REVISTA ESPAÑOLA DE FINANCIACIÓN Y CONTABILIDAD
Vol. XLII, n.º 158 · April-June 2013 · pp. 187-209

Determinants of debt maturity structure across firm size

Determinantes del vencimiento de la deuda. Evidencia según el tamaño de la empresa

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ABSTRACT This study examines the empirical determinants of debt maturity structure across the size of Spanish firms. Our evidence offers support for the relevance of growth opportunities, size, asymmetric information and asset to maturity to explain debt maturity structure. The paper also provides evidence regarding the differences in explanations according to firm size. It is shown that debt maturity in small firms is higher when the slope of the interest rate term structure increases and for very low-risk and very risky firms.

KEYWORDS Debt maturity; Firm size; Growth opportunities; Asymmetric information; Maturity of assets; Taxes.

RESUMEN El objetivo de este trabajo es analizar los determinantes empíricos del vencimiento de la deuda para empresas españolas de diferente tamaño. Los resultados obtenidos ponen de manifiesto la relevancia de las oportunidades de crecimiento, el tamaño, la asimetría informativa y el vencimiento de los activos para explicar la estructura de vencimiento de la deuda de las empresas españolas. *This study examines the empirical determinants of debt maturity structure across the size of Spanish firms*. El trabajo también proporciona evidencia relativa a las diferentes explicaciones del vencimiento de la deuda según el tamaño empresarial. En concreto, se muestra que el vencimiento de al deuda de las empresas de menor tamaño aumenta cuando lo hace la pendiente de los tipos de interés y para las empresas de bajo y elevado riesgo.

PALABRAS CLAVE Vencimiento de la deuda; Tamaño empresarial; Oportunidades de crecimiento; Información asimétrica; Vencimiento de activos; Impuestos.

* **Acknowledgments:** I am grateful to Francisco González, Nuria Suárez and an anonymous referee for their helpful comments and suggestions. Financial support from the Ministry of Science and Technology of Spain (MCT)-ERDF, Project ECO2009-11758 is gratefully acknowledged. A previous version of this paper has been published as working paper no. 490/2009 of the working paper series of the Fundación de las Cajas de Ahorros (FUNCAS).
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Received 30-06-11 · Accepted 08-08-12 · ISSN: 0210-2412

1. INTRODUCTION

Capital structure research has traditionally focused on explaining the incentives that lead large public corporations to choose particular financing policies. There has been less research on other features of debt financing, such as debt maturity structure. Theories of debt maturity have focused on the roles of agency costs (Myers, 1977; Barnea *et al.*, 1980), asset maturity (Myers, 1977; Stohs and Mauer, 1996), asymmetric information (Flannery, 1986; Diamond, 1991; Berger *et al.*, 2005) and taxes (Brick and Ravid, 1985, 1991; Lewis, 1990) (1).

In line with these theories, empirical analysis has identified several factors that can affect a firm's choice of debt maturity structure. These factors include the firm's options for growth as a measure of agency costs of debt, the maturity of existing assets, the level of asymmetric information, and the effective income tax rate of the firm. Barclay and Smith (1995), Stohs and Mauer (1996), Guedes and Opler (1996), and Ozkan (2000) have provided empirical evidence about the determinants of maturity structure of debt for large firms. Other papers have focused on small firms, such as Scherr and Hulburt (2001), and Berger *et al.* (2005) (2). The evidence provided by these papers is mixed. Barclay and Smith (1995), Guedes and Opler (1996) and Ozkan (2000) provide strong support for the hypothesis that firms with more growth opportunities in their investment sets tend to have more shorter-term debt. In line with Diamond's (1991) prediction, Barclay and Smith (1995), Stohs and Mauer (1996) and Scherr and Hulburt (2001) find evidence of a nonmonotonic relationship between debt maturity structure and credit quality as a consequence of the adverse selection problem (3). The evidence also provides strong support for the maturity-matching hypothesis, which predicts that firms match the maturity of their debt to that of their assets.

Several papers have examined the influence of the country's financial systems and institutional aspects on debt maturity structure. For example, Antoniou *et al.* (2006) analyze the determinants of the debt maturity structure of French, German and UK firms, finding that the impact of firm-specific factors on debt maturity is country dependent. Along similar lines, Demirgüç-Kunt and Maksimovic (1999) examine the maturity of debt in 30 countries and highlight the relevance of the effectiveness of the legal system, the level of activity of the stock market, and the size of the banking sector as determinants of debt maturity. González and González (2008) and Hernández-Cánovas and Koëter-Kant (2008) find results consistent with the influence of the bank system on debt maturity. González and González (2008) show that bank concentration positively influences debt maturity for a sample of listed firms in 39 countries. The results obtained by Hernández-Cánovas and Koëter-Kant (2008) reveal that stronger

(1) See Ravid (1996) for a survey of debt maturity.

(2) This paper only tests the implications of the models of Flannery (1986) and Diamond (1991) concerning the effects of asymmetric information.

(3) Barclay and Smith (1995) and Stohs and Mauer (1996) use a bond rating variable based on a firm's S&P bond rating, while Scherr and Hulburt (2001) use Altman's Z score (1968) as a measure of default risk, seeing as the debt of small firms is not rated.

firm-bank relationships lengthen the maturity of bank loans for a sample of SMEs from 19 European countries.

For Spain, Cuñat (1999) has provided evidence on the determinants of debt maturity structure for a sample of 227 listed firms in the period 1983-1994. His results show that firms with higher growth opportunities shorten the maturity of their debt significantly, although there is no evidence in favor of signaling or tax models. Furthermore, bigger firms and those with a greater degree of government participation present a higher maturity. Although this author also analyses the existence of an effect of size in the determinants of debt maturity, he uses only listed firms. García-Teruel and Martínez-Solano (2010) study the effects of ownership structure on debt maturity of listed firms. Additionally, two papers have analyzed the determinants of debt maturity in Spanish SMEs. García-Teruel and Martínez-Solano (2007) analyze the debt maturity structure of small and medium-sized firms in terms of the risk and return trade-off associated with the use of short-term debt (Jun and Jen, 2003). López-Gracia and Mestre-Barberá (2011) analyze the influence of the tax effect on SME debt maturity structure.

Within this context, the present paper examines the factors that Spanish firms take into consideration when choosing the maturity of their debt, analyzing whether the validity of the agency cost hypothesis, the signaling hypothesis, the maturity-matching hypothesis and the tax hypothesis varies with firm size. There have been studies analyzing the explanations of debt maturity in small firms, such as Scherr and Hulburt (2001) for US firms and García-Teruel and Martínez-Solano for Spanish firms, although neither of these papers considered large firms. The main contribution of the present paper is that of analyzing the relevance of these explanations jointly for a large sample of small, medium-sized and large firms. As far as we know, there are no papers that have tested the validity of these explanations on a single sample that includes both large and small firms. Considering a single sample allows us to test the existence of a different validity for each of the explanations proposed in the literature in accordance with firm size.

The results highlight the relevance of growth opportunities, size, signaling and asset maturity explanations in explaining debt maturity. The main differences when considering firm size are the existence of lower validity with respect to the predictions of Diamond's (1991) model for small firms, and higher debt maturity in smaller firms when the slope of the interest rate term structure increases.

The rest of the paper is organized as follows. Section 2 discusses the validity of theoretical arguments as determinants of debt maturity. Section 3 describes the database and methodology employed. Section 4 discusses the empirical results, while Section 5 tests the robustness of our results to the presence of endogeneity. Finally, Section 6 concludes the paper.

2. THEORETICAL BACKGROUND AND HYPOTHESES

Four non-mutually exclusive hypotheses have been put forward to explain corporate debt maturity structure: asset maturity, agency costs, asymmetric information and taxes. In what follows, we summarize these explanations, which are then tested by the empirical model.

2.1. Asset maturity

Firms match their debt maturities to their asset maturities. If the maturity of debt is shorter than that of assets, the firm may not have sufficient cash available to pay its financial obligations when they are due. However, if debt has a longer maturity, debt payments remain due when the cash flows from assets cease. Matching the maturities of assets and debt reduces these risks. Myers (1977) argues that the underinvestment problem can be mitigated by matching the maturity of liabilities and assets. Therefore, a positive relationship is expected between debt maturity and asset maturity.

2.2. Agency costs

The agency costs of debt may influence corporate debt maturity bearing in mind that outstanding debt may create incentive problems for shareholders. There are two such incentive problems: underinvestment and risk-shifting (Ravid, 1996). When a firm has future options for growth via a profitable investment opportunity set, the existence of risky debt in the capital structure means that the benefits from undertaking profitable investment projects will go only partly to shareholders. Debtholders will share the benefit, because the probability of default is reduced by the investment projects. As the benefit goes partly to debtholders, shareholders have incentives to reject positive net present value projects, thus leading to what is known as the underinvestment problem [(4)].

Myers (1977) argues that a firm may control this underinvestment incentive by shortening the effective maturity of its debt so that debt matures before growth options are exercised. This explanation of debt maturity based on agency costs suggests that firms whose value depends to a large extent on investment opportunities have an incentive to borrow short-term. Several papers have provided favorable evidence for this relationship, such as Barclay and Smith (1995), Guedes and Opler (1996) and Ozkan (2000).

The risk-shifting problem consists in the incentives of shareholders to substitute a risky project for a less risky one whose losses they do not bear, but whose gains accrue solely to shareholders (Black and Scholes, 1973; Jensen and Meckling, 1976). Agency problems between shareholders and debtholders may be particularly severe for small firms as a consequence of underinvestment incentives and risk shifting (Pettit and Singer, 1985; Smith and Warner, 1979). Like Myers (1977), Barnea *et al.* (1980) suggest that these problems may be reduced by issuing shorter-term debt. These arguments thus suggest that debt maturity varies directly with firm size. Barclay and

(4) See Diamond and He (2010) for an in-depth analysis on the effects of debt maturity on the equity incentives to undertake both current and future investments and to identify the forces that determine overhang.

Smith (1995), Stohs and Mauer (1996) and Ozkan (2000) provide results in line with a positive relationship between size and debt maturity.

2.3. Asymmetric information

Diamond (1991) provides a model to explain why risky firms with long-term projects might use short-term debt under the existence of asymmetric information. Firms with favorable private information and low-risk (high credit ratings) may choose short-term debt at relatively low interest rates because the refinancing risk is small. Firms with favorable private information and intermediate risk may choose long-term debt at a higher rate to reduce their greater liquidity risk of being unable to refinance the debt if they choose short-term debt. Since short-term borrowing exposes firms to the risk of excessive liquidations, firms with high-risk (low credit ratings) prefer long-term debt so as to reduce this refinancing risk. Firms with higher default risk may be unable to borrow long-term because of the high probability of bad projects. Thus, Diamond's (1991) model predicts debt maturity to have a nonmonotonic relationship with risk ratings. Very low-risk firms and very risky firms borrow short term and firms with intermediate risks are more likely to borrow long term.

Several studies analyze the relationship between debt maturity and risk ratings. Barclay and Smith (1995) show a nonmonotonic relationship between debt maturity and bond ratings. Firms with higher bond ratings tend to have more short-term debt than those with lower bond ratings. Firms without bond ratings have more short-term debt. Stohs and Mauer (1996) and Scherr and Hulburt (2001) also provide results in line with Diamond's (1991) predicted nonmonotonic relationship. More recently, Berger et al. (2005) also provide support to the predictions of Diamond's (1991) model for low-risk firms. In effect, maturity is an upward-sloping function of risk ratings. However, their evidence for high-risk firms conflicts with the predictions of Diamond's model insofar as high-risk firms do not present significantly different maturities to intermediate-risk firms.

2.4. Taxes

Brick and Ravid (1985, 1991) argue that the expected value of tax benefits depends on the maturity of debt when the term structure of interest rates is not flat. If the yield curve is upward sloping, firms increase their value by increasing the amount of long-term debt. A term structure of interest rates with a positive slope implies that, under the unbiased expectations theory, the interest expense from issuing long-term debt is greater than the expected interest expense from rolling short-term debt in early years, and will be lower in later years. For that reason, the benefits of debt are accelerated using long-term debt. Likewise, short-term debt increases firm value if the yield curve has a negative slope. Consequently, a positive relationship can be expected between the term structure of interest rates and the proportion of long-term debt according to the tax explanation of debt maturity.

Kane *et al.* (1985) develop a model in which the optimal debt maturity structure involves a trade-off between bankruptcy and debt issue flotation costs and the per-period tax advantage of debt financing. In this context, the maturity of debt should rise if the effective tax rate decreases, the flotation cost increases and the volatility of firm value decreases. The empirically testable hypothesis is that a firm's debt maturity increases as its effective tax rate decreases.

Little favorable evidence has been reported for the tax hypothesis, receiving mixed support in Stohs and Mauer (1996). As predicted, these authors find a negative relation between tax rate and debt maturity, although there is no evidence that the debt maturity structure is positively related to the slope of the term structure. Barclay and Smith (1995), Guedes and Opler (1996) and Ozkan (2000), on the other hand, find no evidence for the tax hypothesis. For Spain, López-Gracia and Mestre-Barberá (2011) offer strong evidence for the tax explanation of debt maturity structure for a sample of small and medium-sized firms.

3. ECONOMETRIC SPECIFICATION AND DATABASE

We use the following model to investigate the determinants of the debt maturity structure of firms:

$$\begin{aligned} DEBTMAT_{it} &= a_0 + a_1 GROWTH_{it} + a_2 SIZE_{it} + a_3 DEFAULT\_RISK_{it} + \\ & a_4 ASSETMAT_{it} + a_5 TERM\_PREMIUM_t + a\ TAX\_EXP_{it} + \sum_{t=1995}^{2006} Y_t + v_i + \varepsilon_{it} \end{aligned} \quad (1)$$

where *DEBTMAT* is the debt maturity of firm i in the year t and the determinants are agency costs (*GROWTH* and *SIZE*), credit quality (*DEFAULT RISK*), maturity of assets (ASSETMAT), and taxation (TERM PREMIUM and TAX EXP). $\sum_{t=1995}^{2006}$ is a set of dummy time variables for each year that capture any unobserved firm-invariant time effect not included in the regression, v_i is the firm effect, which is assumed constant for firm i over t, and ε_{it} is the error term.

Most of the literature on debt maturity has adopted a similar framework to this paper. However, other papers assume that firms have long-run optimal debt maturity structures and examine the speed at which they adjust to their target. Dynamic adjustment models have frequently been used to study capital structure (among others Shyam-Sunder and Myers, 1999; Frank and Goyal, 2003; Welch, 2004; Flannery and Rangan, 2006; and González and González, 2008), and, to a lesser extent, maturity structure (Ozkan, 2000; Antoniou *et al.*, 2006; and López-Gracia and Mestre-Barberá, 2011).

To test the empirical determinants of debt maturity, we use a sample of Spanish firms during the period 1995-2006. The data come from SABI and consist of financial statement data and ratios for over a million Spanish companies. We select non-financial corporations (firms with SIC codes 6000-6999 have been excluded) that have (1) more than 10 employees, and (2) data throughout the 12-year sample period to construct the variables used. We exclude firms reporting zero debt. Finally, the sample is made up of 39,603 corporations and 246,344 observations, although the number of observations varies depending on the variables used.

SABI reports the amount of long-term debt payable in one year. To measure the maturity structure of a firm's debt (DEBTMAT), we examine the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. Prior studies have used various measures of debt maturity, considering either a balance sheet approach or an incremental approach. Examples of the balance sheet approach are Scherr and Hulburt (2001), Barclay and Smith (1995) or Ozkan (2000). Scherr and Hulburt (2001) use two specifications, long-term debt payable after one year to total debt, as in this paper, and weighted-average debt maturity, reporting that differences in results between the two specifications of debt maturity are minor; Barclay and Smith (1995) use the percentage of long-term debt payable after three years to total debt; while the dependent variable in Ozkan (2000) is the ratio of debt that matures in more than five years to total debt.

Guedes and Opler (1996) and Berger *et al.* (2005), on the other hand, use an incremental approach. Guedes and Opler (1996) consider the maturity of debt issues as the dependent variable; while Berger *et al.* (2005) use a sample on new loans to small businesses. The argument for using the maturity of new issues is that some questions about the determinants of debt maturity, such as signaling models of maturity choice, can only be properly tested using the incremental approach. However, the incremental approach is not well suited to testing theories that relate asset maturity to the average of the maturities of the firm's existing liabilities, since the term-to-maturity of an individual issue only provides information about incremental financing choices.

We use a balance sheet approach in the present paper. This is driven primarily by the nature of the sample. Seeing as we are concerned with whether there are differences among the determinants of corporate debt maturity structure according to firm size, we need a dependent variable that can be measured for firms of any size. The balance sheet approach allows us to use a measure of debt maturity common to all firms. Moreover, the debate concerning the use of a balance sheet or incremental approach is of less importance in Spain. Garcia-Teruel and Martínez-Solano (2007) show a high proportion of short-term debt with respect to total debt. For their sample of 11,533 small and medium-sized firms, 80.81% of total debt is short-term debt. We also find a high percentage of short-term debt in our sample, as will be seen in Table 1. If debt is mainly short term, the limitations related to maturity structure approximation based on the ratio of long-term debt to total debt are less relevant.

Growth options have usually been proxied by the market-to-book ratio (Barclay and Smith, 1995; Guedes and Opler, 1996; Stohs and Mauer, 1996; and Ozkan, 2000). Seeing as we consider non-listed firms, it is not possible to measure a firm's growth opportunities by the market-to-book ratio, as is usual in other papers. One way of measuring a firm's growth opportunities (*GROWTH*) is to assess its past growth, assuming that firms that grow faster also have greater opportunities for future growth. We measure the ratios of current sales to prior sales (*SALESGROWTH*) and current assets to prior assets (*ASSETGROWTH*) to capture past growth. We also use the ratio of depreciation to total assets (*DEPREC_TA*) to measure the weight of tangible assets, as in Scherr and Hulburt (2001), which are expected to be negatively related to growth opportunities (5). Size, on the other hand, is measured as the natural logarithm of firm assets (*LNASSETS*) in constant 1995 thousands of euros.

The predictions of Diamond's (1991) model have usually been tested by using bond ratings to measure default risk, as in Barclay and Smith (1995), Guedes and Opler (1996), and Stohs and Mauer (1996). As our database includes small firms whose debt is not rated, we have used Altman's Z score (1968) as a measure of default risk (DEFAULT RISK) following Scherr and Hulburt (2001). Altman's Z score is computed using five accounting ratios, with high values indicating a low probability of default:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 1.0X_5 \quad (2)$$

where:

X_1 = (current assets-current debt) / total assets;

X_2 = retained earnings/total assets;

X_3 = earnings before interest and taxes / total assets;

X_4 = equity / total debt;

X_5 = sales / total assets.

For the empirical test of the maturity-matching hypothesis, asset maturity (*ASSETMAT*) is computed by means of the ratio between property, plant and equipment and the annual depreciation (*PPE_DEPREC*). The idea underlying this measure is that longer maturity assets will depreciate at a slower rate (6). A similar definition has been used by Ozkan (2000).

To test the tax hypothesis, we measure the term structure of interest rates as the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds (*TERM PREMIUM*). The data are obtained from the database provided by the Central Bank of Spain. To measure the effective tax rate, we use the ratio of income tax expense to total assets (*TAX EXP*) (Guedes and Opler, 1996).

We have split the sample into small, medium-sized and large enterprises applying the criteria of firm size defined by the European Union in the Commission Recommendation of 3.rd April 1996 (96/280/EC) (7). A small firm is defined as an enterprise that has

(5) Another alternative is to consider the ratio of R&D expenses to total sales to measure growth-oriented investments. The number of firms for which we have this information drops considerably, providing only 11,886 observations. The results for this variable are not significant.

(6) Similar results are obtained when the variable *PPE_DEPREC* is multiplied by the ratio between property, plant and equipment and total assets.

(7) This criteria was the one in force during the period covered by our study. On 6.th May 2003, the Commission adopted a new Recommendation (2003/361/EC) regarding the definition of SMEs which replaced Recommendation 96/280/EC as from 1.st January 2005. We have found that the results do not vary with the new classification of firm size.

fewer than 50 employees but more than 10, and has either an annual turnover not exceeding seven million euros or an annual balance-sheet total not exceeding five million euros. Medium-sized firms are defined as enterprises that have between 50 and 249 employees, and have either an annual turnover not exceeding 40 million euros, or an annual balance-sheet total not exceeding 27 million euros. Firms that exceed these limits are considered large enterprises.

Table 1 presents mean values for debt maturity and independent variables in Panel A, and the differences among subsamples in Panel B. The first aspect worth highlighting is the low long-term debt of the sample of Spanish firms. Barclay and Smith (1995) report a percentage of total long-term debt of around 70%, versus 23.28% for the sample under study shown in table 1. The division of the sample into small, medium-sized and large firms does not reflect major differences in the percentage of total debt according to firm size, although these differences are significant when we compare small and medium-sized versus large firms. The percentage of long-term debt is significantly larger in small firms compared to large and medium-sized firms.

TABLE 1
DESCRIPTIVE STATISTICS

The table presents the mean values of the dependent and independent variables and the differences in these variables among subsamples. *TOTAL DEBT* is the ratio of total debt (short- and long-term debt) to total assets. *DEBT MAT* is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALES GROWTH* is the ratio of current sales to prior sales. *ASSET GROWTH* is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LNASSETS* is the natural logarithm of firm assets in constant 1995 thousands of euros. *DEFAULT RISK* is Altman's *Z* score. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERM PREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAX EXP* is the ratio of income tax expense to total assets. Firms have been split into small, medium-sized and large enterprises applying the criteria of firm size defined by the European Union in the Commission Recommendation of 3.rd April 1996 (96/280/EC). ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

Panel A. Mean values of variables				
	Total sample	*Small firms*	*Medium firms*	*Large firms*
TOTAL DEBT (%)	63.62	63.54	63.64	64.49
DEBT MAT (%)	23.28	24.89	20.52	19.80
SALES GROWTH (%)	10.35	9.02	12.27	14.65
ASSET GROWTH (%)	11.69	11.07	12.72	13.28
DEPREC_TA (%)	4.55	4.68	4.30	4.44
LN ASSETS	8.03	7.38	8.92	10.61
DEFAULT RISK	2.57	2.62	2.48	2.47
PPE_DEP	17.86	15.90	22.20	16.96
TERM PREMIUM (%)	1.31	1.31	1.31	1.29
TAX EXP (%)	1.50	1.41	1.66	1.70
No. of observations	229,769	147,371	69,473	12,925
Panel B. Differences among subsamples				
		Small vs Medium-sized	*Small vs Large*	*Medium-sized vs Large*
TOTAL DEBT (%)		-0.10	-0.96**	-0.86*
DEBT MAT (%)		4.37***	5.09***	0.72***
SALES GROWTH (%)		-3.26***	-5.63***	-2.37
ASSET GROWTH (%)		-1.64***	-2.21***	-0.56*
DEPREC_TA (%)		0.38***	0.24***	-0.14***
LN ASSETS		-1.54***	-3.22***	-1.68***
DEFAULT RISK		0.15***	0.15***	0.00
PPE_DEP		-6.30*	-1.06	5.24
TERM PREMIUM (%)		0.00	0.02***	0.02***
TAX EXP (%)		-0.26***	-0.30***	-0.04

The sample under study contains extreme values of *SALESGROWTH* and *ASSETGROWTH*, especially for large firms. We exclude from the analysis the observations with SALES *GROWTH* and *ASSET GROWTH* above the 99.th percentile. After excluding these observations, the mean values for *SALES GROWTH* (*ASSET GROWTH*) are thus 10.35% (11.69%), 9.02% (11.07%), 12.27% (12.72%), and 14.65% (13.28%) respectively for the total sample, small, medium-sized and large firms. According to the differences shown in panel B for the DEFAULT RISK variable, large and medium-sized firms have higher default risk than small firms, these differences being significant.

Table 2 shows the relation between Altman's *Z* score and debt maturity for the total sample and for small, medium-sized and large firms. As we can see in this table, the values of the ratio of total debt to total assets and the ratio of earnings before interest and taxes plus depreciation expenses to total assets corroborate the classification of default risk obtained for Altman's *Z* score. It can be observed that the level of total debt decreases with firm solvency, while profitability grows as solvency improves according to Altman's *Z* score. The firms belonging to the lower solvency group ($Z < 0$) present a mean proportion of total debt to assets of 123.15% and a profitability of –25.05%. However, for the group made up of the more solvent firms ($Z \geq 7$), the level of total debt is situated at 35.14% and profitability at 19.95%. Moreover, the ratio of total debt to assets is monotonically decreasing according to Altman's Z score, whereas profitability is monotonically increasing. This shows the validity of Altman's Z score as a proxy of the financial strength of Spanish firms.

As regards the analysis of the relation between debt maturity and default risk, it can be seen in Panel A in table 2 that the mean value of long-term debt decreases from a value of 38.78% for *Z* values between 0 and 1 to 18.04% for *Z* values above 7. Furthermore, the mean percentage of long-term debt for *Z* values below zero (firms with very high risk) is 31.38%. These values are partially consistent with Diamond's (1991) model seeing as the average debt maturity is lower for firms with high default probabilities and for firms with low default probabilities with respect to firms with intermediate-range default probabilities. The firms with high risk are only those presenting *Z* values less than one. This relationship between default risk and debt maturity is similar to that obtained by Scherr and Hulburt (2001) for a sample of US small firms. The main difference is that firms with an Altman Z score higher than two have less percentage of long-term debt than the average (20.65% versus 23.28%), whereas Scherr and Hulburt (2001) show that firms with a Z score higher than six are the ones that have less debt than the average (43.5% *versus* 44.31%).

This fulfilling of the predictions based on Diamond's model (1991) is maintained when firm size is taken into account (Panels B, C and D in table 2). The breakdown of the sample into subgroups according to firm size following the criteria of European Commission Recommendation 96/280/EC provides similar results to those already reported for the total sample. Small, medium-sized and large firms with low risk have lower than average long-term debt. Very high risk firms ($Z < 0$), on the other hand, have less long-term debt than firms that present an intermediate risk situation ($0 \leq Z < 1$).

Table 2

Debt maturity, default risk, and firm size

The table presents the mean values of debt maturity according to various ranges of Altman's *Z* score. *TOTALDEBT* is the ratio of total debt (short- and long-term debt) to total assets. *DEBTMAT* is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *PROFITABILITY* is measured as earnings before interest and taxes plus depreciation expenses divided by total assets. Altman's *Z* (1968) is the measure of default risk and is calculated according to Equation [1]. Firms have been split into small, medium-sized and large enterprises applying the criteria of firm size defined by the European Union in the Commission Recommendation of 3rd April 1996 (96/280/EC).

	$Z < 0$	$0 \leq Z < 1$	$1 \leq Z < 2$	$2 \leq Z < 3$	$3 \leq Z < 4$	$4 \leq Z < 5$	$5 \leq Z < 6$	$6 \leq Z < 7$	$Z \geq 7$
Panel A: Total sample									
DEBTMAT (%)	31.38	38.78	28.46	20.65	16.49	14.93	14.60	15.00	18.04
TOTALDEBT (%)	123.15	80.12	71.63	62.10	52.51	46.45	43.68	42.62	35.14
PROFITABILITY (%)	-25.05	3.14	8.05	11.08	14.15	16.40	17.42	17.95	19.95
No. of observations	4,247	20,062	66,052	70,941	39,684	16,154	6,176	1,687	3,766
Panel B: Small firms									
DEBTMAT (%)	32.40	39.56	30.87	22.24	17.78	16.82	16.86	16.80	19.94
TOTALDEBT (%)	128.97	80.32	71.62	62.23	52.50	46.26	43.34	43.54	35.20
PROFITABILITY (%)	-26.44	3.01	8.17	10.97	13.89	16.12	16.86	17.54	19.80
No. of observations	2,773	12,879	40,730	45,540	26,459	10,453	3,973	1,773	2,791
Panel C: Medium firms									
DEBTMAT (%)	28.99	37.69	24.50	17.84	14.32	11.88	10.63	11.55	13.05
TOTALDEBT (%)	113.53	79.58	71.65	61.83	52.04	46.30	43.36	39.79	33.96
PROFITABILITY (%)	-22.39	3.34	7.96	11.24	14.54	16.58	18.01	18.36	21.56
No. of observations	1,223	5,948	21,520	21,680	10,946	4,698	1,827	784	847
Panel D: Large firms									
DEBTMAT (%)	31.70	35.80	25.05	17.51	11.94	9.61	10.06	11.23	9.54
TOTALDEBT (%)	105.68	80.68	71.58	62.13	54.83	49.17	48.76	47.06	41.83
PROFITABILITY (%)	-22.62	3.61	7.36	11.58	15.24	18.55	20.43	21.16	12.77
No. of observations	251	1,235	3,802	3,721	2,279	1,003	376	130	128

Table 3 reports the correlation matrix. According to the arguments of asset maturity, debt maturity is positively correlated with the ratio between property, plant and equipment and annual depreciation (PPE_DEP). The correlation of debt maturity with default risk is negative, highlighting less long-term debt as the solvency of the firm increases. The correlation between debt maturity and the tax rate is negative, in line with the arguments of Kane et al. (1985). The independent variables do not present high correlations with one another.

TABLE 3

CORRELATIONS

The table presents the correlation matrix. *DEBTMAT* is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALESGROWTH* is the ratio of current sales to prior sales. *ASSETGROWTH* is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LNASSETS* is the natural logarithm of firm assets. *DEFAULTRISK* is Altman's *Z* score. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERMPREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAXEXP* is the ratio of income tax expense to total assets. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

	DEBTMAT	*SALESGROWTH*	*ASSETGROWTH*	*DEPREC_TA*	*LNASSETS*	*DEFAULTRISK*	*PPE_DEP*	*TERMPREMIUM*
SALESGROWTH	-0.0059*** (0.0061)							
ASSETGROWTH	0.0024 (0.2512)	0.0626*** (0.0000)						
DEPREC_TA	0.1563*** (0.0000)	-0.0028 (0.1889)	-0.1405*** (0.0000)					
LNASSETS	-0.0026 (0.1962)	0.0122*** (0.0000)	0.0933*** (0.0000)	-0.1089*** (0.0000)				
DEFAULTRISK	-0.0331** (0.0000)	0.0026 (0.2306)	-0.0238*** (0.000)	-0.0478*** (0.0000)	-0.0244*** (0.0000)			
PPE_DEP	0.0234*** (0.0000)	-0.0005 (0.8114)	0.0081 (0.0001)	-0.0184*** (0.0000)	0.0348*** (0.0000)	-0.0017 (0.4059)		
TERMPREMIUM	-0.0056*** (0.0055)	-0.0063*** (0.0035)	-0.0219*** (0.0000)	0.0231*** (0.0000)	0.0024 (0.2402)	0.0016 (0.4243)	0.0007 (0.7237)	
TAXEXP	-0.1255*** (0.0000)	0.0134*** (0.0000)	0.0443*** (0.0000)	0.0503*** (0.0000)	0.0232*** (0.0000)	0.0769*** (0.0000)	-0.0048** (0.0163)	0.0054*** (0.0067)

4. RESULTS

Debt maturity explanations are tested using panel data. Prior to testing, we use the Breusch-Pagan test (Breusch and Pagan, 1980) to identify the existence of individual effects. The null hypothesis of no unobserved heterogeneity is rejected. In this context, a model capturing individual heterogeneity, as the panel data methodology does, is appropriate. The methodology of panel data presents several benefits. It is more informative due to providing more variability, less collinearity among variables, and more degrees of freedom, and is consequently more efficient. However, the main benefit is that it corrects for unobserved firm-specific and time-specific effects. The panel data estimation was calculated using fixed effects, as the Hausman test (1978) rejects the null hypothesis of the lack of correlation between individual effects and

TABLE 4

DETERMINANTS OF FIRM DEBT MATURITY

Regressions are estimated using panel data. The dependent variable (*DEBTMAT*) is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALESGROWTH* is the ratio of current sales to prior sales. *ASSETGROWTH* is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LN_ASSETS* is the natural logarithm of firm assets in constant 1995 thousands of euros. *DEFAULTRISK* is Altman's *Z* score. *SQ(DEFAULT)* is the *Z* score times the absolute value of the *Z* score. *HIGHDEFAULT* is a dummy variable that equals one if the firm has a negative value for Altman's *Z* score, and zero otherwise. *LOWDEFAULT* is a dummy variable that equals one if Altman's *Z* score is above the 66.th percentile, and zero otherwise. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERMPREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAXEXP* is the ratio of income tax expense to total assets. *T-statistics* are in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

	Expected sign	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Intercept		-0.3993***	-0.2651***	-0.2705***	-0.3756***	-0.2347***	-0.2309***	-0.3023***	-0.1911***	-0.1897***
		(-42.43)	(-28.84)	(-29.75)	(-39.56)	(-25.36)	(-25.02)	(-31.47)	(-20.64)	(-20.67)
SALES GROWTH	-	-0.0010***			-0.0010***			-0.0009***		
		(-4.22)			(-4.07)			(-3.77)		
ASSET GROWTH	-		-0.0064***			-0.0079***			-0.0113***	
			(-4.98)			(-6.17)			(-8.84)	
DEPREC_TA	+			0.0878***			0.0469***			0.0963***
				(8.97)			(4.72)			(9.94)
LNASSETS	+	0.0776***	0.0733***	0.0732***	0.0755***	0.0706***	0.0695***	0.0672***	0.0644***	0.0632***
		(68.47)	(64.71)	(67.16)	(66.33)	(62.24)	(63.18)	(58.30)	(56.48)	(57.33)
DEFAULT RISK	+	0.0002***	-0.0004***	-0.0003**	-0.0026***	-0.0047***	-0.0045***			
		(3.74)	(-4.43)	(-2.59)	(-15.88)	(-24.87)	(-23.13)			
SQ(DEFAULT)	-				0.0000***	0.0000***	0.0000***			
					(17.86)	(25.51)	(24.07)			
HIGH DEFAULT	-							-0.0387***	-0.0385***	-0.0389***
								(-12.22)	(-13.08)	(-13.23)
LOW DEFAULT	-							-0.0464***	-0.0490***	-0.0483***
								(-41.94)	(-46.16)	(-45.62)
PPE_DEP	+	0.0000***	0.0000**	0.0000***	0.0000***	0.0000**	0.0000**	0.0000***	0.0000**	0.0000***
		(6.24)	(2.54)	(2.59)	(6.06)	(2.28)	(2.31)	(6.11)	(2.53)	(2.57)
TERM PREMIUM	+	0.0025***	-0.0403***	-0.0399***	0.0026***	-0.0397***	-0.0386***	0.0022***	-0.0362***	-0.0350***
		(4.45)	(-19.32)	(-19.23)	(4.46)	(-19.05)	(-18.66)	(3.93)	(-17.45)	(-16.95)
TAX EXP	-	-0.6557***	-0.5169***	-0.5180***	-0.6148***	-0.4623***	-0.4672***	-0.5015***	-0.3881***	-0.3923***
		(-42.92)	(-39.42)	(-39.54)	(-39.83)	(-34.85)	(-35.26)	(-31.79)	(-28.90)	(-29.25)
Hausman test		2,723.57***	4,247.28***	5,367.15***	8,8847.12***	3,993.28***	5,001.82***	3,834.43***	4,117.55***	4,515.46***
F test		439.91***	386.82***	390.41***	439.91***	403.59***	402.62***	534.53***	501.31***	502.59***
# observations		212,696	229,769	229,769	212,696	229,769	229,769	212,696	229,769	229,769
# firms		37,233	38,993	38,993	37,233	38,993	38,993	37,233	38,993	38,993

observable variables in all regressions. The estimation that takes into account the possible correlation between individual effects and independent variables is the within-group estimation.

Table 4 reports the results of the determinants of debt maturity structure. The coefficients estimated on the growth of sales [column (1)] and the growth of assets [column (2)] are significant in a way that is consistent with the agency cost hypothesis. Additionally, the ratio of depreciation to total assets [column (3)] has the expected sign [(8)]. Thus, firms that have more conflicts between shareholders and debtholders use a higher proportion of short-term debt to mitigate these conflicts. According to the coefficient of *ASSET GROWTH* in column (8) in table 4, a one standard deviation increase in growth of assets raises debt maturity by 7.17%. The prediction that the debt maturity structure decreases as the proportion of growth options in the firm's investment opportunity set increases is also obtained for large and small Spanish firms respectively by Cuñat (1999) and García-Teruel and Martínez-Solano (2007). Favorable evidence for the negative relationship between growth opportunities and debt maturity has been also provided in other institutional contexts by Barclay and Smith (1995), Barclay *et al.* (2003), Guedes and Opler (1996) or Ozkan (2000).

The coefficients on size (*LNASSETS*) are positive in all the estimations. This means that larger firms have longer debt maturity structures. This result is consistent with the role of short-term debt in reducing agency problems between shareholders and debtholders that might be particularly severe for small firms. Barclay and Smith (1995) and Stohs and Mauer (1996) also provide evidence along these lines. To measure the economic significance of the influence of firm size on debt maturity structure, we estimated the percent change in the dependent variable that results from a one standard deviation change in the explanatory variable. Considering the coefficient on size in column (7) in Table 4, a one standard deviation increase in size raises debt maturity by 37.69%.

In column (1) in table 4, we report a significant and positive relation between firm quality and debt maturity. In columns (2) and (3), however, we obtain a negative and significant coefficient for *DEFAULT RISK* variable. Seeing as an increase in *Z* corresponds to a reduction in default probability, this negative coefficient is in line with the use of longer-term debt when the default risk increases.

The proxy for the asset maturity of firms, i.e., the ratio of net property, plant and equipment to annual depreciation expense (*PPE_DEP*), presents a positive and significant coefficient. Firms with longer-lived assets use longer-maturity debt. The economic significance of the influence of asset maturity on debt maturity structure is 6.90%. This implies support for the maturity-matching hypothesis. Cuñat (1999) shows weak evidence on firms matching their debt maturities to their asset maturities for a sample of Spanish listed firms.

We find mixed evidence for the tax hypothesis. On the one hand, the tax hypothesis predicts an inverse relationship between debt maturity structure and the ratio of taxes

(8) We also obtain a positive coefficient using a straightforward measure of the tangibility of assets, such as the ratio between property, plant and equipment and total assets.

paid to assets (*TAX EXP*). In line with this prediction, the coefficient of *TAX EXP* shown in table 4 is negative and significant. From the coefficient in column (7), a one standard deviation in the ratio of taxes paid to assets decreases debt maturity by 6.42%.

On the other hand, there is no clear evidence that debt maturity is positively related to the slope of term structure (*TERM PREMIUM*). The relationship between *TERM PREMIUM* and *DEBTMAT* is positive and significant only when growth opportunities are measured as the ratio of current sales to prior sales (*SALES GROWTH*). In this case, this finding would imply favorable evidence for this hypothesis. However, when growth opportunities are measured by *ASSET GROWTH* or *DEPREC_TA*, there is a negative and significant association between the term premium and debt maturity [(9)]. As a consequence of these contradictory results, our findings might be seen as providing modest support for the tax hypothesis.

In columns (4) to (6) in table 4, we test the predictions of Diamond's (1991) model. To do so, we include the square of Altman's *Z* score [*SQ(DEFAULT)*] [(10)] in the estimations. We expect a positive relation between debt maturity and default risk and a negative relation of debt maturity with the *SQ(DEFAULT)* variable. The results for these variables shown in columns (4) to (6) underscore a negative coefficient of *DEFAULT RISK* and a positive coefficient of the *SQ(DEFAULT)* variable. These signs are the opposite of what is expected following Diamond (1991). As can be seen in table 2, our sample shows two important characteristics regarding the relationship between the *Z* score and debt maturity: (1) the increase in debt maturity for intermediate-risk firms proposed by Diamond (1991) only applies to *Z* scores less than one; and (2) a flattening in the relationship between debt maturity and the *Z* score for values of *Z* higher than 4. The negative coefficient of the *DEFAULT RISK* variable thus captures the negative relationship between the *Z* score and debt maturity for values of *Z* higher than 1 and the positive coefficient of *SQ(DEFAULT)* captures the flattening of this relationship for *Z* score values higher than 4.

In view of this result, we also test the implications of Diamond's (1991) model by building two dummy variables according to the level of default risk. The first dummy variable is *HIGH DEFAULT*, which takes a value of one if the firm has a negative value for Altman's *Z* score, and zero otherwise. *LOW DEFAULT* is the second dummy variable and equals one if Altman's *Z* score is above the $66.^{th}$ percentile, and zero otherwise [(11)].

The results are shown in columns (7) to (9) in Table 4. The two dummy variables are significant and negative. These coefficients reveal that firms belonging to the category with the lowest credit score as well as those with the highest credit score borrow on a shorter term. This result is consistent with the nonmonotonic relationship between debt maturity and default risk and provides evidence that is favorable to the implications

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(9) This negative relationship between term premium and debt maturity was also the result obtained by Guedes and Opler (1996).

(10) Bearing in mind that the Z score may have a negative sign, in order to calculate the square of Z score we multiply the Z score by the absolute value of Z (Scherr and Hulburt, 2001).

(11) The value of the 66^{th} percentile is 2.84, while an Altman Z score equal to zero corresponds to a percentile of 1.85%.

of Diamond's (1991) model. The coefficients in column (7) indicate that, all else being equal, debt maturity structure decreases by 2.28% and 8.68% respectively for a one standard deviation in *HIGH DEFAULT* and *LOW DEFAULT*.

The findings for growth opportunities, maturity of assets and tax explanation are similar to those discussed previously when testing the predictions of Diamond's (1991) model in columns (4) to (9).

4.1. Determinants of firm debt maturity according to size

Tables 5 and 6 show the findings regarding the determinants of debt maturity structure according to firm size. The sample has been split applying the criteria defined by the European Union in Commission Recommendation 96/280/EC. Firstly, the basic model tested in Table 4 for the entire sample is applied in Table 5 to the three subsamples of small, medium-sized and large firms. Secondly, the results for the different validities of the explanations are shown in table 6, where these are analyzed using interaction variables between the independent variables and the dummy variable SMALL. In columns (1) to (3), the dummy variable SMALL takes the value of 1 if the firm is a small-sized firm according to EU criteria, and zero otherwise. In columns (4) to (6), the dummy variable SMALL takes the value of 1 if the firm is a small or medium-sized firm according to EU criteria, and zero otherwise. These interaction terms allow us to analyze whether the determinants of debt maturity are equally valid in small firms versus medium-sized and large firms. Due to the fact that table 6 provides a test of the significance of the differences according size, only the results obtained in columns (1) to (3) in Table 6 are discussed.

The results for the independent variables of the basic model are similar to those reported in table 4. Evidence favorable to the expected relationships is found for the agency costs of debt, asymmetric information and maturity-matching hypotheses and mixed evidence for the tax hypotheses. Since these findings have been highlighted previously, our comments focus here on the interaction terms.

Our findings show that the main difference when comparing firms according to their size is the existence of a different effect of asymmetric information in smaller firms versus medium-sized and large firms. The variables *SMALL*HIGH DEFAULT* and *SMALL*LOW DEFAULT* present a positive and significant coefficient. This sign underscores the presence of greater long-term debt for small firms that have very high or very low risk. Thus, although the predictions of Diamond's (1991) model are fulfilled in smaller firms, they are fulfilled to a greater extent in large firms. This difference disappears almost completely when considering the differential effect of small and medium-sized firms versus large firms [columns (4) to (6)].

The coefficients of the variables *SMALL*SALES GROWTH* [column (4)] and *SMALL*ASSET GROWTH* [columns (2) and (5)] are consistent with a lesser validity of agency costs explanations in small versus large firms. However, the positive coefficient of *SMALL*DEPREC_TA* [columns (3) and (6)] suggests that smaller firms with more investment in tangible assets have longer-term debt, thus providing favorable

Table 5

Determinants of firm debt maturity according to size

Regressions are estimated using panel data. The dependent variable (*DEBTMAT*) is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALESGROWTH* is the ratio of current sales to prior sales. ASSETGROWTH is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LNASSETS* is the natural logarithm of firm assets in constant 1995 thousands of euros. *HIGHDEFAULT* is a dummy variable that equals one if the firm has a negative value for Altman's *Z* score, and zero otherwise. LOWDEFAULT is a dummy variable that equals one if Altman's *Z* score is above the 66th percentile, and zero otherwise. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERMPREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAXEXP* is the ratio of income tax expense to total assets. Firms have been split into small, medium-sized and large enterprises applying the criteria of firm size defined by the European Union in the Commission Recommendation of 3rd April 1996 (96/280/EC). *T-statistics* are in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

		SMALL			MEDIUM			LARGE		
	Expected sign	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**	**(9)**
Intercept		-0.3884*** (-31.63)	-0.2627*** (-21.61)	-0.2590*** (-21.72)	-0.3634*** (-19.46)	-0.3244*** (-17.69)	-0.3199*** (-17.39)	-0.6271*** (-12.69)	-0.5431*** (-11.72)	-0.5004*** (-10.75)
SALES GROWTH	-	-0.0010*** (-2.80)			-0.0006** (-2.17)			-0.0184*** (-4.15)		
ASSET GROWTH	-		-0.0133*** (-8.14)			-0.0139*** (-6.54)			-0.0277*** (-5.50)	
DEPREC_TA	+			0.1037*** (9.89)			0.1488*** (5.37)			0.0739 (1.29)
LNASSETS	+	0.0869*** (53.93)	0.0835*** (51.61)	0.0818*** (52.88)	0.0642*** (31.60)	0.0687*** (33.08)	0.0669*** (33.07)	0.0780*** (17.20)	0.0788*** (17.39)	0.0733*** (16.44)
HIGH DEFAULT	-	-0.0528*** (-12.99)	-0.0491*** (-13.05)	-0.0496*** (-13.18)	-0.0421*** (-8.13)	-0.0400*** (-8.15)	-0.0404*** (-8.23)	-0.0607*** (-5.31)	-0.0606*** (-5.59)	-0.0614*** (-5.63)
LOW DEFAULT	-	-0.0395*** (-28.46)	-0.0439*** (-33.18)	-0.0431*** (-32.63)	-0.0486*** (-26.43)	-0.0490*** (-27.16)	-0.0481*** (-26.74)	-0.0460*** (-10.69)	-0.0485*** (-11.51)	-0.0467*** (-11.09)
PPE_DEP	+	0.0001*** (8.66)	0.0000 (1.48)	0.0000 (1.58)	0.0000 (0.79)	0.0000 (1.11)	0.0000 (1.15)	0.0000 (0.25)	0.0000 (1.47)	0.0000 (1.42)
TERM PREMIUM	+	0.0010 (1.32)	-0.0432*** (-16.23)	-0.0419*** (-15.80)	0.0041*** (4.59)	-0.0304*** (-8.95)	-0.0285*** (-8.44)	0.0050** (2.47)	-0.0349*** (-4.51)	-0.0302*** (-3.92)
TAX EXP	-	-0.5528*** (-26.32)	-0.3564*** (-21.69)	-0.3611*** (-22.01)	-0.4181*** (-17.44)	-0.4080*** (-17.27)	-0.4147*** (-17.58)	-0.3628*** (-6.50)	-0.3762*** (-6.90)	-0.3778*** (-6.91)
Hausman test		1,869.40***	1,879.42***	2,286.77***	642.01***	802.13***	1,001.32***	202.49***	178.81***	245,37***
F test		385.09***	349.60***	351.54***	127.27***	171.96***	171.09***	38.58***	37.31***	35.53***
# observations		134,637	147,371	147,371	65,674	69,473	69,473	12,385	12,925	12,925
# firms		27,862	29,898	29,898	14,498	15,098	15,098	2,682	2,766	2,766

Table 6

Determinants of firm debt maturity according to size

Regressions are estimated using panel data. The dependent variable (*DEBTMAT*) is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALESGROWTH* is the ratio of current sales to prior sales. *ASSETGROWTH* is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LNASSETS* is the natural logarithm of firm assets in constant 1995 thousands of euros. *HIGHDEFAULT* is a dummy variable that equals one if the firm has a negative value for Altman's *Z* score, and zero otherwise. *LOWDEFAULT* is a dummy variable that equals one if Altman's *Z* score is above the 66.th percentile, and zero otherwise. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERMPREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAXEXP* is the ratio of income tax expense to total assets. In columns (1) to (3), *SMALL* is a dummy variable that takes the value of 1 if the firm is a small firm, and zero otherwise. In columns (4) to (6), *SMALL* is a dummy variable that takes the value of 1 if the firm is a small or medium-sized firm, and zero otherwise. Firms have been split into small, medium-sized and large enterprises applying the criteria of firm size defined by the European Union in the Commission Recommendation of 3.rd April 1996 (96/280/EC). *T-statistics* are in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	-0.3183*** (-32.81)	-0.2180*** (-23.19)	-0.2125*** (-22.86)	-0.3087*** (-31.95)	-0.1973*** (-21.19)	-0.1948*** (-21.12)
SALES GROWTH	-0.0011*** (-3.13)			-0.0262*** (-5.67)		
ASSET GROWTH		-0.0249*** (-12.02)			-0.0346*** (-6.83)	
DEPREC_TA			-0.0415** (-2.03)			-0.0319 (-0.72)
LNASSETS	0.0691*** (59.35)	0.0677*** (58.50)	0.0661*** (59.13)	0.0680*** (58.64)	0.0652*** (56.83)	0.0638*** (57.59)
HIGH DEFAULT	-0.0497*** (-9.62)	-0.0527*** (-10.86)	-0.0500*** (-10.29)	-0.0572*** (-4.62)	-0.0594*** (-5.04)	-0.0559*** (-4.72)
LOW DEFAULT	-0.0520*** (-29.49)	-0.0538*** (-31.25)	-0.0512*** (-29.79)	-0.0525*** (-12.25)	-0.0564*** (-13.48)	-0.0532*** (-12.64)
PPE_DEP	0.0000** (2.34)	0.0000* (1.93)	0.0000* (1.92)	0.0000 (0.52)	-0.0000 (-0.64)	-0.0000 (-0.89)
TERM PREMIUM	-0.0017** (-2.38)	-0.0398*** (-18.81)	-0.0374*** (-17.66)	-0.0008 (-0.53)	-0.0395*** (-15.76)	-0.0376*** (-14.75)
TAX EXP	-0.5024*** (-21.53)	-0.4640*** (-20.27)	-0.4779*** (-20.96)	-0.4390*** (-7.68)	-0.4329*** (-7.80)	-0.4471*** (-8.08)
*SMALL*SALES GROWTH*	0.0004 (0.81)			0.0254*** (5.49)		
*SMALL*ASSET GROWTH*		0.0196*** (7.98)			0.0244*** (4.73)	
*SMALL*DEPREC_TA*			0.1628*** (7.84)			0.1324*** (2.97)
*SMALL*HIGH DEFAULT*	0.0165*** (2.62)	0.0215*** (3.68)	0.0163*** (2.77)	0.0194 (1.53)	0.0222* (1.83)	0.0180 (1.48)
*SMALL*LOW DEFAULT*	0.0088*** (4.26)	0.0078*** (3.89)	0.0052*** (2.60)	0.0067 (1.52)	0.0079 (1.85)	0.0053 (1.24)
*SMALL*PPE_DEP*	0.0001*** (8.07)	0.0000 (1.52)	0.0000* (1.69)	0.0000 (0.79)	0.0000 (0.79)	0.0000 (1.05)
*SMALL*TERM PREMIUM*	0.0063*** (8.60)	0.0060*** (8.29)	0.047*** (6.17)	0.0032** (2.12)	0.0035*** (2.33)	0.0028* (1.77)
*SMALL*TAX EXP*	0.0082 (0.28)	0.1153*** (4.27)	0.1293*** (4.82)	-0.0657 (-1.12)	0.0466 (0.82)	0.0576 (1.02)
Hausman test	4,251.59***	4,364.04***	4,998.81***	3,932.18***	2,776.45***	4,601.25***
F test	398.54***	382.99***	383.75***	390.97***	372.68***	372.98***
# observations	212,696	229,769	229,769	212,696	229,769	229,769
# firms	37,233	38,993	38,993	37,233	38,993	38,993

evidence for the hypothesis that smaller firms with more growth opportunities control suboptimal investment incentives by shortening the maturity of their debt.

The differential effect of the interest rate term structure on smaller firms reveals that these firms consider term structure to be an important determinant of debt maturity. Only the debt maturity of smaller firms varies directly with the slope of the term structure of interest rates. For large firms, term structure has a negative influence on debt maturity. There is no clear differential effect, however, of tax expenses on debt maturity according to firm size.

The estimations do not provide strong support for the maturity-matching hypothesis or the tax-based hypothesis as explanations that vary between firms according to their size. As regards the maturity matching hypothesis, the results in Table 6 only show the existence of a differential effect for smaller firms in some estimations, highlighting the greater validity of matching the maturity of assets and debt to reduce the risks of refinancing and liquidity in small firms.

TABLE 7

TEST OF ROBUSTNESS. DETERMINANTS OF FIRM DEBT MATURITY

Regressions are estimated using panel data. The dependent variable (*DEBTMAT*) is the percentage of the firm's total debt (long-term debt plus debt in current liabilities) that has a maturity of more than one year. *SALESGROWTH* is the ratio of current sales to prior sales. *ASSETGROWTH* is the ratio of current assets to prior assets. *DEPREC_TA* is the ratio of depreciation to total assets. *LN_ASSETS* is the natural logarithm of firm assets in constant 1995 thousands of euros. *DEFAULT_FITTED* is the predicted value of *DEFAULT RISK* using as instruments the first lag of *Z* score, profitability and total debt. *SQ(DEFAULT_FITTED)* is *DEFAULT_FITTED* times the absolute value of *DEFAULT_FITTED*. *PPE_DEPREC* is the ratio between property, plant and equipment and annual depreciation. *TERMPREMIUM* is the difference between the month-end yield on ten-year government bonds and the month-end yield on six-month government bonds. *TAXEXP* is the ratio of income tax expense to total assets. *T-statistics* are in parentheses. ***, ** and * represent significance at the 1%, 5% and 10% level, respectively.

	Expected sign	(1)	(2)	(3)	(4)	(5)	(6)
Intercept		-0.4384***	-0.4365***	-0.4288***	-0.3671***	-0.3480***	-0.3630***
		(-38.48)	(-37.15)	(-38.31)	(-31.95)	(-29.10)	(-32.16)
SALES GROWTH	-	-0.0008***			-0.0009***		
		(-3.54)			(-3.94)		
ASSET GROWTH	-		-0.0104***			-0.0016	
			(-6.73)			(-1.01)	
DEPREC_TA	+			0.0930***			0.0837***
				(8.59)			(7.76)
LNASSETS	+	0.0845***	0.0836***	0.0821***	0.0830***	0.0784***	0.0797***
		(62.02)	(59.25)	(61.81)	(61.24)	(55.50)	(60.23)
DEFAULT_FITTED	+	-0.0092***	-0.0061***	-0.0063***	-0.0340***	-0.0254***	-0.0254***
		(-22.99)	(-19.98)	(-20.55)	(-43.91)	(-40.82)	(-41.48)
SQ(DEFAULT_FITTED)	-				0.0002***	0.0001***	0.0001***
					(37.34)	(35.55)	(35.98)
PPE_DEP	+	0.0001***	0.0000***	0.0000***	0.0001***	0.0000**	0.0000**
		(7.76)	(2.81)	(2.83)	(7.34)	(2.52)	(2.54)
TERM PREMIUM	+	0.0043***	0.0041***	0.0040***	0.0056***	0.0049***	0.0049***
		(7.22)	(7.01)	(6.78)	(9.46)	(8.40)	(8.29)
TAX EXP	-	-0.6192***	-0.6137***	-0.6151***	-0.5607***	-0.5681***	-0.5654***
		(-35.41)	(-36.61)	(-36.73)	(-32.11)	(-33.95)	(-33.80)
Hausman test		3,127.66***	-1,662.51***	4,879.79***	3,291.25***	3,422.71***	4,281.81***
F test		420.59***	384.44***	386.42***	489.71***	442.63***	446.52***
# observations		161,862	174,261	174,261	161,862	174,261	174,261
# firms		32,475	34,173	34,173	32,475	34,173	34,173
Durbin-Wu-Hausman test		488.59***	310.07***	343.77***	413.12***	326.12***	370.57***

(Continue in next page)

5. ROBUSTNESS

It could be argued that the Z score may be subject to endogeneity. For example, Barclay and Smith (1995) find a positive correlation between leverage and debt maturity. Thus, the level of long-term debt could be a determinant of the default risk of a firm. For this reason, we now carry out an analysis to consider the potential endogeneity of the *DEFAULT RISK* variable. Table 7 reports the results of the determinants of debt maturity structure for the first six columns in table 4, as these are the estimations which directly include the *DEFAULT RISK* variable.

We address the concerns regarding the potential endogeneity of the *Z* score using instrumental variables estimation. As instruments for the Z score, we chose the first lag of the *Z* score, profitability and total debt. We perform a Durbin-Wu-Hausman test of overidentifying restrictions for each regression (Davidson and Mackinnon, 1993). The test verifies the null hypothesis that the introduction of instrumental variables has no effect on the estimates of the regression's coefficients. We performed the Durbin-Wu-Hausman test on each of the first six regressions in table 4, the results of which are reported in the bottom line of table 7. The test is rejected at the one percent level in all the estimations. Therefore, the predicted value for *DEFAULT RISK (DEFAULT_FITTED)* is included instead of the observed value in the regressions. The *SQ(DEFAULT_FITTED)* is the *DEFAULT_FITTED* times the absolute value of this variable.

In all the regressions, we find that the introduction of the fitted value for *DEFAULT RISK* variable does not alter the results presented previously. The sign and significance of the coefficients remain similar to the results in table 4. Therefore, the results obtained are robust as regards the issue of endogeneity.

6. CONCLUSIONS

In this paper, the empirical determinants of a firm's debt maturity structure are examined for a sample of 38,993 non-financial Spanish firms over the period 1995-2006. Our results show the relevance of growth opportunities, size, asymmetric information, and asset maturity in explaining debt maturity. Our findings are not significantly different to those reported for US firms. The main difference with respect to the institutional environment arises from the maturity of debt and not from the determinants. Spanish firms present a lower ratio of long-term debt to total debt compared to US firms.

We find strong evidence in line with the agency cost approach that debt maturity is used to control conflicts of interest between shareholders and debtholders. On the one hand, smaller firms tend to use shorter-term debt. On the other, debt maturity is inversely related to proxies for growth opportunities. We obtain evidence consistent with Diamond's (1991) prediction of a nonmonotonic relationship between debt maturity structure and probability of default, although this is only true for very specific values of the Z score. We also find evidence in favor of the asset maturity explanation, as in Scherr and Hulburt (2001) and Stohs and Mauer (1996) for US firms or Ozkan (2000) for UK firms.

Like Cuñat (1999), we provide evidence in favor of the growth opportunities and asset maturity hypotheses and no clear support for tax arguments, the difference residing in the influence of asymmetric information. Cuñat (1999) finds that smaller firms tend to use shorter-term debt, as do we. However, this evidence is obtained considering only listed firms. García-Teruel and Martínez-Solano (2007) show more solvent firms using higher proportional short-term debt, as do we. However, we also show that firms with the lowest credit score borrow on a shorter term. Our results show a positive influence of the term structure of interest rates on debt maturity, as do López-Gracia and Mestre-Barberá (2011).

Given that the main contribution of the paper consists in analyzing the different validity of the empirical determinants of debt maturity structure for small, medium-sized and large firms, we likewise provide evidence on the differences in the explanations according to firm size. We show that the term structure of interest rates and the probability of default are the determinants that have a differential influence between small and large firms. Debt maturity in smaller firms is higher when the slope of the interest rate term structure increases and for very low-risk and very risky firms. This last result implies that the prediction of Diamond's (1991) model is fulfilled to a greater extent in large firms than in smaller firms.

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