\mu_{it}) = \alpha + \boldsymbol{\beta_W}(\boldsymbol{x}_{it} - \overline{\boldsymbol{x}}_i) + \boldsymbol{\beta_B}\overline{\boldsymbol{x}}_i + \boldsymbol{\beta_R}\boldsymbol{x}_{it} + \boldsymbol{\gamma}\boldsymbol{c}_i + u_i \tag{1.3}$$

where $g(\cdot)$ is the link function, α is the constant, $\boldsymbol{\beta_W}$ is the coefficient vector for the "within" effects, $\boldsymbol{\beta_B}$ is the coefficient vector for the "between" effects, $\boldsymbol{x}_{it}$ is the vector of time-variant variables for company i in year t, $\overline{\boldsymbol{x}}_i$ is the vector of time-means of the $\boldsymbol{x}_{it}$, $\boldsymbol{\beta_R}$ is the coefficient vector for the time-variant variables when β_W and β_B are statistically equal, $\boldsymbol{\gamma}$ is the coefficient vector for the time-invariant variables c_i and u_i is the random intercept.

They are 'generalised' models, so it is possible to estimate them for dependent variables that follow different distributions. Taking into account the type of data in our dependent variables, we consider three different distributions in the model specification: negative binomial for the count variable which was very over-dispersed (ENV), Poisson for the count variables that were not (SOC and GOV), both with a log link; and Gaussian with an identity link for the principal components ($PCENVSOC$ and $PCGOV$).

Finally, we include as regressors the financial variables (*size*, *profitability*, *leverageta*, *ppenetta* and *mtbv*), one of the two sector variable groups (*sector* or *sensind*) and one of the six country variable groups (*country*, *continent*, *currency*, *regulation*, *taxhaven* or *hdi*). The selection of these variables is explained in Section Two and the reasons for not including all of them simultaneously are given in Section Three.

Altogether, we estimate twelve models for each of the five dependent variables: two sector variable groups combined with six country variable groups.

4.2 Results

The tables included in this section show only the results of the estimations with the two PC combinations (*PCENVSOC* and *PCGOV*) as the dependent variable because, as shown in Table 1.4, they summarise the other three efficiently. However, we also give information about the results for the count variables, although it is not included in the tables. Moreover, we only show the results of the estimations using Economic Sector dummies (the reference sector is Energy), but we comment on the results using Sensitive Industry as the sector variable. Thus, the tables are organised in six columns for the sake of readability, each showing the estimations for one country variable group. The variables for which coefficients are shown are, generally, only those that have at least one which is significantly different from zero. The results for only some of the countries are presented (the reference country is Australia -AU-), specifically the 6-8 countries with the 3-4 highest and 3-4 lowest coefficients, as long as there are at least 20 companies from that country in the sample. The same 3 currency dummies (the reference currency is the Australian Dollar -AU$-) are shown in all the tables: the Euro (the only currency shared evenly by companies from several countries), the US Dollar (because of its economic importance in the world) and the South African Rand (because it is the currency of one of the pioneers in non-financial reporting). Full estimation results are available from the authors upon request.

We calculate the VIFs (Variance Inflation Factors) for the regressors in our models and find that they are all below the threshold of 10, which means that there is no multicollinearity problem in them. As goodness-of-fit measures we include AIC (Akaike Information Criterion), BIC (Bayesian Information Criterion)[11] and the Adjusted McFadden's Pseudo R^2 in the tables. The latter is very high in all cases[12].

Environmental and Social Principal Component

Table 1.12 shows the results of the estimations for the environmental and social principal component, *PCENVSOC*. In general, the coefficients for the same variables in different models are similar.

We find that *size* has significantly positive coefficients both within and between. This shows that as a company grows it reports more environmental and social information and that bigger companies generally report more such information. The "within" effect of *profitability*, financial situation (*leverageta*) and growth opportunities (*mtbv*) is not statistically significant, which shows that companies report neither more nor less environmental and social information as their profitability or growth opportunities increase or decrease, or as their financial situation gets better or worse. However, their "between" effects are significantly different from zero: they are positive in the case of profitability and growth opportunities, and negative in the case of

[11] For both criteria, one model is a better fit than another if the value of the IC is smaller.

[12] As stated in McFadden (1978), 'values between 0.2 and 0.4 represent an excellent fit'.

leverage. Therefore, more profitable companies, companies with higher growth opportunities and those less in debt tend to report more environmental and social data. The effect of capital intensity (*ppenetta*) on environmental and social reporting is less clear. The "within" coefficients for capital intensity are negative, which means that becoming more capital intensive tends to make companies report less environmental and social information, but the "between" coefficients are positive and larger than the "within", which shows that more capital intensive companies tend to report more environmental and social information.

The results obtained also show that it is the Basic Materials sector that reports the most environmental and social information. Its coefficients are significantly positive in comparison to the Energy sector. Companies in the Cyclical Consumer Goods & Services, Telecommunication Services and, especially, Financials sectors report significantly less than those in the Energy sector. The estimations for Sensitive Industry instead of sector dummies produce very similar results, with Sensitive Industry being significantly positive, as expected.

Companies from China, Peru, the USA and Argentina are at the lowest reporting levels of the whole sample, while Finnish companies are on top, closely followed by Spanish, French and South African companies. This is consistent with the results per continent, which show Africa and Europe to be the continents which report most in our sample and North America to be the worst performer. The results for Africa may be surprising at first, but it must be noted that, as shown in Appendix B, the African companies in the sample come basically from South Africa. For currencies, belonging to the European Monetary Union can be shown to have a positive effect on environmental and social reporting. However, the South African Rand has one of the largest effects (although not presented in Table 1.12, the coefficient for the Pound Sterling is the highest of all). The US Dollar has a significantly negative effect, showing that companies reporting in US Dollars (mostly companies from the USA) report significantly less environmental and social information than others.

As expected, we find that the introduction of a mandatory general sustainability disclosure regulation[13] increases environmental and social reporting and that companies in countries with such regulations tend to report more environmental and social information.

Surprisingly, the country a company is from being a tax haven has a significantly positive effect on environmental and social reporting. This might be due to those countries trying to offset the lack of reporting of other types of information (such as governance information) by developing environmentally conscious financial markets.

A higher HDI in the country of a company makes it report more environmental and social information, but companies from countries with higher HDI report less information (the "between" coefficient is significantly negative although smaller than the "within" coefficient in absolute terms). The former is consistent with our thoughts but the latter is not. However, this result might be due to the fact that about one third of the sample comprises companies from the USA. As mentioned above, they report significantly less environmental and social information

[13]The effect of the specific reporting regulations *manenv* and *mansoc* is analysed in the subsections on the environmental and social count variables, respectively. (Remember that they could not be included simultaneously due to multicollinearity). The results for *PCENVSOC* when either of them is included are similar to those set out below.

than others and the USA has quite a high HDI (above the mean for the sample in almost all years).

Taking everything into account, our hypotheses H1, H2, H3, H5, H6a, H6b, H7a, H7b, H7c and H7d can be confirmed for environmental and social reporting analysed together. H4 and H7f, cannot be confirmed, because we obtain mixed results. Finally, for H7e the results are the opposite of what we expected.

Table 1.12: Results of Estimations for the Environmental and Social Principal Component

This table shows the results of the estimations for the environmental and social principal component. * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

PCENVSOC	Country (ref. AU)	Continent (ref. Oceania)	Currency (ref. AU$)	Regulation	Tax Haven	HDI
size (W)	0.140 (10.69)**	0.140 (10.71)**	0.140 (10.69)**	0.143 (10.91)**	0.142 (10.81)**	0.134 (10.24)**
size (B)	0.299 (46.30)**	0.301 (46.18)**	0.299 (46.61)**	0.323 (47.80)**	0.308 (45.45)**	0.282 (40.51)**
profitability (B)	0.338 (4.86)**	0.351 (4.97)**	0.332 (4.74)**	0.507 (6.33)**	0.532 (6.54)**	0.387 (5.28)**
leverageta (B)	-0.424 (9.14)**	-0.409 (8.35)**	-0.410 (8.79)**	-0.473 (8.82)**	-0.525 (9.49)**	-0.489 (9.28)**
ppenetta (W)	-0.195 (3.21)**	-0.195 (3.22)**	-0.195 (3.21)**	-0.193 (3.18)**	-0.197 (3.24)**	-0.159 (2.61)**
ppenetta (B)	0.384 (11.01)**	0.405 (11.16)**	0.377 (10.72)**	0.316 (7.84)**	0.334 (7.99)**	0.320 (8.01)**
mtbv (B)	0.013 (5.01)**	0.012 (4.83)**	0.014 (5.28)**	0.008 (2.85)**	0.006 (2.07)*	0.006 (2.15)*
Basic Materials	0.322 (7.23)**	0.324 (6.85)**	0.311 (6.92)**	0.394 (7.43)**	0.401 (7.42)**	0.381 (7.29)**
Cyclical Consumer Goods & Services	-0.175 (4.28)**	-0.182 (4.23)**	-0.177 (4.31)**	-0.076 (1.56)	-0.157 (3.16)**	-0.136 (2.84)**
Non-cyclical Consumer Goods & Services	-0.094 (1.96)	-0.094 (1.86)	-0.109 (2.27)*	0.029 (0.52)	-0.040 (0.70)	-0.053 (0.95)
Financials	-0.666 (17.17)**	-0.701 (17.27)**	-0.675 (17.37)**	-0.641 (13.86)**	-0.702 (14.71)**	-0.663 (14.36)**
Technology	-0.011 (0.25)	-0.004 (0.09)	-0.018 (0.40)	0.019 (0.36)	-0.127 (2.35)*	-0.103 (1.97)*
Telecommunication Services	-0.209 (3.38)**	-0.241 (3.60)**	-0.224 (3.63)**	-0.058 (0.78)	-0.082 (1.10)	-0.133 (1.81)
Argentina	-0.441 (2.44)*					
China	-0.991 (15.77)**					
Finland	1.027 (7.43)**					
France	0.720 (11.29)**					

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PCENVSOC	Country (ref. AU)	Continent (ref. Oceania)	Currency (ref. AU$)	Regulation	Tax Haven	HDI
Peru	-0.746 (6.36)**					
South Africa	0.699 (11.69)**					
Spain	0.947 (10.10)**					
USA	-0.582 (21.81)**					
Africa		0.591 (9.46)**				
Asia		-0.157 (4.52)**				
Europe		0.425 (13.02)**				
North America		-0.539 (20.39)**				
South America		0.173 (2.28)*				
Euro			0.532 (11.93)**			
South African Rand			0.701 (11.71)**			
US Dollar			-0.585 (21.92)**			
mangen (W)				0.166 (8.49)**		
mangen (B)				0.426 (18.41)**		
taxhaven (R)					0.106 (2.95)**	
hdi (W)						7.290 (8.73)**
hdi (B)						-2.005 (12.98)**
cons	-177.813 (53.62)**	-177.705 (53.67)**	-177.830 (53.69)**	-167.441 (47.31)**	-177.157 (53.23)**	-131.396 (22.70)**
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
AIC	70,839.02	71,507.97	70,945.22	72,588.85	73,245.98	72,633.44
BIC	71,470.39	71,753.51	71,480.13	72,808.08	73,456.44	72,852.67
Adjusted McFadden's Pseudo R^2	0.4794	0.4746	0.4787	0.4666	0.4618	0.4663

Governance Principal Component

Table 1.13 shows the results of the estimations for the governance principal component, *PCGOV*, where, again, there are no big differences between the coefficients of the variables that are included in more than one model.

Size has a significantly positive effect on governance reporting, just as it has on environmental and social reporting, but some of the "between" coefficients are negative, though smaller than the positive "within" coefficients. The results for profitability are different from those obtained for environmental and social reporting: in most cases there are no significant effects. The effect of the financial situation is negative and the "within" and "between" coefficients are equal in some of the models, showing that greater leverage leads to less governance reporting. However, in some of the cases where they are not equal the "between" coefficient is significantly positive, which means that more indebted companies tend to report more governance information than less indebted ones (or at least the same amount). Capital intensity seems to have a negative effect on governance reporting, unlike its effect on environmental and social reporting. In most cases, the "between" effect is equal to the "within" effect, showing that becoming more capital intensive makes companies less prone to report governance information and that companies which are more capital intensive also report less governance information. Increases in growth opportunities seem to reduce the quantity of governance information reported with a significantly negative "within" coefficient. In some cases the "between" coefficient is positive, which means that companies with larger growth opportunities tend to report more governance information.

Table 1.13 shows that it is the Energy sector (and possibly the Telecommunication Services sector, although the effect is not as clear) which reports most governance information, while in environmental and social reporting it is Basic Materials that reports the most. The estimations with Sensitive Industry instead of sector dummies show that Sensitive Industry is not statistically relevant for governance reporting, unlike its effect on environmental and social information.

An analysis of which countries' companies report the most governance information points not only to South Africa again but also to the USA and the United Kingdom, which has the highest coefficient. Peruvian, Japanese and Argentinian companies report the least. These results are reflected in the estimations using the continent dummies, which show that companies from North America report the most, followed by African and Oceanian companies, while Asian and South American companies report the least. Companies that report in Euros report significantly less than companies that report in Australian Dollars or in US Dollars. Companies that report in South African Rands report slightly more than those that report in Australian Dollars.

The results for specific governance disclosure regulations are mixed. The "between" coefficient is positive, which means that companies in countries with such regulations tend to report more governance information, but the "within" coefficient is negative (although much smaller), showing that the entry in force of such regulations reduces governance reporting. This might be due to the nature of the regulations, which are more specific and cover fewer variables to be reported than general sustainability regulations. In fact, the variable for mandatory general sustainability reporting regulations has "within" and "between" coefficients which are both significantly positive.

The country a company is from being a tax haven has a significantly negative effect on governance reporting, as expected, because governance reporting requires transparency and lack of transparency is a characteristic of tax havens.

Last, HDI has a significantly positive "between" effect and a "within" effect that is statistically non-existent, which is consistent with our initial thoughts.

All in all, our hypotheses H6a, H7a, H7b, H7c, H7e and H7f can be confirmed for governance reporting, while the results obtained for profitability reject H2. As for H1, H3, H5 and H7d, we obtain mixed results. For H4 the results are the opposite of what we expected.

Table 1.13: Results of Estimations for the Governance Principal Component

This table shows the results of the estimations for the governance principal component. * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

PCGOV	Country (ref. AU)	Continent (ref. Oceania)	Currency (ref. AU$)	Regulation	Tax Haven	HDI
size (W)	0.152 (15.80)**	0.147 (15.15)**	0.151 (15.73)**	0.140 (14.52)**	0.147 (15.14)**	0.146 (15.05)**
size (B)	0.078 (21.77)**	0.044 (8.40)**	0.078 (21.00)**	0.028 (4.54)**	-0.026 (4.04)**	-0.022 (3.18)**
profitability (B)		0.226 (3.95)**				
leverageta (W)		-0.130 (3.30)**		-0.132 (3.39)**	-0.130 (3.31)**	-0.128 (3.26)**
leverageta (B)		0.003 (0.08)		0.087 (1.63)	0.183 (3.21)**	0.199 (3.47)**
leverageta (R)	-0.113 (4.24)**		-0.112 (4.12)**			
ppenetta (R)	-0.085 (3.73)**	-0.120 (3.74)**	-0.087 (3.69)**	-0.109 (3.12)**	-0.121 (3.38)**	-0.123 (3.43)**
mtbv (W)	-0.004 (4.40)**	-0.004 (4.42)**	-0.004 (4.40)**	-0.004 (4.51)**	-0.004 (4.42)**	-0.004 (4.39)**
mtbv (B)	0.002 (1.28)	0.014 (6.56)**	0.002 (1.34)	0.015 (5.93)**	0.019 (7.15)**	0.022 (8.07)**
Basic Materials	0.009 (0.45)	-0.116 (3.31)**	0.001 (0.02)	-0.211 (4.88)**	-0.230 (5.23)**	-0.220 (4.96)**
Industrials	-0.017 (0.81)	-0.176 (5.11)**	-0.017 (0.76)	-0.329 (8.12)**	-0.298 (7.00)**	-0.326 (7.71)**
Cyclical Consumer Goods & Services	-0.002 (0.12)	-0.145 (4.20)**	-0.010 (0.44)	-0.256 (6.23)**	-0.209 (4.91)**	-0.241 (5.70)**
Non-cyclical Consumer Goods & Services	0.008 (0.34)	-0.115 (2.66)**	0.016 (0.62)	-0.332 (6.37)**	-0.293 (5.48)**	-0.289 (5.42)**
Financials	-0.104 (4.83)**	-0.112 (3.49)**	-0.113 (4.84)**	-0.225 (5.88)**	-0.104 (2.72)**	-0.117 (3.07)**
Healthcare	0.033 (1.40)	-0.084 (2.27)*	0.031 (1.20)	-0.125 (2.88)**	-0.086 (1.91)	-0.122 (2.73)**
Technology	0.023 (0.96)	-0.224 (6.13)**	0.026 (1.00)	-0.348 (7.25)**	-0.249 (5.27)**	-0.308 (6.51)**

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PCGOV	Country (ref. AU)	Continent (ref. Oceania)	Currency (ref. AU$)	Regulation	Tax Haven	HDI
Telecommunication Services	0.121 (3.11)**	0.041 (0.68)	0.108 (2.64)**	-0.238 (3.71)**	-0.166 (2.59)**	-0.125 (1.97)*
Utilities	-0.073 (2.47)*	-0.053 (1.09)	-0.084 (2.71)**	-0.304 (5.12)**	-0.270 (4.21)**	-0.242 (3.95)**
Argentina	-2.306 (36.41)**					
Japan	-2.323 (85.20)**					
Peru	-2.385 (19.28)**					
South Africa	0.071 (2.51)*					
United Kingdom	0.151 (6.91)**					
USA	0.045 (2.25)*					
Africa		-0.058 (1.12)				
Asia		-1.209 (33.94)**				
Europe		-0.251 (9.01)**				
North America		0.057 (2.55)*				
South America		-1.833 (36.22)**				
Euro			-0.598 (19.20)**			
South African Rand			0.072 (2.53)*			
US Dollar			0.033 (1.62)			
mangov (W)				-0.134 (12.10)**		
mangov (B)				0.909 (27.52)**		
mangen (W)				0.109 (7.38)**		
mangen (B)				0.409 (15.97)**		
taxhaven (R)					-0.597 (15.10)**	
hdi (B)						2.698 (17.41)**
cons	-159.599 (68.95)**	-161.935 (68.16)**	-159.914 (68.90)**	-166.607 (65.49)**	-161.134 (67.10)**	-158.996 (39.44)**

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PCGOV	Country (ref. AU)	Continent (ref. Oceania)	Currency (ref. AU$)	Regulation	Tax Haven	HDI
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
AIC	46,648.65	53,576.74	47,231.27	55,583.66	56,925.52	56,865.73
BIC	47,253.71	53,813.50	47,739.88	55,802.89	57,118.43	57,067.42
Adjusted McFadden's Pseudo R^2	0.6556	0.6037	0.6512	0.5885	0.5789	0.5793

Environmental Count Variable

Most of the results for the environmental count variable are the same as for the environmental and social principal component, though there are a few minor differences.

First, for capital intensity only the "between" effect is significantly positive, with the "within" effect being statistically zero, which means that H4 can be accepted for environmental reporting. The "within" coefficients for *mtbv* are negative and when the "within" and "between" coefficients are equal the coefficient obtained is negative. However, when they are not equal the positive "between" coefficient is larger. This means that H5 is neither accepted nor rejected for environmental reporting.

Apart from the Basic Materials sector, Industrials, Non-cyclical Consumer Goods & Services, Technology and Utilities also seem to perform better than the Energy sector in terms of environmental reporting. France and Spain are no longer among the top performing countries and the United Kingdom and Sweden can be found along with South Africa and Finland. We were able to include both *manenv* and *mangen* in the models, and our finding is that the introduction of mandatory environmental information reporting regulations has a significantly positive effect, but that, generally, companies from countries where such regulations exists report less environmental information, and this latter effect is larger. The results for mandatory general disclosure regulations are similar to those for *PCENVSOC*, with a positive "between" effect but a "within" coefficient that is statistically zero. This means that H7d cannot be accepted for environmental reporting. Finally, the statistically negative "between" coefficient for *hdi* is bigger than its statistically positive "within" effect, so H7f cannot be accepted for environmental reporting.

Social Count Variable

The results for the social count variable also resemble those obtained for the environmental and social principal component, with the main differences explained below.

There are three differences in the financial variables. First, the "within" coefficient for *leverageta* is significantly negative instead of statistically insignificant, which means that becoming further indebted makes a company report less social information. Second, the "within" effect of capital intensity is statistically zero instead of negative so H4 can be accepted for social reporting. Third, increases in growth opportunities seem to make companies do less social reporting. However, the "between" coefficient is significantly positive and greater than the negative "within" coefficient. Due to these mixed results, H5 cannot be accepted for social reporting.

As with environmental reporting, the companies that report most social information are South African, Finnish and British. The worst four performing countries in terms of social reporting are Peru, China, Argentina and Japan. Additionally, being domiciled in the Eurozone seems to have neither a positive nor a negative effect on social reporting compared to companies that report in Australian Dollars. The results are again mixed for the effect of regulations. Companies in countries with mandatory social information reporting regulations seem to report less social information, and the introduction of such regulations seems to reduce social reporting. As with *ENV*, the introduction of a mandatory general information reporting regulation seems to have no effect on social reporting, but companies in countries with such regulations tend to report more social information. Due to those mixed results, H7d cannot be accepted for social reporting. The coefficient for *taxhaven* is statistically zero for social reporting, which means that companies from countries that are tax havens do not report more or less social information than companies from other countries. This leads to the rejection H7e for social reporting.

Governance Count Variable

When the governance count variable is analysed instead of the governance principal component only a couple of differences emerge.

First, the "between" coefficients for capital intensity are statistically zero in some cases. Second, the coefficient for Sensitive Industry is significantly positive rather than statistically zero, which means that H6b can be accepted for governance reporting. However, this raises a conflict because it is not accepted for *PCGOV*.

In terms of continents, North America does not outperform Oceania, but Oceania outperforms Africa. The companies that perform best in this case are, as for *PCGOV*, the United Kingdom, the USA and South Africa, but Canada is the second-best performer. Moreover, the "within" coefficient for the mandatory governance regulation is statistically zero. Finally, the "within" coefficient of *hdi* is significantly positive instead of statistically zero.

5 Conclusions

This paper analyses the different non-financial reporting patterns of 6,578 companies from 10 different sectors all around the world for 2002-2017. To the best of our knowledge, it is the first study to analyse such a big dataset, and to perform both separate and combined analyses for environmental, social and governance information. We start out with 73 different non-financial information variables, so we use agglutinative measures to reduce the dimensions of our analysis: environmental, social and governance count variables are reported, along with environmental and social and governance principal components.

The models estimated vary due to the different distributions of the count variables and the principal components. However, they are all hybrid panel data models with robust standard errors clustered by company that include time fixed-effects. The independent variables that explain non-financial reporting in our models are financial (those usually found in the literature), sectoral and related to the country in which each company is domiciled.

One of our main findings is that reporting patterns are different for environmental and social information on the one hand and governance information on the other. This is especially clear for the following examples and effects.

First, in countries such as South Africa (as expected from an ESG reporting pioneer) and Finland environmental and social reporting is remarkably higher than in other countries. South Africa is also one of the best performers in terms of governance disclosure, which proves that it is possible to do well in all three dimensions of ESG reporting, but it is in the United Kingdom where there is most governance reporting. The USA follows close behind. In fact, the case of the USA stands out: there is significantly less environmental and social disclosure but significantly more governance reporting than in other countries. The first part might not be surprising as the USA is known to be 'lagging behind in regulations' concerning sustainability (Tînjală et al., 2015). However, the Sarbanes-Oxley Act is known to be a significant governance reporting regulation, which has led companies in the USA to report more governance information (Krishnan and Visvanathan, 2007). The worst performers overall are Argentina and Peru.

Second, companies in the Euro Area seem to report more environmental information but less governance information than others. The greater environmental reporting is in line with the fact that the European Union is ahead of other regions in sustainability reporting regulation (Tînjală et al., 2015), but the reasons for the lower governance reporting should be analysed in more depth in future research.

Another difference is that companies established in a country that can be considered as a tax haven report less governance information but more environmental information, which is not what has been found before by authors such as Preuss (2012). The greater environmental reporting is probably due to the wish to offset the lack of governance reporting.

In terms of sectors, companies in sensitive industries tend to report more environmental and social information, as found in Stolowy and Paugam (2018). When analysing sectors one by one, we find that companies in the Basic Materials sector report significantly more environmental and social information than others, while companies in the Energy sector report more governance information. The Financial sector underperforms in all types of non-financial reporting. These results are in line with those in Brammer and Pavelin (2006).

We have obtained no conclusive results as to what types of regulation increase non-financial reporting. However, mandatory general sustainability reporting regulations seem to have the most stable positive effect, so we conclude that regulations of that type may encourage companies to report more non-financial information. Moreover, a higher HDI seems to be related to higher levels of governance reporting.

As for company characteristics, bigger and more profitable companies clearly report more non-financial information, especially environmental and social. The former is widely supported in the existing literature, but the positive effect of profitability has not usually been found (Freedman and Jaggi, 2005; Brammer and Pavelin, 2006; Clarkson et al., 2008; Stanny and

Ely, 2008; Clarkson et al., 2011; D'Amico et al., 2016, among others), perhaps because scholars have not separated "within" and "between" effects when analysing reporting. Less indebted companies usually report more environmental and social information (as found by Brammer and Pavelin (2006) and others) but not governance information. Nevertheless, becoming more indebted seems to reduce the amount of governance data that a company reports, which is a topic that may merit further research. Companies that are more capital intensive report more environmental and social information, but becoming more capital intensive seems to reduce reporting of those types (although that effect is smaller). In addition, a higher capital intensity tends to reduce the amount of governance information reported. These results are consistent with the findings of previous studies into environmental reporting (Clarkson et al., 2008, 2011; Stolowy and Paugam, 2018), and add to them the finding of a negative effect on governance reporting, which should be researched in more depth. Finally, companies that have larger growth opportunities tend to report more non-financial information, but an increase in such opportunities produces a reduction in reporting. The former is generally the stronger effect, which is in line with previous publications (Prado-Lorenzo et al., 2009a,b; Prado-Lorenzo and García-Sánchez, 2010).

From the results obtained in this study and previous research, it can be concluded that the cost of generating ESG information is high, so bigger and more profitable companies report most. Thus, if policy advice for increasing non-financial reporting were to be given, it would be to provide funding to those companies that struggle most to generate non-financial data. It would also be positive to provide training on how to prepare and generate such data.

A further research step could be to perform the analysis with regulation variables, but measure their scope in terms of the quantity of ESG variables that must be reported, in the hope that this will clarify the mixed results obtained in this study. It also would be interesting to analyse best-in-class cases in more depth, so as to be able to establish specific measures for increasing non-financial reporting in the future. Running a comparative case study of countries that behave differently such as Finland and the USA is another possible way of filling that gap in the literature. Another future line of research could be to perform the analysis decomposing the sectors into subsectors, because some of the economic sectors in the TRBC are very diverse in terms of non-financial reporting. For example, the Energy sector includes both Oil & Gas and Renewable Energy companies, which are assumed to have different reporting patterns. Finally, it would also be of great interest to know whether companies that perform better in non-financial terms tend to disclose more ESG information or not.

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7 Appendices

A List of ESG variables (and their codes)

This table shows the variable codes and names and the explanation of the original ESG variables associated with them.

Variable Code	Variable Name	Explanation of original variable (non-binary)
Panel A: Environmental variables		
CO2EmT	CO2 Equivalents Emission Total	Total CO2 and CO2 equivalents emissions
CO2DirEm	CO2 Equivalents Emission Direct	Direct CO2 and CO2 equivalents emissions
CO2IndEm	CO2 Equivalents Emission Indirect	Indirect of CO2 and CO2 equivalents emissions
FlaNG	Flaring of Natural Gas	Total direct flaring or venting of natural gas emissions
OzDepSub	Ozone-Depleting Substances	Total amount of ozone depleting (CFC-11 equivalents) substances emitted
NOxEm	NOx Emissions	Total amount of NOx emissions
SOxEm	SOx Emissions	Total amount of SOx emissions
VOCEm	VOC Emissions	Total amount of volatile organic compounds (VOC) emissions
WasTot	Waste Total	Total amount of waste produced
NhazWas	Non-Hazardous Waste	Total amount of non-hazardous waste produced
WasRecT	Waste Recycled Total	Total recycled and reused waste
HazWas	Hazardous Waste	Total amount of hazardous waste produced
WatDis	Water Discharged	Total volume of water discharged
WatPolEm	Water Pollutant Emissions	Total weight of water pollutant emissions
ISOEMSCP	ISO 14000 or EMS Certified Percent	The percentage of company sites or subsidiaries that are certified with an environmental management system.
EnvExp	Environmental Expenditures	Total amount of environmental expenditures.
EnvProv	Environmental Provisions	Environmental provisions as reported on the balance sheet.
CO2S3	CO2e Indirect Emissions, Scope 3	Total CO2 and CO2 equivalent Scope Three emissions

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Variable Code	Variable Name	Explanation of original variable (non-binary)
CoffCre	Carbon Offsets/Credits	The equivalent of the CO2 offsets, credits and allowances purchased and/or produced by the company during the fiscal year.
ENVRDExp	Environmental R&D Expenditures	Total amount of environmental R&D spending (without clean up and remediation costs).
EnUTot	Energy Use Total	Total direct and indirect energy consumption
IndEnU	Indirect Energy Use	Indirect energy consumption
WWTot	Water Withdrawal Total	Total water withdrawal
FWWTot	Fresh Water Withdrawal Total	Total fresh water withdrawal
WatRec	Water Recycled	Amount of water recycled or reused
Panel B: Social variables		
AlcRev	Alcohol Revenues	The revenues generated by the company from the sale of alcohol.
TobRev	Tobacco Revenues	The revenues generated by the company from the sale of tobacco.
FDAWLTot	FDA Warning Letters	Number of FDA warning letters received by the company.
ProdDel	Product Delays	Total number of products or services which have been delayed.
NappDrug	Non Approved Drug	Total number of drugs which have not been approved by regulators or similar official bodies.
DonTot	Donations Total	Total amount of all donations by the company.
PolCon	Political Contributions	Total amount of political donations, support of political candidates or contributions to parties as reported by the company.
WomEmp	Women Employees	Percentage of women employees.
NwomEmp	New Women Employees	Percentage of new women employees.
WomMan	Women Managers	Percentage of women managers.
HRCCEqIn	HRC Corporate Equality Index	The score of the company in the HRC corporate equality index from the Human Rights Campaign Foundation.
DisEmp	Disabled Employees	Percentage of employees with a disability (either mental or physical).
SalWag	Salaries and Wages from CSR reporting	Total value of salaries and wages paid to all employees and officers, including all benefits, as reported by the company in its CSR reporting.

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Variable Code	Variable Name	Explanation of original variable (non-binary)
Nemp	Number of Employees from CSR reporting	Number of employees as reported by the company in its CSR reporting.
TURep	Trade Union Representation	Percentage of employees represented by independent trade union organizations or covered by collective bargaining agreements.
TurnEmp	Turnover of Employees	Percentage of employee turnover.
AnLay	Announced Layoffs	Total number of layoffs announced by the company.
PTEmp	Part-time employees	Number of part-time employees.
EmpHSTH	Employee Health & Safety Training Hours	Total hours of health & safety training
TotInjR	Total Injury Rate	Total number of injuries and fatalities including no-lost-time injuries relative to one million hours worked.
AcciT	Accidents Total	Number of injuries and fatalities reported by employees and contractors while working for the company.
OcDisR	Occupational Disease Rate	Number of occupational diseases or any disease caused by continued exposure to conditions inherent in a person's occupation reported relative to one million hours worked.
EmpFat	Employee Fatalities	Number of employee fatalities resulting from operational accidents.
ConFat	Contractor Fatalities	Number of contractor fatalities resulting from operational accidents.
LTIR	Lost-Time Injury Rate	Total number of injuries that caused the employees and contractors to lose at least a working day relative to one million hours worked.
LostWD	Lost Working Days	Number of working days lost by employees and contractors.
AvTrainH	Average Training Hours	Average hours of training per year per employee.
TrainCT	Training Costs Total	Total training costs for all the training taken by all employees.
EmpSatP	Employee Satisfaction Percentage	The percentage of employee satisfaction as reported by the company.

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Variable Code	Variable Name	Explanation of original variable (non-binary)
CSP	Customer Satisfaction Percentage	The percentage of customer satisfaction as reported by the company
	Panel C: Governance variables	
AudCInd	Audit Committee Independence	Percentage of independent board members on the audit committee as stipulated by the company.
AudCNEM	Audit Committee Non-Executive Member	Percentage of non-executive board members on the audit committee as stipulated by the company.
CompCInd	Compensation Committee Independence	Percentage of independent board members on the compensation committee as stipulated by the company.
CompCNEM	Compensation Committee Non-Executive Member	Percentage of non-executive board members on the compensation committee as stipulated by the company.
NomCInd	Nomination Committee Independence	Percentage of independent board members on the nomination committee as stipulated by the company.
NomCNEM	Nomination Committee Non-Executive Member	Percentage of non-executive board members on the nomination committee as stipulated by the company.
BoMeeNum	Number of Board Meetings	The number of board meetings during the year.
BoMeeAAv	Board Meeting Attendance Average	The average overall attendance percentage at board meetings as reported by the company.
CoMeeAAv	Committee Meeting Attendance Average	The average overall attendance percentage at board committee meetings as reported by the company.
BoSize	Board Size	The total number of board members at the end of the fiscal year.
BoMemReY	Board Member Re-election Years	The smallest interval of years in which the board members are subject to re-election.
SELTCI	Senior Executive Long-term Compensation incentives	The maximum time frame for targets to reach full senior executives' compensation.
BoMeLTCI	Board Member Long-term Compensation incentives	The maximum time frame for the board member's targets to reach full compensation.

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Variable Code	Variable Name	Explanation of original variable (non-binary)
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NEBoMeTC	Non-Executive Board Member Total Compensation	The total compensation of non-executive board members (if total aggregate is reported by the company).
SETC	Total Senior Executives Compensation	The total compensation paid to all senior executives (if total aggregate is reported by the company).
ESGRepSc	ESG Reporting Scope	The percentage of the company's activities covered in its Environmental and Social reporting.
VotCapP	Voting Cap Percentage	The percentage of maximum voting rights allowed or ownership rights.
AdvNotP	Advance Notice Period	The minimum interval (in days) prior to the next shareholder meeting beyond which a shareholder proposal will not be accepted

B List of Economic Sectors (and their codes)

This table shows the codes and the names of the different sectors represented in the sample.

Economic Sector Code	Name of Economic Sector
S_50	Energy
S_51	Basic Materials
S_52	Industrials
S_53	Cyclical Consumer Goods & Services
S_54	Non-Cyclical Consumer Goods & Services
S_55	Financials
S_56	Healthcare
S_57	Technology
S_58	Telecommunications Services
S_59	Utilities

C List of countries

This table shows the different countries from which companies come and the number of companies from each country included in the sample.

Africa

EGYPT	10	NIGERIA	1
MOROCCO	3	SOUTH AFRICA	144

Asia

ABU DHABI	5	MALAYSIA	55
CHINA	102	PHILIPPINES	27
DUBAI	8	QATAR	12
HONG KONG	184	RUSSIAN FEDERATION	37
INDIA	105	SAUDI ARABIA	12
INDONESIA	38	SINGAPORE	56
ISRAEL	18	SOUTH KOREA	127
JAPAN	454	TAIWAN	142
KAZAKHSTAN	1	THAILAND	39
KUWAIT	10	TURKEY	27

Europe

AUSTRIA	19	IRELAND	16
BELGIUM	31	ITALY	61
CYPRUS	1	NETHERLANDS	46
CZECH REPUBLIC	3	NORWAY	27
DENMARK	29	POLAND	33
FINLAND	27	PORTUGAL	12
FRANCE	111	SPAIN	58
GERMANY	108	SWEDEN	74
GREECE	22	SWITZERLAND	72
HUNGARY	4	UNITED KINGDOM	433

North America

BERMUDA	1	MEXICO	41
CANADA	376	UNITED STATES	2639

Oceania

AUSTRALIA	505		

South America

ARGENTINA	24	CHILE	41
BRAZIL	99	COLOMBIA	20
CAYMAN ISLANDS	1	PERU	27

D List of Currencies (and their codes)

This table shows the codes and the names of the different currencies of the companies included in the sample.

Currency Code	Currency Name	Currency Code	Currency Name
AU$	Australian Dollar	MD	Moroccan Dirham
AP	Argentinian Peso	MP	Mexican Peso
C	Brazilian Real	NG	Nigerian Niara
C$	Canadian Dollar	NK	Norwegian Krone
CE	Chilean Peso	PP	Philippine Peso
CH	Chinese Yuen Renminbi	PS	Peruvian Sol
CK	Czech Koruna	PZ	Polish Zloty
CP	Colombian Peso	Q	Qatari Rial
DK	Danish Krone	R	South African Rand
€(E)	Euro	RI	Indonesian Rupiah
ED	United Arab Emirates Dirham	S$	Singaporean Dollar
EL	Egyptian Pound	SF	Swiss Franc
HF	Hungarian Forint	SK	Swedish Krona
IL	Israeli Pound	SR	Saudi Arabian Riyal
IR	Indian Rupee	TB	Thai Baht
K$	Hongkonger Dollar	TL	Turkish Lira
KD	Kuwaiti Dinar	TW	New Taiwanese Dollar
KT	Kazakhstani Tenge	US$	United States Dollar
KW	South Korean Won	UR	Russian Rouble
L	British Pound	Y	Japanese Yen
M$	Malaysian Ringgit		

E List of Tax Havens

This table shows the countries included in the sample which are considered as tax havens and the number of companies in the sample in each of them.

ABU DHABI	5
BERMUDA	1
CAYMAN ISLANDS	1
DUBAI	8
HONG KONG	184
MALAYSIA	55
MOROCCO	3
PERU	27
QATAR	12
SOUTH KOREA	127
SWITZERLAND	72
TAIWAN	142
THAILAND	39
TURKEY	27

2

Measures for Sustainable Investment Decisions and Business Strategy

A Triple Bottom Line Approach

Published in: *Business Strategy and the Environment, Volume 27, Issue 1, pages 16–38*

1 Introduction

Traditionally, when making investment decisions, investors take into consideration the classic measures of profitability and risk (Markowitz, 1952; Merton, 1969; Samuelson, 1969; Li and Ng, 2000), which are concerned with the economic aspects of investment. However, in the last few decades, and especially since the first definitions of sustainability[1] (Ehrenfeld, 2008) and sustainable development [contained in WCED (1987)] were drawn up, environmental, social and corporate governance (ESG) issues have become more important for both companies and individuals. This is due to increased awareness of the fact that economic activities also generate externalities (Pigou, 1920; Coase, 1960; Turvey, 1963) that affect society. However, for a long time this effect was not taken into account by those who carry out the activities in question, because it did not directly affect their private costs.

By making an investment, investors are financing the activities that a company carries out and are, therefore, essential for the company's survival. If investors consider not only economic factors but also environmental and/or social factors when making investment decisions their analysis will be much more accurate. This is the standpoint of the so-called triple bottom line

[1]Sustainability has three pillars: economic, social and environmental.

(TBL) approach, first introduced by Elkington (1997) and also explained by other authors such as Slaper and Hall (2011). In fact, socially responsible investment (SRI) is a promising line of research (Renneboog et al., 2008).

On top of that, financial stakeholders can make it more probable for companies to pay attention to sustainability problems that they consider important (Neugebauer et al., 2016) and to address them 'by planned strategy making' (McWilliams et al., 2016). For Jansson et al. (2017), in order for this to happen, a company must be market oriented. Moreover, a company that 'incorporates sustainability into its marketing strategy could have a differential advantage over the competition' (Ferrell et al., 2010; Crittenden et al., 2011). However, sometimes, when companies try to comply with new regulations, their efforts are disconnected from strategic planning (Mårtensson and Westerberg, 2016). Therefore, as Beckmann et al. (2014) state, 'responsibility management' can (and should) be seen 'as an integral part of any corporations *strategic management*'. In fact, business strategy has to take into account the concept of sustainable development and be adapted in order to satisfy the 'increasing environmental and social demands' (Welford, 2016). This way, companies are more profitable and more likely to survive in the long run (Jansson et al., 2017).

Nevertheless, for investors and companies to be able to consider these factors, they need data and measures to help them to make sense of the data.

A slow but steady data disclosure process started towards the end of the 20th century (with the creation of the Global Reporting Initiative (GRI) and other systems) and indeed continues today. In the beginning the disclosure of ESG data, for example taking part in the GRI, was voluntary. The United Nations Global Compacts, another worldwide initiative in which reporting is mandatory in order to remain in it, was created in 2001 and has since promoted data disclosure with good results, as Williams (2004) anticipated and Rasche (2011) later confirmed.

Later, legislators started to require companies to publish ESG data. In fact, quotting United Nations Global Compact (2014): 'Once only a voluntary activity, there is a trend towards mandatory non-financial reporting. For example, in South Africa, China, Denmark, Finland, Indonesia, and most recently the European Union there are requirements in place for companies, be they large, publicly-listed or state-owned companies, to disclose ESG practices'. In the case of the European Union, Directive 2013/34/EU of the European Parliament and of the Council of 26 June 2013 on the annual financial statements, consolidated financial statements and related reports of certain types of undertakings[2] obliges large companies with more than 500 employees, such as listed companies and banks, to disclose information regarding environmental, social and other matters as well as issues concerning human rights and anticorruption measures affecting their company. This has led to what has come to be called 'integrated reporting' (Jensen and Berg, 2012; Abeysekera, 2013; Cheng et al., 2014; De Villiers et al., 2014), the creation of single reports that include both economic and non-economic information about companies. Such initiatives have increased the disclosure of non-economic information by companies, as Ioannou

[2]Also taking into account amending Directive 2006/43/EC of the European Parliament and of the Council and repealing Council Directives 78/660/EEC and 83/349/EEC (Directive 2013/34/EU) as amended by Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014 amending Directive 2013/34/EU as regards disclosure of non-financial and diversity information by certain large undertakings and groups (Directive 2014/95/EU).

and Serafeim (2011) show. However, ESG data disclosure is not consistent from one country and one sector to another (Peiró-Signes et al., 2012).

Reporting itself may be considered a strategic movement to improve a company's reputation, that is, a part of a legitimation strategy. However, as Lai et al. (2016) state, the complexity of the kind of reporting considered and as a consequence the degree of involvement of different parts of the company needed to create the report, explain if the reporting is being done within a legitimation strategy or not.

Although increasing data disclosure is very positive, for most investors data are just data: they do not reveal whether one company is more sustainable than another. As Clapp et al. (2016) mention in their report, 'investors need clear and tailored information to enable climate-smart financial decisions'. The same goes for other environmental and social variables. In fact, as Cohen et al. (2015) state, investors prefer 'nonfinancial information that is concise, comprehensive, comparable, [...]'. This is where measures have a part to play (Escrig-Olmedo et al., 2017).

To date, there have been many attempts to create measures for the 'integration of economic, social and corporate governance performance and reporting in enterprises' (Hřebíček et al., 2011b). These same authors proposed a series of environmental indicators in Hřebíček et al. (2011a), but did not really present any integrating measure that made the companies comparable. Kocmanová and Dočekalová (2012) also highlight the importance of creating economic indicators of the environmental, social and governance performance of companies but fail to present any formula for simple calculation; their study is also based on a survey rather than objective data. Some authors, such as some researchers belonging to the ECRI Ethics in Finance & Social Value group, have conducted private analyses of the sustainability of some firms. However, such analysis is based on private data, is not necessarily subject of public disclosure and cannot feasibly be carried out by investors. Closer to our objective, Sustainalytics and similar companies have created ESG scores that are included in databases such as Datastream or Morningstar, but the way that scores are calculated is not fully disclosed (they outline the process but do not describe the calculations in detail). Furthermore, they do not match closely the interests of stakeholders (Escrig-Olmedo et al., 2017). Herbohn et al. (2014) also create a sustainability measure, which rates companies according to a modified version of the framework proposed by International Finance Corporation (2001), based on indicators scaled in levels and not on continuous variables. Moreover, it does not give a reference of comparison to the sector's performance. The closest measure to the one that we sought can be found in the paper by Hahn and Figge (2011), which presents a formula for calculating the sustainable value of a company that, unfortunately, is of no use for comparing one company to another since it is not a size-adjusted measure. All in all, our review of the existing tools for sustainable investment decision making reveals a lack of disclosure of methods of calculation [except Hahn and Figge (2011)] in those cases in which the measures allow for comparison of companies (for example, the ratings by Sustainalytics).

One of the aims of this paper is to fill this gap in the literature and propose a *sustainable performance measure*. In addition to taking into account the environmental and/or the social aspects of the activity carried out, any such measure must use objective[3] public data for its calculations and make it feasible to draw comparisons between companies. We also propose a second measure of the *commitment-failure* or non-persistence of companies in improving their environmental and/or social performances. The objective is to learn whether the apparent commitment of companies on sustainability issues is real or just coincidental. Finally, with these two measures we propose a *2D graphical sustainability analysis* which enables different companies' sustainability performances and levels of commitment to be compared, similarly to what is done in a financial 'mean-variance' analysis, as Escrig-Olmedo et al. (2017) suggest in their paper. The ultimate objective is to provide investors with a simple[4], visual analysis that can be understood by anyone, regardless of their knowledge of finance or sustainability. Given that 'a powerful driver of non-financial reporting is the investment community' (United Nations Global Compact, 2014), we expect the availability of tools that facilitate data analysis to strengthen the already existing virtuous circle between the disclosure of data by companies and their use in analysis by investors.

To show the implementation of our measures and analysis, we have applied them to real data from the chemical sector. We have validated our measures and shown the usefulness of the 2D graphical sustainability analysis.

The rest of this paper is organised as follows. The next section presents and discusses the above-mentioned measures. The third section presents the data from the chemical sector that are used in the implementation exercise presented in the fourth section. The last section presents our conclusions.

2 Measures for sustainable investment decision making

This section presents the measures that we propose for a more complete company analysis: the *Relative Sustainable Performance Measure (RSPM)* and the *Measure of Commitment-failure (MC)*. The ultimate aim of obtaining these measures is to present a *two dimensional (2D) graphical sustainability analysis* that shows how well a company is performing in certain non-economic issues and its commitment or lack of commitment to those issues.

2.1 Relative Sustainable Performance Measure (RSPM)

The Relative Sustainable Performance Measure provides an assessment of how well a company is performing in environmental and social matters[5] that makes it possible to draw comparisons between companies. It is based on the profitability measure proposed by Hahn and Figge (2011), i.e. the value contribution of the resource (VCR).

It is a measure that is calculated relative to the market, defined as the set of companies in a specific industrial sector. First, it is hard to judge whether a company's level of, for example,

[3] Taking into account Escrig-Olmedo et al. (2017)'s conclusions, we use data that show results of the strategies the companies may implement.

[4] We also want it to be easy to compute, which is one of the main differences with the fuzzy multi-criterion decision-making used by Escrig-Olmedo et al. (2017).

[5] Following the TBL approach, it takes into account the 3 pillars of sustainability.

carbon dioxide (CO_2) emissions is high or low, but comparing its emissions with the emissions of the market gives a clear idea about the company's performance on that issue. Accordingly, Hahn and Figge (2011) argue that environmental and social resources create value if they are used by companies in a more efficient way than the average in the market. Second, it is clear that comparisons only make sense for companies that belong to the same industrial sector.

The measure presented in Hahn and Figge (2011) is the following:

$$VCR_{i,t}^{C} = Profit_{t}^{C} - RU_{i,t}^{C} * RE_{i,t}^{Market} \tag{2.1}$$

where $VCR_{i,t}^{C}$ is the value contribution (to the profit) of resource i by company C in year t, $Profit_{t}^{C}$ is the total returns of the company C in year t measured, in our case, as the EBIT in millions of USD, $RU_{i,t}^{C}$ is the use of resource i by company C, measured in the units required in each case, and $RE_{i,t}^{Market} = \frac{Profit_{t}^{Market}}{RU_{i,t}^{Market}} = \frac{\sum_{C=1}^{N} Profit_{t}^{C}}{\sum_{C=1}^{N} RU_{i,t}^{C}}$ is the efficiency[6] of use of resource i by the market in year t, with N being the total number of companies.

The resources considered are not the conventional land, labour and capital but range from CO_2 emissions to total donations. They are considered as resources by Hahn and Figge (2011) in the sense that they are things that the company can manage better or worse in carrying out its activities. In the case of CO_2 emissions, the company should try to obtain the same profit with lower emissions, whereas in the case of total donations it should try to be able to donate more.

Equation 2.1 shows that the profit of company C is corrected by the profit that company C would have obtained if it had performed the same way as the market in the use of resource i (measured as: $RU_{i,t}^{C} * RE_{i,t}^{Market}$). This gives the positive/negative excess profit that the company has obtained ($VCR_{i,t}^{C} > 0$ / $VCR_{i,t}^{C} < 0$) by using a certain resource more/less efficiently than the market ($RE_{i,t}^{Market} < RE_{i,t}^{C}$ / $RE_{i,t}^{Market} > RE_{i,t}^{C} = \frac{Profit_{t}^{C}}{RU_{i,t}^{C}}$).

From Equation 2.1, given the relative (to the market) nature of the VCR, it can be inferred that any cross-sectional average of the VCR is conceptually equal to zero ($\sum_{C=1}^{N} VCR_{i,t}^{C} = 0$). Additionally, $\sum_{i=1}^{I} VCR_{i,t}^{C} \neq Profit_{t}^{C}$, where I is the total number of resources considered.

On the basis of this first approximation made by Hahn and Figge (2011), and because our aim is to be able to compare different companies regardless of their size, we propose a modification to the measure of Hahn and Figge (2011) that makes every company comparable to every other:

$$RSPM_{i,t}^{C} = \frac{VCR_{i,t}^{C}}{TA_{t}^{C}} \tag{2.2}$$

where $RSPM_{i,t}^{C}$ is the relative sustainable performance measure of resource i of company C in year t and TA_{t}^{C} is the total assets of company C in year t.

The difference in the way in which the RSPM and the VCR rank different companies is related to the spread of the TA. The bigger the spread the bigger the difference, and the higher

[6]Using Hahn and Figge (2011)'s terminology.

the TA the bigger the change in the ranking for a single company[7]

The value of the RSPM for each company and resource increases with the company's profit ($\frac{\partial RSPM_{i,t}^C}{\partial Profit_t^C} > 0$) and decreases with the use of the resource ($\frac{\partial RSPM_{i,t}^C}{\partial RU_{i,t}^C} < 0$).

The higher the total assets (TA) are, *ceteris paribus*, the smaller the RSPM is in absolute terms[8]. When the RSPM is positive, the higher the TA the smaller the RSPM ($\frac{\partial RSPM_{i,t}^C}{\partial TA_t^C} < 0$ when $RSPM > 0$). By contrast, when the RSPM is negative, higher TA make the RSPM less negative, i.e. higher ($\frac{\partial RSPM_{i,t}^C}{\partial TA_t^C} > 0$ when $RSPM < 0$).

Once the RSPMs are calculated for every resource considered, they can be grouped into less specific resource combinations by working out an arithmetic average[9] of the RSPMs to be grouped. This gives an environmental RSPM, a social RSPM and a total RSPM, grouping the environmental, social and total resources considered (although any combination is possible).

Moreover, for the ultimate objective of this paper, we calculate the time series average value for each company for each resource and for the environmental, social and total RSPM during the period analysed.

2.2 Measure of Commitment-failure (MC)

The Measure of Commitment-failure emerged from the idea that, since sustainability is a relatively new matter for companies, investors could be interested in having a way to measure how companies are performing environmentally and socially over time.

Like financial downside measures that only take into account the left (negative) side of the distribution of the variable analysed [the downside risk presented in Sortino and Van Der Meer (1991)], we propose a way to detect which companies have decreased their interest in these matters over time. In particular, we need to separate upward and downward movements of the RSPM over time and disregard upward movements, since they are not dangerous in this case. Therefore, we propose a measure, the MC, that works like downside-risk measures and considers only downward RSPM movements:

$$MC_i^C = \left| \frac{\sum_{t=2}^{T} A_{i,t}^C * Z(A_{i,t}^C)}{W} \right| \tag{2.3}$$

where $A_{i,t}^C = RSPM_{i,t}^C - RSPM_{i,t-1}^C$, $Z(A_{i,t}^C)$ is a function which is 1 if $A_{i,t}^C < 0$ and 0 if $A_{i,t}^C \geq 0$, T is the last year for which data are available and W is the total number of two

[7] For example, in the implementation in this paper, the largest company had the third worst VCR in 2009, but had nine companies behind it in the RSPM that same year.

[8] Conceptually, the underlying logic is that when a company is larger (higher TA) a high (positive) VCR is less praiseworthy than it would be for a smaller company (lower TA), since the larger company has easier access to, for example, newer and less polluting technologies that can result in lower use of environmental resources. This is supported by González-Benito and González-Benito (2006), who state that 'large companies have more resource availability'. It is this ease of access that also makes a low (negative) VCR less alarming in a bigger company than in a smaller one, because it gives the company a greater ability to improve its performance in environmental, social and economic terms.

[9] This average can be weighted either equally (as it is in this paper) or according to the investor's preferences [as Escrig-Olmedo et al. (2017) recommend], or indeed according to objective criteria such as the relative damage (good) caused by the use of the different resources.

consecutive year periods for which information is available to compute $A^C_{i,t}$.

The aim of only taking downward movements into account is that we seek to detect companies that start neglecting environmental and social issues, whether their average performance is bad or good, and punish them. Whether a company is a good or bad performer is already shown by the RSPM measure. The MC measures something different and shows a positive value if a company's RSPM has decreased in any of the two-year sub-periods in the period analysed and a level of 0 if its performance has remained constant or improved over the whole period. Thus, the measure has a minimum value of 0, which corresponds to the ideal case of companies that have a constant or improving performance over the whole period, and the higher the MC the worse the trend in the company's performance is over time.

The rationale of punishing a company that has been performing well and better for many years but fails to improve or maintain its performance in one year is open to argument. Our answer is that it makes sense for two reasons. On the one hand the company's time series average RSPM will stay positive anyway. On the other hand, if the downturn in the RSPM is relatively small the MC will not be as big as the MC of a company that has had downward movements in more periods.

Some readers may wonder if the MC in fact adds anything new to conventional standard deviation. We want to emphasize that it is not the same as standard deviation because it only takes downward movements into account and it does not take the mean as a reference. We analyse this further later in this paper.

Last, it must be noted that this is a dynamic measure, so the MC of a company for a specific resource or combination of resources is affected by changes in the efficiency both the company and the market in the use of the resource(s) involved in the calculation.

The changes in the latter are not only a result of the change in the individual companies' profits and use of the resources, but also of the way the market is defined. In our case, to make the analysis as comprehensive as possible we define the complete market as the group of companies in a sector that have reported data about the specific resource in the specific year analysed, so the market may vary from one resource to another and its composition may change over time either because companies enter or exit the market or because they start (or even stop) reporting environmental and social data. As the last mentioned changes can distort realness, they are unwanted. We expect these changes to diminish in the future with new legislation that obliges companies to report environmental and social data so that only entries into and exits from the market will change the market's composition.

3 Data

In this section we discuss data availability and sample selection criteria for the empirical implementation of our measures.

3.1 Sample selection

The data used in this study are taken from the ASSET4 database in Datastream. At the time of our data collection in May 2015 there was yearly ESG information[10] available about companies' *use* of many resources from 2002 to 2014 for many sectors[11]. As not all sectors and years had enough data for the set of companies in them to be considered as the market[12], we chose a sector that on the one hand is highly affected by environmental and social issues[13] and on the other has a large amount of published ESG data: the chemical sector. According to Datastream, the chemical sector between 2009 and 2013 was made up of 127 companies[14] from all around the world.

Once the sector was chosen, we had to decide what ESG resources and years to include in our study. The selection criteria relied heavily on *representativity*, which was calculated as follows for each resource i and year t:

$$Representativity_{i,t} = \left| \frac{\sum_{C=1}^{N}(TA_t^C * W_{i,t}^C)}{\sum_{C=1}^{N}(TA_t^C)} \right| \tag{2.4}$$

where TA_t^C is the total assets of company C in year t and $W_{i,t}^C$ is a function which is valued at 1 if there are data available for the resource i for company C in year t and at 0 if there are none, with N being the total number of companies in the sector according to Datastream.

For example, as can be seen in Table 2.1, the representativity of the resource 'CO_2 emissions' in 2002 is 8.04%, meaning that CO_2 emission data are available for a set of companies that represents 8.04% of the total assets of the chemical sector (according to Datastream). The sampling criterion was to choose those resources that had a representativity in excess of 40% for more than one year, and the years in which the representativity level for all those resources was higher than 30%. The average representativity in the sample is 60.5%, which we consider representative enough.

As a result, the sample selected[15] consists of the annual data available for 2009 to 2013 for

[10] `https://uvalibraryfeb.files.wordpress.com/2013/09/asset4_esg_data_glossary_april2013.xlsx`

[11] In May 2015, many companies had not yet reported their 2014 data.

[12] ESG reporting is not mandatory in all countries or for all companies, and in those where it is the dates on which it became mandatory differ. For example, as stated in the Directive 2014/95/EU of the European Parliament and of the Council of 22 October 2014, in the European Union it will be mandatory from 2017.

[13] This is considered to be one of the most polluting industries (Xing and Kolstad, 2002) and, due to the materials involved in its production processes, one of the industries where most labour risk prevention measures must be taken.

[14] The list of companies includes, among others, Dow Chemical, LG Chem, Lotte Chemical, Hanwha Chemical, Air Liquide, AzkoNobel, Mitshubishi Chemical, LyondellBasell and Formosa Plastics.

[15] It is noteworthy that the representativity percentages would probably be different (and result in a different sample in terms of resources and years) in other sectors. For example, environmental issues may be less important than social issues in the financial sector, so there would be higher representativity percentages for social resources

the following resources, classified according to their nature:

1. Environmental resources:
   (a) carbon dioxide (CO_2) equivalent emissions (CO2Em), measured in thousands of tonnes
   (b) mono-nitrogen oxide (NO_X) emissions (NOxEm), measured in tonnes
   (c) mono-sulphur oxide (SO_X) emissions (SOxEm), measured in tonnes
   (d) volatile organic compound (VOC) emissions (VOCEm), measured in tonnes
   (e) total waste (WasteTot), measured in thousands of tonnes
   (f) hazardous waste (HazWaste), measured in thousands of tonnes
   (g) total energy use (EnUseTot), measured in terajoules (TJ)
   (h) water use (WaterUse)[16], measured in cubic hectometres (hm^3)
2. Social resources:
   (a) injury rate (InjuryR)[17], measured as the ratio of the total number of injuries and fatalities including no-lost-time injuries relative to one million hours worked
   (b) total donations (DonTot), measured in thousands of USD

The reader should note that *total donations* are a different kind of resource, because they are not considered negative but positive for society, i.e. the more a company donates the better it is for society. This means that, unlike all the other resources selected, it is good if $RE^C < RE^{Market}$. We have therefore introduced a sign change when calculating the total donations RSPM, thus making a difference between resources that have positive and negative impact on sustainability, as in Escrig-Olmedo et al. (2017).

Regarding representativity, the heterogeneity of the sample is evident in Table 2.1, as not all companies report all data. Therefore, the number of observations, i.e. the number of companies that have reported data for a specific resource in a specific year (out of the 127 possible companies that comprise the worldwide chemical sector according to Datastream's ASSET4 database) is different for each resource in each year, as Table 2.2 shows[18].

than for environmental ones.

[16]In this paper we consider that a lower level of water consumption is better than a higher one. However, we are aware of the use of water as one of the least (if not the least) pollutant solvents in the chemical sector, so our consideration of water use as a negative resource is open to argument. As our analysis is flexible in these matters, each analyst or investor can change the sign of the variable (positive resource) or not take it into account at all (neutral resource).

[17]Although TBL literature includes $safety$ variables in the *environmental* section, we choose to consider them a *social* resource, as done by Datastream ASSET4.

[18]Exceptionally, there are companies that report ESG values but not EBIT, which prevents their RSPMs from being calculated.

Table 2.1: Representativity of data

This table shows the representativity of the data available calculated as follows: $Representativity_{i,t} = \left|\frac{\sum_{C=1}^{N}(TA_t^C * W_{i,t}^C)}{\sum_{C=1}^{N}(TA_t^C)}\right|$.

Year	CO2Em	NoxEm	SoxEm	VOCEm	WasteTot	HazWaste	EnUseTot	WaterUse	WaterRec	EmplLeav	InjuryR	AvTrainH	DonTot
2002	8.04%	7.71%	7.71%	8.30%	4.97%	8.85%	3.32%	5.34%	0.00%	0.00%	14.08%	8.84%	13.45%
2003	13.77%	4.86%	4.86%	7.93%	7.83%	10.40%	7.57%	4.65%	0.00%	5.69%	16.12%	10.22%	12.66%
2004	29.07%	23.38%	22.74%	12.51%	18.99%	8.37%	20.21%	25.76%	0.54%	3.35%	16.60%	10.33%	11.21%
2005	50.56%	50.36%	43.99%	29.16%	25.72%	8.19%	32.41%	42.26%	0.54%	2.90%	21.79%	14.99%	20.01%
2006	56.94%	55.26%	51.41%	32.63%	31.30%	10.41%	34.99%	51.92%	0.55%	2.05%	23.50%	10.22%	21.38%
2007	62.45%	55.04%	51.47%	40.95%	43.01%	23.84%	59.76%	55.64%	2.85%	12.69%	27.30%	19.70%	23.47%
2008	62.26%	59.08%	56.50%	39.93%	56.31%	34.34%	60.66%	57.05%	5.37%	19.93%	28.28%	25.28%	29.86%
2009	68.66%	62.79%	58.10%	42.44%	61.07%	35.70%	62.82%	65.33%	10.01%	25.72%	32.10%	23.12%	39.25%
2010	76.96%	68.11%	64.69%	51.51%	67.93%	42.97%	72.30%	71.79%	16.36%	30.21%	41.38%	28.54%	40.60%
2011	77.77%	67.40%	63.69%	54.19%	70.79%	44.08%	69.89%	72.35%	18.03%	38.69%	43.17%	30.72%	55.83%
2012	81.70%	70.71%	67.67%	56.65%	74.70%	46.57%	77.62%	75.92%	17.99%	40.04%	45.28%	32.44%	57.83%
2013	74.74%	65.97%	63.67%	55.54%	72.50%	43.40%	75.92%	72.19%	18.55%	38.70%	43.45%	35.04%	57.57%
2014	2.77%	2.20%	2.20%	2.64%	2.72%	2.35%	2.98%	2.87%	2.64%	2.20%	2.90%	0.62%	2.90%

Table 2.2: Number of observations

This table shows the number of companies (out of a total of 127) that have provided data for the different variables and years selected.

Year	CO2Em	NoxEm	SoxEm	VOCEm	WasteTot	HazWaste	EnUseTot	WaterUse	InjuryR	DonTot
2009	66	55	51	34	57	34	62	60	31	32
2010	78	57	56	38	65	35	74	69	43	39
2011	85	62	60	44	73	45	78	75	46	54
2012	89	62	61	44	78	48	86	80	51	58
2013	79	57	57	43	75	45	82	76	49	57

In addition, for each company and year we have also used data on the following economic variables for our RSPM calculations:

1. earnings before interests and taxes (EBIT), measured in millions of USD
2. total assets (TA), measured in millions of USD

It is important to note that the data obtained are aggregate data for each company, regardless of whether the company operates and uses resources in one country or more. Therefore, we are unable to disaggregate the data in order to analyse resource use by country or continent, nor can we analyse the effect of the different legislations that exist.

3.2 Descriptive Statistics

Table 2.3 summarizes the descriptive statistics of the resources used in the study. As a general comment, the descriptives are stable throughout the period, with some exceptions that we explain below. It is worth mentioning that the median is always lower than the mean, which shows that the most extreme values are on the right-hand side of the distribution. This is confirmed by the fact that the variables are all positively skewed and leptokurtic.

As Panel A shows, average CO_2 equivalent emissions remained quite stable from 2009 to 2012 but in 2013 they doubled, due to Sumimoto Chemical more than quadrupling its emissions. As the other descriptives show, this resource's distribution has fatter tails than a normal distribution (leptokurtic) and is positively skewed, which means that the extreme events are more extreme on the right-hand side of the distribution (the high emission values). The facts that the median is lower than the mean, and the standard deviation is double or more than double the mean, as well as the minimum and maximum values, only confirm the description of the distribution given above.

NO_X emissions, shown in Panel B, have a similar distribution to CO_2 equivalent emissions. However, it is worth noting that there were no big changes in the former during the period analysed and that NO_X emissions are about one-thousandth of the CO_2 equivalent emissions. Moreover, the coefficients of variation are about double the values of the same statistic for CO_2 equivalent emissions, which means that the tails are fatter. This is confirmed by a much higher level of kurtosis.

As shown in Panel C, SO_X emissions have a similar distribution to those of NO_X.

Table 2.3: Descriptives of the Resources year by year

This table shows the descriptive statistics of all the environmental and social resources used in this study, each measured in its respective unit of measure as stated above.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
Panel A: CO_2 emissions (CO2Em)								
2009 (n=66)	5,373.06	2,337.50	19.80	71,322.00	10,222.88	1.90	4.63	28.42
2010 (n=78)	5,294.35	2,160.90	26.62	74,976.00	10,328.12	1.95	4.61	28.99
2011 (n=85)	5,061.68	1,844.87	26.81	74,778.00	9,988.64	1.97	4.74	30.70
2012 (n=89)	5,212.09	2,196.00	27.10	75,448.00	9,864.04	1.89	4.77	31.53
2013 (n=79)	10,600.67	2,340.00	27.21	412,400.00	47,039.39	4.44	8.17	70.06
Panel B: NO_X emissions (NOxEm)								
2009 (n=55)	6,224.79	1,363.00	7.00	160,000.00	21,628.89	3.47	6.72	48.20
2010 (n=57)	7,103.75	1,530.00	10.30	165,000.00	22,834.12	3.21	6.12	41.92
2011 (n=62)	6,572.40	1,544.00	10.20	155,000.00	21,036.07	3.20	6.11	42.13
2012 (n=62)	6,859.90	1,965.40	10.50	155,000.00	20,972.13	3.06	6.12	42.30
2013 (n=57)	6,007.37	1,683.60	7.70	158,000.00	20,916.65	3.48	6.91	50.69
Panel C: SO_X emissions (SOxEm)								
2009 (n=51)	7,277.93	730.00	0.70	233,000.00	32,549.61	4.47	6.73	47.18
2010 (n=56)	7,915.59	852.00	0.50	241,000.00	32,742.76	4.14	6.66	47.61
2011 (n=60)	6,897.28	519.00	0.29	208,000.00	27,637.17	4.01	6.67	48.47
2012 (n=61)	6,722.88	899.00	0.26	202,000.00	26,607.04	3.96	6.73	49.34
2013 (n=57)	6,059.67	494.00	0.15	215,000.00	28,455.88	4.70	7.13	52.84
Panel D: VOC emissions (VOCEm)								
2009 (n=34)	3,418.72	767.00	64.80	47,000.00	8,164.55	2.39	4.68	25.39
2010 (n=38)	3,560.36	915.50	25.21	47,700.00	7,924.14	2.23	4.74	26.77
2011 (n=44)	3,200.57	918.00	22.47	46,500.00	7,180.57	2.24	5.17	31.51
2012 (n=44)	3,302.62	1,160.00	21.00	47,200.00	7,318.16	2.22	5.10	30.87
2013 (n=43)	3,327.73	1,049.00	2.00	47,500.00	7,437.71	2.24	5.06	30.38
Panel E: Total Waste (WasteTot)								
2009 (n=57)	1,540.17	93.94	2.99	34,506.00	5,646.03	3.67	4.61	24.37
2010 (n=65)	1,093.07	71.92	2.02	29,089.50	4,507.19	4.12	5.39	31.29
2011 (n=73)	4,463.39	88.70	3.91	218,393.00	26,050.86	5.84	7.78	64.08
2012 (n=78)	4,460.50	84.43	3.05	246,129.06	28,225.92	6.33	8.22	70.72
2013 (n=75)	4,389.52	80.00	3.57	252,974.46	29,449.88	6.71	8.19	69.54
Panel F: Hazardous Waste (HazWaste)								
2009 (n=34)	68.36	18.67	0.20	560.00	121.53	1.78	2.89	11.20
2010 (n=35)	112.99	28.05	0.20	1,199.00	231.47	2.05	3.46	15.57
2011 (n=45)	143.10	23.50	0.15	2,287.51	384.15	2.68	4.46	23.82
2012 (n=48)	131.29	20.16	0.10	2,284.42	369.22	2.81	4.73	26.44
2013 (n=45)	130.56	18.74	0.15	1,877.75	328.49	2.52	4.10	20.53
Panel G: Total Energy Use (EnUseTot)								
2009 (n=62)	66,538.59	24,497.35	396.00	521,000.00	95,964.13	1.44	2.65	11.00
2010 (n=74)	69,610.01	24,737.71	530.00	590,600.00	105,103.96	1.51	2.67	11.21
2011 (n=78)	72,133.60	26,452.23	424.63	606,600.00	108,536.90	1.50	2.56	10.48
2012 (n=86)	72,889.40	30,600.00	452.26	592,900.00	107,042.87	1.47	2.47	9.84
2013 (n=82)	70,633.98	28,049.33	517.83	592,800.00	104,307.64	1.48	2.66	11.25
Panel H: Water Use (WaterUse)								
2009 (n=60)	175.57	51.41	0.28	3,009.00	453.06	2.58	5.04	29.59
2010 (n=69)	155.18	42.26	0.39	2,693.00	378.38	2.44	5.11	32.27
2011 (n=75)	156.19	35.13	0.29	2,830.00	392.71	2.51	5.11	32.21
2012 (n=80)	160.81	38.61	0.30	2,770.00	378.03	2.35	4.91	31.39
2013 (n=76)	153.74	40.25	0.38	3,052.00	403.36	2.62	5.58	38.09
Panel I: Injury Rate (InjuryR)								
2009 (n=31)	3.94	2.70	0.00	13.50	3.44	0.87	1.44	4.53
2010 (n=43)	3.49	2.70	0.00	14.15	3.23	0.92	1.46	5.13
2011 (n=46)	4.25	2.30	0.00	46.91	7.21	1.70	4.79	28.54
2012 (n=51)	3.97	2.48	0.00	38.33	5.77	1.46	4.41	26.35
2013 (n=49)	3.81	2.31	0.07	35.58	5.41	1.42	4.43	26.14
Panel J: Total Donations (DonTot)								
2009 (n=32)	4,691.96	2,546.04	1.10	26,800.00	6,633.03	4.23	4.86	25.75
2010 (n=39)	4,261.18	2,152.07	1.40	40,060.00	7,288.51	3.51	4.44	23.44
2011 (n=54)	5,174.06	1,782.87	0.00	51,400.00	8,920.26	4.20	5.60	35.87
2012 (n=58)	5,364.80	1,626.47	0.00	50,550.00	10,029.00	5.63	7.03	51.68
2013 (n=57)	6,286.90	2,000.00	1.54	73,511.33	12,281.77	5.04	6.28	42.13

Panel D shows that VOC emissions have a similar distribution to CO_2 equivalent emissions between 2009 and 2012. The minima in 2012 and especially in 2013 correspond to the company Yara International, which seems to have made a real effort to improve its resource $efficiency$ over the whole 2009-2013 period.

As Panel E shows, average total waste reported by companies quadrupled from 2010 to 2011. This is due, at least in part, to one company, MOSAIC, having approximately sextupled its total waste from 2009 to 2011 (in 2010 it did not report any data for this variable).

Panel F shows two significant changes in the hazardous waste variable. One happens in the period 2009-2010, when the mean of the variable nearly doubles. This is due to the company Lyondellbasell Inds.Cl.A starting to report its data in 2010 and its value being 2010's maximum. In 2011 the maximum almost doubled again, when the company Incitec Pivot started providing data on this variable.

Panel G shows that total energy use has the least leptokurtic distribution of all the resources used in this study. However, it is positively skewed and leptokurtic, just as all the other variables are.

Panel H shows that the distribution of water use looks similar to that of VOC emissions.

In Panel I some interesting facts about the injury rate variable can be seen. First of all, the minimum is really low throughout the period. This means that those companies that have fewer injuries relative to one million hours worked are close to or at zero, which is good news. Secondly, a big increase in the maximum can be seen in 2010-2011. This is due to the company K+S starting to report these data in 2011 and its figures being very high in comparison to those reported by other companies in the years before. This made the distribution more positively skewed and leptokurtic in 2011.

Total donations, shown in Panel J, show a steady increase, indicating that at least some companies have become more socially aware (especially those that donate most: Dow Chemical, the biggest company in the sample in terms of total assets in the first four years, although it decreased its donations in 2013, and Sasol, which shows a steady increase culminating in the maximum for 2013).

Table 2.4 shows the trend in the average EBIT of the chemical sector in the 2009-2013 period. There is a tendency towards EBIT growth, but some years are not as good as others. One company, Lyondellbasell Inds.Cl.A, is worth mentioning since it started in 2009 and 2010 with the lowest value in the distribution and ended up in 2011 with the highest, with the latter being much higher than any of the other maxima. This value made the distribution more positively skewed and more leptokurtic.

Table 2.5 shows a steady increase in the average total assets of the companies. The maxima in all the years of the period are those of Dow Chemical, the largest company in our sample.

Table 2.4: Descriptives of Earnings before Interest and Taxes year by year

This table shows the descriptive statistics for the variable Earnings before Interest and Taxes (EBIT), which is measured in millions of USD.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
2009 (n=122)	490.17	267.74	-5,411.81	4,942.40	981.02	2.00	0.01	18.17
2010 (n=123)	363.80	186.80	-2,620.84	2,995.90	664.67	1.83	0.92	9.28
2011 (n=125)	746.46	387.30	-4.15	10,434.17	1,127.78	1.51	5.55	45.30
2012 (n=125)	780.40	443.93	-40.47	4,863.12	866.66	1.11	2.09	7.82
2013 (n=125)	677.96	379.11	-1,574.22	4,648.76	903.60	1.33	2.09	8.54

Table 2.5: Descriptives of Total Assets year by year

This table shows the descriptive statistics of the variable Total Assets (TA), which is measured in millions of USD.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
2009 (n=122)	6,864.50	4,379.11	0.57	41,574.00	7,858.43	1.14	2.09	7.39
2010 (n=123)	7,116.85	4,200.30	2.54	63,898.00	8,805.62	1.24	3.12	16.83
2011 (n=125)	7,947.85	5,004.22	33.17	67,509.00	9,525.71	1.20	2.95	15.33
2012 (n=125)	8,448.89	5,426.06	37.26	66,665.00	9,596.75	1.14	2.79	14.06
2013 (n=125)	8,797.76	5,539.06	109.09	66,272.00	9,819.35	1.12	2.67	12.92

4 Results

This section presents the main results of applying the measures proposed to data for the companies in the chemical sector worldwide.

4.1 Descriptives and analysis of the RSPM and the MC

With the variables presented in the previous section, we calculated the RSPM for each company, year and resource (and for the environmental, social and total resources) and their associated MCs.

Tables 2.6 and 2.7 summarize the main statistical descriptive measures for the RSPM and the MC, respectively, along with some other values, that we consider relevant in each case.

We analyse the RSPM first. To make it easier to interpret, we start by taking an example from Table 2.6. The mean value of the RSPM which takes into account CO_2 emissions is 0.0316. This means that, on average[19], each company in the sample obtained a profit that exceeded that of the market by about 3% of their total assets due to their good management of CO_2 emissions in 2009-2013.

Table 2.6 shows that the mean is statistically zero for 6 out of 13 resources or combinations of resources. The other values are positive for some environmental resources and negative for social resources and their combination, and for the combination of all resources, at different levels of significance. The fact that the total RSPM is negative (although only at the 10% level of significance) is remarkable, and means that on average for the whole period and all companies the profit obtained was lower than it would have been if they had performed the same way as the

[19]This is the cross-sectional mean of the time-series means calculated previously for each company.

Table 2.6: Descriptives of the RSPM for the individual and grouped resources

This table shows the descriptive statistics of the relative sustainability performance measure (RSPM) for each resource and resource combination. Specifically, it shows the mean, the median, the minimum, the maximum, the standard deviation, the coefficient of variation, the skewness, the kurtosis, the percentage of positive values (out of the total values calculated), the percentage of companies with a positive average RSPM during the whole 2009-2013 period (out of all the companies with an RSPM average value for the period, i.e. those for which there are at least 2 yearly values) and the percentage of companies that have a positive RSPM value in at least one of the years from 2009 to 2013 (out of all of the companies that have at least one RSPM value).
, and * denote that the mean value is statistically different from zero, according to the sign test with confidence levels of 1%, 5% and 10%, respectively.

	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis	% of positive values	% of companies with a positive average value	% of companies with at least one positive value
CO2Em	0.0316***	0.0362	-0.2535	0.2491	0.0844	2.6686	-0.6917	5.1010	68.39%	76.47%	94.39%
NoxEm	-0.0423	0.0516	-4.4297	0.1855	0.5762	13.6255	-7.1999	55.1195	75.00%	76.19%	98.84%
SoxEm	-0.0280	0.0566	-3.6731	0.1873	0.5032	17.9847	-6.6199	47.7138	80.36%	81.67%	95.35%
VOCEm	0.0064	0.0222	-0.5486	0.1885	0.1395	21.9263	-2.0216	8.5229	61.11%	64.44%	73.61%
WasteTot	0.0069	0.0651	-2.7736	0.1941	0.3735	54.1826	-6.1167	43.2009	87.54%	90.79%	98.89%
HazWaste	-0.0245	0.0510	-2.1164	0.1780	0.3642	14.8468	-4.6391	25.7971	67.51%	67.39%	70.00%
EnUseTot	0.0244**	0.0312	-0.5941	0.2613	0.1116	4.5803	-2.1189	13.5623	64.69%	69.41%	91.00%
WaterUse	0.0413***	0.0531	-0.2400	0.2529	0.0931	2.2540	-0.5939	3.6139	69.05%	71.43%	89.16%
InjuryR	-0.2239***	-0.0068	-3.3186	0.1618	0.6701	2.9937	-3.4182	14.6102	51.40%	50.00%	69.01%
DonTot	-0.0333***	-0.0340	-0.2867	0.4607	0.1058	3.1759	1.1345	9.9991	32.92%	33.33%	54.55%
Environmental	0.0108	0.0399	-1.3134	0.2613	0.1740	16.0366	-5.2024	38.9016	67.31%	73.33%	92.92%
Social	-0.1421***	-0.0241	-3.3186	0.4979	0.5074	3.5700	-5.1550	30.9043	38.32%	40.00%	56.41%
Total	-0.0317*	0.0142	-1.4361	0.1790	0.1975	6.2312	-4.5911	29.7709	57.36%	58.00%	84.21%

market due to the managing of the combination of all the resources considered. Specifically, if they had performed the same way as the market, they would have obtained, on average, a profit higher by an average of about 3% of their total assets (the mean of total RSPM is -0.0317).

Furthermore, it can be seen in Table 2.6 that the median RSPM (of the time series averages calculated for each company) is positive for all environmental resources and their combination, and negative for all social resources and their combination, which means that more and less than 50% of the companies respectively obtained positive time-series average RSPM values. The percentage of companies with a positive average RSPM confirms that more companies perform better/worse than the market in the cases where the median is positive/negative. The percentage of positive values (without making time-series averages for the companies) is also similar. These facts show that most companies generally perform better in environmental matters than in social matters, which may imply that the companies that made up the chemical sector between 2009 and 2013 were more aware of environmental concerns than of social concerns. It might be thought that a high percentage of positive values means that the sector is performing fine, and in a way it is, but the somewhat symmetric nature of the VCR, the measure on which the RSPM is built, must not be forgotten. This means that the higher the percentage of positive values is, the more probable it is that there are more companies that are performing really badly, with extremely negative RSPM values. For example, NO_x Emissions RSPM, with 76.19% of positive values, has a very negative minimum (-4.4297) but the rest of the values are around and especially just above 0. The maximum is 0.1855, very little in absolute terms compared to the minimum. Last, the percentage of companies that have at least one positive RSPM value during the period is really high for most of the resources or combinations of them. This means that almost every company has performed better than the market at least once (though some do not perform this way regularly, as the lower percentages of companies with an average positive value show).

The trend over time in the RSPM for the combinations of environmental, social and all resources over the years analysed is displayed in Figure 2.1, where each coloured line represents a company. It can be seen that there is heterogeneity between companies and that although there are positive values for some companies the most extreme values are negative[20]. This means that some companies perform really badly in environmental and social issues, which should be a reason for investors not to choose these companies in their investment portfolios. However, most of the companies in question seem to have improved their performance by the end of the period, which may also be a positive sign for investors.

Moreover, the most remarkable point in Figure 2.1 is that the RSPMs of many of the companies remain quite stable over time. This can be seen more clearly in the next section, when the MC is added to the analysis.

In order to validate our measure as something new, we need to demonstrate that it provides information that is not included in the classic measures used in investment decision making. We take the return on total assets ($ROTA$) as the classic economic measure with which to compare the RSPM.

[20]It is evident that there are some companies for which we do not have data for all the years, as expected from Table 2.2. This is especially evident in the most negative cases.

Figure 2.1: Trend in RSPM over time

This graph shows the trend in the RSPM of the combination of the environmental resources, the combination of the social resources and the combination of all the resources for each company from 2009 to 2013. Each line on the graph corresponds to a company.

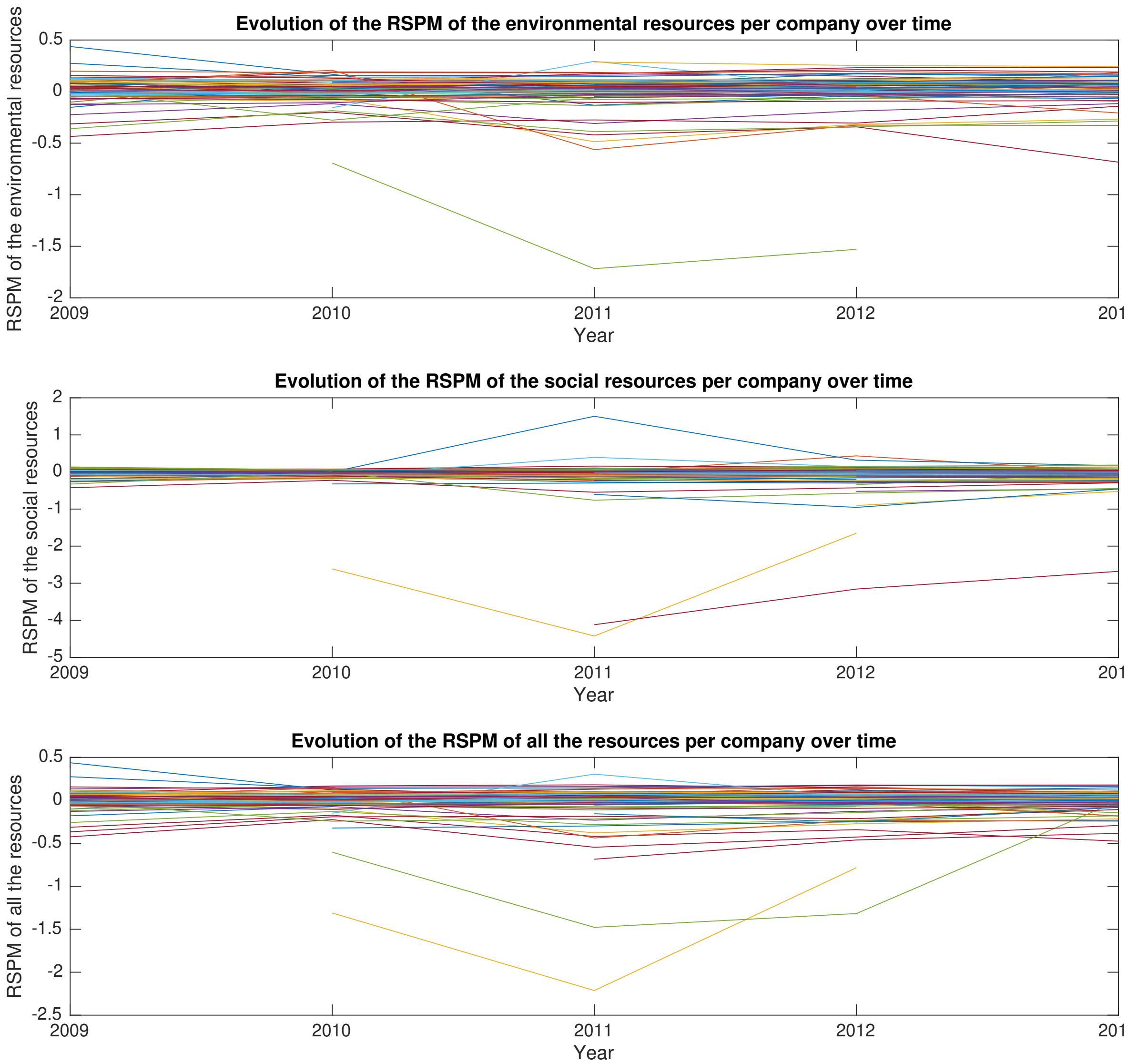


Table 2.7: Descriptives of the MC for the individual and grouped resources

This table shows the descriptive statistics of the measure of commitment-failure (MC) for each of the resources and resource combinations. Specifically, it shows the mean, the median, the minimum, the maximum, the standard deviation, the coefficient of variation, the skewness, the kurtosis and the percentage of zero values (out of all the values calculated, one for each company that has at least two RSPM yearly values).
** denotes that the mean value is statistically different from zero, according to the sign test with a level of confidence of 1%.

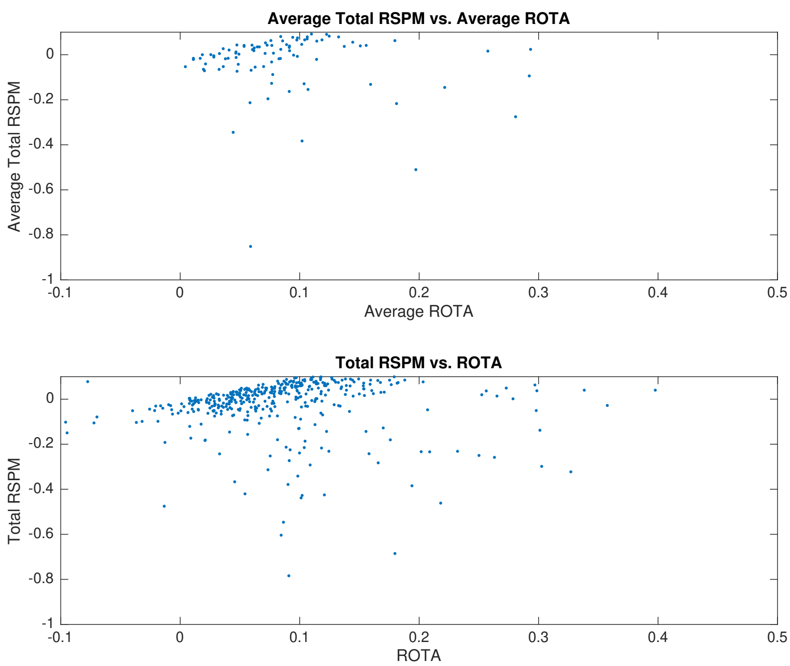
	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Asymmetry	Kurtosis	% of 0 values
CO2Em	0.0195***	0.0128	0.0000	0.2949	0.0344	1.7630	6.2822	49.9086	10.59%
NoxEm	0.0322***	0.0137	0.0000	0.8253	0.1036	3.2200	7.3020	56.3585	6.35%
SoxEm	0.0321***	0.0127	0.0000	0.6953	0.0913	2.8408	6.5980	48.0668	3.33%
VOCEm	0.0189***	0.0087	0.0000	0.1091	0.0253	1.3386	2.0065	6.6563	11.11%
WasteTot	0.0140***	0.0118	0.0000	0.0644	0.0121	0.8692	1.3212	5.5994	13.16%
HazWaste	0.0139***	0.0048	0.0000	0.0860	0.0198	1.4234	1.8955	6.4542	28.26%
EnUseTot	0.0193***	0.0111	0.0000	0.1220	0.0233	1.2087	2.4349	9.7886	11.76%
WaterUse	0.0177***	0.0132	0.0000	0.0849	0.0171	0.9641	1.7889	6.6942	6.49%
InjuryR	0.0277***	0.0072	0.0000	0.4525	0.0676	2.4434	5.2137	31.9810	23.08%
DonTot	0.0219***	0.0073	0.0000	0.3331	0.0462	2.1114	5.4028	36.0701	20.00%
Environmental	0.0238***	0.0114	0.0000	0.2560	0.0410	1.7208	3.6182	17.3344	12.22%
Social	0.0284***	0.0092	0.0000	0.4525	0.0659	2.3221	4.8455	28.3275	18.75%
Total	0.0238***	0.0156	0.0000	0.2257	0.0375	1.5721	3.6134	17.8775	14.00%

The $ROTA$ is calculated as follows, using the information available in our database: $ROTA_t^C = \frac{EBIT_t^C}{TA_t^C}$.

Accordingly, we conducted four analyses, one graphical and three analytical. For the graphical analysis the total RSPM (rescaled for a better graphic representation) has been plotted against the $ROTA$ in Figure 2.2, both for time series averages per company and for all the company-year observations. In both cases it can be seen that there are companies that perform well financially (high $ROTA$) but not environmentally and socially (low RSPM) and viceversa. This evidence seems to confirm that our measure provides new information for investors (although there are also companies that perform well or badly in both financial and environmental/social issues).

Figure 2.2: Total RSPM vs. ROTA (Time series average and company-year observations)

This graph shows the Total RSPM plotted against the $ROTA$ for both time series averages per company and all company-year observations.



We prove this also by calculating the Pearson correlation coefficient for the total RSPM and $ROTA$, obtaining low values for both average and non-average data (0.1002 and 0.1915, respectively). Although only the first is statistically equal to 0 (p-values for the 2-tailed test are 32.13% and 0% respectively), the value of the correlation is not high enough to make us reject the idea that the RSPM is, indeed, a different measure from the $ROTA$.

In addition, we performed linear regression analysis through ordinary least squares (OLS) to see if the $ROTA$ was capable of explaining the different RSPMs calculated. The model tested for each resource i or combination of resources is the following:

$$RSPM_{i,t}^C = \alpha_i + \beta_i * ROTA_t^C \tag{2.5}$$

Table 2.8 shows the main results obtained. We find that in 8 out of 13 cases they are closely related, with significant betas (at the 5% confidence level). However, except in one case where the adjusted R^2 is nearly 60%, the figures do not exceed 40%, which makes us believe that the RSPM is not only measuring what the $ROTA$ measures.

Table 2.8: Results of the linear regressions RSPM vs. ROTA

This table shows the betas, their p-values and the adjusted R^2 for the 13 regressions conducted. The model tested is: $RSPM_{i,t}^{C} = \alpha_i + \beta_i * ROTA_t^C$.

	Beta	P-value	Adj. R^2
CO2Em	0.8742	0.00%	31.89%
NoxEm	0.7736	6.01%	0.88%
SoxEm	0.4585	20.96%	0.21%
VOCEm	0.6087	0.00%	8.17%
WasteTot	-0.5150	11.11%	0.46%
HazWaste	0.7874	1.71%	2.38%
EnUseTot	0.9934	0.00%	39.60%
WaterUse	1.0972	0.00%	58.42%
InjuryR	-0.0599	92.47%	-0.47%
DonTot	-0.5869	0.00%	10.00%
Environmental	0.7755	0.00%	11.82%
Social	-0.3112	34.07%	-0.03%
Total	0.4957	0.00%	3.46%

Last, we also calculated the Spearman correlation between the two variables, obtaining high positive and negative[21] values that are significantly different from zero and range from -0.5 to 0.84. This shows that the two measures do not rank the same way by definition, since if that had been the case we would have expected to find similar coefficients of correlation between the ROTA and the different implementations of the RSPM (different resources and resource combinations). In fact, we confirmed this by looking at a selection of particular cases selected, which can be seen in Table 2.9. As an example, it can be seen that there are companies such as MOSAIC or DULUXGROUP that have two of the highest ROTA values of the sample but have negative average Total RSPMs.

Altogether, we can confirm that RSPM and ROTA do not measure the same thing and that the contribution of our measure RSPM is relevant.

Table 2.7 contains the descriptive statistics for the MC. 0.0195 is the mean of downward movements of the companies' CO_2 Emission RSPM during the period (taking into account only the years with RSPM data for each company). It can be seen that the median is low compared to the maximum in all cases, which means that some values are far away from the majority (see the maxima, Figures 2.4 and 2.5 and 2.6). The fact that the mean is always higher than the median confirms this. The minima are zero in all cases, which is the theoretical minimum of the measure. This shows that there are indeed companies that improve or, at least, do not worsen their performance over time, which is good. However, the percentage of companies that show such behaviour is low, for example 14% for the total MC, as can be seen in the last column of the table. This shows that most companies are not really committed to environmental and social issues. It is also worth noting that, although they generally perform worse in social issues, chemical companies do not worsen their performance in social issues as much as in environmental

[21]It is noteworthy that the negative values correspond to total donations and the social factor grouping.

Table 2.9: ROTA, RSPM and MC for all the individual and grouped resources for different companies

This table shows the values of the ROTA, RSPM and MC for all the individual and grouped resources for 8 selected companies.

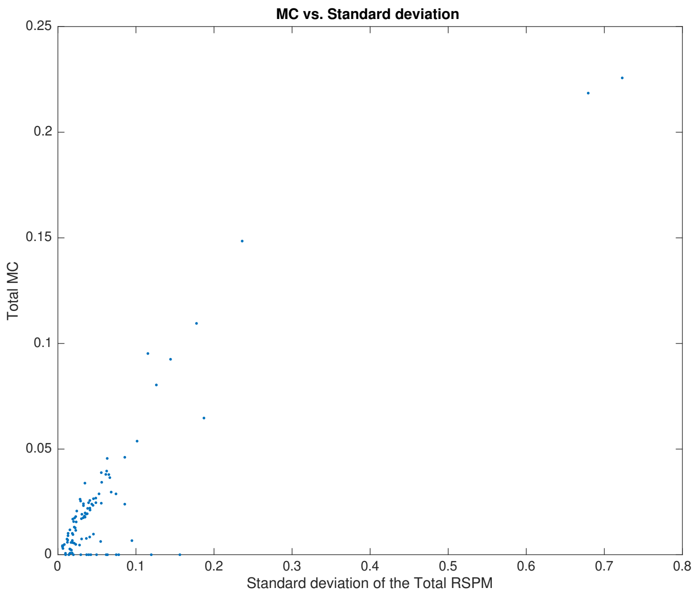
	CLARIANT	LG CHEM	URALKALI	CANEXUS	UPL	DULUXGROUP	MOSAIC	NIPPON KAYAKU
ROTA	0.0329	0.1749	0.2366	0.0385	0.1226	0.1973	0.2214	0.0759
Average RSPM CO2Em	0.0120	0.0994	0.0729	0.0236	No data	0.1908	0.1795	0.0721
MC CO2Em	0.0063	0.0217	0.0451	0.0000	No data	0.0051	0.0806	0.0039
Average RSPM NOxEm	0.0236	0.1613	0.1016	No data	No data	No data	0.1816	0.0749
MC NOxEm	0.0121	0.0269	0.0492	No data	No data	No data	0.0794	0.0049
Average RSPM SOxEm	0.0234	0.1678	0.1626	No data	No data	No data	0.0727	0.0756
MC SOxEm	0.0112	0.0263	0.0445	No data	No data	No data	0.1115	0.0048
Average RSPM VOCEm	0.0178	0.1634	0.0439	No data	No data	No data	0.1885	0.0674
MC VOCEm	0.0076	0.0000	0.1091	No data	No data	No data	0.0943	0.0042
Average RSPM WasteTot	0.0230	0.1689	-1.0616	No data	No data	0.1941	-2.7736	0.0723
MC WasteTot	0.0103	0.0273	0.0000	No data	No data	0.0059	0.0000	0.0048
Average RSPM HazWaste	-0.0514	0.1697	0.1581	No data	No data	No data	No data	0.0512
MC HazWaste	0.0006	0.0276	0.0410	No data	No data	No data	No data	0.0036
Average RSPM EnUseTot	0.0145	0.0477	0.1511	No data	0.0928	0.1881	0.1428	0.0940
MC EnUseTot	0.0078	0.0299	0.1220	No data	0.0093	0.0060	0.0845	0.0045
Average RSPM WaterUse	-0.0183	0.1525	0.1469	No data	No data	0.1939	0.1025	0.0551
MC WaterUse	0.0024	0.0267	0.0355	No data	No data	0.0064	0.0114	0.0049
Average RSPM InjuryR	0.1473	0.0987	-0.1482	-2.8959	No data	-3.3186	0.0415	0.0288
MC InjuryR	0.0256	0.0043	0.0035	0.4525	No data	0.0000	0.0088	0.0031
Average RSPM DonTot	0.0637	0.4607	0.0666	No data	0.0881	No data	-0.0521	No data
MC DonTot	0.0433	0.3331	0.0379	No data	0.0000	No data	0.0072	No data
Average Environmental RSPM	0.0056	0.1397	0.0912	0.0236	0.0928	0.1917	-0.1849	0.0675
MC Environmental	0.0051	0.0251	0.1424	0.0000	0.0093	0.0059	0.1929	0.0043
Average Social RSPM	0.1055	0.4979	0.0827	-2.8959	0.0881	-3.3186	-0.0554	0.0288
MC Social	0.0213	0.3331	0.0179	0.4525	0.0000	0.0000	0.0079	0.0031
Average Total RSPM	0.0051	0.1326	0.1292	-1.4361	0.0904	-0.5103	-0.1453	0.0629
MC Total	0.0049	0.0234	0.1095	0.2257	0.0008	0.0000	0.1485	0.0054

issues (12.22% vs. 18.75% of zero-values).

In order to make sure that the MC is not the same as the standard deviation of the RSPM, we again conducted four analyses: one graphical and three analytical. First of all, we plotted the total MC against the standard deviation of the total RSPM (see Figure 2.3). As can be seen, there is a positive link between the two variables when the MC is positive, but no clear pattern exists for companies with an MC value of zero.

Figure 2.3: MC vs. Standard deviation

This graph shows the Total MC plotted against the standard deviation of the Total RSPM.



In our second analysis, we obtained high significant correlations between MCs for different resources and resource combinations and the standard deviations of their corresponding RSPMs. We attribute these high correlations to the low zero-value percentages, because not taking into account (that is, not punishing) upward movements is the most distinctive part of our measure. Since the percentage of companies with MC values of zero is really low, they do not offset the highly correlated MCs and standard deviations of the badly performing companies . To prove this, we calculated the correlation between the correlations calculated earlier (of which there were 13, one for each resource or resource combination) and the percentage of MC values of zero. The result was a value of -0.34, which means that the higher the percentage of 'zero values' is, the bigger the difference is between the values of the standard deviation of the RSPM and the MC. Although that correlation is not significantly different from zero (probably due to the fact that only 13 data items were used to calculate it), we consider the result enough to corroborate that the MC is not the same as the standard deviation of the RSPM.

Moreover, we used OLS to linearly regress the MCs for each resource and resource combination against the standard deviations of the corresponding RSPMs, testing the following cross-sectional model:

$$MC_i^C = \alpha_i + \beta_i * \sigma(RSPM_i^C) \tag{2.6}$$

where $\sigma(RSPM_i^C)$ is the standard deviation of the time series of RSPM for resource or combination of resources i of company C.

The results obtained (see Table 2.10) show that in 11 of the 13 cases the beta is statistically significant. Furthermore, in most of the cases where the percentage of zero-values of the MC is lower the adjusted R^2 is much higher, almost explaining the whole MC in some cases. Therefore, we continue to attribute the close relationship between the MC and the standard deviation of the RSPM to the low percentage of companies with MC values equal to zero.

Table 2.10: Results of the linear regressions MC vs. $\sigma(RSPM)$

This table shows the betas, their p-values and the adjusted R^2 for the 13 regressions conducted. The model tested is: $MC_i^C = \alpha_i + \beta_i * \sigma(RSPM_i^C)$.

	Beta	P-value	Adj. R^2
CO2Em	0.5241	0.00%	84.81%
NoxEm	0.4789	0.00%	98.76%
SoxEm	0.4640	0.00%	98.10%
VOCEm	0.1815	0.07%	21.67%
WasteTot	-0.0006	93.32%	-1.34%
HazWaste	0.0632	5.70%	5.90%
EnUseTot	0.5134	0.00%	65.84%
WaterUse	0.2947	0.00%	42.07%
InjuryR	0.2327	0.00%	62.56%
DonTot	0.4563	0.00%	88.13%
Environmental	0.5154	0.00%	86.62%
Social	0.2887	0.00%	69.43%
Total	0.3324	0.00%	79.73%

Finally, we calculated the Spearman correlations between the two variables. Although they are significantly different from zero (as expected), the coefficients are never higher than 0.72. We can thus confirm that the rankings of companies that result from each of the two variables are different.

In short, we have proven that the MC is not the same measure as the standard deviation of the RSPM and that it is therefore a good contribution to the literature.

Finally, we sought to learn whether there was a relationship between the RSPM and the MC. We calculated the Pearson correlation for the 13 resources or resource combinations and, in most cases, obtained negative correlations significantly different from zero. This means that in general those companies that perform better in the different categories presented are also more committed to those issues.

4.2 2D graphical sustainability analysis

This section takes both measures proposed into account at the same time and presents the 2D[22] graphical sustainability analysis: a tool for making *sustainable* investment decisions. By using it investors can choose those companies that not only have positive RSPM values but also work to maintain them or even make them better.

One really valuable aspect of this 2D graphical sustainability analysis is that investors can

[22]Referring to the two-dimensional nature of the graph and not to the number of sustainability pillars taken into account: all three are covered, economic, social and environmental.

apply it to whatever resource or set of resources[23] they are concerned about or consider most important, as RSPM and MC are calculated for each of them.

The 2D graphical analysis for the environmental (Figure 2.4) and social (Figure 2.5) resources separately and for the above-mentioned different combinations (Figure 2.6) can all be seen. In each graph we represent the MC on the x-axis and the time series average RSPM for each company on the y-axis. Therefore, every point on a graph corresponds to a company. For the sake of illustration we have selected some of the most representative companies (see Table 2.9) and included three of them[24] in the above-mentioned Figures. As mentioned in the previous section, and although it is not very clear graphically, there is a general pattern: the better (higher) the RSPM, the better (lower) the MC. However, there are also companies that have better RSPM while having worse MC values and viceversa.

According to our analysis, investors should choose companies with high RSPM and low MC (especially $MC = 0$) over those with lower RSPM and/or higher MC. Thus, preferences expand to the top left part of the graph. However, the final investment decision will depend on the investor's specific concerns and his/her threshold of tolerance.

An examination of Table 2.9 and Figures 2.4-2.6 enables us to identify some companies that are always (or almost always) preferable to investors, no matter what their particular concerns may be. For example, Table 2.9 shows that LG CHEM is a better performer than URALKALI in all the emissions analysed, because its RSPM is higher and its MC lower. This can also be seen in Figure 2.6, for example, when comparing the performances of LG CHEM and MOSAIC in relation to environmental resources, in which the former is clearly better than the latter. However, there are other cases where the RSPM is higher but the MC is higher too (see Figure 2.5 for the graph of total donations). In these cases, for example when deciding whether to invest in LG CHEM or CLARIANT based on their performance in total donations, investors must decide whether they prefer a better-performing company or a company that is working on improving its performance (or, at least, not neglecting it as much).

Whatever the investor's specific concerns (and threshold of tolerance) for each individual resource or combination of them, we believe that this 2D graphical sustainability analysis can be a useful tool in investment decision making.

[23] It is important to note that in the resource combinations (Figure 2.6) some of the downward movements offset upward ones in other resources, so the same company can have $MC = 0$ in an aggregate measure and $MC > 0$ for some of the individual resources of which it is composed. Therefore, if an investor is concerned, for example, about environmental issues, especially NO_x emissions, he/she should take into account both issues, analysing the two different relevant 2D analyses, thus giving a solution to the fungibility problem of other sustainability measures [Escrig-Olmedo et al. (2017) consider it very important to avoid this issue]. He/she could evaluate one company using one analysis and, if it fulfils his/her expectations, go on to evaluate the company using the other to see whether it performs in the range acceptable to him/her. The order of the analysis depends on his/her priorities.

[24] LG CHEM, MOSAIC and CLARIANT, which have data for almost all the measures represented.

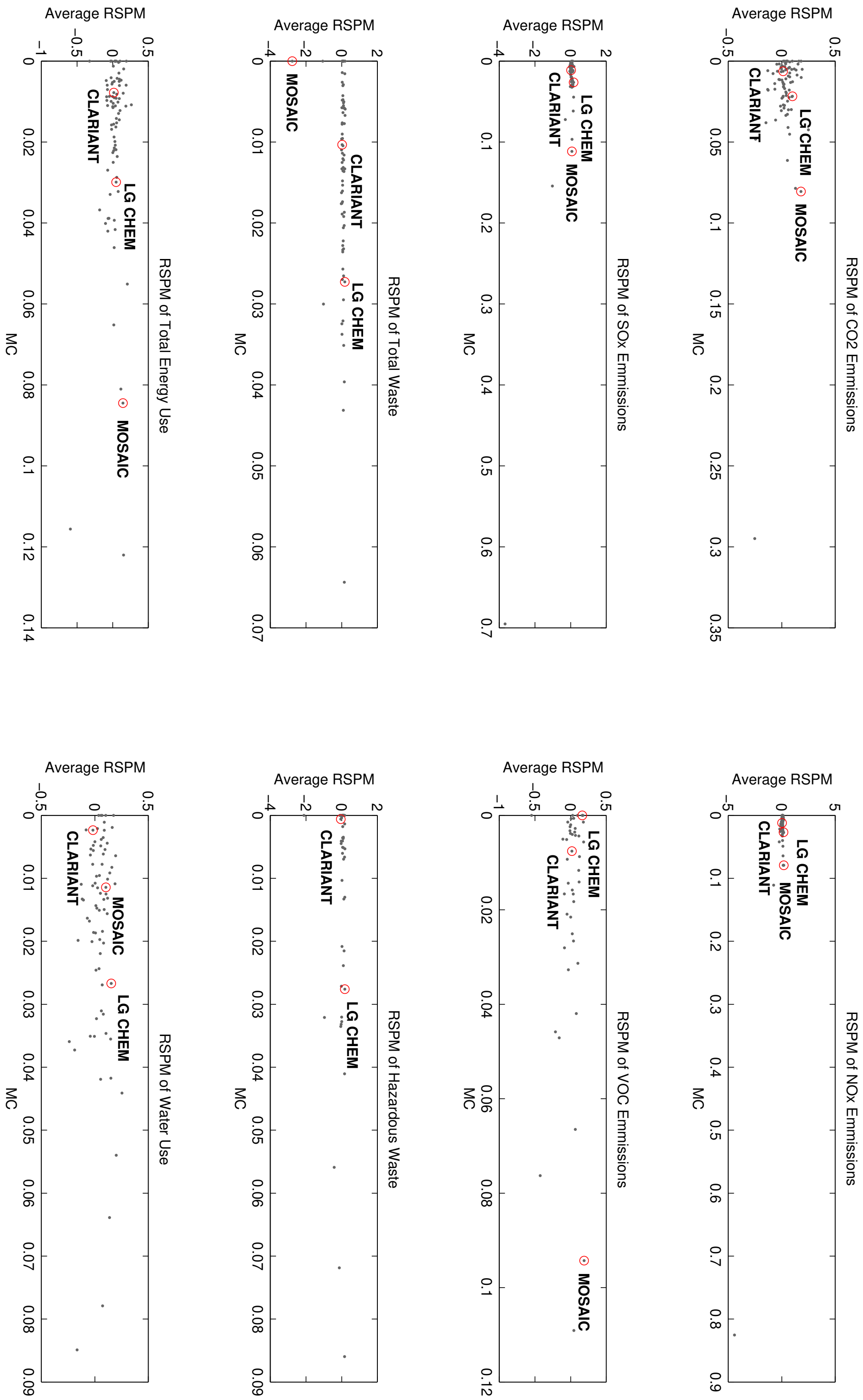
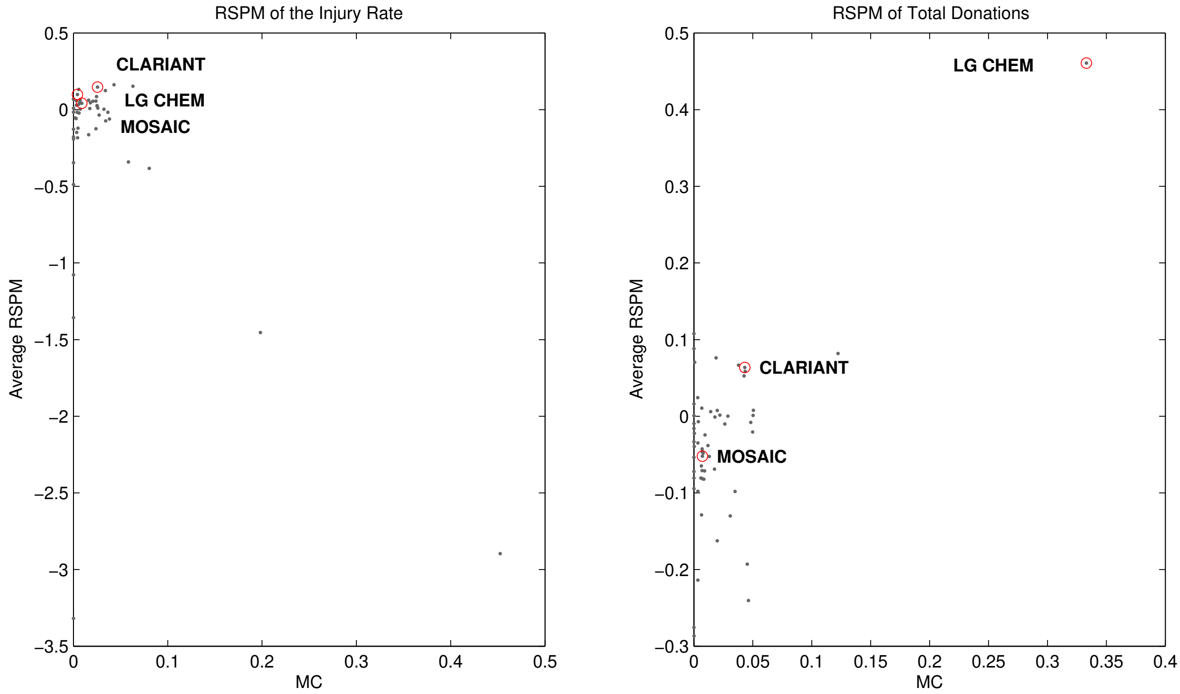


Figure 2.4: 2D analysis for individual environmental resources

This figure shows the 2D analysis for environmental resources individually. Each point corresponds to a company.

Figure 2.5: 2D analysis for individual social resources

This figure shows the 2D analysis for social resources individually. Each point corresponds to a company.



5 Conclusions

In this paper we present two measures that enable sustainable investment decisions to be made, following the TBL approach: the RSPM, which shows how well a company performs in environmental and social matters; and the MC, which detects which companies have decreased their interest in these matters. Both measures are very flexible and thus really useful, because they can be calculated for different resources and resource combinations (in which the resources can be weighted as desired in line with the investor's preferences) and for different time frames.

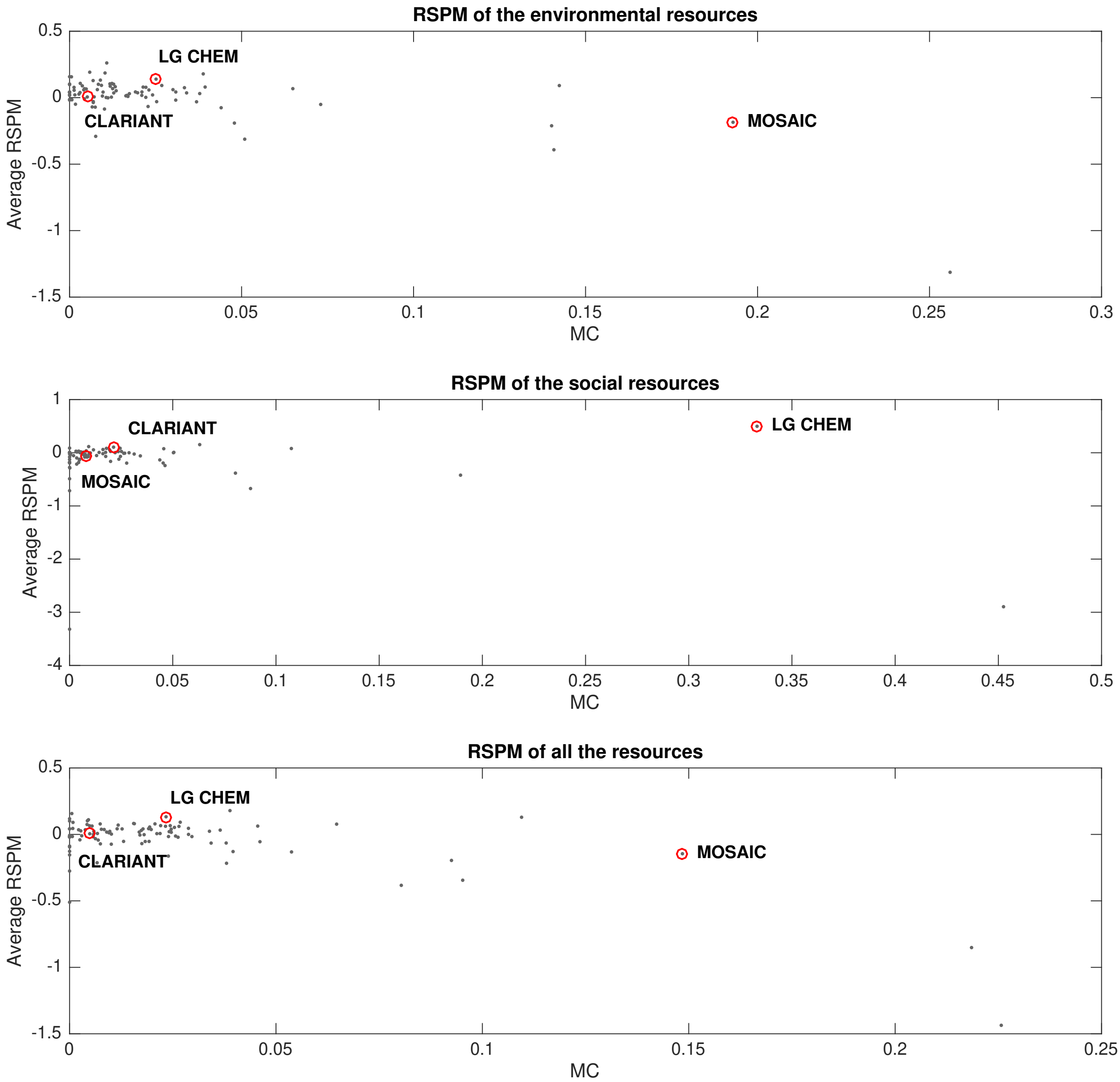
This is a contribution to the sustainable investment literature, because to the best of our knowledge no-one has presented measures with calculation formulas, and to date there have been no dynamic measures such as the MC.

We also apply these measures to real public data on companies in the chemical sector and validate them. In particular, we show that the RSPM is different from the $ROTA$ and that the MC is different from the standard deviation of the RSPM. It is noteworthy that both the measures proposed are applicable to any industrial sector and that the relevant/selected resources may be different in each one.

Moreover, we propose an intuitive 2D graphical analysis based on the two measures proposed. This is a useful tool that can help investors make investment decisions: investors should choose companies with high RSPM and low MC (especially $MC = 0$) over those with lower RSPM and/or higher MC. It is useful both to investors seeking to maximize profits and to those more concerned about non-economic issues, since it can be a supplement to or be supplemented by

Figure 2.6: 2D analysis for grouped resources

This figure shows the 2D analysis for the grouped resources: environmental, social and total. Each point corresponds to a company.



well known economic and financial measures. In our opinion it would be very useful for the databases that investors use in their analysis of companies (Datastream and Bloomberg, for instance) to include our analysis, so that investors can also easily take into account the non-financial performance of companies.

In addition, the measures and the 2D graphical sustainability analysis that we propose could also be useful for policy makers during the regulation making process, helping to define limits in the use of some resources, or even levying different taxes on companies depending, for example, on whether and with what frequency they report, or on their RSPM and MC directly.

Finally, companies could also benefit from our measures, since they can be seen as a tool for assessing their sustainability performance. Thus, companies can use the information that they offer to manage and improve their efficiency in the use of a resource in their production process, possibly selecting another similar company as a benchmark. Once the assessment has been done, companies can apply tools to optimize their performance in managing the TBL, avoiding the resistance of financial stakeholders, as in McWilliams et al. (2016). In fact, improving sustainability can be transformed into a win-win situation, not necessarily sacrificing financial outcomes (Beckmann et al., 2014) and making the company more profitable and more likely to survive in the long run.

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3

Do Credit Ratings Take into Account the Sustainability Performance of Companies?

Published in: *Sustainability, Volume 10, Issue 11, article number 4272*

1 Introduction

Since the publication of the Brundtland Commission's definition of Sustainable Development (SD), which states that 'sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs' (WCED, 1987), concerns about it have increased. If society as a whole wants to achieve SD, different measures have to be taken to redirect our world towards a sustainable path. This is why the Sustainable Development Goals (UNDP, 2016) were drawn up. From them, disciplines such as education for sustainable development (UNESCO, 2016) and Corporate Social Responsibility (CSR) have grown, on the one hand to educate future citizens on the importance of SD and on the other to get companies also to contribute to a sustainable future. In fact, as Hasan et al. (2018) stated, there have been 'increased demands of external stakeholders that hold companies accountable for social and environmental issues'. Related with CSR, other concepts such as 'corporate citizenship, sustainability, triple bottom line and social performance' have often been used as synonyms (Menz, 2010). In this study, we use the concept of sustainability in relation to the above-mentioned definition of SD, which takes into account economic, environmental and social issues.

Different performance measures have been proposed to assess whether companies carry out their activities sustainably, as Poveda and Lipsett (2011) reviewed in their paper. Two of the most novel measures are the Relative Sustainable Performance Measure (RSPM) and the Measure of Commitment-failure (MC) by Cubas-Díaz and Martínez Sedano (2018). The latter is, to the best of our knowledge, the first measure of commitment, and we think it is very important to consider this dimension of sustainability, because in order to really pursue SD, one has to be committed to it. Both measures can easily be calculated with public data about quantitative Environmental, Social and Governance (ESG) variables, thus being, in our opinion, more reliable than measures calculated with qualitative variables. They are also highly flexible. For example, if one is concerned about CO_2 emissions, one can build up a measure that takes into account only that issue (along with company earnings), but if one wants an environmental, social or overall measure, one can also be calculated by following the above-mentioned proposal. This is a big advantage compared to other measures such as KLD scores, which, due to their agglutinative nature, make it difficult to identify firms that pursue value-destroying CSR practices (Gloßner, 2018).

In the last few decades, increasing numbers of scholars have examined the relationship between Corporate Social Performance (CSP) and Corporate Financial Performance (CFP) or firm value. They have found mixed results. For example, some authors such as Ameer and Othman (2012) (in some sectors) and Cai et al. (2012), Cheung et al. (2013), Gregory et al. (2014), Jo and Harjoto (2011), Li et al. (2016), Lourenço et al. (2012), Rodgers et al. (2013), Torugsa et al. (2012), Waddock and Graves (1997) and Zanzana (2018) concluded that there was a positive relationship between CSP and CFP, while Surroca et al. (2010) stated that there was no direct relationship, but that the link was mediated by intangibles. The work in McWilliams and Siegel (2000) and Soana (2011) (in the banking sector) found a neutral relationship between the two performances. In contrast, Baird et al. (2012) concluded that the CSP-CFP relationship was negative, and Menz (2010) found the same effect of CSR in the bond market. These mixed results may be caused by the treatment of CSP as an overall score, as Perrini et al. (2011) suggested. The work in Peng and Yang (2014) added evidence on the link between the two constructs being weaker when ownership is more concentrated. The work in Alshammari (2015) also found a moderating effect of ownership structure and corporate reputation. More recently, Hasan et al. (2018) four that CSP affects Total Factor Productivity (TFP) positively and that 'TFP mediates the CSP-CFP relationship'. The work in Li et al. (2018) also concluded that even the disclosure of ESG information increases firm value.

Other authors such as Pae and Choi (2011) and La Rosa et al. (2018) have found that better corporate governance and ethics/CSR decrease the cost of capital. Similarly, El Ghoul et al. (2018) found that higher corporate environmental performance also reduces the cost of capital. The work in Girerd-Potin et al. (2014) and Breuer et al. (2018) stated that the cost of equity is lower for sustainably responsible firms, and Ye and Zhang (2011) found that there is an optimal level of CSR, beyond which debt financing costs increase. In line with this last paper, Sun et al. (2018) found a U-shaped relationship between CSR and shareholder value.

In a related line of literature, it has been found that announcements on good CSR have no significant effect on shareholder wealth (Clacher and Hagendorff, 2012), but that illegal behaviour reduces financial performance (Zeidan, 2013) and that the disclosure of environmental violations sparks less reaction in China than elsewhere (Xu et al., 2012).

The work in Hsu and Chen (2015), Jo and Na (2012) and Mishra and Modi (2013) stated that positive CSR reduces the risk of companies, but Nguyen and Nguyen (2015) concluded that CSR strengths and concerns both increase company risk. The work in Gloßner (2018) found that ESG risks are not valued in stock markets, which leads to negative surprises when ESG incidents occur.

Other researchers have analysed whether credit rating agencies take ESG issues into account when determining credit ratings, e.g., Gupta and Sharma (2017) in their conceptual model. Similarly, Birindelli et al. (2015) and Zeidan et al. (2015) created ethical ratings/sustainability credit scores for banks.

According to Standard & Poor's Ratings Services (2014), a credit rating is an 'opinion of the general creditworthiness of a particular issuer [...] based on relevant risk factors'. Thus, credit ratings enable investors to make use of the expertise of rating agencies (Bereskin et al., 2015). As Scalet and Kelly (2012) stated, the credit rating industry impacts very strongly on the financial markets and governments of the world. The work in Kirchschläger (2017) also highlights its power. Standard & Poor's, as stated in Standard & Poor's Ratings Services (2014), analysed both the financial and the business risk profiles of companies, which, according to Attig et al. (2013), include CSR-related issues. They also took governance and other factors into account as modifiers of their ratings. The work in Fitch Ratings, Inc. (2016) described the rating process, including the information used to determine ratings: information related to the company and information related to the market in which it operates, which could also include CSR information. However, none of those documents issued by the rating agencies stated clearly that they took into account sustainability issues when determining the credit ratings of the companies (neither measured as qualitative, nor quantitative variables). Therefore, it becomes an empirical issue.

The work in Ashbaugh-Skaife et al. (2006) and Bhojraj and Sengupta (2003) found that good governance is a positive driver of credit ratings, and Chang et al. (2017) stated that 'trust underlies the corporate social responsibility (CSR) effects on long-term credit rating'. In line with the concerns of these scholars, we believe that it is important to learn whether sustainability measures are taken into account when these ratings are established, i.e., whether the credit rating agencies are valuing sustainable behaviour by companies as a factor to increase their creditworthiness, thus reducing their debt risk premiums (Menz, 2010). In the case of corporate bond markets, Menz (2010) found that the effect of being socially responsible is non-significant or just the opposite of what was expected. However, Attig et al. (2013) and Devalle et al. (2017) found that rating agencies do indeed 'collect and process CSR-related information in assessing the companies' creditworthiness', so companies that get a better CSR score are more likely to have a better rating. The work in Chang et al. (2017) stated that 'CSR has a positive effect on long-term credit rating and such effect varies with country- and firm-level trust'.

In our paper, we extend these earlier studies by using the measures introduced by Cubas-Díaz and Martínez Sedano (2018) as the sustainability measures, due to their flexibility, their completeness and the fact that they are calculated based on both financial and environmental and/or social quantitative variables.

To the best of our knowledge, the sustainability performance of companies has traditionally been measured in terms of scores (usually combinations of binary variables). We propose to use a more quantitative and reliable magnitude such as *RSPM* when analysing whether the sustainability performance of companies affects their credit ratings.

Additionally, there have been no analyses of the drivers of credit ratings, which have included a commitment measure. In our opinion, investors concerned with sustainability would appreciate the consideration of the degree of commitment towards those issues in the credit ratings. Therefore, we analyse if it has indeed been taken into account by rating agencies.

Thus, the aim of this paper is to assess whether a good sustainability performance increases the creditworthiness of companies and whether not being committed to sustainability issues decreases the ratings.

We estimate fixed-effects ordered probit models with Standard & Poor's (S&P) credit ratings as the dependent variable and *RSPM* or *MC* as explanatory variables in order to measure the statistical effect of those sustainability measures on credit ratings.

Our analysis yields several key findings. First, quantitative sustainability performance measures such as *RSPM* have been taken into account to a lesser extent than more traditional ESG scores. Second, commitment (failure) measures such as *MC* have not been taken into account at all in establishing credit ratings.

The next section presents the data used in our estimations, including how the sample was selected. In Section 3, we discuss our results, and Section 4 presents our conclusions.

2 Data

Here, we present the data used in this paper and their sources. We also include and briefly analyse the descriptive statistics for each item.

It is important to note that, once all the variables were obtained and computed, we had an unbalanced panel of 7365 observations representing 1008 companies from all over the world for 2008–2014 plus two additional years for credit ratings and control variables (2015 and 2016) to enable us to estimate models with lags of sustainability performance and commitment measures.

2.1 Sustainability Performance Measures

First, we describe how *RSPM* and *MC* are calculated. The following definitions and formulas are taken from Cubas-Díaz and Martínez Sedano (2018):

- *RSPM* is a measure that 'shows how well a company performs in environmental and social matters'. It is calculated using the following formula:

$$RSPM_{i,t}^{C} = \frac{Profit_t^C - RU_{i,t}^C * RE_{i,t}^S}{TA_t^C} \tag{3.1}$$

where $RSPM_{i,t}^{C}$ is the Relative Sustainable Performance Measure of the resource i of company C in year t, $Profit_t^C$ is the total returns of company C in year t measured as its EBIT in thousands of USD, $RU_{i,t}^{C}$ is the Use of Resource i by company C, measured in the units required in each case, and $RE_{i,t}^{S} = \frac{Profit_t^S}{RU_{i,t}^S} = \frac{\sum_{C=1}^{N} Profit_t^C}{\sum_{C=1}^{N} RU_{i,t}^C}$ is the efficiency of use of resource i by sector S in year t, with N being the total number of companies, and TA_t^C is the total assets of company C in year t in thousands of USD. We take the 10 Economic Sectors from Thomson Reuters Business Classification (TRBC).

- *MC* is a measure that 'detects which companies have decreased their interest in those matters'. Since we are looking for *MC* time series, we calculate it for two-year periods using the following formula:

$$MC_i^C = \left| A_{i,t}^C * Z(A_{i,t}^C) \right| \tag{3.2}$$

  where $A_{i,t}^C = RSPM_{i,t}^C - RSPM_{i,t-1}^C$, $Z(A_{i,t}^C)$ is a function, which is one if $A_{i,t}^C < 0$ and zero if $A_{i,t}^C \geq 0$.

The RSPMs for different resources can be grouped into RSPMs of resource combinations by calculating the arithmetic average of the former. Consequently, the MCs for those combinations can also be calculated.

In order to calculate both of these figures, we obtained yearly ESG data on the use of 45 resources from Datastream ASSET4 by Thomson Reuters (`https://uvalibraryfeb.files.wordpress.com/2013/09/asset4_esg_data_glossary_april2013.xlsx`), and on Earnings Before Interest and Taxes (EBIT) and total assets (TA) from the Datastream Worldscope database for 2002–2015.

We followed the procedure presented in Cubas-Díaz and Martínez Sedano (2018) and calculated the Representativityof each resource in each sector taking into account the amount of total assetsrepresented in the sample. We selected the resources that had, for most sectors, a Representativity in excess of 40% for more than one year and the years in which the representativity levels for all those resources in all sectors was greater than 30%. In line with these criteria, the period selected is 2008–2014, and the resources considered are carbon dioxide equivalent emissions (CO_2), Total Waste (WasteT), total Energy Use (EnU), Water Use (WaterU) and total Donations (Don).

We computed the *RSPM* and the *MC* for these resources (RSPMCO2 and MCCO2, RSPMWasteT and MCWasteT, RSPMEnU and MCEnU, RSPMWaterU and MCWaterU, and RSPMDon—the only *RSPM* for which we changed the sign—and MCDon) and years, for the (equally weighted) combinations of all the resources (RSPMcomb1 and MCcomb1) and for environmental resources only, i.e., all except total donations (RSPMcomb2 and MCcomb2).

Since *RSPM* and, therefore, *MC* are calculated for the companies in each sector, we standardised the *RSPM* values for each sector and year. For *MC*, we rescaled the values according to the following methodology:

$$MCrs_{i,t}^C = (MC_{i,t}^C - min(MC_{i,t}^S)/(max(MC_{i,t}^S) - min(MC_{i,t}^S))$$

where $MCrs_{i,t}^C$ is the rescaled *MC* of resource i of company C in year t and $max(MC_{i,t}^S)$ and $min(MC_{i,t}^S)$ are, respectively, the maximum and minimum of the *MC*s of resource i for all the companies in sector S in year t.

We chose to make the two variables comparable in different ways because of their natures. *RSPM* is not bounded on either side; however, *MC* is bounded on the left side, and it is very important to maintain the zero values, because they have the special meaning of a company whose sustainability performance has not worsened over time. We therefore chose the classical approach of standardising the *RSPM*, but not the *MC*, and decided to rescale the latter in a way that maintained the zero values as they were.

Finally, some outlier observations were eliminated from the dataset using the following heuristics presented in Verzani (2014), based on the boxplot function presented in Chambers et al. (1983):

$$LowerLimit = Q1 - k * (Q3 - Q1) \tag{3.3}$$

and:

$$UpperLimit = Q3 - k * (Q3 - Q1) \tag{3.4}$$

where Qs is the s-th quartile and k a scalar (usually 1.5). In our case, we adjusted k to eliminate the observations that were causing problems in the estimations.

Table 3.1 shows the descriptive statistics for the various RSPMs calculated and standardised year by year. The mean in all cases is close to zero, and the standard deviation is practically one. The reason why the mean is not zero and the standard deviation is not one is that, for the RSPMs to be more realistic, the standardisation was performed taking into account all the RSPMs in the sample even if some of the values were not going to be included in the estimations (and in the description of the variable) because they were from incomplete observations. In all cases (except for RSPMDon, which always behaves oppositely to the other RSPMs), the absolute value of the minimum is larger than the maximum. Since the median is higher than the mean in all but one of the cases, this shows that most of the values are on the positive side. This is reflected in the negative skewness coefficient. Moreover, the distributions are all leptokurtic, which means that they are more peaked than a normal distribution and have heavier tails.

It is also noteworthy that the median decreases over time, accompanied by a decrease in the minimum, while the maximum stays around similar levels. This shows that, as a whole, those companies that were performing worst have worsened their performance, while those companies that were performing best have remained at similar levels.

Table 3.2 shows the correlation coefficients between the different RSPMs. The correlations between the four environmental RSPMs are moderate (between 0.26 and 0.67), showing that companies that perform better for some environmental issues tend also to do well for other environmental issues. Apart from that, both combinations are logically quite closely correlated with their elements, with the correlations being higher than 0.41. The only exception is the correlation of RSPMcomb1 with RSPMDon, which is 0.28. This is because RSPMDon behaves differently from all the other individual RSPMs, as can be seen in the negative correlations between RSPMDon and the four environmental RSPMs.

Table 3.3 presents the descriptive statistics of the rescaled MCs. It can be seen that the mean is closer to zero than to one in all cases and that the median is very close to zero or is actually zero in many cases, which shows that more than half the companies have not worsened their sustainability performance over time. All this is reflected in the positive skewness of the distributions, which are also leptokurtic. Moreover, it is worth noting that the mean of the different MCs decreases from 2008–2014, which shows that companies became more committed to environmental and social issues over the period, in spite of the drop in the median of the *RSPM*.

Table 3.4 shows the correlation coefficients between the different MCs, revealing a pattern very similar to that in Table 3.2. Some of the coefficients between the MCs of the combinations and their elements are slightly lower and some slightly higher than the corresponding values for the RSPMs, while the correlations between the individual environmental MCs are higher (showing that companies that are more committed to some environmental issues are also committed to other environmental issues).

Moreover, to enable us to compute robustness checks, we also obtained data on different grouped ESG scores given by Thomson Reuters ASSET4 (henceforth ASSET4) to the companies selected (Environmental (EnvScoreA4), Social (SocScoreA4) and ESG ratings, which we call "scores" (TotScoreA4)). We do not take the corporate governance score into account, as we do not have any quantitative values for resources of that type. These scores have been traditionally used to measure the sustainability performance of companies both by professionals and scholars. The data are for 2008–2015 (one year more than we were reliably able to calculate for RSPMs and MCs). We have not rescaled them in any way because they are comparable across sectors as Thomson Reuters (2013) states. According to that publication, the total rating or score is calculated by ASSET4 as the equally-weighted average of the environmental, social and governance ratings or scores, which, in turn have been calculated using so-called raw scores. Those raw scores are computed from the different data points applying different values or calculations depending on the nature of the data point (Boolean 'yes/no' or quantitative), weighting them with the 'Relative Level of Importance' (defined in the document), and afterwards fitted to a bell curve. Thus, the scores rank the different companies and have most of the values around 50 and very small values close to zero and to 100. The whole calculation process is described in depth in Thomson Reuters (2013).

Table 3.5 shows the descriptive statistics for the above-mentioned scores. The mean and median values are not very far apart and are both closer to the maximum (close to 100%) than to the minimum (around 5–10%), and the median is always higher than the mean. This leads to the distributions being slightly negatively skewed, with the left tail of the distribution being longer and with more than half of the observation values being higher than 50%. It is also worth mentioning that the mean and median increase over time, contrary to what happens with the medians of the RSPMs, which is quite interesting. The fact that calculations for RSPMs also include financial information makes the two measures different.

Table 3.6 shows that all three scores are closely correlated. It is particularly noteworthy that the environmental and social scores are closely correlated, showing that most companies that are performing well environmentally are also performing well socially according to ASSET4 scores.

Table 3.1: Descriptions of the standardised RSPMs year by year.

This table shows the descriptive statistics for the environmental and social standardised RSPMs used in this study, for 2008-2014.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of variation	Skewness	Kurtosis
Panel A: CO_2 RSPM (RSPMCO2)								
2008 (n = 441)	−0.011	0.199	−7.960	2.235	0.976	88.014	−2.477	15.266
2009 (n = 523)	−0.007	0.175	−9.044	3.755	0.945	127.317	−2.203	20.376
2010 (n = 573)	−0.001	0.180	−9.183	3.954	0.966	882.213	−2.556	20.312
2011 (n = 640)	−0.012	0.158	−10.599	2.708	0.996	81.339	−3.639	28.886
2012 (n = 677)	−0.029	0.160	−10.059	2.846	1.014	34.602	−2.973	21.501
2013 (n = 670)	0.005	0.130	−10.814	2.765	0.976	181.291	−3.805	31.779
2014 (n = 676)	0.009	0.106	−10.827	2.876	0.969	109.540	−3.816	33.563
Panel B: Waste Total *RSPM* (RSPMWasteT)								
2008 (n = 302)	0.025	0.159	−6.781	2.289	0.958	38.398	−2.841	15.716
2009 (n = 335)	0.031	0.140	−4.786	2.744	0.903	28.693	−1.290	7.980
2010 (n = 380)	0.012	0.137	−7.943	2.318	0.984	79.981	−2.958	18.636
2011 (n = 418)	0.017	0.129	−8.703	2.485	0.991	58.234	−3.556	24.026
2012 (n = 443)	0.033	0.123	−8.928	2.300	0.923	28.204	−3.527	27.769
2013 (n = 470)	0.029	0.144	−8.083	3.904	0.937	32.793	−3.361	24.281
2014 (n = 501)	0.027	0.106	−9.899	3.756	0.911	33.261	−3.386	33.522
Panel C: Energy Use Total *RSPM* (RSPMEnU)								
2008 (n = 374)	−0.027	0.148	−8.493	1.853	0.986	36.682	−3.229	21.429
2009 (n = 423)	0.000	0.205	−7.853	2.738	0.967	5736.542	−2.974	20.633
2010 (n = 487)	−0.021	0.145	−8.922	3.047	1.010	48.189	−3.852	26.890
2011 (n = 522)	−0.029	0.145	−9.549	2.372	1.037	35.395	−4.152	28.121
2012 (n = 562)	−0.016	0.141	−10.167	3.691	1.036	63.627	−4.867	37.436
2013 (n = 602)	−0.017	0.137	−10.040	3.719	1.041	61.577	−4.088	31.099
2014 (n = 606)	−0.013	0.141	−10.485	3.696	1.031	79.743	−4.786	36.161
Panel D: Water Use *RSPM* (RSPMWaterU)								
2008 (n = 356)	−0.027	0.270	−5.353	2.014	0.984	36.353	−2.389	10.779
2009 (n = 396)	0.005	0.202	−7.678	2.530	0.894	172.811	−2.849	20.041
2010 (n = 447)	−0.016	0.120	−10.029	3.808	0.998	60.785	−5.793	50.875
2011 (n = 482)	−0.016	0.149	−9.325	3.755	0.992	62.758	−3.757	30.710
2012 (n = 520)	−0.007	0.113	−10.277	2.879	0.989	139.131	−4.159	37.165
2013 (n = 555)	−0.011	0.137	−10.566	2.283	1.034	90.722	−4.631	36.145
2014 (n = 577)	0.008	0.121	−10.340	2.794	1.000	117.749	−3.127	28.034
Panel E: Donations Total *RSPM* (RSPMDon)								
2008 (n = 360)	0.034	−0.218	−2.003	6.322	0.997	29.576	2.769	14.050
2009 (n = 402)	0.007	−0.103	−2.363	6.087	0.845	117.386	2.035	13.207
2010 (n = 449)	0.058	−0.143	−2.546	9.266	1.069	18.545	4.195	26.214
2011 (n = 479)	0.051	−0.115	−2.835	9.853	1.028	20.186	4.460	32.722
2012 (n = 535)	0.052	−0.117	−2.884	10.063	1.008	19.227	4.351	34.843
2013 (n = 580)	0.039	−0.126	−2.900	11.151	1.003	26.031	5.806	52.793
2014 (n = 589)	0.016	−0.130	−3.549	9.473	0.997	61.315	3.762	30.291
Panel F: *RSPM* of the combination of all resources (RSPMcomb1)								
2008 (n = 544)	−0.002	0.148	−7.796	6.657	1.036	511.456	−2.492	24.241
2009 (n = 610)	0.009	0.121	−7.755	3.816	0.908	96.494	−1.798	17.642
2010 (n = 669)	0.007	0.098	−13.035	7.669	1.057	152.527	−5.024	64.402
2011 (n = 718)	−0.011	0.096	−13.533	6.088	1.061	98.911	−4.158	48.593
2012 (n = 779)	−0.005	0.095	−14.305	10.281	1.024	210.071	−4.300	76.525
2013 (n = 807)	0.000	0.100	−14.554	8.615	1.018	2710.369	−5.191	74.259
2014 (n = 826)	0.012	0.093	−14.425	10.156	0.998	86.350	−4.033	78.975
Panel G: *RSPM* of the combination of only environmental resources (RSPMcomb2)								
2008 (n = 480)	−0.012	0.184	−7.195	2.464	1.002	82.539	−2.904	18.106
2009 (n = 556)	0.015	0.158	−6.961	3.119	0.911	59.730	−2.043	16.172
2010 (n = 618)	−0.003	0.120	−11.388	3.857	1.018	371.750	−5.844	57.352
2011 (n = 676)	−0.015	0.112	−12.124	2.814	1.038	71.576	−4.167	38.372
2012 (n = 723)	−0.008	0.111	−12.694	2.856	1.029	129.181	−4.992	47.700
2013 (n = 729)	0.000	0.127	−12.670	2.812	1.023	40539.154	−5.380	49.778
2014 (n = 738)	0.010	0.109	−12.530	3.003	0.988	95.818	−5.581	54.883

Table 3.2: RSPM correlation matrix.

This table shows the correlation coefficients between all the various RSPMs. ** and *** denote that the coefficients are significantly different from zero at 1% and 0.1%, respectively.

	RSPMcomb1	RSPMcomb2	RSPMCO2	RSPMWasteT	RSPMEnU	RSPMWaterU	RSPMDon
RSPMcomb1	1						
RSPMcomb2	0.835 ***	1					
RSPMCO2	0.428 ***	0.540 ***	1				
RSPMWasteT	0.652 ***	0.754 ***	0.473 ***	1			
RSPMEnU	0.491 ***	0.694 ***	0.569 ***	0.263 ***	1		
RSPMWaterU	0.413 ***	0.563 ***	0.664 ***	0.521 ***	0.398 ***	1	
RSPMDon	0.280 ***	−0.175 ***	−0.125 **	−0.146 **	−0.242 ***	−0.208 ***	1

2.2 Credit Ratings

We obtained the S&P long-term issuer credit ratings of the companies for 2008–2016 from Bloomberg. The rating methodology for S&P is set out in Standard & Poor's Ratings Services (2014). Following the relevant literature (Bhojraj and Sengupta, 2003; Blume et al., 1998; Attig et al., 2013, among others), we transformed the credit ratings into an ordinal scale, and we assigned the following values:

- AAA+, AAA and AAA−: 9
- AA+, AA and AA−: 8
- A+, A and A−: 7
- BBB+, BBB and BBB−: 6
- BB+, BB and BB−: 5
- B+, B and B−: 4
- CCC+, CCC and CCC−: 3
- CC+, CC and CC−: 2
- DDD, DD and D: 1

Table 3.7 shows the number of S&P issuer ratings year by year. Most of the ratings are between BB− and A+, CC being the one with the least values. Moreover, probably due to the effects of the financial crisis, AA and AAA ratings decreased over the period analysed.

Additionally, to conduct robustness checks, we also obtained data on Fitch issuer credit ratings for the same period from the Datastream ASSET4 database. The rating methodology can be found in Fitch Ratings, Inc. (2016). The correlation between S&P and Fitch ratings is 0.825, which shows that the ratings given by the two companies are very similar.

Table 3.8 shows the number of Fitch issuer ratings per year. The distribution is very similar to that for S&P, but the sample is considerably smaller.

Table 3.3: Descriptions of the rescaled MCs year by year.

This table shows the descriptive statistics for the environmental and social rescaled MCs used in this study, for 2008-2014.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of Variation	Skewness	Kurtosis
Panel A: CO_2 *MC* (MCCO2)								
2008 (n = 377)	0.086	0.001	0	1	0.198	2.287	3.283	13.904
2009 (n = 438)	0.105	0.005	0	1	0.201	1.920	2.735	10.711
2010 (n = 512)	0.081	0	0	1	0.193	2.391	3.035	11.872
2011 (n = 585)	0.078	0.000	0	1	0.177	2.261	3.525	16.389
2012 (n = 646)	0.076	0	0	1	0.175	2.320	3.333	15.137
2013 (n = 636)	0.080	0	0	1	0.176	2.200	3.335	15.143
2014 (n = 655)	0.062	0	0	1	0.158	2.538	4.027	20.893
Panel B: Waste Total *MC* (MCWasteT)								
2008 (n = 251)	0.120	0	0	1	0.238	1.979	2.587	9.134
2009 (n = 290)	0.149	0.033	0	1	0.236	1.584	2.030	6.754
2010 (n = 331)	0.081	0	0	1	0.217	2.670	3.344	13.342
2011 (n = 377)	0.093	0.000	0	1	0.207	2.236	3.002	11.896
2012 (n = 415)	0.138	0.009	0	1	0.242	1.757	2.167	7.024
2013 (n = 437)	0.093	0	0	1	0.192	2.077	3.058	13.087
2014 (n = 464)	0.082	0	0	1	0.183	2.225	3.109	13.294
Panel C: Energy Use Total *MC* (MCEnU)								
2008 (n = 309)	0.081	0.002	0	1	0.196	2.406	3.488	15.461
2009 (n = 362)	0.108	0.001	0	1	0.204	1.889	2.588	9.919
2010 (n = 423)	0.078	0	0	1	0.188	2.398	3.142	13.311
2011 (n = 484)	0.079	0.002	0	1	0.197	2.497	3.531	15.267
2012 (n = 520)	0.074	0.001	0	1	0.192	2.579	3.608	16.039
2013 (n = 559)	0.054	0	0	1	0.149	2.763	4.524	26.094
2014 (n = 588)	0.078	0.001	0	1	0.181	2.316	3.250	14.168
Panel D: Water Use *MC* (MCWaterU)								
2008 (n = 303)	0.100	0.006	0	1	0.207	2.067	3.014	12.290
2009 (n = 345)	0.111	0	0	1	0.208	1.875	2.498	9.302
2010 (n = 387)	0.066	0	0	1	0.188	2.839	3.914	18.172
2011 (n = 447)	0.075	0	0	1	0.183	2.459	3.413	15.120
2012 (n = 484)	0.110	0.001	0	1	0.217	1.975	2.527	9.060
2013 (n = 514)	0.083	0	0	1	0.183	2.214	3.155	13.613
2014 (n = 548)	0.080	0	0	1	0.183	2.296	3.181	13.706
Panel E: Donations Total *MC* (MCDon)								
2008 (n = 270)	0.094	0	0	1	0.216	2.305	3.195	12.863
2009 (n = 352)	0.095	0.008	0	1	0.199	2.097	3.050	12.474
2010 (n = 379)	0.091	0	0	1	0.200	2.185	3.080	12.677
2011 (n = 436)	0.077	0	0	1	0.195	2.540	3.400	14.628
2012 (n = 469)	0.094	0	0	1	0.203	2.166	2.791	10.570
2013 (n = 521)	0.050	0.003	0	1	0.148	2.932	5.145	31.439
2014 (n = 558)	0.068	0	0	1	0.178	2.615	3.805	18.027
Panel F: *MC* of the combination of all resources (MCcomb1)								
2008 (n = 459)	0.072	0	0	1	0.193	2.663	3.531	15.504
2009 (n = 540)	0.081	0.001	0	1	0.181	2.228	3.301	14.712
2010 (n = 603)	0.039	0	0	1	0.148	3.768	5.031	29.160
2011 (n = 681)	0.063	0	0	1	0.155	2.475	3.731	18.690
2012 (n = 741)	0.041	0	0	1	0.125	3.071	5.320	35.826
2013 (n = 775)	0.041	0	0	1	0.128	3.156	5.602	38.536
2014 (n = 812)	0.043	0	0	1	0.138	3.183	5.220	32.945
Panel G: *MC* of the combination of only environmental resources (MCcomb2)								
2008 (n = 413)	0.087	0.000	0	1	0.196	2.265	3.223	13.597
2009 (n = 476)	0.094	0	0	1	0.194	2.060	2.844	11.518
2010 (n = 551)	0.045	0	0	1	0.162	3.558	4.655	24.804
2011 (n = 629)	0.069	0	0	1	0.168	2.423	3.614	17.196
2012 (n = 690)	0.063	0	0	1	0.166	2.646	3.925	19.591
2013 (n = 696)	0.054	0	0	1	0.152	2.817	4.491	25.415
2014 (n = 722)	0.049	0	0	1	0.145	2.966	4.799	28.765

Table 3.4: MC correlation matrix.

This table shows the correlation coefficients between all the various MCs. *, ** and *** denote that the coefficients are significantly different from zero at 5%, 1% and 0.1%, respectively.

	MCcomb1	MCcomb2	MCCO2	MCWasteT	MCEnU	MCWaterU	MCDon
MCcomb1	1						
MCcomb2	0.930 ***	1					
MCCO2	0.589 ***	0.657 ***	1				
MCWasteT	0.532 ***	0.555 ***	0.664 ***	1			
MCEnU	0.668 ***	0.734 ***	0.662 ***	0.604 ***	1		
MCWaterU	0.608 ***	0.667 ***	0.659 ***	0.643 ***	0.699 ***	1	
MCDon	0.102 *	−0.108 *	−0.125 **	−0.169 **	−0.125 *	−0.109 *	1

Table 3.5: Descriptions of the ASSET4 scores year by year.

This table shows the descriptive statistics for the scores (environmental, social and total) given by ASSET4 used in this study, for 2008–2015.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of Variation	Skewness	Kurtosis
Panel A: Environmental Score (EnvScoreA4)								
2008 (n = 151)	67.186	81.170	9.820	94.100	29.018	0.432	−0.872	2.232
2009 (n = 158)	67.489	80.380	10.090	94.410	28.698	0.425	−0.842	2.201
2010 (n = 163)	69.486	83.520	9.240	94.960	27.305	0.393	−0.962	2.490
2011 (n = 169)	70.438	82.090	9.130	94.650	25.619	0.364	−1.013	2.688
2012 (n = 178)	70.237	81.130	8.580	94.260	24.695	0.352	−0.987	2.722
2013 (n = 183)	71.073	81.300	8.740	94.360	24.393	0.343	−1.027	2.812
2014 (n = 189)	72.508	82.260	9.380	94.620	22.493	0.310	−1.036	2.969
2015 (n = 191)	77.987	86.360	12.690	95.050	19.767	0.253	−1.433	4.233
Panel B: Social Score (SocScoreA4)								
2008 (n = 172)	69.263	77.965	3.930	97.810	26.675	0.385	−0.972	2.793
2009 (n = 183)	70.116	82.700	6.770	97.630	27.443	0.391	−0.926	2.550
2010 (n = 187)	71.512	82.650	6.330	97.420	26.083	0.365	−1.022	2.791
2011 (n = 195)	70.925	80.700	4.730	97.220	25.573	0.361	−1.007	2.812
2012 (n = 204)	70.041	81.610	4.920	96.960	26.245	0.375	−0.948	2.615
2013 (n = 212)	70.698	82.540	4.940	96.890	25.841	0.366	−0.987	2.770
2014 (n = 220)	71.359	82.750	5.000	96.780	24.685	0.346	−1.032	2.906
2015 (n = 221)	77.332	86.570	9.040	96.290	20.352	0.263	−1.400	4.063
Panel C: Total Score (TotScoreA4)								
2008 (n = 167)	72.292	85.780	5.030	97.400	25.988	0.359	−1.000	2.757
2009 (n = 177)	72.132	83.790	5.150	97.440	26.949	0.374	−0.973	2.614
2010 (n = 181)	74.079	86.190	5.220	96.620	25.551	0.345	−1.170	3.120
2011 (n = 189)	73.649	85.510	4.410	96.420	25.312	0.344	−1.208	3.319
2012 (n = 198)	73.197	85.390	3.400	96.750	25.599	0.350	−1.136	3.075
2013 (n = 203)	74.028	85.030	4.700	96.680	24.986	0.338	−1.255	3.490
2014 (n = 210)	74.911	82.520	5.340	96.810	22.347	0.298	−1.318	3.982
2015 (n = 212)	80.288	86.600	11.160	96.070	17.757	0.221	−1.816	6.000

Table 3.6: ASSET4 score correlation matrix.

This table shows the correlation coefficients between all the different scores given by ASSET4. *** denotes that the coefficients are significantly different from zero at 0.1%, respectively.

	TotScoreA4	EnvScoreA4	SocScoreA4
TotScoreA4	1		
EnvScoreA4	0.837 ***	1	
SocScoreA4	0.813 ***	0.738 ***	1

Table 3.7: Standard & Poor's ratings year by year.

This table shows the number of Standard & Poor's issuer ratings year by year for 2008-2016. Ratings are converted to an ordinal scale: 9 (AAA+, AAA and AAA-), 8 (AA+, AA and AA-), 7 (A+, A and A-), 6 (BBB+, BBB and BBB-), 5 (BB+, BB and BB-), 4 (B+, B and B-), 3 (CCC+, CCC and CCC-), 2 (CC+, CC and CC-) and 1(DDD, DD and D).

Year	S&P Ratings									Total
	1	2	3	4	5	6	7	8	9	
2008	1	0	0	18	121	340	243	85	6	814
2009	0	0	1	25	122	335	242	64	4	793
2010	0	0	0	27	125	346	251	57	4	810
2011	0	1	2	32	124	387	255	54	5	860
2012	1	1	3	33	126	419	247	47	5	882
2013	0	0	6	34	131	432	245	50	5	903
2014	0	0	5	44	143	423	264	51	5	935
2015	3	0	7	43	149	428	253	54	5	942
2016	1	1	13	46	153	418	244	54	3	933
Total	6	3	37	302	1194	3528	2244	516	42	7872

Table 3.8: Fitch ratings year by year.

This table shows the number of Fitch issuer ratings year by year for 2008-2016. Ratings are converted to an ordinal scale: 9 (AAA+, AAA and AAA-), 8 (AA+, AA and AA-), 7 (A+, A and A-), 6 (BBB+, BBB and BBB-), 5 (BB+, BB and BB-), 4 (B+, B and B-), 3 (CCC+, CCC and CCC-), 2 (CC+, CC and CC-) and 1(DDD, DD and D).

Year	Fitch Ratings									Total
	1	2	3	4	5	6	7	8	9	
2008	1	0	1	9	48	165	161	81	4	470
2009	1	0	1	11	62	183	174	66	4	502
2010	1	0	1	14	70	210	180	62	4	542
2011	1	1	1	16	73	239	188	49	3	571
2012	2	1	2	16	78	266	179	45	2	591
2013	3	0	1	18	85	268	176	46	2	599
2014	3	0	1	18	82	270	175	43	2	594
2015	3	0	1	17	81	268	172	43	2	587
2016	3	0	1	15	64	242	155	40	2	522
Total	18	2	10	134	643	2111	1560	475	25	4978

2.3 Control Variables

We control for a group of variables traditionally used in the literature analysing the drivers of credit ratings (Attig et al., 2013; Bhojraj and Sengupta, 2003; Blume et al., 1998, among others), namely:

- CAPINT: ratio of property, plant and equipment (PPE) or Fixed Assets to TA
- COVERAGE: ratio of EBIT plus interest expense to interest expense
- LEVERAGE: ratio of long-term debt to TA
- LOSS: a variable that takes a value of one if the company had a negative net income before extraordinary items in the current year and the previous one and zero if not
- MARGIN: ratio of operating income to sales
- SIZE: natural logarithm of TA. As Dang et al. (2018) stated, SIZE is a fundamental variable when doing research on empirical corporate finance, and as it can be measured in different ways, the selection of one measure over others has to be justified. In our case, we use the natural logarithm of TA, because it is less related to the market than market capitalizationand also to firm performance, because that is what the sustainability measures already included in the estimations deal with, especially *RSPM*. On top of that, the natural logarithm of TA is the most commonly-used SIZE measure in the literature that analyses the drivers of credit ratings.
- STD: Standard Deviation of the yearly returns on investment in the company, taking seven-year moving windows

We obtained the yearly data needed to calculate the above-mentioned controls for 2008–2016 from the Datastream Worldscope database.

Table 3.9 shows the descriptions of the control variables for the whole sample (including 2015 and 2016). The means of CAPINT and LEVERAGE are about 1/3 and 1/5, respectively, of the TA, showing that the companies included in the sample have, on average, less fixed assets than current assets and more short-term debt and equity than long-term debt. For COVERAGE and MARGIN, the means are positive. However, in the case of COVERAGE, the mean is much closer to the minimum than to the maximum, which makes the distribution highly positively skewed. For MARGIN, the opposite is true. LOSS is an indicator variable, so its value is either zero or one. Since its mean is very close to zero, most of the companies in the sample did not have negative net income before extraordinary items for two years in a row in the period analysed. Moreover, it can be deduced from the SIZE variable that the average total assets of the companies in the sample is 24,079.03 millions of USD, going from 54.38 millions of USD to 4,766,630.16 millions of USD, thus covering a wide range of company sizes. Finally, STD is quite small for all the companies and years, but there are some higher values as is the maximum.

Table 3.10 shows the correlation coefficients between the control variables and RSPMcomb2, MCcomb2 and TotScoreA4. The correlations between the control variables are quite low, except for CAPINT and LEVERAGE, which is 0.429. This helps avoid multicollinearity.

Table 3.9: Descriptions for the control variables.

This table shows the descriptive statistics of the control variables used in the model estimation for the whole period 2008-2016.

Year	Mean	Median	Minimum	Maximum	Standard Deviation	Coefficient of Variation	Skewness	Kurtosis
CAPINT (n = 7365)	0.335	0.287	0	0.984	0.274	0.819	0.448	1.997
COVERAGE (n = 7365)	39.676	5.958	−1511.575	140,633.500	1646.577	41.500	84.577	7219.264
LEVERAGE (n = 7365)	0.224	0.209	0	0.870	0.142	0.633	0.644	3.233
LOSS (n = 7365)	0.051	0	0	1	0.220	4.306	4.073	17.590
MARGIN (n = 7365)	0.054	0.125	−188.687	10.483	3.368	62.165	−41.913	1958.038
SIZE (n = 7365)	16.997	16.852	10.904	22.285	1.481	0.087	0.591	3.412
STD (n = 7365)	0.379	0.313	0.042	4.953	0.281	0.742	4.191	41.617

Table 3.10: Control variable correlation matrix.

This table shows the correlation coefficients between all the control variables and one of the RSPMs and one of the MCs used in the model estimation. *, ** and *** denote that the coefficients are significantly different from zero at 5%, 1% and 0.1%, respectively.

	RSPMcomb2	MCcomb2	TotScoreA4	CAPINT	COVERAGE	LEVERAGE	LOSS	MARGIN	SIZE	STD
RSPMcomb2	1									
MCcomb2	−0.442 ***	1								
TotScoreA4	0.100	0.0260	1							
CAPINT	−0.113 **	0.0836 *	−0.114 **	1						
COVERAGE	0.194 ***	−0.161 ***	0.0346	−0.0229	1					
LEVERAGE	−0.0521	0.0408	−0.198 ***	0.429 ***	−0.159 ***	1				
LOSS	−0.179 ***	0.00881	−0.167 ***	0.127 ***	−0.0489 *	0.175 ***	1			
MARGIN	0.0700	−0.109 **	0.0902 *	0.0430 *	0.00787	0.0454 *	−0.0254	1		
SIZE	0.115 **	−0.148 ***	0.276 ***	−0.290 ***	0.0117	−0.313 ***	−0.116 ***	0.0449 *	1	
STD	−0.0794 *	0.0702	−0.249 ***	−0.0182	−0.0444 *	0.0163	0.109 ***	−0.0205	−0.186 ***	1

Moreover, the correlation coefficients between RSPMcomb2 and TotScoreA4, and MCcomb2 and TotScoreA4 are not significantly different from zero, which shows that RSPMcomb2 and MCcomb2 are not at all related to TotScoreA4. Once again, it can be seen that the use of novel measures, that are not as known as the scores by ASSET4, such as *RSPM* and *MC*, can improve our knowledge of the relationship between credit ratings and sustainability performance and commitment. In fact, we think that the quantitative nature of the data used to calculate it makes *RSPM* a better proxy of sustainability performance and that *MC* adds information that is essential to assess it: the commitment of the companies towards sustainability.

Finally, the correlation between RSPMcomb2 and MCcomb2 is significantly negative, which shows that companies that perform better in environmental and social issues are also more committed to them.

3 Results

This section presents the results of our estimation of fixed-effects ordered probit panel regressions, clustering robust standard errors by company and including economic sector and year dummies. We used an ordered probit model, because our dependent variable is categorical and ordered.

The models that we estimate in this section follow this equation:

$$Rating_t^C = \beta_{SM} * SM_{t-k}^C + \beta_{CV} * CV_{t-1}^C + \beta_S * Sectordummies^C + \beta_Y * Yeardummies_t + \epsilon_t^C \quad (3.5)$$

where *Rating* is the credit rating, C identifies the companies, t is the number of observations in each cluster (years), k is the number of lags, SM is the sustainability measure included in most of the models (RSPMs, MCs or the scores from ASSET4), CV are the seven control variables presented above, *Sectordummies* represents the nine dummies for the different sectors (excluding one used as reference), $Yeardummies$ are the dummies for the different years (excluding always one used as reference) and ϵ stands for errors. In order to avoid multicollinearity, we only include one sustainability measure in each model estimated.

Note that, in order to mitigate a possible endogeneity problem and following Li (2016), we have included the remedies proposed in that paper that best suit our case:

- Lagged independent variables: to alleviate the simultaneity problem and to be able to claim causality of the potentially found relationships between sustainability measures and credit ratings
- Firm and sector fixed effects: to ensure that time-invariant firm and sector characteristics are not absorbed by the error term
- Year fixed effects: to capture the effect that economic conditions and other market shocks may have on both credit ratings and sustainability performance
- Control variables: to ensure that time-variant firm characteristics are not captured by the error term

3.1 Main Models

We have estimated the model specified in Equation (3.5), where *RSPM* is the sustainability measure. We included none or one of the RSPMs, either the one- or two-year lag. In principle, we found it more logical to include the one-year lag, because, as we have realised, the values of the quantitative variables used to calculate the RSPMs were usually available the next year. After analysing the results of both options, we concluded that the best method is to use the one-year lag in the estimations, because the results were more sensible, and this is consistent with our initial thoughts, with the estimation period thus being 2009–2015. Those results are included in Table 3.11. We use the adjusted McFadden's pseudo-R^2 as the goodness of fit measure. It modifies McFadden's pseudo-R^2 presented in McFadden (1974), taking into account the number of covariates in each estimation. It is important to note that the unbalanced nature of the data panel caused the number of observations to be different for each model, so to ensure comparability, we included the adjusted McFadden's pseudo-R^2 for both the model estimated and the model without *RSPM* for the different subsamples used in each case.

It can be seen that the results for the control variables were quite consistent with the prior literature: for example, LEVERAGE, LOSS and STD had a negative relationship with credit ratings, as shown by their significantly negative coefficients. The only difference is that the coefficient of the variable MARGIN is significantly negative in more than one case. We found that all of the environmental RSPMs have significantly positive coefficients, which shows that companies that perform better environmentally tend to receive higher credit ratings. The coefficient of

RSPMDon was not significant. However, the coefficient being negative is interesting and led us to think that donationswere not considered good in the credit rating industry, probably because they reduced net profit. RSPMcomb2, the *RSPM* of the combination of all the environmental resources, was the only combination that had a significant coefficient.

The adjusted McFadden's pseudo-R^2 was quite high. [McFadden's pseudo-R^2 is usually much lower than the traditional R^2, and values of 0.2–0.4 'represent an excellent fit' (McFadden, 1978)]. in all of the models, and as revealed by the significance of the coefficients, the pseudo-R^2 of the estimations increased most in relative terms with respect to the model with only the controls in the models with RSPMCO2 and RSPMWaterU, especially in the former (6.41% vs. 4.26%).

Next, we estimated the same models for the different MCs. In this case, the best models were those with the two-year lag. Therefore, the estimation period was 2010–2016. Since *MC* measures *commitment-failure* over time, it should take longer to affect the determination of credit ratings.

Table 3.12 shows the results of the different estimations. The results for the control variables are consistent with the prior literature. The coefficients for the MCs were negative in all cases, because the *MC* became worse the higher it was. However, none had significant coefficients.

As for the adjusted McFadden's pseudo-R^2, only the models with MCEnU and MCDon increased their values in comparison with the models with only the control variables. This shows that in all the cases, but the two mentioned, including MCs did not increase the explanatory capability of the models. Thus, sustainability commitment (or non-commitment) measures of this type seem not to be considered by credit rating agencies, though our opinion is that they should be.

3.2 Robustness Checks

To ensure the reliability of our previous results, this section presents four alternative robustness checks: breaking down the sample into sub-periods, estimating the models by sector, using Fitch ratings instead of S&P ratings as the dependent variable and using ASSET4 scores instead of the *RSPM* as the sustainability performance measure. In all cases, we present the results of only some of the estimations, but the remaining results are available from the authors upon request.

Sample Break-Down

First, we divided the sample into two and four periods of time. Remember that the dates go from 2009–2015 for *RSPM* and from 2010–2016 for *MC*.

Table 3.13 presents the results for RSPMcomb2, where, surprisingly, a decreasing pattern of the influence of the RSPMs on S&P ratings is shown. It was in the earliest periods that the adjusted McFadden's pseudo-R^2 increased the most with respect to the models without the RSPMs. Similar findings were obtained for alternative *RSPM* measures, RSPMCO2 having the most persistent effect.

We also estimated the models for all of the MCs in different time frames, and the results

Table 3.11: Models with *RSPM*.

This table shows the results of the fixed-effects ordered probit model estimation with the various RSPMs and all the controls for 2009-2015. In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

RatingSP	RSPMcomb1Lag1		0.069 (1.88)						
	RSPMcomb2Lag1			0.117 (2.61) **					
	RSPMCO2Lag1				0.217 (3.31) **				
	RSPMWasteTLag1					0.144 (2.75) **			
	RSPMEnULag1						0.102 (2.25) *		
	RSPMWaterULag1							0.170 (4.04) **	
	RSPMDonLag1								−0.074 (1.84)
	CAPINTLag1	0.572 (3.71) **	0.676 (3.96) **	0.750 (4.10) **	0.860 (4.66) **	0.781 (3.67) **	0.825 (4.06) **	0.925 (4.28) **	0.420 (1.93)
	COVERAGELag1	0.000 (0.37)	0.000 (1.19)	0.000 (1.86)	0.001 (1.79)	0.001 (1.59)	−0.000 (0.50)	0.000 (2.84) **	−0.000 (1.20)
	LEVERAGELag1	−1.971 (6.91) **	−2.285 (7.43) **	−2.342 (7.38) **	−2.312 (6.89) **	−2.780 (6.99) **	−2.468 (7.33) **	−2.582 (7.00) **	−2.312 (6.45) **
	LOSSLag1	−1.201 (12.17) **	−1.158 (9.63) **	−1.158 (9.29) **	−1.072 (8.19) **	−1.047 (7.03) **	−1.138 (8.47) **	−1.068 (7.54) **	−0.835 (5.07) **
	MARGINLag1	−0.001 (0.29)	−0.003 (1.51)	−0.005 (2.32) *	−0.007 (3.63) **	−0.002 (0.47)	−0.005 (2.99) **	−0.006 (3.52) **	1.510 (3.33) **
	SIZELag1	0.356 (13.79) **	0.350 (13.20) **	0.338 (12.40) **	0.345 (12.32) **	0.349 (10.18) **	0.326 (10.91) **	0.350 (10.88) **	0.377 (11.85) **
	STDLag1	−1.445 (8.94) **	−1.511 (7.01) **	−1.458 (6.18) **	−1.529 (5.56) **	−1.651 (7.09) **	−1.839 (9.20) **	−1.695 (8.39) **	−1.907 (10.53) **
N		6006	4622	4228	3940	2657	3328	3129	3233
Adjusted McFadden's Pseudo-R^2		0.1814	0.1830	0.1873	0.2005	0.1987	0.1891	0.1868	0.2059
Adjusted McFadden's Pseudo-R^2 of model without *RSPM*		0.1814	0.1817	0.1837	0.1884	0.1940	0.1862	0.1792	0.2045

Table 3.12: Models with *MC*.

This table shows the results of the fixed-effects ordered probit model estimation with the various MCs and all the controls for the period 2010-2016. In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

RatingSP	MCcomb1Lag2		−0.069 (0.65)						
	MCcomb2Lag2			−0.044 (0.43)					
	MCCO2Lag2				−0.090 (0.94)				
	MCWasteTLag2					−0.045 (0.45)			
	MCEnULag2						−0.180 (1.63)		
	MCWaterULag2							−0.022 (0.21)	
	MCDonLag2								−0.209 (1.95)
	CAPINTLag1	0.572 (3.71) **	0.569 (3.36) **	0.610 (3.41) **	0.639 (3.41) **	0.293 (1.26)	0.733 (3.66) **	0.852 (4.01) **	0.445 (2.01) *
	COVERAGELag1	0.000 (0.37)	0.001 (1.80)	0.001 (1.80)	0.001 (1.77)	0.000 (1.40)	0.001 (1.77)	0.001 (1.72)	0.001 (1.61)
	LEVERAGELag1	−1.971 (6.91) **	−2.020 (6.57) **	−2.074 (6.46) **	−2.227 (6.53) **	−2.972 (7.46) **	−2.231 (6.21) **	−2.304 (6.28) **	−2.307 (6.13) **
	LOSSLag1	−1.201 (12.17) **	−1.212 (11.71) **	−1.208 (11.16) **	−1.258 (11.35) **	−0.874 (6.46) **	−1.214 (10.84) **	−1.111 (9.58) **	−0.937 (6.48) **
	MARGINLag1	−0.001 (0.29)	−0.000 (0.11)	−0.000 (0.19)	−0.001 (0.29)	2.381 (6.30) **	−0.002 (0.95)	−0.001 (0.83)	1.793 (4.36) **
	SIZELag1	0.356 (13.79) **	0.338 (12.47) **	0.324 (11.52) **	0.323 (11.01) **	0.335 (9.08) **	0.317 (9.87) **	0.331 (9.88) **	0.368 (11.22) **
	STDLag1	−1.445 (8.94) **	−1.747 (10.97) **	−1.773 (9.77) **	−1.858 (9.59) **	−1.685 (7.58) **	−2.028 (11.31) **	−1.615 (7.40) **	−1.799 (9.13) **
N		6006	4430	3997	3683	2426	3077	2907	2939
Adjusted McFadden's Pseudo-R^2		0.1814	0.1877	0.1881	0.1895	0.2085	0.1949	0.1767	0.2075
Adjusted McFadden's Pseudo-R^2 of model without *MC*		0.1814	0.1878	0.1883	0.1896	0.2088	0.1948	0.1769	0.2073

Table 3.13: Models with RSPMcomb2Lag1 for different time frames.

This table shows the results of the fixed-effects ordered probit model estimation with the combination of the environmental RSPMs and all the controls for different time frames. In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

		2009–2012	2013–2015	2009–2010	2011–2012	2013–2014	2015
RatingSP	RSPMcomb2Lag1	0.152	0.071	0.235	0.093	0.076	0.060
		(2.82) **	(1.57)	(3.70) **	(1.49)	(1.56)	(1.11)
	CAPINTLag1	0.922	0.573	1.184	0.729	0.470	0.745
		(4.22) **	(2.96) **	(4.43) **	(3.13) **	(2.26) *	(3.45) **
	COVERAGELag1	0.000	0.002	0.000	0.000	0.002	0.002
		(2.46) *	(3.49) **	(1.20)	(1.12)	(2.84) **	(3.04) **
	LEVERAGELag1	−2.501	−1.838	−2.800	−2.316	−1.945	−1.672
		(6.69) **	(5.18) **	(6.32) **	(5.59) **	(5.00) **	(4.21) **
	LOSSLag1	−0.924	−1.373	−1.169	−0.757	−1.417	−1.349
		(4.77) **	(9.21) **	(4.24) **	(3.26) **	(7.89) **	(6.87) **
	MARGINLag1	−0.008	−0.004	0.162	−0.007	−0.003	−0.005
		(1.31)	(2.49) *	(0.57)	(1.33)	(2.19) *	(2.54) *
	SIZELag1	0.340	0.353	0.362	0.335	0.382	0.307
		(11.01) **	(11.65) **	(9.76) **	(10.13) **	(11.91) **	(8.99) **
	STDLag1	−1.877	−1.260	−2.402	−1.619	−1.377	−1.119
		(8.25) **	(4.37) **	(7.84) **	(6.59) **	(5.07) **	(3.34) **
N		2183	2045	966	1217	1354	691
Adjusted McFadden's Pseudo-R^2		0.1904	0.1949	0.2175	0.1676	0.2071	0.1626
Adjusted McFadden's Pseudo-R^2 of model without *RSPM*		0.1846	0.1939	0.2060	0.1659	0.2060	0.1627

were also consistent: we found that no *MC* is significant in any time frame, as can be seen in Table 3.14 for the case of MCcomb2.

By Sectors

To learn whether sustainability performance is more significant in some sectors than others, we estimated the model by sectors and obtained some interesting results. Although not shown here, we found that RSPMcomb1 had no effect in any sector, and that RSPMcomb2 was only taken into account in the Basic Materialssector, which includes Chemicalsamong others. The results for RSPMDon are also interesting: it was considered positive in the Energysector, but negative in Basic Materials, Industrial Goods, Non-Cyclical Consumer Goodsand Utilities. Moreover, the results for Financialsshow that none of the RSPMs had a significant effect on the credit ratings of companies in that sector.

Finally, we found that RSPMCO2 was one of the two (together with RSPMWasteT) that had the most influence on ratings, possibly because of the visibility of CO_2 emissions. We show these results in Table 3.15. It can be seen that RSPMCO2 has a significantly positive coefficient in four out of the 10 sectors; surprisingly, Telecommunication Serviceswas one of them.

The adjusted McFadden's pseudo-R^2 was found to vary from sector to sector, being very high in some, such as Healthcareand Telecommunication Services, and very low in others, such as the Cyclical Consumer Goodsand Utilitysectors. Moreover, it can be seen that when the RSPMCO2 is included in the models, the pseudo-R^2 is greater than in the model without it in all cases except for the Financial sector. It increases especially in the Utility, Telecommunication

Table 3.14: Models with MCcomb2Lag2 for different time frames.

This table shows the results of the fixed-effects ordered probit model estimation with the MC of the combination of the environmental RSPMs and all the controls for different time frames.In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

		2010–2013	2014–2016	2010–2011	2012–2013	2014–2015	2016
RatingSP	MCcomb2Lag2	−0.023	−0.056	0.126	−0.211	−0.163	0.199
		(0.18)	(0.35)	(0.71)	(0.98)	(0.81)	(0.81)
	CAPINTLag1	0.762	0.526	0.864	0.616	0.534	0.545
		(3.40) **	(2.81) **	(3.07) **	(2.72) **	(2.67) **	(2.78) **
	COVERAGELag1	0.001	0.002	0.000	0.002	0.002	0.002
		(1.48)	(3.29) **	(1.19)	(2.09) *	(3.78) **	(2.65) **
	LEVERAGELag1	−2.673	−1.509	−2.819	−2.377	−1.696	−1.295
		(6.82) **	(4.38) **	(5.37) **	(5.73) **	(4.48) **	(3.56) **
	LOSSLag1	−1.096	−1.323	−0.917	−1.277	−1.393	−1.221
		(6.80) **	(11.38) **	(3.78) **	(6.19) **	(9.16) **	(6.61) **
	MARGINLag1	−0.003	0.002	0.172	−0.003	−0.003	0.008
		(1.52)	(0.70)	(0.98)	(2.08) *	(1.44)	(3.77) **
	SIZELag1	0.333	0.326	0.316	0.357	0.342	0.299
		(10.27) **	(10.53) **	(7.83) **	(10.58) **	(10.75) **	(8.83) **
	STDLag1	−1.803	−1.832	−2.068	−1.670	−1.934	−1.700
		(8.21) **	(8.06) **	(6.82) **	(7.99) **	(8.45) **	(6.21) **
N		1988	2009	846	1142	1329	680
Adjusted McFadden's Pseudo-R^2		0.1852	0.1929	0.1725	0.1899	0.1976	0.1711
Adjusted McFadden's Pseudo-R^2 of model without MC		0.1856	0.1933	0.1732	0.1903	0.1979	0.1719

Services and Basic Materials sectors.

In the case of MC (not shown in the tables), almost all coefficients were found not to be significantly different from zero, and there was hardly any difference from one sector to another. There were three exceptions for different MCs in different sectors that we did not consider relevant. However, in those cases, the sign of the coefficient was negative, which is the right direction.

Fitch Ratings

To test whether the positive influence of the $RSPM$ and lack of influence of the MC are also found in ratings from other credit rating agencies, we estimated the main models presented above using Fitch credit ratings instead of S&P ratings as the dependent variable. Surprisingly, we found that most RSPMs did not have significant coefficients (only RSPMcomb2, RSPMEnU and RSPMWaterU did). Since the number of observations was smaller for Fitch than for S&P ratings, we estimated the models with the reduced sample of observations that had values for both ratings, and we found similar results. We therefore concluded that this subsample showed less influence from sustainability performance measures. Moreover, none of the MCs have significant coefficients, as occurred with the S&P ratings.

Table 3.16 presents the results for the combination of the environmental resources. As with the S&P ratings' models, RSPMcomb2 was significantly positive at a 5% level, while MCcomb2 was not. This is also reflected in the adjusted McFadden's pseudo-R^2: for the $RSPM$ model, it

Table 3.15: Models by sector.

This table shows the results of the fixed-effects ordered probit model estimation with RSPMCO2 and all the controls for each sector. In all models year effects are taken into account with year dummies. * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

Sector		Energy	Basic Materials	Industrials	Consumer Cyclicals	Consumer Non-Cyclicals	Financials	Healthcare	Technology	Telecommunication Services	Utilities
RatingSP	RSPMCO2Lag1	0.317	0.341	0.239	0.182	0.236	−0.063	0.239	0.448	0.570	0.197
		(2.43) *	(4.39) **	(1.42)	(1.18)	(1.58)	(1.48)	(1.32)	(2.44) *	(3.00) **	(1.95)
	CAPINTLag1	−0.179	−0.208	0.842	1.405	2.691	−0.300	5.751	1.305	2.263	1.107
		(0.23)	(0.33)	(0.98)	(1.34)	(2.63) **	(1.04)	(2.49) *	(1.36)	(2.24) *	(1.76)
	COVERAGELag1	0.007	−0.004	0.002	0.002	0.017	0.004	0.001	0.000	0.008	0.068
		(2.10) *	(0.59)	(2.46) *	(1.21)	(1.75)	(2.70) **	(2.15) *	(0.80)	(1.87)	(1.48)
	LEVERAGELag1	−2.053	−4.455	−7.149	−1.443	−3.503	0.374	−8.472	−1.463	−7.072	0.372
		(1.43)	(4.36) **	(5.61) **	(1.35)	(2.80) **	(0.53)	(3.44) **	(2.04) *	(6.53) **	(0.38)
	LOSSLag1	−2.708	−0.855	−1.673	−1.079	−0.883	−0.698		−1.553	0.263	−0.374
		(3.91) **	(3.84) **	(4.48) **	(2.86) **	(2.19) *	(2.51) *		(4.29) **	(0.36)	(1.01)
	MARGINLag1	−0.416	−0.004	8.366	2.270	3.314	0.206	4.207	1.965	0.790	−0.637
		(0.35)	(1.57)	(4.90) **	(1.14)	(1.90)	(1.35)	(1.90)	(1.58)	(0.33)	(0.59)
	SIZELag1	0.493	0.441	0.531	0.372	0.352	0.329	1.741	0.599	0.442	0.299
		(3.73) **	(3.91) **	(4.07) **	(3.66) **	(3.24) **	(6.82) **	(5.37) **	(5.39) **	(3.71) **	(3.09) **
	STDLag1	−2.311	−1.128	−0.553	−0.532	−3.723	−3.029	−8.249	−1.554	−4.459	−3.369
		(3.17) **	(3.87) **	(0.78)	(2.14) *	(4.38) **	(5.49) **	(4.09) **	(3.61) **	(3.23) **	(4.55) **
N		355	565	235	306	446	764	200	312	236	521
Adjusted McFadden's Pseudo-R^2		0.3424	0.1847	0.3162	0.0995	0.2189	0.1731	0.5387	0.2865	0.3480	0.1112
Adjusted McFadden's Pseudo-R^2 of model without MC		0.3331	0.1598	0.3153	0.0932	0.2082	0.1729	0.5381	0.2741	0.3087	0.1054

increased with respect to the model with only the control variables, and for the MC model it decreased.

Table 3.16: Models with Fitch rating.

This table shows the results of the fixed-effects ordered probit model estimation of one of the models presented above with the rating by Fitch instead of S&P as the dependent variable. In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

RatingFitch	RSPMcomb2Lag1		0.105 (2.65) **	
	MCcomb2Lag2			−0.034 (0.25)
	CAPINTLag1	0.682 (3.11) **	0.906 (3.38) **	0.644 (2.29) *
	COVERAGELag1	−0.000 (0.44)	0.000 (1.24)	0.001 (3.15) **
	LEVERAGELag1	−1.648 (4.38) **	−2.013 (4.79) **	−1.511 (3.60) **
	LOSSLag1	−0.430 (3.02) **	−0.450 (2.71) **	−0.436 (2.73) **
	MARGINLag1	1.433 (4.38) **	1.457 (3.83) **	1.804 (4.56) **
	SIZELag1	0.448 (12.60) **	0.433 (11.45) **	0.448 (11.25) **
	STDLag1	−1.255 (5.25) **	−1.370 (4.71) **	−1.499 (5.83) **
N		4052	3014	2803
Adjusted McFadden's Pseudo-R^2		0.1910	0.2027	0.2038
Adjusted McFadden's Pseudo-R^2 of model without *RSPM* or *MC*		0.1910	0.2003	0.2040

ASSET4 Scores

Finally, we also wanted to know whether scores frequently used in the literature to assess sustainability were considered when establishing the credit ratings of companies. To that end, we included the sustainability performance measures by ASSET4 presented in the Data section.

Table 3.17 presents the results of our estimations. The coefficients of all three scores from ASSET4 were significantly positive, and they all improved on the model with only the control variables. We also estimated the model with TotScoreA4 with the reduced sample using the observations that included values for both TotScoreA4 and RSPMcomb2 (and also EnvScoreA4 and RSPMCO2). We found, on the one hand, similar adjusted McFadden pseudo-R^2 values and, on the other hand, less significance for the RSPMs, showing that the more popular ASSET4 scores were taken into account more than measures such as the *RSPM* when determining the credit ratings of companies.

Table 3.17: Models with ASSET4 scores.

This table shows the results of the fixed-effects ordered probit model estimation with the different scores from ASSET4 and all the controls.In all models industry and year effects are taken into account with industry and year dummies (not included in the table). * and ** denote that the coefficients are significantly different from zero at 5% and 1%, respectively.

RatingSP	TotScoreA4Lag1		0.008 (2.85) **		
	EnvScoreA4Lag1			0.008 (3.50) **	
	SocScoreA4Lag1				0.008 (2.99) **
	CAPINTLag1	0.572 (3.71) **	0.645 (2.45) *	0.513 (1.88)	0.713 (2.78) **
	COVERAGELag1	0.000 (0.37)	0.002 (3.63) **	0.002 (3.80) **	0.002 (3.63) **
	LEVERAGELag1	−1.971 (6.91) **	−2.447 (5.14) **	−2.169 (4.39) **	−2.437 (5.24) **
	LOSSLag1	−1.201 (12.17) **	−1.088 (6.14) **	−1.081 (5.86) **	−1.184 (6.58) **
	MARGINLag1	−0.001 (0.29)	1.203 (2.58) **	1.209 (2.60) **	1.180 (2.65) **
	SIZELag1	0.356 (13.79) **	0.348 (7.36) **	0.348 (7.37) **	0.335 (7.08) **
	STDLag1	−1.445 (8.94) **	−2.218 (7.94) **	−2.449 (7.80) **	−2.333 (8.46) **
N		6006	2065	1922	2137
Adjusted McFadden's Pseudo-R^2		0.1814	0.2561	0.2515	0.2582
Adjusted McFadden's Pseudo-R^2 of model without ASSET4 Score		0.1814	0.2501	0.2444	0.2518

4 Discussion

This paper checks whether the novel sustainability performance and commitment measures presented by Cubas-Díaz and Martínez Sedano (2018) (namely, *RSPM* and *MC*) are taken into account in the real world, in the special case of credit ratings. We conducted fixed-effects ordered probit model estimations with robust standard errors clustered by company and included economic sector and year dummies.

We find that the one-year lag of *RSPM* is included in ratings by S&P in some cases, especially RSPMCO2 and RSPMWaterU, showing that there are concerns about those issues. However, the two-year lag of *MC* is not taken into account at all, which shows that the commitment of companies to not worsen their performance is not given importance when credit ratings are awarded to them.

Analysing the trend in this behaviour over time, we find that the tendency to value good sustainability performance by increasing the creditworthiness of companies decreased between 2009 and 2015, while the commitment of companies on those issues is not taken into account in any of the periods analysed.

Our sector by sector analysis shows that the *RSPM* included most in credit ratings is RSPMCO2, which has a significantly positive effect on the credit ratings of companies in four out of 10 sectors, including Energy and Basic Materials.

We also performed the analysis using Fitch ratings instead of S&P and found that for the subsample with observations for both Fitch and S&P ratings, the RSPMs are not significant for either rating. This is something that will have to be tested further to see if there are really differences between the two ratings or not.

Finally, we confirmed the findings of other authors concerning the importance of more traditional and popular scores such as those given by ASSET4 when determining credit ratings. It is, however, worth mentioning that the calculation of those specific scores had been discontinued in 2018 and that a new methodology to calculate ESG scores had been proposed by ASSET4 in 2017.

All in all, we can conclude that traditional sustainability measures are taken into account by credit rating agencies more than novel quantitative sustainability performance measures and that commitment measures are not considered at all in the credit rating process.

We think that credit rating agencies should consider including both measures to a greater extent in the rating process in order to better reflect the creditworthiness of the companies. Using them, credit rating agencies would be able to select the most important ESG factors for each sector, not having to rely on agglutinative scores.

The increasing sustainability consciousness of investors could provoke the above-mentioned change in the rating process, and that way, the risks associated with irresponsible sustainability behaviours would be penalised. Moreover, taking the sustainability performance and commitment of companies into account when establishing credit ratings could foster improvements in corporate governance (Bereskin et al., 2015), as well as environmental and social improvements. Interestingly, Aktas et al. (2018) stated that companies that have lost their investment grade rating engage more in CSR afterwards. Similarly, Chiang et al. (2017) find that companies 'near a broad bond rating change tend to reduce their irresponsible CSR activities more than firms that are not near a broad bond rating change'. This implies that if credit rating agencies take into consideration sustainability performance and commitment measures such as *RSPM* and *MC* when determining the ratings, they could encourage companies to behave more sustainably, thus themselves also contributing to a more sustainable future.

This would also imply that firm managers would have to put sustainability in a more centered position within the company's strategy in order to pursue more non-financial objectives, for instance reducing their CO_2 emissions. This would benefit them because they would get better credit ratings and be more sustainable, both economically, environmentally and socially. More importantly, society as a whole would also benefit from their strategic switch.

With this paper, we have filled some gaps in the literature, such as the use of other sustainability measures and not only global, but also individual measures, as suggested by Menz (2010). However, the results suffer from the limitation derived from the scarcity of non-financial reporting. Therefore, it would be useful to repeat this study when more information about more resources is published by companies and to customise the performance measures by including the resources most relevant to each sector (or sub-sector if enough information is available).

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Conclusions

This thesis covers three different but closely related topics.

First, Chapter 1 analyses ESG reporting patterns for a broad international set of companies over a 16 year period. The analysis is conducted for environmental, social and governance disclosure separately and using previously calculated principal components. To perform that analysis hybrid mixed-effects generalised linear panel data models with robust standard errors clustered by company that include time fixed-effects are estimated. The main highlights of the findings are the following:

1. Reporting patterns are different for environmental and social information and governance information.
2. Companies in environmentally sensitive industries report more environmental and social information, but neither more nor less governance information.
3. South Africa is the best performer overall, proving that it is possible to do well in all three dimensions of ESG reporting, and Peru and Argentina are the worst performers.
4. The USA is one of the best performers in terms of governance reporting, but one of the worst in terms of environmental and social information disclosure.
5. Being domiciled in the Euro area has a positive effect on environmental reporting but a negative effect on governance reporting.
6. Companies domiciled in tax havens also tend to report more environmental information and less governance information.
7. Mandatory general sustainability disclosure regulations have a positive effect on all types of reporting.

Second, Chapter 2 proposes two measures that process the ESG data disclosed by companies into single figures that are easily understood:

- The Relative Sustainable Performance Measure (RSPM) measures non-financial performance of companies with reference to their sector. It is positive if a company is performing better than average for the sector and negative if it is performing worse.
- The Measure of Commitment-failure (MC) shows whether the trend in RSPM his downward (and if so how much) over time. Its value is zero if a company has not worsened

its performance over the period analysed and greater than zero if it has. The higher the value, the more the company's performance has worsened.

In the same study RSPM and MC are implemented for a sample of companies in the chemical sector and the figures obtained are shown in the *graphical 2D sustainability analysis*, which makes it easy to compare ESG performance because it resembles a mean-variance graph.

Finally, Chapter 3 analyses the influence of sustainability performance and commitment measures on credit ratings. The analysis is conducted using fixed-effects ordered probit model estimations with robust standard errors clustered by company that include economic sector and year dummies. The main findings of this study are:

1. Sustainability performance measures matter in the credit rating process.
2. More novel measures are taken into account less than traditional sustainability performance measures.
3. The influence of sustainability performance is especially relevant for some sectors, such as energy and basic materials, which is consistent with the results obtained in Chapter 1. These are the two sectors that report most ESG data, which, in turn, makes it easier for rating agencies to take their sustainability performance into account when determining credit ratings.
4. Commitment measures are not taken into consideration at all by credit rating agencies.

All in all, this thesis fills some gaps in the literature but the findings also raise new questions, especially those in Chapters 1 and 3. For example, related to Chapter 1, further research should be done analysing the effect of regulations on non-financial reporting in more depth, taking into account the number of ESG items that firms must report. Comparative case studies would be interesting to extend knowledge of how to increase ESG reporting by following the best-in-class. Finally, to improve the study conducted in Chapter 3, performance measures considered as possible determinants of credit ratings could be customised by including the resources most relevant to each sector.