56h

THE EFFECT OF ENVIRONMENTAL PERFORMANCE ON FINANCIAL DEBT. EUROPEAN EVIDENCE

Carmen Fernández-Cuesta
Paula Castro
María T. Tascón
Francisco J. Castaño

Universidad de León

Área Temática:

B) Valoración y finanzas

Con economía ambiental (D. Contabilidad de Gestión)

Palabras clave/Keywords: Low Carbon Economy, GHG Emissions, Financial Debt, European public firms

Workshop 3. «Buen gobierno corporativo: estructura, diversidad y otros aspectos»

THE EFFECT OF ENVIRONMENTAL PERFORMANCE ON FINANCIAL DEBT. EUROPEAN EVIDENCE

Abstract

This paper analyzes the impact of firms' reductions in carbon emissions on the financial leverage of European listed firms. The carbon risk and tangibility of capital expenditures are found to be the main environmental drivers addressing the use of financial debt. Our results show that the general positive impact of carbon emissions on financial debt, induced by the role of emissions as an indicator of activity, is mitigated by the carbon environmental performance (CEP) of the firm. Thus, a better CEP allows the firms to obtain more long-term financial debt to finance the relevant environmental investments made by industrial firms.

1. Introduction

The 2030 Agenda for Sustainable Development that was adopted by the United Nations (UN) (2015) requires a low-carbon economy (Foxon, 2011; European Environment Agency, 2005). The European Union (EU), whose greenhouse gas (GHG) emissions comprised up to 20% of world emissions at the beginning of the 20th century, but were approximately 7.7% in 2015, plays a leading role in reaching the low-carbon targets.

The Kyoto Protocol has been trying to address the climate change since 1997, even though it just came into effect in 2007. The target of decreasing GHG emissions is tied to the economic development and the level of technology of the countries. To accomplish the commitments that were ratified in the Kyoto Protocol, the European Union Emissions Trading System (EU ETS) was created in 2005 (EU, 2015) and established as the main international carbon market. Currently, the EU ETS covers approximately 45% of GHG emissions that were produced by approximately 12000 installations and 1400 aircraft operators in 31 countries. Notwithstanding, the concentration of CO2 in the atmosphere is growing and it is expected to intensify in the near future, which will contribute to further constraints and more stringent regulations.

In this setting, European firms are under pressure from regulatory authorities and other stakeholders (such as suppliers, clients, investors, and creditors) to find suitable strategic decisions to reduce carbon emissions (Kolk and Pinkse, 2005; Hoffman, 2005). High-polluting industries are specially concerned by future expected environmental liabilities (Busch and Hoffmann, 2011; Pätäri et al., 2012). Thus, climate change has become an increasingly determinant business issue (Brinkman et al., 2008; Lee, 2012). To date, the main financial focus of research has been the relationship between financial performance and environmental performance, but how the environmental strategy impinges the firms' capital structure has not been addressed yet. In this work, we fill this void by studying how carbon efficiency influences the proportion of financial debt of the firm.

The role of debt in the firms' economic performance is crucial to understanding how firms incorporate environmental issues into their business. As is well known, value creation requires higher economic performance than financing costs (i.e., Nissim and Penman, 2001); hence, the relationship between them must be rebalanced as a critical aspect of the environmental strategy.

Our work contributes to the growing amount of studies about the relationship between environmental performance and financial performance by analyzing the impact of reducing carbon emissions on the financial debt of European public firms. This is the first work in an unexplored research stream that studies the effects of environmental management and operations over the firms' capital structure. Specifically, we find that the general positive impact of carbon emissions on financial debt that is induced by the role of emissions as indicator of activity is mitigated by the carbon environmental performance (CEP) of the firm. Our results show that a better CEP allows the firms to obtain more financing. Furthermore, we find that long-term debt is the main type of financing required for the relevant environmental investments and that industrial firms are the more favored group of firms obtaining additional financial debt to reward their environmental performance.

The remainder of this paper is organized as follows. In section 2, we start with a literature review to derive our hypotheses. Section 3 describes the data, the methodology, and the models that are proposed. Section 4 presents the results. Finally, section 5 draws conclusions.

2. Literature review and hypotheses

There is a large body of literature studying how emission variations affects firms' financial performance (Gallego, 2012) since carbon emissions impact not only the business environment but also the firms' current and future operations (Busch and Hoffmann, 2011). Notwithstanding, the results about the relationship between carbon emissions and firm performance cannot be considered conclusive.

Two different lines of reasoning have been adduced: win–win and win–lose (Boiral et al., 2012). The win-win approach suggests that any effort to reduce emissions would contribute to improving the firm's competitiveness, whereas the win-lose approach indicates that the firms' big efforts to reduce their emissions are cost-bearing and might reduce their competitiveness.

On the one hand, the environmental 'win' obtained by the reduction in carbon emissions can be rewarded with an economical 'win' for firms. Thus, using the natural resources more efficiently implies new opportunities for profits, thus generating a competitive advantage (Porter and Van der Linde, 1995; Hart, 1995).

The development of the abilities and the reduction of costs due to a more efficient use of resources may boost the firm's performance (Trumpp and Guenther 2017; Dixon-Fowler et al., 2013) since this competitive advantage is more valuable for the stakeholders (Hart, 1995). It is worth noting that when unaffected by regulatory compliance, firms would voluntarily adopt policies to reduce carbon emissions only if the benefits were higher than the costs. In other cases, the firm might not engage in emissions reduction (Porter and van der Linde, 1995; Welch et al., 2000).

A stream inside this line of research has paid attention to the effects of environmental performance on the firms' market performance. The preferences of firms for mitigating the climate change effect that is materialized in their carbon performance could be acting as a business strategy (Lewandowski, 2017) since the managers' compensation could be increased by the economic performance derived from the reduction of emissions (Nishitani and Kokubu, 2012). In this sense, the environmental performance is included as a part of the efficient management operations as a consequence of the potential influence of shareholders on managers' behavior, thus supporting the agency theory (Nishitani and Kokubu, 2012). Therefore, in addition to the possible economic performance derived from those better skills applied to production and management, there is an immaterial advantage detected by the market concerning the avoidance of future environmental liabilities.

On the other hand, the reduction of carbon emissions would imply additional costs for firms, thus reducing the firms' financial performance (Newell, 2010; Pinkse and Kolk, 2010; Wang et al., 2014). Two types of costs can be distinguished with different considerations from the strategic management of the firm: (1) costs derived from environmental actions, such as the prevention, reduction and repair of environmental damages, and resource conservation efforts; and (2) environmental losses, such as fines, penalties, awards from lawsuits, and costs without lasting economic benefits (CICA, 1993).

In addition, previous literature has highlighted the relevance of regulatory compliance and how the environmental regulations led by the governments can condition the incorporation of environmental issues in firms' decisions, thus changing the win–win solutions (Beckmann et al., 2014).

In an effort to explain both opposite effects, some authors (Trumpp and Guenther, 2017; Lewandowski, 2017; Pekovic et al., 2018) find that the relationship between carbon emissions and economic performance could be more complex than positive or negative. Trumpp and Guenther (2017) identify a U-shaped relationship between carbon performance and profitability, as well as between waste intensity and profitability in both the manufacturing and service industries, and the level of environmental performance is the key differential driver. Lewandowski (2017) evidences a positive (negative) relationship for companies with superior (inferior) carbon performance. However, Pekovic et al. (2018) find that the U-inverted curve of environmental performance is induced by the level of environmental investments, which can be explained as a demonstration of the too-much-of-a-good-thing effect.

Many more inquiries on the environmental policies, costs and returns seem to be needed to complete the puzzle of the effects of environmental actions on business financial performance. In this work, we focus on a necessary element between them: the financing of the environmental actions and investments undertaken by firms.

Relation between debt and CEP carbon environmental performance

To the best of our knowledge, how environmental policies, climate change, and the reduction of carbon emissions are changing the capital structure of firms and how indebtedness is specifically affected have not been considered in this line of research yet. However, we can adduce some close findings and assumptions to support our reasoning. Previous literature suggests that the impact of climate change-related policies on the firms' operations could affect the sources of financing (Gallego, 2012). Specifically, the increasingly severe regulations on carbon emissions may represent future potential losses and require current debts (Kim et al. 2015). Du et al. (2017) found a negative relationship between corporate environmental performance and the interest rate on debt, thus supporting the idea that lenders favor firms with better environmental performance. In addition, governmental financial incentives would improve access to capital for firms that reduce emissions (Gallego, 2012).

The first related stream has analyzed how the cost of capital is influenced by the carbon productivity (Konar and Cohen, 2001; Sharfman and Fernando, 2008; Kim et al., 2015; Jung et al., 2016). The reduction of the cost of capital would result from reducing the compliance (regulatory) costs (Konar and Cohen, 2001; Sharfman and Fernando, 2008; Nishitani and Kokubu, 2012) and from reducing the carbon risk (Nishitani and Kokubu, 2012), which would consist of regulation, litigation, competition, production, and reputation risks (Kim et al., 2015). Furthermore, Jung et al. (2016) find that the carbon risk's effect on cost of capital can be mitigated when firms use carbon awareness as a business strategy. The complimentary view is the supply side of capital, which has been identified as a relevant explanatory factor of debt (Graham and Leary, 2011). As banks are increasingly aware of environmental issues and have changed their credit risk criteria to incorporate those issues in lending decisions (Weber, Fenchel and Scholz, 2008; Jung et al., 2016; Herbohn et al., 2017), they reward carbon performance with more favorable financing terms. We can consider that low-emitters are less volatile firms facing lower expected costs of financial distress and therefore, according to the trade-off theory, could use more debt (Frank and Goyal, 2009). Furthermore, as a reduction in the firms' cost of capital means a lower carbon risk that reduces the firm's financing costs, we hypothesize that carbon productivity exerts a higher positive effect on the amount of debt that firms contract to finance their business.

H1a. With higher levels of activity, positive carbon performance induces a higher proportion of debt financing.

In line with our previous reasoning, GHG-emitters can be framed into the group of information asymmetric firms that the pecking order theory would attribute a preference for retained earnings instead of debt. However, environmental capital investment mitigates information asymmetry since it mainly consists of long-term assets that can be used as collateral. Thus, considering the nature of the required capital investments, with long-term expected use and high costs jointly with a possible collateral use, we hypothesize a preference for long-term financial debt.

H1b. With higher levels of activity, positive carbon performance induces a higher proportion of long-term financial debt.

The industry has been considered a relevant explanatory factor of debt (Ross et al., 2008; Graham and Leary, 2011) since the firms within the same industry face common advantages and drawbacks to obtain financing. Two factors identified in the previous literature on environmental performance that can be industry-specific with potential differential effects on the firms' capital structure are carbon risk and tangibility. Carbon risk is stronger for high-polluting industries (Johnston, 2005), whereas the environmental capital expenditures have been found to play a different role for low-polluting and high-polluting firms (Clarkson et al., 2004). As the tangibility rate is highly correlated inside industries (Rauh and Sufi, 2012) and the level of emissions is a clear industry-specific factor, we have posed a more focused hypothesis for manufacturing firms.

H1c. With higher levels of activity, positive carbon performance induces a higher proportion of long-term financial debt for manufacturing industries.

Empirical evidence has converged in the negative effect of profitability on leverage, thus supporting the pecking order theory (Myers 1993). Similarly, Fama and French (2002) find an inverse relationship between leverage and profitability, thus suggesting that debt is only issued when retained earnings are insufficient to finance projects. Therefore, according to the positive relationship found the in the literature between carbon performance and financial performance, we hypothesize that the positive effect of carbon performance on financial debt can mitigate the negative effect of profitability on debt, which is supported by the pecking order theory. In parallel with our first group of hypotheses, we pose second and third sub-hypotheses concerning the maturity of debt financing and the differential effects on manufacturing industries.

H2a. With higher levels of profitability, positive carbon performance induces a higher proportion of debt financing.

H2b. With higher levels of profitability, positive carbon performance induces a higher proportion of long-term debt financing.

H2c. With higher levels of profitability, positive carbon performance induces a higher proportion of long-term debt financing for manufacturing firms.

A second related but scattered stream addresses environmental capital expenditures. As was previously exposed, a part of environmental costs are derived from environmental actions, given that the required capital investments are enormous (Okereke, 2007; Milne and Grubnic, 2011). For example, technological change and innovations require new plants, equipment and machinery (Joshi et al., 2001; Okereke, 2007; Simon, Bumpus and Mann, 2012). Therefore, to pose our third group of hypotheses, we have focused on capital investment as a differential driver of indebtedness. Following Pekovic et al. (2018), we have tested investment intensity as a proxy for the level of environmental investments. In line with the reasoning adduced for H1b, we hypothesize that there will be better access to debt for firms with better carbon performance. Again, we pose second and third sub-hypotheses concerning the maturity of debt financing and the industry effect.

H3a. With additional capital investments, positive carbon performance induces a higher proportion of debt financing.

H3b. With additional capital investments, positive carbon performance induces s higher proportion of long-term debt financing.

H3b. With additional capital investments, positive carbon performance induces a higher proportion of long-term debt financing in investment-intense firms.

3. Data and methodology

3.1. Data description

By using hand-collected data on carbon emissions data from the Source Emissions database provided by the EU, we calculate carbon emissions and environmental performance. We merge the resulting database with firm-level characteristics extracted from Compustat Global to collect the accounting and financial information. To avoid the effects of outliers, we winsorize all continuous variables at the bottom and the top 1% of their distributions.

We analyze the public firms listed in the most important index in 16 European Countries for the period from 2005 to 2015: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Poland, Portugal, Spain, Sweden and United Kingdom. In our final sample, we have 4,223 firm-year observations from 428 European firms.

3.2. Methodology and model

To evidence the relationship between environmental performance and financial leverage, we use panel data (specifically the fixed effect model estimator) to control for the unobservable heterogeneity. We also include time-varying, country-varying and sector-varying variables in the model.

The reduction of GHG emissions is proxied by carbon environmental performance (CEP). CEP is calculated by changing the sign of the total verified emissions (to reflect better environmental performance) and dividing it by total sales (such as in Trumpp et al. (2015) and Trumpp and Guenther (2017)).

$$CEP = \frac{-Log(emissions)}{Log(sales)} \tag{1}$$

According to the previous literature, the variables included in our models are the key factors of the financing deficit. All of them play an important role in determining the firm's leverage (Rajan and Zingales, 1995). Furthermore, we have included some interactions of CEP with the proxies needed to contrast our hypotheses. Equation 2 proxies the firms' activity by using the ratio of sales to total assets (*Sales*), such as was done in Singh and Davidson (2003). Equation 3 interacts CEP with profitability, which is computed as operating income before depreciation to total assets. Finally, equation 4 shows the interaction between CEP and investment intensity (*Investment*), which is measured as capital expenditures over total sales (Santanlo and Becerra, 2008).

$$Debt_{it} = \alpha + \beta_1 CEP_{it} * Sales + \beta_2 \Pr of_{it} + \beta_3 Size_{it} + \beta_4 Tang_{it} + \beta_5 NDTS_{it} + \beta_6 RDA_{it} + \sum_{k=1}^{m} C_k + \sum_{m=1}^{n} S_m + \sum_{t=2005}^{2015} Y_t + \mu_{it} + \gamma_i \quad (2)$$

$$Debt_{it} = \alpha + \beta_1 CEP_{it} * \mathrm{Prof} + \beta_2 Size_{it} + \beta_3 Tang_{it} + \beta_4 NDTS_{it} + \beta_5 RDA_{it} + \sum_{k=1}^{m} C_k + \sum_{m=1}^{n} S_m + \sum_{t=2005}^{2015} Y_t + \mu_{it} + \gamma_i \quad (3)$$

$$Debt_{it} = \alpha + \beta_1 CEP_{it} * Investment + \beta_2 Size_{it} + \beta_3 Tang_{it} + \beta_4 NDTS_{it} + \beta_5 RDA_{it} + \sum_{k=1}^{m} C_k + \sum_{m=1}^{n} S_m + \sum_{t=2005}^{2015} Y_t + \mu_{it} + \gamma_i \quad (4)$$

There are different factors that the capital structure theories have proposed in previous literature to explain financial leverage, and we have selected a group of well supported ones to be included in our model. Financial debt (*Debt*) is the dependent variable. The selected control variables are profitability (*Prof*), size (*Size*), tangible assets (*Tang*), non-debt tax shields (*NDTS*), and research and development expenses[1] (*RDA*). The variables are described in Appendix A. In addition, we provide robustness to our results by adding C_k as the set of country dummy variables that are controlling for other aspects beyond those explicitly included in the equation, S_m captures the set of industry dummies based on the 12 sectors of Fama and French, and Y_t is a set of time dummy variables for each year. All of them help us to capture any unobserved country, sector, or time effect that is not included in the regression. μ_{it} is the error term, and γ_i is the firm effect, which is assumed to be constant for firm *i* over *t*.

To test the hypotheses about the relationship between environmental performance and debt maturity, we first substitute the dependent variable of the previous model with short-term debt and then with long-term debt. *Short_debt* is the ratio of current liabilities to total assets, and *Long_debt* is calculated as the long-term debt to total assets. The final sample excludes observations with missing or zero values for total assets or total

[1] Following Edmans et al. (2017) and Himmelberg et al. (1999) we replace missing R&D values by zero.

debt and firm-years with total, short-term or long-term debt outside the unit interval. Moreover, we replace missing verified emissions values by zero.

4. Results and analysis

4.1. Descriptive statistics

Table 1 presents the sample distribution by year, industry, and country (Panels A, B, and C, respectively). Panel A shows an increase of emissions from 2008 to 2010. It is consistent with the effect of the economic crisis (Hart and Ahuja, 1996; Gallego, 2012). In periods of lower performance, the firms would be focusing all their efforts on recovering economic performance instead of reducing emissions, thus cutting environmental investment and innovation. The subsequent increase of emissions occurs at the beginning of the Third Phase when first the ‘aviation’ (2012) and then ‘new gases and activities’ (2013) were incorporated into the included industries. In contrast with the perceived increase of figures, in 2014, GHG emissions had been reduced by more than 20% over 1990 levels in the EU. Furthermore, according to the preliminary data presented by the European Environmental Agency (2017), GHG emissions were reduced by 23% over 1990 levels.

Table 1. Panel A. Year descriptive data

Year	Obs.	Debt	Log(emissions)	CEP
2005	386	0.236	2.863	-0.317
2006	393	0.242	2.862	-0.311
2007	394	0.259	2.847	-0.311
2008	400	0.272	3.089	-0.336
2009	405	0.263	3.013	-0.335
2010	411	0.244	3.020	-0.328
2011	410	0.249	2.957	-0.319
2012	412	0.252	3.189	-0.342
2013	411	0.245	3.226	-0.341
2014	412	0.238	3.214	-0.339
2015	189	0.245	3.175	-0.332
Total	4223	0.250	3.037	-0.328

This table shows the sample distribution by year for the period ranging from 2005 to 2015. The final sample contains 4,381 observations from 12 industry sectors.

In Panel B, the industry breakdown is based on the 12 industries classified by Fama and French. The Finance sector reaches the minimum values for emissions (0.251) and CEP (0.000), while the maximum values (emissions 10.719 and CEP -1.149) are obtained by the Utilities sector. This is consistent with the data issued by the European Court of Auditors (2017) who has stated that the production and consumption of energy contribute 79% of GHG emissions in the EU, followed by Chemicals and Allied

Products, Oil, Gas and Coal Extraction, Manufacturing and Consumer Durables emissions.

Table 1. Panel B. Industry descriptive data

Industry	Obs.	Debt	Log(emissions)	CEP
Consumer NonDurables	322	0.299	2.541	-0.293
Consumer Durables	154	0.330	4.652	-0.425
Manufacturing	574	0.247	5.151	-0.591
Oil, Gas, and Coal Extraction	229	0.237	6.394	-0.631
Chemicals and Allied Products	212	0.211	7.693	-0.852
Business Equipment	198	0.157	0.616	-0.076
Telephone and Television Transmission	259	0.364	0.319	-0.036
Utilities	229	0.361	10.719	-1.149
Wholesale, Retail, and Some Services	263	0.205	1.692	-0.175
Healthcare, Medical Equipment, and Drug	231	0.256	3.885	-0.444
Finance	869	0.191	0.251	0.000
Other	683	0.263	1.492	-0.185
Total	4,223	0.250	3.037	-0.328

This table shows the sample distribution by industry for the period ranging from 2005 to 2015

Panel C shows that Germany is the country with the maximum values for emissions and CEP, whereas Italy is the one with higher proportion of business debt. The GHG emissions in Germany and Poland are especially significant as the 30 installations have issued 29% of total combustion emissions each year.

Table 1. Panel C. Country descriptive data

Country	Obs.	Debt	Log(emissions)	CEP
AUSTRIA	158	0.248	4.431	-0.53
BELGIUM	143	0.201	2.315	-0.276
DENMARK	173	0.275	2.047	-0.247
FINLAND	237	0.228	3.711	-0.425
FRANCE	352	0.239	3.254	-0.309
GERMANY	300	0.231	6.811	-0.675
GREECE	160	0.284	1.272	-0.166
IRLAND	160	0.245	3.489	-0.445
ITALY	285	0.285	2.054	-0.208
NETHERLANDS	211	0.226	2.456	-0.268
NORWAY	201	0.252	1.997	-0.229
POLAND	203	0.149	3.336	-0.385
PORTUGAL	185	0.337	2.547	-0.305
SPAIN	318	0.321	3.528	-0.41
SWEDEN	275	0.261	2.154	-0.202
UNITED KINGDOM	862	0.233	2.601	-0.265
Total	4,223	0.25	3.037	-0.328

This table shows the sample distribution by country for the period ranging from 2005 to 2015

The average levels of emissions across different industries are depicted in Figure 1 with the time period separated into three stages: 2005-2007; 2008-2012 and 2013-2015 (EUETS). The Utilities industry shows the highest level of emissions with a lightly increasing pattern from 2005 to 2015. It is followed by Chemicals that shows a stronger growth pattern. The rest of the industries are all quite low emitters with average emissions lower than one thousand tons.

The decline in the average level of emissions in Manufacturing and the progressive increases in Chemicals and Allied Products and Oil, Gas and Coal Extraction are remarkable since they have taken part in the EU ETS since The Pilot Plan (2005-2007) (which included Coke ovens, Iron and steel plants, Cement clinker, Glass, Lime, Bricks, Ceramics, Pulp and Oil refineries). It must be noted that during the 3rd Phase (2013-2020), additional industries such as Aluminium and Petrochemicals were incorporated into the EU ETS.

Figure 1. Average industry emissions

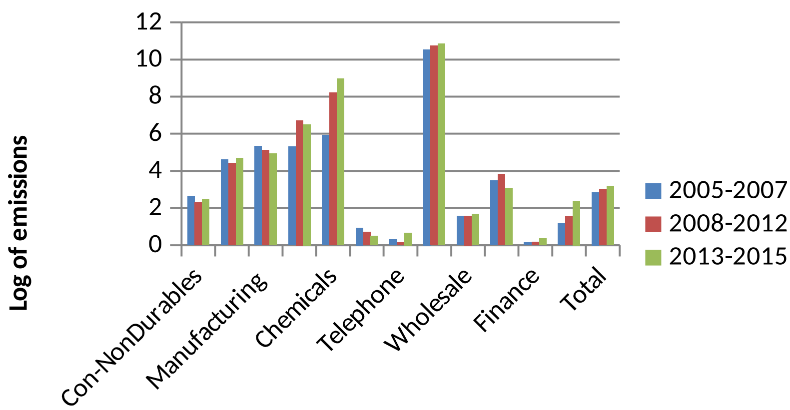

Table 2. Emissions by manufacturing industries versus services industries

	Mean		Observations
Sector	**Emissions**	**CEP**	
Manufacturing	4.77	-0.519	2,412
Services	0.267	-0.008	1,128
Other	1.492	-0.185	683
Total	3.037	-0.328	4,223

After assigning the industries to the manufacturing and the services blocks, we appreciate the relevance of manufacturing activities when only direct GHG emissions are considered (Scope 1 of GHG Reporting Protocol). The difference between both groups would be lower had indirect GHG emissions been considered (energy consumption in Scope 2, and other in Scope 3) (World Resources Institute and World Business Council for Sustainable Development, 2004).

Table 3. Descriptive statistics
Panel A: All sample

	Mean	**St. Dev**	**Min**	**P25**	**Median**	**P75**	**Max**
Debt	0.25	0.16	0.000	0.133	0.239	0.352	0.71
Short_debt	0.058	0.064	0.000	0.014	0.041	0.078	0.338
Long_debt	0.189	0.142	0.000	0.081	0.173	0.273	0.625
Emissions	3.037	5.467	0.000	0.000	0.000	0.000	17.844
CEP	-0.328	0.602	-2.077	0.000	0.000	0.000	0.000
Prof	0.116	0.086	-0.046	0.055	0.104	0.154	0.441
Size	9.28	1.991	4.293	7.948	9.11	10.529	14.255
Tang	0.239	0.221	0.000	0.037	0.185	0.382	0.861
NDTS	0.032	0.025	0.000	0.014	0.03	0.044	0.129
RDA	0.011	0.025	0.000	0.000	0.000	0.008	0.143
Sales	0.869	0.53	0.087	0.523	0.761	0.100	0.662
Investment	0.084	0.104	0.002	0.027	0.05	1.068	3.036

Panel B: Debt variables in non-emitters firms

	Mean	St. Dev	Min	P25	Median	P75	Max
Debt	0.238	0.168	0.000	0.104	0.221	0.348	0.71
Short_debt	0.056	0.064	0.000	0.009	0.037	0.077	0.338
Long_debt	0.18	0.148	0.000	0.057	0.155	0.268	0.625

Panel C: Debt variables in emitters firms

	Mean	St. Dev	Min	P25	Median	P75	Max
Debt	0.285	0.129	0.002	0.196	0.274	0.359	0.693
Short_debt	0.065	0.062	0.000	0.027	0.051	0.08	0.338
Long_debt	0.219	0.118	0.000	0.137	0.207	0.283	0.625

This table presents descriptive statistics for the variables used in the financial debt model. The sample contains 4,223 observations from 2005 to 2015. Panel A shows the full sample; meanwhile, in Panel B and C, we separate the sample in non-emitters and emitters firms, respectively.

Panel A of table 3 reports some descriptive statistics for our variables. In general, all variables are in line with those reported in previous literature (Wang et al., 2014; Trumpp and Guenther, 2017). In Panels B and C, we report the summary statistics of our debt variables by separating non-emitters and emitters. All debt variables show higher ratios for emitters, with total debt being approximately 20% higher for emitters than for non-emitters. This is consistent with previous studies that show negative correlations between leverage and CEP (Trumpp and Guenther, 2017), and positive correlations between leverage and emissions (Matsumura et al., 2014; Kim et al., 2015).

4.2. Results on the impact of environmental performance

We present the results of our regression models on the effect of environmental performance over financial debt in Tables 4, 5, and 6. We have run all the regressions to explain financial debt using environmental performance (CEP). For the whole sample, CEP is a general negative driver of debt because the straightforward reasoning indicates that the firm will produce less carbon emissions when the production decreases and that lower dimension of production would require less financing. The control variables show the usual signs when explaining the financial debt of big profitable listed firms. We highlight that size and non-debt tax shields are strong and significantly positive inductors of debt, whereas profitability is a strong and significant negative inductor of debt.

Previous literature has found that through the win-win approach, environmental performance can reduce operating costs or increase operating income as a result of better abilities and more efficient use of resources (Dixon-Fowler et al., 2013; Trumpp and Guenther 2017). In terms of debt, our results confirm that profitability is a strong and significant negative inductor regardless of the conditions of the firms under study, andtherefore profitable environmental actions will reduce the financing need.

However, the win-lose approach has shown the existence of additional costs for the firm to tackle the reduction of carbon emissions (Newell, 2010; Pinkse and Kolk, 2010). In this sense, the second relevant inductor of financial debt that we identify is non-debt-tax-shield, which is a proxy for the activity level of capital investments. Being that the required capital investment for technological change and innovations is substantial (Okereke, 2007; Milne and Grubnic, 2011), our results point to the costs of using capital investment (NDTS) as a better inductor of debt than tangibility itself.

To test our hypotheses, we have used three different interactions[2]. First, by interacting sales with CEP, we avoid the possibility that the reduction of emissions comes from a reduction of the firm's activity. Our results confirm H1a by showing that firms with better CEP obtain more financial debt than other firms with similar levels of activity (Table 4, col. 1). Second, by interacting profitability with CEP, we assess the effect of the environmental factors on debt independently of the strong influence exerted by the firm's economic performance. Profitability maintains its strong negative effect on debt and our coefficients for the interactions show that CEP can mitigate the negative effect. At similar levels of profitability firms with higher CEP obtain more debt (Table 4, col. 2).

Third, we include an interaction between investment intensity and CEP to assess the effect of the capital investment when it means a better environmental performance

[2] We reduce multicollinearity between the interaction terms and the environmental performance by using a de-mean approach, such as Vallascas and Hagendorff (2013). Therefore, for each variable used for the interaction, we calculate its sample mean before computing the interaction term.

(Table 5, col. 1). Our results confirm H3a since investment intensity is a positive driver of financial debt, but firms with higher CEP obtain further higher proportions of debt.

Table 4. **The impact of environmental performance on financial debt. Firm's activity**

	(1) Full sample	(2) Full sample	(3) Manufacturing	(4) Services	(5) Manufacturing	(6) Services
Sales	-0.0309***		-0.0540***	0.107		
	[0.00888]		[0.0118]	[0.0947]		
CEP	-0.0151**	-0.0251***	-0.0124	0.0800*	-0.0224***	-0.0165
	[0.00667]	[0.00663]	[0.00786]	[0.0470]	[0.00792]	[0.0511]
Sales*CEP	0.0374***		0.0282***	0.130		
	[0.00936]		[0.00995]	[0.127]		
PROF	-0.370***	-0.356***	-0.382***	-0.633***	-0.452***	-0.447***
	[0.0352]	[0.0298]	[0.0395]	[0.173]	[0.0359]	[0.148]
PROF*CEP		0.244***			0.155***	0.698
		[0.0432]			[0.0442]	[0.464]
SIZE	0.0348***	0.0239***	0.0361***	0.0606***	0.0435***	0.0120*
	[0.00477]	[0.00384]	[0.00614]	[0.0190]	[0.00601]	[0.00628]
TANG	0.0343	0.0489**	-0.0351	-0.0237	-0.0420	0.277***
	[0.0240]	[0.0240]	[0.0298]	[0.174]	[0.0301]	[0.100]
NDTS	0.658***	0.864***	0.279	2.070***	0.118	2.495***
	[0.161]	[0.159]	[0.187]	[0.488]	[0.186]	[0.382]
RDA	0.0835	-0.144	0.219	-1.702	0.120	-2.265*
	[0.168]	[0.170]	[0.160]	[1.532]	[0.160]	[1.229]
Constant	-0.0412	-0.0243	-0.0239	-0.184	-0.125**	0.00725
	[0.0442]	[0.0381]	[0.0574]	[0.156]	[0.0564]	[0.0727]
Observations	3,354	4,223	2,412	259	2,412	1,128
R-squared	0.128	0.095	0.163	0.229	0.153	0.122
Number of firms	333	428	239	26	239	121
Industry dummies	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES

This table reports the regression of the fixed effects model estimation on the relationship between environmental performance (**CEP**) and the financial debt (**DEBT**) while controlling for firm characteristics, industry dummies (based on Fama-French 12), country dummies and year dummies. In the first two columns, we study the effect of CEP on financial debt while considering the firm's activity through sales (**Sales**) and profitability (PROF) respectively. In the following columns we separate the sample into the manufacturing and services industries. The set of controls include profitability (**Prof**), size (**Size**), tangible assets (**Tang**), non-debt tax shields (**NDTS**), and research and development expenses (**RDA**). The variables definitions are reported in Appendix I. Statistical significance is based on industry-year clustered standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

To test hypotheses H1c and H2c, we have run regressions for two groups of firms. The first group is made up of firms included in manufacturing industries, and the second group included services firms. Our results show that the significant effect of environmental performance over the financial debt occurs in manufacturing firms but not in services firms (Table 4, cols. 3-6). Regarding hypothesis H3c, we have run regressions on two different groups, but this time we have distinguished firms by investment intensity by dividing the sample by the median value into higher investment intensity and lower investment intensity. Our results show that the effect of the environmental performance over the financial debt is only working for firms with higher investment intensity. Therefore, investment intensity and CEP are significant drivers of financial debt, but only for firms with higher levels of investment intensity. In line with our hypothesis H3c, firms with a high intensity level and environmental performance will increase their proportion of debt since these types of firms (high CEP) have better access to debt and lenders applaud their environmental actions by favoring the financing conditions (Table 5, cols. 2-3).

Table 5. The impact of environmental performance on financial debt. Firm's investment activity

	(1) Full sample	(2) High investment	(3) Low investment
Investment	0.0526***	0.0545***	0.354
	[0.0138]	[0.0141]	[0.264]
CEP	-0.0233***	-0.0247***	-0.00700
	[0.00676]	[0.00825]	[0.0267]
Investment*CEP	0.0484***	0.0568***	0.0912
	[0.0170]	[0.0175]	[0.388]
PROF	-0.430***	-0.432***	-0.423***
	[0.0316]	[0.0471]	[0.0457]
SIZE	0.0340***	0.0355***	0.0184**
	[0.00465]	[0.00664]	[0.00740]
TANG	0.0166	0.0647*	-0.111*
	[0.0246]	[0.0335]	[0.0579]
NDTS	0.581***	0.132	1.192***
	[0.164]	[0.227]	[0.266]
RDA	0.0242	0.00220	-0.0525
	[0.167]	[0.336]	[0.199]
	[0.00703]	[0.00996]	[0.0101]
Constant	-0.0157	-0.0167	0.131*
	[0.0443]	[0.0646]	[0.0743]
Observations	3,330	1,673	1,657
R-squared	0.123	0.140	0.116
Number of firms	333	243	236
Industry dummies	YES	YES	YES
Time dummies	YES	YES	YES

This table reports the regression of the fixed effects model estimation on the relationship between environmental performance (**CEP**) and the financial debt (**DEBT**) while controlling for firm characteristics, industry dummies (based on Fama-French 12), country dummies and year dummies. In the first column, we study the effect of CEP on financial debt while considering the firm's investment intensity (**Investment**). In the following columns, we separate the sample into manufacturing and services industries. The set of controls include profitability (**Prof**), size (**Size**), tangible assets (**Tang**), non-debt tax shields (**NDTS**), and research and development expenses (**RDA**). The variables definitions are reported in Appendix I. Statistical significance is based on industry-year clustered standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

When the total financial debt is separated into short-term and long-term financial debt, our results show that the interaction between sales and CEP is still strongly significant, although only in explaining long-term debt (Table 6, cols. 1 and 2). Similarly, the interaction between profitability and CEP maintains the sign and the strong significance but only in explaining long-term debt. Thus, firms with better CEP obtain higher proportions of long-term debt at similar levels of profitability (Table 6, cols. 3 and 4). Finally, investment intensity is a positive significant driver of long-term debt but not of short-term debt. The previous intensifying effect exerted by the interaction between investment intensity and CEP in increasing financial debt is only addressed by the long-term debt (Table 6, cols. 5 and 6). We repeat the study by considering Emissions instead of CEP and the results are similar (untabulated results).

Table 6. The impact of environmental performance on debt maturity

	(1)	(2)	(3)	(4)	(5)	(6)
	Short_debt	Long_debt	Short_debt	Long_debt	Short_debt	Long_debt
Sales	-0.00619	-0.0201**				
	[0.00493]	[0.00837]				
CEP	-0.00640*	-0.00830	-0.00580	-0.0192***	-0.00582	-0.0165***
	[0.00370]	[0.00628]	[0.00393]	[0.00619]	[0.00377]	[0.00637]
Sales*CEP	-0.000695	0.0390***				
	[0.00520]	[0.00882]				
PROF*CEP			0.0207	0.236***		
			[0.0256]	[0.0404]		
Investment					-0.0106	0.0544***
					[0.00767]	[0.0130]
Investment*CEP					-0.00600	0.0486***
					[0.00947]	[0.0160]
PROF	-0.109***	-0.251***	-0.0948***	-0.237***	-0.127***	-0.288***
	[0.0195]	[0.0331]	[0.0177]	[0.0279]	[0.0176]	[0.0298]
SIZE	-0.00180	0.0393***	-0.00410*	0.0254***	-0.00187	0.0380***
	[0.00265]	[0.00449]	[0.00227]	[0.00359]	[0.00259]	[0.00438]
TANG	0.0176	0.0246	0.0323**	0.0241	0.0210	0.00700
	[0.0133]	[0.0226]	[0.0142]	[0.0224]	[0.0137]	[0.0231]
NDTS	0.108	0.340**	0.202**	0.514***	0.0367	0.324**
	[0.0894]	[0.152]	[0.0941]	[0.148]	[0.0915]	[0.155]
RDA	0.0261	0.0497	-0.0509	-0.117	0.0241	0.000158
	[0.0935]	[0.159]	[0.100]	[0.158]	[0.0933]	[0.158]
Constant	0.0698***	-0.132***	0.0702***	-0.0675*	0.0762***	-0.109***
	[0.0245]	[0.0416]	[0.0226]	[0.0356]	[0.0247]	[0.0417]
Observations	3,354	3,354	4,223	4,223	3,330	3,330
R-squared	0.050	0.112	0.032	0.073	0.051	0.109
Number of firms	333	333	428	428	333	333
Industry dummies	YES	YES	YES	YES	YES	YES
Time dummies	YES	YES	YES	YES	YES	YES

This table reports the regression of the fixed effects model estimation on the relationship between environmental performance (**CEP**) and debt maturity (**Short_debt or Long_debt**) while controlling for firm characteristics, industry dummies (based on Fama-French 12), country dummies and year dummies. In the first four columns, we study the effect of CEP by taking into account the firm's activity (**Sales** and **Prof**). In the last columns we analyze the effect of **CEP** on debt maturity while considering the firm's investment intensity (**Investment)**. In columns (1), (3) and (5) we use short-term debt (**Short_debt**) as the dependent variable meanwhile in columns (2), (4) and (6) we consider long-term debt (**Long_debt**). The set of controls include profitability (**Prof**), size (**Size**), tangible assets (**Tang**), non-debt tax shields (**NDTS**), and research and development expenses (**RDA**). The variables definitions are reported in Appendix I.

Statistical significance is based on industry-year clustered standard errors. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

5. Discussion and conclusions

To date, the large body of literature that relates the environmental performance to the financial performance of firms has obtained mixed results. In this still incomplete puzzle, a relevant piece could be the effects of environmental strategies over the capital structure of the firm since the financial performance depends on the margin between economic returns and financial costs. To fill this void, our work provides evidence on the relationships between environmental performance and financial debt by extending the idea of lower costs of debt induced by higher environmental performance, as was recently evidenced in other studies (Du et al., 2017). Our results indicate that the firms' commitment to the reduction of carbon emissions contributes to reducing information asymmetry between creditors and emitting borrowers, thus facilitating a better access to credit by those emitters with better CEP.

Previous literature on environmental performance has provided relevant evidence of two specific costs: the carbon risk (Nishitani and Kokubu, 2012; Kim et al., 2015) and the investment intensity (Pekovic et al., 2018). The carbon risk is detected by the market (including shareholders and financing entities) and induces higher costs of capital (Kim et al., 2015; Jung et al., 2016). For the investment intensity, new capital investment has been used as a proxy for innovation and technical change, thus making possible that the carbon performance translates into financial performance.

To incorporate the lower carbon risk to explain the firms' financial debt we have included the carbon performance (CEP). We interpret the general negative coefficient of CEP to explain financial debt (and the negative correlation between them) as a proxy for the firms' production. However, our results evidence that carbon performance (CEP) is a significant positive driver of financial debt when the firm's sales increase. Additionally, CEP is able to offset/counteract the negative effect of profitability over debt, and, finally, CEP is able to further improve the proportion of debt induced by investment intensity. These results are consistent with the reduction of carbon risks, which includes regulation, litigation, competition, production, and reputation risks (Kim et al., 2015). The reduction of risks is detected by the market and specifically by the financial entities, which would provide carbon efficient firms with better debt terms (Jung et al., 2016; Herbohn et al., 2017). As analyzed in more detail, we find that these general results are addressed by long-term financial debt for specific groups of firms. That is, carbon efficiency induces firms to obtain a higher proportion of long-term (but not short-term) financial debt in manufacturing industries (but not in services industries). Finally, we find that carbon efficiency induces firms with higher investment intensity to obtain higher proportions of long-term debt. Our results are in line with the role as collateral for long-term capital investments, which is supported by the trade-off and the pecking order theories since collateral reduces both information asymmetry and costs. Manufacturing firms include higher proportions of fixed assets, and the improvement of environmental performance would require costly changes in those fixed assets (Okereke, 2007; Milne and Grubnic, 2011) that would be financed by long-term financing.

Therefore, our work shows that financing is a critical factor to be taken into account by manufacturing firms in their relevant role to reach a low-carbon economy. In short, less debt is required when the necessary environmental costs are rewarded with higher operating income (economic performance, i.e., profitability) and a better access to debt (lower cost and higher amount) is obtained as a result of lower environmental risk.

Our study has several limitations that could be solved by future research. First, the current study uses carbon emissions and CEP as environmental variables of interest. This is in line with the stream of literature that links environmental with financial performance, but environmental performance is a multidimensional construct made up of the management and the operational dimensions (Trumpp and Guenther, 2017). Even though our variables fit the European objective of becoming a low carbon economy, we are taking climate change as the only category of environmental impact and are disregarding other relevant categories such as natural resources' depletion, and the generation and treatment of waste and spillage (Wiedmann and Minx, 2008). Second, our work has focused on financial debt, but the study of the comprehensive capital structure would require the analysis of all the firms' sources of funds. Therefore, the effect of environmental strategies on operating liabilities and equity could contribute interesting and complimentary views to the results presented in this work

References

Beckmann, M., Hielscher, S., Pies, I., 2014. Commitment strategies for sustainability: how business firms can transform trade-offs into win–win outcomes. Bus. Strategy Environ. 23(1), 18–37.

Boiral, O., Henri, J-F., Talbot, D., 2012. Modeling the impacts of corporate commitment on climate change. Bus. Strategy Environ. 21(8), 495–516.

Brinkman, M.W., Hoffman, N., Oppenheim, J.M., 2008. How climate change could affect corporate valuations. McKinsey Q. 29, 1–7.

Busch, T., Hoffmann, V.H., 2011. How hot is your bottom line? Linking carbon and financial performance. Bus. Soc. 50(2), 233–265.

CICA (The Canadian Institute of Chartered Accountants), 1993. Environmental costs and liabilities: Accounting and financial reporting issues. Research Report. 1–129. Toronto, Ontario.

Clarkson, P.M., Li, Y., Richardson, G.D., 2004. The market valuation of environmental capital expenditures by pulp and paper companies. Account. Rev. 79(2), 329–353.

Dixon-Fowler, H.R., Slater, D.J., Johnson, J.L., Ellstrand, A.E., Romi, A.M., 2013. Beyond 'does it pay to be green?' A meta-analysis of moderators of the CEP–CFP relationship. J. Bus. Ethics 112(2), 353–366.

Du, X., Weng, J., Zeng, Q., Chang, Y., Pei, H., 2017. Do lenders applaud corporate environmental performance? Evidence from Chinese private-owned Firms. J. Bus. Ethics 143(1), 179–200.

Edmans, A., Fang, V.W., Lewellen, K.A., 2017. Equity vesting and investing. Rev. Financ. Stud. 30(7), 2229–2271.

European Court of Auditors, 2017. EU action on energy and climate change. Landscape Review. Luxemburg: European Court of Auditors.

European Environment Agency, 2005. Climate change and a European low-carbon energy system. Copenhagen, Denmark: European Environment Agency.

European Environment Agency, 2017. Trends and projections in Europe 2016 — Tracking progress towards Europe's climate and energy targets.

EU, 2015. EU ETS Handbook. European Union. European Commission. https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

Fama, E., French, K.R., 2002. Testing trade-off and pecking order predictions about dividends and debt. Rev. Financ. Stud. 15(1), 1–33.

Foxon, T.J., 2011. A coevolutionary framework for analysing a transition to a sustainable low carbon economy. Ecol. Econ. 70(12): 2258-2267.

Frank, M.Z., Goyal, V.K., 2009. Capital structure decisions: Which factors are reliably important? Financ. Manag. 38(1), 1–37.

Gallego Álvarez, I., 2012. Impact of CO2 emission variation on firm performance. Bus. Strategy Environ. 21(7), 435–454.

Graham, J.R., Leary, M.T., 2011. A review of empirical capital structure research and directions for the future. Annu. Rev. Financ. Econ. 3(1), 309–345.

Hart, S.L., 1995. A natural-resource-based view of the firm. Acad. Manag. Rev. 20(4), 986–1014.

Hart, S., Ahuja, G., 1996. Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance. Bus. Strategy Environ. 5(1), 30–37.

Herbohn, K., Gao, R., Clarkson, P., 2017. Evidence on whether banks consider carbon risk in their lending decisions. J. Bus. Ethics 1–21.

Himmelberg, C.P., Hubbard, R.G., Palia, D., 1999. Understanding the determinants of managerial ownership and the link between ownership and performance. J. Financ. Econ. 53(3), 353–384.

Hoffman, A.J. 2005. Climate change strategy: The business logic behind voluntary greenhouse gas reductions. Calif. Manag. Rev. 47, 21–46.

Johnston, D. 2005. An investigation of regulatory and voluntary environmental capital expenditures. J. Account. Public Pol. 24(3), 175–206.

Joshi, S., Krishnan, R., Lave, L., 2001. Estimating the hidden costs of environmental regulation. Account. Rev. 76(2), 171–198.

Jung, J., Herbohn, K., Clarkson, P., 2016. Carbon risk, carbon risk awareness and the cost of debt financing. J. Bus. Ethics 1–21.

Kim, Y.B., An, H.T., Kim, J.D., 2015. The effect of carbon risk on the cost of equity capital. J. Clean. Prod. 93, 279–287.

Kolk, A., Pinkse, J., 2005. Business responses to climate change: identifying emergent strategies. Calif. Manag. Rev. 47, 6–20.

Konar, S., Cohen, M.A., 2001. Does the market value environmental performance? Rev. Econ. Stat. 83(2), 281–289.

Lash, J., Wellington, F., 2007. Competitive advantage on a warming planet. Harv. Bus. Rev. 85(3), 95–102

Lee, S.Y., 2012. Corporate carbon strategies in responding to climate change. Bus. Strateg. Environ. 21(1), 33–48.

Lewandowski, S., 2017. Corporate carbon and financial performance: The role of emission reductions. Bus. Strateg. Environ. 26(8), 1196–1211.

Matsumura, E.M., Prakash, R., Vera-Muñoz, S.C., 2014. Firm-value effects of carbon emissions and carbon disclosures. Account. Rev. 89(2), 695–724.

Milne, M.J., Grubnic, S., 2011. Climate change accounting research: Keeping it interesting and different. Account. Audit. Account. J. 24(8), 948–977.

Myers, S.C., 1993. Still searching for optimal capital structure. J. Appl. Corp. Financ. 6(1), 4–14.

Newell, R.G., 2010. The role of markets and policies in delivering innovation for climate change mitigation. Oxford Rev. Econ. Pol. 26(2), 253–269.

Nishitani, K., Kokubu, K., 2012. Why does the reduction of greenhouse gas emissions enhance firm value? The case of Japanese manufacturing firms. Bus. Strategy Environ. 21(8), 517–529.

Nissim, D., Penman, S.H., 2001. Ratio analysis and equity valuation: From research to practice. Rev. Account. Stud. 6(1), 109–154.

Okereke, C., 2007. An exploration of motivations, drivers and barriers to carbon management: The UK FTSE 100. Eur. Manag. J. 25(6), 475–486.

Pätäri, S., Jantunen, A., Kyläheiko, K., Sandström, J., 2012. Does sustainable development foster value creation? Empirical evidence from the global energy industry. Corp. Soc. Resp. Environ. Manag. 19(6), 317–326.

Pekovic, S., Grolleau, G., Mzoughi, N., 2018. Environmental investments: Too much of a good thing? Int. J. Prod. Econ. 197, 297–302.

Pinkse, J., Kolk, A., 2010. Challenges and trade-offs in corporate innovation for climate change. Bus. Strategy Environ. 19(4), 261–272.

Porter, M.E., Van der Linde, C., 1995. Toward a new conception of the environment–competitiveness relationship. J. Econ. Perspect. 9(4), 97–118.

Rauh, J.D., Sufi, A., 2012. Explaining corporate capital structure: Product markets, leases, and asset similarity. Rev. Financ. 16(1), 115–155.

Ross, S.A., Westerfield, R.W., Jaffe, J. 2008. Corporate Finance, 8th Ed. New York, McGraw-Hill Irwin.

Sharfman, M.P., Fernando, C.S., 2008. Environmental risk management and the cost of capital. Strateg. Manag. J. 29(6), 569–592.

Simon, G.L., Bumpus, A.G., Mann, P., 2012. Win-win scenarios at the climate–development interface: Challenges and opportunities for stove replacement programs through carbon finance. Glob. Environ. Chang. 22(1), 275–287.

Trumpp, C., Endrikat, J., Zopf, C., Guenther, E., 2015. Definition, conceptualization and measurement of coporate environmental performance: A critical examination of a multidimensional construct. J. Bus. Ethics 126, 185-204.

Trumpp, C., Guenther, T., 2017. Too little or too much? Exploring U-shaped relationships between corporate environmental performance and corporate financial performance. Bus. Strategy Environ. 26(1), 49–68.

Vallascas, F., Hagendorff, J., 2013. The risk sensitivity of capital requirements: evidence from an international sample of large banks. Rev. Financ. 17, 1947-1988.

Wang, L., Li, S., Gao, S., 2014. Do greenhouse gas emissions affect financial performance? – An empirical examination of Australian public firms. Bus. Strategy Environ. 23(8), 505–519.

Weber, O., Fenchel, M., Scholz, R.W., 2008. Empirical analysis of the integration of environmental risks into the credit risk management process of European banks. Bus. Strategy Environ. 17(3), 149–159.

Welch, E.W., Mazur, A., Bretschneider, S., 2000. Voluntary behavior by electric utilities: levels of adoption and contribution of the climate challenge program to the reduction of carbon dioxide. J. Pol. Anal. Manag. 19(3), 407–425.

Wiedmann, T., Minx, J., 2008. A Definition of 'Carbon Footprint'. In: Pertsova, C.C., Ecological Economics Research Trends. (1-11). Hauppauge NY, USA: Nova Science Publishers.

World Resources Institute and World Business Council for Sustainable Development, 2004 The greenhouse gas protocol. A corporate accounting and reporting standard. WRI & WBCSD. Washington, DC (USA) - Geneva (Switzerland).

Appendix A. Variables

The table shows the definition of variables used in the paper and their sources.

Table I. Variable definitions

Name	Definition	Source	Exp. sign
Debt	Total debt over total assets. Total debt is defined as debt in current liabilities plus long-term debt	Compustat	
Emissions	Logarithm of total verified emissions	Source Emissions	+
CEP	Environmental performance is measured as carbon performance, where carbon performance is calculated as the negative total verified direct carbon emission (Scope 1) produced by firm divided by sales. (EU Database Emission)	EU Source Emissions & Compustat	-
Prof	Operating income before depreciation over total assets	Compustat	-
Size	Logarithm of total assets measured in millions US$	Compustat	+
Tang	Net property, plant, and equipment over total assets	Compustat	+
NDTS	Depreciation and amortization over total assets	Compustat	+
RDA	Research and development expenses over total assets	Compustat	-
Sales	Sales over total assets	Compustat	+
Investment	Capital expenditure over total sales	Compustat	+