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

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Abstract: In the last few decades, sustainability performance measuring has become a widely-studied issue, and various measurement proposals have been put forward. However, it is also important to know whether those measures are actually being used in the real world. In this case, we take one very important indicator used by investors when they make investment decisions: the credit rating of the potential investment. We test whether credit ratings take into account the above-mentioned measures. Following the literature, we 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. We find that companies with higher sustainability performance tend to have higher credit ratings, though having a less consistent performance over time seems to have no effect. To check the robustness of our results, we also perform the analysis for different sectors and sub-periods. In addition, we conduct the analysis using sustainability scores provided by ASSET4 (Datastream) as an explanatory variable and using Fitch credit ratings as the explained variable.

Keywords: sustainability performance; sustainability commitment; credit ratings; ESG criteria

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' [1], 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 [2] were drawn up. From them, disciplines such as education for sustainable development [3] 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 [4] 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 [5]. 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 [6] 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 [7]. 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 [8].

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 [9] (in some sectors) and [10–19] concluded that there was a positive relationship between CSP and CFP, while [20] stated that there was no direct relationship, but that the link was mediated by intangibles. The work in [21,22] (in the banking sector) found a neutral relationship between the two performances. In contrast, [23] concluded that the CSP-CFP relationship was negative, and [5] 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 [24] suggested. The work in [25] added evidence on the link between the two constructs being weaker when ownership is more concentrated. The work in [26] also found a moderating effect of ownership structure and corporate reputation. More recently, [4] four that CSP affects Total Factor Productivity (TFP) positively and that 'TFP mediates the CSP-CFP relationship'. The work in [27] also concluded that even the disclosure of ESG information increases firm value.

Other authors such as [28,29] have found that better corporate governance and ethics/CSR decrease the cost of capital. Similarly, [30] found that higher corporate environmental performance also reduces the cost of capital. The work in [31,32] stated that the cost of equity is lower for sustainably responsible firms, and [33] found that there is an optimal level of CSR, beyond which debt financing costs increase. In line with this last paper, [34] 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 [35], but that illegal behavior reduces financial performance [36] and that the disclosure of environmental violations sparks less reaction in China than elsewhere [37].

The work in [38–40] stated that positive CSR reduces the risk of companies, but [41] concluded that CSR strengths and concerns both increase company risk. The work in [8] found that ESG risks are not valued in stock markets, which leads to negative surprises when ESG incidents occur.

Other researchers have analyzed whether credit rating agencies take ESG issues into account when determining credit ratings, e.g., [42] in their conceptual model. Similarly, [43,44] created ethical ratings/sustainability credit scores for banks.

According to [45], 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 [46]. As [47] stated, the credit rating industry impacts very strongly on the financial markets and governments of the world. The work in [48] also highlights its power. Standard & Poor's, as stated in [45], analyzed both the financial and the business risk profiles of companies, which, according to [49], include CSR-related issues. They also took governance and other factors into account as modifiers of their ratings. The work in [50] 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 [51,52] found that good governance is a positive driver of credit ratings, and [53] 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 behavior by companies as a factor to increase their creditworthiness, thus reducing their debt risk premiums [5]. In the case of corporate bond markets, [5] found that the effect of being socially responsible is non-significant or just the opposite of what was expected. However, [49,54] 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 [53] 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 [7] 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 analyzing 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 analyze 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 analyze 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 [7]:

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

$$RSPM_{i,t}^{C} = \frac{Profit_t^C - RU_{i,t}^C * RE_{i,t}^S}{TA_t^C} \quad (1)$$

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:

$$MC_i^C = \left| A_{i,t}^C * Z(A_{i,t}^C) \right| \quad (2)$$

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 [7] 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 standardized 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 standardizing 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 [55], based on the boxplot function presented in [56]:

$$LowerLimit = Q1 - k * (Q3 - Q1) \tag{3}$$

and:

$$UpperLimit = Q3 - k * (Q3 - Q1) \tag{4}$$

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 1 shows the descriptive statistics for the various RSPMs calculated and standardized 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 standardization 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 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 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 4 shows the correlation coefficients between the different MCs, revealing a pattern very similar to that in Table 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).

Table 1. Descriptions of the standardized RSPMs year by year.

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

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

Table 2. RSPM correlation matrix.

	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

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.

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 [57] 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 [57].

Table 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 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. Descriptions of the rescaled MCs year by year.

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

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

Table 4. MC correlation matrix.

	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

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.

Table 5. Descriptions of the ASSET4 scores year by year.

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

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

Table 6. ASSET4 score correlation matrix.

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

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%.

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 [45]. Following the relevant literature ([49,52,58], 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 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 analyzed.

Table 7. Standard & Poor's ratings year by year.

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

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).

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 [50]. 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 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 8. Fitch ratings year by year.

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

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).

2.3. Control Variables

We control for a group of variables traditionally used in the literature analyzing the drivers of credit ratings ([49,52,58], 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 [59] 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 analyzes 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 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 analyzed. 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 9. Descriptions for the control variables.

Variable	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

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

Table 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 10. Control variable correlation matrix.

	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

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.

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:

$$Rating_t^C = \beta_{SM} * SM_{t-k}^C + \beta_{CV} * CV_{t-1}^C + \beta_S * Sectordummies^C + \beta_Y * Yeardummies_t + \epsilon_t^C \quad (5)$$

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 [60], 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 (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 realized, the values of the quantitative variables used to calculate the RSPMs were usually available the next year. After analyzing 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 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 [61], 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' [62]) 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 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.

Table 11. Models with *RSPM*.

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

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.

Table 12. Models with *MC*.

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

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.

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.

3.2.1. 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 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.

Table 13. Models with RSPMcomb2Lag1 for different time frames.

		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

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.

We also estimated the models for all of the MCs in different time frames, and the results were also consistent: we found that no *MC* is significant in any time frame, as can be seen in Table 14 for the case of MCcomb2.

Table 14. Models with MCcomb2Lag2 for different time frames.

		2010–2013	2014–2016	2010–2011	2012–2013	2014–2015	2016
RatingSP	MCcomb2Lag2	−0.023 (0.18)	−0.056 (0.35)	0.126 (0.71)	−0.211 (0.98)	−0.163 (0.81)	0.199 (0.81)
	CAPINTLag1	0.762 (3.40) **	0.526 (2.81) **	0.864 (3.07) **	0.616 (2.72) **	0.534 (2.67) **	0.545 (2.78) **
	COVERAGELag1	0.001 (1.48)	0.002 (3.29) **	0.000 (1.19)	0.002 (2.09) *	0.002 (3.78) **	0.002 (2.65) **
	LEVERAGELag1	−2.673 (6.82) **	−1.509 (4.38) **	−2.819 (5.37) **	−2.377 (5.73) **	−1.696 (4.48) **	−1.295 (3.56) **
	LOSSLag1	−1.096 (6.80) **	−1.323 (11.38) **	−0.917 (3.78) **	−1.277 (6.19) **	−1.393 (9.16) **	−1.221 (6.61) **
	MARGINLag1	−0.003 (1.52)	0.002 (0.70)	0.172 (0.98)	−0.003 (2.08) *	−0.003 (1.44)	0.008 (3.77) **
	SIZELag1	0.333 (10.27) **	0.326 (10.53) **	0.316 (7.83) **	0.357 (10.58) **	0.342 (10.75) **	0.299 (8.83) **
	STDLag1	−1.803 (8.21) **	−1.832 (8.06) **	−2.068 (6.82) **	−1.670 (7.99) **	−1.934 (8.45) **	−1.700 (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

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.

3.2.2. 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 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 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.

Table 15. Models by sector.

Sector		Energy	Basic Materials	Industrials	Cyclical Consumer Goods	Non-Cyclical Consumer Goods	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

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.

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

Table 16. Models with Fitch rating.

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

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.

3.2.4. 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 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 17. Models with ASSET4 scores.

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

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.

4. Discussion

This paper checks whether the novel sustainability performance and commitment measures presented by [7] (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.

Analyzing the trend in this behavior 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 analyzed.

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 behaviors would be penalized. Moreover, taking the sustainability performance and commitment of companies into account when establishing credit ratings could foster improvements in corporate governance [46], as well as environmental and social improvements. Interestingly, [63] stated that companies that have lost their investment grade rating engage more in CSR afterwards. Similarly, [64] 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 [5]. 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 customize the performance measures by including the resources most relevant to each sector (or sub-sector if enough information is available).

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Abbreviations

The following abbreviations are used in this manuscript:

RSPM	Relative Sustainable Performance Measure
MC	Measure of Commitment-failure
S&P	Standard and Poor's
SD	Sustainable Development
CSR	Corporate Social Responsibility

CO_2	Carbon dioxide
CSP	Corporate Social Performance
CFP	Corporate Financial Performance
TFP	Total Factor Productivity
ESG	Environmental, Social and Governance
USD	United States Dollars
EBIT	Earnings Before Interest and Taxes
TA	Total Assets
PPE	Property, Plant and Equipment

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