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The Determinants of Corporate Debt Maturity Structure

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1. Introduction

According to Stiglitz (1974) and Modigliani and Miller (1958), in efficient and integrated markets, the financial management policy cannot decrease the costs of capital due to the interrelation between the different types of capital costs. Consequently, there is no gain from substituting debt for equity. However, evidence has been found against this claim, demonstrating that equity financing is related to the predictability of stock returns. For example, firms issue equity when the equity premium is low in order to time an inefficient market and reduce the cost of capital borrowing and/or to optimize capital structure together with expected returns (Baker et al., 2003). On the other hand, there is substantially less literature on debt financing. For example, according to Bosworth (1971), debt maturity is related to market conditions, such as the interest and inflation rates. Furthermore, Barclay and Smith (1995) find firms with higher information asymmetries to issue short-term debt. They determine a positive relationship between debt-maturity and dividend yield as well as a negative relationship between the maturity of debt and the term-spread (Barclay & Smith, 1995). Although the above papers provide support for the association between debt and returns, none offers information on the cost of capital borrowing at different times of debt maturity due to lack of analysis of returns data.

The relationship between debt maturity and cost of capital borrowing is examined by Baker et al. (2003). In their paper, they analyze the variation in the maturity of debt due to debt market conditions (inflation and interest rates) as well as the excess bond returns. Excess bond returns are an index of investment-grade corporate bonds over commercial papers (Baker et al., 2003). In their article, the authors utilize aggregate annual time-series data and find a close relation between debt maturity and predictable variation in the excess bond returns. According to their findings, firms issue long-term debt when bond returns are low and short-term debt when returns are high. They explain the above evidence as managers timing an inefficient capital market using public information to guide their debt maturity decisions. They are, however, unable to conclude whether firms actually reduce the overall cost of capital borrowing from timing the market as a result of difficulties in interpreting the predictions of the regression results (Baker et al., 2003).

This paper extends the empirical analysis performed by Baker et al. (2003) to the pooled time- and cross-sectional data in order to examine the relationship between the excess bond returns and the corporate debt maturity structure. In addition, the analysis extends previous studies such as that conducted by Barclay and Smith (1995) by incorporating the bond returns information in the corporate debt maturity structure research. As a result, the study accounts for the relationship between debt maturity and the cost of borrowing at different maturities.

The goal of this paper is to examine the hypothesis of the effect of the macroeconomics variables, excess bond returns, as well as the corporate debt determinants on the debt maturity structure at the individual firm level data. The Principal – Agent Theory and the Efficient Market Hypothesis provide the theoretical framework for the analysis. The Principal - Agent Theorem describes the relationship between the lenders (banks) and borrowers (firms) in the credit market as well as the process of loan issuance. As firms' investment decisions are not directly observable by the banks, the terms of the loan (interest rate, loan size, and length) are usually based on the firms' observable characteristics such as wealth and size. The Efficient Market Hypothesis states that it is impossible in an efficient market to profit from market timing in the long-run. Market timing is defined as the opportunity to obtain higher return on investment by simply observing and responding to the changes in macroeconomic variables (Baker et al., 2003).The Efficient Market Hypothesis widely recognized by economists has been questioned by financial analysts. Several empirical studies including studies by Baker et al. (2003), Bosworth (1971) and Malkiel (2004), however, have found support for profiting from market timing in the short-run.

Based on these theorems, it is predicted that small and unregulated firms with more investment growth options have less long-term debt. When the bond market cannot distinguish between high - and low – quality firms, defined by the firm's abnormal earnings, the high-quality firms will signal their wealth through issuance of less underpriced short-term debt. Both investors and low - quality firms realize the high – quality firm's behavior, forcing the high - quality firms to issue more short-term debt (Kale & Noe, 1990). Similarly, firms with large potential information asymmetries are likely to issue short-term debt due to their larger information costs associated with long-term debt (Flannery, 1986). On the other hand, when the high – quality firms are faced with low risk of debt refinancing, they are more likely to issue short-term debt while less creditworthy firms will issue longer-term debt. The very poor firms cannot issue long-term debt as they face a higher likelihood of reporting low profits and facing higher borrowing costs (Berlin, 2006).

Additionally, according to Baker et al. (2003) debt maturity is also related to debt market conditions, such as interest and inflation rates as well as a term spread. It is expected that the macroeconomic variables are negatively related to the maturity of debt. Following Baker et al. (2003), it is predicted that firms issue long-term debt when bond returns are low. Finding support for the impact of macroeconomics variables including excess bond returns on debt maturity decisions implies that in the short-run period firms lower the cost of capital borrowing from timing the market. In the long-term, however, this hypothesis should not be supported by the model's results as suggested by the Efficient Market Hypothesis.

The research objective is achieved by investigating the relationship between the excess bond returns, macroeconomics variables, as well as the determinants of the firm's debt and the corporate debt maturity structure. In order to perform the analysis, the pooled time- and cross-sectional (panel) data for year 1991- 2000 from COMPUSTAT as well as the Federal Reserve are utilized. The variables used in the econometric analysis are: the dependent variable: share of long-term debt, and the explanatory variables: excess bond returns, market-to-book ratio, regulatory dummy variable, log of market value of firm, abnormal earnings, term spread, inflation, and short-term interest rates.

There are several Ordinary Least Squares (OLS) estimation methods employed to estimate the relationship between debt maturity and its determinants. First, the pooled OLS estimation is utilized; however, there is a problem of unobserved error term dependence, which results in biased and inconsistent findings (Wooldridge, 2002). In order to correct for this issue, a cross-sectional OLS regression method is utilized in combination with the time-series mean of each variable for an individual firm. However, this method only accounts for the variation across firms without analyzing the time-variation (Barclay & Smith, 1995).

In order to investigate the time-series dispersion, fixed and random effects regression models are employed. In the fixed effects regression, the cross-sectional variation is arbitrarily correlated with the explanatory variables. In the random effects regression model, it is assumed, on the other hand, that the cross-sectional variation is random, and it is a part of the unobserved variation included in the error term. The Hausman specification test is used to test for the sufficiency of random effects estimation. Finally, in order to correct for the existing heteroskedasticity and serial correlation across panels, the generalized least squares estimation is used to obtain efficient estimators (Wooldridge, 2002).

The results obtained from the OLS estimation provide evidence in support of a negative relationship between the debt maturity and the excess bond returns. Furthermore, the market-to-book ratio, abnormal earnings, as well as term spread and inflation are negatively related to the share of long-term debt. However, no statistically significant relationships were found for regulatory dummy and short-term interest rate although the coefficients of these variables had the predicted signs.

The results confirm the hypothesis of debt determinants and their impacts on the structure of corporate debt. The findings imply that firms with few investment growth opportunities, large in size, and of high quality have a large share of long-term debt in their financing structure. There is, however, an ambiguous result with regard to hypothesis of market timing lowering the cost of capital borrowing. On one side, managers time the debt market and incorporate the debt market conditions as well as the excess bonds returns in their debt financing decisions. On the other hand, the short-term interest rate does not have a statistically significant impact on a firm's financing decision as suggested by the Efficient Market Hypothesis. The research results add to the undeveloped literature of debt financing by extending the analysis of the impact of debt determinants on debt maturity and by analyzing returns data and providing evidence for relationship between debt maturity and cost of borrowing at different maturities.

2. Literature review

The notion of the corporate debt maturity structure is explained by the determinants of debt structure and market conditions. All of the hypotheses tested here are derived based on the Principal-Agent Theory and the Efficient Market Hypothesis. The hypotheses employed in this article include: Signaling and Agency Costs Hypotheses (all based on the Principal-Agent Theory), as well as Market Timing Theory (based on the Efficient Market Hypothesis). The following empirical analysis review represents the empirical evidence either for or against the implications resulting from employment of the proposed theoretical framework when analyzing the financial decisions of corporate companies.

Several terms should be defined before in depth discussion of the empirical issues related to the cost of capital borrowing and corporate debt maturity structure. Table 1 defines finance terminology needed for the article understanding.

Terminology	Description
Share of Long-Term Debt to Total Debt	The percentage of the firm's total debt that has a maturity of more than three years
Excess Bond Returns	An index of investment-grade corporate bonds over commercial paper
Abnormal Earnings	The difference between next year's and this year's earnings per share scaled down by this year's share price
Market-to-Book Ratio	The estimated market value of assets divided by the book value assets
Real Short-Term Rate	The annualized Treasury bill return minus inflation
Term Spread	The difference between the Treasury bond yield and the annualized Treasury bill return
Inflation	The annual percentage change in the Consumer Price Index
Debt Market Timing	Responsiveness to the changes in macroeconomic variables

Table 1. Glossary of Finance Terminology

According to Barclay and Smith (1995), debt determinants are part of the agency cost and signaling hypotheses derived from the Principal – Agent Theorem. As discussed earlier, lenders are not able to observe directly firms' behavior. As a result, specific loan contract terms help banks to differentiate between different types of borrowers while observing firms' observable characteristics such as size and wealth. Based on the findings of the Principal – Agent Theory, the Agency Cost Hypothesis states that risky debt financing may enlarge the suboptimal investment incentives when a firm's investment opportunity set includes growth options. Managers undertake underinvestment[1] decisions controlled by issuing a short-term debt maturing before the firm's growth opportunity is exercised (Myers, 1977). Consequently, the agency cost hypothesis states that firms with larger growth options in their investment opportunity set issue more short-term debt.

Studies by Antoniou et al. (2002), Jun and Jen (2003), and Chen et al. (1999) find firms with larger growth options issuing more short-term debt. Antoniou et al. (2002) argue that the cost of financial distress of high growth firms is relatively high and therefore mangers are reluctant to raise debt capital (Antoniou et al., 2002). Furthermore, according to Jun and Jen (2003), firms with greater financial flexibility and financial strength are more likely to issue more short-term debt. On the other hand, Harvey et al. (2001) also find that closely monitored debt creates shareholder value, because it reduces the agency costs associated

[1] **Underinvestment** – unwillingness of shareholders to take a positive net present value project when the profits will accrue mainly to the creditors (Foo and Yo, 2005).

with overinvestment. The lower costs of debt financing are a result of a long-term relationship established between the firms and the creditors (Antoniou et al., 2002).

According to Barclay and Smith (1995), firms with relatively large numbers of investment opportunities tend to be smaller and take on short-term debt to avoid the underinvestment decisions and paying higher issuance costs associated with long-term debt. Issuing short-term debt avoids the above problem as the price at which the firm repurchases its debt is fixed. Issuing a short term debt allows the stockholders to capture most of the returns from the new investments (Myers, 1977). Additionally, banks have a comparative advantage in monitoring and maintaining a stronger bargaining position when loaning short-term. Banks' monitoring is especially important for firms with large informational asymmetries as these firms use more bank loans with short-term maturity (James, 1987).

In accordance with the above hypothesis, larger firms issue debt with maturities on average longer by about 6 years (FEMA, 2006). However, Dennis and Sharpe (2005) find that as the borrower size increases, negotiating power with the lender and information transparency increase. The lender is able to spread the fixed costs of loan production across a larger dollar value of the loan and as a result, issue debt to larger firms (Dennis & Sharpe, 2005).

Finally, regulated firms issue longer debt maturity than unregulated firms. This follows from the fact that managers of regulated firms have less discretion over future investment. Lower level of managers' judgment over future investments lowers the adverse impact of the long-term debt. Consequently, a longer maturity period is preferred by the regulated companies (Barclay & Smith, 1995). In summary, it is predicted that small and unregulated firms with more growth options have less long-term debt.

In the Signaling Hypothesis, the pricing of long-term debt is more sensitive to changes in firm value compared to the short-term debt. For example, high-quality firms defined as firms with positive abnormal earnings[2] tend to issue more short-term debt compared to low-quality firms defined as firms with negative abnormal earnings due to lower refinancing and mispricing[3] costs (Barclay & Smith, 1995). Richardson and Sloan (2003) as well as Antonenko et al. (2006) find empirical evidence for low-quality firms obtaining overpriced long-term debt (higher interest rate than usual put on long-term debt). Richardson and Sloan (2003) further find that long-term debt follows a decreasing stock return period. On the other hand, Ozkan (2002) and Antoniou et al. (2002) find no empirical support for the signaling hypothesis. The volatility of earnings is found not to have a significant impact on the capital structure among the studied firms. Although not confirmed by all empirical studies, it is expected that high-quality firms (firms with positive abnormal earnings) issue short-term debt. Consequently, there is a negative relationship between the corporate debt maturity and the quality level of the firm (Barclay & Smith, 1995).

According to Baker et al. (2003) debt maturity is also related to macroeconomic variables such as inflation, interest rates, term spread, and excess bond returns, although the impact of macroeconomic variables on debt maturity has not been examined thoroughly in the literature. As predicted by other finance articles, the macroeconomics variables should be

[2] **Abnormal Earnings** - measured as the difference between next year's and this year's earnings per share scaled down by this year's share price (Barclay and Smith, 1995).

[3] **Misspricing** – investor's overestimation of the persistence of accruals and underestimation of the persistence of cash flow (Barclay and Smith, 1995).

negatively related to the maturity of debt. For example, firms issue long-term debt when the excess bond returns are low (Baker et al., 2003). Furthermore, Stohs and Mauer (1996) find debt maturity to be negatively related to the term spread. Baker et al. (2006) additionally uncover that the term spread is positively related to future excess bond returns, which further implies that short-term debt is preferred when short-term rates are lower compared to long-term. Marsh (1982) as well as Graham and Harvey (2001), who also studied the impact of macroeconomics variables on debt maturity, find the amount of debt to vary with interest rates. The long-term debt is issued when interest rates are particularly low (Graham & Harvey, 2001).

The fact that debt maturity is responsive to the changes in macroeconomic variables is called the debt market-timing. Market timing implies the opportunity to obtain higher return on investment by simply observing and responding to the changes in macroeconomic variables. Baker et al. (2003), Baker et al. (2003), and Baker et al. (2006) find evidence for managers timing the debt market by utilizing publicly available information on market conditions as a guide to their debt maturity decisions. For example, a large fraction of chief financial officers admit to following general debt market conditions while deciding on debt issuance decisions (Baker et. al, 2006).

The phenomenon of market timing is, however, viewed as a short-run model. As presented in the Efficient Market Hypothesis section, in the long-run, it is not possible to profit from market timing as all investments are traded at their fair market value (Fema, 1970). In accordance with the hypothesis, Berlin (2006) believes that managers cannot time the market, because they do not have any information on future interest rate movements and therefore are not able to forecast the interest rates accurately. As a result, if the managers do not have accurate forecasts, the short- and long-term borrowing should lead to exactly the same borrowing costs (Berlin, 2006).

3. Methodology

3.1 Empirical model description

The debt-maturity decision is modeled based on the Principal – Agent Theory and the Efficient Market Hypothesis. The lender maximizes its expected returns from providing the investment loans to the borrowers subject to the borrowers' expected utility based on the chosen loan offer. The borrowers maximize their own expected level of utility provided by the chosen risk-level of the investment, the end-of-period wealth level, as well as the associated loan requirements set by the lender: interest rates and loan collateral. Consequently, the theoretical model guiding this empirical analysis is as follows:

$$\textbf{Lender: } Max\ v = \sum [p^m(1 + r^m{}_l) + (1 - p^m)C_l] \tag{1}$$

$$\textbf{Borrower: } Subject\ to \sum EU^l = U_1(W + R - (1 + r^m{}_l))\, p^m + U_0(W - C_l))(1 - p^m) \tag{2}$$

where v represent lender's expected returns from providing a loan offer, p^m is the of the borrower's probability of project success based on the chosen investment technique (risky or safe), $r^m{}_l$ represents the loan interest rate variable based on the firms wealth and risk level, C_l is the loan collateral variable based on firms initial wealth, U represents the borrower's utility level, W is the firm's wealth level, R is the firm's investment return on the project.

The optimal condition for deciding on the amount and maturity of debt depends on the probability of project success as well as the borrower's expected utility obtained from the project success:

$$p^m/(1 - p^m) = [U_0'(1- p^m)]/[U_1'p^m]\ ^4 \tag{3}$$

Based on the Efficient Market Hypothesis, the borrower decides on the optimal investment decisions based on the results of the profit and utility maximization. The firm profit maximization is defined as:

$$Max\ \Pi = R - TC = f(I_0) - (1+ r^m{}_l)\ I_0 \tag{4}$$

where R is the firm's investment return on the project, I_0 is the investment level, TC is the total cost of investing in the project, and $r^m{}_l$ represents the loan interest rate. The manager's utility maximization problem is defined as:

$$Max\ U(Y_0, Y_1) = U_0(W_0 - I_0) + U_1((1+ r^m{}_l)I_0)/(1 + \rho) \tag{5}$$

where W_0 is the initial wealth and ρ is the subjective rate of time preference. The first order condition derived by taking the first derivative of both the profit and utility maximization problems with respect to I_0 results in the following condition:

$$f'(I_0) = U'_0(1 + \rho)/U'_1 = r^m{}_l \tag{6}$$

Thus, in the Efficient Market Equilibrium the market interest rate offered for the loan ($r^m{}_l$) is equal to the marginal inter-temporal utility as well as it equals the marginal rate of return on investment.

Based on the maximization problems description, the debt-maturity decision is defined as a series of simultaneous decisions made by the firm and the lender. Equations (1) and (2) present that probability of investment success as well as the prevailing interest rate impact on the investment decision of the firms. As it is difficult to directly predict the firm's probability of project success, the lenders approximate the success probability by observing the firm specific characteristics and based on the information issue a loan contract geared towards the firms' needs. The loan conditions include cost of capital borrowing and debt maturity period. On the other hand, the firms might actively take into account changes in macroeconomics variables such as the interest and inflation rates when making their financing decisions.

As presented above, only a system of simultaneous equations can represent these joint decisions as banks offer a number of loans from which the borrowers choose their desired contract features based on the loans' characteristics as well as their own ability to pay off the debt in the future (Dennis et al., 2000). Financial theory does not provide the appropriate restrictions allowing for such analysis although several studies have attempted to estimate this simultaneous equation framework (Dennis et al., 2000). As a result, the debt-maturity model is a reduced-form regression based on the simultaneous equations system (Baker et al., 2003; Barclay & Smith, 1995).

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[4] The first order conditions with respect to interest rate and collateral are:

$dl/d\ r^m{}_l = pm - \lambda[U_1'p^m] = 0$

$dl/d\ C = 1- p^m + \lambda[U_0'(1- p^m)] = 0$

$p^m/[U_1'p^m] = 1- p^m/[U_0'(1- p^m)]$

The corporate debt-maturity model utilized in this article follows the model described by Barclay and Smith (1995) and Baker et al. (2003). As a result, the theoretical debt-maturity model is presented as follows:

$$LTD_{it} = f\,(MB_{it}, LMV_{it}, AE_{it}, EBR_{it}, TS_{it}, INF_{it}, STR_{it}, RD_{i}) \tag{7}$$

where LTD_{it} is the share of long-term debt to total debt, MB_{it} denotes the market-to-book ratio, LMV_{it} is the natural logarithm of market value of the firm, AE_{it} is the abnormal earnings, EBR_{it} is the excess bond returns, TS_{it} is the term spread, INF_{it} denotes the inflation, and STR_{it} is the short-term interest rate. The subscript i denotes the ith firm (i = 1,…, 652), and the subscript t represents the tth year (t = 1991,…, 2000). RD_i is the firm regulation dummy variable, which does not vary over time.

3.2 Empirical data tests

Following the model specifications used by Barclay and Smith (1995) as well as Baker et. al (2003), the debt-maturity model estimated in this analysis is as follows:

$$\mathrm{LTD_{it}} = \alpha_{\mathrm{i}} + \beta_1\mathrm{MB_{it}} + \beta_2\mathrm{RD_i} + \beta_3\mathrm{LMV_{it}} + \beta_4\mathrm{AFE_{it}}$$

$$+ \beta_5 EBR_{it} + \beta_6 TS_{it} + \beta_7 INF_{it} + \beta_8 STR_{it} + \boldsymbol{D'\lambda}_i + v_{it} \tag{8}$$

where $\boldsymbol{D'}$ is a row vector of dummy variables created for each firm's month when the fiscal year ends, excluding the month of December and $\boldsymbol{\lambda}_i$ is a column vector of associated weights. The variable was added to control for the possibility of seasonal time heterogeneity in the model. Furthermore, it is assumed that the disturbance term in equation (2) is specified as a one-way error component model:

$$u_{it} = a_i + v_{it} \tag{9}$$

where $v_{it} \sim NIID\,(0, \delta_v^2)$; i = 1,..., 652; t = 1991,..., 2000; α_i denotes a firm-specific effect, and v_{it} is the idiosyncratic error term (Hsiao, 2002).

In order to adequately specify the equation to be estimated, the debt-maturity model is tested for violation of assumptions such as: normality, heteroskedasticity, autocorrelation, and multicollinearity. The software utilized in this analysis is Stata 8. In order to test the normality assumption, the Bera and Jarque's LM skewness-kurtosis test for normality is used. The test is, however, sensitive to outliers and rejection of the null hypothesis provides no information about the alternative distribution to be used (Wooldridge, 2002). The problem of heteroskedasticity is examined utilizing the Breusch-Pagan test with the null hypothesis being that the u_{it} are serially uncorrelated. The null hypothesis is rejected for negative values of δ_a^2 (Wooldridge, 2002). Finally, testing the idiosyncratic errors v_{it} for serial correlation identifies autocorrelation. Testing autocorrelation in panel data uses the time-series errors ($v_{it^{..}}$), which are found to be negatively correlated when the v_{it}'s are uncorrelated. The null hypothesis for this test is that the time-demeaned[5] errors are serially correlated. If serial correlation is found, the asymptotic variance matrix estimator and test statistics can be adjusted (Wooldridge, 2002).

[5] **Time-demeaned Data** - panel data where, for each cross-sectional unit, the average over time is subtracted from the data in each time period (Wooldridge, 2002).

3.3 Model specifications

3.3.1 Ordinary least square estimation

There are several ways of estimating the debt maturity model. The Ordinary Least Square (OLS) regression is usually employed as it utilizes the actual values of the dependent variable. In order to allow for panel data estimation, OLS is often employed with either fixed or random-effects models (Berger et al., 2004; Hackethal & Jansen, 2006). The fixed- and random-effects models are discussed in the upcoming sections. On the other hand, other articles employ Tobit regression to estimate the debt maturity. As often the debt variable ranges between values of 0 and 1 (some firms might not have any long term debt), the data is truncated at the 0 point and exclude observations below this threshold from the analysis. Truncation might also occur when the observations are missing from the sample due to other sensitivity limits put on the variable of interest in the data set (Antoniou et al. 2002; Magri, 2006).

Although the Tobit model might seem like an appropriate method to estimate debt maturity data, several studies including Margi (2006) have criticized the utilization of Tobit model for panel data estimation. When Tobit model is employed in combination with random-effects, it may suffer from inconsistent estimates. The estimate inconsistency results from the absence of correlation between regressors and unobserved individual effects being not satisfied. Although several fixed-effects methods have been proposed to resolve this problem, the estimation process still yields inconsistent results or introduces complicated estimation processes not easily handled by current statistical software (Magri, 2006). Due to the several estimation limitations of different model specifications, different panel data forms of the OLS regression are employed in this article (Antoniou et al. 2002; Magri, 2006).

3.3.2 Panel OLS regression types

According to Dennis et al. (2000), the employment of the reduced form of debt-maturity model estimated using OLS estimation yields unbiased results. There are several OLS estimation methods employed to estimate the relationship between debt maturity and its determinants. First, the pooled OLS estimation is utilized; however, there is a problem of unobserved error term dependence, which results in biased and inconsistent findings (Wooldridge, 2002). In order to correct for this issue, a cross-sectional OLS regression method is utilized in combination with the time-series mean of each variable for an individual firm. However, this method only accounts for the variation across firms without analyzing the time-variation (Barclay & Smith, 1995).

In order to investigate the time-series dispersion, both fixed and random effects regression models are employed. In the fixed effects regression, the cross-sectional variation is arbitrarily correlated with the explanatory variables. In the random effects regression model, it is assumed, on the other hand, that the cross-sectional variation is random and it is a part of the unobserved variation included in the error term. The Hausman specification test is used to test for the sufficiency of random effects estimation. Finally, in order to correct for the existing heteroskedasticity and serial correlation across panels, the generalized least squares estimation is used to obtain efficient estimators (Wooldridge, 2002).

3.3.2.1 Ordinary least square regression

The basic technique for estimating the debt-maturity model is pooled OLS estimation. To perform this procedure, the model is rewritten as follows:

$$LTD_{it} = \beta_0 + \beta_1 MB_{it} + \beta_2 RD_i + \beta_3 LMV_{it} + \beta_4 AFE_{it}$$

$$+ \beta_5 EBR_{it} + \beta_6 TS_{it} + \beta_7 INF_{it} + \beta_8 STR_{it} + \boldsymbol{D'\lambda}_i + u_{it} \quad (10)$$

where $u_{it} = \alpha_i + v_{it}$; $v_{it} \sim NIID\ (0,\ \delta_v^2)$; i = 1,..., 652; t = 1991,..., 2000. The underlying assumptions of this model are: 1) the explanatory variables (x_{it}) in each time period are uncorrelated with the idiosyncratic error in each time period: $E(x_{it}'v_{it}) = 0$, i = 1,..., 652, t = 1991,…, 2000; and 2) the explanatory variables are uncorrelated with the unobserved effect in each time period: $E(x_{it}'a_i) = 0$, i = 1,..., 652, t = 1991,…, 2000. The regression estimation provides consistent estimators as long as the underlying assumptions are satisfied (Barclay & Smith, 1995; Wooldridge, 2002).

3.3.2.2 Cross-sectional regression with time-series mean

Since the OLS assumption of serially uncorrelated composite errors is not satisfied in the pooled OLS specifications, the t-statistics are overstated. To account for the potential error-dependence problem, a single cross-sectional regression with the time-series mean of each variable by firm is used to perform the regression analysis. Running the OLS cross-sectional equations eliminates the problem of serially correlated composite errors. The estimated model is re-specified as follows:

$$LTD_i = a_i + \beta_1 MB_i + \beta_2 RD_i + \beta_3 LMV_i + \beta_4 AFE_i$$

$$+ \beta_5 EBR_i + \beta_6 TS_i + \beta_7 INF_i + \beta_8 STR_i + \boldsymbol{D'\lambda}_i + v_i \quad (11)$$

where $v_i \sim NIID\ (0,\ \delta_v^2)$; i = 1,..., 652; t = 1991,..., 2000 (Barclay and Smith, 1995; Wooldridge, 2002).

3.3.2.3 Fixed and random effects models

Estimating the model by the cross-sectional regressions preserves the dispersion across firms; however, it does not exploit the time-series variation in the observations (Barclay and Smith, 1995). To correct for the serially correlated errors, a random or fixed effects regression model can be utilized. In a random effects model, the α_i is included in the error term, and the model takes the following specification:

$$LTD_{it} = \beta_0 + \beta_1 MB_{it} + \beta_2 RD_i + \beta_3 LMV_{it} + \beta_4 AFE_{it}$$

$$+ \beta_5 EBR_{it} + \beta_6 TS_{it} + \beta_7 INF_{it} + \beta_8 STR_{it} + \boldsymbol{D'}\lambda_i + u_{it} \quad (12)$$

where $u_{it} = a_i + v_{it}$; $\alpha_i \sim NIID\ (0,\ \delta_a^2)$; $v_{it} \sim NIID\ (0,\ \delta_v^2)$; i = 1,..., 652; t = 1991,..., 2000. In the random effects approach, α_i is incorporated in the composite error term under the assumption that it is orthogonal to the explanatory variables, (x_{it}), $E(x_{it}'a_i) = 0$, i = 1,..., 652, t = 1991,..., 2000. Furthermore, the method accounts for the implied serial correlation in the composite error, $u_{it} = a_i + v_{it}$, identical to the generalized least squares (GLS) estimation (Wooldridge, 2002).

In the fixed effects model, the model specification is as follows:

$$LTD_{it} = a_i + \beta_1 MB_{it} + \beta_2 RD_i + \beta_3 LMV_{it} + \beta_4 AFE_{it}$$

$$+ \beta_5 EBR_{it} + \beta_6 TS_{it} + \beta_7 INF_{it} + \beta_8 STR_{it} + \boldsymbol{D'}\lambda_i + v_{it} \quad (13)$$

where $v_{it} \sim NIID\ (0,\ \delta_v^2)$; i = 1,..., 652; t = 1991,..., 2000. In the fixed effects analysis, α_i is arbitrarily correlated with x_{it}, $E(x_{it}'a_i) \neq 0$, i = 1,..., 652, t = 1991,..., 2000 (Wooldridge, 2002).

In order to identify whether fixed or a random effects estimation technique is appropriate for the analysis, the Hausman test is performed to examine the appropriateness of the random effects estimator. A Hausman test compares two estimators. Under the null hypothesis, the fixed and random effects estimators are consistent, but one is more efficient; under the alternative hypothesis, the more efficient of the two becomes inconsistent but the less efficient remains consistent. Thus, if the null is not rejected, the two estimators should be similar; divergence indicates rejection of the null. Rejection of the null further implies the effects are correlated with the individual variances, and the fixed effects should be used for estimation. The Hausman test statistic is as follows:

$$W = (\beta^{\wedge F} - \beta^{\wedge R})'\Sigma^{-1}(\beta^{\wedge F} - \beta^{\wedge R}),\ W \sim X^2\,(k) \tag{14}$$

where k is the number of estimated coefficients and Σ^{-1} is the difference of the estimated covariance matrices from the two estimators. Based on the test results, one of the methods is chosen to perform the econometric analysis (Wooldridge, 2002).

As noted earlier, the problem of heteroskedasticity and autocorrelation is a common issue associated with panel data; GLS estimation can correct for violations of the underlying assumptions. On the other hand, the random effects model accounts for the serial correlation in the composite error term and, therefore, corrects for the serial correlation of errors (Wooldridge, 2002).

3.3.3 GLS model corrected for panel heteroskedasticity and AR(1)

Finally, the last problem associated with panel data is the problem of heteroskesdasticity and serial correlation across panels. The fixed and random effects models overlook these correlations and, therefore, yield inefficient estimators. The heteroskedasticity test compares the maximum likelihood of the model with panel-level heteroskedasticity to the model with homoskedasticity across panels. The autocorrelation across panels is tested based on the assumption that the idiosyncratic errors, v_{it}, are serially uncorrelated in the random and fixed effects model specifications (Stata 8 Manual, 2005; Wooldridge, 2002). By correcting for heteroskedasticity and autocorrelation across panels, the estimation procedure yields an error variance-covariance estimator, which is robust to the common problems associated with panel data (Stata 8 Manual, 2005).

4. Data

In order to investigate the relationship between debt maturity and its determinants, a large sample is constructed, following Barclay and Smith's (1995) and Baker and colleague's (2003) sampling method. The time- and cross-sectional data set merges the COMPUSTAT industrial annual file of debt determinants and the Federal Reserve's file of macroeconomic variables. The sample is restricted to firms with Standard Classification codes from 2000 to 5999 to focus on the industrial corporate sector. Furthermore, firms utilized in the study are present in the sample over the specified time period and have complete data for the explanatory variables. Consequently, the total number of firms included in the empirical analysis is 652. The data span is 1991 through 2000.

The construction method of the sample might cause a survivorship bias, which represents a tendency for some companies to be excluded from performance studies due to the fact that they no longer exist (Investorwords.com, 2005). In the present investigation, only firms with complete data for 1991-2000 are included in the analysis. The bias affects the results towards finding the predicted relationship between the debt maturity and debt determinants, because most of the surviving firms are larger and older with less investment opportunities and, therefore, issue more long-term debt. On the other hand, the bias prevents the analysis from finding the results predicted for the macroeconomic variables due to their high volatility over the time period of the study.

The time- and cross-sectional data series are debt determinants: 1) total assets, common shares outstanding, debt due in one, two, three, four and five years, earnings per share, total equity, and stock price; and 2) macroeconomic variables: twenty-year government bond and commercial paper return, six-month treasury bill yield, inflation, and term spread.

COMPUSTAT reports the amount of long-term debt payable in years one through five from the firm's fiscal year end. Following Barclay and Smith (1995), the maturity structure of a firm's debt is defined as the percentage of the firm's total debt that has a maturity of more than three years. Several firms have less than zero percent or more than 100 percent of their total debt maturing in more than three years. Since these observations reflect data-coding errors, they are deleted.

Excess bond returns are measured by an index of investment-grade corporate bonds over commercial paper. The corporate bond indices track portfolios that are continually redefined to a constant 20-year maturity. Excess government and corporate bond returns are the difference between the long-term corporate bond and commercial paper returns, respectively (Baker et al., 2003).

There are four debt determinant variables used in this study: market-to-book ratio, a regulatory dummy variable, firm size, and abnormal earnings. Consistent with the Agency Cost Hypothesis, the market-to-book ratio is a proxy for the firm's investment opportunity set. The market value of the firm's assets is estimated as the book value of assets minus the book value of equity plus the market value of equity (the price of shares multiplied by the total number of shares outstanding). The market-to-book ratio is the estimated market value of assets divided by the book value of assets (Barclay & Smith, 1995). In accordance with Baker et al. (2006), the variable is hypothesized to carry a negative sign.

To estimate the effect of regulation on debt maturity, a dummy variable is constructed. It takes a value of one for regulated firms, and zero otherwise. Regulated industries include airlines, telecommunications, as well as gas and electric utilities. The firm size is the estimated natural logarithm of the market value of the firm (Barclay & Smith, 1995). As found in the studies by Chen et al. (1999) and Antonenko et al. (2006), the log of firm value is expected to be positively related to the share of long-term debt as a proportion of total debt.

Signaling models assume that managers have better information about the firm's value (or quality) than investors. To estimate the firm's quality empirically, the firm's abnormal earnings are defined as a proxy. The variable is measured as the difference between next year's and this year's earnings per share divided by this year's share price. It is assumed that high-quality firms have positive abnormal earnings, and low-quality firms have negative abnormal earnings (Barclay and Smith, 1995). Following Barclay and Smith (1995), observations with the absolute value of abnormal earnings greater than five were disregarded. The exclusion of the extreme values might affect the coefficient for the abnormal earnings, but should not influence the other variables in the analysis.

Debt market conditions are represented by three variables: inflation, the real short-term rate, and the term spread. Inflation is the annual percentage change in the Consumer Price Index. The real short-term rate is estimated as the annualized Treasury bill return minus inflation. The term spread is the difference between the Treasury bond yield and the annualized Treasury bill return. In order to account for the cross-sectional variation of the debt determinants data, the market variables ending dates are matched with the firm's fiscal year end (Baker et al., 2003). The descriptive statistics for each variable used in the analysis are presented in Table 2.

Variable		Mean	Standard Deviation	Min Value	Max Value
Share of Long-Term Debt to Total Debt	Overall	0.587608	0.2489763	0	1
	Between[a]		0.1307427	0.085569	0.938587
	Within[b]		0.2119414	-0.23633	1.29564
Market-to-Book Ratio	Overall	1.549547	0.9116479	0.360198	22.81232
	Between[a]		0.707687	0.639052	7.222132
	Within[b]		0.575302	-1.81968	21.19958
Regulatory Dummy Variable[c]	Overall	0.21319	0.4095923	0	1
	Between[a]		0.4098753	0	1
	Within[b]		0	0.21319	0.21319
Log of Market Value	Overall	2.698775	0.9371075	0.152839	5.435521
	Between[a]		0.9146363	0.550687	5.332079
	Within[b]		0.2067988	0.473086	4.102186
Abnormal Earnings	Overall	0.030876	0.4310666	-5	5
	Between[a]		0.1028505	-0.35749	0.820588
	Within[b]		0.4186344	-5.67963	4.901274
Excess Bond Returns	Overall	0.010944	0.022473	-0.052	0.079
	Between[a]		0.004737	-0.00534	0.01641
	Within[b]		0.021968	-0.03572	0.080104
Term Spread	Overall	0.012496	0.0120939	-0.0068	0.0351
	Between[a]		0.0017139	0.01113	0.01565
	Within[b]		0.011972	-0.00967	0.034366
Inflation	Overall	0.027276	0.0068753	0.0137	0.0565
	Between[a]		0.0009295	0.02662	0.029
	Within[b]		0.0068123	0.011976	0.055196
Short-Term Rate	Overall	0.021536	0.0127056	-0.0549	0.0501
	Between[a]		0.0066697	-0.01892	0.02339
	Within[b]		0.0108171	-0.01444	0.090556

Variable		Mean	Standard Deviation	Min Value	Max Value
	Overall	0.062883	0.2427718	0	1
	Between[a]		0.2429396	0	1
January Dummy	Within[b]		0	0.062883	0.062883
	Overall	0.019939	0.1398002	0	1
	Between[a]		0.1398968	0	1
February Dummy	Within[b]		0	0.019939	0.019939
	Overall	0.055215	0.2284164	0	1
	Between[a]		0.2285743	0	1
March Dummy	Within[b]		0	0.055215	0.055215
	Overall	0.015337	0.1229004	0	1
	Between[a]		0.1229853	0	1
April Dummy	Within[b]		0	0.015337	0.015337
	Overall	0.026074	0.1593665	0	1
	Between[a]		0.1594766	0	1
May Dummy	Within[b]		0	0.026074	0.026074
	Overall	0.07362	0.2611709	0	1
	Between[a]		0.2613514	0	1
June Dummy	Within[b]		0	0.07362	0.07362
	Overall	0.016871	0.1287986	0	1
	Between[a]		0.1288876	0	1
July Dummy	Within[b]		0	0.016871	0.016871
	Overall	0.019939	0.1398002	0	1
	Between[a]		0.1398968	0	1
August Dummy	Within[b]		0	0.019939	0.019939
	Overall	0.075153	0.2636589	0	1
	Between[a]		0.2638411	0	1
September Dummy	Within[b]		0	0.075153	0.075153
	Overall	0.049233	0.216371	0	1
	Between[a]		0.216201	0	1
October Dummy	Within[b]		0.0117498	-0.05077	0.949233
	Overall	0.016871	0.1287986	0	1
	Between[a]		0.1288876	0	1
November Dummy	Within[b]		0	0.016871	0.016871

[a] Between Group Estimates – variation between mean groups.
[b] Within Group Estimates - deviations from a group mean.
[c] Mean derived based on a dummy variable (i.e. Regulatory Dummy Variable) present the percent of the data falling into the '1' category.

Table 2. Data Descriptive Statistics Employed in Corporate Debt Estimation Process

5. Discussion of the results

5.1 Comparison of alternative OLS models

Results of tests of the debt-maturity model for violation of assumptions of normality, heteroskedasticity, and autocorrelation are presented in Table 3. These results revealed significant heteroskedasticity and serial correlation issues. In order to account for misspecification problems, different model specifications were estimated including pooled and cross-sectional OLS, as well as GLS regressions. The precision and efficiency of the parameter coefficients were found to be sensitive to the chosen form. Finally, the Hausman specification test was utilized to examine the appropriateness of random effects estimation. As presented in Table 3, fixed effects estimation appears to be the appropriate model choice as the null hypothesis representing the difference in coefficients not being systematic is rejected ($X^2(8) = 22.24$). For the purpose of proving the debt theory, however, both random and fixed effects are presented for comparison purposes.

Test	Null Hypothesis	Test Statistic	Probability > Test Statistic
Ordinary Least Square Regression			
Bera and Jarque's LM Skewness-Kurtosis Test for Normality	No Skewness and Kurtosis	$X2(2) = 1.76$	0.414
Breusch-Pagan Test for Heteroskedasticity	Constant Variance	$X2(1) = 91.47$	0
Test of Residuals	Serial Correlation	t = 20.45	0.006
Fixed and Random Effects Regression			
Breusch and Pagan Lagrange Multiplier Test for Random Effects	Constant Variance	$X2(1) = 844.55$	0
Hausman Specification Test	Difference in Coefficients Not Systematic	$X2(8) = 22.24$	0.0045
GLS Model Corrected for Panel Heteroskedasticity and AR(1)			
Likelihood-Ratio Test for Heteroskedasticity Across Panels	No Panel Heteroskedasticity	$X2(651)= 2024.73$	0
Wooldridge Test For Autocorrelation Across Panels	No First-Order Autocorrelation	F(1, 651) = 78.425	0

Table 3. Specification Test of the Corporate Debt Maturity Model Specifications

Overall, the test-statistic and log likelihood values of each model specification indicate that each regression in Table 4 is significant at conventional levels. Comparing the models' R-square values suggests that variation in debt maturity structure across firms provides some of the explanatory power in these regressions. The R-square value for the different specifications ranges from 0.0101 to 0.1218, which implies that from 1 percent to 12 percent

Variables	Pooled OLS	Cross-Sectional OLS	Fixed Effects	Random Effects	GLS Model Corrected for Panel Heteroskedasticity and AR(1)
Dependent Variable	Share of Long-Term Debt to Total Debt				
Intercept (b_1)	0.43717***	0.08306	0.27612***	0.47550***	0.59842***
	(17.22)	(0.08)	(5.06)	(15.93)	(39.03)
Market-to-Book Ratio (b_2)	-0.00951***	-0.13057*	-0.00474	-0.00796**	-0.00674**
	(-2.79)	(1.80)	(-0.99)	(-1.99)	(-2.16)
Regulatory Dummy Variable (b_3)	0.01040	0.01082	Dropped	0.00809	0.00656
	(1.29)	(0.83)		(0.63)	(0.99)
Log of Market Value (b_4)	0.04724***	0.04365***	0.11800***	0.05250***	0.01366***
	(13.42)	(7.40)	(7.37)	(9.71)	(4.48)
Abnormal Earnings (b_5)	-0.01543**	-0.08694*	-0.00955	-0.01269*	-0.01212**
	(-2.19)	(-1.79)	(-1.44)	(-1.94)	(-2.18)
Excess Bond Returns (b_6)	-0.23884*	-0.12034***	-0.23886*	-0.25854**	-0.06003***
	(-1.87)	(-2.34)	(-1.70)	(-2.03)	(-2.42)
Term Spread (b_7)	-0.02786	0.02743	0.70750*	0.029691	-0.29725*
	(-0.08)	(0.34)	(1.89)	(0.09)	(-1.67)
Inflation (b_8)	-0.34899	-0.46010	-0.26200	-0.34895	-0.57826**
	(-0.54)	(-0.04)	(-0.44)	(-0.59)	(-2.16)
Short-Term Rate (b_9)	-0.27210	-0.19125	-0.09694	-0.25854	-0.11847
	(-0.72)	(-0.98)	(-0.28)	(-0.75)	(-0.85)
January Dummy (b_{10})	0.01737	-0.04619	Dropped	0.01713	0.03400***
	(1.29)	(-0.34)		(0.8)	(2.54)
February Dummy (b_{11})	-0.00884	0.11801	Dropped	-0.00758	0.00954
	(-0.40)	(0.22)		(-0.21)	(0.04)
March Dummy (b_{12})	-0.0646***	0.04413	Dropped	-0.06550***	-0.05803***
	(-4.55)	(0.09)		(-2.96)	(-5.91)
April Dummy	-0.00073	0.00564	Dropped	0.00377	-0.02318

Variables	Pooled OLS	Cross-Sectional OLS	Fixed Effects	Random Effects	GLS Model Corrected for Panel Heteroskedasticity and AR(1)
Dependent Variable	Share of Long-Term Debt to Total Debt				
(b_{13})	(-0.03)	(0.03)		(0.01)	(-1.06)
May Dummy	0.00897	-0.04860	Dropped	0.00953	0.44310*
(b_{14})	(0.37)	(-0.36)		(0.28)	(1.65)
June Dummy	0.00786	-0.09589	Dropped	0.01010	0.07890***
(b_{15})	(0.64)	(-0.38)		(0.52)	(9.54)
July Dummy	0.00369	-0.12577	Dropped	0.00524	0.02657
(b_{16})	(0.15)	(-0.38)		(0.36)	(1.01)
August Dummy	0.00967	0.00738	Dropped	0.01286	-0.00612
(b_{17})	(0.44)	(0.08)		(0.14)	(-0.33)
September Dummy	-0.00963	-0.06278	Dropped	-0.00701	0.01354
(b_{18})	(-0.12)	(-0.52)		(-0.37)	(1.16)
October Dummy	-0.00170	-0.00627	0.07469	0.00102	0.00293
(b_{19})	(-0.81)	(-0.14)	(0.32)	(0.04)	(0.24)
November Dummy	0.06158***	-0.00320	Dropped	0.06315*	0.11411***
(b_{20})	(2.6)	(-0.02)		(1.66)	(16.49)

Note: The coefficient estimates are represented as the first number for each independent variable. Numbers is parenthesis represents the standard error of each parameter coefficient. An * (**) (***) indicates significance at 10% level (5% level and 1% level). Pooled OLS regression: R-Square = 0.0388; F-stat = F (19, 6500) = 13.79. Cross-sectional OLS regression: R-Square = 0.1218; F-stat = F(19, 632) = 5.17. Fixed effects regression: R-Square = 0.0122; Wald $X^2(19)$ = 137.54. Random effects regression: R-Square = 0.0101; Wald $X^2(19)$ = 596.82. GLS Regression Corrected for Panel Heteroskedasticity and AR(1): Log Likelihood = 1601.881; Wald $X^2(19)$ = 596.82.

Table 4. Estimation Results for the Corporate Debt Maturity Model

of the variation in the debt maturity variable, is explained by the explanatory variables in the model specifications.

5.2 Report of empirical results for different model specifications

5.2.1 Ordinary least square regression

Results presented in Table 4 suggest that debt maturity decisions are related to excess bond returns, debt determinants, and macroeconomic variables. The pooled OLS model specification indicates that excess bond returns are negatively related to debt maturity (b_6 = -0.23884) at the 10% significance level. Furthermore, market-to-book ratio and abnormal earnings are inversely associated with the debt maturity variable at the 1% and 5% levels, respectively. Log market value is positively correlated to the dependent variable at a 1% level of significance. There is no regulatory effect found on the debt maturity decisions, although the coefficient on the dummy variable is positive, as predicted. Furthermore, none of the macroeconomic variables is statistically significant, yet all of them are negatively related to the dependent variable, which is in agreement with theoretical predictions. Finally, there is a statistically significant difference for the firms with fiscal year ending in March and November and the amount of long-term debt issued compared to the firms with fiscal year ending in December. For example, firms with fiscal year end in March tend to issue more short-term debt.

5.2.2 Cross-sectional regression with time-series mean

To account for the error-dependence problem in pooled OLS estimation, a single cross-sectional regression with the time-series mean of each variable by firm was used to estimate the model. The excess bond returns are statistically significant at the 5% level of significance and have a coefficient of b_6 = -0.12034. The debt determinants: the market-to-book ratio and abnormal earnings negatively relate to the long-term debt decisions and have higher magnitudes compared to those obtained in the pooled OLS estimation (b_1 = -0.01305 vs. b_1 = -0.00613; b_4 = -0.08694 vs. b_4 = -0.01413). Log market value is positively associated with debt decisions and is higher compared to the pooled OLS estimate. Again, no market variables are statistically significant and term spread carries a positive sign. Finally, there is no statistical difference for long-term debt in capital structure for firms with fiscal year end in December and other months.

5.2.3 Fixed and random effects models

The cross-sectional regressions preserve dispersion across firms, but do not exploit time-series variation in the observations (Barclay & Smith, 1995). The fixed effects regression model was estimated to correct for this problem. Both fixed and random effects results are reported and discussed. For the random and fixed effects regressions, there is a difference between the parameter coefficients and their efficiency levels. In the fixed effects estimation, the excess bond returns are negatively related to debt maturity (b_6 = -0.23886). The coefficient is smaller in absolute value than the random effects coefficient by 0.02, yet it is less efficient (the t-statistic associated with the independent variable in fixed effects model is lower compared to the t-statistic in the random effects model specification). Furthermore, the log of firm market value is positively associated with the debt maturity (b_3 = 0.11800), and it is the only debt determinant statistically significant in the model. The coefficient is larger than the random effect estimate coefficient (b_3 = 0.05250) and has a larger standard error. Parameter estimates for market-to-book ratio and abnormal earnings diverge under the two models; in the random effects equation both variables are statistically significant and inversely correlated with the dependent variable, while in fixed effects equation both variables are statistically insignificant. In the fixed effects model, only term spread is statistically significant among the macroeconomic variables; the positive coefficient contradicts theoretical predictions. Finally, in the case of random effects regression, there is a statistically significant difference between the firms with fiscal year ending in March and November in the level of long-term debt issued compared to the firms with fiscal year end in December. Due to multicolinearity observed in the case of fixed effects, most of the seasonal dummy variables were dropped from the estimation by Stata 8.

5.2.4 GLS model corrected for panel heteroskedasticity and AR(1)

Heteroskedasticity and autocorrelation across panels are corrected by generalized least square estimation applying the correction for heteroskedasticity and first-order autocorrelation across panels with autocorrelation coefficient of $\rho = 0.4070$. The modification improved the precision and efficiency of the parameter coefficients in the regression compared to the previous specifications. The excess bond returns are statistically significant at the 1% level, and negatively correlated to debt maturity decision ($b_6 = -0.06003$). The parameter coefficient is the lowest among all specifications. As before, market-to-book ratio and abnormal earnings are negatively related to the debt maturity decision. Log firm market value is positively related to debt maturity ($b_3 = 0.01366$) at the 1% significance level. In the case of macroeconomic variables, term spread and inflation are negatively associated with debt maturity at the 10% and 5% levels, respectively. These coefficients have the largest magnitudes among all the regression specifications. Finally, there is a statistically significant difference in the debt-maturity decisions for firms with fiscal year ending in January, March, May, June, and November compared to those with fiscal year-ending in December. For example, firms with fiscal year end in January, May, June, and November have a higher share of long-term debt compared to those in December.

5.3 Results summary

The fixed effects model as well as model corrected for heteroskedasticity and autocorrelation across panels are the specifications that should be given more weight when interpreting the regression results. The pooled OLS and cross-sectional model with time-series mean display issues with the estimation of panel data. The pooled OLS model does not account for the error-dependence problem while a single cross-sectional regression with the time-series mean of each variable by firm does not employ the time-series variation within each panel. To correct for these estimation issues the fixed effects model is utilized. The model specification corrected for heteroskedasticity and autocorrelation across panels also should carry a higher weight in results comparisons as it improves the precision and efficiency of the parameter coefficients when compared to the other specifications.

Based on the results presented in Table 4, there is a negative relationship between debt maturity and excess bond returns in all specifications. Furthermore, market-to-book ratio, abnormal earnings, as well as term spread and inflation are negatively related to the share of long-term debt. The firm size is positively related to debt maturity. Finally, there is a difference in long-term debt issues for firms with fiscal year ending in January, March, May, June, and November. However, no statistically significant relationships were found for the regulatory dummy and short-term interest rate, although the signs for these coefficients are consistent with theoretical predictions. Results here indicate the precision and efficiency of the model were sensitive to the model specification; corrections for violations of underlying assumptions are responsible for the magnitudes of these differences.

6. Discussion and conclusions

The debt financing decisions are a set of simultaneous decisions made by lenders and borrowers. Since lenders are unable to observe directly the firms' investment decisions, the banks offer contracts based upon the observable firm characteristics such as wealth and size. The contracts offered to each firm differ with respect to the cost of capital borrowing as well as its maturity. When deciding on the financing decisions, firms might also take into account the changes in macroeconomics variables in order to lower the cost of borrowing. As a result, the goal for this article was to examine the hypothesis of the effect of the debt determinant as well as the macroeconomics variables on the debt maturity structure at the individual firm level data. The research objective was achieved by investigating the relationship between these variables and the corporate debt maturity structure. A reduced form of the simultaneous debt decision model was estimated by employing several OLS estimation methods to analyze the relationship between debt maturity and its determinants.

The examination of the excess bond returns as well as the debt and market determinants of corporate debt maturity supports the hypothesis that excess bond returns are negatively associated with debt maturity. For example, firms tend to issue long-term debt when excess bond returns are low. Furthermore, results here are consistent with Barclay and Smith's (1995) and Antoniou et al. (2002) findings that firms with more growth options in their investment opportunity set issue more short-term debt. As a result, reducing debt maturity helps control the underinvestment problems as presented by Myers (1977). For example, underinvestment occurs when the debt maturity is not appropriately timed and debt refinancing occurs after investment options expire so the gains from new investments accrue to the debt holder (Johnson, 2003).

As discussed by FEMA (2005), there is also evidence for a strong positive association between firm size and debt maturity in which large firms issue a significantly higher share of long-term debt. Finally, there is support for the hypothesis that firms use the maturity of debt to signal information to the market. In accordance with Barclay and Smith's (1995) and Richardson and Sloan's (2003) findings, high-quality firms issue short-term debt, while low-quality firms issue long-term debt. There is no statistically significant evidence found supporting the impact of firms' regulatory status on debt maturity, although the variable does carry the predicted sign, implying that regulated firms issue more long-term debt.

The results obtained for the market variables are consistent with the hypothesis of macroeconomic variables impacting the debt maturity. The evidence is supported by the inverse relationship between the corporate debt maturity and the macroeconomic variables: inflation and term spread. Firms borrow long term when debt market conditions suggest that the relative cost of long-term debt is low. Although there is no evidence found in support of impact of short-term interest rates on debt maturity, the variable carries the predicted negative sign.

The sign and the magnitude of impact of the term spread changes depending on the model specification. These differences can be explained by linking the variable to the impact of taxes on the debt maturity decisions. Due to a firm's default on debt payments, the expected value of the firm's tax liabilities depends on the debt maturity structure as long as it is not flat. For example, if the term structure is upward sloping, issuing long-term debt reduces the firm's expected tax liability and, therefore, increases the firm's market value. As a result, there is a positive relationship between long-term debt and a slope of the term structure (Brick & Ravid, 1985).

The limited impact of the term spread is explained by Lewis (1990) and Terra (2005) as taxes having no effect on the optimal debt maturity when the optimal debt-asset ratios and debt maturity structure are chosen simultaneously. Terra (2005), however, finds that taxes do have a negative relationship with debt maturity in the case of Latin American firms. As many researchers, he struggles to explain why taxes have no impact on debt maturity although the average effective tax rate for the U.S. companies is greater than those of other countries so the negative impact of the term spread should be statistically influential (Terra, 2005).

The finding of the negative relationship between the macroeconomic variables and debt maturity confirms the fact of the chief financial officers timing the market by issuing short-term debt when short-term rates are low or when long-term rates are expected to decline. The finding is especially significant in the case of large firms, which have easy access to financial markets (Berlin, 2006). The findings confirm also the belief that managers watch the debt and therefore lower the borrowing cost. For example, Faulkendler (2005) finds that managers believing in market timing purchase a swap, amplifying the firm's exposure to rising interest rates while undertaking new borrowings instead of hedging against the increase in interest rate risk. This implies that managers are likely to swap fixed interest rate payments for floating interest rates payments at the same time of the debt offering when the term premium is high (Faulkendler, 2005).

On the other hand, not finding the short-term interest rate statistically significant is in agreement with the view shared by Berlin (2006) which states that chief financial officers cannot time the market due to limited information on interest rate movements (Berlin, 2006). As a result, managers might simply be wrong in their beliefs that market timing helps to decrease the cost of borrowing. Even if the cost of borrowing is lowered, it might not be a result of market-timing. Although Baker et al. (2003) find managers to exploit inefficiencies in debt markets and therefore, find lower borrowing cost, Butler et al. (2004) criticizes their econometric techniques and remains unconvinced of the market-timing phenomenon. His opinion as well as Berlin's (2006) opinion is in agreement with the Efficient Market Hypothesis, which states that it is impossible to "beat the market" because market efficiency causes existing investment prices to always incorporate and reflect all relevant information with regard to the market conditions (Fama, 1970).

The analysis here has some potential limitations. First, results obtained in this study are affected by a survivorship bias due to the sample generating process, which only included firms with complete data for the entire 10 years of study. As a result, the firms that are included in the sample as a result are more likely to be larger and older with less investment opportunities. These firm characteristics bias the sample towards finding issuance of long-term debt. On the other hand, the bias works against finding the inverse relationship between debt maturity and excess bond returns as well as macroeconomic variables. High volatility of the explanatory variables over the time of the analysis makes it harder to obtain the predicted results due to lack of persisting trend in the variables. Consequently, based on the bias possibility, the results for firm characteristics have to be taken lightly.

Second, as discussed by Barclay and Smith (1995), the debt-maturity analysis could be better executed if more disaggregated data were used in the study. For example, firms with more growth options in their investment opportunity set issue more short-term debt; however, it is questionable whether the total variation might result in variation among instruments with different maturities such as short-term bank debt or long-term public debt. A more detailed examination of the mix of debt instruments issued by different companies would add to the depth and understanding of firms obtaining the observed debt structure (Barclay & Smith, 1995).

Further research on the debt maturity structure should not only include the mix of debt instruments, but also one, two, and three-year cumulative excess bond returns. By including the cumulative returns in the model, debt maturity sensitivity to the impact of long- and short-term returns could be estimated. Such analysis would provide further information on the cost of debt borrowing at different maturities. Additionally, the sample used in the analysis should include information for as many firms and years as are available, in order to increase the precision and efficiency of the results. Furthermore, a large number of firms included in the sample will decrease the possibility of a survivorship bias and offer a more representative sample of firms, so obtained results could be extrapolated and interpreted for all firms in general. In order to investigate in more detail the relevance of the Market Timing Hypothesis in capital borrowing process, the weekly/monthly data points instead of yearly values should be employed in the model. As mentioned earlier, the market-timing phenomenon is a short-run process, so with more frequent data points finding support for the hypothesis is more likely to be achieved.

Finally, several changes should be made to the functional form of debt maturity and the empirical estimation framework. Since the functional form of the debt maturity function has not been defined by the finance literature at this point, the estimation process of the OLS models should include the specification tests for higher orders and interaction effects between the independent variables. Finding the right functional form of the debt maturity will improve the precision and efficiency of the model estimates and identify the debt maturity drivers. In addition, the empirical analysis framework should be extended to a mixing (averaging) estimator model to improve the efficiency of the estimation process. The idea behind the mixing estimator model is to average the estimators obtained from different OLS models to attain more efficient results compared to those derived from estimating each model individually while controlling for the omitted variable bias. The employment of the mixing estimator model results in fitted estimates that are asymptotically efficient with a minimum value of squared error in the class of discrete model average estimators (Hansen, 2006).

In conclusion, the analysis found evidence in support of impact of debt determinants and macroeconomic variables on the structure of debt maturity. Furthermore, as suggested by Backer et al. (2003), empirical studies of debt maturity need to incorporate the market conditions and the excess bond returns in order to adequately explain patterns in debt maturity data.

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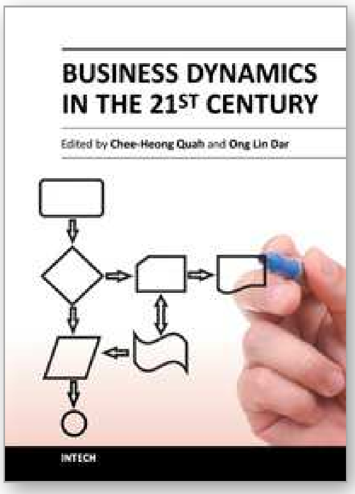

Business Dynamics in the 21st Century

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In this 21st century of opportunity and turbulence, business firms need to equip themselves with new competencies that were never thought of before. For this reason, this book is timely as it introduces new insights into new problems in the aspects of performance and quality improvement, networking and logistics in the interconnected world, as well as developments in monetary and financial environment surrounding private enterprises today. Readers shall find that reading this book is an enlightening and pleasant experience, as the discussions are delivered in a clear, straightforward, and "no-frills" manner - suitable to academics and practitioners. If desired, the book can serve as an additional piece of reference for teaching and research in business and economics.

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