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# Does Debt Capacity Matter in the Choice of Debt in Reducing the Underinvestment Problem?

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## Abstract

We test the impact of debt capacity on firms' simultaneous decisions of leverage and debt maturity in reducing underinvestment problems. Examining 24 OECD countries for the period between 1990 and 2011, we find strong evidence, that, unlike previous studies, the role of leverage and debt maturity in reducing underinvestment problems is not homogeneous across firms with varied debt capacity. We find new evidence that, when firms face lower debt capacity constraints, they benefit from their ability to use a greater amount of debt if they shorten their debt maturity, or gain from using longer maturity of debt if they decrease their leverage to reduce underinvestment problems. Our results suggest that they also benefit from the ability of their firms to gain from interest tax shields by financing more with debt or long-term debt, and hence use debt maturity and leverage as strategies substitutes. However, when firms are constrained by concerns over debt capacity, they tend to opt for a lower level of debt that is mainly short-term to reduce the underinvestment problem. Our results suggest that firms with lower debt capacity cannot completely resolve their underinvestment problems by using short-term debt or low leverage, implying that the effects of the liquidity risk outweigh those of underinvestment problems, and hence impose a constraint on firms' choice of debt.

*Key words*: Capital structure, debt maturity, debt capacity, liquidity costs, underinvestment problems

*JEL Classification*: G31, G32

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# Does Debt Capacity Matter in the Choice of Debt in Reducing the Underinvestment Problem?

## 1. Introduction

One particular attribute that has received much attention in the subsequent literature is the agency conflict between shareholders and debt-holders which results in different choices of debt-equity as well as in corporate debt with different maturities. In the presence of agency conflicts between equity- and debt-holders, debt financing results in debt overhang problem (Myers, 1977). When a firm is highly leveraged and debt is risky, shareholders have a disincentive to raise new capital to invest in projects that would make debt safer, even if these projects have a positive net present value, causing underinvestment problems.[2]

Within the agency costs theory, Myers (1977) argues that high-growth firms are expected to rely on lower levels of debt and/or short-term debt to mitigate their underinvestment problems. However, a short-term debt strategy creates liquidity risk[3] because lenders ignore the full value of control rents, so that, following Diamond (1991, 1993), shorter maturity of debt and lower leverage (a proportion of debt relative to total assets) are used as complementary strategies to alleviate the cost of roll-over. The cost of roll-over constrains the use of short-term debt; hence firms do not gain the benefits of using shorter maturity of debt to control their underinvestment problems. While short-term debt can mitigate the underinvestment cost and thereby increase leverage, it can also increase the cost of roll-over and hence reduce leverage (Johnson, 2003). Therefore, these arguments suggest that leverage and debt maturity (a proportion of long-term debt relative to total debt) could be

[2] To illustrate this problem with a simple example, consider a company with the following balance sheet (assets (£850) = liabilities (£1000) + equity (-£150)). The company has a positive NPV project with the cost of £300 and the future increase in the firm's asset value is £400. Shareholders invest if the benefit of this project exceeds. If they invest in this project, equity will be increased by £250. As the cost is £300, shareholders lose £50, and hence they choose not to invest, indicating that debt overhand distorts the investment decision.

[3] The liquidity risk is the probability-weighted expected costs related to bankruptcy, and, hence thereafter we use the term "roll-over" risk instead of liquidity risk.

either strategic complements (use both leverage and debt maturity) or substitutes (choose between leverage and debt maturity) in reducing underinvestment problems.

The limited literature has not investigated any condition under which leverage and debt maturity are expected to act as strategic complements or substitutes to control underinvestment incentives. In this paper, we investigate how debt capacity affects a joint choice of leverage and debt maturity in order to alleviate the underinvestment problem. Debt capacity plays a central role in capital structure dynamics which is related to financial flexibility hypothesis.[4] Unlike previous studies, ours tests the hypothesis that firms which face lower debt capacity constraints are more likely to use debt maturity and leverage as strategic substitutes, as they could borrow long or short-term debt without constraining their ability to issue the other. Lemmon and Zender (2010) argue that firms which are not constrained by concerns over debt capacity are larger and have more stable returns, and thereby have higher ratings. Such firms, with their lower roll-over risk (Diamond, 1991 and 1993) and greater financial flexibility (Denis and McKeon, 2012), can shorten their debt maturity to reduce the underinvestment problem without having to reduce leverage (Johnson, 2003).

In contrast, firms that are constrained by concerns over debt capacity are more likely to be low-credit quality firms and hence less able to gain access to public debt markets.[5] Consistent with Mauer and Ott's (1998) model, according to which firms that shorten their debt maturity to reduce the underinvestment problem can also reduce their leverage to mitigate the roll-over costs, we expect that, for firms with limited debt capacity, the relatively large roll-over risk outweighs the underinvestment problem, and hence that they should reduce their leverage to avoid roll-over risk when they shorten their debt maturity to mitigate the cost of the underinvestment problem. Therefore, we expect that, in contrast to

[4] See DeAngelo and DeAngelo (2007) and Graham & Harvey (2001) who survey CFOs.
[5] See Lemmon and Zender (2010).

unconstrained firms, low-debt capacity companies are more likely to use debt maturity and leverage as complementary strategies in reducing the underinvestment problem.

To test our hypotheses, our study, unlike previous studies that focus on single countries mainly in the UK and US, uses a sample that spans 24 OECD countries containing 12951 firms within the period 1990 to 2011, resulting in about 117,160 firm-year observations. However, our investigation extends beyond simply checking the robustness of previous studies, by including a sample from different countries. We also expand the literature by addressing the impact of debt capacity, a factor that is not extensively covered in previous studies on the simultaneous decision of leverage and debt maturity in reducing underinvestment incentives. We use the indicator of debt capacity to determine whether the firm, based on its underlying characteristics, has a high likelihood of being able to access the public debt markets. We measure debt capacity as Pr= -10.048+1.212 LogTA+0.028 ROA-0.136 PPE-0.077 MB+3.917 Lev+0.363 LogAge-4.944 SdR ,which is based on the likelihood that a firm can access public debt markets (Pr), which is the function of logarithm of total assets (LogTA), return on assets (ROA), net property, plant and equipment (PPE), the market-to-book ratio (MB), logarithm of firms' age (LogAge), and standard deviation of stock returns (SdR) (Lemmon and Zender, 2010). A firm is classified as a high-debt capacity firm if its debt capacity is above its yearly industry median. In addition, we find that leverage is 25% and debt maturity is 62% for firms that are not constrained over debt capacity.

We find strong evidence, that, the role of leverage and debt maturity in reducing underinvestment problems is not homogeneous across firms with varied debt capacity. We find new evidence that, when firms face lower debt capacity constraints, they benefit from their ability to use a greater amount of debt if they shorten their debt maturity, or gain from using longer maturity of debt if they decrease their leverage to reduce underinvestment problems. However, we find that companies complete their target leverage in more than three years while debt maturity is relatively sticky as firms move towards their target in about one year and half, suggesting that managers are more likely to change leverage over a relatively short time to mitigate underinvestment problems. Our results suggest that they also benefit from the ability of their firms to gain from interest tax shields by financing more with debt or long-term debt, and hence use debt maturity and leverage as strategies substitutes. However, when firms are constrained by concerns over debt capacity, they tend to opt for a lower level of debt that is mainly short-term to reduce the underinvestment problem. Our results suggest that firms with lower debt capacity cannot completely resolve their underinvestment problems by using short-term debt or low leverage, implying that the effects of the roll-over risk outweigh those of underinvestment problems, and hence impose a constraint on firms' choice of debt.

## 2. Data and Sample

As we use dynamic models of estimation, we require at least three consecutive annual observations. We first collect all firms registered in OECD countries from *DataStream*. We exclude Korea, Czech Republic, Chile, Estonia, Greece, Hungary, Iceland, Slovak Republic, and Slovenia for lack or unreliable data. We also exclude Finland, Japan, Luxemburg, Poland, and Turkey between 1990 and 1999 because of lack data. Therefore, we left with 24 OECD countries.[6] In addition, we exclude financial firms and those non-financial firms with negative book equity. Our final sample includes 12951 firms from 1990 to 2011, resulting in 117,160 firm-year observations. To control for survivorship bias, the sample includes all live and dead companies over the study period. Data for firm-specific variables is collected form *DataStream* and *Thomson ONE Banker*. We defined our data in Appendix 1. Figure 1 shows capital structure and debt maturity across countries from 1990 to 2011. As the figure shows,

[6] Our sample of 24 OECD countries includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Ireland, Japan, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, the UK and US.

the highest leverage ratio is in Portugal. The second highest leverage ratio is in Norway where debt obligations have the longest maturities while Turkey is with the lowest long-term debt obligations.

[Insert Figure 1 here]

## 3. Results and Discussions

### 3.1 Descriptive Statistics

Table 1, Panel A, reports the summary of statistics for the variables used in our analysis. This table also shows that mean (median) leverage, *Lev*, is 23% (21%), while, on average, 57% of the debt issued is long-term debt, *Mat*. In unreported results, we find that, for the group of firms that most likely to be constrained by debt capacity, they rely on more equity and use less short-term debt as their leverage and debt maturity are 19% and 40%, respectively, compared to 25% leverage and 62% debt maturity for firms that are not constrained over debt capacity, having higher debt capacity. In Panel B, we compute the Pearson correlation coefficients for dependent and independent variables. The results reported in Table 1, Panel B, suggest that, in addition to size (measured by natural logarithm of market capitalisations, *Size*), growth opportunities (measured by the market-to-book ratio, *MB*), tangibility of assets (measured by the ratio of tangible fixed assets over total assets, *Tg*), and profitability (measured by return on assets, *ROA*), debt capacity (measured by the likelihood of being able to access the public debt markets, *Debt cap*) potentially influences leverage and debt maturity. In particular, firms with higher debt capacity have higher leverage and longer maturity of debt. In addition, larger firms with more tangible assets (*Tg*) have higher leverage and longer maturity of debt. However, profitable firms, measure by return on assets (*ROA*), lave lower leverage but use more long-term debt. Leverage and debt maturity are negatively correlated with the market-to-book ratio as a proxy for underinvestment problems.

[Insert Table 1 here]

### 3.2 Regression Results

*3.2.1 Changes in Leverage and Debt Maturity*

We consider the impact of debt capacity on the decision to change leverage and debt maturity. For these purposes, we estimate the following logit regressions:

$$\Pr(dLev_{i,t} = 1) = \alpha_0 + \alpha_1\, Mat_{i,t} + \alpha_2\, GO_{i,t} + \alpha_3\, Mat_{i,t} * GO_{i,t} + \alpha_4\, Debt\ cap_{i,t} + \sum_{j=5}^{J} \alpha_j X_{i,t} + \varepsilon_{i,t} \quad (1)$$

$$\Pr(dMat_{i,t} = 1) = \alpha_0 + \alpha_1\, Lev_{i,t} + \alpha_2\, GO_{i,t} + \alpha_3\, Lev_{i,t} * GO_{i,t} + \alpha_4\, Debt\ cap_{i,t} + \sum_{j=5}^{J} \alpha_j X_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where $dLev_{i,t}$ is an indicator of weather firms in our sample, increase (issue more debt), or decrease (issue equity or debt reduction) their leverage. $dMat_{i,t}$ is an indicator of weather firms in our sample, increase, or decrease their debt maturity. Where $Lev_{i,t}$ is leverage measured by total debt divided by total assets of firm *i* at time *t*. $Mat_{i,t}$ is debt maturity, measured by debt with more than one year maturity for firm *i* divided by total debt at time *t*. $GO_{i,t}$ is growth opportunities of firm *i* at time *t*, which is computed as the ratio of the book value of assets less the book value of equity plus the market value of equity all divided by the book value of assets of firm *i* at time *t*. $Mat_{i\,t}*GO_{i,t}$ is the interaction between growth opportunities of firm *i* at time *t* and long-term debt maturity of firm *i* at time *t*. $Debt\ cap_{i,t}$ is debt capacity of firm *i* at time *t*. $Lev_{i\,t}*GO_{i,t}$ is the interaction between growth opportunities of firm *i* at time *t* and leverage of firm *i* at time *t*. $X_{i,t}$ is a set of control variables for both equations which are defined in Appendix 2.

We report the logit regressions in Table 2 to assess these factors on increasing leverage in Panel A and long-term debt maturity in Panel B. In Panel A, the results of full sample show that firms with higher debt capacity tend to increase their leverage. Moreover, the results for overall sample show that firms are more likely to increase their leverage if they use more long-term debt, indicating that firms increase their leverage (total debt/total assets) through issuing more debt by about 0.03 for a unit increase in long-term debt relative to total debt (debt maturity). The results support the roll-over hypothesis, that too much short-term debt creates significant roll-over risk, and thereby reducing leverage to mitigate bankruptcy costs. However, we provide weak evidence for the impact of roll-over costs for high-debt capacity firms. The interaction term (*Mat**GO*) is negatively significant for both low- and high-debt capacity firms, but is larger in magnitude for firms with higher debt capacity. Considering the stand-alone coefficient on debt maturity (*Mat*) and the interaction term (*Mat**GO*), the results suggest that the total effect of debt maturity on leverage is negative for high-debt capacity firms as their leverage is affected only by the stand-alone coefficient. Therefore, they tend to increase their leverage if they adapt a short-term strategy to mitigate their underinvestment problems. In contrast, this total effect remains positive and significant for low-debt capacity firms, suggesting that they are subject to significant roll-over risks.

The overall effect of growth opportunities on leverage is also affected by the interaction term between debt maturity and growth opportunities. The results support that high-debt capacity firms are less likely to decrease their leverage when they adopt a short-term debt maturity strategy in reducing their underinvestment problems. While, for low-debt capacity firms, the results suggest that they cannot completely resolve their underinvestment problems by using short-term debt, as the effects of the roll-over risk outweigh those of underinvestment problems, and hence impose a constraint on firms' choice of debt.

The results in Panel B are reported for the probability of increasing long-term debt maturity. Firms with higher debt capacity are likely to increase their long-term debt maturity by about 3.30 for a unit decrease in their leverage while firms with lower debt capacity increase their long-term debt maturity by about 0.99 for a unit increase in their leverage. The results for high-debt capacity firms suggest that they are more likely to use shorter maturity of debt when they have higher leverage, implying that they tend to us leverage and debt maturity as strategic substitutes. Considering the coefficients on effective tax rates, the results for high-debt capacity firm suggest that they are more likely to adjust their leverage and debt maturity to gain from interest tax shields. Therefore, they tend to increase their debt maturity to take the tax advantage of long-term debt, when they mitigate their underinvestment problems by adopting a low-leverage strategy. While low-debt capacity firms change their leverage and debt maturity positively irrespective of underinvestment problems and taxes, suggesting that roll-over costs are more significant for low-debt capacity firms.

For low-debt capacity firms, we provide weak evidence for the impact of growth opportunities and interaction term (*Lev*GO*) on debt maturity, suggesting that roll-over costs play a more important role in determining their structure of debt maturity. In contrast, for high-debt capacity firms, we support the attenuation effect of leverage as the interaction term (*Lev*GO*) is negative and significant.

[Insert Table 2 here]

*3.2.1 Leverage and Debt Maturity*

In this section, we follow the model provided by Johnson (2003) and Dang (2011), which controls for leverage and debt maturity simultaneously (Equations (3 and 4)). Following Flannery and Rangan (2006), the lagged dependent variables ($Lev_{i,\ t-1}$ and $Mat_{i,t-1}$)

are also included to control for the dynamic framework of capital structure. The speed of adjustment, $\delta$, is expected to be significantly positive.[7]

$$Lev_{i,t} = \alpha_0 + (1-\delta)\, Lev_{i,t-1} + \alpha_1\, Mat_{i,t} + \alpha_2\, GO_{i,t} + \alpha_3\, Mat_{i,t} * GO_{i,t} + \alpha_4\, Debt\ cap_{i,t} + \sum_{j=5}^{J} \alpha_j X_{i,t} + \varepsilon_{i,t} \quad (3)$$

$$Mat_{i,t} = \alpha_0 + (1-\delta)\, Mat_{i,t-1} + \alpha_1\, Lev_{i,t} + \alpha_2\, GO_{i,t} + \alpha_3\, Lev_{i,t} * GO_{i,t} + \alpha_4\, Debt\ cap_{i,t} + \sum_{j=5}^{J} \alpha_j X_{i,t} + \varepsilon_{i,t} \quad (4)$$

*3.2.2.1 Leverage Equation*

The model developed in the previous section includes two equations (Equations (3) and (4)) in which leverage and debt maturity are treated as endogenous. Estimation of each equation will result in simultaneous-equations bias, and hence we use a two-stage estimation in which the endogenous variable is replaced with its predicated variable (see Wooldridge, 2002). Therefore, we start with the two-stage least square estimator (2SLS) in which the fitted value is created for the endogenous variable. However, Equations (3) and (4) are dynamic panel models in which the lagged dependent variables are correlated with individual effects. To overcome this problem, we use the GMM-system method which considers lagged repressors in both levels and first differences to reduce the finite sample bias substantially by exploiting the additional moment conditions (Blundell and Bond, 1998).

Table 2 presents the results of the 2SLS and GMM-system.[8] Panel A reports the results for the leverage equation (Equation (3)), using two-stage regressions. The first stage estimates the fitted value of debt maturity which is not reported in Table 2 because of space considerations. While the GMM-system is more efficient than 2SLS estimator, both

[7] Main variables are defined in Equations 1 and 2. Control variables are defined in Appendix 2.

[8] The AR(2) tests suggest that the GMM-system provides satisfactory evidence as there is no any second-order serial correlation, and the p-value of Sargan tests for over-identifying restrictions supports the validity of instruments.

estimators relatively provide relatively similar results. The coefficient on the lagged leverage (*L.Lev*) supports the dynamic model of leverage. The results suggest – after controlling for other reported variables– the adjustment speed for the overall sample is relatively 30%, indicating that companies complete their target leverage deviation in more than three years. These findings suggest that managers may change firms' leverage over a relatively short time, and hence they trade-off the costs of changing leverage and benefits of solving the underinvestment problem to move towards their target leverage. The results are relatively consistent across firms with different debt capacity.

The results for the overall sample show that debt capacity (*Debt cap*) is positively and significantly related to leverage. The results are in line with the argument that firms that are not constrained by concerns over debt capacity have more access to public debt market as they have stable cash flows, larger collateral, and more information transparency.

The relationship between leverage and debt maturity depends on the costs of roll-over and the underinvestment problem. Firms with a significant risk of roll-over are expected to have a positive relationship between leverage and debt maturity, suggesting that firms with a short-term debt can mitigate the cost of roll-over by adopting a low-leverage strategy. The results show that the coefficient on debt maturity, *Mat*, is found to be insignificant for firms with higher debt capacity in contrast to firms who are constrained by concerns over debt capacity. The results suggest that roll-over affects are more important for low-debt capacity firms, and hence they shorten their debt maturity and simultaneously decrease their leverage to alleviate roll-over risks. Our results are related to Bolton and Freixas(2000), who argue that constrained firms are riskier, have smaller assets to use as a collateral, and are subject to higher asymmetric information problems.

Considering the stand-alone coefficient on debt maturity (*Mat*) and the interaction term between debt maturity and growth (*Mat*GO*), the results show that the net effect of debt maturity on leverage is positive for low-debt capacity firms while is negative for high-debt capacity firms. The coefficient estimate of debt maturity for firms with lower (higher) debt capacity is 0.391 (-0.321), while that of the interaction is -0.019 (-0.023). Thus the partial derivative of leverage with respect to debt maturity is positive (0.391-0.019=0.372) for low-debt capacity firms while is negative (-0.321-0.023=-0.344) for firms with higher debt capacity. The positive effect of debt maturity on leverage for low-debt capacity firms suggests that while short-term debt attenuates the negative effect of growth opportunities on leverage, it increases the roll-over risk, and thus that firms decrease their leverage to mitigate their roll-over cost. However, the roll-over risk is not very important for firms with higher debt capacity, facing fewer constraints on extending their debt maturity as they have more ability to access to public debt markets and have greater financial flexibility.

Myers (1977) argues that high-growth firms lower their leverage to reduce the underinvestment problem and the results consistently show that the coefficients on the stand-alone market-to-book ratios are negative and significant for low-debt capacity firms. While, for companies with higher debt capacity, the coefficients on the stand-alone market-to-book ratios, *MB*, are statistically significant, but not economically meaningful. Considering the interaction term between debt maturity and growth opportunities, (*Mat**GO*), the results show that use of short-term debt to mitigate the underinvestment problem can eliminate the negative relationship between leverage and growth opportunities. These results provide strong support for the attenuation of the negative effect of growth opportunities on leverage.

The net effect of growth opportunities, *GO*, on leverage is the partial derivative of leverage with respect to growth opportunities, which is captured by the interaction term between growth opportunities and debt maturity (*Mat**GO*) and the stand-alone coefficient of growth opportunities (*GO*). The results for high-debt capacity firms show that the stand alone coefficient of growth opportunities, *GO*, is not economically significant while that of the interaction, *Mat*GO*, is highly significant and has a larger magnitude. These results suggest that, for such firms, debt maturity and leverage are strategic substitutes to mitigate the underinvestment problem and are consistent with the argument that if companies use short-term debt efficiently as a device to mitigate the underinvestment problem, the negative effect of growth opportunities on leverage will vanish. In contrast, the results for firms with lower debt capacity show that they use leverage and debt maturity as complementary strategies, as the use of short-term debt in reducing the underinvestment problem increases the roll-over risk, and thereby decreases leverage. The results indicate that the roll-over risk outweighs those of underinvestment problem for low-debt capacity and that therefore they have an incentive to reduce their leverage when they use short-term debt to diminish their underinvestment problem.

For high-debt capacity firms, the results for the coefficients on effective tax rates, *EFTR*, are larger in magnitude and consistent in all regressions, as compared to the respective coefficients for low-debt capacity firms. These results suggest that unconstrained firms tend to opt for a high-leverage strategy, when they shorten their debt maturity to reduce their underinvestment problems, to maximise the benefit of debt financing through interest tax shields. However, low-debt capacity firms, regardless of the tax advantage of debt financing, reduce their leverage and shorten their debt maturity simultaneously to mitigate their underinvestment problems.

The results for control variables using the GMM-system and 2SLS are consistent with the trade-off theory, tangibility of assets (*Tg*), size measured by the natural logarithm of market capitalisation, and risk measured by the interest coverage are positively related to leverage. Consistent with the predictions of the pecking order theory, the coefficient of return on assets as a proxy for profitability is negative and significant, suggesting the firms with greater profitability prefer internal financing and thus have lower leverage.

*3.2.2.2 Debt Maturity Equation*

Table 2-Panel B reports the results for debt maturity using Equation (4). Like Panel A, Pale B is based on the results from the GMM-system and 2SLS, using two-stage regressions. The first stage estimates the fitted value of leverage which is not reported in Table 2 because of space considerations. While the GMM-system is more efficient than 2SLS estimator, both estimators relatively provide relatively similar results. The coefficient on the lagged debt ratio is positive and significant across different samples, supporting the dynamic framework of debt maturity that companies have target debt maturity. The adjustment speed for the overall sample is relatively 70%, suggesting that companies complete their target debt maturity deviation in about one year and half. These findings indicate that debt maturity is relatively sticky, and hence managers have less flexibility to change debt maturity to mitigate underinvestment problems.

The results for the overall sample show that debt capacity (*Debt cap*) is positively and significantly related to debt maturity, suggesting that the higher the debt capacity, the more likely firms are to use longer maturity of debt.

In Table 2-Panel B, for firms with higher debt capacity, the results for the stand-alone coefficients on leverage are positive and significant, suggesting that companies face greater roll-over risk when they use a low-leverage strategy to mitigate the underinvestment problem. Therefore, the relationship between leverage and debt maturity becomes significant, suggesting that leverage and debt maturity can be used as complementary strategies to control the risk of suboptimal liquidation. In contrast, the results for high-debt capacity firms suggest that roll-over risk is not important as leverage is weakly significant.

The results show that debt maturity and leverage are substitute strategies and that thus the interaction term between leverage and growth opportunities, *Lev*GO*, is relatively negative and significant, providing strong support for the attenuation effect of debt maturity on the negative relationship between leverage and growth opportunities. The results for high-debt capacity firms show that the overall effect of debt maturity on leverage is affected only by the level of growth opportunities (*GO*), as the partial derivative of debt maturity with respect to leverage is significant only for the coefficient on the interaction tem between leverage and growth opportunities, *Lev*GO*. The results suggest that those firms with higher debt capacity use leverage and debt maturity as complementary strategies as they face lower roll-over risk. While low-debt capacity firms shorten their debt maturity when they use a low-leverage strategy to mitigate the underinvestment, supporting that roll-over risk effects are more important for lower credit quality firms.

Considering the impact of growth opportunities on debt maturity, growth opportunities (*GO*), measured by the market-to-book ratios, are negatively related to debt maturity for firms with lower debt capacity and the full sample. However, growth opportunities are not economically significant for high-debt capacity firms, while the coefficients on the interaction term between growth opportunities and leverage (*GO*Lev*) is both economically and statistically significant. Moreover, the results suggest that for firms that control the underinvestment problem by using a low-leverage strategy, firms may not shorten their debt maturity, and hence the relationship between leverage and growth opportunities can theoretically be abolished.

For high debt-capacity firms, in line with Mauer and Lewellen (1987) and Brick and Palmon (1992), who argue that the higher the tax rate, the more likely firm are to take benefits of tax shields, we find a positive relationship between the effective tax rate and the maturity structure of debt. Our results suggest that unconstrained firms use longer debt maturity to gain form interest tax shields when they adopt a low-leverage strategy in reducing underinvestment problems. In contrast, for low-debt capacity firms, we find weak evidence for the impact of effective tax rates on debt maturity, suggesting that they use debt maturity regardless of the tax benefit of debt financing. [9]

The coefficients of the other variables in Panel B show that maturity of assets (*AM*) has a positive and significant impact on debt maturity, supporting that firms can chose their debt maturity along with their asset life to mitigate the risk. Moreover, firm size is positively related to debt maturity, suggesting that larger firms use longer maturity of debt because of lower bankruptcy costs and stronger reputations. The coefficient on term structure on the interest rate (*TS*) is relatively significant Inconsistent with the signalling hypothesis, the results show that the effect of abnormal earnings (*ABE*) as a proxy for firms' quality on debt maturity is relatively positive. Finally, the results for risk, measured by the interest coverage ratios, are positive and significant.

[Insert Table 3 here]

## 4. Conclusions

Using non-financial firms in 24 OECD countries, unlike previous studies, ours finds that roll-over costs are not significant for firms who are not constrained by concerns over debt capacity, and that hence they use leverage and debt maturity as substitute strategies. Our results support the claim that, for high-debt capacity firms, debt maturity attenuates the negative effect of growth opportunities on leverage, which is in line with Johnson's (2003) argument. Our results suggest that, as unconstrained firms have higher financial flexibility and lower roll-over costs, they tend to opt for a high-leverage strategy, when they use shorter maturity of debt to reduce underinvestment problems, to gain from interest tax shields of debt financing. Conversely, they are more likely to use longer debt maturity, when they adapt a

[9] The results are qualitatively similar when we control for high-growth and low-growth firms as robustness check. We also use alternative proxy for debt capacity. Following Leary and Roberts (2010), debt capacity is expressed as a function of firms' characteristics including assets, market-to-book ration, profitability, and tangibility. The results did not change significantly.

low-leverage strategy to mitigate the underinvestment problem, to gain form interest tax shields of long-term debt.

In contrast, our results for low-debt capacity firms suggest that too much short-term debt accelerates the cost of suboptimal liquidation, which may reduce the benefit of using short-term debt in reducing the underinvestment problem, and, thereby, regardless of the tax benefit of debt, decreases the optimal leverage. These results are in line with Johnson (2003), who argues that if companies use a low-leverage/short-term debt strategy to alleviate their underinvestment problems, they have less incentive to shorten their debt maturity/lower their leverage. However, they cannot resolve their underinvestment problems by choosing short-term debt/low leverage because of the costs of roll-over. Therefore, while short-term debt attenuates a negative effect of growth opportunities on leverage, it accelerates the suboptimal liquidation costs, and thus imposes a constraint on firms' choice of debt that matures in a year. For low-debt capacity firms, the net effect of the related costs shows that roll-over risk is more important in determining firms' joint choice of leverage and debt maturity, suggesting that; overall, they use leverage and debt maturity as complementary rather than as substitute strategies. Our results are strong after controlling for the other theories in the literature of debt maturity and capital structure, including the signalling, matching, and tax hypotheses.

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**Table 1: Descriptive Statistics**

Panel A: summary statistics of variables

| Variables | N | Mean | SD | Min | Median | Max |
|---|---|---|---|---|---|---|
| Lev | 117,160 | 0.230 | 0.162 | 0.000 | 0.214 | 0.550 |
| Mat | 117,160 | 0.573 | 0.335 | 0.000 | 0.632 | 1.000 |
| Debt cap | 117,160 | 10.451 | 5.251 | -0.448 | 9.567 | 27.323 |
| GO | 117,160 | 2.243 | 2.066 | 0.410 | 1.550 | 9.040 |
| Size | 117,160 | 12.062 | 2.063 | 8.356 | 11.934 | 15.767 |
| AM | 117,160 | 0.317 | 0.226 | 0.010 | 0.277 | 0.801 |
| ROA | 117,160 | 0.027 | 0.150 | -0.536 | 0.057 | 0.221 |
| ABE | 113,096 | 0.003 | 0.035 | -0.072 | 0.000 | 0.079 |
| Tg | 117,160 | 0.280 | 0.123 | 0.102 | 0.203 | 0.459 |
| EFTR | 117,160 | 0.228 | 0.185 | 0.000 | 0.246 | 0.552 |
| TS | 115,812 | 0.556 | 1.100 | -1.629 | 0.810 | 2.374 |
| Int.C | 115,353 | 12.950 | 34.870 | -44.933 | 4.547 | 124.944 |

Panel B: correlation matrix

| | Lev | MAT | Debt cap | GO | Size | AM | ROA | ABE | Tg | EFTR | TS | Int.C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lev | 1 | | | | | | | | | | | |
| Mat | 0.238 | 1 | | | | | | | | | | |
| Debt cap | 0.163 | 0.225 | 1 | | | | | | | | | |
| GO | -0.021 | -0.047 | -0.041 | 1 | | | | | | | | |
| Size | 0.038 | 0.315 | 0.727 | 0.155 | 1 | | | | | | | |
| AM | 0.274 | 0.197 | 0.127 | -0.130 | 0.089 | 1 | | | | | | |
| ROA | -0.004 | 0.145 | 0.295 | -0.136 | 0.380 | 0.066 | 1 | | | | | |
| ABE | -0.010 | 0.018 | 0.021 | -0.015 | 0.032 | -0.007 | 0.127 | 1 | | | | |
| Tg | 0.130 | 0.011 | 0.167 | -0.103 | 0.216 | **0.003** | 0.370 | 0.012 | 1 | | | |
| EFTR | 0.010 | 0.013 | -0.011 | 0.009 | -0.008 | 0.055 | -0.016 | 0.001 | -0.006 | 1 | | |
| TS | 0.045 | -0.068 | 0.016 | -0.141 | 0.030 | 0.036 | 0.081 | 0.034 | 0.108 | 0.009 | 1 | |
| Int.C | -0.338 | -0.104 | 0.095 | -0.022 | 0.196 | -0.093 | 0.525 | 0.059 | 0.371 | 0.015 | 0.011 | 1 |

The sample includes 117,160 firm/year observations from 24 OECD countries. Panel A reports summary statistics of the variables defined in Table 1. It also includes number of observations (N), mean, standard deviation (SD), minimum (Min), median, and maximum (Max). Panel B presents the Pearson correlation coefficients across our variables. All correlation coefficients are significant at 1% level except those in bold. The data is winsorized at the top and bottom 1%.

**Table 2: Logit Regressions**

| Independent variables | Exp.sign | Coeff. | ME | Coeff. | ME | Coeff. | ME |
|---|---|---|---|---|---|---|---|
| | | Full sample | | High-debt capacity | | Low-debt capacity | |
| Panel A | | Dependent variable: Leverage | | | | | |
| **Mat** | + | **5.048*** ** | **0.036** | **0.272** | **0.003** | **3.406*** ** | **0.067** |
| | | **(10.01)** | | **(0.85)** | | **(5.28)** | |
| **Mat*GO** | - | **-6.407*** ** | **-0.046** | **-0.016*** ** | **-0.041** | **-0.103*** | **-0.018** |
| | | **(-4.85)** | | **(-3.27)** | | **(-1.94)** | |
| **GO** | - | **-1.610*** ** | **-0.011** | **-0.055** | **-0.001** | **-0.052** ** | **-0.009** |
| | | **(-6.95)** | | **(-1.56)** | | **(-1.98)** | |
| Size | + | 0.088*** | 0.000 | 0.205*** | 0.022 | 0.158*** | 0.028 |
| | | (3.16) | | (10.30) | | (4.16) | |
| Tg | + | 1.446*** | 0.015 | 0.157 | 0.017 | 0.292* | 0.051 |
| | | (10.69) | | (1.59) | | (1.65) | |
| ROA | +/- | 1.701*** | 0.012 | 1.463*** | 0.162 | 1.103*** | 0.196 |
| | | (13.23) | | (11.95) | | (12.52) | |
| EFTR | + | 0.180*** | 0.011 | 0.009** | 0.010 | 0.032 | 0.005 |
| | | (3.02) | | (2.13) | | (0.53) | |
| Int.C | + | 0.015*** | 0.000 | 0.001 | 0.000 | 0.003*** | 0.000 |
| | | (17.75) | | (1.60) | | (3.42) | |
| Debt cap | + | 0.076*** | 0.012 | | | | |
| | | (4.75) | | | | | |
| Constant | | -2.258*** | | -3.442*** | | -2.404*** | |
| | | (-3.94) | | (-2.54) | | (-4.88) | |
| N | | 97,835 | | 55,972 | | 41,863 | |
| Time | | Yes | | Yes | | Yes | |
| Industry | | Yes | | Yes | | Yes | |
| Country | | Yes | | Yes | | Yes | |
| Pseudo $R^2$ | | 0.146 | | 0.106 | | 0.078 | |
| Panel B | | Dependent variable: Debt maturity | | | | | |
| **Lev** | + | **2.397** | **0.319** | **-3.302*** | **-0.825** | **0.245** ** | **0.993** |
| | | **(1.12)** | | **(-1.81)** | | **(1.95)** | |
| **Lev*GO** | - | **-0.235*** ** | **-0.058** | **-0.043*** ** | **-0.011** | **-0.100** | **-0.025** |
| | | **(-11.68)** | | **(-2.73)** | | **(-1.14)** | |
| **GO** | - | **-0.012** ** | **-0.010** | **-0.021** | **-0.005** | **-0.015** | **-0.014** |
| | | **(-2.20)** | | **(-1.06)** | | **(-0.38)** | |
| Size | + | 0.257*** | 0.064 | 0.084*** | 0.021 | 0.103*** | 0.025 |
| | | (5.55) | | (10.01) | | (6.18) | |
| AM | + | 5.217 | 1.299 | 0.683** | 0.171 | 3.925 | 0.968 |
| | | (1.15) | | (2.33) | | (1.01) | |
| ABE | - | 0.948*** | 0.236 | 0.905*** | 0.226 | 0.970*** | 0.239 |
| | | (5.12) | | (3.55) | | (3.59) | |
| TS | + | 0.002 | 0.001 | 0.012 | 0.003 | 0.016 | 0.004 |
| | | (0.32) | | (1.43) | | (1.61) | |
| Int.C | + | 0.044 | 0.011 | 0.009** | 0.002 | -0.023 | -0.006 |
| | | (1.14) | | (2.46) | | (-0.99) | |
| EFTR | + | 0.681 | 0.169 | 0.259** | 0.065 | 0.005 | 0.001 |

| | | | | | |
|---|---|---|---|---|---|
| | | (1.24) | | (2.46) | (0.05) |
| Debt cap | + | 0.001** | 0.004 | | |
| | | (2.07) | | | |
| Constant | | 2.364 | | -0.408 | 1.951 |
| | | (0.78) | | (-1.28) | (0.58) |
| N | | 94,466 | | 53,864 | 40,602 |
| Time | | Yes | | Yes | Yes |
| Industry | | Yes | | Yes | Yes |
| Country | | Yes | | Yes | Yes |
| Pseudo $R^2$ | | 0.060 | | 0.054 | 0.059 |

This table shows the results for Equations (1) and (2). We report the results for full sample, high- and low-debt capacity firms. A firm is classified as a high-debt capacity firm if its debt capacity is above its yearly industry median. The results of this table are based on a two-stage procedure; the results in the first stage used to generate the estimated values of leverage and debt maturity are not reported because of space considerations. In Panel A, the dependent is a dummy variable equal to 1 if firms in our sample increase their leverage and 0 otherwise. In Panel B, the dependent variable a dummy variable equal to 1 if firms in our sample increase their long-term debt maturity and 0 otherwise. See Table 1 for other variable definitions. We also report marginal effects of coefficients, ME, number of observations, N, Pseudo $R^2$, year, industry, and country dummies to control for time, industry, and country effects. t-statistics are reported in parenthesis. *, **and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively.

**Table 3: Leverage and Debt Matrutiy**

| Independent variables | Exp. sign | Full sample | High-debt capacity | Low-debt capacity | Full sample | High-debt capacity | Low-debt capacity |
|---|---|---|---|---|---|---|---|
| | | 2SLS | | | GMM-system | | |
| *Panel A-Dependent variable: Leverage (total debt/ total assets)* | | | | | | | |
| L.Lev | + | 0.652*** | 0.705*** | 0.612*** | 0.753*** | 0.808*** | 0.729*** |
| | | (4.58) | (5.87) | (4.25) | (3.59) | (6.00) | (5.00) |
| **Mat** | **+** | **0.418**** | **-0.321** | **0.391***** | **0.025** | **-0.060** | **1.385***** |
| | | **(2.51)** | **(-1.22)** | **(10.61)** | **(1.07)** | **(-1.52)** | **(8.62)** |
| **Mat*GO** | **-** | **-0.018***** | **-0.023***** | **-0.019***** | **-0.006***** | **-0.092***** | **-0.051***** |
| | | **(-4.33)** | **(5.13)** | **(-7.27)** | **(-5.65)** | **(-6.41)** | **(-6.71)** |
| **GO** | **-** | **-0.004***** | **-0.001*** | **-0.015***** | **-0.002***** | **-0.009*** | **-0.023***** |
| | | **(-4.82)** | **(-1.72)** | **(-8.04)** | **(-5.48)** | **(-1.68)** | **(-5.83)** |
| Size | + | 0.019*** | 0.017*** | 0.020*** | 0.001 | 0.078*** | 0.062*** |
| | | (20.40) | (19.01) | (9.23) | (0.64) | (3.62) | (8.94) |
| Tg | + | 0.262*** | 0.235*** | 0.293*** | 0.060*** | 0.362*** | 0.411*** |
| | | (5.72) | (5.99) | (29.16) | (9.45) | (3.81) | (10.63) |
| ROA | +/- | -0.202*** | -0.145*** | -0.247*** | -0.116*** | -0.108*** | -0.030 |
| | | (-5.16) | (-3.72) | (-8.41) | (-5.80) | (-3.26) | (-0.84) |
| EFTR | + | 0.005** | 0.149*** | 0.003* | 0.001* | 0.007** | -0.012 |
| | | (3.01) | (9.12) | (1.79) | (1.76) | (2.54) | (-1.05) |
| Int.C | + | 0.002*** | 0.003*** | 0.002*** | 0.000*** | 0.003*** | 0.002*** |
| | | (85.21) | (71.61) | (45.29) | (5.57) | (3.56) | (10.06) |
| Debt cap | + | 0.024*** | | | 0.002*** | | |
| | | (24.52) | | | (19.26) | | |
| Constant | | 0.173*** | 0.180*** | 0.127*** | | | |
| | | (47.80) | (33.58) | (13.98) | | | |
| N | | 109,000 | 59,344 | 49,300 | 95,400 | 54,585 | 41,863 |
| Time | | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry | | Yes | Yes | Yes | Yes | Yes | Yes |
| Country | | Yes | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | | 0.15 | 0.17 | 0.25 | | | |
| AR (1) test | | | | | -1.65* | -1.63 | -1.59 |
| AR (2) test | | | | | -1.33 | -0.19 | -1.31 |
| Sargan p-value | | 0.351 | 0.201 | 0.152 | 0.283 | 0.244 | 0.353 |
| *Panel B-Dependent variable: Debt maturity (long-term debt/ total debt)* | | | | | | | |
| L.Mat | + | 0.258*** | 0.325*** | 0.399*** | 0.355*** | 0.400*** | 0.409*** |
| | | (5.25) | (4.12) | (3.87) | (8.59) | (5.30) | (3.41) |
| **Lev** | **+** | **2.759*** | **1.112** | **6.097***** | **0.959** | **0.16** | **4.241***** |
| | | **(1.92)** | **(1.46)** | **(5.84)** | **(1.32)** | **(1.28)** | **(5.60)** |
| **Lev*GO** | **-** | **-0.126***** | **-0.110***** | **-0.010** | **-0.208***** | **-0.120***** | **-0.042*** |
| | | **(-4.72)** | **(-3.90)** | **(-1.22)** | **(-6.19)** | **(-3.38)** | **(-2.51)** |
| **GO** | **-** | **-0.025***** | **-0.000*** | **-0.017***** | **-0.040***** | **-0.006** | **-0.012***** |
| | | **(-2.63)** | **(-1.69)** | **(-5.67)** | **(-3.62)** | **(-1.08)** | **(-2.93)** |
| Size | + | 0.038*** | 0.042*** | 0.056*** | 0.035*** | 0.026*** | 0.095*** |
| | | (4.19) | (5.94) | (6.14) | (4.31) | (9.15) | (5.16) |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| AM | + | 0.276*** | 0.03 | 1.375*** | 0.16* | 0.120*** | 1.015*** |
| | | (6.85) | (1.66) | (7.21) | (1.89) | (5.29) | (3.70) |
| ABE | - | 0.085** | 0.020 | 0.125*** | 0.641*** | 0.933*** | 0.050 |
| | | (3.25) | (0.63) | (3.20) | (2.78) | (8.36) | (0.21) |
| TS | + | 0.027*** | 0.030*** | 0.019*** | 0.026*** | 0.001 | 0.012*** |
| | | (3.54) | (7.41) | (3.78) | (6.23) | (0.64) | (3.45) |
| Int.C | + | 0.002*** | 0.010 | 0.008*** | 0.00 | 0.011** | 0.006*** |
| | | (7.09) | (0.91) | (7.56) | (0.64) | (3.10) | (2.64) |
| EFTR | + | 0.120** | 0.125** | 0.015 | 0.058* | 0.041** | 0.008* |
| | | (1.95) | (2.12) | (1.64) | (1.92) | (1.99) | (1.68) |
| Debt cap | + | 0.005** | | | 0.025** | | |
| | | (2.49) | | | (2.69) | | |
| Constant | | -0.406*** | -0.207*** | 0.851*** | | | |
| | | (-4.88) | (-9.53) | (5.17) | | | |
| N | | 109,000 | 59,344 | 49,300 | 95,403 | 54,585 | 40,818 |
| Time | | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry | | Yes | Yes | Yes | Yes | Yes | Yes |
| Country | | Yes | Yes | Yes | Yes | Yes | Yes |
| $R^2$ | | 0.28 | 0.39 | 0.38 | | | |
| AR (1) test | | | | | -2.20** | -1.73* | -1.75* |
| AR (2) test | | | | | -0.33 | -0.20 | -0.39 |
| Sargan p-value | | 0.187 | 0.156 | 0.147 | 0.256 | 0.222 | 0.221 |

The table reports the results for leverage equation using Equation (3) in Panel A and debt maturity using Equation (4) in Panel B. In Panel A, the dependent variable is leverage, computed as total debt over total assets, *Lev*. In Panel B, the dependent variable is debt maturity, computed as debt maturing in more than one year over total debt, *Mat*. For the full sample, we also control for debt capacity. We report the results for full sample, high- and low-debt capacity firms (defined in Table 2). The results are based on a two-stage procedure; the results in the first stage used to generate the estimated values of debt maturity are not reported for space considerations. This table shows the second-stage results of leverage in Equation (3) and debt maturity in Equation (4) using the 2SLS and GMM-system. The two-step GMM-system estimation method includes the lagged dependent variable, lagged leverage (*L.Lev*) in Panel A and lagged maturity (*L.Mat*) in Panel B. We use the second-lagged leverage and debt maturity as an instrument for the first-lagged leverage and debt maturity in Panels A and B, respectively. In Panel A, the instruments for debt maturity include firms' quality measured by abnormal earnings and term structure of interest rate. In Panel B, the instruments for leverage include non-debt tax shields, tangibility of assets, and profitability (Dang, 2011). In both panels, second lagged control variables are also included as instruments to yield better fit. See Table 1 for variable definitions. We also report number of observations, N, and R squared, $R^2$. Year, industry, and country dummies are included to control for time, industry, and country effects. AR(1) and AR(2) are tests for first-order and second-order serial correlation, asymptotically distributed as $N(0,1)$ under the null of no first-order and second-order serial correlation, respectively, and the *p-value* of Sargan tests for over-identifying restrictions under the null of valid instruments is reported. t-statistics are reported in parenthesis. *, **and *** indicate the coefficient significant at 10%, 5% and 1% levels, respectively

**Figure 1: Median Leverage and Debt Maturity of Sample Firms (1990-2011)**

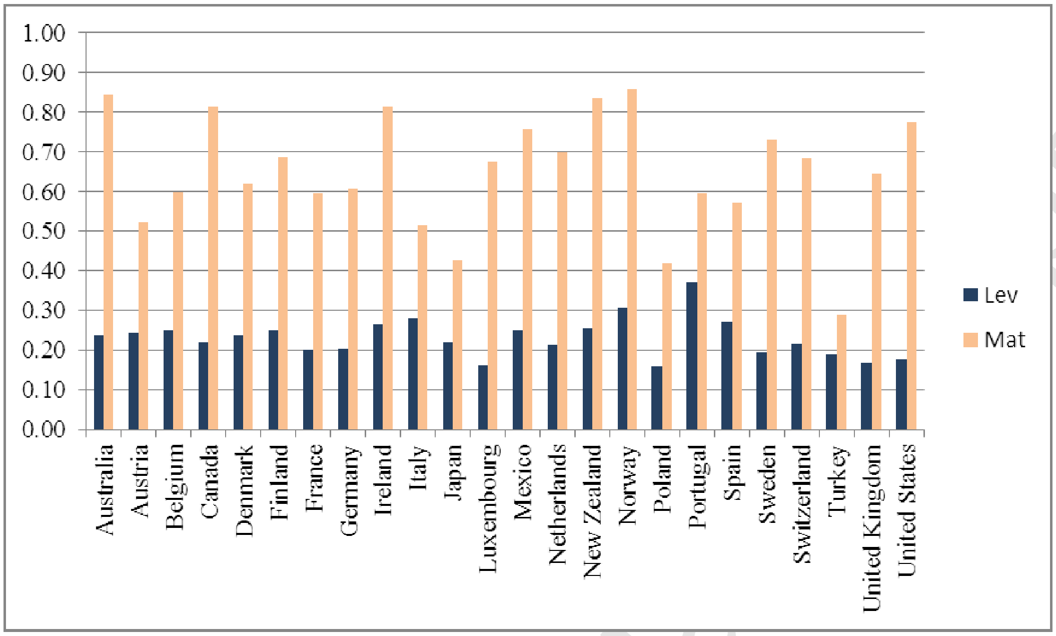


Figure 1 plots the median leverage and debt maturity ratios across 24 OECD countries. The leverage ratio (*Lev*) is measured as total debt over total assets of the firms. Debt maturity (*Mat*) is computed as long-term debt over total debt.

Appendix 1: Definitions and Data Sources

| Variables | Description | Source |
|---|---|---|
| Lev | TD/TA | DataStream & Thomson ONE Banker |
| Mat | LTD/TD | DataStream & Thomson ONE Banker |
| GO | Market to Book Ratio (MB) | DataStream & Thomson ONE Banker |
| Lev*GO | (TD/TA)*MB | DataStream & Thomson ONE Banker |
| Mat*GO | (LTD/TD)*MB | DataStream & Thomson ONE Banker |
| Size | LnMK | DataStream & Thomson ONE Banker |
| AM | PPE/ Dep | DataStream & Thomson ONE Banker |
| ROA | EBIT/TA | DataStream & Thomson ONE Banker |
| ABE | $(EPS_{t+1} - EPS_t)/ SP_t$ | DataStream & Thomson ONE Banker |
| Tg | Tangible Fixed Assets/ TA | DataStream & Thomson ONE Banker |
| EFTR | Tax/ EBIT | DataStream & Thomson ONE Banker |
| TS | $BY_{10y} – BY_{3m}$ | DataStream & Thomson ONE Banker |
| Int.C | EBIT/ Interest Expenses | DataStream & Thomson ONE Banker |
| Debt cap | Pr= -10.048+1.212LogTA+0.028ROA-0.136PPE -0.077MB+3.917Lev+0.363LogAge-4.944SdR | Lemmon and Zender (2010) |

This table shows the definitions and data sources for our sample including 24OECD countries. Our sample of 24 OECD countries includes Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Italy, Ireland, Japan, Luxemburg, Mexico, Netherlands, New Zealand, Norway, Poland, Portugal, Spain, Sweden, Switzerland, Turkey, the UK and US. Lev is leverage computed as total debt over total assets. Mat is debt maturity computed as long-term debt maturing in more than one year over total debt. GO is growth opportunities, calculated as a firm's market value of assets to book value of assets (MB). Lev*GO is the interaction term between leverage and growth opportunities. Mat*GO is the interaction term between debt maturities and growth opportunities. Size is natural logarithm of market value of firms. AM is asset maturity which is the ratio of net property, plant and equipment (PPE) to depreciation (Dep). ROA is return on assets computed as earnings before interests and taxes over total assets (EBIT). ABE is abnormal earnings calculated as $EPS_{t+1}$-$EPS_t$/ $SP_t$ which is earnings per share in year *t+1* minus earnings per share in year *t*, divided by share price in year *t*. Tg is tangibility computed as tangible fixed assets over total assets. EFTR is the effective tax rate, computed as tax expenses over EBIT. TS is the term structure of interest rates calculated as the differences between the month-end yields on 10-year government bond and three-month treasury bills ($BY_{10y}$-$BY_{3m}$) or interbank rate if the data is not available). Int.C is interest coverage calculated as EBIT over interest expenses. Debt cap is debt capacity is based on the likelihood that a firm can access public debt markets (Pr), which is the function of logarithm of total assets (LogTA), return on assets (ROA), net property, plant and equipment (PPE), the market-to-book ratio (MB), logarithm of firms' age (LogAge), and standard deviation of stock returns (SdR) (Lemmon and Zender, 2010). All variables are measured in US dollars.

## Appendix 2: Details of Control Variables

| Variable | Measure | Hypothesis and predicted sign |
|---|---|---|
| Proxy variables for leverage equations (1 and 3): | | |
| Effective tax rate (EFTR) | The ratio of tax expensed over earnings before interests and taxes | The trade-off theory predicts a positive relationship between leverage and the effective tax rate as firms use more debt to take advantage of higher interest tax shields (DeAngelo and Masulis, 1980; Fama and French, 2002). |
| Tangibility (*Tg*) | The proportion of fixed tangible assets to total assets. | Firms with more tangible assets lose less firm value when they go into bankruptcy, and thus are less financially distressed than those companies with lower tangible assets. Therefore, it is expected that firms with higher collateral will obtain more debt financing (Titman and Wessels, 1988; Frank and Goyal, 2003). |
| Interest coverage (*Int.C*) | Earnings before interest and taxes (EBIT) over interest expenses. | Since interest coverage decreases, the default probability increases, and thereby interest coverage positively affects leverage. Accordingly, interest coverage is included as a proxy for risk and it is expected to be positively related to leverage (Harris and Raviv, 1990). |
| Return on assets (*ROA*) | The ratio of EBIT over total assets. | Firms prefer internal finance to external finance for the purpose of mitigating this asymmetric information problem. A preference for financing first with internal funds indicates that leverage is negatively related to profitability (Myers, 1984). |
| Size of the firm (*Size*) | The natural logarithm of market capitalisation | Firm size is expected to be positively related to leverage, as larger companies face low bankruptcy and transaction costs, and hence are more likely to use debt (Frank and Goyal, 2003 and 2009). |

| Proxy variables for debt maturity equations (2 and 4): | | |
|---|---|---|
| Abnormal earnings (*ABE*) | Earnings per share in year *t+1* minus earnings per share in year *t*, divided by share price in year *t* of firm *i* at time *t* | Regarding the signalling hypothesis (Falnnery, 1986), high- quality firms use short-term debt to signal their quality to the market, and hence a negative relationship between debt maturity and firms' quality is expected. |
| Term structure of interest rate (*TS*) | The differences between the yields on ten-year government bonds and yield on three-month government bonds | Brick and Ravid (1985) argue that the tax benefit of using long-term debt increases when the term structure of interest rate is upward sloping and thereby the term structure of interest rate positively affects debt maturity. |
| Effective tax rate (*EFTR*) | The ratio of tax expensed over earnings before interests and taxes (EBIT) | The higher the tax rate, the more likely firm are to take benefits of tax shields, and thus we expect a positive relationship between the effective tax rate and the maturity structure of debt (Mauer and Lewellen, 1987; Brick and Palmon, 1992). |
| Interest coverage (*Int.C*) | EBIT over interest expenses | In conformity with Kane et al.'s (1985) argument that risky firms use more long-term debt as short-term debt increases the risk of suboptimal liquidation, thereby a negative relationship between interest coverage and long-term debt is predicted. |
| Size (*Size*) | The natural logarithm of market capitalisation | Larger firms with more market reputation and lower asymmetric information are expected to use more long-term debt (e.g., Ozkan, 2000; Antoniou et al., 2006). |
| Asset maturity (*AM*) | Net property, plant, and equipment divided by depreciation | Morris (1976) argues that firms can choose their debt maturity along with their assets life to mitigate the risk. Hence, it is expected to be positively related to debt maturity. |