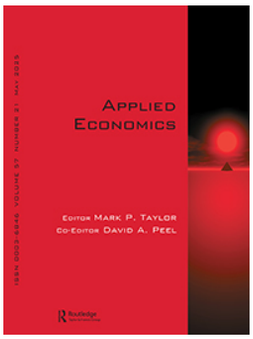

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The effect of environment, social and governance on demand and supply of debt

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ABSTRACT

This paper investigates how Environment, Social and Governance (ESG) performance affects the zero-leverage phenomenon. Using a sample of European-listed firms for the 2002–2020 period and bivariate probit models with partial observability, we find that a greater ESG performance decreases the firm's propensity to have zero leverage. The negative effect of ESG performance on zero leverage is determined by creditors-related reasons and not by firms' own decisions, since it only impacts significantly the supply of debt. Creditors seem to be willing to grant debt at more favourable conditions to firms with greater ESG performance. Using propensity score methods, we estimate that a greater ESG performance decreases a firm's zero-leverage propensity by approximately 3.9% points.

KEYWORDS

Zero leverage; ESG performance; bivariate probit models; capital structure; PS methods

JEL CLASSIFICATION

G32; G30

I. Introduction

All over the world, countries and firms are facing some important challenges to their existence. Environmental challenges, society development, easy access to information and higher educational levels have forced governments and firms to adjust their activities and goals to reduce climate change threatens and to value human capital. Adopting a sustainable development becomes an essential principle at both the macro and micro-economic levels. The challenging goals imposed by the European Grean Deal to European countries to achieve carbon neutrality (European Comission 2019) are leading to the emergence of new private investment funds and public social funds. For instance, the InvestEU Programme running until 2027 brings back the European Fund for Strategic Investments along with other financial instruments, triggering at least €650 billion for investment with a priority on sustainable development.

The new challenges raised to firms have affected firm's sustainability, social responsibility and governance mechanisms. To adjust their practices, firms may also need to adjust their capital sources, but the literature has remained relatively silent on this issue. Some (partial) exceptions are Sharfman and Fernando (2008), which shows that lower capital costs are observed when there is an improved environmental risk management, with firms transiting from carbon-intensive activities to more sustainable economies typically gaining easier access to capital markets and increasing debt ratios; Nguyen and Phan (2020), which concludes that heavy carbon emitting firms, by facing higher carbon costs that increase their risk of suffering from financial distress, are forced to decrease their debt values; Fernández-Cuesta et al. (2019), which finds that firms' commitment to the reduction in carbon emissions contributes to reducing information asymmetry between creditors and borrowers, allowing those firms to have better access to long-term debt to finance their relevant environmental investments; and Tascón et al. (2020), which shows that environmental transaction costs slow down the speed of adjustment to target debt levels for carbon emitters. All these studies are limited in scope, being specific for carbon emitting firms

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and not fully covering the new economic, societal and environmental challenges faced by firms.

The last decades have been marked by a firm's deleveraging trend, becoming usual to find debt-free firms. Some studies show that there is a growing number of firms that do not hold any amount of (short- and long-term) debt, the so-called 'zero-leverage phenomenon' (Strebulaev and Yang 2013). Previous literature shows that we are dealing with a global and persistent phenomenon that is influenced by country and institutional specificities and is observed in both large/listed firms and small/private firms (Bessler et al. 2013; Devos et al. 2012; Ghoul et al. 2018; Morais, Serrasqueiro, and Ramalho 2021; Ramalho, Rita, and Silva 2018; Saona, Vallelado, and Martín 2020) and may contribute to raising firm's value (Chipeta, Aftab, and Machokoto 2021; Hamelin, Lefebvre, and Weill 2022). Zero leverage is commonly identified as a consequence of financing constraints or the firm's desire to build up financial flexibility. In the former case, zero leverage results from impositions of creditors who do not wish to grant credit to firms, while in the latter firms deliberately opt for zero-debt policies to build up financial slack and preserve borrowing capacity (Dang 2013; Huang, Li, and Gao 2017; Morais, Serrasqueiro, and Ramalho 2020).

In this paper, we focus on the potential effects of firms' sustainability, social responsibility and governance practices over their probability of adopting a zero-debt policy. As a proxy for those practices, we use the Environment, Social and Governance (ESG) combined score available at the *DataStream* database, with a higher score reflecting a better performance in the mentioned practices. Because firm leverage results not only from the demand for debt, but also requires the supply of debt, we investigate the effects of the ESG index on those two quantities. This is in marked contrast with the classical literature on zero leverage, which typically relies on an empirical model (standard logit or probit specifications) that only allows to estimate the overall effect of an explanatory variable on the probability of firms having debt or not. Here, because, as discussed above, zero leverage may be the result of a firm's own decision or a creditor refusal to grant credit to the firm, we use the bivariate probit model with partial observability (Poirier 1980), which allows to separately estimate the effect of any explanatory variable on both the demand and supply of debt. In addition, we use propensity score analysis to estimate the overall effect of the ESG score on the firm's probability of having zero leverage. In all estimations we use an unbalanced panel of European listed firms for the 2002–2020 period.

The remainder of the paper is organized as follows. Section II formulates some research hypotheses. Section III describes the data and the methodology applied in the empirical analysis. Section IV presents and discusses the main results of the paper. Section V concludes.

II. ESG and capital structure: research hypotheses

Firms' ESG scores represent a measure for the influence that economic growth, environmental protection, social efficiency and governance elements exert into a firm operation. Several studies focus on a particular element of the ESG score and explore their potential effects on firms. Exploring the environmental element of the ESG score, Huynh and Xia (2020) show that bond returns of firms more sensitive to news about climate change obtain lower returns. In a recent study, Duan et al. (2023) found a positive relationship between lower carbon intensity and bond returns. On the other hand, Bolton and Kacperczyk (2021), exploring whether carbon emissions affect US stock returns, found that carbon emissions positively affect stock returns.

The effects of ESG performance on firm's activities and attractiveness have recently started to be investigated. Studies have been dedicated to the potential effects of ESG scores on firms' performance and despite mixed empirical results, most of the studies report a positive effect of ESG performance on firm's financial performance (Busch and Friede 2018; Friede, Busch, and Bassen 2015; Ray and Goel 2023).

The research on the relationship between ESG scores and firm's debt is limited. For example, Gao et al. (2022) provide evidence that a positive media ESG spotlight reduces firms' cost of debt by increasing firm's reputation. This effect is particularly important for firms with poor governance

mechanisms. Brogi et al. (2022) found that high ESG scores are associated with a reduction in firm credit risk and Zhang (2022) shows that some firms, recognizing the importance of ESG performance, 'greenwash' their activities making misleading ESG disclosures to be more attractive for external investors. However, to the best of our knowledge, there are no studies investigating the impact of ESG scores on firm's capital structure. Next, we formulate two hypotheses regarding the impact of ESG scores on the probability of a firm adopting a zero-leverage policy, considering both demand and supply factors.

At the demand level, firm's ESG performance may have two distinct effects on firms' capital structure. On the one hand, firms with superior performance may have fewer incentives to engage in harmful environmental projects, such as those that are fossil-fuel based, since such investments may be penalized or declared unsuitable by local governmental entities, investors and/or creditors. In this sense, a better ESG performance is expected to increase the propensity for zero-leverage policies. On the other hand, promoting sustainability, creating wealth and qualified jobs and complying with the environmental and human goals requires considerable investments to allow firms to adjust their activities and technologies (Sharfman and Fernando 2008). Consequently, a greater firm's ESG performance may instead decrease the likelihood of firms having zero leverage. Overall, since most firms are still in a transition phase, we expect this second effect to be superior to the first one in most cases. Therefore, in this paper we test the following hypothesis:

H1: A higher firms' ESG performance decreases the propensity for zero leverage by firms' own decisions.

From a supply-side perspective, we expect a greater willingness of creditors to grant debt to firms with greater levels of sustainability and social responsibility and with better governance mechanisms, since these factors may be a signal of a better-governed firm with good prospects. In fact, there is some evidence that firms with higher ESG scores tend to present a better financial performance than firms with lower ESG scores (*e.g.*, Friede, Busch, and Bassen 2015; Ray and Goel 2023). Moreover, ESG performance have been identified as a mechanism that reduces information asymmetry (Kim and Park 2023). Therefore, banks have been motivated to incorporate environmental issues into their lending decisions (Herbohn, Gao, and Clarkson 2019; Jung, Herbohn, and Clarkson 2018; Weber, Scholz, and Michalik 2010) and to offer favourable financing conditions to better carbon performers and firms with superior social responsibility (Herbohn, Gao, and Clarkson 2019; Jung, Herbohn, and Clarkson 2018; Weber, Scholz, and Michalik 2010). Therefore, the following hypothesis is formulated:

H2: A higher firm's ESG performance decreases the propensity for zero leverage due to an increased willingness of creditors to grant debt.

Hence, both due to debt demand and supply factors, we expect that firms with higher ESG scores are less prone to have zero debt.

III. Data, methodology, and variables

The sample

Firm's accounting, financial and market data were obtained from the *DataStream* database. Data were collected for listed firms from 14 Western European countries (Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Portugal, Spain, Sweden and the UK) over the period ranging from 2002 to 2020. The European context is particularly suitable to investigate the potential effect of ESG performance on the zero-leverage phenomenon since all selected countries are implementing the most recent European Green Deal (European Comission 2019).

The firm's ESG scores were obtained from the new Eikon Refinitiv ESG rating system, which comprises some of the most common ESG indicators used in European studies (Erhart 2022; Gigante and Manglaviti 2022). Relative to others, this rating has the advantage of being normalized by industry and based on percentile-ranked scores. For example, a score of 0.7 means that a firm

performs better than 70% of other firms in the same industry. The Refinitiv ESG rating system has also the advantage of being available in *DataStream* for firms of the selected countries since 2002.

Using the FTSE/Dow Jones Industry Classification Benchmark (ICB), we excluded from the sample utility and financial firms and also firms without an industry code. We also removed from the sample firm/year observations with missing information for any variable used in the econometric models and observations with obvious errors (e.g. negative sales). Finally, we allowed firms' entry and exit from the sample to avoid the possible survivorship bias that could arise from considering only successful firms. Our final sample is represented by an unbalanced panel data with 7,095 firm-year observations, corresponding to 1,299 firms.

The bivariate probit model with partial observability

To examine the potential effect of firm's ESG performance on zero leverage, most empirical studies on the zero-leverage phenomenon use standard probit specifications, which account for the binary nature of the dependent variable (= 1 if the firm has debt and 0 otherwise). This model assumes that all firms' requests for debt are successful, which is not true since creditors may not be willing to grant them the requested debt. Conversely, creditors could be willing to grant debt to firms that do not request it. Hence, a problem of partial observability arises since we can only observe the joint outcome of the firm and creditors' decisions about debt. Therefore, to examine if the potential effect of ESG performance on zero leverage is due to a firm's own decision or is an imposition of creditors, or both, we use bivariate probit models with partial observability in the sense of Poirier (1980).

We assume that firm's demand for (short- and long-term) debt is represented by a dichotomous variable y_1, which is equal to 1 if the firm wants to resort to debt and is 0 otherwise, while creditors' supply of debt is defined by the dichotomous variable y_2, which takes on the value 1 if the creditor is willing to grant debt and is 0 otherwise. Each dichotomous variable is determined by one latent variable, y_1^* or y_2^*, being 1 when the associated variable is positive. The latent variables are governed according to:

$$y_1^* = \beta_1' x_1 + \varepsilon_1 \tag{1}$$

$$y_2^* = \beta_2' x_2 + \varepsilon_2 \tag{2}$$

where x_1 (for the demand function) and x_2 (for the supply function) are vectors of explanatory variables, β_1 and β_2 represent the respective coefficients, and ε_1 and ε_2 are error terms assumed to follow a bivariate normal distribution $\Phi_2(\varepsilon_1, \varepsilon_2)$, with $E(\varepsilon_1) = E(\varepsilon_2) = 0$, $Var(\varepsilon_1) = Var(\varepsilon_2) = 1$ and $Cov(\varepsilon_1, \varepsilon_2) = \rho$.

We can identify four possible decisions on leverage ('firms want to resort to debt', $y_1 = 1$, and 'creditors want to grant debt', $y_2 = 1$; 'firms want to resort to debt', $y_1 = 1$, but 'creditors do not want to grant debt', $y_2 = 0$; 'firms do not want to resort to debt', $y_1 = 0$, but 'creditors would grant debt', $y_2 = 1$; and 'firms do not want to resort to debt', $y_1 = 0$, and 'creditors would not grant debt', $y_2 = 0$), with the last three ending up indistinguishable as all we can observe is that firms are debt-free. Therefore, unlike typical zero-leverage empirical studies, we need to directly model the probability of a firm being levered, not of being debt-free. Figure 1 summarizes the partial observability problem surrounding decisions about debt.

In this context, the probability that a firm decides to resort to debt and that the debt is actually granted by the creditor is given by:

$$\begin{aligned} Prob[y = 1] &= Prob\left[y_1^* > 0, y_2^* > 0\right] \\ &= Prob[\varepsilon_1 > -\beta_1' x_1, \varepsilon_2 > -\beta_2' x_2] \\ &= \Phi_2\left(\beta_1' x_1, \beta_2' x_2, \rho\right) \end{aligned} \tag{3}$$

Reciprocally, the probability that the firm holds no debt results from:

$$Prob[y = 0] = 1 - Prob[y_1 = 1] \tag{4}$$

As noted by Poirier (1980), in spite of not observing y_1 and y_2, estimation of the coefficients of the demand and supply functions remains feasible. The model's likelihood function is:

$$L = \prod_{y=1}\left[\Phi_2\left(\beta_1' x_1, \beta_2' x_2, \rho\right)\right] \prod_{y=0}\left[1 - \Phi_2\left(\beta_1' x_1, \beta_2' x_2, \rho\right)\right] \tag{5}$$

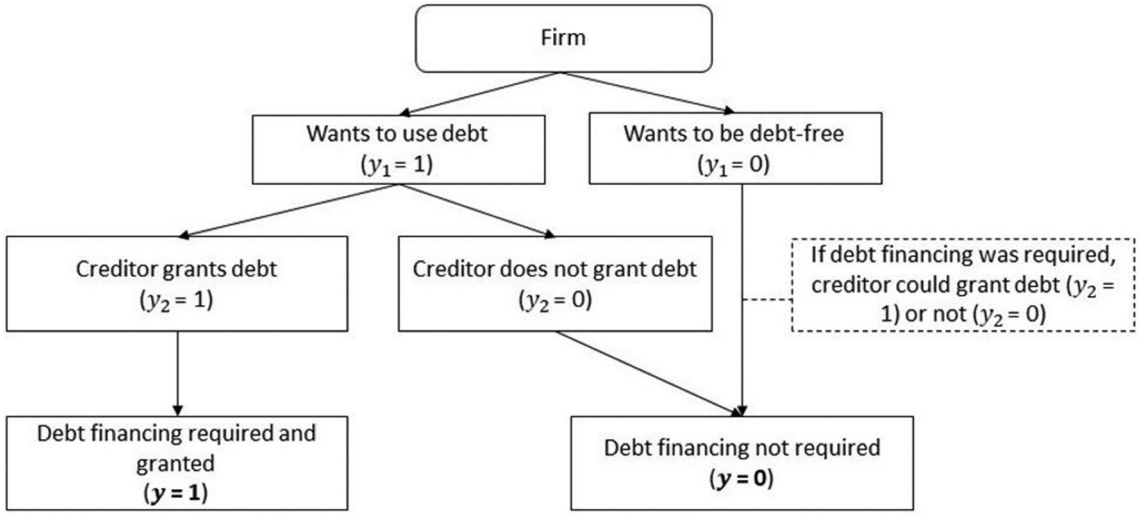

Figure 1. Partial observability problem. Source: Morais et al. (2020).

with the demand and supply equations being jointly estimated by maximum likelihood. A requirement for the model to be identified is that at least one of the variables contained in x_1 does not appear in x_2, or vice versa $(x_1 \neq x_2)$.

The explanatory variables

Our main explanatory variable is based on the *ESG-combined score*, which provides a comprehensive scoring of a firm's Environment, Social and Governance performance discounted by negative media stories (ESG controversies). The score ranges between 0 (poor ESG performance) and 1 (excellent ESG performance). We consider two alternative sets of models. In one set, we use directly *ESG combined score* as explanatory variable. In the second, we use a dummy variable that distinguishes between firms with higher ESG performance from firms with lower ESG performance. In particular, the *ESG dummy* variable assumes the value 1 for firms with values in the third tercile of the variable *ESG combined score* and the value 0 for firms with values in the first tercile. Terciles are computed separately for each year. Firms in the second tercile were dropped from the analysis in order to avoid misclassification of what is considered a higher or lower ESG score.

The estimated econometric models also include a set of standard firm-specific control variables commonly found in the literature to be important for explaining firm's capital structure decisions, such as *Cash holdings, Growth opportunities, Profitability, Dividend payout, Non-debt tax shields, Tangibility and Size*. In addition, to control for the influence of the different non-leverage regulatory environments that characterize the countries included in our sample, the models also include the *Investment grade* dummy variable, which is commonly evaluated regardless of country. Some country-specific control variables are also included in the models. We use the *GDP growth rate* to control for macroeconomic shocks that may be specific to each country and year. Furthermore, considering that Europe has been deeply affected by the 2008 financial crisis, which affected public and private access to external sources of financing (Laeven and Valencia 2018), we use a dummy variable, *Crisis*, to indicate if a country was in a financial crisis in a given year. In particular, following the classification of Laeven and Valencia (2018), we consider that the 2008 global financial crisis affected countries in different ways, lasting longer in the European countries that suffered a sovereign debt crisis after the original financial crisis. Finally, industry and year dummies are also included in the models.

To meet with the model assumptions, there are variables that we consider as relevant only for the demand for debt (*Cash holdings*, *Non-debt tax shields*) or for the supply of debt (*Size, Investment grade*), since the finance literature presents mostly

demand- or supply-related theoretical arguments to justify their effects on debt.[1] Thus, because cash represents the firm's most liquid asset and creditors rely mainly on more stable assets to make their credit decisions, cash holdings are usually considered as a measure mostly influencing the demand for debt (e.g. Dang 2013; Morais, Serrasqueiro, and Ramalho 2020). Also, *Non-debt tax shields*, while relatively irrelevant for creditors' decisions, may contribute to explain firm's decisions about debt given that firms with high levels of depreciations and amortizations display lower propensity to take advantage of debt tax shields given the potential substitution between the two sources of tax shields (Morais, Serrasqueiro, and Ramalho 2020). On the other hand, firm size and the investment-grade classification are traditional and accepted measures used by creditors to evaluate the firm's ability to comply with future obligations and therefore are in general viewed as influencing mainly the supply of debt (Dang 2013).

The remaining variables (*ESG-combined score* or the *ESG dummy*, *Growth opportunities*, *Profitability*, *Dividend payout*, *Tangibility* and *GDP growth rate* and *Crisis*) may be indistinguishable used as possible factors influencing both demand and supply of debt. Table 1 provides a formal definition of the variables considered in

Table 1. Definition of the variables.

Variable	Definition
Leverage	Dummy that equals 1 if a firm has leverage greater than zero in a given year and is 0 otherwise.
ESG combined score	Environment, Social and Governance (ESG) scores measure the firm's ESG performance based on publicly reported data such as company websites, annual reports, and corporate social responsibility reports across 10 different ESG topics (Environment: Resource use, Emissions, Innovation; Social: Workforce, Human rights, Community, Product responsibility; Governance: Management, Shareholders, Corporate Social Responsibility strategy). The ESG Combined Score provides a rounded and comprehensive evaluation of a firm's ESG performance with ESG controversies overlay captured from global media sources. The main objective of this score is to discount the ESG performance score based on negative media stories. The score ranges between 0 and 1 (Source: Refinitiv ESG Scores).
ESG dummy	Equals 1 if the firm's ESG performance is in the third tercile of the variable *ESG combined score* (higher ESG performance) and 0 if it is in first tercile (lower ESG performance). Terciles are calculated separately for each year.
Cash holdings	Ratio of cash and short-term investments to book assets.
Growth opportunities	Market-to-book ratio (the market value of equity plus the book value of debt, divided by total assets).
Profitability	Ratio of earnings before interests, taxes, and depreciation (EBITDA) to book assets.
Dividend payout	Ratio of common dividends to book assets.
Non-debt tax shields	Ratio of depreciation and amortizations to book assets.
Tangibility	Ratio of fixed assets to book assets.
GDP growth rate	Annual GDP growth rate (source: World Development Indicators, The World Bank).
Crisis	Equals 1 if the observation corresponds to the years of financial and sovereign debt crises in Europe (the period of crisis goes from 2008 to 2009, 2011 or 2012, depending on the country being considered) and is 0 otherwise (source: Laeven and Valencia 2018).[a]
Investment grade	Equals 1 for a firm with an investment-grade rating (BBB- or higher) and 0 otherwise.
Size	Logarithm of total book assets.

[a]The longest crisis period is considered only for the following countries: Austria, Belgium, Greece, Ireland, Portugal and Spain. For UK the crisis period is 2008–2011 and for the remaining countries only the 2008–2009 period is considered as a crisis period. See Laeven and Valencia (2018).

Table 2. Descriptive statistics.

Variable	N	mean	sd	min	median	max
Leverage	7,095	0,951	0,216	0,000	1,000	1,000
ESG combined score	7,095	48,223	19,275	0,314	48,831	93,656
ESG dummy	4,713	0.499	0.500	0.000	0.000	1.000
Cash holdings	7,095	0.133	0.136	0.000	0.092	0.960
Growth opportunities	7,095	1.717	1.938	0.000	1.158	19,567
Profitability	7,095	0.117	0.139	−2.385	0.115	1.701
Dividend payout	7,095	0.017	0.039	0.000	0.002	0.877
Non-debt tax shields	7,095	0.037	0.033	0.000	0.033	0.710
Tangibility	7,095	0.249	0.209	0.000	0.194	0.970
GDP growth rate	7,095	0.201	3.682	−10.823	1.672	9.030
Investment grade	7,095	0.967	0.178	0.000	1.000	1.000
Size	7,095	14.092	2.135	6.967	14.266	20.024

[1]To avoid some subjectiveness on the variables included in a single equation, in a sensitivity analysis on the robustness tests section we consider alternative specifications where some of the variables that previously appeared in only one equation are added to the other equation.

the econometric models and Table 2 presents descriptive statistics for them. Almost 95% of firm-year observations are classified as levered firms, which means that only 5% of firm-year observations are classified as zero-leverage firms.

To examine the overall impact of ESG performance on zero leverage we also used PS methods (Rosenbaum and Rubin 1983), which have the advantage of accounting for sample selection effects and promote a direct comparison of the propensity to have zero leverage between firms with greater ESG performance and lower ESG performance. We use the *ESG dummy* variable as the treatment variable. Hence, firms with ESG dummy equal to 1 are the 'treatment group' and firms with ESG dummy equal to 0 are the 'control group'. We use a logit model, with *Leverage* as dependent variable, to estimate the PS conditional on all the independent variables considered in the bivariate probit models. Next, using nearest-neighbour matching, we match each firm with greater ESG performance with the lower ESG performance firms that display the closest predicted propensity scores, and vice-versa. Finally, we estimate the differences between the predicted performances for each match and compute the effect of ESG performance on zero leverage by averaging those differences for the whole sample.

IV. Results

Main models

Table 3 presents the results of the effects of ESG performance on zero leverage. Model (1) is a standard probit model with random effects, while Model (2) is a bivariate probit model with partial observability, analysing separately the determinants that affect firm's decision to resort to debt and creditors' decision to grant debt to the firm, which allows testing hypotheses H1 and H2, respectively. Both models use the variable *ESG combined score* as explanatory variable. Models (3) and (4) are similar to models (1) and (2),

Table 3. Regression results.

	(1)	(2)		(3)	(4)	
Independent variables		Demand	Supply		Demand	Supply
ESG combined score	0.003*	0.002	0.007**			
	(1.81)	(1.05)	(1.98)			
ESG dummy				0.402**	0.295	0.243**
				(2.01)	(1.50)	(2.06)
Cash holdings	−1.788***	−2.235***		−1.798***	−2.397***	
	(−9.59)	(−7.70)		(−7.87)	(−5.80)	
Growth opportunities	0.001	0.008	−0.002	0.003	0.009	−0.001
	(0.43)	(0.49)	(−0.54)	(1.03)	(0.78)	(−0.54)
Profitability	−0.880***	−1.477***	0.393*	−0.767**	−1.884***	0.263*
	(−2.64)	(−3.52)	(1.93)	(−1.99)	(−2.59)	(1.66)
Dividend payout	−0.617	2.335***	−3.373***	0.267	1.595**	−3.320***
	(−1.40)	(3.64)	(−5.13)	(0.42)	(2.07)	(−3.53)
Non-debt tax shields	3.620***	24.487***		3.853***	19.516***	
	(3.14)	(4.04)		(2.70)	(2.83)	
Tangibility	0.011	−0.591***	4.796***	0.131	−0.596**	7.786***
	(0.06)	(−2.96)	(3.01)	(0.57)	(−2.45)	(3.27)
GDP growth rate	−0.087***	−0.072***	−0.080***	−0.113***	−0.079***	−0.109***
	(−7.60)	(−3.69)	(−5.45)	(−7.67)	(−3.10)	(−6.96)
Crisis	−0.480***	0.154	−0.569***	−0.523***	−0.021	−0.603***
	(−5.52)	(0.48)	(−5.16)	(−5.07)	(−0.08)	(−4.83)
Investment grade	0.396***		0.451***	0.454***		0.477**
	(2.88)		(2.75)	(2.78)		(2.20)
Size	0.261***		0.336***	0.277***		0.341***
	(17.03)		(14.67)	(14.79)		(14.90)
Constant	−1.848***	1.462***	−2.614***	−2.135***	1.521***	−2.698***
	(−7.76)	(6.81)	(−8.54)	(−7.59)	(6.26)	(−8.52)
Industry dummies	Yes	Yes		Yes	Yes	
Year dummies	Yes	Yes		Yes	Yes	
Observations	7,070	7,070		4,713	4,713	
Wald test for joint significance	602.31***	512.52***		450.18***	509.07***	
ρ		2.274*			3.747***	

This table presents results from the econometric models. Models (1) and (3) are traditional univariate (random-effects) probit models while models (2) and (4) are bivariate probit model with partial observability. *Leverage* is the dependent variable. For each independent variable, we report regression coefficients and robust z-statistics (in parentheses).

***,**,* indicates statistically significance at 1%, 5% and 10% level, respectively.

respectively, but use *ESG dummy* as explanatory variable. For all estimated equations, for each independent variable we report in the first row the estimated coefficient and in the second row (in parentheses) the result of an heteroskedasticity-robust Wald test for its individual statistical significance.

The Wald tests for the individual and joint statistical significance of the independent variables confirm the ability of both models to explain the respective dependent variables. The estimated ρ in the bivariate probit models with partial observability is statistically significant, confirming that Equations (1) and (2) are interrelated and suggesting that using the bivariate probit model would allow efficiency gains over separate probit estimation of demand and supply equations if that was possible.

Models (1) and (3), on the one hand, and models (2) and (4), on the other hand, present quite similar results in terms of the sign and significance of the coefficients. Therefore, next we present and discuss only the results of models (3) and (4). The former model shows that firm's ESG performance influence its capital structure. In particular, the *ESG dummy* variable has a positive and significant coefficient, implying that firms with greater ESG performance are more likely to use debt and thus less prone to have zero leverage. This result may be justified by the argument that to obtain and keep a superior ESG performance, firms need to adjust their activities and technologies, create qualified jobs and improve work conditions, which may imply important investments and hence require more external financing (Sharfman and Fernando 2008). It may be also the case that firms with better ESG performance are able to raise debt in more favourable conditions and hence are more prone to use debt. Looking only at the results of Model (3), we are unable to conclude if both explanations are valid or not.

Model (4) shows that the variable *ESG dummy* is significant only in the supply equation. Therefore, the overall negative effect of ESG performance on zero leverage, found in Model (3), is not motivated by firms' decision or need to resort to more debt, but due to a greater creditor's willingness to grant debt to firms. Thus, our results suggest that ESG performance favours access to debt financing. In fact, the emergence of new programmes destined to fund innovation and social entrepreneurship projects at a cost below the usual market conditions seems to be particularly aimed at firms with better ESG performance (Nguyen and Phan 2020). These results allow to reject hypothesis H1 and to confirm hypothesis H2.

Model (4) also shows that some of the other variables influencing zero leverage also affect in distinct ways the demand and supply of debt, namely *Profitability*, *Dividend payout*, *Tangibility* and *Crisis*. *Profitability* decreases the firm's propensity to resort to debt but increases the creditor's willingness to grant debt to them. The demand effect is supported by the financial flexibility theory, which states that firms use their internal sources of liquidity to build up financial slack and preserve debt capacity to be able to invest in the future (Dang 2013; Huang, Li, and Gao 2017). The supply effect results from the natural greater willingness of creditors to lend to more profitable firms. On the other hand, *Dividend payout* seems to not significantly affect firm's debt (univariate probit models), but this happens because it has a positive effect on firms' decision, or need, to resort to debt, but a negative effect on the decision of creditors to fund firms that pay higher dividends. A possible explanation for the latter effect is that dividend payers are more prone to decapitalize their firms and leave them less able to comply with their debt service, reducing thus the creditor propensity to grant debt to them (Morais, Serrasqueiro, and Ramalho 2020). Asset tangibility decreases the propensity for firms resorting to debt, but, on the other hand, increases the propensity for creditors granting debt to them. The supply effect was expected, since firms with greater asset tangibility (more collateral) are less exposed to information asymmetries and consequently less credit constrained (Benmelech and Bergman 2009). In contrast, the demand effect is somewhat surprising, since firms with higher levels of tangibility have lower costs of financial distress and bankruptcy given that, in case of bankruptcy, these assets retain their value (Myers 1977). Finally, the 2008 financial crisis did not affect debt demand, but increased the propensity towards zero leverage, because creditors were less available to grant credit to firms (Santos 2011).

For the remaining variables, their effects on the propensity for firms having debt are the most commonly found in previous literature. The negative effect of *Cash holdings* on debt demand conforms with the financial flexibility theory. The positive effects of *Size* and *Investment grade* on debt supply conforms with the financial constraints' perspective, which states that larger firms with an investment-grade rating have higher reputation in the debt market, suffering lower information asymmetries (Devos et al. 2012; Huang, Li, and Gao 2017). The negative effects of *GDP growth rate* on both debt demand and supply reflects, respectively, the greater availability of internal sources of financing due to the improved economic conditions and the idea that in periods of economic growth the costs of adverse selection are lower, increasing investor's preference for financing through equity (Choe, Masulis, and Nanda 1993).

Robustness tests

As explained before, to identify the two equations (demand and supply) of the bivariate probit model with partial observability it is necessary that the demand and supply equations do not contain exactly the same set of variables. Although we have justified theoretically our variable selection for each equation, other arguments can lead to different exclusion restrictions. Therefore, to test the robustness of the results produced by models (2) and (4) of Table 3, now we consider alternative specifications where some of the variables that previously appeared in only one equation are now added also to the other Equation. In particular, assuming that cash holdings may be also used by outsiders to predict firm's bankruptcy (Ohlson 1980), we add the *Cash holdings* variable to the supply Equation (Model 4a); and, considering that firm size may also explain its demand for debt, since a greater level of assets means investment that perhaps had to be financed by debt, we add the *Size* variable to the demand equation (Model 4b). To save space, in Table 4 we only present the results of the specifications that use Model (4) of Table 3 as baseline.

As Table 4 shows, these modifications do not change our main findings. In particular, the sign

Table 4. Alternative variables for the demand and supply equations of the bivariate probit model.

	(4a)		(4b)	
Independent variables	Demand	Supply	Demand	Supply
ESG dummy	0.105	0.361***	0.176	0.312***
	(0.56)	(3.25)	(1.24)	(3.09)
Cash holdings	−2.560***	0.047	−2.936***	
	(−8.33)	(0.07)	(−9.83)	
Growth opportunities	−0.004	0.010	0.015	0.002
	(−0.64)	(1.08)	(0.87)	(0.23)
Profitability	−1.949***	1.018***	−2.303***	0.081
	(−5.05)	(2.92)	(−7.08)	(0.34)
Dividend payout	3.697***	−1.529***	0.082	−4.137**
	(3.46)	(−2.57)	(0.17)	(−4.61)
Non-debt tax shields	32.659***		3.260**	
	(2.95)		(1.99)	
Tangibility	−0.643**	16.937***	−1.078***	13.094***
	(−2.37)	(3.16)	(−4.16)	(6.23)
GDP growth rate	−0.056**	−0.123***	−0.123***	−0.073***
	(−1.97)	(−6.57)	(−6.69)	(−3.88)
Crisis	−0.117*	−0.626***	−0.263	−0.571***
	(−1.66)	(−5.33)	(1.510)	(−4.65)
Investment grade		0.704***		0.768***
		(3.73)		(3.62)
Size		0.293***	0.163*	0.245***
		(11.78)	(1.73)	(8.08)
Constant	0.560**	−1.772***	−0.522	−2.903***
	(2.47)	(−5.23)	(−1.27)	(−6.97)
Industry dummies	Yes		Yes	
Observations	4,713		4,713	
Wald test for joint significance	455.75***		400.21***	
ρ	0.818*		19.680***	

This table presents results from the econometric models. Model 4a adds the *Cash holdings* variables to the supply equation and Model 4a adds the variable *Size* to the demand equation. Both models apply bivariate probit models with partial observability to analyse the determinants of both demand and supply of debt. The explanatory variable used is the *ESG dummy*, and *Leverage* is the dependent variable. For each independent variable, we report regression coefficients and robust z-statistics (in parentheses).

***,**,* indicates statistically significance at 1%, 5% and 10% level, respectively.

and statistical significance of the *ESG dummy* variable do not change across models. Moreover, the variables added to the other equation (*Cash holdings* to the supply equation and *Size* to the demand equation) keep a greater relevance in the equation where we considered them initially.

Propensity score analysis

Table 5 presents the results of the propensity score matching analysis. In the first row of Table 5 we report the predicted effect of ESG performance on zero leverage. In the other rows, we present diagnostic criteria for the propensity score analysis performed. In particular, for both the original and matched sample, we present descriptive statistics and Rubin's (2001) diagnostic criteria for the balance of the distribution of the covariate values for the greater and lower ESG performance group of firms. A perfect matching would imply a standardized mean difference of zero across groups and a variance ratio of one. Although not being perfect, the level of balance between the groups improves substantially in the matched sample in all cases and Rubin's (2001) measures suggest that the matched samples are sufficiently balanced.

Table 5 confirms that firms with greater ESG performance have a lower propensity to have zero leverage. In particular, it is predicted that ESG performance decreases a firm's zero-leverage propensity by approximately 3.9pp.

Table 5. Propensity score matching estimates.

	Leverage
ESG dummy	0.039***
	(0.007)
Diagnostic criteria for the propensity score matching	
Standardized mean differences	
– Raw sample	0.061
– Matched sample	0.013
Rubin (2001) B statistic	
– Raw sample	15.60
– Matched sample	3.70
Variance ratios	
– Raw sample	0.744
– Matched sample	0.954
Rubin (2001) R statistic	
– Raw sample	0.10[#]
– Matched sample	1.21
N. observations	4,713

Robust standard errors based on the correction by Abadie and Imbens (2016) are reported in parenthesis. Standardized mean differences are the means of the absolute values of the standardized differences of the sample means in the control and treatment sub-samples calculated separately for each independent variable considered in the estimation of the propensity scores. Rubin (2001) B statistic is an indicator of whether those differences are relevant ($B > 25$) or not ($B < 25$), being calculated as the absolute standardized difference of the means of the linear index of the propensity score in the control and treatment groups. Variance ratios are the means of the variance ratios of treated over control firms calculated separately for each independent variable considered in the estimation of the propensity scores. Rubin (2001) R statistic is an indicator of whether the variance ratios are relatively similar ($0.5 \leq R \leq 2$) or not ($R < 0.5$ or $R > 2$), being calculated as the ratio of treated to non-treated variances of the propensity score index.

***significance at the 1% level.

[#]B > 25 or R outside [0.5, 2].

V. Conclusion

This paper examines the effect of firm's ESG performance on the zero-leverage phenomenon, with a particular focus on how ESG performance influences firm's decision to resort to debt and creditor's decision to grant debt. In this analysis, we used bivariate probit models with partial observability in the sense of Poirier (1980). Our results suggest that the higher the ESG performance the lower the propensity for firms having zero leverage. However, ESG performance does not seem to significantly influence firm's decision to raise or not debt. Indeed, it affects only debt supply, since creditors are found to be willing to grant debt in more favourable conditions to firms with greater levels of ESG performance. Overall, according to our PS analysis, firms with greater ESG performance have a propensity to become debt-free that is 3.9pp smaller than that of firms with lower performance.

The observed increase in debt among firms with superior ESG performance may indicate a positive response to financing initiatives that promote sustainable practices. Those firms may benefit from easier access to financing and lower capital costs, resulting in increased profit margins. This can stimulate significant investments in sustainable initiatives, allowing firms to implement more robust environmental and social practices, contributing to long-term sustainability. In short, adopting ESG practices not only mitigates legal and reputational risks associated with environmental and social issues but can also result in tangible financial benefits. However, it is also important to consider potential negative repercussions for firms that meet ESG criteria. Indeed, the easy access to financing can lead to increased indebtedness, which may result in unsustainable debt levels for some companies, thereby increasing financial vulnerability during economic turbulence. It is essential to underscore the need for the efficient deployment of the financing they

receive to avoid debt accumulation and suboptimal investments. Creditors can also play a pivotal role by requiring well-defined investment plans prior to disbursement, coupled with ongoing monitoring and evaluation mechanisms, thus ensuring that resources are used effectively. By actively avoiding inefficient financial allocation, stakeholders can foster a conducive environment for sustained economic and sustainable development fostering ESG-oriented firms with an increased capacity to raise the finance needed to develop their business.

Our results are also important for the traditional and extensive literature on capital structure, since they show that classical firm-specific characteristics may not be sufficient to fully explain firm's capital structure. New theoretical approaches that incorporate the new challenges faced by societies and firms need to be developed to better explain firms' financial choices.

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