New empirical evidence on the debt maturity choice and the role of credit risk

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Abstract:

Using cross-sectional time series data on 710 US firms over the period from 1995 to 1998 this paper firstly employs a new approach to estimate the maturity of a firm's total debt based on debt level and flow data. We secondly provide new insights into the role of credit risk in the debt maturity choice. Consistent with theory our results confirm the nonmonotonic relation between credit rating and debt maturity. However, in contrast to previous studies we observe a considerable deviation in the debt maturity structure for unrated firms and for firms with medium credit ratings. Introducing alternative measures for credit risk our results show that the predicted screen-out of firms with low credit quality from the long-term maturity market is less pronounced based on these alternative measures.

Keywords: *debt maturity structure, credit risk*

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Introduction

This paper investigates the determinants of firms' debt maturities with a focus on the role of credit risk. A lot of theoretical work has attempted to assess the debt maturity choice and has developed a variety of hypotheses. The preference for short- or long-term debt is primarily affected by agency costs (Barnea, et al. (1980), Myers (1977)), asymmetric information (Diamond (1991), Flannery (1986), Kale and Noe (1990)), and tax considerations (Brick and Ravid (1985), Kane, et al. (1985)). Less focus was put on empirical studies about the drivers of debt maturity since detailed information on corporate debt is difficult and time-consuming to obtain.[3] Empirical evidence and underlying theories have come to partly inconsistent and contradictory results and the prevailing question about the determinants of the debt maturity choice is still not sufficiently answered.

One of the most discussed determinants of the debt maturity choice is a firm's credit risk since the relation between debt maturity and credit risk is rather complex. Short-term debt carries the risk that the borrower is not able to roll over debt at the refinancing date. This might be caused by a deterioration in financial or economic conditions which forces the investor to raise the default premium on new debt too high or even refuse to extend credit at all (Diamond (1991), Sharpe (1991), Titman (1992)). Rolling short-term debt not only involves a reinvestment risk but also causes greater opportunity costs of management time (Barclay and Smith (1995)). Financial distress might also lead to indirect costs, e.g. if customers and/or management churn. Therefore, firms with a high credit risk have an incentive to borrow long-term. In fact, results from a comprehensive survey in which Graham and Harvey (2001) compare the current practice of corporate finance with underlying finance theories underline that many companies issue long-term so that they do not have to refinance in "bad times".

However, some firms might not be able to borrow long-term because of agency problems. The high compensation required from lenders for bearing the long-term credit risk could lead to risky asset substitution (Diamond (1991)). Barnea, et al. (1980) argue that employing short-term debt reduces the risk of asset substitution because short-term debt is more insensitive to shifts in the risk of the underlying asset. As a consequence, firms with low credit quality could be screened out of the long-term end of the maturity spectrum. Only medium and high-quality firms with stable cash flows obtain access to the long-term credit market. The better their credit quality the more flexibility firms have in choosing their optimal maturity. For firms with high

[3] See Morris (1992) for a discussion on the difficulty of obtaining precise information on the maturity of a firm's debt.

credit quality liquidity risk might be outweighed by the effect of expecting favorable news in the future. Since positive information at the refinancing date allows for a reduction of the interest rate short-term debt in this case is advantageous (Diamond (1991)). As a result, only medium-quality firms might have an incentive to borrow long-term.

Empirically, Guedes and Opler (1996) find strong evidence for the nonmonotonic relationship between credit risk and debt maturity. According to their study large firms with high credit quality use both short-term and long-term debt whereas high risk firms typically use medium-term maturities. Stohs and Mauer (1996) also strongly support the prediction of a nonmonotonic relation between credit risk and debt maturity. Beginning at the smallest value for AAA-rated firms, average maturity increases for each further lower rating until it reaches a maximum for B-rated firms. Subsequently, average maturity drops significantly for CCC-rated and even more for unrated firms. In contrast, Barclay and Smith (1995) find that over all a firm’s debt maturity is positively correlated with credit risk, whereas the evidence for nonmonotonicity is driven solely by the unrated firms in the sample.

The contribution of this paper to the existing literature is twofold. Firstly, we introduce a new algorithm that estimates debt maturities based on debt flow and level data. Empirical studies to date have used balance sheet debt ratios, the time to maturity of new debt issues only or complex measures of weighted averages of all firm liabilities to estimate debt maturities. Our approach provides a comprehensive view on the debt maturity structure from a different perspective since we examine the effective instead of the previously explored nominal debt maturities. Secondly, we revisit the role of credit risk in the debt maturity choice and provide new empirical evidence for alternative measures of credit risk. Particularly for unrated firms where the usual proxy S&P credit rating is not applicable it seems necessary to employ alternative credit risk measures. Therefore we extend the notion of credit risk by including measures that additionally capture bankruptcy risk and market risk.

Our results indicate that the relation between credit risk and debt maturity heavily depends on the definition of the proxy. Although we partly confirm the nonmonotonic relation between a firm’s credit rating and its debt maturity we observe considerable deviations from previous studies. Unrated firms tend to have significantly longer debt maturities than predicted and the expected monotonic increase in average debt maturity from AAA-rated firms to B-rated firms is non existent. Instead, the screenout process for firms with low credit quality seems to start below A-rated firms. If credit risk is proxied by alternative measures using accounting and market based figures our results indicate that the nonmonotonicity is less pronounced. In support of the liquidity hypothesis the relation appears to be rather linear. The more credit risk a firm faces the more longer-term is the average debt maturity structure.

The paper unfolds as follows: The next section provides the empirical methodology and describes in detail the algorithm to estimate the debt maturities. In section two the data set is introduced. In section three we discuss our empirical findings and section four concludes.

1 Empirical methodology

A. Algorithm to measure the maturity of debt

Empirical studies have developed various proxies to estimate the maturity of debt. A first line of research employs a ratio of long-term debt to total debt as proxy (Barclay and Smith (1995), Scherr and Hulburt (2001), Schiantarelli and Sembenelli (1997)). However, there are many different definitions of long- and short-term debt and balance sheet debt ratios can only provide a rather vague estimation of the true average maturity. Long-term is defined as longer than one year (i.e., Scherr and Hulburt (2001)), three years (i.e., Barclay and Smith (1995)) or five years (i.e., Schiantarelli and Sembenelli (1997)). As a consequence, these ratios do not differentiate e.g. between long-term debt of 5 years and long-term debt of 15 years.

Another group of authors investigated new debt issues only and defined the average term to maturity of the issued debt as their dependent variable (Guedes and Opler (1996), Mitchell (1993), Morris (1992)). However, this approach only offers information on the incremental maturity choice that might significantly deviate from the average maturity of the existing total debt portfolio. Thus, the conclusion of tests that relate balance sheet items such as asset maturities to incremental debt issues appears to be limited (Stohs and Mauer (1996)).

From this critique a third measurement approach evolved which tried to incorporate all different debt instruments. Stohs and Mauer (1996) measured a firm's debt maturity as the weighted average maturity of its entire liability structure. However, thorough information on all debt features is scarce. Moreover, their complex measurement could not fully reflect unexpected or unplanned debt payments caused by e.g. affirmative covenants[4] or embedded options in the call or sinking-fund provisions (Barclay and Smith (1995)).

[4] Affirmative covenants force firms to maintain specific levels in financial ratios. An infringement could significantly change the effective time to maturity of debt (Barclay and Smith (1995)).

In this paper we introduce a novel approach that estimates the maturity of a firm's debt based on debt flow and level data. This approach provides a comprehensive view on the characteristics of the debt maturity structure as it implicitly includes all kind of debt instruments and features. The resulting effective maturities might have different characteristics to the more commonly explored nominal maturities.

In a first step, we divide a firm's balance sheet total debt position into long-term and short-term debt. By definition, short-term debt matures in less than one year, therefore it seems plausible to assume an average maturity of 0.5 years. The more challenging part is to estimate the time to maturity of long-term debt since it differs considerably between firms and over time. In our analysis we estimate the maturities by counting lags between cumulative inflows and cumulative outflows of long-term debt. The real data example in table 1 should help to clarify the calculations.

The counting method is based on the following underlying equation:

$$(1) \qquad \mathrm{LD_t} = \mathrm{LD_{t\text{-}1}} + \mathrm{LDI_t} - \mathrm{LDO_t}$$

$$\text{where} \qquad \mathrm{LDI_t} = \mathrm{LDICF_t} + \mathrm{LDIO_t}$$

$$\mathrm{LDR_t} = \mathrm{LDRCF_t} + \mathrm{LDOO_t}$$

The level of long-term debt at time t ($\mathrm{LD_t}$) equals the level of long-term debt at t-1 ($\mathrm{LD_{t\text{-}1}}$) plus the amount of long-term debt inflows at t ($\mathrm{LDI_t}$) and minus the amount of long-term debt outflows at t ($\mathrm{LDO_t}$). The amount of inflows includes the cash flow statement position "long-term debt issuance" ($\mathrm{LDICF_t}$) and an additional term "other long-term debt inflow" ($\mathrm{LDIO_t}$). Correspondingly, the amount of outflows contains the position "long-term debt reductions" ($\mathrm{LDRCF_t}$) and an additional term "other long-term debt outflow" ($\mathrm{LDOO_t}$). The two additional terms lump together the effects of acquisitions and divestitures and various accounting items such as convertible debt, reclassifications of debt, etc. that are not directly reflected in the cash flow data but complete equation (1).

In our example in table 1, the level of long-term debt in period 1 (2,580) equals the level of long-term debt in the previous period 0 (2,399) plus debt issuances in period 1 (461) minus debt outflows in period 1 (288) plus additional debt inflows (8).

We now compute actual maturities by constructing separate time series for cumulative debt inflows and for cumulative debt outflows. The starting value for the times series for cumulative inflows equals the level of debt at the end of the prior period. Cumulative outflows always begin at zero. Accordingly, the equations for cumulative long-term debt inflows ($CLDI_T$) and cumulative long-term debt outflows ($CLDO_S$) are

(2) $$CLDI_T = \sum_t^T LDI_t$$

(3) $$CLDO_S = \sum_s^S LDO_s$$

In the sample calculation, the starting value of cumulative debt inflows in period 1 (2868) is computed as level of debt in period 0 (2,399) plus debt issuance in period 1 (461) plus an additional inflow in period 1 (8). The starting value of the cumulative debt outflows equals the level of debt redemptions in period 1 (288). In period 2 the cumulative debt inflow (3,663) is derived from adding the sum of debt inflows in period 2 (795) to the computed level in period 1 (2,868). Equivalently, cumulative debt outflows in period 2 (557) equal the corresponding level in the previous period (288) plus the debt outflows in period 2 (269). This procedure is continued for the subsequent periods.

For each period *T* we count the number of periods it takes until the value of cumulative debt outflows exceeds the value of cumulative debt inflows from period *T*. Essentially, this counting algorithm replicates the average time span *S*-*T* between the period in which the debt outstanding in period *T* or an equal amount was redeemed. Counting lags should therefore provide fairly accurate estimates for the average number of periods that firms need to repay their outstanding long-term debt. The resulting number equals the average maturity of long-term debt.

(4) $$LDMAT_T = S - T \qquad \text{if } CLDI_T - CLDO_S \leq 0$$

In the example, the cumulative inflows of period 1 are redeemed in period 7 when cumulative outflows (3,382) exceed the value of inflow of period 1 (2,868). Counting lags for the following period 2 we observe that cumulative inflows in period 2 (3,663) are repaid in period 9 (3,909). Correspondingly, the maturity of long-term debt from period 1 is 6 years, the maturity from period 2 is 7 years.

By construct, maturities resulting from the counting-lags technique are biased slightly upwards. Consider that cumulative outflows at the end of year 8 (3,592) are just slightly smaller than cumulative inflows at the end of year 2 (3,663). Although virtually all cumulative inflows from period 2 have already been repaid after 6 years our technique will still produce an average maturity of 7 years.

The total maturity of a firm's debt outstanding is computed as the weighted average of short-term and long-term maturity. Assuming a maturity of short-term debt of 0.5 years the equation emerges to

$$(5) \qquad DEBTMAT_t = LD_t \times LDMAT_t + SD_t \times 0.5$$

In the example, the average debt maturity for period 1 evolves as 5.68 years and for period 2 as 6.50 years.

B. Empirical proxies for explanatory variables

After we have described the algorithm to derive the estimates of debt maturity we now describe the measures we use in our analysis to proxy the main explanatory variable credit risk and the control variables.

B.1 Credit risk

Credit rating **-** Following Stohs and Mauer (1996) RATING represents the S&P long-term issuer credit rating set equal to 1 for AAA through 6 for B. Defining this variable we exclude unrated firms since the characteristics of unrated firms could lead to potential measurement biases.[5] It seems implausible to assume that unrated firms have worse characteristics than firms with the worst credit rating. Similarly to Stohs and Mauer (1996) we use the square of the firm's credit rating (RATING_SQUARE) to test nonlinear effects.

Altman's Z-score **-** As in Scherr and Hulburt (2001) who explore the debt maturity structure of small firms we include Altman's Z-score (ZSCORE) as additional proxy. The Z-score predicts the risk of bankruptcy and is designed to forecast failure in the short-term (up to two years). [6] To control for nonmonotonicity, we equivalently use the square of the z-score (ZSCORE_SQUARE).[7]

Beta **-** Following Blume, et al. (1998) we include beta coefficients to capture a firm's market risk assuming that a firm's capacity to meet its financial commitments declines as market risk

[5] Barclay and Smith (1995) and Stohs and Mauer (1996) also include unrated firms as an own cluster assigning them the highest number.

[6] We derive the Altman's Z-score from the COMPUSTAT data base. It consists of a weighted average of five financial ratios (EBIT / total assets, sales / total assets, total equity / total debt, working capital / total assets, retained earnings / total assets). Values below 1.8 indicate high bankruptcy risk, and z-scores above 3 indicate low bankruptcy risk. Z-scores in between lie in a grey area.

[7] Theoretically, Z-scores could take on negative values but they do not do so in our sample.

increases. As beta coefficient we use the absolute value of a firm's unlevered asset beta (BETA) and the square of the beta (BETA_SQUARE) from the market model.[8]

Firm size - The larger firms are in size the higher is the probability to survive in the long run (Queen and Roll (1987)). Therefore we take in firms size as an additional proxy**.** Larger firms tend to have easier access to long-term debt because they bear lower agency costs and are likely to have more tangible assets in relation to future investment options. The issue costs of large public debt also play an important role for employing debt. Large firms benefit from economies of scale reducing the immense fixed cost component. On the contrary, small firms cannot afford the costs of frequent issues and prefer shorter-term private (bank) debt (Blackwell and Kidwell (1988)). Like Barclay and Smith (1995) and Stohs and Mauer (1996) we empirically measure firm size as total market capitalization (SIZE and SIZE_SQUARE).

Leverage - As liquidity risk increases with leverage, high-leveraged firms would be inclined to use more long-term debt (Diamond (1991)). We therefore follow Stohs and Mauer (1996) and control for leverage by including the debt-to-capital ratio (LEVERAGE and LEVERAGE_SQUARE) in the models.

B.2 Control variables

In order to isolate the effect of credit risk on the choice of debt maturity it is necessary to control for other important factors which might influence the debt maturity choice. In theoretical and empirical research on the determinants of the debt maturity structure the following four factors have proved to be most influential.

Asset maturity - According to the results of a large survey among managers (Graham and Harvey (2001) and strong empirical evidence (e.g. Guedes and Opler (1996), Stohs and Mauer (1996)) maturity immunization plays a dominant role. Firms match their debt and asset maturities to control for the costs of financial distress (Myers (1977)). Therefore, we project a positive relation between asset maturity and debt maturity. Similarly to Guedes and Opler (1996) and Stohs and Mauer (1996) we estimate the maturity of a firm's assets by the ratio of Net Property Plant & Equipment over Depreciation (ASSETMAT).

[8] Historical asset betas were estimated by regressing monthly betas on the S&P market index for a rolling two-year time window.

Growth - Myers (1977) argues that risky debt financing can induce suboptimal investment decisions given that a firm's set of future investments provides growth opportunities. Regarding future investments as call options the value of the options is equal to the present value of the growth opportunities and depends on the management's decision to exercise the options. If bondholders capture too much of the benefit of a profitable project, stockholders may have an incentive to "underinvest" and reject positive net present value projects. Myers (1977) claims that shorter-term debt can control for underinvestment problems if it matures before the investment (growth) options are exercised. It then leaves both lenders and borrowers the opportunity to recontract.[9] The mirror image of underinvestment is the asset substitution problem that arises when firms substitute riskier assets for the firm's existing assets and seize value from the debtholders. Barnea, et al. (1980) argue that employing short-term debt reduces the risk of asset substitution because short-term debt is more insensitive to shifts in the risk of the underlying asset. Since firms with high growth opportunities are more likely to suffer from underinvestment and asset substitution problems they should have a strong incentive to borrow short-term. As in most empirical studies, a firm's growth opportunities (GROWTH) are proxied by the ratio of a firm's market value of equity to the book value of equity (price-to-book ratio).[10] The more growth options there are in a firm's investment opportunity set, the larger is a firm's price-to-book ratio (Smith and Watts (1992)).

Signaling - According to Flannery (1986) and Kale and Noe (1990) a firm's debt maturity structure can signal insider information about the firm's quality assuming asymmetric information and positive transaction costs. When a firm has insider information about its prospects, its debt is possibly mispriced. However, mispricing of long-term debt is greater because it is more sensitive to price changes. Undervalued firms could therefore signal their quality by issuing short-term debt whereas overvalued firms would still prefer long-term debt because they cannot afford the roll-over flotation costs. As an empirical proxy for the firm's quality we use the firm's abnormal future earnings assuming that high quality (undervalued) firms have positive future abnormal earnings and low quality (overvalued) firms have negative future abnormal earnings. Abnormal earnings in t+1 (SIGNAL) are defined as EBIT in t+1 minus EBIT in t scaled by EBIT in t.[11]

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[9] Other ways to mitigate the underinvestment problem include an overall reduction of debt in the capital structure and restrictive debt covenants.

[10] This measure is also used in e.g. Barclay and Smith (1995), Guedes and Opler (1996), Stohs and Mauer (1996).

[11] This measure is also used in e.g. Ozkan (2000), Ozkan (2002). For robustness we also use future abnormal earnings per share (EPS) as in Barclay and Smith (1995), Stohs and Mauer (1996).

Tax benefits - According to Brick and Ravid (1985) and Kane, et al. (1985) the optimal debt maturity depends on the value of the tax advantage of debt. Brick and Ravid (1985) demonstrate that the present value of the tax shield could be enhanced by employing more long-term debt if the yield curve is upward sloping.[12] This applies only if a firm expects unshielded income. Therefore, we predict a positive relation between a firm's effective marginal tax rate and debt maturity. However, Kane, et al. (1985) report an increase in the optimal debt maturity as the tax advantage decreases in order to ensure that the remaining tax shield still outweighs amortized debt issue flotation costs. To measure the effect of tax benefits we include the effective tax rate and the term premium into the models. As in Guedes and Opler (1996) the effective tax rate is calculated as the ratio of income taxes paid to EBIT (TAXRATE) and the term structure as the interest rate spread between 20-year-Government Bond and 3-month-T-Bill, matched to the firm's fiscal year-end (TERM).

2 Data

Data for our analysis was derived from COMPUSTAT, a database that provides extensive balance sheet and cash flow information on firms. The sample was constructed as follows. Initially, relevant annual data from all firms that are S&P Index members (S&P 500, S&P MidCap 400, S&P Small Cap 600) was obtained over a period of 16 years from 1989 to 2004. Secondly, companies that operate in the financial sector were excluded. This sample of 1258 firms was finally reduced to 710 firms primarily because debt flow and level data was unavailable. The maturity window was calculated for a four year time period from 1995-1998. The final sample consists of 710 different firms and 2840 firm years.[13]

Table 2 shows descriptive statistics on the key variables of our analysis. The average firm had a total market capitalization of $1.4 billion, a price-to-book ratio of 3.5 and positive abnormal earnings. Approximately 44% of average capital was financed with debt. 519 firms have a S&P long-term issuer credit rating, 1% with AAA, 4% with AA, 21% with A, 42% with BBB, 26% with BB and 7% with B. In total, 278 firms (54% of all rated firms) have an investment grade rating of BBB and higher. According to Altman's z-score, 56% of firms were considered to have a low bankruptcy risk, 25% lie in a grey area and 19% have a high risk to default. The

[12] Under the assumptions that corporate borrowing has a tax advantage and the term structure of interest rate is nonflat.

[13] Approx. 1.85% of data was unavailable and therefore replaced by the mean of the available data from other years. In three cases where no data was available for the amount of "long-term debt due in one year" it was assumed to be 0. To control for outliers the key variables were winsorized at the 1% level.

sample firms operate in various industries. Manufacturing, transportation/utilities, service and retail firms represent the four largest industries accounting for 87% of all firms in the sample.

3 Results and discussion

In this section we test the underlying hypotheses on credit risk and other control factors by investigating whether the debt maturities estimated in section two can be explained by empirical proxies of the theoretical constructs. Following the liquidity hypothesis we expect a positive relation between debt maturity and credit risk for different measures (RATING, ZSCORE, BETA). As liquidity risk increases with leverage, high-leveraged firms would be inclined to use more long-term debt (LEVERAGE). However, according to theories on asymmetric information and agency costs firms with very high credit risks are screened out of the long-term end of the maturity spectrum and have to borrow shorter-term. Therefore, firms with very high or very low credit risk tend to use more short-term debt than medium credit risk firms. Additionally, we expect small firms (SIZE) with high growth opportunities (GROWTH) and high quality firms (SIGNAL) to use more short-term debt, while other firms prefer long-term debt. Firms are expected to match their asset and debt maturities (ASSETMAT) and to consider tax benefits (TAXRATE).

The analysis of the determinants of corporate debt maturity is presented in three steps. Firstly, we present the results of our calculation of the debt maturities. Secondly, we highlight some key stylized facts and investigate univariate relationships between debt maturity and its explanatory variables. Thirdly, we estimate multivariate Ordinary Least Square (OLS) panel models to analyze multiple effects.

A. Debt maturity estimates

The estimation of the maturity of a firm's outstanding debt yields a positively skewed allocation of maturities with the bulk of observations between two and four years (see figure 1). The mean debt maturity over all firms for the 4-year period from 1995 to 1998 is 4.21 years with a standard deviation of 2.09 years.

Our estimated average debt maturity is slightly higher than the mean maturity of 3.38 years that was found by Stohs and Mauer (1996) for their sample of 328 US firms between 1980 and 1989. A small difference remains even if we consider that our maturities from the counting-lags technique are biased slightly upwards.

Table 3 tabulates the allocation of average debt maturities per year and per industry. The results indicate that the average time to maturity over all firms of approx. 4.2 years remains fairly constant. However, averaging over all firms conceals significant industry-specific trends in debt maturity. In fact, 320 firms in the sample have extended their average time to maturity from 1995 to 1998, 390 firms have reduced it. The maximum increase in maturity within the four years is 6.40 years, the maximum decrease is 6.48 years. These results indicate that our estimation method is applicable and leads to plausible results.

Looking at the median over the four-year time window we observe large industry-specific differences in the development of debt maturity. In manufacturing, in retailing and in the group of other industries (e.g. construction, agriculture) the average debt maturity remains quite stable over the four years. However, we observe a considerable decrease of 12.2% in the transportation/utilities industry. This decline is associated with lower abnormal earnings, higher growth opportunities and lower asset maturities. Conversely, an increase in debt maturity of 11.8% can be observed in the services industry. This increase coincides with a decrease in credit quality and effective tax rate and with an increase in size and leverage. A large increase in debt maturity can be identified for the mining industry with 31.9%. Correspondingly, we observe a sharp increase in leverage and a considerable decline in credit quality, future abnormal earnings and growth. Following a similar trend, average debt maturity in the wholesale industry increases by 29.2% accompanied by a significant decrease in credit quality, asset maturity and growth and a jump in the effective tax rate.

B. Stylized facts and univariate analysis

Figure 2 compares several measures of credit risk in their relation to debt maturity for the pooled time-series cross-sectional data. Consistent with theory on credit risk the first graph indicates a nonmonotonic relation between credit rating and debt maturity. Firms with very high ratings and firms with speculative ratings tend to have shorter debt maturities than firms with a medium rating. Firms with low credit quality would prefer long-term debt to avoid liquidity risks but are screened out of the long-term end of the maturity spectrum. However, the debt maturity structure for medium-rated and unrated firms deviates drastically from the results in Stohs and Mauer (1996). The screenout process of low quality firms seems to start significantly earlier. The average debt maturity reaches a maximum of 5.25 years for A-rated firms and from there decreases monotonically to B-rated firms.[14] Unexpectedly, unrated firms have a slightly higher average debt maturity than B-rated firms. This hump-shaped relation is very similar for

[14] In Stohs and Mauer (1996), figure 2, the average debt maturity monotonically increases to a maximum of 4.92 years for B-rated firms.

all industries. The observation of unusual high maturities for unrated firms is even more pronounced for firms in the transportation/utilities, retailing and service industries.

Consistent with most empirical studies the logarithmized market value of equity (SIZE) shows a positive trend. Although large firm size would suggest low credit risk, the larger a firm, the more long-term debt it holds. However, for very large firms (above 25 $B) this trend is reversed, they borrow on average considerably more shorter-term. The correlation analysis of credit risk factors in table 4 shows a high correlation between SIZE and RATING (-0.535) which might indicate that the hump-shape of credit rating is partly driven by firm size.

In contrast to the credit rating a firm's bankruptcy risk measured by Altman's Z-score clearly confirms the liquidity hypothesis. The higher the bankruptcy risk (the lower Altman's Z-score), the longer is the average debt maturity - except for a small decrease for firms with very low scores. Contrary to the observations in Scherr and Hulburt (2001) the screenout process does not seem to be influenced by the bankruptcy risk measure. It might be the case that banks do not use ratios such as the Z-score to evaluate a firm's credit quality. However, the Z-score consists of important accounting measures that should be part of every credit quality assessment, particularly if no external credit rating is available.

The Z-score is partly driven by leverage as the high correlation between LEVERAGE and ZSCORE (-0.558) underlines. In our data we observe a hump-shaped relation between leverage and debt maturity. Contrary to the findings of previous studies leverage also shows a non-monotonic relationship to debt maturity. Firms with very low leverage and those with very high leverage borrow considerably shorter-term than firms with medium leverage.

For beta factors the nonlinear effect is also visible but less pronounced. High-beta and low-beta firms tend to have shorter debt maturities than medium-beta firms.

In table 5 we depict some descriptive statistics for the control factors: Abnormal earnings (SIGNAL) descend monotonously from band 1 to 4 which indicates that the higher the abnormal earnings the shorter is the average debt maturity. A similar trend can be observed for the average price-to-book ratio (GROWTH). The more growth options a firm has to offer the shorter is the average debt maturity. As expected, the proxy for asset maturity (ASSETMAT) is clearly positively correlated with debt maturity. Fairly constant means can be observed for the effective tax rate (TAXRATE) and the term spread (TERM). Except for these two factors the corresponding Kruskal-Wallis test with the null hypothesis that the variables are uniformly distributed over the four maturity groups can be rejected at the one percent level.

Investigating the diverse characteristics of firms from different industries, Table 6 shows a mean difference test for industry affiliation. Notably, firms from the transportation/utilities industry deviate drastically from other firms in the sample. Firms in this industry are characterized by large size, high leverage and low growth. Measures for credit quality show unambiguous results. The low beta factor points to rather low market risk, but the low average Altman's z-score indicates high bankruptcy risk. Nonetheless, credit rating does not differ significantly. Firms from the transportation/utilities industry are on average the largest firms with the highest debt and asset maturities. The high average debt maturities might be due to the enormous capital investments transportation/utilities firms typically have to make. Regulation might also play a role, in particular for utility firms. According to Smith (1986) the reduced managerial discretion of regulated firms leads to higher agency cost and therefore to longer-term maturities.

C. Multivariate analysis

In order to account for multiple effects we run several multivariate regression models. In the industry-specific descriptive statistic (table 6) we have determined that some of the variation of debt maturities may be attributable to industry specifics. Therefore we control for industry-specific effects by including four industry dummies based on SIC codes representing manufacturing, transportation/utilities, servicing and retailing firms.[15] The results of the multivariate analysis are presented in two steps. Firstly, we summarize the results of the OLS regressions for all determinants of debt maturity. Secondly, in a specification check for the pooled cross-sectional time series data we focus on various alternative measures of credit risk.

C.1 Determinants of debt maturity

Table 7 depicts the results for the panel regression analysis. In the first four columns the results of the pooled and cross-sectional regressions are presented. Heteroskedasticity-consistent standard errors based on Huber (1967) and White (1980) are reported in parentheses. [16] The results of the Prais-Winsten OLS regression are shown in the last two columns.[17] In order to account for heteroskedastic error terms we follow the approach of Beck and Katz (1995) using common

[15] These four industry dummies represent 87% of firms in the sample.

[16] The tests of White and Breusch-Pagan / Cook-Weisberg both indicate heteroskedastic error terms. An analysis of the Variance Inflation Factors (VIF) indicates no multicollinearity among the predictors.

[17] The Woolridge test detected significant autocorrelation (Drukker (2003), Woolridge (2002)). Therefore, we used the Prais-Winsten transformed regression estimators assuming common AR(1) errors to correct for the autocorrelation.

panel-corrected standard errors.[18] Per each regression type we calculated a model with industry dummies and another model without industry dummies. To a large extent the results corroborate previous empirical research and therefore further confirm the validity of our debt maturity estimates.

Results indicate that agency costs of debt play a dominant role in determining debt maturity. The data reports strong evidence for the hypothesis that firms try to match their asset and debt maturities to immunize against duration risk. In all regressions the coefficients of asset maturity are positive and significant at the 1% level. However, the economic impact is less than expected. For example, coefficient estimates from the pooled regression with industry dummies indicate that a one-year increase in asset maturity only induces an 0.086 years increase in debt maturity. The significantly higher coefficient in the regression models without industry dummies implies that the rather weak influence might be due to large industry differences. An industry-specific regression analysis reveals that maturity matching is most important for firms in the transportation/utilities industry whereas it is insignificant for retailing firms. In contrast to the results in Stohs and Mauer (1996) the growth hypothesis could also be strongly confirmed. Firms with high growth opportunities seem to have an incentive to borrow more short-term to avoid underinvestment and asset substitution problems. Coefficient estimates for the price-to-book ratio are negative and significant in all regression models. For example, for the pooled regression the results imply that a one standard deviation increase in the price-to-book ratio decreases average debt maturity by 0.27 years.

Our results also found confirming evidence for the signaling hypothesis which states that undervalued firms signal their quality by issuing short-term debt whereas overvalued firms prefer long-term debt to avoid the roll-over flotation costs. All coefficient estimates on future abnormal earnings show a negative sign and were significant in the pooled and in the cross-sectional regression. For example, the regression coefficients in the pooled regression indicate that a one standard deviation increase in abnormal earnings would decrease the debt maturity structure by 0.14 years. However, the robustness of result seems to be uncertain since coefficient estimates in the Prais-Winsten regression are insignificant.

Tax effects only seem to play a minor role in the debt maturity choice. Results in the pooled and the cross-sectional regressions indicate a significant positive relationship between debt maturity and the effective corporate tax rate. This positive relationship would corroborate the reasoning

[18] Beck and Katz (1995) make a strong case for estimating a common AR parameter for all panels rather than panel-specific AR parameters.

of Brick and Ravid (1985) who state that firms with higher effective tax rates and thus higher benefits from tax shields tend to have more long-term debt than other firms. However, the economic impact of the tax rate appears to be rather weak. For example, coefficient estimates in the pooled regression indicate that a 10-percentage point increase in the effective tax rate results in an increase in average debt maturity of 0.05 years. As in most previous studies the debt maturity choice does not seem to be influenced by the term structure of interest rates. Coefficient estimates of TERM are insignificant in all regressions.

Consistent with the findings of Barclay and Smith (1995) and Guedes and Opler (1996) is the importance of industry affiliation. The industry dummy “Transportation/Utilities” is highly significant in all regression models. The positive sign confirms our previous conjecture that in particular firms from the utility industry tend to have longer debt maturities. This trend can be explained by industry characteristics such as low growth opportunities, low credit quality, high leverage, large size and high asset maturities. A similar positive trend can be observed for the dummy “Retail”, although coefficients in the cross-sectional regression are insignificant.

The relation between credit risk and debt maturity measures will be further assessed in the following section. The negative sign for RATING as well as the insignificant influence of SIZE and LEVERAGE seem to be at odds with previous empirical findings.

C.2 Specification check for different credit risk measures

Results from the univariate and correlation analysis suggest that the relation between credit risk and debt maturity might be different for various empirical proxies of credit risk. Therefore, in a specification check in table 8 we test several alternative measures of credit risk and contrast the results.

As univariate and correlation analyses predict the effect of credit rating is nonmonotonic. In contrast to the results of Barclay and Smith (1995) the negative sign of the variable RATING (model 4) indicates an inverse relationship between credit rating and debt maturity. The decrease in average debt maturity from A-rated to B-rated firms seems to dominate the maturity increase from AAA-rated to A-rated firms. However, if we additionally take the square of RATING into the model the sign of RATING changes to positive and RATING_SQARE turns significantly negative (models 1 and 5). Firms with a high credit ratings seem to be more inclined to borrow shorter term whereas firms with low credit ratings borrow long-term.[19]

[19] This result remains valid if we alternatively include dummies for high and low rated firms.

Coefficient estimates from model (1), for example, indicate that if a firm's credit rating declines by one-letter the debt maturity increases by 0.49 years. However, the rate of increase drops by 0.12 years for each following lower rating.

As acknowledged in the univariate analysis, the credit rating is largely driven by firm size. Regression results imply that the relation between SIZE and DEBTMAT also appears to be nommonotonic. The larger a firm's size the more it tends to borrow at the long-term end of the maturity spectrum, but with a decreasing rate (see models 3 and 4). However, the effect of size turns insignificant if a measure for the S&P credit rating is included in the model (see model 6). SIZE and RATING are highly negatively correlated that firms with a larger size tend to have a better credit rating. The interpretation is that firm size only indirectly affects debt maturity choice as it determines the credit rating. This result differs from previous findings of Stohs and Mauer (1996) and Guedes and Opler (1996) who report significant linear relationships.

Using ZSCORE as a measure for credit risk the picture changes slightly. ZSCORE shows a negative sign in all regressions. Firms with low bankruptcy risk typically borrow shorter-term, whereas firms with high bankruptcy risk borrow longer-term. For example, the regression coefficient from model (2) implies that a one standard deviation increase in credit quality reduces average debt maturity by 0.7 years. The nonlinear effect measured by the square of Z-score seems to be economically rather insignificant. The interpretation is that according to Altman's Z-Score the screen-out process of firms with high credit risk from the long-term debt market is almost not existent. Confirming the trend in the univariate analysis our results deviate from those of Scherr and Hulburt (2001) who find a significant nonmonotonic relation of Z-score for their sample of small firms.

In the univariate analysis the Z-score was partly driven by leverage. In contrast to the empirical results in Stohs and Mauer (1996) the effect of LEVERAGE seems to be nonmonotonic. Only when we include the square of leverage into the models does LEVERAGE become statistically and economically significant. For example, the regression coefficient estimate in model (1) indicates that an increase in leverage by one standard deviation increases average debt maturity by 1.22 years.

Market risk measured by BETA does not seem to explain much in the debt maturity choice. A negative coefficient could be observed for BETA in model 3 which indicates that the higher the systematic risk of a firms' assets the shorter-term is the average debt maturity. If we include the square of BETA into the model, both variables become insignificant (see model 4). Similarly, if we include any other credit risk variable the effect of BETA turns insignificant. Looking at the R^2, beta provides the lowest contribution of all credit risk measures.

In conclusion, the assessment of different proxies for credit risk provides some interesting observations. Firstly, the screen-out of firms with bad credit ratings from the long-term maturity spectrum suggests that the credit rating might be the dominant proxy for credit lenders to assess a borrower's credit quality. Thus, the credit rating determines the firm's flexibility of choosing their optimal debt maturity. The observed shift of the hump in the debt maturity structure for different credit ratings in contrast to previous studies could indicate that firms have to pay even more attention to their credit rating. Secondly, the linear relation of Altman's Z-score supports the liquidity hypothesis and could imply that purely accounting based proxies are less relevant for lenders. Thirdly, market risk appears to have no significant influence on the debt maturity structure of firms.

4 Conclusion

Based on a new approach to measure a firm's debt maturity we have reviewed the role of credit risk in a firm's debt maturity choice and provided new empirical evidence on alternative proxies of credit risk. The strength of the employed algorithm to estimate debt maturities is that it provides a holistic view on effective maturities incorporating all debt instruments and features. The counting-lags method is intuitive and also applicable for non-rated firms.

We calculated a mean debt maturity over all firms of 4.21 years which is slightly higher than in previous studies. The average debt maturity differs enormously between industries. Testing the prevailing hypotheses on the determinants of debt maturity our results largely confirm previous research results and therefore indicate that our debt maturity estimates are reasonable and robust. We focused on different measures for credit risk and came to interesting new insights. We generally confirm the nonmonotonic trend relation between credit risk and debt maturity, but the exact relation strongly depends on the proxy used.

As projected the relation for credit rating as proxy is hump-shaped. However, we observe remarkable differences in the debt maturity structure for firms with medium ratings and unrated firms. The first observation is that the screen-out process of firms with low credit quality appears to begin at credit ratings below A. The second observation is that average debt maturity does not drop for unrated firms, indeed these firms even have a slightly better credit quality than B-rated firms. As our analysis shows the credit rating is largely driven by firm size. Results suggest that in order to maintain flexibility in the debt maturity choice firms might need to monitor closely their credit rating.

Using alternative measures for credit risk incorporating accounting and market based proxies the nonmonotonic trend is less pronounced. The linear relationship between Altman Z-score and debt maturity supports the liquidity hypothesis and might indicate that simple accounting measures do not seem to be critical for the screen-out process of firms with high credit risk. Moreover, market risk measured by beta factors appears not to be insignificant.

A possible extension of this study could be to employ a similar analysis of the role of credit risk in the debt maturity choice for other countries. Foremost, it would be interesting to examine countries with different financial systems where the role of credit rating is in different stages of maturation. In order to further support the hypothesis that firms with very low credit ratings are screened out of the long-term debt market it would be necessary to include information on debt pricing. Moreover, new insights into the role of credit risk might be derived by examining the optimal maturity of total liabilities if debt and equity maturities are chosen simultaneously.

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Figure 1: Range of estimated maturities

Figure 1 depicts the allocation of estimated debt maturities. The allocation is positively skewed and concentrates in the range between two and four years.

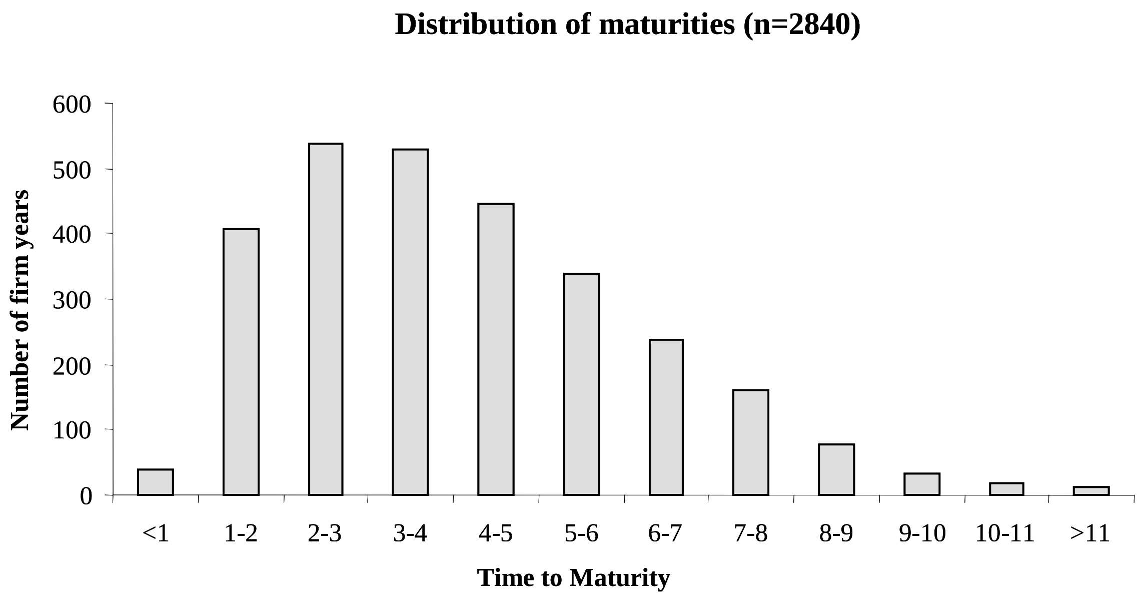

Figure 2: Comparison of credit risk measures

Figure 2 depicts the mean maturities for several proxies of credit risk. S&P Credit Rating represents the S&P long-term issuer credit rating (AA through B, NR denotes Not Rated). Altman's Z-score predicts the risk of bankruptcy up to two years (scores below 1.8 indicate high bankruptcy risk, and z-scores above 3 indicate low bankruptcy risk). Leverage is measured as total debt divided by total invested capital. Beta represents the absolute value of the unlevered asset beta. Size denotes the market value of equity (in $B).

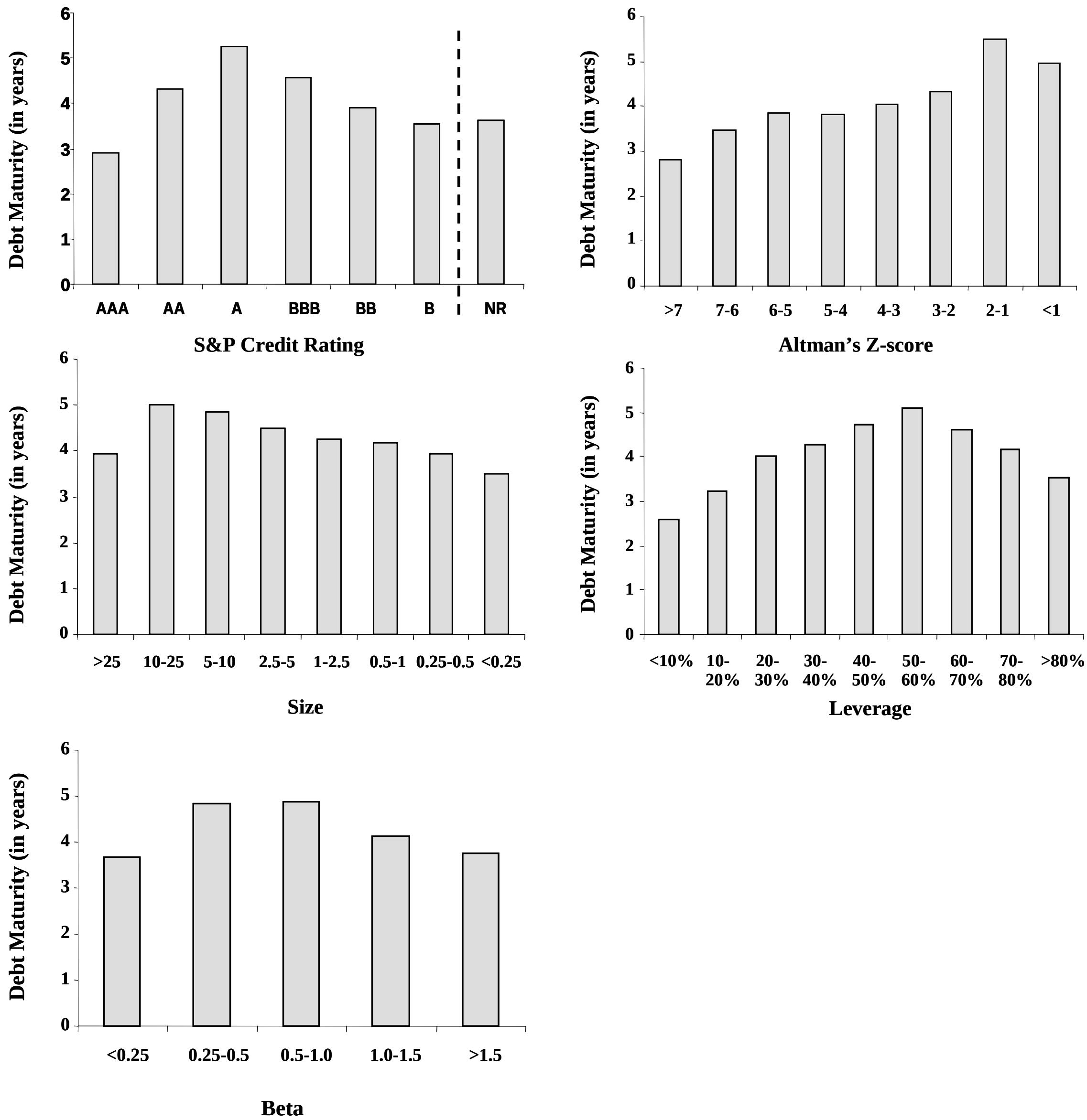

Table 1: Example for a specific firm's debt maturity calculation

The real data example explains the algorithm to derive debt maturities from debt level and flow data. The maturities are calculated based on counting lags between cumulative inflows and cumulative outflows of debt. The counting algorithm replicates debt maturity as the average time span S-T between the period in which the debt outstanding in period T or an equal amount was redeemed.

	Year	0	1	2	3	4	5	6	7	8	9
(1)	ST-debt		**161**	**261**	213	307	211	227	124	176	172
(2)	LT-debt	**2,399**	**2,580**	3,106	3,299	3,673	3,371	2,708	1,921	2,109	2,649
(3)	LT-debt inflow (CF)		**461**	**786**	675	548	290	25	0	398	848
(4)	LT-debt outflow (CF)		**288**	**269**	524	168	642	689	795	209	317
(5a)	Other LT-debt inflow		**8**	**9**	42		50	1	8		9
(5b)	Other LT-debt outflow					6				1	
(6)	Total LT-debt inflow		**2,868**	**795**	717	548	340	26	8	398	857
(7)	Total LT-debt outflow		**288**	**269**	524	174	642	689	795	210	317
(8)	Cum LT-debt inflow		**2,868**	**3,663**	4,381	4,928	5,269	5,295	5,303	5,702	6,558
(9)	Cum LT-debt outflow		**288**	**557**	1,081	1,256	1,898	2,587	**3,382**	3,592	**3,909**
(10)	Maturity LT-debt		**6**	**7**							
(11)	Maturity ST-debt		**0.5**	**0.5**							
(12)	Total debt maturity		**5.68**	**6.50**							

Table 2: Descriptive Statistics

The table reports descriptive statistics on key variables of our analysis. The variables are defined as follows: DEBTMAT is the average maturity of a firm's debt outstanding (in years); SIGNAL are abnormal earnings in t+1 calculated as EBIT in t+1 minus EBIT in t scaled by EBIT in t; ZSCORE denotes short-term credit quality proxied by Altman's Z-score; RATING represents the S&P long-term issuer credit rating (set equal to one for AAA trough 6 for B); BETA represents the absolute value of the unlevered asset beta. GROWTH stands for price-to-book ratio computed as the ratio of market value of equity to book value of equity; SIZE denotes the natural logarithm of the market value of equity (in $B); ASSETMAT is a proxy for asset maturity measured as the ratio of net property, plant & equipment to depreciation (in years); TAXRATE is the effective tax rate calculated as the ratio of income taxes paid to EBIT; TERM denotes the spread between 20-year government bond and 3-month-t-bill (in %); LEVERAGE is measured as total debt divided by total invested capital multiplied by 100.

						Quartiles		
Variable	Obs.	Mean	Stand.Dev	Min	Max	25%	50%	75%
DEBTMAT	2840	4.21	2.09	0.50	12.70	2.64	3.89	5.59
SIGNAL	2840	0.16	1.01	-4.86	5.04	-0.04	0.13	0.33
ZSCORE	2708	3.85	2.71	0.48	16.86	2.11	3.29	4.76
RATING	2064	4.09	0.99	1.00	6.00	3.00	4.00	5.00
BETA	2711	0.40	0.38	0.00	2.22	0.12	0.28	0.52
GROWTH	2816	3.50	3.38	0.35	22.63	1.70	2.49	3.96
SIZE	2828	7.24	1.62	3.68	11.47	6.12	7.08	8.32
ASSETMAT	2832	8.95	5.62	1.32	29.45	5.12	7.34	11.15
TAXRATE	2808	0.23	0.19	-0.60	1.10	0.13	0.24	0.32
TERM	2840	1.24	0.39	0.68	2.17	1.01	1.05	1.66
LEVERAGE	2840	43.97	24.90	1.04	139.79	26.79	43.03	56.68

Table 3: Alternation of the maturity window

Table 3 shows the allocation of average debt maturities for various industries and years. The column presents the result for the four-year period from 1995 to 1998, columns two to five show average results per each year. The last column shows the change in average maturity over the four-year time window.

Debt maturity		**1995-1998**	**1995**	**1996**	**1997**	**1998**	**Change 95-98 (in %)**
Total	Mean	4.21	4.26	4.19	4.16	4.23	-0.86%
	Median	3.89	3.88	3.88	3.865	3.95	1.80%
	St.Dev	2.09	2.22	2.10	2.07	1.96	
	# of obs	2840	710	710	710	710	
Manufacturing	Mean	3.87	3.91	3.87	3.79	3.90	-0.37%
	Median	3.59	3.64	3.6	3.46	3.62	-0.55%
	St.Dev	1.85	1.92	1.86	1.87	1.75	
	# of obs	1404	351	351	351	351	
Transp./Utilities	Mean	5.71	6.07	5.74	5.60	5.42	-10.63%
	Median	5.60	6.05	5.75	5.49	5.31	-12.23%
	St.Dev	2.21	2.40	2.25	2.14	2.00	
	# of obs	540	135	135	135	135	
Retailing	Mean	4.34	4.48	4.23	4.29	4.38	-2.23%
	Median	3.97	3.97	4	3.95	3.95	-0.50%
	St.Dev	2.29	2.46	2.31	2.19	2.24	
	# of obs	248	62	62	62	62	
Services	Mean	3.54	3.53	3.61	3.39	3.62	2.68%
	Median	3.01	3.22	3.02	2.98	3.6	11.80%
	St.Dev	1.76	1.87	1.73	1.63	1.83	
	# of obs	284	71	71	71	71	
Wholesale	Mean	3.94	3.42	3.83	4.25	4.28	25.32%
	Median	3.76	3.04	3.4	3.83	4.01	31.91%
	St.Deb	1.91	1.74	1.96	2.05	1.85	
	# of obs	140	35	35	35	35	
Mining	Mean	3.66	3.22	3.40	3.96	4.06	26.06%
	Median	3	2.975	3	3.71	3.845	29.24%
	St.Deb	1.75	1.48	1.73	1.86	1.84	
	# of obs	136	34	34	34	34	
Other	Mean	3.647159	3.47	3.57	3.75	3.79	9.12%
	Median	3.165	3.025	3.83	3.325	2.965	-1.98%
	St.Deb	1.782349	1.59	1.51	2.02	2.05	
	# of obs	88	22	22	22	22	

Table 4: Correlation analysis of credit risk measures

This table presents pairwise correlation coefficients between all credit risk measures. ZSCORE denotes short-term credit quality proxied by Altman's Z-score; SIZE denotes the natural logarithm of the market value of equity (in $B); RATING represents the S&P long-term issuer credit rating (set equal to one for AAA trough 6 for B); LEVERAGE is measured as total debt divided by total invested capital multiplied by 100; BETA represents the absolute value of the unlevered asset beta. *,**,*** denote significance at the 10%, 5% and 1%-level, respectively.

Correlation Matrix	DEBTMAT	ZSCORE	SIZE	RATING	LEVERAGE
ZSCORE	-0.3086 ***				
	(0.000)				
SIZE	0.162 ***	0.057 ***			
	(0.000)	(0.003)			
RATING	-0.185 ***	-0.232 ***	-0.535 ***		
	(0.000)	(0.000)	(0.000)		
LEVERAGE	0.133 ***	-0.558 ***	0.107 ***	0.114 ***	
	(0.000)	(0.000)	(0.000)	(0.000)	
BETA	-0.183 ***	0.303 ***	-0.203 ***	0.084 ***	-0.268 ***
	(0.000)	(0.000)	(0.000)	(0.002)	(0.000)

Table 5: Comparative statistics on other determinants

Debt maturities are divided into four maturity windows of 0-2, 2-4, 4-6 and more than 6 years. The mean difference test in the table below reveals potential relationships between debt maturity and its determinants. The variables are defined as follows: SIGNAL are abnormal earnings in t+1 calculated as EBIT in t+1 minus EBIT in t scaled by EBIT in t; GROWTH stands for price-to-book ratio computed as the ratio of market value of equity to book value of equity; SIZE denotes the natural logarithm of the market value of equity; ASSETMAT is a proxy for asset maturity measured as the ratio of net property, plant & equipment to depreciation (in years); TAXRATE is the effective tax rate calculated as the ratio of income taxes paid to EBIT; TERM denotes the spread between 20-year government bond and 3-month-t-bill (in % points).

Descriptive statistics across firms							
Window		SIGNAL	GROWTH	SIZE	ASSETMAT	TAXRATE	TERM
0-2y	Mean	0.29	4.29	6.76	6.68	0.25	1.28
	N	447	447	445	447	440	447
	Std. Dev.	1.17	3.77	1.75	3.73	0.19	0.41
2-4y	Mean	0.19	3.87	7.06	7.80	0.22	1.24
	N	1068	1057	1062	1066	1056	1068
	Std. Dev.	1.07	3.72	1.61	4.67	0.19	0.40
4-6y	Mean	0.09	3.07	7.56	9.34	0.24	1.21
	N	784	773	784	782	773	784
	Std. Dev.	0.90	2.91	1.56	5.57	0.20	0.39
6+y	Mean	0.08	2.72	7.53	12.53	0.23	1.22
	N	541	539	537	537	539	541
	Std. Dev.	0.85	2.64	1.45	6.81	0.20	0.39
Kruskal-Wallis p-value		0.0001	0.0001	0.0001	0.0001	0.0341	0.0106

Table 6: Industry analysis

Table 1 shows a mean comparison of the key variables in our analysis by industry affiliation displaying a Kruskal-Wallis test with the null hypothesis that the variables are uniformly distributed over the four maturity groups. DEBTMAT is the average maturity of a firm's debt outstanding (in years); SIGNAL are abnormal earnings in t+1 calculated as EBIT in t+1 minus EBIT in t scaled by EBIT in t; ZSCORE denotes bankruptcy risk proxied by Altman’s Z-score; RATING represents the S&P long-term issuer credit rating (set equal to one for AAA trough 6 for B); BETA represents the absolute value of the unlevered asset beta; GROWTH stands for price-to-book ratio computed as the ratio of market value of equity to book value of equity; SIZE denotes the natural logarithm of the market value of equity; ASSETMAT is a proxy for asset maturity measured as the ratio of net property, plant & equipment to depreciation (in years); LEVERAGE is measured as total debt divided by total invested capital multiplied by 100.

Descriptive statistics across industries

Industry		DEBTMAT	SIGNAL	ZSCORE	RATING	BETA	GROWTH	SIZE	ASSETMAT	LEVERAGE
Manufacturing	Mean	3.87	0.12	4.34	4.89	0.42	3.84	7.35	7.27	40.01
	N	351	351	339	351	348	347	351	351	351
	Std. Dev.	1.60	0.49	2.31	1.62	0.28	3.17	1.62	3.28	22.16
Transportation / Utilities	Mean	5.71	0.13	1.82	4.46	0.27	2.45	7.51	15.04	54.85
	N	135	135	131	135	134	134	133	135	135
	Std. Dev.	2.03	0.39	1.02	1.35	0.21	1.74	1.49	6.48	15.59
Retail	Mean	4.34	0.31	5.04	5.05	0.52	3.61	7.30	10.20	37.36
	N	62	62	62	62	62	62	62	62	62
	Std. Dev.	2.14	0.33	2.23	1.59	0.29	2.61	1.59	4.28	21.47
Services	Mean	3.54	0.30	4.44	5.23	0.43	4.64	6.91	6.61	43.64
	N	71	71	67	71	68	71	70	71	71
	Std. Dev.	1.55	0.63	3.28	1.51	0.26	3.22	1.64	5.55	24.37
Kruskal-Wallis p-value		0.0001	0.0001	0.0001	0.0022	0.0001	0.0001	0.0646	0.0001	0.0001

Table 7: Regression results

The table below reports estimates from pooled, cross-sectional and Prais-Winston panel regressions. SIGNAL denotes abnormal earnings in t+1 calculated as EBIT in t+1 minus EBIT in t scaled by EBIT in t; RATING represents the S&P long-term credit issuer rating (set equal to one for AAA through 6 for B); GROWTH stands for price-to-book ratio computed as the ratio of market value of equity to book value of equity; SIZE denotes the natural logarithm of the market value of equity (in $B); ASSETMAT is a proxy for asset maturiy measured as the ratio of net property, plant & equipment to depreciation (in years); TAXRATE is the effective tax rate calculated as the ratio of income taxes paid to EBIT; TERM denotes the spread between 20-year government bond and 3-month-t-bill (in %); LEVERAGE is measured as total debt divided by total invested capital multiplied by 100; D_MANU is a manufacturing industry dummy; D_TRAUT is a transportation/utility dummy; D_RETAIL is a retail industry dummy; D_SERVICE is a service industry dummy; *,**,*** denote significance at the 10%, 5% and 1%-level, respectively.

	Pooled Regression		Cross-sectional Regression		Prais-Winsten Panel	
Independent Variable	Model 1 (WASE)[b]	Model 2 (WASE)[b]	Model 1 (WASE)[b]	Model 2 (WASE)[b]	Model 1 (PCSE)[c]	Model 2 (PCSE)[c]
Intercept	5.256*** (0.453)	5.094*** (0.462)	4.900*** (1.942)	4.758*** (1.070)	5.023*** (0.400)	4.877*** (0.361)
RATING	-0.425*** (0.052)	-0.451*** (0.054)	-0.404*** (0.092)	-0.434*** (0.096)	-0.413*** (0.054)	-0.433*** (0.055)
SIGNAL	-0.135*** (0.044)	-0.127*** (0.045)	-0.361** (0.142)	-0.330** (0.143)	-0.058 (0.037)	-0.055 0.036
GROWTH	-0.081*** (0.013)	-0.095*** (0.013)	-0.100*** (0.023)	-0.119*** (0.028)	-0.060*** (0.012)	-0.069*** (0.015)
SIZE	0.022 (0.033)	0.034 (0.034)	0.018 (0.062)	0.029 (0.063)	0.035 (0.039)	0.052 (0.037)
ASSETMAT	0.086*** (0.009)	0.125*** (0.008)	0.090*** (0.016)	0.131*** (0.014)	0.077*** (0.011)	0.113*** (0.013)
TAXRATE	0.489** (0.228)	0.472** (0.231)	1.232** (0.601)	1.217** (0.604)	0.177 (0.193)	0.161 (0.204)
TERM	-0.015 (0.110)	-0.041 (0.112)	0.235 (0.474)	0.176 (0.484)	-0.034 (0.035)	-0.046 0.034
LEVERAGE	-0.001 (0.002)	0.001 (0.002)	-0.004 (0.004)	-0.001 (0.004)	0.001 (0.003)	0.003 (0.003)
D_MANU	-0.051 (0.138)		-0.078 0.227		-0.012 (0.280)	
D_TRAUT	0.973*** (0.167)		0.959*** (0.288)		1.083*** (0.423)	
D_RETAIL	0.324** (0.215)		0.314 (0.383)		0.423 (0.357)	
D_SERVICE	-0.146 (0.170)		-0.111 (0.286)		-0.170 (0.295)	
R^2	0.230	0.204	0.292	0.261	0.339	0.321
F / Wald	51.67	59.18	18.87	21	231.04	117.87
# of observations	2004	2004	501	501	2004	2004

[a] common AR(1) autocorrelation [b] White adjusted standard errors [c] panel corrected standard errors

Table 8: Specification check for credit rating

Debt maturity is regressed on several proxies for credit rating and other independent variables. The table below reports estimates for pooled regressions. RATING represents the S&P long-term issuer credit rating (set equal to one for AAA trough 6 for B); ZSCORE denotes bankruptcy risk proxied by Altman's Z-score; BETA represents the absolute value of the unlevered asset beta; SIZE denotes the natural logarithm of the market value of equity (in $B); LEVERAGE is measured as total debt divided by total invested capital multiplied by 100. The variables SIGNAL, ASSETMAT, GROWTH, TAXRATE, TERM are for simplicity not listed. White adjusted standard errors are in parentheses. *,**,*** denote significance at the 10%, 5% and 1%-level.

Independent Variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
Intercept	2.591***	1.301**	0.448	4.601***	3.463***
	(0.543)	(0.581)	(0.595)	(0.326)	(1.042)
RATING	0.493**			-0.509***	0.142
	(0.246)			(0.046)	(0.288)
RATING_SQUARE	-0.122***				-0.086***
	(0.030)				(0.034)
ZSCORE		-0.258***			-0.197***
		(0.040)			(0.053)
ZSCORE_SQUARE		0.007***			0.004
		(0.002)			(0.004)
BETA			-0.293***	0.176	
			(0.096)	(0.299)	
BETA_SQUARE				-0.203	
				(0.189)	
SIZE		0.543***	0.584***		0.376
		(0.150)	(0.155)		(0.232)
SIZE_SQUARE		-0.021**	-0.025**		-0.021
		(0.010)	(0.010)		(0.015)
LEVERAGE	0.044***		0.006***	0.046***	
	(0.005)		(0.002)	(0.006)	
LEVERAGE_SQUARE	0.000***			0.000***	
	(0.000)			(0.000)	
R^2	0.243	0.226	0.193	0.239	0.243
F	70.02	95.25	73.91	57.93	55.32
# of observations	2012	2648	2644	1945	1888