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HOW MUCH DO THE TAX BENEFITS OF DEBT ADD TO FIRM VALUE? EVIDENCE FROM SPANISH LISTED FIRMS*

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The potentially important impact of taxation on corporate financing decisions is widely recognized despite the fact that the empirical evidence is far from conclusive. In this study, we assess the debt tax benefits of Spanish listed firms throughout the period 2007-2013. Specifically, using a simulation approach, we found the capitalized value of gross interest deductions amounts to approximately 6.4% of firms' market value, while the net debt benefit (of personal taxes) is estimated at 2.1%, in contrast to the traditional 11.4% (i.e. marginal tax rate times debt). Conversely, the panel data regression approach reveals a 13.6% (34.2%) debt tax shield in terms of firm (debt) value. This evidence supports the view that taxes influence corporate decision-making and that debt makes a reasonable contribution to firm value.

Key words: capital structure, corporate taxes, marginal tax rate, debt tax shield.

JEL classification: G32, H25.

The tax benefits of debt are the tax savings that result from deducting interest from taxable earnings. By deducting one euro of interest, a firm reduces its tax liability by the marginal corporate tax rate. Since Modigliani and Miller (1963) hypothesized that the tax benefits of debt increase a firm's value, the implications of the debt tax shield on firm valuation and capital structure has attracted attention as well as debate among the financial community. Nowadays, the assessment of the debt tax shield is of ever greater importance, due to circumstances such as the

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large increase in corporate borrowing, the worldwide generalized trend in tax codes changes, as well as the growing importance of valuation in corporate transactions such as mergers and acquisitions (M&As), venture capital, and so on [Cooper and Nyborg (2007)]. But how much does firm value increase by? And, accordingly, how valuable are tax shields? Despite being key questions in corporate finance, there are surprisingly few settled answers. Theory provides a range of predictions while the existing empirical evidence is mixed and sufficiently puzzling that Fama (2011) argues that a major unresolved challenge in corporate finance is to produce evidence on how taxes affect market values and thus optimal financing decisions. As Graham (2008) states, the evidence to support the idea that tax benefits add to firm value is ambiguous because non-tax explanations or econometric issues might cloud interpretation. In this sense, additional research on the tax benefits of debt would be helpful in terms of clarifying or confirming the interpretation of existing regression analysis.

In the spirit of contributing to this academic debate, the main purpose of this study is to estimate the value of the debt tax shield for Spanish listed companies in the period 2007-2013. To attain this goal, we follow two approaches, namely simulation and regression, which rely upon Graham (2000) and Kemsley and Nissim (2002) research.

Most of the previous empirical studies on the value of the debt tax shield have focused on U.S. firms, and the literature has produced a wide range of estimates. A summary of key references regarding the tax shield assessment is shown in Table 1.

The three main approaches to assess the impact of debt tax shield are based on panel / cross-section regressions, event studies and simulation procedures [Graham (2003, 2008, 2013), and Hanlon and Heitzman (2010)]. Firstly, regression studies provide estimates that vary from debt offering no value [Fama and French (1998)], to debt tax shields having a value of 5.5% of firm value [Korteweg (2010)], to 10% (40%) of firm (debt) value [Kemsley and Nissim (2002)] so that there is almost no room for personal taxes and/or debt costs to have an effect [Graham (2008, 2013)]. Secondly, event studies that examine price reactions around changes in debt policy often find a significant value to debt [Masulis (1983), and Kaplan (1989)] but face an identification challenge when controlling for information effects that coincide with the tax event. Other event studies that are free from information effects are often limited to small samples that may be not representative [Engel, Erikson and Maydew (1999)]. Thirdly, some of the more recent and influential estimates of the value of debt tax shields are based on accounting data and simulation methods. In this respect, Graham (2000) found that the gross tax benefit of debt is worth 9.7% of firm value. Van Binsbergen, Graham and Yang (2010) updated Graham (2000) estimates and found that the gross tax benefits of debt averaged about 10.4% of firm value. Graham (2000) is one of the few papers that attempts to concurrently differentiate gross debt tax shields (i.e. without including personal taxes) and net debt tax shields (i.e. including personal taxes); he finds that the value of debt tax shields is as low as 4.3% of firm value after personal taxes.

In countries other than the U.S., Jiang (2004) found significant debt tax shelters for Japanese firms (41% of debt value) and U.K. firms (63% of debt value), but not for either Australian firms or Canadian firms. Conversely, Jiang (2004) found a significantly negative debt tax shelter value of 22% of debt value for German firms and explains this shocking result as due to the relative magnitude of the corporate tax rate and personal

Table 1: EMPIRICAL EVIDENCE ON THE VALUE OF THE DEBT TAX SHIELD

Authors	Gross Debt Tax Benefit (excluding personal taxes)	Net Debt Tax Benefit (including personal taxes)	Country
Masulis (1983) (a)	40% of debt value		U.S.A.
Kaplan (1989) (b)		5.4% – 53.1% of equity value	U.S.A.
Engel *et al.* (1999) (c)	28% of issue size		U.S.A.
Graham (2000)	9.7% of firm value	4.3% of firm value	U.S.A.
Kemsley and Nissim (2002)		10% (40%) of firm (debt) value	U.S.A.
Jiang (2004)		41% of debt value	Japan
Jiang (2004) (d)		64% of debt value	U.K.
Jiang (2004)		-22% of debt value	Germany
Jiang (2004) (e)		11% of debt value	U.S.A.
Korteweg (2010)		5.5% of firm value	U.S.A.
Van Binsbergen *et al.* (2010) (f)	10.4% of asset value		U.S.A.
Ko and Yon (2011) (g)	5.2% (5.5%) of firm value	1.9% (2.0%) of firm value	Korea
Sarkar (2014)	0.6% - 7.2% of equity value		U.S.A.
Doidge and Dyck (2015)	4.6% of firm value		Canada

(a) He regressed stock returns on the change in debt in exchange offers, and found a debt coefficient statistically indistinguishable from the top statutory corporate tax rate at that time; (b) the lower estimates assume that leveraged buyout debt is repaid in eight years and that personal taxes offset the benefit of corporate tax deductions; conversely, the higher estimates assume that leveraged buyout debt is permanent and that personal taxes provide no offset; (c) they examined a capital structure transaction involving two securities that were nearly identical except for their tax treatment, namely trust preferred stock and traditional preferred stock; (d) this relatively large estimated value of the debt tax shield corresponds to the 1993-1999 period, excluding the years 1997-1999 when the U.K. government adopted a series of reforms of tax credits and corporation tax payments, at which time the estimate for debt tax shield diminishes to 17% of debt value; (e) this data corresponds to the period 1993-1999 when Jiang (2004) carried out a cross-country comparison; nevertheless, he also found a 34% (40%) debt tax shelter value for U.S. industrial firms (non-regulated industrial firms) between 1965 and 1999; (f) they simulated tax benefit functions using the Graham (2000) approach; (g) the estimates are based on the Graham (2000) [Blouin, Core and Guay (2010)] simulation approach.

Source: Own elaboration.

tax rates on interest income, dividend income and capital gains in the German tax system. Ko and Yon (2011) conducted an analysis using a data panel on Korean firms and found a gross (net) debt benefit of 5.2% (1.9%) of firm value. In addition, Doidge and Dyck (2015) obtained a figure of 4.6% of firm value for Canadian firms. To the best of our knowledge, however, to date no empirical study on this subject has been carried out in Spain and only one has in Europe [the abovementioned Jiang (2004)].

Our study contributes to the previous literature obtaining new results for the estimation of the value of tax shields under the simulation and the regression approaches. Furthermore, we provide new empirical evidence within a European context, and for the first time for Spain.

The findings in our research for Spanish listed firms clearly show that there is an evident fiscal advantage to using debt financing, though the results are sensitive to the valuation approach chosen. The simulation approach provides a debt tax shield estimate more reasonable compared with the one obtained by the regression approach, and clearly lower than the upper bound of the traditional tax shield value. In particular, we find the gross tax benefit of debt equals 6.4% of firm value, meaning that the median firm at its leverage ratio is worth 6.4% more than the same firm with no debt in its capital structure. After accounting for reductions for personal taxes, we find that the net tax benefit of debt under the marginal benefit curve is 2.1% of firm value. Conversely, under the regression approach that does not allow differentiating between excluding and including personal taxes, the net debt tax shield reaches 13.6% of firm value.

The remainder of the paper is organized as follows. In the next section, we discuss the simulation approach based on the procedure in Graham (2000), while Section 2 deals with the regression approach based on Kemsley and Nissim (2002) proposals. Section 3 presents the data for the study and the descriptive analysis regarding the key variables. The empirical results are discussed in Section 4. Several robustness tests are presented in Section 5 and the final section provides some concluding remarks.

1. Simulation approach

1.1. The value of the debt tax benefit

The value of the debt tax shield is the present value of the tax savings from interest expense [Cooper and Nyborg (2006)]. In a Modigliani and Miller (1963) context, that is with perpetual debt and assuming interest tax shields are completely utilized, the capitalized tax benefit of debt can be simplified to the marginal corporate tax rate times the amount of debt. That is,

$$\frac{t_c \cdot r_d \cdot D}{r_d} \qquad [1]$$

where t_c is the marginal corporate tax rate, r_d is the interest rate on debt and D is the amount of debt.

As pointed out by Miller (1977), an important reservation about the Modigliani and Miller (1963) approach is that it does not consider personal income taxes. With personal taxes, the capitalized tax benefit of debt can be computed as follows,

$$\frac{\left[\left(1-t_p\right)-\left(1-t_c\right)\cdot\left(1-t_e\right)\right]\cdot r_d\cdot D}{\left(1-t_p\right)\cdot r_d} \qquad [2]$$

where t_p and t_e are both marginal personal tax rates that are applied to interest and equity income, respectively. Note that if both t_p and t_e are zero (or they are equal), then Equation [2] is simplified to the Modigliani and Miller (1963) set up (i.e. Equation [1]).

Equity income includes both dividends and capital gains. The personal marginal tax rates on these income streams may differ, and capital gains taxes could be deferred by investors not realizing the gains. Therefore, the marginal personal equity tax rate should be a mixture of dividends and capital gains tax rates. Following Gordon and Mackie-Mason (1990), the personal equity tax rate might be calculated as:

$$t_e = d\cdot t_p + (1-d)\cdot t_p\cdot\gamma \qquad [3]$$

where d is the dividend pay-out ratio and is an adjustment factor that takes into account the possible deferral of taxes on capital gains and the time value of money of the capitalized taxes; the value of the adjustment factor is stablished at 0.25 following Gordon and Mackie-Mason (1990), Graham (1999, 2000), and Green and Hollifield (2003).

Graham (2000, 2001) simulates interest deduction benefit functions and uses them to estimate the tax-reducing value of each incremental euro of interest expense. The tax benefits of debt are estimated by integrating the area under the tax benefit function, which relates marginal tax rates to interest deductions. The process of establishing the tax benefit function follows different stages. First, $MTRit^{0\%}$ is estimated for firm i in year t[1]. This is the marginal tax rate based on taxable income assuming the firm has zero debt and therefore no interest deductions. Second, new marginal tax rates are estimated with different percentages (p%) of the actual interests paid: $MTRit^{p\%}$, where p% ranges from 20% to 800%[2]. Third, the firm's tax benefit function is derived by connecting the previous estimated marginal tax rates with each level of interest.

Marginal tax benefits of debt decline as more debt is added because the probability increases with each incremental euro of interest that it will not be fully exploited in every potential scenario. Figure 1 depicts an example of the tax benefit function in different years for a representative firm of our sample, namely, Meliá Hotels International, S.A. (MEL).

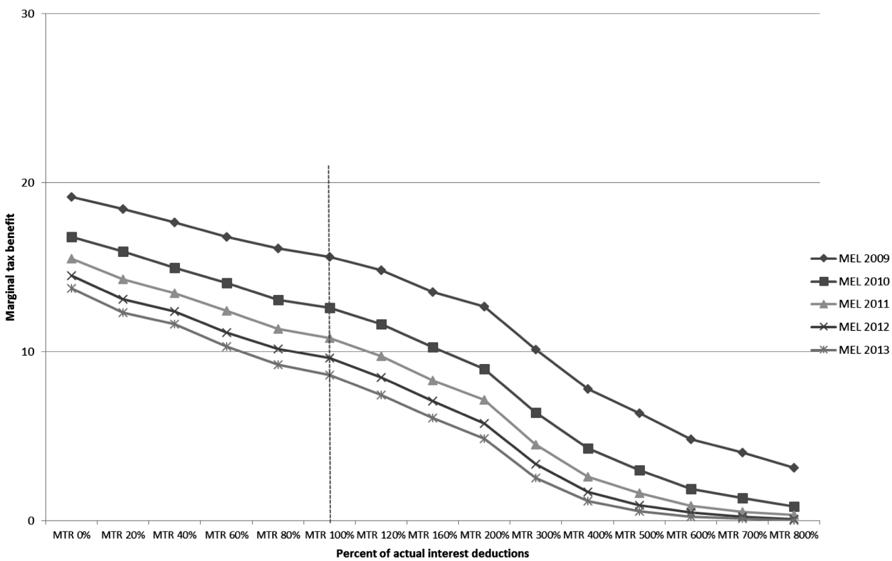
The integration of the area under the tax benefit curve up to the level of actual interest expense reveals the debt tax benefit. In order to determine the firm's annual debt tax shield, for each year and for each firm we measure the area under the firm's tax benefit function up to 100% of annual interest multiplied by actual interest payments. We then estimate the capitalized tax benefits of debt assuming that the debt

(1) As in Graham, Lemmon and Schallheim (1998), marginal tax rates are estimated with pre-financing earnings and assuming that EBIT follows a pseudo-random walk process with a drift [see Clemente-Almendros and Sogorb-Mira (2016) for details].

(2) The exact numbers are 20%, 40%, 60%, 80%, 100%, 120%, 160%, 200%, 300%, 400%, 500% 600%, 700% and 800%.

tax shield computed at the end of year t will be maintained over the following years. As noted by Graham (2000), the tax benefit function is forward-looking and it requires assumptions about future income and interest deductions. We follow Graham (2000) and assume that firms maintain an interest coverage ratio constant in profitable / unprofitable years. The interest rate on debt for each firm, computed as the quotient between interest expenses and debt, is used as the discount rate. Finally, we calculate firm value as the sum of market value of equity and book value of financial debt.

Figure 1: Tax benefit function for Meliá hotels international, s.a. (MEL)



Source: Own elaboration.

1.2. The kink

Graham (2000) offers an empirical measure of companies' underutilization of debt and calls this measure the kink. It is defined as the maximum amount of interest deductions a firm could charge before facing any decline in the marginal tax benefit of debt relative to the actual interest charge the firm incurred given its current debt. Graham (2000) calls it the kink because it is the point at which the next euro paid in interest changes from a flat to a decreasing marginal tax benefit function. We fix the magnitude of the decline in the tax benefit curve at 25 basis points[3]. The ex-

(3) Graham (2000), Blouin *et al.* (2010) and Van Binsbergen *et al.* (2010) define the kink as the first interest increment at which the firm has a decline in its marginal tax rate of at least 50 basis points. We decided to lower this required level in order to capture more variability in our data.

tent to which debt is used to minimize tax payments determines the classification of firms' debt policy as either aggressive or conservative. Accordingly, an aggressive firm with positive earnings before interest and taxes would issue just enough debt to ensure that earnings after interest but before taxes are zero, whereas a conservative firm would issue less debt and therefore face positive taxes. As a result, a firm's debt financing policy could be considered as aggressive (conservative) when its kink is smaller (larger) than one. This characterization is based on the tax benefit of debt without considering its potential costs. Therefore, an aggressive-conservative debt policy in this context does not necessarily imply sub-optimality.

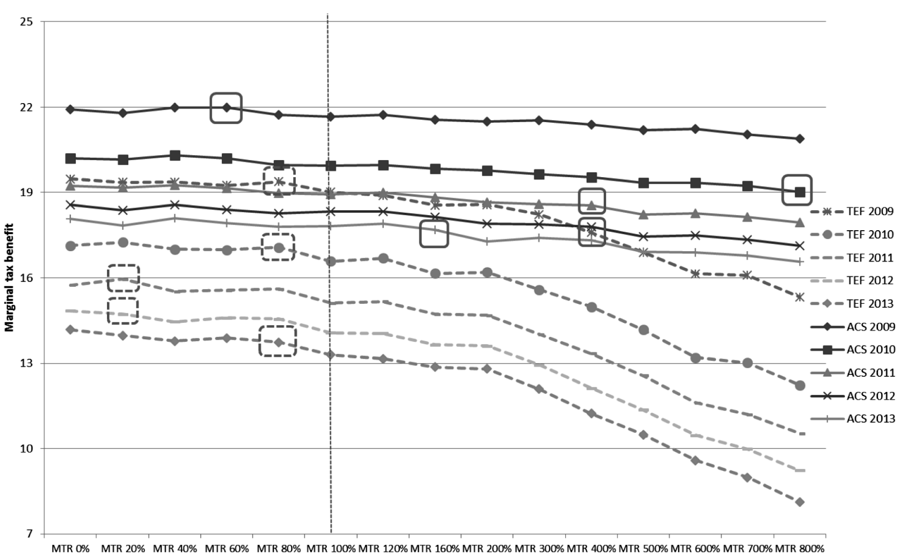
The kink could be computed as a ratio where the numerator is the maximum interest that could be deducted for tax purposes before expected marginal benefits begin to decline, and the denominator is actual interest incurred [Caskey, Hughes and Liu (2012)]:

$$\text{Kink}=\frac{\text{Target Interest}}{\text{Actual Interest}} \qquad [4]$$

where Target Interest is the point at which the firm's tax benefit function starts to slope down as the firm uses more debt.

Figure 2 shows the tax benefit functions of two representative firms of our sample, namely, Telefónica, S.A. (TEF) and Actividades de Construcción y Servicios, S.A. (ACS).

Figure 2: The kink for Telefónica, s.a. (TEF) and Actividades de construcción y servicios, s.a. (ACS)



Source: Own elaboration.

A tax benefit function is relatively flat when interest is moderately small, but declines after a certain point, being this point the kink. As depicted in Figure 2, for example in year 2013, although the tax benefit curve of TEF starts to decline at 80% actual interest (i.e. kink of 0.8), the ACS curve kinks at 160% (i.e. kink of 1.6). In this case, the kink of TEF denotes that the marginal tax benefits resulting from the firm's incremental interest are less than what the firm has received from its current interest. For ACS on the other hand, even when interest payments multiply by 1.6 times, the firm can still enjoy tax benefits at the marginal tax rate. ACS will remain at the flat part of its tax benefit curve even if it increases debt to 160% of the current level.

Underleveraged firms forgo significant tax savings that would have been available if they had increased their debt levels to their kink. Nevertheless, Graham (2000) maintains that firms with large kinks should remain on the flat part of their tax benefit functions, even when their income declines, in order to be called "conservative" in terms of their debt usage. Besides, if two "conservative" firms have the same kink but one has more volatile earnings than the other does, then the firm with more volatile earnings has a less conservative policy since the probability of entering the downward sloping part of the tax benefit function (aggressive debt policy) in the future, is higher for this firm than for the firm with lower volatility. Accordingly, it is necessary to calculate a new measure of the kink to account for this fact. Following Graham (2000), this complementary kink measure called the standardized kink, will reflect the length of the flat part of the tax benefit function per unit of income volatility. Specifically, we compute this standardized measure of the kink as,

$$\text{Standardized Kink}=\frac{\text{Interest Expense at the Kink}}{\text{Standard Deviation of EBIT}} \qquad [5]$$

2. Regression approach

2.1. Forward specification

Considering corporate taxes, Modigliani and Miller (1963) established the valuation of a leveraged firm as follows,

$$V_L = V_U + t_c \cdot D \qquad [6]$$

where V_L is the market value of the leveraged firm, V_U is the market value of the unleveraged firm, t_c is the corporate marginal tax rate and D is the debt level.

If we also take into account personal taxes, Equation [6] will still be valid; although corporate marginal tax rate is substituted by a mixture of corporate and personal tax rates as discussed in Miller (1977). That is,

$$V_L = V_U + \left[1 - \frac{(1-t_c)\cdot(1-t_e)}{(1-t_p)}\right]\cdot D \qquad [6\ \text{bis}]$$

where t_e and t_p are both marginal personal tax rates that are applied to equity and interest income, respectively.

Modigliani and Miller (1963) proxied V_U with the present value of the expected operating income,

$$V_U = \frac{E(FOI)}{\rho} = \frac{E(EBIT \cdot (1 - t_c))}{\rho} \qquad [7]$$

where E() is the expected operator, FOI is future operating income, EBIT is earnings before interest and taxes[4], and ρ is the capitalization rate.

Combining Equations [6] and [7], we derive:

$$V_L = \frac{E(FOI)}{\rho} + t_c \cdot D \qquad [8]$$

And from Equation [8], the forward model specification is developed:

$$V_{L_{it}} = \beta_0 + \beta_1 \cdot \frac{E(FOI)_{it}}{\rho_{it}} + \beta_2 \cdot D_{it} + \eta_i + \varepsilon_{it} \qquad [9]$$

where β_2 represents the estimated value for the debt tax shield; η_i absorbs firm-specific effects, and ε_{it} is the disturbance term. As E(FOI) and r are not observable, we need proxy variables for them.

Deflating the intercept and all explanatory variables by total assets in order to address the issue of heteroskedasticity[5], and considering the capitalization rate (ρ) as a constant, the empirical specification of Equation [9] is now as follows:

$$\frac{V_{L_{it}}}{\text{Total Assets}_{it}} = \frac{\beta_0}{\text{Total Assets}_{it}} + \beta_1 \cdot \frac{E(FOI)_{it}}{\text{Total Assets}_{it}} + \beta_2 \cdot \frac{D_{it}}{\text{Total Assets}_{it}} + \eta_i + \varepsilon_{it} \qquad [10]$$

Empirical estimation of Equation [10] entails certain assumptions about expected future earnings (E(FOI)). Specifically, we proxy E(FOI) as EBIT times one minus marginal corporate tax rate.

Miller and Modigliani (1966) used cross-sectional two-stage least squares regressions and estimated a positive and significant market value for the debt tax shield for U.S. companies within the electric utility industry. Taking a different approach, Fama and French (1998) suggested estimating Equation [6] by regressing V_L on debt interest, dividends, and a proxy of V_U. Specifically, they measured V_L as the excess of market value over book assets, and proxied V_U with several control variables such

(4) The use of EBIT as the basis of valuation is strictly valid only when the underlying real assets are assumed to be perpetual. In such a case, EBIT and cash flow are one and the same [Modigliani and Miller (1963)].

(5) Fama and French (1998) deflated all the explanatory variables but not the intercept; this choice implies that all regression variables in Equation [10] are converted into ratios. The inverse of the deflator is included to mitigate scale effects [Easton and Sommers (2003)]; including a scaled intercept avoids the correlation between the explanatory and the independent variables due to variation in the scaling variable, in this case, total assets [Roychowdhury (2006)]. In our research, FOI may be correlated with debt, and both increase in size.

as current earnings, assets and R&D expenses, as well as future changes in these same variables (with all the regression variables deflated by total assets). A positive coefficient on the interest explanatory variable would be evidence of positive tax benefits of debt. Contrary to expectations, Fama and French (1998) found in their regressions either non-significant or negative estimated coefficients on interest. As a result, they interpreted this evidence as being inconsistent with debt tax benefits having a first-order effect on firm value. They attributed this contradictory evidence to a mismeasurement for expected future profitability and imperfections regarding risk and growth factors that r controls for.

The forward specification model drawn from Equation [10] has two drawbacks. First, debt is likely to be correlated with the value of operations (i.e. E(FOI) and ρ) along several non-tax dimensions, and therefore β_2 would be biased. Second, using the market value of the firm as the dependent variable instead of the market-to-book ratio might preclude considering risk issues related to ρ and expectations about growth in operating income. Thus, in order to circumvent these measurement problems, Kemsley and Nissim (2002) suggest an alternative to the forward specification, called the reverse specification.

2.2. *Reverse specification*

The reverse specification proposal switches the variables in Equation [6], moving V_U to the left-hand side and V_L to the right-hand side of the equation. The resulting relation is:

$$V_U = V_L - \text{coefficient} \cdot D \qquad [11]$$

Now, adapting Equation [8] to this switch,

$$E(FOI) = \rho \cdot (V_L - t_c \cdot D) \qquad [12]$$

Finally, from Equation [12] we derive the following specification model:

$$E(FOI)_{it} = \beta_0 + \beta_1 \cdot \rho_{it} \cdot (V_{L_{it}} - \beta_2 \cdot D_{it}) + \eta_i + \varepsilon_{it} \qquad [13]$$

where β_2 represents the estimated value for the debt tax shield; η_i absorbs firm-specific effects, and ε_{it} is the disturbance term.

The reverse specification model of Equation [13] overcomes the two limitations of the forward model. First, placing E(FOI) on the left-hand side of [13] transfers the measurement error in the proxy for E(FOI) to the dependent variable, allowing the regression residual to capture the random component of the error. Second, moving V_L to the right-hand side of Equation [13] controls for all market information concerning expected operating earnings and ρ.

Equation [13] shows a non-linear relationship among the parameters, and there are essentially two ways to estimate it: on the one hand, by using a linear transformation of the equation and, on the other hand, by using non-linear least squares [Hoaglin (2003), and McGuire, Neuman, Olson and Omer (2014)]. As far as the former procedure is concerned, if we consider ρ as a constant and deflate the intercept and all the explanatory variables by total assets, we can set up the following linear specification of Equation [13],

$$\frac{E(FOI)_{it}}{\text{Total Assets}_{it}} = \frac{\beta_0}{\text{Total Assets}_{it}} + \beta_1 \cdot \frac{V_{Lit}}{\text{Total Assets}_{it}} + \beta_2 \cdot \frac{D_{it}}{\text{Total Assets}_{it}} + \eta_i + \varepsilon_{it} \quad [14]$$

In this method, the estimate for the debt tax shield is calculated as the quotient between $-\beta_2$ and β_1. Using market value as an explanatory variable allows us to control for ρ, although we need to assume market efficiency [Penman (1996)]. On the other hand, we need a proxy for expected future earnings and, as in the forward specification, we use EBIT multiplied by one minus the marginal corporate tax rate.

The second way of estimating Equation [13] is directly by non-linear least squares. Now, instead of considering ρ as a constant, we express the capitalization rate as a linear function of a vector X, with several observable instruments, and a which is associated with risk and growth. To control for any direct relation between E(FOI) and the abovementioned variables, we also include these variables in additive form g' X in the regression [Kemsley and Nissim (2002)]. Finally, to control for industry effects, we replace the intercept in Equation [13] with industry dummies. As a result, we come up with the next empirical specification:

$$E(FOI)_{it} = \alpha' \cdot X \cdot \left(V_{Lit} - \beta \cdot D_{it}\right) + \sum_{i=1}^{8} \gamma_{1i} \cdot \text{Dummy\_Industry}_i + \gamma' \cdot X + \varepsilon_{it} \quad [15]$$

Specifically, in vector X we use four variables: the industry median beta of operations (β_U) [Miller and Modigliani (1966)]; the market-to-book ratio of operations or the quotient between the market value of operations ($V_L - \beta$ D) and net operating assets (NOA) [Fama and French (1992), and Penman (1996)]; size measured as the natural logarithm of NOA; and the natural logarithm of operating liabilities (OL) [Hoaglin (2003), and McGuire *et al.* (2014)]. Consequently, the detailed empirical specification of Equation [15] is as follows,

$$\begin{aligned} E(FOI)_{it} = {} & \left[\beta_0 + \beta_1 \cdot \beta_U + \beta_2 \cdot \frac{V_{Lit} - \beta \cdot D_{it}}{NOA_{it}} + \beta_3 \cdot \ln\left(NOA\right)_{it} + \beta_4 \cdot \ln\left(OL\right)_{it}\right] \cdot \left(V_{Lit} - \beta \cdot D_{it}\right) + \\ & + \sum_{i=1}^{8} \gamma_{1i} \cdot \text{Dummy\_Industry}_i + \gamma_2 \cdot \frac{V_{Lit} - \beta \cdot D_{it}}{NOA_{it}} + \gamma_3 \cdot \ln\left(NOA\right)_{it} + \gamma_4 \cdot \ln\left(OL\right)_{it} + \varepsilon_{it} \quad [15\ bis] \end{aligned}$$

The net tax benefit from a euro of debt, i.e. the debt tax shield, is represented by β. Equation [15] is estimated using non-linear least-squares as it is non-linear in the parameters. To tackle the possible effects of heteroskedasticity, we weight the observations by the reciprocal of the square of total assets, which is consistent with deflating the entire equation by total assets.

3. Data and descriptive statistics

3.1. Sample selection and representativeness

The data used in this paper come from four sources. *The Sistema de Análisis de Balances Ibéricos* (SABI), a database managed by Bureau Van Dijk and Informa D&B, S.A., and the Spanish Securities and Exchange Commission (CNMV), provide the accounting information from annual accounts, while financial market information comes from the quotation bulletins of the Spanish Stock Exchange and Bloomberg.

As is standard in the empirical literature, financial institutions, utilities and governmental enterprises are disregarded because these types of companies are intrinsically different in the nature of their operations and financial accounting information. Overall, we have a data panel containing 88 companies with information for the seven-year period spanning 2007 to 2013. In order to mitigate the effect of outliers, all variables are winsorized at 0.5% in each tail of the distribution.

In order to verify the representativeness of our firms' sample, we relate several key figures describing the companies that we study and compare them with those of the population of large corporate tax payers in Spain with a total income higher than 180 million euros[6]. Using data coming from Agencia Estatal de la Administración Tributaria (AEAT, Estadística por partidas del impuesto sobre sociedades, Years 2007-2013), our sample represents in the case of tax expense a maximum of almost 90% of the population data in 2012 and a minimum of 11% a year before, with a year-average of approximately one third. Regarding earnings, around half of the earnings before interest and taxes (EBIT) of the population is covered by our sample data, and around one third in the cases of earnings before taxes (EBT) and net income. Financial expense in our companies comprise around one fifth of the population data. Previous figures support the relevance and representativeness of our sample within the Spanish large corporate tax payers.

3.2. Descriptive statistics

Table 2 presents summary statistics for the simulation approach tax variables (Panel A) along with the regression approach key variables (Panel B).

In Panel A of Table 2, we observe that the mean value of the before-financing marginal tax rate is 17.37% (17.84% assuming the firm has no interest deductions), with a maximum value of 30% (maximum value for the statutory tax rate in our sample time horizon) and a standard deviation of 8.40% (8.24%). The average firm's marginal tax benefit begins to slope downward when its interest reaches 310% of the current level.

As shown in Panel B of Table 2, the average firm finances 35% of its assets with financial debt and 14% with operating liabilities. The market value of the firm (without considering operating liabilities) is on average 163% of the book value of total assets.

In addition, it is interesting to analyse the time evolution of debt financing and interest expenses of our sample, which is displayed in Table 3.

In 2008, total financial debt (sum of short-term and long-term borrowings) amounts to roughly €62 thousands of millions. It reaches a maximum of nearly €179 thousands of millions in 2011 and then declines. The value of the equity, however, increases from 2008 to 2009, and then declines until 2011, at which point it starts to increase once more. The debt-equity ratio increases consistently from 2008 to 2011, when it shows a slight fall, being more pronounced in 2013. The steady increment in the debt-equity ratio until 2011 is driven by both a decrease in the numerator and an increase in the denominator, the latter higher than the former. Interest expenses reveal an upward trend throughout the whole sample period.

(6) For comparison purposes, we focus on non-financial companies and total income that exceeds 180 million euros as our sample has a mean total income of 557 million euros.

Table 2: DESCRIPTIVE STATISTICS*

Variables	Obs.	Mean	Median	St. Dev.	Min.	Max.
			PANEL A			
$MTR^{0\%}$	454	0.1784	0.1910	0.0824	0.0002	0.3000
$MTR^{100\%}$	454	0.1737	0.1879	0.0840	0.0003	0.3000
Kink	447	3.0765	1.0000	3.2265	0.0000	8.0000
Standardized Kink	447	0.8000	0.2055	1.6352	0.0000	14.6463
			PANEL B			
V_L	615	1.6302	1.1687	1.5939	0.2043	11.6750
OI	447	0.0299	0.0241	0.0772	-0.3506	0.3919
NOA	615	1.0552	0.9310	1.9869	0.1800	23.7903
OL	615	0.1398	0.0718	0.1757	0.0009	0.8200
β_U	444	0.4812	0.4204	0.3382	-0.0775	1.4212
D	615	0.3497	0.3222	0.2293	0	0.9202

* Table A1 in the Appendix provides definitions of all the variables. V_L, OI, NOA, OL and D are all deflated by total assets.

Source: Own elaboration.

Table 3: CAPITAL STRUCTURE AND INTEREST EXPENSES*

Years	Debt €	Interest Expenses €	Equity €	Debt / Equity	Obs.
2008	62,166,838.78	2,808,300.40	111,436,072.36	55.79%	22
2009	171,393,461.72	6,220,856.45	301,837,548.49	56.78%	82
2010	178,504,893.85	6,227,984.92	285,586,357.89	62.50%	85
2011	178,977,685.08	6,894,896.82	259,899,056.12	68.86%	86
2012	175,344,940.99	7,393,591.06	261,530,561.21	67.05%	87
2013	165,273,306.52	7,758,021.04	320,808,810.14	51.52%	85

* Aggregated values, in thousands, by year and for all available observations of the sample.

Source: Own elaboration.

4. EMPIRICAL RESULTS

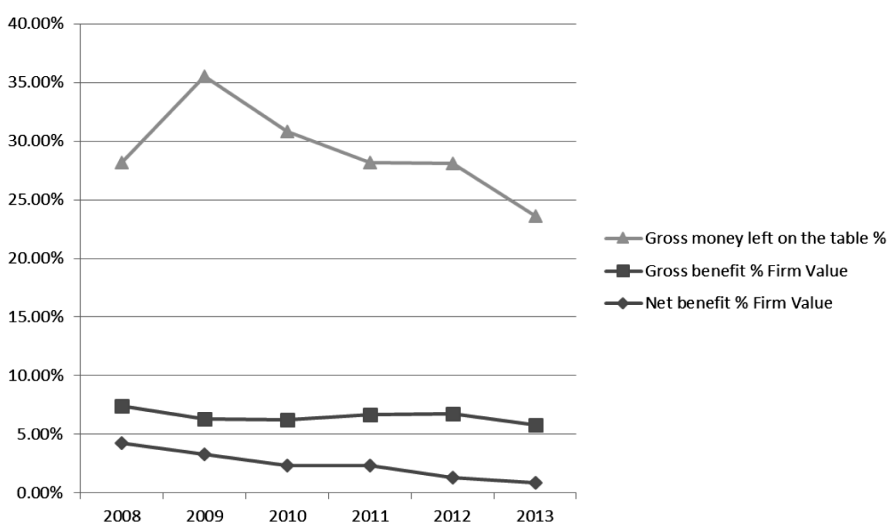
4.1. The value of the debt tax shield by the simulation approach

We first simulate interest deduction benefit functions and use them to estimate the tax-reducing value of each incremental euro of interest expense. Tax benefits of debt are estimated by integrating the area under the tax benefit function, and then computed the capitalized tax benefits of debt as a percentage of firm's market value. Table 4 shows the tax benefit of debt for the whole of our firm's sample, both in gross value (excluding personal taxes) and in net value (including personal taxes).

The total (individual) tax benefit of debt is greatest in 2009 (2008) before gradually diminishing over time. Capitalized tax benefits are the present value of future tax benefits divided by the firm value. The capitalized gross value of interest deductions is about 6.4% of market value over the sample period; this compares to the traditional 11.4% (i.e. marginal tax rate times debt) of firm value, which assumes that full tax benefits are realized on every euro of interest deducted in each scenario. It reaches its highest value in 2008 at 7.5%, and then gradually reduces to 5.8% in 2013. Capitalized net tax benefits after the personal penalty follow a similar trend, but the equivalent figures are obviously smaller.

Firms with a kink larger than one can increase interest, and still receive the maximum marginal tax benefit until they reach their kink. If the incremental non-tax costs of debt are smaller than the incremental tax benefits, then a firm can increase its firm value by issuing more debt. In accordance with Graham (2000, 2008, 2013), for firms with a kink larger than one, we estimate the incremental gross tax benefits from additional debt up to their kink. The resulting number can be interpreted (if many firms are underlevered) as a rough measure of the value loss due to conservative corporate debt policy, or (if most firms are optimally levered) as a lower bound for the difficult-to-measure costs of debt that would occur if a company were to lever up to its kink [Graham (2013)]. Figure 3 presents these incremental gross tax benefits, i.e. gross 'money left on the table', as a percentage of firm value, along with the capitalized gross and net tax benefits of debt already depicted in Table 4.

Figure 3: DEBT TAX BENEFITS



Source: Own elaboration.

Table 4: The aggregate tax benefit of debt

	GROSS DEBT TAX BENEFITS			NET DEBT TAX BENEFITS		
Years	Total €	Per Firm €	% of Firm Value Capitalized	Total €	Per Firm €	% of Firm Value Capitalized
2008	12,974,181,773	589,735,535	7.45	7,475,643,151	339,801,961	4.27
2009	33,673,455,900	410,651,901	6.29	17,544,511,082	213,957,452	3.27
2010	32,344,457,358	380,523,028	6.23	13,056,879,356	153,610,345	2.31
2011	30,452,850,336	354,102,911	6.67	11,569,591,429	134,530,133	2.33
2012	28,521,178,948	327,829,643	6.78	6,195,241,880	71,209,677	1.29
2013	26,037,330,523	306,321,536	5.83	5,133,123,132	60,389,684	0.90
Total	164,003,454,838	366,898,109	6.42	60,974,990,030	136,409,373	2.12

% of Firm Value Capitalized is the present value of future tax benefits, estimated under the assumption that the debt tax shield computed at the end of year t will be maintained over the following years. The interest rate on debt for each firm, calculated as the quotient between interest expenses and debt, is used as the discount rate. We evaluate firm value as the sum of market value of equity and book value of financial debt.

Source: Own elaboration.

For the entire sample period, the incremental gross tax benefits given up by firms are larger than the capitalized gross tax benefits secured. Specifically, the foregone incremental tax benefits represent 28.19% of firm value in 2008, before gradually declining to 23.64% in 2013. These results suggest that the gross money left on the table from conservative debt policy is substantial, though less so over time. The total tax benefits of debt can be computed by adding the incremental tax benefits from additional debt to the capitalized tax benefits from the current debt. As a result, the average firm gains 7.45% of firm value from its current debt level in 2008, and can add 28.19% by leveraging up to its kink. Therefore, in 2008 the total gross tax benefit is 35.64% of firm value. Conversely, in the remaining years, the total gross tax benefits are 41.80% (2009), 37.05% (2010), 34.84% (2011), 34.86% (2012) and 29.46% (2013).

The previous figures would suggest that, on average, firms appear to be underlevered, as the average unexploited tax benefits seem to be larger than the costs of debt that would be incurred if the firms were to lever up. Nevertheless, Almeida and Philippon (2007) show that the expected cost of default approximately equals the estimate of the money left on the table (net of personal taxes). This finding implies that firms on average may not be underlevered. Despite this, it is worth mentioning that the Almeida and Philippon (2007) estimate of the personal tax costs is based on crude estimates [Graham (2013)]. Therefore, if this personal tax penalty happens to be overstated, it is possible that the "underleverage" puzzle might not have been fully resolved.

4.2. The value of the debt tax shield by the regression approach

We use panel data econometrics for the regression approach combining linear and non-linear estimations, thus fully exploiting our data. We begin by estimating the parameters of Equation [10], which is the forward regression with a deflated intercept.[7] The coefficients of these parameters are reported in Table 5.

Table 5: ESTIMATION RESULTS OF EQUATION [10]

	β_0	β_1	β_2	Adj. R^2	N	Obs.
Mean	3.73 10***^{7}	1.7662***	1.3358***	0.9120	87	447
t-statistic	13.18	2.76	8.71			

Fixed effects regression coefficients estimated from Equation [10] with the intercept and all the explanatory variables scaled by total assets. The *t*-statistic is the ratio of the coefficient to its standard error.

Source: Own elaboration.

(7) As an alternative procedure, we have also checked for cross-sectional and serial correlation, and heteroscedasticity in the fixed effects model of Equation [10], without deflating the intercept and the explanatory variables, using the Breusch and Pagan (1980) LM test, Wooldridge (2002) test and the Modified Wald test [Baum (2001)], respectively. The estimated coefficients of the panel data model are almost qualitatively and quantitatively the same as the ones reported in Table 5 (results are available upon request to the authors).

Not surprisingly, the results are consistent with the concern that debt is likely to be related to size; hence, the debt coefficient may be biased upward [Kemsley and Nissim (2002)]. Additionally and as already discussed in Section 2, the dependent variable used in the forward regression raises risk issues related to the capitalization rate and expectations about growth in operating income. In conclusion, the estimated debt coefficient (i.e. 1.3358) is too large to be explained by tax factors; remember that assuming that full tax benefits are achieved on every euro of interest deducted in each fiscal year, the debt tax benefits amounts to 11.4% of firm value.

The next step is to estimate Equation [14], the reverse approach, in order to avoid the drawbacks associated with the forward regression. Nevertheless, in equation [14] we considered ρ as a constant, which would lead us to expect a bias since it is important to control for firm profitability information when estimating the debt tax shelter, and profitability is associated with different capitalization rates [Jiang (2004)]. The estimation results are displayed in Table 6.

Table 6: Estimation results of equation [14]

	β_0	β_1	β_2	Debt Tax Shield	Adj. R^2	N	Obs.
Mean	-1,134,251***	0.0147***	-0.0153	1.0408	0.7467	87	447
t-statistic	-3.98	3.36	-1.15				

Fixed effects regression coefficients estimated from Equation [14] with the intercept and all the explanatory variables scaled by total assets. The *t*-statistic is the ratio of the coefficient to its standard error.

Source: Own elaboration.

As discussed in Subsection 2.2., the estimate for the debt tax shield is calculated as the quotient between $-\beta_2$ and β_1, that is, 0.0153/0.0147, which equals 1.0408. Again, the estimated debt tax shield coefficient is quite large due to a bias effect. The reason might be to considering ρ as a constant in Equations [10] and [14], and therefore without including any specific control for it; furthermore, there might be a measurement error in the empirical proxy for E(FOI).

Our last regression estimation in the regression approach deals with equation [15]. We estimate it by non-linear least squares, but this time, instead of considering ρ as a constant, we express the capitalization rate as a linear function of several observable instruments associated with risk and growth (see our Subsection 2.2. for details). The estimation results of equation [15] are presented in Table 7.

Table 7: Estimation results of equation [15]

	β_0	β_1	β_2	β_3	β_4	Debt Tax Shield	γ_2	γ_3	γ_4
Mean	0.5820***	0.7450***	0.0014	-0.0488***	0.0065**	0.3423***	-4,019,516***	-284,888	455,783***
t-statistic	4.57	7.57	1.05	-6.66	2.07	2.67	-7.27	-1.15	2.63

Non-linear panel data regression coefficients estimated from equation [15].

Source: Own elaboration.

The net debt tax shield in terms of firm value can be computed as the mean leverage ratio (39.81%) multiplied by the estimated coefficient of the debt tax shield in Table 7 (0.3423), which equals 13.62%. Nevertheless, this result should be interpreted cautiously, because compared to the result obtained with the simulation approach, this high figure implies near zero non-tax costs from debt, costs of bankruptcy and/or personal taxes.

5. Robustness of results

In order to verify the robustness of our previous empirical evidence, we perform several different tests.

First, we use an alternative proxy for E(FOI) in Equations [10], [14] and [15]. This new proxy is computed as EBIT times one minus marginal corporate tax rate plus depreciation, averaged over the subsequent five years. The estimation results of our first robustness test are shown in Tables 8, 9 and 10, respectively.

Table 8: Estimation results of equation [10] with a new proxy for e(foi)

	β_0	β_1	β_2	Adj. R^2	N	Obs.
Mean	3.62 10***[7]	1.9878	1.3048***	0.9107	87	447
t-statistic	12.58	1.61	8.60			

Fixed effects regression coefficients estimated from Equation [10] with the intercept and all the explanatory variables scaled by total assets. The *t*-statistic is the ratio of the coefficient to its standard error.

Source: Own elaboration.

Table 9: Estimation results of equation [14] with a new proxy for e(foi)

	β_0	β_1	β_2	Debt Tax Shield	Adj. R^2	N	Obs.
Mean	-148.550	0.0056*	0.0120	-2.1429	0.9195	87	447
t-statistic	-0.80	1.78	1.46				

Fixed effects regression coefficients estimated from Equation [14] with the intercept and all the explanatory variables scaled by total assets. The *t*-statistic is the ratio of the coefficient to its standard error.

Source: Own elaboration.

Table 10: Estimation results of equation [15] with a new proxy for e(foi)

	β_0	β_1	β_2	β_3	β_4	Debt Tax Shield	γ_2	γ_3	γ_4
Mean	0.5860***	0.8404***	-0.0014	-0.0552***	0.0120***	0.2715*	-3.684.373***	431.098	113.635
t-statistic	4.65	8.14	-0.95	-7.49	3.56	1.89	-6.81	1.59	0.62

Non-linear panel data regression coefficients estimated from equation [15].

Source: Own elaboration.

As can be observed from Tables 8, 9 and 10, the computation of E(FOI) with a new proxy does not qualitatively change the results nor the conclusions obtained in Subsection 4.2.

Second, a number of studies have attempted to analyse the tax implications of financing decisions on the firm's value by considering the interest expense instead of the debt level as explanatory variable [see Fama and French (1998), Kemsley and Nissim (2002), Jayaraman (2006), and Sinha and Bansal (2014), among others]. Therefore, our second robustness test entails including the interest expense variable in the regression analysis. Fama and French (1998) argue that poor controls for future profitability could distort the relation between firm value and debt. In order to address this concern, we include capital expenditures to better control for the firm's future profitability, and firm size to take into account other firm-level factors.

In line with previous research, we formulate the following empirical specification:

$$\frac{\text{VALUE}_{\text{it}}}{\text{Total Assets}_{\text{it}}} = \beta_0 + \beta_1 \cdot \frac{\text{INT}_{\text{it}}}{\text{Total Assets}_{\text{it}}} + \beta_2 \cdot \frac{\text{OI}_{\text{it}}}{\text{Total Assets}_{\text{it}}} + \beta_3 \cdot \frac{\text{DIV}_{\text{it}}}{\text{Total Assets}_{\text{it}}} + \beta_4 \cdot \frac{\text{CAPEX}_{\text{it}}}{\text{Total Assets}_{\text{it}}} + \beta_5 \cdot \text{SIZE} + \eta_{\text{i}} + \varepsilon_{\text{it}} \quad [16]$$

Where VALUE is the difference between market and book value of the firm, INT is the interest expense and constitutes the pivotal value (i.e., its coefficient leads to the estimated value for the debt tax shield), OI is earnings before interest and taxes multiplied by one minus the marginal corporate tax rate, DIV is the amount of dividends paid, CAPEX is capital expenditures, and SIZE is the natural logarithm of sales; η_i absorbs firm-specific effects, and ε_{it} is the disturbance term.

Estimating Equation [16] requires testing for the potential endogeneity of the contemporaneous interest variable. The implementation of the Hausman (1978) test of endogeneity reveals the absence of endogeneity for the interest regressor[8].

Table 11 shows the estimated coefficients of Equation [16].

The interpretation of the estimated coefficient associated with the interest variable (i.e. β_1) is the following. Recall that the value of a leveraged firm is the sum of the value of the unleveraged firm and the present value of the debt tax shield. We can compute the present value of the debt tax shield as the quotient between the marginal tax rate and the capitalization rate (i.e. cost of debt) times the interest expense. Therefore, the estimated marginal tax rate may be calculated as $\hat{t}_c = \hat{\beta}_1 \cdot r_d$. Specifically, 7.705 multiplied by the median interest rate (3.14%) equals 24.19%, which represents the debt tax shield in terms of debt value. If we now multiply 24.19% by the mean leverage ratio (39.81%), we obtain the debt tax shield in terms of firm value (9.63%).

As an additional test to verify the effect of including interest expense instead of debt level, we re-estimate Equation [15] with interest expense as a replacement for debt where applicable. Panel A in Table 12 reports these new estimation results.

(8) $\chi^2 = 0.81$ (0.999) accepting the null of absence of endogeneity. We instrument the interest variable with its one-period lagged value.

Multiplying the median interest rate (3.14%) by 4.1998 gives the debt tax shield in terms of debt value (13.19%). The debt tax shield in terms of firm value results from multiplying 13.19% by the mean leverage ratio (39.81%), which amounts to 5.25%.

In addition to the re-estimation of Equation [15], we also carry out another estimation of this Equation but including the same alternative proxy for E(FOI) variable as was used for Tables 8, 9 and 10. The new coefficient estimates are shown in Panel B in Table 12, and as can be observed the new values of the debt tax shield in terms of debt value (11.23%) and the corresponding figures in terms of firm value (4.47%) are in the same vein as those obtained in Table 11 and Table 12.

Table 11: ESTIMATION RESULTS OF EQUATION [16]

Explanatory Variables	Dependent Variable: VALUE
INT	7.705* (1.93)
OI	-0.757 (-1.44)
DIV	4.384*** (3.28)
CAPEX	-0.189 (-0.34)
SIZE	0.016 (0.32)
Observations	432
R-Squared Within	0.1472
Wald test (F-statistic)	5.82 (0.000)
Hausman test (χ^2)	88.90 (0.000)

Fixed-effect regression coefficients estimated from Equation [16] with t-statistic in brackets. Superscript asterisks indicate statistical significance at 0.01(***), 0.05(**) and 0.10(*) levels. Wald's test statistic refers to the null hypothesis that all coefficients of the explanatory variables are equal to zero. Hausman's test refers to the null hypothesis of both fixed effects and random effects being equivalent.

Source: Own elaboration.

Table 12: ESTIMATION RESULTS OF EQUATION [15] WITH INTEREST EXPENSE AND A NEW PROXY FOR E(FOI)

	β_0	β_1	β_2	β_3	β_4	Debt Tax Shield	γ_2	γ_3	γ_4
PANEL A: Estimation Results of Equation [15] with Interest Expense									
Mean	0.5703***	0.7083***	0.0017	-0.0473***	0.0062*	4.1998**	-3,917,979***	-262,558	454,296***
t-statistic	4.75	7.54	1.29	-7.05	1.99	2.51	-7.81	-1.06	2.62
PANEL B: Estimation Results of Equation [15] with a New Proxy for E(FOI) and with Interest Expense									
Mean	0.5958***	0.8001***	-0.0012	-0.0549***	0.0118***	3.5760**	-3,672,214***	447,100*	108,059
	4.95	8.03	-0.83	-8.16	3.60	2.03	-7.45	1.67	0.59

Non-linear panel data regression coefficients estimated from equation [15].

Source: Own elaboration.

Finally, as Kemsley and Nissim (2002) state, all else being equal, the value of the debt tax shield should increase in firm-specific corporate tax rates. In order to take advantage of firms' differing corporate tax rates, we use the pre-financing marginal tax rates explained in Subsection 1.1., to split our observations according to the sample median marginal tax rate. Thus, we create two dummy variables that helps to counteract the effect of any measurement error in the firm level marginal tax rates. The first dummy variable, $DMTR_1$, equals one if the marginal tax rate is below the median marginal tax rate (i.e. low-tax observations), and the second one, $DMTR_2$, equals one if the marginal tax rate is above the median marginal tax rate (i.e. high-tax observations). The mean (median) marginal tax rate is 24.38% (24.63%) and 10.62% (11.46%) for high-tax and low-tax observations, respectively. Moreover, we interact these dummy variables with the intercept, the capitalization rate, and debt. The resulting regression equation is as follows:

$$\begin{aligned} E(FOI)_{it} = & \left[\sum_{i=1}^{2} \beta_{0i} \cdot DMTR_{it} + \beta_1 \cdot \beta_U + \beta_2 \cdot \frac{V_{Lit} - \sum_{i=1}^{2} \beta_{5i} \cdot DMTR_{it} \cdot D_{it}}{NOA_{it}} + \beta_3 \cdot \ln\left(NOA\right)_{it} + \beta_4 \cdot \ln\left(OL\right)_{it} \right] \\ & \cdot \left(V_{Lit} - \sum_{i=1}^{2} \beta_{5i} \cdot DMTR_{it} \cdot D_{it} \right) + \sum_{i=1}^{8} \gamma_{1i} \cdot DMTR_{it} + \sum_{i=1}^{8} \gamma_{2i} \cdot Dummy\_Industry_i + \\ & + \gamma_3 \cdot \frac{V_{Lit} - \sum_{i=1}^{2} \beta_{5i} \cdot DMTR_{it} \cdot D_{it}}{NOA_{it}} + \gamma_4 \cdot \ln\left(NOA\right)_{it} + \gamma_5 \cdot \ln\left(OL\right)_{it} + \varepsilon_{it} \end{aligned} \quad [17]$$

The estimation results of the last robustness test are shown in Table 13.

Table 13: Estimation results of equation [17]

	β_{01}	β_{02}	β_1	β_2	β_3	β_4	β_{51}	β_{52}	γ_3	γ_4	γ_5
Mean	0.8705***	0.8349***	0.4078***	0.0019	-0.0515***	0.0011	0.3060*	2.7254***	-4,151,547***	-1,297,652***	801,121***
t-statistic	5.29	5.14	2.96	1.59	-5.75	0.33	1.90	3.77	-6.20	-3.46	4.74

Non-linear panel data regression coefficients estimated from Equation [17].

Source: Own elaboration.

As reported in Table 13, the results are qualitative as expected, with the value of the net debt tax shield increasing with firm-specific corporate tax rate.

6. Concluding remarks

This paper provides empirical evidence of how valuable are the tax benefits of debt, and directly estimates the so-called debt tax shield under two different approaches, using panel data of Spanish listed firms throughout the period 2007-2013.

To the best of our knowledge, it is the first empirical analysis to assess the tax benefit of debt and its contribution to firm value within a Spanish context, and one of the few in the European economies.

Our research structure relies upon Graham (2000) and Kemsley and Nissim (2002) frameworks. The results obtained prove that the tax benefits of debt for Spanish listed firms are significant. Under the simulation approach, the mean capitalized gross (net) tax benefit of current interests is estimated to be 6.4% (2.1%) of firm value. For the entire sample period, the mean incremental tax benefit is found to be 28.9% of firm value. Conversely, the regression approach leads to a 13.6% (34.2%) debt tax shield in terms of firm (debt) value.

As regards comparison of the two approaches, their figures confirm our expectations. The simulation approach provides a debt tax shield estimate more reasonable compared with the one obtained by the regression approach, and clearly lower than the upper bound of 11.4% (that is, the traditional tax shield value that is computed as the marginal tax rate times debt). Since econometric issues could cloud interpretation, our results coming from the regression approach, should be interpreted with caution. For instance, there might be measurement errors in the variables, risk and growth are very difficult to be controlled for using proxies for the discount rate, and the same applies to profitability for the unlevered firm value. Moreover, the regression approach does not allow differentiating between excluding and including personal taxes, an issue that the simulation approach does, and in the case of being relevant could offset much of the fiscal advantage of debt financing.

We run a number of robustness tests in order to verify our empirical results. We show that our conclusions are robust to using alternative variables proxies such as the measurement of the expected future operating income or the use of interest expense instead of debt level. Furthermore, as expected, the value of the debt tax shield increases with firm-specific marginal corporate tax rates.

The evidence presented in this paper raises interesting implications. Firstly, owners and investors could figure out a global assessment of the debt tax shield within the Spanish firms' tissue, which could be considered in firm valuation. Secondly, policymakers should bear in mind the considerable value of the debt tax shield when regulating the fiscal treatment of the different sources of firms' financing. Thirdly, and from an academic perspective, our results bring about the call for new research that relies more on tax returns and takes into account times-series evidence of firm-specific changes in tax status.

Appendix

Table A1: Definition of variables

Variables	Definition
$MTR^{0\%}$	Marginal tax rate estimated following the Graham *et al.* (1998) approach, and assuming the firm has no interest deductions
$MTR^{100\%}$	Marginal tax rate estimated following the Graham *et al.* (1998) approach, and using the firm's actual interest deductions
Kink	Point at which the tax benefit function starts to slope downwards
Standardized Kink	Actual interest at the kink divided by the standard deviation of income
V_L	Market value of the firm calculated as market value of equity plus book value of debt
OI	Operating income calculated as earnings before interest and taxes multiplied by one minus the marginal corporate tax rate
NOA	Net operating assets calculated as total assets minus operating liabilities
OL	Operating liabilities (i.e. all non-debt liabilities)
β_U	Unlevered beta
D	Total financial debt

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RESUMEN

El impacto potencialmente relevante de la fiscalidad en las decisiones de financiación corporativa está ampliamente reconocido, y ello a pesar de que la evidencia empírica está lejos de ser concluyente. En este estudio valoramos los beneficios fiscales de la deuda para empresas cotizadas españolas en el período 2007-2013. En particular, y utilizando un enfoque de simulación, encontramos que el valor bruto actualizado de las deducciones de los intereses supone aproximadamente el 6.4% del valor de mercado de las empresas, mientras que el beneficio neto (de impuestos personales) de la deuda se estima en un 2.1%, en contraste con el cálculo tradicional (esto es, tipo impositivo marginal multiplicado por la deuda) que asciende a un 11.4%. Por otro lado, el enfoque de regresiones con datos de panel muestra un valor del 13.6% (34.2%) de escudo fiscal de la deuda en términos del valor de la empresa (deuda). Esta evidencia apoya la idea de que los impuestos influyen en la toma de decisiones corporativas y que la deuda aporta valor a la empresa de forma razonable.

Palabras clave: estructura de capital, impuestos corporativos, tipo impositivo marginal, escudo fiscal de la deuda.

Clasificación JEL: G32, H25.