Zero leverage in SMEs: does sustainable development influence the phenomenon?

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Abstract

Contrary to what is predicted by classical capital structure theories, many firms do not use debt to finance their activity. This paper investigates how sustainable development at a macro level affects this so-called zero-leverage phenomenon as well as the demand for and the supply of debt. Using a sample of SMEs from Portugal for the period 2009-2019, we find that a higher level of regional sustainable development decreases SMEs propensity to have zero leverage, being this result robust to the use of several non-linear specifications including instrumental variables tools. Based on the bivariate probit model with partial observability in the sense of Poirier (1980), we also find that the negative effect of sustainable development on zero leverage is determined by creditors-related reasons and not by firms' own decisions, since it only impacts significantly the supply of debt. In particular, creditors seem to be more willing to grant debt to SMEs in regions with a greater sustainable development level, reducing thus SMEs propensity for zero leverage by offering them access to debt in more favourable terms.

Keywords: SMEs; Sustainable development; Zero leverage; Bivariate probit models

1. Introduction

Six decades have passed since Modigliani and Miller's (1958) ground-breaking capital structure irrelevance theorem, but firm's financial leverage is still one of the most important research topics in the corporate finance field.[1] All classical capital structure theories agree that debt brings benefits to firms and that, until a sustainable level, it raises firm value. In particular, the trade-off theory states that debt brings tax shields (Modigliani and Miller, 1963); the pecking order theory claims that debt issuance generates lower information costs than equity (Myers, 1984; Myers and Majluf, 1984); and the signalling theory argues that debt can be also used as a way of signalling good firm's prospects and the existence of value creating projects, as well as management commitment with the firm's investment plan (Ross, 1977), which also contributes to decrease the so-called principal-agent problems as postulated by the agency theory (Jensen and Meckling, 1976; Jensen, 1986).

Recently, it has been noted that there is a significant and growing number of firms that do not hold any amount of (short- and long-term) debt and hence are likely to not act as predicted by

[1] A search performed during March 2024 on Web of Science bibliographic database by papers published during 2023 that include on the title the words "capital structure" returned a total of 196 documents. The number grows substantially when we search for papers that have as one of the topics "capital structure", in which case a total of 2,803 documents is returned.

classical capital structure theories. This so-called zero-leverage phenomenon affects both large/listed firms and small/private firms all over the world (Bessler et al., 2013; Ghoul et al. 2018; Ramalho et al., 2018, Strebulaev and Yang, 2013)[2]. New capital structure theories have emerged in the literature to explain the existence of zero-debt firms, such as the financial constraints approach, which states that zero leverage results from an imposition of creditors who do not wish to grant credit, and the financial flexibility approach, which argues that firms deliberately opt for zero-debt policies to build up financial flexibility and preserve borrowing capacity (Dang, 2013). Country and institutional specificities have also been extensively linked to the zero-leverage phenomenon, which seems to be more prevalent in countries with market-based financial systems and common-law systems (Bessler et al., 2013; Ghoul et al., 2018). In addition, the effects on zero leverage of classical firm-specific determinants of capital structure, such as firm size, growth opportunities, tangibility, liquidity and earnings volatility (Frank and Goyal, 2009), have also been widely investigated (Dang, 2013; Huang et al., 2017; Ramalho et al., 2018).

Despite the considerable advances made during the last decade, researchers have failed so far to provide a completely satisfactory explanation of the zero-leverage phenomenon, as recently stressed by Saona et al. (2020). Therefore, they have recently started to search for less conventional determinants of zero-leverage policies, including in their studies factors that, by affecting the society, may also influence capital structure decisions (i.e., contextual factors as proposed by Nguyen and Canh, 2021). An example is Ghoul et al. (2018), which studied the impact of country's cultural indicators on zero leverage. Other examples, from the more general topic of capital structure, are Mamede et al. (2021), which studied the effects on debt ratios of corruption, immigration and concentration of refugees in a given region/country; Nguyen and Phan (2020), which studied the effects of the level of carbon emissions on firm's capital structure after the ratification of the Kyoto Protocol by Australia in December 2007; Tascón et al. (2021), which added to the analysis how the firm's life cycle affects the relationship between carbon performance and financial debt; and Nguyen et al. (2021), which studied the effect of entrepreneur's education level on the propensity for SMEs use formal credit. However, such studies are still rare and do not fully cover the effects of new challenges to society such as environmental protection and human development.

In this paper we focus on the potential effects of sustainable development levels on firm's financing decisions. We conjecture that a greater sustainable development level, in a first moment, may contribute to decrease the probability of firms having zero debt, since they need to invest in

[2] For example, Strebulaev and Yang (2013) found that almost 20% of US listed firms were debt-free in the beginning of the 2010s, while Ramalho et al. (2018) reported that around 34% of their sample of Portuguese private firms comply with their classification of zero leverage.

new technology and human resources training, but, at a later stage, may increase that probability, since there will be less incentive for firms to engage in harmful environmentally projects. Thus, this study focuses on the following research question: 1) *Does sustainable development impact firm's zero leverage?.* Because we find this to be true, then a second research question emerges, since it becomes important to check whether the impact is mainly due to firm's own financing decisions or results from creditors' pressure: 2) *Is the impact of sustainable development on zero leverage driven by firms' financing decisions or by creditors' impositions?*

To answer these questions, we use an unbalanced panel of 6,794 SMEs from Portugal, for the 2009-2019 period. Portugal is a country where firms are strongly dependent on bank debt (Demirgüç-Kunt and Levine, 2004), which implies that firms' zero-leverage policies will not be simply a consequence of a financial system prone to firms eschew debt. We focus on SMEs, because, similarly to other countries, in Portugal they are the backbone of the economy, accounting for 99.9% of the business community, employing 32% of the Portuguese population and generating 60.4% of the total gross value added of companies (PORDATA, 2021). Also, Portugal is the first country in the world aiming to be carbon neutral by 2050 after a 50 percent of reduction in emissions and 80 percent of consumed electricity coming from renewable sources by 2030. This paradigm is leading to the emergence of new private investment funds and public social funds from European 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 priority to sustainable development, SME's and innovation. From those, at least €6.9 billion are destined to SME's. Another example is the Social Innovation Fund (SIF), which can be accessed by Portuguese SMEs that propose innovation and social entrepreneurship initiatives. With the SIF debt instrument, SME's can fund their initiatives using specific credit lines.

To examine the effect of sustainable development on zero leverage we use as explanatory variable an adaptation of Hickel's (2020) Sustainable Development Index (SDI), which will be computed for each one of the 25 regions defined by the Portuguese Nomenclature of Territorial Units for Statistical Purposes (NUTS III). This index adds to the three dimensions (health, education and income) considered by the Human Development Index (HDI) from United Nation Development Programme (UNDP) information on ecological efficiency and hence is more suitable to our analysis than the more popular HDI. Similar to most of the empirical studies dealing with the zero-leverage phenomenon, we use standard logit and probit specifications (Wooldridge, 2012) to explain the probability of a SME being debt-free. In addition, to examine whether the possible influence of sustainable development on zero leverage is due to SMEs' own decision or an imposition of creditors, or both, we use bivariate probit models with partial observability in the sense of Poirier (1980). These models allow to overcome the limitations of standard probit/logit

models, which assume that there is only one decision maker in capital structure decisions. Instead, the bivariate probit model with partial observability recognizes that there are two decision-makers (the firm and the creditor) and, without requiring more data, allows to separately estimate the effect of any explanatory variable on both the demand and supply of debt (Morais et al., 2020). The methodological procedure allows to add that some variables affect in opposite directions demand and supply of debt, while some others influence SMEs demand but not supply of debt, and vice-versa.

Some other contributions to the academic literature can be derived from our study. For literature on financial conservatism, we add that for some SMEs zero-leverage emerges as their own financing policy, while for others is seems an imposition raised by the market. For literature on sustainability issues, we adjust an aggregated index to measure sustainable development, in terms of human and ecological issues, for each Portuguese region. In particular, we examine a possible effect of sustainable development on debt decisions. Our findings show that sustainable development can be used as a new determinant for SMEs capital structure, mostly by determining the creditors willingness to concede funds for SMEs. Therefore, we suggest that traditional firm-specific characteristics may not be sufficient to explain SMEs' capital structure, contributing also for the great field of firm's capital structure.

The remainder of the paper is organised as follows. Section 2 reviews the empirical literature about zero leverage and sustainable development, connects both research topics and formulates some empirical hypotheses. Section 3 describes the data, the methodology and the variables. Section 4 presents and discusses the main results of the paper. Finally, section 5 concludes.

2. Zero leverage and sustainability: evidence and hypotheses

2.1 The zero-leverage phenomenon revisited

Research about zero leverage advanced considerably during the past decade, giving rise to what is known in the literature as the "mysterious zero-leverage phenomenon" (Strebulaev and Yang, 2013). Academics started by identifying and quantifying the existence of a substantial number of debt-free firms. Strebulaev and Yang (2013) and Devos et al. (2012) found that there was an increasing trend toward zero leverage, with almost 20% of their sampled US listed firms holding no debt at all, many of which for several years in a row. The magnitude of the zero-debt phenomenon was confirmed by Bessler et al. (2013) and Ghoul et al. (2018), which found that zero leverage is a worldwide trend.

After catching the attention of the scientific community, researchers then focussed on the reasons behind such an extreme conservative financing policy. The literature seems to agree that for some firms zero leverage is actually the consequence of a financing policy freely taken by them, for example to preserve a financial slack and debt capacity to be able to invest when good growth opportunities arise – this is the basis of the so-called financial flexibility theory (e.g. Dang, 2013; Huang et al., 2017). For other firms, more than a financing decision, zero leverage seems to be the consequence of firm's lack of reputation in the credit market. These firms are rationed by lenders who refuse to grant debt to them or impose prohibitive conditions to provide funds, arguments that are the basis of the financial constraint's theory (e.g. Bessler et al., 2013; Devos et al., 2012; Stiglitz and Weiss, 1981). The financing constraints argument seem to be even more relevant to explain zero leverage on SMEs, since small and informationally opaque businesses, with deteriorated public support and credit history, are less likely to raise debt (Aristei and Angori, 2021).

Using a sample of European listed firms, Morais et al. (2020) show that zero-leverage firms may be, in fact, the consequence of both debt supply side reasons (creditors' decisions) and debt demand reasons (firm's decisions). The authors also found that some variables may affect debt demand and supply in different ways. For example, the greater the firm's profitability the lower its demand for debt but the greater the willingness of creditors to grant debt; asset tangibility increases the supply of debt but does not affect its demand, decreasing the propensity for zero leverage by creditor-related reasons; firm's size is only a debt supply determinant, as claimed by the financing constraints theory and most models predicting financial constraints levels, with creditors more prone to fund larger firms; and cash holdings levels decrease firms demand for debt, increasing the propensity for firms having zero leverage by their own decision.

Most of the empirical studies on zero leverage carried out so far have focussed on listed firms. Nevertheless, the few papers that considered private firms found similar determinants for the zero-leverage behaviour, such as Ramalho and Silva (2009), which considered a sample of micro, small, medium and large unlisted firms where more than 70% of observations corresponded to firms with no (long-term) debt. Using a similar classification for financial conservatism, Ramalho et al. (2018) suggest the use of new determinants for zero-leverage policies. They found that family ownership decreases the propensity for zero long-term debt, while geographical location in a metropolitan or a rural area seems to be irrelevant for the probability of a firm using or not long-term debt. Another paper considering less conventional determinants of zero leverage is Ghoul et al. (2018), which found that firms located in countries that, in cultural terms, are characterized by high levels of conservatism, assertiveness and trust, are more likely to adopt a zero-leverage policy.

In this paper we examine the impact of new possible determinants on zero leverage of SMEs in a country where most firms were expected to be highly dependent on debt, as an attempt to assure that observed effects are not being driven by a financial system prone to zero leverage.

2.2 Sustainability: definition and its influence on firms

There are many alternative definitions of sustainability. In fact, Kates et al. (2005) assert that the resonance of the word 'sustainability' comes from the ambiguity of its meaning. Sustainability is indeed a malleable concept that remains open and dynamic and encompasses diverse perspectives such as human, ecological, economic and social. To Brundtland (1987), sustainability is a policy concept that concentrates on environmental protection and economic development. Kuhlman and Farrington (2010) refers to the three dimensions of sustainability as economy, society and environment, which should be balanced to achieve the well-being of future generations and preserve irreplaceable natural resources. Imran et al. (2014) stress the need to reinterpret the definition of sustainable development to give it a more holistic and ecocentric perspective in face of the changing global environment. Accordingly, the concept of sustainability should include also the interaction of the economic, societal and environmental dimensions with other dimensions and subsystems playing a role in long-term development.

In the corporate subsystem, sustainability requires that, in addition to the usual goals of growth and profitability, firms should also pursue societal goals. Here, corporate sustainability plays a major role. As stated by several authors (e.g. Baumgartner and Ebner 2010; Lozano 2015), corporate sustainability needs to consider three dimensions: (i) the business or economic case; (ii) the natural or environmental case; and (iii) the societal or social case. As a management model, corporate sustainability aims at providing competitive outcomes in the short-term, while improving and protecting the human and natural resources in the long-term. To measure the influence that economic growth, environmental protection, social efficiency and governance elements exert into a company operation, the concept of Corporate Sustainability Performance (CSP) was created. Artiach et al. (2010) explored the factors that influence firms' decisions to invest in corporate sustainability and found that size, profitability and potential for growth are associated with a higher CSP for US firms. Other internal and external drivers of corporate sustainability are legal compliance (e.g. Boros, and Fogarassy 2019), economic and financial performance (e.g. Orlitzky et al 2003), social and environmental responsibility (e.g. Orlitzky et al. 2011) and innovation (e.g. Van Bommel 2011), among others.

On the other hand, the effects of corporate sustainability on firm's activities have also been investigated, with empirical research mainly focussed on its influence on firm's performance. Conflicting results have been obtained so far, with a number of authors arguing that there is a

negative effect of corporate sustainability on financial performance (López et al. 2007; Wagner and Blom 2011), others suggesting that there is no effect at all (Martin Curran and Moran 2007; Surroca et al. 2010) and some finding positive impacts (Matsumura et al. 2014; Stefan and Paul, 2008). It has also been argued that corporate sustainability increases firm's competitive advantage (Stead and Stead, 2013) and reputation (Alon and Vidovic 2015) and reduces its risk (Yilmaz and Flouris, 2010) and capital cost (Ng and Rezaee 2015). High environmental, social, and governance (ESG) awareness scores are also strongly associated with a reduction in firm credit risk (Brogi et al., 2022). Recognizing the importance of ESG performance, some firms "greenwash" their activities by, for example, make misleading ESG disclosures to be more attractive for external investors (Zhang, 2022). Bellandi (2023) argues that firms should calibrate financial growth targets based on where it stands from an ESG perspective, suggesting that financial decisions and ESG standards can be related. Regarding the impact of corporate or other sustainability indicators on firm's capital structure, there are only a few studies on this topic, and it remains unclear whether there is any relevant impact or not. Next, we review some of those papers and formulate some research hypotheses about the effect of sustainable development on zero leverage, all of which will be tested in the empirical part of the paper.

2.3 The effect of sustainable development on zero leverage: research hypotheses

Studies on the effects of sustainability on firm capital structure only recently caught the researchers' attention (*e.g.* El Ghoul et al. 2011; Chava 2014; Nguyen and Phan 2020). Some papers suggest that firms with environmental concerns incur higher costs of capital. For instance, Chava (2014) found that not only investors demand higher expected returns on stocks excluded by environmental screens, but also lenders charge higher interest rates to such firms. On contrary, lower capital costs are observed when there is an improved environmental risk management (Sharfman and Fernando, 2008). Moreover, firms with superior CSP adjust faster towards their target leverage ratios, a result that seems to indicate that a higher CSP helps to lower adjustment costs (Ho et al. 2021). Furthermore, firms transiting from carbon-intensive activities to more sustainable economies typically gain easier access to capital markets, leading to an increase in their financial leverage (Sharfman and Fernando, 2008). However, heavy carbon emiting firms, by facing higher carbon costs that increase their risk of suffering from financial distress, may decrease their debt values (Nguyen and Phan, 2020).

Previous literature focussed on firm-specific indicators of sustainability instead of more comprehensive metrics. Considering sustainable development at a macro level, two main arguments may be used regarding its potential effect on zero leverage. On the one hand, in a sustainability-oriented economy, firms have less incentives to engage in harmful environmentally

projects, such as those that are fossil-fuel based. Since some investments may be penalized or declared unsuitable by local governmental entities, investors and/or creditors, a consequence of a greater general sustainable development in some country or region may be the existence of lower debt levels and a greater propensity for zero-leverage policies. However, it is well known that promoting sustainability, creating wealth and qualified jobs and raising economic growth usually requires considerable investments. Under this perspective, a greater sustainable development level in a given region may indicate a greater need for firms to invest to adjust their activities and technologies to achieve the levels of sustainability demanded in the region where they are located (Sharfman and Fernando, 2008). Consequently, a greater debt level is expected to allow firms' investment to comply with environmental and human goals established by governmental entities and local institutions. Therefore, a greater sustainable development level is expected to decrease the likelihood of firms having zero leverage. Overall, since countries 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 sustainable development at macro level decreases the propensity for zero leverage.

Firm leverage results not only from the demand for debt but also requires the supply of debt (Dang, 2013). Therefore, firms may have zero debt due to their only decision or because lenders do not wish to grant them debt. Hence, it is important to investigate whether the potential negative effect of sustainability on zero leverage previously hypothesized is due to the influence of sustainable development on debt demand, debt supply, or both. To justify hypothesis H1, we used mainly demand side arguments. Thus, using similar reasons we may formulate the following hypothesis:

H2: A higher sustainable development level at macro level decreases the propensity for zero leverage by firms' own decision.

From a supply side perspective, we expect a greater willingness of creditors to grant debt to firms located in regions with a higher sustainable development level, where harmful environmentally projects tend to be rejected by the community. In such regions, lenders impose less stringent conditions to firms, requiring, *e.g.*, lower compensation, fewer collaterals, etc.. Given that firms are able to access debt in more favourable conditions, the following research hypothesis is postulated:

H3: A higher sustainable development level at macro level decreases the propensity for zero leverage due to an increased willingness of creditors to grant debt.

3. Data, empirical model and variables

3.1 Data

SMEs' accounting, financial and economic data were taken from the SABI (Analysis System of Iberian Balance Sheets) database that is produced by Bureau Van Dijk and jointly managed by this company and Informa, S.A.. Data were collected for the period between 2009 and 2019 for Portuguese unlisted SMEs. According to the European Commission (recommendation 2003/361/EC), a firm is classified as SME when it fulfils at least two of the following criteria: (i) less than 250 employees, (ii) assets under 43 million Euros, and (iii) an annual turnover under 50 million Euros. Based on the NACE classification (Classification of Economic Activities in the European Union), utilities and financial SMEs were excluded from our sample due to the regulations imposed to these firms that impact their capital structure. SMEs without an industry code were also excluded as well as any observations with missing data or obvious errors (*e.g.*, negative or zero sales and other negative values when they should be positive or null). To mitigate potential survivor bias, we allowed firms' entry and exit from the sample. After applying the described criteria, a final sample of 6,794 SMEs was obtained, corresponding to an unbalanced panel data with 64,721 firm-year observations.

3.2 Empirical model

Following the literature in the area, to investigate the effect of sustainability on zero leverage we need to use non-linear regression models accounting for the binary nature of the dependent variable, such as probit or logit specifications (Wooldridge, 2012). Indeed, the dependent variable in such studies holds the value of 1 if the firm presents no debt and is 0 otherwise, implying that linear regression models, which assume that the dependent variable can take any positive or negative value, should not be used in this context, since they would produce biased results (Hosmer *et al.*, 2013; Wooldridge, 2012). In this paper we use the probit model, which has the following form:

$$P(y = 1|x) = \Phi(\beta' x) \quad (1)$$

where y is the binary dependent variable, $\Phi(\cdot)$ is the cumulative normal distribution function, x represents the vector containing the explanatory variables defined in Table 1 (see the next sub-section) and β represents the vector of the variable coefficients. Unlike previous studies, we define

y as being 1 if the firm holds debt and 0 otherwise, in order to allow a direct comparison of the results of the probit model with those of the model described next.

The probit model only allows to establish which factors explain why a SME has debt or not, but does not provide any insights into what really affects the decision of the SME over whether to resort to debt or not and what affects the decision of the creditor over whether to grant credit or not (Morais et al., 2020). In fact, SME's leverage is the result of two separate decisions taken by two different decision-makers: the SME, which decides if it wants to resort to debt or not; and the creditor, which decides if it is willing to grant debt or not. Note that authors using univariate logit or probit models to examine firm's leverage assume that all firms' requests for debt are successful, which may not be true considering that creditors may not be willing to grant them the requested debt. Considering both decision processes, a bivariate probit model is better suited to model the probability of a firm holding zero debt or not. As we can observe only the joint outcome of both decisions, and not the result of each decision separately, a problem of partial observability arises. To deal with this issue, we use the so-called bivariate probit model with partial observability (Poirier, 1980), which allows to estimate the determinants of SMEs' decision to seek debt financing (demand side) and of creditors' lending decision (supply side). The application of the bivariate probit model with partial observability is relatively rare in empirical work, being recently used by Morais et al. (2020) in the analysis of zero leverage decisions.

We assume that SME demand for debt is represented by a dichotomous variable y_1, which is equal to the unit if the firm wants to resort to debt and is zero otherwise, while creditors supply for debt is defined by the dichotomous variable y_2, which takes on the value 1 if the creditor is willing to grant debt to the SME and is zero otherwise. Each dichotomous variable is determined by one latent variable, y_1^* or y_2^*, being one when the associated variable is positive. In turn, the latent variables are governed according to:

$$y_1^* = \beta_1' x_1 + \varepsilon_1 \quad (2)$$

$$y_2^* = \beta_2' x_2 + \varepsilon_2 \quad (3)$$

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 ("SMEs want to resort to debt", y_1 = 1, and "creditors want to grant debt", y_2= 1; "SMEs want to resort to debt", y_1 = 1, but "creditors do not want to grant debt", y_2 = 0; "SMEs do not want to resort to debt", y_1 = 0, but "creditors would grant debt", y_2 = 1; and "SMEs 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 SMEs 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.

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

$$\begin{aligned} Prob[y = 1] &= Prob[y_1^* > 0, y_2^* > 0] \\ &= Prob[\varepsilon_1 > -\beta_1' x_1, \varepsilon_2 > -\beta_2' x_2] \\ &= \Phi_2(\beta_1' x_1, \beta_2' x_2, \rho) \end{aligned} \tag{4}$$

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

$$Prob[y = 0] = 1 - Prob[y_1 = 1] \tag{5}$$

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:

$$L = \prod\nolimits_{y=1} [\Phi_2(\beta_1' x_1, \beta_2' x_2, \rho)] \prod\nolimits_{y=0} [1 - \Phi_2(\beta_1' x_1, \beta_2' x_2, \rho)] \tag{6}$$

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 ($x_1 \neq x_2$).

3.3 Variables

Table 1 provides a definition of the variables considered in our empirical analysis, namely the dependent, explanatory and control variables used in the main regression models. The dependent

variable, denoted by y in the previous sub-section, is *Leverage*, which takes the value of 1 if in a given year the book leverage ratio is greater than zero and is 0 otherwise. Following previous literature about SMEs capital structure, book leverage ratio is defined as the sum of the short- and long-term debt divided by total assets (Serrasqueiro et al., 2016).

[INSERT TABLE 1 ABOUT HERE]

The explanatory variable is the *Sustainability index*. The concept of sustainable development has been measured by a wide variety of indicators. Recently, an index emerged adding information on ecological efficiency, the SDI, was proposed by Hickel (2020). This index, which takes into account information provided by the Ecological Impact Index (EII) developed by the same author, has the advantage of surpassing the limitation of UNDP's HDI, which does not consider ecological issues. Therefore, following UNDP (2019) and Hickel (2020), we estimated the Regional SDI for the 25 Portuguese regions (NUTS III).

As stated by Hickel (2020), SDI can be calculated as follows:

$$SDI = \frac{HDI}{EII} \tag{7}$$

Following UNDP (2019), the HDI encompasses three dimensions (health, education and income) and requires the calculation of three indexes for each country or region: Life Expectancy Index, which is estimated through life expectancy at birth; Education Index, which is based on the mean of years of schooling for adults aged 25 years and more and the expected years of schooling for children of school entering age; and Income Index, which is measured through the Gross National Income (GNI) *per capita*. Because GNI is not available for Portuguese regions, in this paper we assess the income dimension through the Gross Domestic Product (GDP) *per capita*. The HDI is given by:

$$HDI = \sqrt[3]{(I_{Health} . I_{Education} . I_{Income})} \tag{8}$$

where I_{Health}, $I_{Education}$ and I_{Income} are normalized versions of the three indicators described above. For I_{Health} and I_{Income}, normalization is based on the formula

$$\frac{actual\ value - minimum\ boundary}{maximum\ boundary - minimum\ boundary} \tag{9}$$

Following UNDP (2019), the minimum and maximum boundaries for life expectancy at birth was set at 20 and 85 years, respectively. For GDP per capita, UNDP (2019) defines a minimum of 100€, a fair amount of unmeasured subsistence and non-market production in economies close to the minimum in terms of production and livelihood. The maximum is set in 75000€, a value above which Kahneman and Deaton (2010) have shown that there is virtually no gain in well-being. In the case of education, the following formula is used:

$$I_{education} = \frac{SSR + GER}{2} \tag{10}$$

where SSR is the (normalized) Secondary School Transition/Completion Rate, used as a proxy for mean years of schooling of adults, and GER is the (normalized) Gross Enrolment Rate in Secondary Education, used as a proxy for expected years of schooling of children as in Silva and Ferreira-Lopes (2014). For both SSR and GER the normalization was also based on (9), using their respective maximum and minimum sample values as boundaries.

Regarding EII, this index is given by:

$$EII = \begin{cases} 1 + \dfrac{e^{AO} - e^{1}}{e^{4} - e^{1}} & if \quad AO \leq 4 \\ AO - 2 & if \quad AO > 4 \end{cases} \tag{11}$$

where AO is the average overshoot, calculated as

$$AO = \sqrt{\left(\frac{MF}{boundary} \geq 1\right) \times \left(\frac{CO2}{boundary} \geq 1\right)} \tag{12}$$

with material footprint (MF) and $CO2$ emissions values being divided by their respective planetary boundaries: 6.8t per person and 1.74t per person/year, respectively. The boundary of 6.8t per person in MF was settled by Bringezu (2015) who divided the value of sustainable threshold per year by global population to achieve that value. The boundary of 1.74t per person/year of CO2 emissions follows the Intergovernmental Panel on Climate Change (IPCC) (2018).

To estimate SDI for the 25 Portuguese regions all the necessary data were collected from Statistics Portugal. Because MF and CO2 emissions are not available at a regional level, their total values for Portugal were weighted by the regional GDPs.

The econometric models used in this paper also include a set of standard firm-specific variables commonly found in the literature to be important for explaining SMEs capital structure, namely *Cash holdings*, as a proxy for SME's internal liquidity and financial flexibility (Myers, 1984;

Myers and Majluf, 1984); *Non-debt tax shields*, as a proxy for SME's tax shields from sources other than debt (DeAngelo and Masulis, 1980); *Growth*, as a proxy for SME's growth opportunities (Bigelli et al., 2014)[3]; *Profitability*, as a proxy for SME's ability to generate profits and internal funds from their operational activity (Myers, 1984; Myers and Majluf, 1984); *Earnings volatility*, as a proxy for SME's risk (Bigelli et al., 2014); *Tangibility*, as a proxy for SME's financial distress, bankruptcy costs and collateral to debt (Benmelech and Bergman, 2009; Myers, 1977); and *Size*, a proxy for SME's dimension, opacity and reputation on the market (Hadlock and Pierce, 2010). In order to control for non-observed specific effects, all models include industry dummy variables (based on the 1-digit NACE code).

A requirement of bivariate probit models with partial observability is that the vectors of explanatory variables for the demand and supply equations differ in some variables. To comply with this requirement, similar to Morais et al. (2020), 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*). In fact, *Cash holdings* is the most liquid asset possessed by a firm and a traditional measure of the firm's source for financial flexibility, while firm's *Non-debt tax shields* allows the firm to catch tax shields others than debt. Therefore, following previous literature, we consider and interpret these variables as influencing demand rather than supply of debt (Dang, 2013; Morais et al., 2020). On contrary, *Size* represents a traditional and accepted measure of access to external finance, generally interpreted as influencing the supply of debt (Bessler et al., 2013; Dang, 2013). Remaining variables (*Growth*, *Profitability*, *Earnings volatility*, *Tangibility* and the *Sustainability index*) may be indistinguishable used as possible factors influencing both demand and supply of debt.

4. Empirical evidence

4.1 Descriptive analysis

Table 2 presents the distribution of observations and debt-free firms by region.

[INSERT TABLE 2 ABOUT HERE]

[3] Given the absence of market value for most of SMEs, the most usual way to capture firm's growth opportunities such the market-to-book ratio is not possible to use. Alternatively, following traditional literature on SMEs financing decisions, we use sales growth as a proxy for growth opportunities (Bigelli and Sánchez-Vidal, 2012; Bigelli et al., 2014; Ramalho et al., 2018).

Almost 45% of the observations are relative to the metropolitan regions of Lisbon and Porto. Between 2009 and 2019 around 26% of firm-year observations are classified as having zero leverage. This percentage of SMEs with zero leverage is higher than the figures presented by studies focusing on large, listed firms (e.g. Dang, 2013 – 12% for UK; Strebulaev and Yang, 2013 – almost 11% of US firms; Ghoul et al., 2018 and Morais et al., 2021 – 13% and 11%, respectively, for their international samples). This difference between SMEs and large, listed firms is not surprising and corroborates the arguments of a considerable branch of literature that argues that smaller firms, by being more prone to face higher financial constraints (e.g. Hadlock and Pierce, 2010), are more likely to remain debt-free. Therefore, even in a financial system like the Portuguese one where prevails a bank-lending relationship, which motivates the development of close relationships between firms and banks, there is a great propensity for SMEs having zero leverage. Finally, note that debt-free SMEs are present in every one of the 25 identified regions.

Table 3 presents descriptive statistics for the model variables. As implied by the previous analysis, 73.97% of firm-year observations correspond to leveraged SMEs. Regarding the Sustainability Index, the minimum value of 0.720 and the maximum value of 0.826 suggest the presence of some regional heterogeneity, but with no outliers or cases of extreme underdevelopment or overdevelopment. On the other hand, the mean value of 0.789 indicates that Portugal is a country with a great focus on sustainable development goals, holding one of the best European SDI. Actually, despite Portugal being classified as a high-income country by World Bank (2021), its Sustainability Index is closer to countries with an upper middle income such as Hungary or Bulgaria. The Portuguese SDI contrasts with for example Spain (0.462 in 2019) and France (0.522 in 2019), countries that have currently a longer path to go in terms of sustainability.

[INSERT TABLE 3 ABOUT HERE]

Table 4 presents the Pearson pairwise correlation coefficients between the independent variables. The correlations between the variables are always below 0.4, which coupled with the variance inflation factor (VIF) lower than 5 in all cases suggests that multicollinearity is not a problem.

[INSERT TABLE 4 ABOUT HERE]

4.2 Econometric analysis

Table 5 presents the results that allows us to test the hypotheses regarding the effect of sustainability on zero leverage. Model (1) presents the estimates from a Probit regression and is used to test hypothesis H1, which regards the overall effect of sustainability on zero leverage. Model (2) uses the bivariate probit model with partial observability to analyse the determinants that affect firm's decisions to resort to debt (model 2a) and creditor's decisions to grant debt to the firm (model 2b), which allows testing hypotheses H2 and H3, respectively. For the three estimated equations, for each independent variable we report in the first row the estimated coefficient, in the second row (in parentheses) the result of a Wald test[4] for its individual statistical significance and in the third row (in brackets), considering that the value of the regression coefficients is not directly interpretable in nonlinear models, the estimated (average) partial effect. The reported partial effects measure the change in the probability of adopting a non-zero debt policy due to a one standard deviation change in a continuous explanatory variable (Wooldridge, 2012).

[INSERT TABLE 5 ABOUT HERE]

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 (2) are interrelated and suggesting that the application of univariate decision models to study zero leverage would not be a good option even if y_1 and y_2 were observed, since in such a case a bivariate probit model would allow efficiency gains over separate probit estimation of demand and supply equations (Meng and Schmidt, 1985).

Model (1) suggests that SMEs' zero leverage is in part explained by the existence of financial constraints and in part by financial flexibility reasons. On the one hand, traditional variables proxying for firms' financial constraints, such as firm size (*Size*) and asset tangibility (*Tangibility*) (Hadlock and Pierce, 2010; Benmelech and Bergman, 2009) present a negative and statistically significant effect on zero leverage. In particular, the increase of one standard deviation in *Size* or *Tangibility*, *ceteris paribus*, decreases SMEs propensity to have zero leverage by around 6.7 percentage points (pp) or 7.3pp, respectively. Given the higher propensity to have zero leverage for smaller and with lower asset tangibility SMEs, these results confirm that zero leverage seems to be the consequence of SME's lack of reputation in the credit market, which leads creditors to

[4] Despite binary models automatically accounting for heteroscedasticity by applying the maximum likelihood estimations (Wooldridge, 2012), the Wald test use robust standard errors that are adjusted for heteroscedasticity and clustered by firm to mitigate concerns about within-firm correlation.

impose severe conditions to concede funds to them (Bessler et al., 2013; Devos et al., 2012; Stiglitz and Weiss, 1981). On the other hand, typical variables used to proxy SMEs' desire to build financial flexibility, such as internal liquidity (*Cash holdings*) and ability to generate profits (Profitability) (Arslan-Ayaydin et al., 2014; Ferrando et al., 2017) present a positive and statistically significant effect on zero leverage. Specifically, the increase of one standard deviation in the level of cash holdings and profitability, *ceteris paribus*, increases, respectively, by around 45pp or 11pp the SME's likelihood of having zero leverage. These results support the idea that SMEs with high internal liquidity, represented by high cash holdings and profitability, have zero leverage to hold on debt capacity (Dang, 2013; Huang et al., 2017). This evidence let us conjecture that for a number of SMEs, zero leverage is actually a financing policy taken by their own decision, while for others it seems to be an imposition of the financial market.

Regarding the effect of sustainable development on zero leverage, the *Sustainability index* variable has a positive and statistically significant coefficient, implying that a SME located in a region with a greater sustainability level is less likely to have zero leverage. In particular, the increase of one standard deviation on the level of sustainable development, with the other variables remaining constant, increases by around 60pp the SMEs' likelihood of being levered. This result suggests that the higher the sustainability goals in a given region are, the greater the need for SMEs to invest and to adjust their activities and technologies to comply with the expected sustainable development for that region, which ultimately decreases the propensity towards zero leverage. Overall, our results seem to corroborate previous literature that, using firm-specific indicators of sustainability, show that more ecological firms are less prone to reduce their debt levels (Ginglinger and Moreau, 2019; Nguyen and Phan, 2020). Hence, based on these results, hypothesis H1 is validated.

Model (2) reveals some interesting results. In particular, it shows that not all variables influencing zero leverage affect in a similar way demand and supply of debt, showing that the findings of Morais et al. (2020) for large firms also apply to SMEs. For example, *Profitability* decreases the SMEs' propensity to resort to debt, but increases the creditor's willingness to grant debt to SMEs. Therefore, more profitable SMEs are more likely to have zero leverage by their own decision, but when they decide to resort to debt, they face a greater willingness from creditors to fund them. The overall positive effect of SMEs' profitability on zero leverage is thus determined by their own decision to remain debt-free rather than from an imposition of creditors

Regarding the impact of the level of sustainable development on debt decisions, the variable *Sustainability index* is statistically significant only in the supply equation. Therefore, contrary to our expectations, the overall negative effect of sustainability on zero leverage, found in model (1), is not motivated by SMEs' decision to resort to debt. Hence, hypothesis H2 is rejected. In

contrast, the positive effect of the sustainable development index on the supply of debt shows that a greater sustainable development level increases creditor's willingness to grant debt to SMEs. Thus, the reduced propensity for zero leverage due to sustainability issues is due to creditor-related reasons, validating hypothesis H3.

The interesting demand and supply side effects found for the sustainability development factor may be explained by the fact that transitions from carbon-intensive activities to more sustainable economies are usually motivated through investment programmes that facilitate the access to capital and debt financing (Ginglinger and Moreau, 2019; Nguyen and Phan, 2020; Sharfman and Fernando, 2008). In fact, the emergence of new private investment funds and European Union programmes destined for SMEs, in particular the availability of debt instruments allowing SMEs to fund innovation and social entrepreneurship projects at a cost under the usual market conditions, seems to be the most plausible reason why greater levels of sustainable development increase debt financing. Our results show that this increment is mainly due to actions of supply side institutions, which are successful in attracting SMEs to this kind of projects by offering them favourable conditions to invest, rather than the effect of a SME decision to increase its sustainability regardless of the market conditions. In the particular case of Portugal, the ambitious goals and commitment revealed by Portuguese institutions to become carbon neutral and to quickly increase the weight of renewable energies in the country clearly worked as a mechanism capable of attracting SMEs for financing at favourable terms.

The literature claims that SMEs tend to preserve their debt capacity to be able to invest when good growth opportunities arise (e.g. Dang, 2013; Huang et al., 2017). Given that sustainability development seems to decrease the SMEs' propensity to zero leverage mainly because they have access to funds that, without the mentioned programmes, would be too expensive for them, it is worthwhile to note that some SMEs may be getting unplanned funds, which may be applied in inefficient investments or even spent in day-to-day activities leading to inefficient production. Therefore, the granting of funds to SME's should be closely monitored by policymakers. Specifically, to access funds related to sustainable development, a proper investment project should not only be required but also closely monitored throughout implementation.

4.3 Robustness tests

To evaluate the robustness of the results produced by models (1) and (2) of Table 5, in this section we perform two sets of additional tests and analyses. First, to validate our initial findings about the overall impact of sustainable development on SMEs' zero leverage, we re-estimate model (1) by using alternative regression models for binary dependent variables. Second, to confirm that the level of sustainable development only impacts zero leverage through the supply equation, we

perform a sensitivity analysis based on model (2), considering alternative combinations of the variables that appear in the demand and supply equations. To save space in this section partial effects are not reported.

Table 6 presents the results obtained by estimating four alternative econometric models. The models in columns (1), (2) and (3) are estimated using, respectively, Random-effects Probit, Pooled Logit and Random-effects Logit methods.[5] Because a common threat to corporate empirical finance literature is that firm's decisions may be endogenously determined, in column (4) we present results from an instrumental variable approach, namely Newey's (1987) probit model with continuous endogenous covariates. We use this model to deal with possible reverse causality between debt and firm size, a relationship that can run from the dependent to the independent variable and often brings some concerns to researchers (Serrasqueiro and Nunes, 2011). In particular, zero-leverage SMEs may bypass value creating projects and decrease their investments by not levering up, which may contribute to present a lower size. Therefore, we assume *Size* as endogenous and use the first lag of the remaining SME-specific variables as instruments. The first-stage F statistic reported in Table 6 confirms the correlation between the selected instruments and *Size*. Overall, the results obtained for the new models show that our main findings are robust to the estimation method applied, with all variables keeping their sign and statistical significance as in model (1).

[INSERT TABLE 6 ABOUT HERE]

As discussed in section 3.3, for the bivariate probit model with partial observability to be identified, it is necessary that the variables presented in the demand and supply equations are not all the same. Although we have justified theoretically our variable selection for each equation, other authors can use other arguments that eventually can lead to different exclusion restrictions. Therefore, to test the robustness of the results produced by model (2) of Table 5, in Table 7 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 SME's outsiders to predict their bankruptcy (Ohlson, 1980), we add *Cash holdings* variable to the supply equation (Column 1); and, considering that SMEs size may also justify their demand for debt, since a greater level of assets means investment that perhaps had to

[5] Note that in the framework of non-linear models, fixed-effects estimators are only available for logit models and their use implies a huge loss of observations, because observations without within group variance are omitted from the analysis. For example, SMEs that are debt-free or leveraged in all years of the period of analysis would be dropped from the model. Therefore, we do not consider fixed-effects estimators in our study.

be performed through debt, we add *Size* variable to the demand equation (Column 2).[6] As Table 7 clearly shows, these modifications do not change our main findings.

[INSERT TABLE 7 ABOUT HERE]

5. Conclusion

This paper focused on the role played by the level of sustainable development on the explanation of the zero-leverage phenomenon. To perform this study, we used a sample of SMEs from 25 Portuguese regions, where about 26% of the observations between 2009 and 2019 correspond to zero-debt firms in a given year. A figure that is considerable higher than the percentage of zero-leverage large, listed firms found previously in Portugal and other European bank-based systems. Evidence that seems to corroborate the arguments of the financial constraint's perspective, i.e., smaller firms by facing higher information asymmetries are often rationed by lenders, which may increase the propensity for zero leverage on SMEs.

We found that the higher the regional level of sustainable development, the lower the propensity for SMEs to have zero leverage. This result suggests that the greater firm's investment in renewable energy, technology, qualified jobs, a good and safe workplace, and all that may increase firm's sustainability, which is necessary in regions with a higher sustainable development level in order to comply with human and environmental goals set by regional governmental institutions, is financed, at least partially, by debt. These results complement previous studies looking for the impact of firm-specific indicators of sustainability on firm's capital structure and are robust to the use of different econometric methods that account for the binary nature of the dependent variable, including instrumental variable models that allow for endogeneity in firm size.

A very interesting finding, which at first sight may seem to be in contraction with our previous conclusion, is that SMEs do not increase their demand for debt despite the greater investments that they need to make when located in regions with higher sustainable development levels. What happens is that they become more prone to use debt only because lenders are willing to grant them debt in more favourable conditions as the level of regional sustainable development increases. Indeed, the estimated bivariate probit models with partial observability showed that the negative effect of sustainable development on zero-leverage SMEs is entirely due to creditor behaviour.

[6] Despite not being reported, to save space, a more comprehensive sensitivity analysis was performed, where we dropped/added arbitrarily one variable at a time from/to the demand or the supply equations, considering multiple combinations of variable overlap and excluded/added variables. For example, we dropped one of the variables that appears on both demand and supply equations (*Growth*, *Profitability*, *Earnings volatility* and *Tangibility*) from one of the equations, keeping it only on the side that the finance literature offers more arguments to justify their effects on debt. In all the experiments performed, our main findings did not change. Results are available upon request.

Therefore, the lower (greater) propensity for firm's zero-leverage policies in the presence of a greater (lower) sustainable development level is not as much a consequence of an isolated financing decision taken by the SME as the result of a behavioural change from creditors that become more (less) willing to grant debt at favourable conditions to promote investment in sustainability.

Several theoretical implications can be derived from our study. First, for literature on financial conservatism we show that zero leverage is a financing policy also visible on SMEs. Second answering our research questions, we show that sustainable development can be used as a new determinant for firm's capital structure, mostly by determining the creditors willingness to concede funds for SMEs. Confirming that traditional firm-specific characteristics may not be sufficient to explain SME's capital structure, thus new theoretical approaches that understand sustainable development must be proposed to govern SMEs' capital structure. Third, extending UNDP (2019) and Hickel (2020) we adjust an aggregated index to measure sustainable development, in terms of human and ecological issues, for each Portuguese region. Beyond theoretical the paper has also methodological implications. The use of bivariate probit models with partial observability allows to show that some variables affect in opposite directions demand and supply of debt, while some others influence SMEs demand but not supply of debt, and vice-versa. Therefore, ours is the first study to consider that SMEs' capital structure is a bivariate process, where both SMEs and creditors take decisions about debt.

The paper has important implications also for practitioners. For managers, it reveals that it is easier for them to improve their firm's sustainability in regions with higher levels of sustainability development, since they are likely to benefit from a higher availability of debt at a lower cost in such regions. For governmental entities and private institutions supplying external funds to promote firm's sustainability, it shows that is crucial that such funds are lent at attractive rates to convince SMEs to use them.

Finally, our results support the idea that future research should continue to look for new, less conventional determinants for SME's capital structure, such as more specific indicators of ecological and human development, which will contribute to establish theories linking the society concerns and firm's capital structure. They also highlight the importance of future studies using the bivariate probit with partial observability model, or other similar models, to estimate the potential heterogeneous effects of zero-leverage determinants over debt demand and supply. So far, such models have been rarely applied in the capital structure literature.

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Table 1: Definition of the variables

This table defines the main variables used in the study.

Variable	Definition
Leverage	Dummy that equals 1 if a firm has leverage greater than zero in a given year and 0 otherwise
Sustainability index	Aggregated index obtained by estimating the Regional SDI for the 25 Portuguese regions (NUTS III) (Source: UNDP (2019), Hickel (2020) and Statistics Portugal).
Cash holdings	Ratio of cash and cash equivalents to book assets
Non-debt tax shields	Ratio of depreciation and amortizations to book assets
Growth	Sales in t minus sales in t–1 divided by sales in t–1
Profitability	Ratio of earnings before interests, taxes, and depreciation (EBITDA) to book assets
Earnings volatility	The absolute value of the difference between firm's annual % change in EBITDA and the (time-series) average of those changes.
Tangibility	Ratio of fixed assets to book assets
Size	Logarithm of total book assets

Table 2: Sample characteristics by region

This table summarizes the distribution of firms by region highlighting the percentage of observations corresponding to zero-leverage SMEs. First two columns report the number of observations (N. obs.) and the percentage of observations (%) for all firms. The last column presents the percentage of observations (% obs.) classified as debt-free SMEs. A firm is classified as a zero-leverage SME if it has no long-term and short-term debt in a given year.

Region	All firms		Debt-free firms
	N. obs.	%	% obs.
Alentejo Central	1,036	1.60	20.08
Alentejo Litoral	216	0.33	16.67
Algarve	1,227	1.90	19.48
Alto Alentejo	502	0.78	38.25
Alto Minho	1,319	2.04	23.12
Alto Tâmega	254	0.39	20.47
Área Metropolitana de Lisboa	15,007	23.19	34.38
Área Metropolitana do Porto	13,320	20.58	27.09
Ave	4,096	6.33	21.00
Baixo Alentejo	577	0.89	25.13
Beira Baixa	509	0.79	25.34
Beiras e Serra da Estrela	1,287	1.99	28.67
Cávado	4,021	6.21	22.68
Douro	1,039	1.61	24.64
Lezíria do Tejo	1,345	2.08	19.85
Médio Tejo	1,333	2.06	16.58
Oeste	2,059	3.18	22.92
Região Autónoma da Madeira	625	0.97	41.12
Região Autónoma dos Açores	245	0.38	21.22
Região de Aveiro	2,340	3.62	24.23
Região de Coimbra	2,238	3.46	20.78
Região de Leiria	3,765	5.82	19.95
Terras de Trás-os-Montes	674	1.04	18.25
Tâmega e Sousa	3,892	6.01	23.05
Viseu Dão Lafões	1,795	2.77	16.82
Total	64,721	100	26.03

Table 3: Descriptive statistics

Variable	N	mean	sd	min	median	max
Leverage	64,721	0.7397	0.4388	0.0000	1.0000	1.0000
Sustainability index	58,574	0.7897	0.0167	0.7203	0.7905	0.8258
Cash holdings	64,721	0.1609	0.1934	0.0000	0.0818	0.9900
Non-debt tax shields	64,721	0.0403	0.0448	0.0000	0.0276	0.9188
Growth	64,257	0.1842	3.5035	-0.9967	0.0223	484.0000
Profitability	64,721	0.0887	0.1322	-8.6948	0.0748	2.0255
Earnings volatility	63,865	1.6226	5.1290	0.0000	0.6525	588.5493
Tangibility	64,721	0.2784	0.2476	0.0000	0.2108	0.9998
Size	64,721	6.2161	1.1031	4.6052	6.0355	10.5166

Table 4: Pearson correlation matrix and Variance Inflation Factor (VIF)

This table shows the Pearson correlation coefficients between independent variables and, in the last column, the VIF. *** and ** indicates statistically significance at 1% and 5% level, respectively

Variables	Sustainability index	Cash holdings	Non-debt tax shields	Growth	Profitability	Earnings volatility	Tangibility	Size	VIF
Sustainability index	1.0000								1.01
Cash holdings	0.0449***	1.0000							1.19
Non-debt tax shields	-0.0746***	-0.0488***	1.0000						1.29
Growth	-0.0036	-0.0021	-0.0067	1.0000					1.01
Profitability	0.0211***	0.1945***	0.3210***	0.0297***	1.0000				1.18
Earnings volatility	-0.0120***	-0.0143***	-0.0334***	0.0671***	-0.0431***	1.0000			1.01
Tangibility	0.0019	-0.3151***	0.3257***	-0.0049	0.0229***	-0.0112***	1.0000		1.29
Size	0.0092**	-0.1788***	-0.0591***	0.0095**	-0.0163***	0.0093**	0.1869***	1.0000	1.08

Table 5: Regression results

This table presents results from the econometric models. Model 1 applies traditional univariate probit models while model 2 applies bivariate probit models with partial observability to analyse the determinants of both demand and supply of debt. *Leverage* is the dependent variable. For each independent variable, we report regression coefficients, robust z-statistics (in parentheses) and the (average) partial effect (in brackets).

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

	Univariate Probit (1)	Bivariate Probit (2)	
Explanatory variables		Demand (a)	Supply (b)
Sustainability index	2.087***	0.355	3.743***
	(3.54)	(0.57)	(5.32)
	[0.599]	[0.630]	
Cash holdings	-1.553***	-1.970***	
	(-24.10)	(-36.93)	
	[-0.446]	[-0.356]	
Non-debt tax shields	3.915***	11.371***	
	(11.26)	(15.78)	
	[0.124]	[0.099]	
Growth	0.001	0.005	-0.002
	(0.41)	(1.24)	(-1.50)
	[0.000]	[0.001]	
Profitability	-0.379***	-1.263***	0.197*
	(-3.72)	(-9.42)	(1.85)
	[-0.109]	[-0.198]	
Earnings volatility	-0.007***	-0.004**	-0.007***
	(-3.90)	(-2.28)	(-2.80)
	[-0.002]	[-0.002]	
Tangibility	0.254***	0.230**	0.058
	(4.07)	(2.06)	(0.51)
	[0.073]	[0.050]	
Size	0.232***		0.585***
	(15.97)		(30.31)
	[0.067]		[0.088]
Constant	2.354***	-0.772	-5.203***
	(4.99)	(1.54)	(-9.10)
Industry Dummies	Yes	Yes	
Observations	57.773	57.773	
Wald test for joint statistical significance	1496.83***	4828.03***	
ρ		8.154***	
Log pseudolikelihood	-29474.76	-29096.057	

Table 6: Robustness tests using alternative econometric methods

Table 6 re-estimates model (1) presented on Table 5, using alternative econometric methods: Column (1) uses Random-effects Probit; Column (2) Pooled Logit; Column (3) Random-effects Logit methods; and Column (4) uses a Probit model with continuous endogenous covariates as regression method. *ZL* is the dependent variable. For each independent variable we report the regression coefficients and robust z-statistics (in brackets).

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

Independent variables	Random-effects Probit (1)	Pooled Logit (2)	Random-effects Logit (3)	Instrumental Variable Probit (4)
Sustainability index	2.643***	3.735***	4.670***	1.554***
	(2.83)	(3.70)	(2.75)	(4.04)
Cash holdings	-1.345***	-2.543***	-2.377***	-1.610***
	(-14.94)	(-23.29)	(-14.78)	(-46.65)
Non-debt tax shields	3.613***	7.617***	7.063***	4.254***
	(8.03)	(11.60)	(8.38)	(23.12)
Growth	-0.0001	0.001	-0.0001	0.003
	(-0.03)	(0.52)	(-0.02)	(0.95)
Profitability	-0.511***	-0.798***	-1.076***	-0.326***
	(-3.43)	(-5.12)	(-4.42)	(-6.51)
Earnings volatility	-0.003**	-0.013***	-0.006**	-0.007***
	(-2.24)	(-3.56)	(-2.39)	(-6.28)
Tangibility	0.722***	0.434***	1.3077***	0.226***
	(7.70)	(3.89)	(7.70)	(7.50)
Size	0.603***	0.411***	1.093***	0.222***
	(23.37)	(15.81)	(23.40)	(33.16)
Constant	-4.623***	-4.309***	-8.330***	-1.856***
	(-6.15)	(-5.31)	(-6.08)	(-6.06)
Industry dummies	Yes	Yes	Yes	Yes
Observations	57.773	57.773	57.773	49.899
First-stage F statistics				
- Size				71315.68***
Wald test for joint statistically significance	2133.39***	1416.87***	2045.07***	5360.36***
Log pseudolikelihood	-20674.04	-29457.201	-20647.057	

Table 7: Alternative variables for the demand and supply equations of the bivariate probit model

This table presents robustness tests using alternative specifications of model (2) of Table 5. Column (1) adds *Cash holdings* to the supply equation, considering it simultaneously on both equations. Column (2) adds *Size* to the demand equation, considering it simultaneously on the two equations. *Leverage* is the dependent variable. For each independent variable, we report regression coefficients and robust z-statistics (in parentheses).

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

	Column (1)		Column (2)	
Independent variables	Demand (a)	Supply (a)	Demand (b)	Supply (b)
Sustainability index	0.8145	2.822***	0.359	3.747***
	(0.95)	(4.77)	(0.57)	(5.32)
Cash holdings	-1.445***	-0.373	-1.969***	
	(-7.00)	(-0.96)	(-35.85)	
Non-debt tax shields	25.057***		11.363***	
	(3.27)		(15.29)	
Growth	0.007	-0.001	0.005	-0.002
	(1.34)	(-0.63)	(1.24)	(-1.50)
Profitability	-2.093***	0.259***	-1.262***	0.197*
	(-7.62)	(2.72)	(-9.22)	(1.85)
Earnings volatility	-0.0001	-0.006**	-0.004**	-0.007***
	(-0.02)	(2.35)	(-2.28)	(-2.80)
Tangibility	0.148	0.112	0.230**	0.057
	(0.99)	(1.29)	(2.05)	(0.49)
Size		0.395***	0.001	0.586***
		(6.12)	(0.07)	(30.59)
Constant	0.321	-3.485***	0.763	-5.206***
	(0.641)	(-5.18)	(1.46)	(-9.11)
Industry Dummies	Yes		Yes	
Observations	57,773		57,773	
Wald test for joint statistically significance	3954.13***		5086.57***	
ρ	5.760**		9.162***	
Log pseudolikelihood	-29010.295		-29096.056	