Debt Maturity and Asymmetric Information: Evidence from Default Risk Changes†

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June 16, 2009

Abstract

Asymmetric information models suggest that borrowers' choices of debt maturity depend on their private information about the probability of default. Borrowers with favorable information prefer short-term debt, and those with unfavorable information prefer long-term debt. We test this implication by tracing the evolution of debt issuers' default risk. We find that short-term debt issuance leads to a decline in borrowers' asset volatility and an increase in their distance-to-default. The opposite is true for long-term debt issues. The results strongly support the predictions of the asymmetric information models of debt maturity choice.

JEL classification: G30, G32

Keywords: Debt Maturity, Debt Issuance, Default Risk, Signaling, Timing, Distance-to-Default, Asset Volatility

†We thank Michael Faulkender, Wei Jiang, and Darren Kisgen and seminar participants at Queen's University for helpful comments. Wei Wang thanks the Queen's School of Business for financial support. Vidhan K. Goyal thanks the Research Grants Council of the Hong Kong Special Administrative Region for financial support.

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1. Introduction

In this paper, we examine the predictions of asymmetric information models by tracing the evolution of default risk of firms conditional on debt maturity choices. Asymmetric information models, such as those by Flannery (1986) and Diamond (1991), show that information asymmetries result in debt securities being mispriced in a way that varies with debt maturity. Information theories model a borrower's willingness to subject his financing costs to new information as a tradeoff between the information effect of expecting that future news will be favorable, and the refinancing risk. For borrowers with favorable private information about future default risk changes, the market imputes a higher likelihood of credit quality deterioration than does the borrower. Consequently, borrowers that expect an improvement in their credit quality will raise short-term debt to benefit from refinancing on favorable terms when their true credit quality is revealed to the market at a later date. Conversely, when borrowers have unfavorable private information about future default risk, they prefer long-term debt and thereby eliminate uncertainty about the future refunding costs or exposure to liquidity risks.[1]

If private information about default risk is guiding a firm's choice of its debt maturity, then we expect borrowers issuing short-term debt to exhibit a decline in default risk, and those issuing long-term debt to exhibit an increase in default risk. We test this key prediction of information models by examining how default risk evolves in the period following issues of corporate debt classified by maturity. Our tests focus on two market-based measures of a firm's

[1] Diamond (1991) discusses some very low-rated borrowers who have no choice but to settle for short-term debt. These supply-side factors complicate inferences from the information models. However, as Diamond suggests, very low-rated borrowers with restricted access to public debt market most likely use short-term bank debt.

default risk: asset volatility, which is directly related to a firm's default risk; and distance-to-default, which is inversely related to default risk.

Based on a sample of 4,089 debt issues for the period 1983-2003, we find that short-term debt issuers experience a significant decline in default risk, i.e., their distance-to-default increases and asset volatility declines in the period following the short-term debt issue. Firms that complete long-term debt issues exhibit the opposite pattern. These patterns of default risk changes around debt issues match the predictions of the information asymmetry theories. These changes in default risks are also economically large.

We provide further evidence on information theories by examining the effect of maturity choice on future default risk changes for different classes of firms. Previous debt maturity studies show that small and high-growth firms are more likely to issue short-term and that large and low-growth firms are more likely to issue long-term debt. Issuers whose debt maturity choices differ from those observed normally given their firm characteristics are likely to be issuers with private information about their future default risk changes. Thus, we expect large and low-growth issuers to experience a more pronounced decline in default risk following short-term debt issues. Conversely, we expect small and high-growth issuers to experience a more pronounced increase in default risk following long-term debt issues.

Consistent with these predictions, the results show that small and high-growth firms exhibit a much larger increase in default risk following a long-term debt issue. Similarly, large and low-growth firms exhibit a much larger decline in default risk following a short-term debt issue.

We extend these tests by including other determinants of debt maturity choice in a multivariate setting. This setting predicts debt maturities of firms based on observable firm characteristics at the time of issue. We then examine future default risk changes of issuers classified by the deviation between predicted maturity and actual maturity. Firms that were predicted to issue short-term debt but actually issued long-term debt have a much larger deterioration in default risk relative to a broader population of long-term debt issuers. Conversely, firms that were predicted to issue long-term debt but actually issued short-term debt have a much larger improvement in default risk following debt issues. Overall, our evidence strongly suggests that information considerations play an important role in a firm's choice of its debt maturity.

The paper is organized as follows. In Section 2 we present a brief review of previous studies. We discuss our data and key variables in Section 3. We present our key results in Sections 4 and 5. In Section 6 we examine default risk changes for issuers whose debt maturity choices differ from those that are based on standard maturity models. Section 7 concludes.

2. Background

The literature on debt maturity typically tests information models of debt maturity choice in a cross-sectional setting. These tests relate debt maturity to risk ratings, and to variables reflecting the degree to which a firm's ex ante private information is favorable or unfavorable. The existing studies that examine the relation between risk ratings and debt maturity assume that firms' maturity choices allow creditors to infer some of what was previously firm-specific private information, and that creditors use this information in assigning risk ratings. Since the models predict that firms with high ratings (those with favorable information) will prefer to issue short-term debt and those with low ratings will prefer to issue long-term debt, the expectation is that debt maturity will be positively associated with debt ratings. Diamond's (1991) model predicts a nonmonotonic relation between debt maturity and credit ratings.

Barclay and Smith (1995) relate the maturity structure of existing debt to bond ratings. They find that lower-rated firms use more short-term debt than do higher-rated firms. For firms with rated debt, there is a strict monotonic relation between the maturity of existing debt and bond rating. They also find that nonrated firms have more short-term debt. Since nonrated debt is mostly private debt, which usually has shorter maturity, it is unclear whether the nonmonotonicity is driven by factors other than a firm's credit risk. A study by Stohs and Mauer (1996), which uses bond ratings for publicly traded industrial firms, and a study by Scherr and Hulbert (2001), which uses an accounting measure of risk (Altman Z-score), both find similar evidence of nonmonotonic relation between risk ratings and debt maturity structure. Because these studies focus on debt maturity structure, which reflects the stock of debt that has been built up over time, the researcher cannot distinguish the maturities of new debt from the remaining time on the stock of existing debt contracts. The maturity structure of the existing stock of debt reflects decisions made at different historical points and may not correspond with asymmetric information during the sample period.

Recognizing that asymmetric information models are more about the maturity of new debt issues at the time of origination and less about the maturity structure of existing debt at a given point in time, many studies relate the maturity of new debt issues to risk measures. These studies present conflicting results. Mitchell (1993) finds that issuers with higher bond ratings issue longer-maturity debt. But Guedes and Opler (1996) find that firms that are rated investment grade issue both shorter- and longer-term debt. Noninvestment grade firms issue intermediate-maturity debt. Berger et al. (2005) test information asymmetry models on a large sample of bank loans and find that the maturity of new loans to small businesses is positively related to risk ratings. Ortiz-Molina and Penas (2008) use an accounting measure of risk and find that firms rated as low risk issue longer-maturity debt.

Many papers test the signaling models by including variables that reflect the degree to which a firm's ex ante information is favorable or unfavorable. The papers by Barclay and Smith (1995), Stohs and Mauer (1996), and Johnson (2003) include future abnormal earnings in debt maturity regressions. These papers propose that firms with favorable private information will have positive abnormal earnings and firms with unfavorable private information will have negative future abnormal earnings. If firms with favorable private information prefer to issue short-term debt and those with unfavorable private information prefer to issue long-term debt, the expectation is that debt maturity will be negatively related to future abnormal earnings.

While the evidence reported in these papers is consistent with the predictions of information models, the economic magnitudes of these effects remain small. One explanation for these weak results is that the ex post variables, such as future abnormal earnings or stock returns (as in Guedes and Opler, 1996), are noisy measures of ex ante private information. In addition, there is a severe identification problem in these tests: firms with significant growth opportunities are likely to experience high earnings growth, and a random walk model of normal earnings will identify growth firms as experiencing positive future abnormal earnings.

Our paper differs from other studies in that we examine the evolution of default risk changes of firms following short- and long-term debt issues. Thus, we directly test the key prediction of the asymmetric information models that firms with favorable private information about their future default risk will prefer to issue short-term debt and firms with unfavorable private information will prefer to issue long-term debt. If this is true, then firms issuing short-term debt will witness a decline in their default risk while those issuing long-term debt will witness an increase in their default risk.

3. Data and variables

Our sample, which we obtain from the Securities Data Company (SDC) New Issues database, comprises public straight debt issues by U.S. firms from 1983 to 2003. Since we require three years of data after issuance, the sample ends in 2003. We exclude debt issues with missing maturities and issue amounts, and debt issues by financial firms (6000-6999), financial leasing firms (7359), and utilities (4910-4940). We obtain financial statement data from Compustat. The daily market values and daily stock returns are from the CRSP daily files. We require issuers to be listed on both CRSP and Compustat in the year prior to the issue. For issuers that offer multiple debt securities during a month, we construct a weighted average term-to-maturity in which the weights reflect the amount issued.

3.1 Measuring default risk

As noted in the Introduction, we use distance-to-default and asset volatility as measures of default risk. These risk measures improve upon the accounting measures of default risk such as such as the Z-score in Altman (1968), or the conditional logit model in Ohlson (1980), or debt ratings as has been done in previous studies.[2] This section describes the construction of these measures.

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[2] The information contained in accounting models is considered backward-looking so their desirability as measures of default risk is uncertain. In addition, accounting models do not consider volatility of a firm's assets in estimating its risk of default. Covitz and Harrison (1999) also study the changes of firm default risk post debt issuance by examining rating migrations. Several commentators argue that bond ratings are a noisy estimate of a firm's likelihood of default (see, for example, Vassalou and Xing, 2004). Ratings adjust slowly as rating agencies generally adopt a through-the-cycle approach, a policy that is aimed at avoiding excessive rating reversals. With this philosophy, rating agencies disregard short-term fluctuations in default risk. Furthermore, ratings only partially adjust to the actual level of the permanent component of default risk (see discussion in Cantor and Mann, 2003,

3.1.1 Distance-to-default

Several recent papers use the distance-to-default, an inverse measure of a firm's likelihood of default, as a measure of default risk.[3] Our method closely follows that of Vassalou and Xing (2004) and is based on the contingent claims method of Black and Scholes (1973) and Merton (1974).

The procedure starts with an estimate of the volatility of equity (σ_E) using daily data from the past 12 months. We use this estimate as an initial value for the estimation of the volatility of assets (σ_A). We then use the Black and Scholes formula to compute the value of assets (V_A) for each trading day, using the market value of equity (V_E) of that day. We use these daily values to compute the standard deviation of V_A, which we then use as an estimate for the next iteration. We repeat this procedure until the σ_A obtained from two consecutive iterations converge. With the converged value of σ_A, we can back out V_A through the Black-Scholes formula. Using a 12-month rolling estimation window, we can estimate the value of σ_A at the end of every month. In the Black-Scholes estimation, the risk-free rate is the one-year T-bill.

We then estimate the distance-to-default (DTD) as:

$$DTD_{i,t} = \frac{\ln\left(\frac{V_{i,t}}{K_{i,t}}\right) + \left(\mu_{i,t} - \frac{1}{2}\sigma_{Ai,t}^2\right)T}{\sigma_{A\,i,t}\sqrt{T}}, \qquad (1)$$

where $K_{i,t}$ is the book value of debt at time t, estimated as the short-term debt plus one-half of the long-term debt, both of which we obtain from firms' quarterly financial statements (See

and Altman and Rijken, 2004). In addition, small changes in borrower's financial default risk are unlikely to affect ratings because ratings follow a grid.

[3] See, for example, Vassalou and Xing (2004), Guner (2006) and Acharya, Bharath, and Srinivasan (2007).

Crosbie and Bohn (2002)).[4] We estimate the drift, $\mu_{i,t}$, as the mean of the change in the natural logarithm of the value of assets.[5]

3.1.2 Asset volatility

One concern with the use of distance-to-default is that short- and long-term debt issues might affect the future evolution of leverage differently for the two sets of issuers. If debt issues affect the evolution of leverage differently for short- and long-term debt issuers, then this may bias our inferences. Although our regression control for leverage changes, we focus on a second measure of default risk that is unaffected by variation in leverage. This measure of default risk is the asset volatility, σ_A, which we estimate above in Eq. (1).[6]

3.2 Control Variables

Changes in default risk could be driven by changes in other firm characteristics. Although these firm characteristics may evolve from firm-specific private information, we are interested in the changes in default risk over time that reflect private information about default probabilities that is beyond those captured by ex post changes in firm characteristics.

The firm characteristics that we control for in our default risk regressions include leverage, firm size, profitability, asset tangibility, coefficient of variation of operating income (CV(OI)), and growth opportunities. We define the variables in Table 1. We include leverage, since

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[4] Crosbie and Bohn (2002) argue that it is important to include long-term debt for two reasons. First, firms need to service long-term debt and therefore interest payments are part of their short-term obligations. Second, a firm's ability to roll over its short-term debt depends on the size of its long-term debt.

[5] Based on the average ratio of half long-term plus short-term debt to book assets of 0.18, the average drift $\mu_{i,t}$ of 0.10, the average asset volatility σ_A of 0.27, the average distance-to-default calculated based on book assets is $\mathrm{DTD} = \frac{\ln(1/0.18)+\left(0.10-\frac{1}{2}0.27^2\right)1}{0.27\sqrt{1}} = 6.59$.

[6] Debt issuers in our sample exhibit somewhat lower asset volatility than that reported for a broader population of Compustat firms by Vassalou and Xing (2004). This difference perhaps reflects the relatively better credit quality of public debt issuers.

leverage has substantial effects on default probabilities. We control for firm size because larger firms are more diversified and likely have greater financial flexibility. Consequently, they face lower default risk. We control for profitability because profitable firms are considered less risky. Their higher margins contribute to internal equity, thus reducing their default risk. We include coefficient of variation of operating income because firms with greater income volatility may not be able to meet their fixed obligations. They are generally considered more risky.

We also include the tangibility of assets, because tangible assets are easier for outsiders to value. Therefore, the asymmetric information problems are less severe when a firm's assets are mostly tangible. It is also difficult for managers to increase the risk of the firm when a firm has more tangible assets.

We also control for growth opportunities by including the ratio of market to book value of assets.[7] Higher growth firms have higher default risk. In addition, managers of high growth firms have a greater ability to increase the risk of assets.

In addition, we control for macroeconomic variables that proxy for the variation in aggregate default risk over time. These include short-term interest rates and default spread. The level of short-term interest rates affects the aggregate level of default risk – credit risk is low when debt is issued in an environment of low interest rates. Similarly, default spread is a proxy for aggregated default risk. Debt issued during an environment when default spreads are generally high will have higher default risk, on average.

[7] Adam and Goyal (2008) show that the market-to-book assets ratio has the highest information content with respect to investment opportunities.

Recent studies show that the maturity of aggregate debt issues also varies with macroeconomic conditions (Kaplin and Levy (2001), Baker, Greenwood, and Wurgler (2002)). Kaplin and Levy (2001) show that the ratio of aggregate short-term debt to long-term debt varies countercyclically. There is pronounced increase in short-term debt during recessions. It could be explained by the transitory nature of the shock. Second, there is need to finance inventory buildup, in part due to reduction in sales. Thus, in our tests, we also examine the robustness of results after including indicator variables to identify recessionary periods and its interaction with debt maturity variables.

4. Univariate results

4.1 Descriptive statistics

Table 2 shows the time-series and cross-sectional distribution of the sample debt issues. The sample consists of 4,089 debt offerings over the period from 1983 to 2003. The table shows that compared to the 1980s, debt issues are significantly more numerous in the 1990s and the early 2000s. Column (2) of Panel A reports the average issue amount (in constant dollars as at the year 2000) by year. Over the entire period, the issue size averages to about $179 million with no obvious trends. Column (3) reports the stated debt maturity. The average stated debt maturity is about 12 years. We note a significant reduction in stated maturities in the more recent period.

Almost one third of our debt issues are callable, with call dates concentrating around five, seven, and ten years from the date of issuance. The call provisions provide firms with an opportunity to redeem their bonds at the first call date and effectively determine the earliest opportunity for a firm to refinance its existing debt (King and Mauer (2000)). Therefore, we use adjusted maturities that replace the maturity of callable bonds with time to first call. To check robustness, we replicate our results by using stated maturities, and find similar results. The adjusted maturity averages to about eight years and shows a pattern similar to that of stated maturities.

Panel B shows debt characteristics classified by adjusted maturity. We classify debt as short-term if the adjusted maturity is less than or equal to three years, as medium-term if between three and seven years, and as long-term if it exceeds seven years. The studies by Barclay and Smith (1995) and Guedes and Opler (1996) use similar cutoffs. Short-term debt issues are larger in amount than are debt issues of longer maturity. Both short- and long-term debt issues have higher debt ratings and lower yield spreads compared to medium-term debt.

Table 3 reports average borrower characteristics for different maturity classes in the period before the issue. Firms that issue short-term debt are larger compared to those that issue medium- and long-term debt. In addition, short-term issuers have lower leverage, higher market-to-book ratios, lower tangibility of assets, higher profits, and lower debt ratings than do long-term debt issuers.

4.2 Changes in default risk: plots

To examine how default risk changes for short- and long-term debt issuers, we start by plotting the two default risk measures over the six-year period surrounding the debt issue. Figure 1(A) plots the average distance-to-default before and after debt issues by maturity classes. The plot shows that for the short-term issuers, the distance-to-default declines before the issue and increases substantially after the issue. By contrast, for long-term debt issuers, the distance-to-default shows no change before the issue and then a marked decline in the period following the issue. Figure 1(B) also plots the evolution of asset volatility. The figure shows that for short-term debt issuers, asset volatility increases in the period before the issue and then declines significantly in the post-issue period. As expected, the pattern of asset volatility for long-term debt issuers is the reverse.

4.3 Changes in default risks: univariate tests

We present formal tests of the default risk differences before and after issuances for short- and long-term debt issuers in Table 4. The table presents average default risk measures in the period around debt issues. The column titled "-1" presents the average distance-to-default and asset volatility for the 12 month period before the issue month. The column titled "0" shows the average risk measures in the month of issuance. Columns titled "1" and "2"present averages for one and two years after issue, respectively. For short-term issuers, the distance-to-default increases from 6.69 in the month of the issuance to 7.24 two years after (the difference is significant with a p-value of zero). Consistent with a decline in default risk for short-term debt issuers, we find that asset volatility declines during the two years following the issue (from 0.31 at the time of issuance to 0.29 in year 2). This difference is also statistically significant at the 1% level.

By contrast, for the long-term issuers, both of the default risk measures increase following issuance. The distance-to-default drops from 7.79 in the month of the issue to 7.28 two years later, and asset volatility increases from 0.26 to 0.27. Both of these changes are significant at the 1% level. Firms that issue medium-term debt also show a decline in asset volatilities but no change in distance-to-default following debt issue.

Overall, the time-series changes in default risk for short- and long-term debt issuers are consistent with the main predictions of the information models.

4.3 Changes in the financial condition of issuers surrounding debt issuances

We want to determine if ex post changes in firm characteristics differ for short- and long-term debt issuers. If these characteristics reflect the degree to which a firm's ex ante information is favorable or unfavorable, then we expect these characteristics to differ for both short- and long-term debt issuers, i.e., short-term issuers will show an improvement in their financial condition and long-term debt issuers will show a worsening. We focus on several financial variables to understand if changes in default risk show up in observable firm characteristics.

Table 5 presents the average values of profitability, CV(OI), cash holdings, leverage, and market-to-book assets ratio, tangibility of assets, capital expenditures, total investments, and net investments. Although many of the firm characteristics either do not change significantly across time or else do not differ significantly across short- and long-term debt issuers, two results stand out. First, we find significant differences in the cash policies of short- and long-term debt issuers. The increase in cash levels after issuance is significantly greater for short-term debt issuers compared to that for long-term issuers. Second, we find that investments in fixed assets from year -1 to year 0 increase only for long-term debt issuers. Short-debt issuers exhibit no change in fixed asset investments between the year prior to debt issue and the year of the issue. Taken together, the evidence suggests that short-term debt issuers build up relatively larger amounts of cash while long-term debt issuers invest more in fixed assets in the year of the issue.

5. Regression Results

5.1 Main results

Table 6 examines the changes in distance-to-default and asset volatility around debt offerings. We control for firm size, market-to-book assets, leverage, profitability, asset tangibility, operating-income variability, and term structure variables, such as the Treasury rate and the spread of Baa bond yield over the one-year Treasury yield.

The key variables of interest are the time-period indicator variables that trace out changes in default risk measures from year -1 to year 2 relative to the offer month. For example, I_{-1} takes a value of one if the observation pertains to one year prior to debt issuance, and picks up the difference in default risk in the preceding 12 months, relative to its value in the offer month; I_{+1} takes a value of one if the observation pertains to the 12 months following the offer month, and picks up incremental default risk increase in the first year relative to the offer month; I_{+2} takes a value of one if the observation is for months 13 to 24 relative to the offer month, and picks up incremental default risk in the second year.

Our tests also include indicator variables for debt ratings. The ratings reflect risk characteristics that rating agencies can observe, and control for credit risk of issuers at the time of issue. If ratings reflect some of the private information that issuers have about their future default risk changes, then our tests are decidedly conservative. Therefore, the time-period indicator variables (I_{-1}, I_{+1}, and I_{+2}) pick up changes in default risk that are not reflected in time-varying firm characteristics or in the debt ratings at the time of origination. We also include industry indicator variables based on the Fama-French 38 industries. The standard errors are corrected for heteroskedasticity and are clustered at the issuer level.

If default risk declines for short-term debt issuers and rises for long-term debt issuers, then the coefficient on I_{+1} and I_{+2} in the distance-to-default regressions should be positive when firms issue short-term debt and negative when they issue long-term debt. We also expect the coefficient on I_{+1} and I_{+2} in the asset volatility regressions to be negative when firms issue short-term debt and positive when they issue long-term debt

We report the results for the distance-to-default regressions in Table 6, columns (1) to (3). The coefficient estimates on time-period indicators confirm our predictions. In the two-year period following issue, both the short- and medium-term debt issuers show a significantly higher distance-to-default. By contrast, the long-term debt issuers show a large decline in the distance-to-default.

The results for the asset volatility regressions reported in columns (4) to (6) are consistent with those reported earlier. The asset volatility declines significantly in the two-year period after issuance for the short-term debt issuers and increases significantly for long-term debt issuers.

The results on other control variables mostly confirm our expectations. Firm size negatively affects asset volatility and positively affects distance-to-default. Firms with higher market/book assets ratio have higher asset volatility. Leverage negatively affects both distance-to-default and asset volatility. Profitability is positively related to distance-to-default and negatively related to asset volatility. Tangibility also increases distance-to-default and negatively affects asset volatility. The variability of income has no effect on either measure of default risk. The coefficient estimates on interest rate variables suggest that when Treasury rate and the credit spread are higher, default risk rises. The coefficient estimates on rating indicator variables are not reported separately in the table but the results confirm that as ratings worsen, distance-to-default declines and asset volatility increases.

5.2 Alternative Estimations

We test the robustness of the results in Table 6 by re-estimating the default risk regressions in changes. These results are reported in Table 7. The dependent variable in column (1) is the change in distance-to-default between the issue month and 24 months following the issue. The dependent variable in column (2) is the change in asset volatility over the same period. These regressions also include changes in firm characteristics measured over the same period. The key variables in these regressions are the indicator variables for short- and long-term debt.

In column (1), the coefficient on short-term debt indicator is positive and significant at the 1% level. Relative to medium-term debt, the benchmark category, firms that issue short-term debt have the change of distance-to-default that is higher by 0.90. Since the average distance-to-default is about seven, the increase appears to be economically significant. Also consistent with earlier results, we find that the coefficient on long-term debt is significantly negative. In terms of changes in firm characteristics, only changes of leverage appear to be related to changes in distance-to-default. A decline in leverage leads to a significant increase in distance-to-default. Changes in Treasury spreads and Baa spreads also affect changes in the distance-to-default.

In column (2), we report the results from regressions on the changes in asset volatility. Once again, consistent with a decline in default risk for short-term debt issuers and an increase in the risk for long-term debt issuers, we find that the coefficient on short-term debt is negative and significant, and that the coefficient on long-term debt is positive and significant.

Column (3) reports results from probit estimates in which the dependent variable takes a value of one if the change in distance-to-default is positive over the two periods following the debt issue, and zero otherwise. Consistent with the OLS results reported in column (1), the coefficient on short-term debt is positive and statistically significant at the 1% level, while the coefficient on long-term debt is negative but not significant at the conventional levels. In column (4), the dependent variable is an indicator variable that takes a value of one if asset volatility increases in the 24-month period following debt issuance. The probit estimates reported in column (4) suggest that asset volatility declines for short-term debt issuers and increases for long-term debt issuers. The F-test statistics on the equality of short- and long-term debt dummies are significant at the 1% level in all four regressions, suggesting that default risk changes following short-term debt issues differ from those around long-term debt issues.

In columns (5) to (8) of Table 7, we control for macroeconomic cycles by including a recession dummy variable that is equal to one if the debt security is issued during NBER recession years. In these tests, we also include interaction variables between various debt maturity indicators and the NBER recession indicator variable. We find that in recession years, default risk declines following both short- and long-term debt issues. During non-recessionary periods, short-term debt issuers experience a reduction while long-term debt issuers experience an increase in default risk after debt issuance.

Our results are robust to how we classify the debt issues. In unreported results, we redefine short-term debt as debt with a maturity less than or equal to four years or five years, medium-term debt as debt with maturity between four or five and ten years, and long-term debt as debt with a maturity above ten years. The results remain unchanged. We also examine how robust our results are to our definition of modified maturity. We use stated maturity instead of the adjusted maturity and find qualitatively identical results. We also define adjusted maturity as the average between the bond maturity and the number of years of call protection. Again, this change had no material effect on our findings.

Taken together, the results in Tables 6 and 7 are consistent with the predictions of Flannery (1986) and Diamond (1991). We find that default risk falls following short-term debt issues and rises after long-term debt issues.

6. Predicted Compared to Actual Maturity

6.1 Firm classes

The debt maturity literature shows that debt maturity choices are related to observable firm characteristics, and that these choices are consistent with both asymmetric information models and agency models. If firms have preferences in terms of debt maturity, then the signaling implications will be relatively more significant when a firm issues debt of a maturity that is against its type. Thus, we expect default risk changes to be significantly larger when, for example, large firms issue short-term debt or when small firms issue long-term debt. And if a high-growth firm issue long-term debt or a low growth firm issue short-term debt, it is likely that the firm's maturity choice is guided by its private information about its default risk.

Thus, we examine if the changes in default risk subsequent to issuance are greater when a firm issues debt of a maturity that is contrary to the maturity that is expected of it, based on its characteristics. We focus on two firm characteristics based on previous literature – firm size and growth opportunities. We define large firms as those with assets greater than the sample's median, and small firms as those with assets that are below the sample's median. We define high-growth firms as those with market/book assets ratios greater than the median for the sample. We classify the remaining firms as low-growth firms.

Figure 2 shows the issuer distance-to-default around debt issuance for different subsample of firms based on size and market-to-book ratio. Panels A and B are for short-term debt issuers. Panels C and D show the patterns of default risk for medium term issuers and Panels E and F are for long-term debt issuers. We note that Panel A shows that large firms experience a sizeable increase in distance-to-default after debt issuance while small firms experience a reduction. We find that default risk changes are more pronounced for large firms that issue short-term debt. Panel B shows that both high- and low-growth firms experience an increase in distance-to-default. Panel E shows that small firms have a larger decrease in distance-to-default following issuance of long-term debt. Panel F shows that high-growth firms experience a significant reduction of distance-to-default after they issue long-term debt. Overall, Figure 2 shows that default risk changes are significantly larger when small and high-growth firms issue long-term debt and large and low-growth firms issue short-term debt. Figure 3 yields similar conclusions from plots for the issuer asset volatility around debt issues for different subsamples of firms.

We present more formal tests in Table 8. Our empirical strategy is to generate subsamples based on firm size and growth opportunities and thus replicate Table 7 results for these subsamples. In column (1), we present results for distance-to-default regressions for the small-firm sample. Column (3) presents corresponding distance-to-default regression results for the large-firm sample. The results show that the coefficient on long-term debt indicator variable is -0.549 when small firms issue long-term debt, and -0.331, statistically insignificant, when large firms issue long-term debt. The coefficient on the short-term debt indicator variable in distance-to-default regression is 1.223 when large firms issue short-term debt, compared to 0.100 when small firms issue short-term debt. These coefficients suggest that default risk changes are relatively larger when small firms issue long-term debt or when large firms issue short-term debt. We find a similar pattern in the asset volatility change regressions for small and large firms (reported in columns (2) and (4)). Overall, the default risk changes are significantly larger when firms' predicted maturity choices differ from their actual maturity.

In Table 8, Columns (5) to (8) present results for subsamples based on the market-to-book assets ratio. We define high-growth firms as those whose market-to-book ratio is above the median for the sample and low-growth firms as those with below-median market-to-book ratios. We predict that high-growth firms will issue short-term debt and low-growth firms will issue long-maturity debt. We find that increases in asset volatility are greater when high-growth firms issue long-term debt compared to when low-growth firms issue long-term debt. The results on the distance-to-default measure are not consistent with this pattern.

6.2 Predicted Maturity

The tests in the previous section focus on firm size and growth opportunities as two main firm characteristics that influence debt maturity choices. However, the debt maturity literature identifies other characteristics that may also affect a firm's choice of its debt maturity. Therefore, we estimate debt maturity by using a regression framework that relies on models of debt maturity such as those by Barclay and Smith (1995), Guedes and Opler (1996), and Stohs and Mauer (1996). These models predict that debt maturity is a function of leverage, market-to-book assets, firm size and firm-size squared, asset maturity, abnormal earnings, coefficient of variation of operating income, term spread, an indicator variable for regulatory firms, and rating indicator variables. We present the results in the appendix. Consistent with findings in other studies, the maturity increases with firm size and asset maturity and decreases with the market-to-book assets ratio, abnormal earnings, and CV(OI). Firm size has a nonlinear effect on maturity.

Using these estimates, we predict the maturity choices of issuers in our sample and compare those with actual maturities chosen by the sample firms. Table 9 presents the average distance-to-default and asset volatility for the four groups of issuers, based on predicted and actual maturities. The table shows that when we predict that firms will issue short-term debt but instead issue long-term debt, the distance-to-default declines significantly from 8.95 in the year before the issue to 7.51 in the second year after the issue (the p-value for the change is zero). For this group of issuers, the asset volatility increases from 0.28 to 0.30 (the increase has a p-value of 0.03). When we predict that a firm will issue long-term debt and they do so, the default risk also declines but the decline is smaller in magnitude compared to those for cases when the predicted maturity was short.

We also find that when firms are predicted to issue long-term securities but they instead issue short-term debt, the distance-to-default increases significantly from 6.99 in the year before the debt issue to 7.46 in the second year after the offer (p-value equals 0.02). The asset volatility in these cases declines from 0.29 in the year before the offer to 0.28 in the second year after the offer (the p-value for the difference equals zero). Consistent with our conjecture, the differences in distance-to-default is small and non-significant when firms predicted to issue short-term debt do in fact issue short-term debt but the results show a significant reduction in asset volatility.

Overall, when issuers issue debt with actual maturity that is different from the predicted choice, they experience a relatively larger changes in default risk compared to the scenarios when the actual maturity matches the predicted maturity.

7. Conclusion

In this paper we test the extent to which information asymmetry plays a role in firms' debt maturity choices. We examine changes in the market-based default risk characteristics of debt issuers conditional on their maturity choice. With asymmetric information, a firm with favorable private information about its default risk will find that the market's default risk premia are excessive. These distortions are greater for long-term debt. Therefore, because they expect to roll over this debt at a price that reflects what the firm’s future condition will be at the time of refinancing. Firms with favorable private information prefer short-term debt. For the opposite reason, firms with unfavorable private information prefer long-term debt. The key testable implication of these models is that firms issuing short-term debt will have favorable private information about their default risk, and firms issuing long-term debt will have unfavorable private information. This implication leads to the prediction that short-term debt issuers will exhibit an improvement in their default risk while long-term debt issuers will show deterioration in their default risk.

Focusing on two market-based default risk measures, asset volatility and distance-to-default, we examine how default risk measures change after debt issues. Our results show that long-term issuers experience a significant increase in default risk, and that short-term debt issuers experience a significant improvement in the period immediately following the debt issue.

We also examine issuers whose debt maturity choices are different from those predicted from standard maturity models. We find significant default risk declines for short-term debt issuers that were predicted to issue long-term debt. This decline is larger for this group of issuers compared to a broader population of short-term debt issuers. We also find that default risk increases for long-term debt issuers that were predicted to issue short-term debt. Again, this increase is larger for this group of issuers compared to that for a broader population of long-term debt issuers. Overall, our evidence strongly supports the predictions of the asymmetric information models of debt maturity choice.

References

Acharya, V., S.T. Bharath, and A. Srinivasan, 2007. Does industry-wide distress affect defaulted firms? Evidence from creditor recoveries, Journal of Financial Economics 85, 368-419.

Adam, T., and V.K. Goyal, 2008, The investment opportunity set and its proxy variables, Journal of Financial Research 31, 41-63.

Altman, E.I., 1968, Financial ratios, discriminant analysis and the prediction of corporate bankruptcy, Journal of Finance 23, 589-609.

Altman, E.I. and H.A. Rijken, 2004, How rating agencies achieve rating stability? Journal of Banking and Finance 28, 2679-2714.

Baker, M., R. Greenwood, and J. Wurgler, 2002, The maturity of debt issues and predictable variation in bond returns. Journal of Financial Economics 70, 261-291.

Barclay, M.J., and C.W. Smith, 1995, The maturity structure of corporate debt, Journal of Finance 50, 609-631.

Berger, A.N., M.A. Espinosa-Vega, W.S. Frame, and N.H. Miller, 2005, Debt maturity, risk, and asymmetric information, Journal of Finance 60, 2895-2923.

Black, F., and M. Scholes, 1973, The pricing of options and corporate liabilities, Journal of Political Economy 81, 637-654.

Cantor, R., and C. Mann, 2003, Are corporate bond ratings procyclical? Special comment, Moody's Investors Services, October.

Covitz, D.M., and P. Harrison, 1999, The timing of debt issuance and rating migration: Theory and evidence, Working paper, Federal Reserve Board.

Crosbie, P.J., and J.F. Bohn, 2002, Modeling default risk, Technical Document, Moody's KMV LLC.

Diamond, D.W., 1991, Debt maturity structure and liquidity risk, Quarterly Journal of Economics 106, 709-737.

Flannery, M., 1986, Asymmetric information and risky debt maturity choice, Journal of Finance 41, 19-37.

Guedes, J.R., and T. Opler, 1996, The determinants of the maturity of corporate debt issues, Journal of Finance 51, 1809-1833.

Guner, B.A., 2006, Loans sales and the cost of corporate borrowing, Review of Financial Studies 19, 687-716.

Johnson, S., 2003, Debt maturity and the effects of growth opportunities and liquidity risk on leverage, Review of Financial Studies 16, 209-236.

Kaplin, A., A. Levy, 2001, Corporate security issues and asset returns, Unpublished working paper, University of California at Berkeley.

King, T.D., and D.C. Mauer, 2000, Corporate call policy for nonconvertible bonds, Journal of Business 73, 403-444.

Merton, R.C., 1974, On the pricing of corporate debt: The risk structure of interest rate, Journal of Finance 29, 449-470.

Mitchell, K., 1993, The debt maturity choice: An empirical investigation, Journal of Financial Research 16, 309-320.

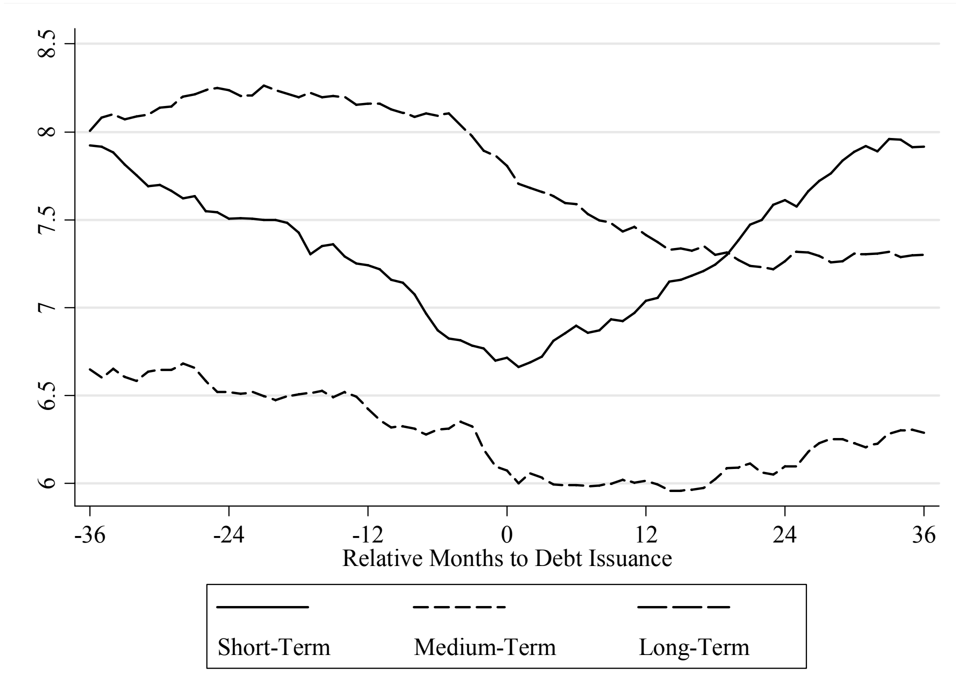
Ohlson, J., 1980, Financial ratios and the probabilistic prediction of bankruptcy, Journal of Accounting Research 18, 109-131.

Ortiz-Molina, H., and M.F. Penas, 2008, The role of loan maturity in addressing information problems, Small Business Economics 30, 361-383.

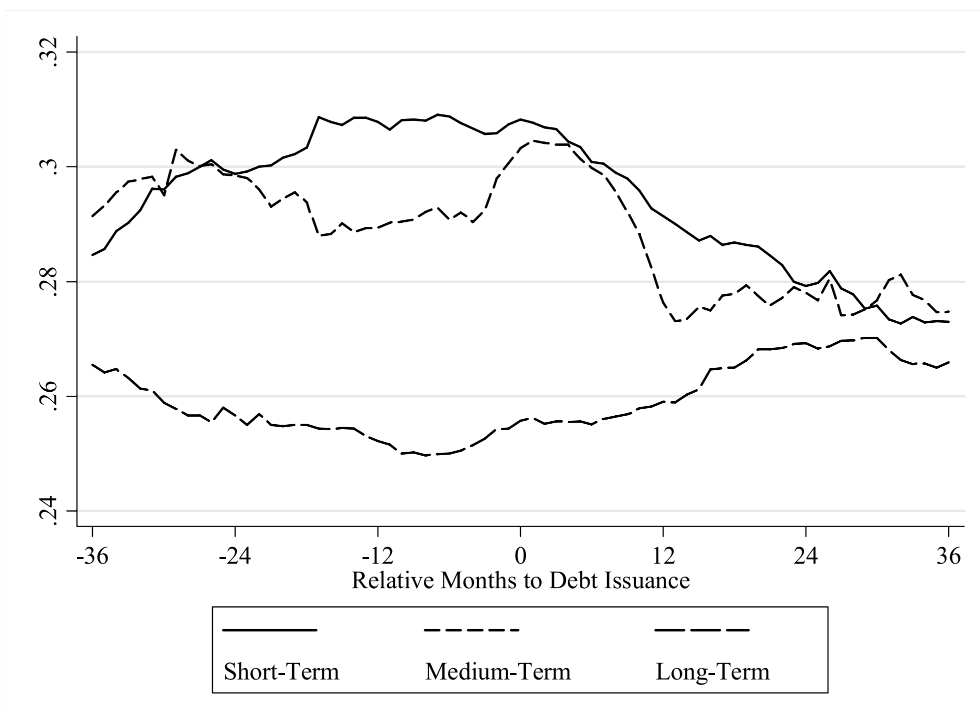
Scherr, F.C., and H.M. Hulbert, 2001, The debt maturity structure of small firms, Financial Management 30, 85-111.

Stohs, M.H., and D.C. Mauer, 1996, The determinants of corporate debt maturity structure, Journal of Business 69, 279-312.

Vassalou, M., and Y. Xing, 2004, Default risk in equity returns, Journal of Finance 59, 831-868.

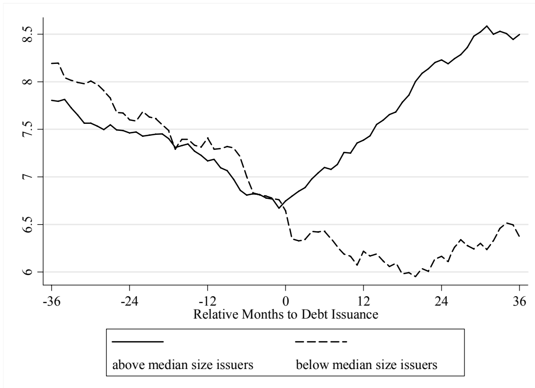


(A) Distance-to-default by adjusted maturity

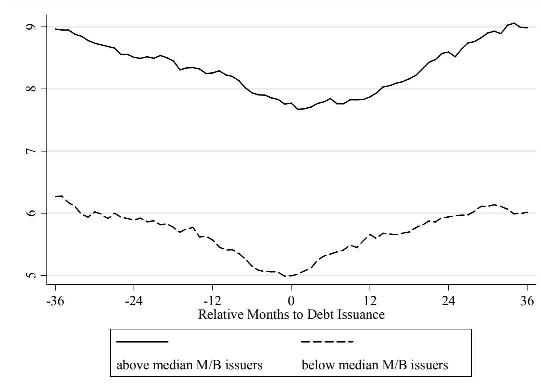


(B) Asset volatility by adjusted maturity

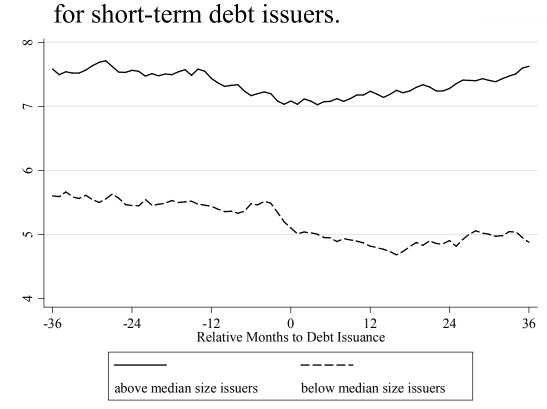
Figure 1: Issuer Distance-to-Default and asset volatility by Maturity



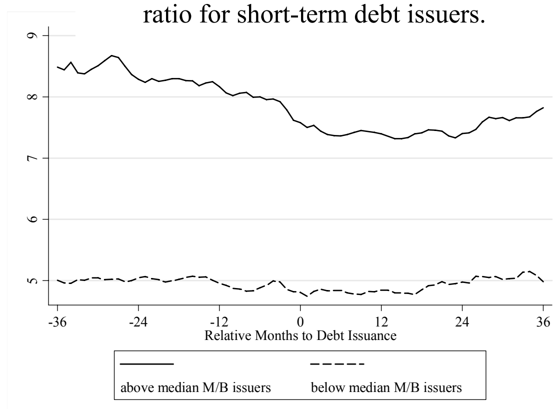
(A) Distance-to-Default around issuance month by firm classes sorted by size for short-term debt issuers.



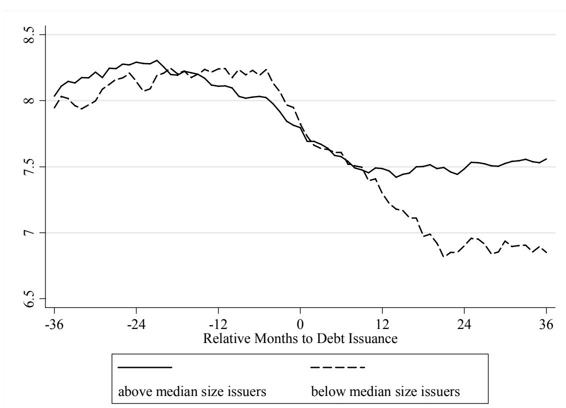
(B) Distance-to-Default around issuance month by firm classes sorted by M/B ratio for short-term debt issuers.



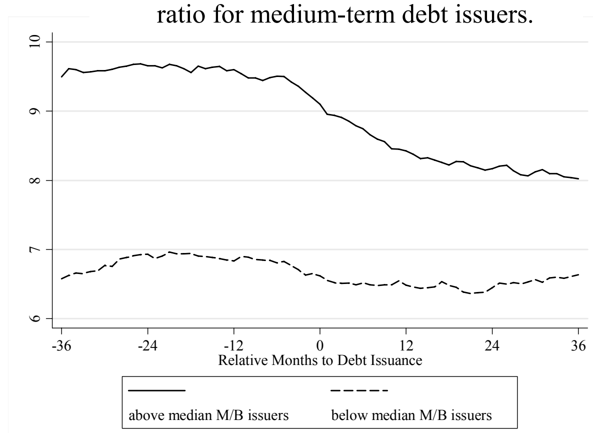
(C) Distance-to-Default around issuance month by firm classes sorted by size for medium-term debt issuers.



(D) Distance-to-Default around issuance month by firm classes sorted by M/B ratio for medium-term debt issuers.

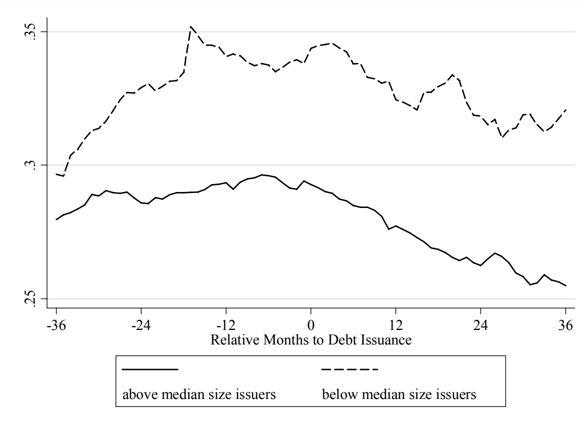


(E) Distance-to-Default around issuance month by firm classes sorted by size for long-term debt issuers.

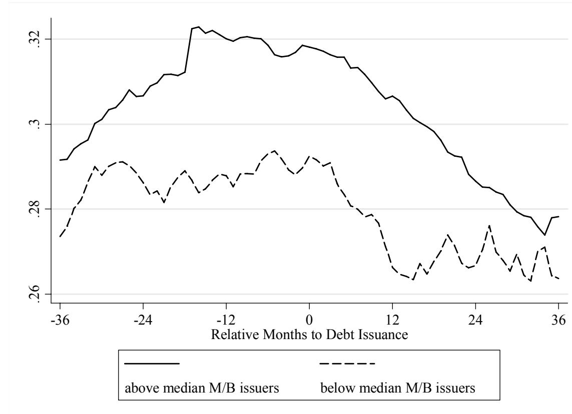


(F) Distance-to-Default around issuance month by firm classes sorted by M/B ratio for long-term debt issuers.

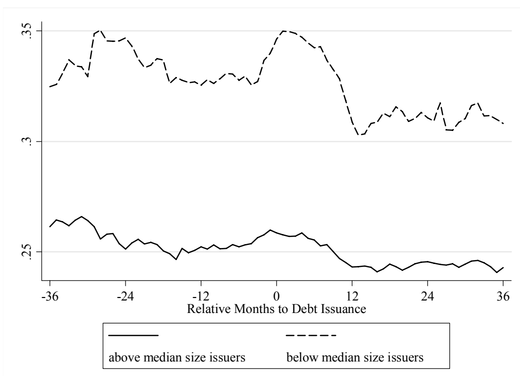
Figure 2: Issuer Distance-to-Default around issuance month by size and M/B.



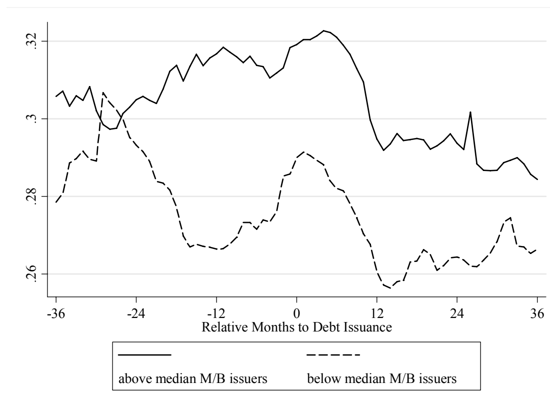
(A) Asset volatility around issuance month by firm classes sorted by size for short-term debt issuers.



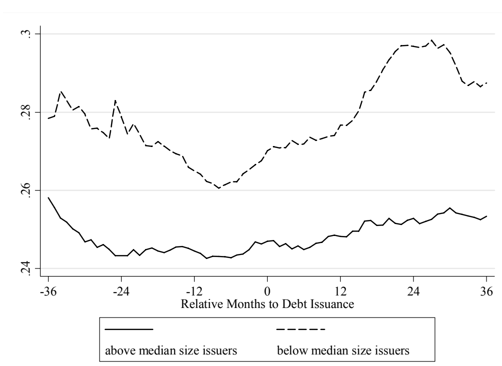
(B) Asset volatility around issuance month by firm classes sorted by M/B ratio for short-term debt issuers.



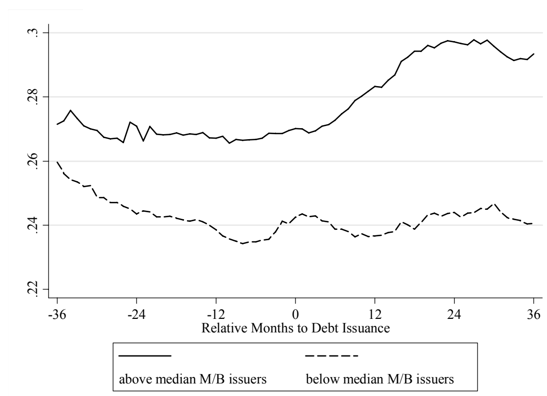
(C) Asset volatility around issuance month by firm classes sorted by size for medium-term debt issuers.



(D) Asset volatility around issuance month by firm classes sorted by M/B ratios for medium-term debt issuers.



(E) Asset volatility around issuance month by firm classes sorted by size for long-term debt issuers.



(F) Asset volatility around issuance month by firm classes sorted by size for long-term debt issuers.

Figure 3: Issuer asset volatility around issuance month by size and M/B.

Table 1

Variable definitions

This table describes the variables used in the study.

Variable	Definition
Distance-to-default	Distance-to-default or $DTD_{i,t} = \frac{\ln\left(\frac{V_{i,t}}{K_{i,t}}\right)+\left(\mu_{i,t}-\frac{1}{2}\sigma^2_{Ai,t}\right)T}{\sigma_{A\ i,t}\sqrt{T}}$,where VA is the value of assets, K is the book value of debt, r is the one-year T-Bill rate, σA is the volatility of assets, and T is the maturity of debt.
σ_v	The volatility of asset values is estimated from the Black-Scholes model through an iterative procedure.
Firm size	The natural logarithm of assets (item 6), where assets are deflated to constant 2000 dollars.
Market/book assets ratio	Estimated as the ratio of market value of assets (MVA) to, assets (item 6).
Leverage	Total Debt/Market Value of Assets: the ratio of book value of debt (item 9 + item 34) to MVA, market value of assets. MVA is obtained as the sum of market value of equity (item 199, price-close × item 54, shares outstanding) + debt in current liabilities (item 34) + long-term debt (item 9) + preferred- liquidation value (item 10) - deferred taxes and investment tax credit(item 35).
Profit	Profitability is the ratio of operating income before depreciation (item 13) to assets (item 6).
Tangibility	Defined as the ratio of net property, plant and equipment (item 8) to total assets (item 6).
CV(OI)	Coefficient of variation of operating income (item 13) measured over a three-year period using annual income statement data.
Rating	Long-term issuer ratings from S&P's (item 280). Numerical values are mapped to credit rating in the following way: AAA=20, AA+=19, AA=18, AA-=17, A+=16, A=15, A-=14, BBB+=13, BBB=12, BBB-=11, BB+=10, BB=9, BB-=8, B+=7, B=6, B-=5, CCC+=4, CCC=3, CCC-=2, CC/C=1.

Variable	Definition
Treasury yield	Yield on a one-year T-bill (Source: http://www.federalreserve.gov/release).
Baa spread	Estimated as the difference between yield on Baa-rated bonds and Aaa-rated bonds (Source: http://www.federalreserve.gov/release).

Table 2
Summary statistics

Panel A reports the frequency of debt issues during the 1983 to 2003 period. It also reports the average principal amount, stated and adjusted maturity in each of the years during the sample period. Issue amount is expressed as constant 2000 dollars. Stated maturity is the debt maturity stated in the offering prospectus at the time of bond issue. Adjusted maturity adjusts debt maturity to the call start date for bonds that are callable. Panel B presents the debt characteristics grouped by adjusted maturity. Debt issue rating is the S&P bond rating, taken from SDC. Yield spread is the difference between bond yield and comparable Treasury bond yield.

Panel A: Average stated and adjusted debt maturities by year

Year	N	Issue amount ($ millions)	Stated maturity	Percent callable	Adjusted maturity
	(1)	(2)	(3)	(4)	(5)
1983	59	134.9	15.4	76.3%	6.9
1984	50	167.0	13.2	72.0%	6.8
1985	87	190.1	14.6	80.5%	6.8
1986	147	229.4	16.2	67.4%	8.5
1987	99	194.5	14.0	57.6%	6.9
1988	67	200.0	12.6	71.6%	6.8
1989	95	220.8	12.6	54.7%	7.1
1990	97	200.0	9.0	12.4%	8.3
1991	236	173.9	12.1	5.1%	11.5
1992	222	197.5	12.0	24.3%	10.0
1993	241	185.0	15.8	24.9%	13.3
1994	163	141.7	9.4	27.6%	7.1
1995	225	137.5	12.6	22.2%	10.1
1996	289	143.2	13.4	20.1%	11.4
1997	389	134.1	15.4	20.6%	9.7
1998	505	137.5	12.7	28.1%	8.5
1999	216	186.7	10.3	37.5%	5.5
2000	164	236.9	7.8	34.8%	5.0
2001	257	242.6	9.7	66.2%	4.1
2002	294	190.2	8.6	52.0%	4.4
2003	187	260.8	9.6	72.2%	3.4
Total	4089	179.1	12.2	37.1%	8.1

Panel B: Issue characteristics by maturity

	Short-term debt	Medium-term debt	Long-term debt
	(N=1168)	(N=1094)	(N=1827)
Principal amount (in $millions)	214.618	156.843	169.688
Principal amount/book assets	0.046	0.090	0.033
Debt issue rating	14.311	12.717	14.437
Yield spread	1.460	1.855	1.080

Table 3

Issuer characteristics by debt maturity

This table presents the average values of lagged characteristics of debt issuers grouped by the adjusted maturity of their debt offering. The variables are defined in the Table 1. Columns (4) to (6) report p-values from two-tailed tests of the null hypotheses of no differences in firm characteristics across debt maturities.

	Short-term debt (N=783)	Medium-term debt (N=751)	Long-term debt (N=1295)	Long – short (p-value)	Long – medium (p-value)	Medium – short (p-value)
	(1)	(2)	(3)	(4)	(5)	(6)
Assets (in $billions)	16.800	12.560	12.610	0.00	0.96	0.00
Market/book assets	1.587	1.291	1.287	0.00	0.92	0.00
Leverage	0.281	0.380	0.301	0.01	0.00	0.00
Profit	0.163	0.152	0.157	0.04	0.09	0.00
Tangibility	0.398	0.424	0.468	0.00	0.00	0.02
CV(OI)	0.944	0.971	0.946	0.85	0.00	0.01
Rating	14.170	13.144	14.488	0.03	0.00	0.00

Table 4

Default risk changes around debt issues

This table reports the average values of distance-to-default and asset volatility (σ_A) in a four-year window surrounding the debt issues. We classify the debt issues as short-term if the adjusted maturity is less than three years, as medium-term if the adjusted maturity is between three and seven years, and as long-term if the adjusted maturity is more than seven years. Columns (5) and (6) report p-values from a two-tailed t-test of the null hypotheses that default risk measures between year 2 and year 0, and between year 2 and year -1 are similar.

		Year relative to offer					
Debt Maturity	Default risk measure	-1	0	1	2	Yr. 2 - Yr. 0 p-value	Yr. 2 - Yr. -1 p-value
		(1)	(2)	(3)	(4)	(5)	(6)
Short-term	Distance-to-default	6.987	6.685	6.831	7.241	0.00	0.18
(N=783)	σ_A	0.308	0.308	0.302	0.288	0.00	0.00
Medium-term	Distance-to-default	6.315	6.056	6.010	5.996	0.76	0.10
(N=751)	σ_A	0.293	0.303	0.297	0.280	0.00	0.05
Long-term	Distance-to-default	8.072	7.792	7.550	7.280	0.00	0.00
(N=1295)	σ_A	0.252	0.255	0.256	0.267	0.00	0.00

Table 5

Changes in Financial Variables

This table reports the time-series averages of profitability, CV(OI), cash, leverage, the market/book assets ratio, tangibility, capital expenditure, total investment, and net investment around debt issues from annual balance sheet, income statements, and cash flow statements. We define total investment as the sum of capital expenditure (item 128), acquisitions (item 129), and increase in investment (item 113)). We define net investment as total investment plus other use of funds (item 219), minus sale of PPE (item 107), and minus sale of investment (item 109). We code capital expenditure, acquisitions, increase in investment, other use of funds, sale of PPE, and sale of investment as zero if they were missing. We classify the debt issues as short-term if the adjusted maturity is less than three years, and as long-term if the adjusted maturity is more than seven years.

	Year relative to offer				Yr. 2 - Yr. 0	Yr. 2 - Yr. -1
	-1	0	1	2	p-value	p-value
Panel A: Profitability						
Short-term issuer	0.164	0.158	0.155	0.151	0.00	0.00
Long-term issuer	0.157	0.150	0.148	0.147	0.05	0.00
Panel B: CV(OI)						
Short-term issuer	0.944	0.945	0.954	0.960	0.00	0.00
Long-term issuer	0.946	0.949	0.962	0.970	0.00	0.00
Panel C: Cash						
Short-term issuer	0.044	0.046	0.049	0.053	0.00	0.00
Long-term issuer	0.039	0.041	0.042	0.043	0.19	0.01
Panel D: Leverage						
Short-term issuer	0.281	0.302	0.307	0.305	0.37	0.00
Long-term issuer	0.301	0.321	0.326	0.329	0.03	0.00
Panel E: Market/book asset						
Short-term issuer	1.587	1.545	1.511	1.509	0.16	0.01

Long-term issuer	1.287	1.294	1.282	1.283	0.56	0.60
Panel F: Tangibility						
Short-term issuer	0.397	0.393	0.389	0.382	0.00	0.00
Long-term issuer	0.468	0.464	0.457	0.452	0.00	0.00
Panel G: Capital expenditure						
Short-term issuer	0.073	0.069	0.064	0.059	0.00	0.00
Long-term issuer	0.088	0.083	0.078	0.074	0.00	0.00
Panel H: Total investments						
Short-term issuer	0.120	0.114	0.099	0.096	0.00	0.00
Long-term issuer	0.124	0.127	0.115	0.112	0.00	0.00
Panel H: Net investments						
Short-term issuer	0.098	0.097	0.077	0.073	0.00	0.00
Long-term issuer	0.107	0.111	0.090	0.078	0.00	0.00

Table 6

Default risk changes and debt maturity

In this table we use the accounting variables from the fiscal year that ends right before the observation's period of distance-to-default and asset volatility. Numbers in parentheses are standard errors adjusted for heteroskedasticity and firm clustering. [a], [b], and [c] denote significance at the 1%, 5%, and 10% levels, respectively.

	Distance-to-default			Asset volatility		
	Short-term debt (1)	Medium-term debt (2)	Long-term debt (3)	Short-term debt (4)	Medium-term debt (5)	Long-term debt (6)
I_{-1}	0.664[a]	0.471[a]	0.459[a]	-0.009[c]	-0.022[a]	-0.009[a]
	(0.140)	(0.124)	(0.105)	(0.006)	(0.006)	(0.003)
I_{+1}	0.448[b]	0.254[c]	-0.138	-0.013[b]	-0.021[a]	0.004
	(0.179)	(0.136)	(0.099)	(0.006)	(0.006)	(0.003)
I_{+2}	0.910[a]	0.329[b]	-0.240[c]	-0.019[b]	-0.017[b]	0.016[a]
	(0.322)	(0.156)	(0.143)	(0.008)	(0.007)	(0.005)
Firm size	0.180	0.329[a]	0.130	-0.010[b]	-0.018[a]	-0.006[b]
	(0.121)	(0.061)	(0.100)	(0.005)	(0.003)	(0.003)
Market/book assets	-0.067	0.160	-0.094	0.027[a]	0.013[a]	0.026[a]
	(0.143)	(0.183)	(0.141)	(0.005)	(0.005)	(0.005)
Leverage	-8.772[a]	-7.846[a]	-8.497[a]	-0.127[a]	-0.173[a]	-0.156[a]
	(0.744)	(0.564)	(0.675)	(0.036)	(0.024)	(0.027)
Profit	5.617[c]	6.020[a]	8.527[a]	-0.384[a]	-0.230[a]	-0.277[a]
	(2.934)	(1.536)	(2.164)	(0.118)	(0.089)	(0.078)

Tangibility	1.768[a]	2.080[a]	1.116[c]	-0.045[c]	-0.049[b]	-0.021
	(0.618)	(0.511)	(0.636)	(0.026)	(0.021)	(0.018)
CV (OI)	0.629	-0.193	-0.307	-0.045	0.043	-0.007
	(0.906)	(0.451)	(0.845)	(0.035)	(0.039)	(0.037)
Treasury	-0.775[a]	-0.183[a]	-0.335[a]	0.017[a]	0.004	0.009[a]
	(0.102)	(0.058)	(0.055)	(0.004)	(0.002)	(0.002)
Baa spread	-0.933[a]	-0.088	-0.419[a]	0.020[a]	0.003	0.010[a]
	(0.133)	(0.084)	(0.084)	(0.005)	(0.004)	(0.002)
Constant	11.097[a]	4.982[a]	8.321[a]	0.367[a]	0.458[a]	0.354[a]
	(1.999)	(1.079)	(1.719)	(0.068)	(0.066)	(0.065)
F-test statistics ($I_{-1}=I_{+2}$)	0.58	0.66	20.13[a]	1.09	0.62	20.52[a]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Rating indicators	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.42	0.53	0.41	0.20	0.24	0.18
N	3020	2822	4941	3020	2822	4941

Table 7

Change of Distance-to-Default, σ_A, and Maturity Choice

In columns (1) and (5), the dependent variable is the change of distance-to-default. In columns (2) and (6), the dependent variable is the change of asset volatility. The changes are measured from the month of issuance to 24 months after issuance. In columns (3) and (7), the dependent variable equals one if the change of DTD is positive. Similarly, in columns (4) and (8), the dependent variable equals 1 if the change of σ_A is positive. The independent variables are changes from the fiscal year in which debt was issued to two years after. NBER recession dummy is equal to one if debt is issued in years 1990, 1991, 2001 and 2002, and zero otherwise. In parentheses are standard errors adjusted for heteroskedasticity and firm clustering. [a], [b], and [c] denote significance at the 1%, 5%, and 10% levels, respectively.

	OLS		Probit		OLS		Probit	
	ΔDTD	$\Delta\sigma_A$	ΔDTD>0	$\Delta\sigma_A>0$	ΔDTD	$\Delta\sigma_A$	ΔDTD>0	$\Delta\sigma_A>0$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short-term	0.899[a]	-0.019[b]	0.260[a]	-0.212[b]	0.428[c]	0.003	0.218[b]	-0.051
	(0.266)	(0.009)	(0.075)	(0.095)	(0.231)	(0.011)	(0.089)	(0.103)
Long-term	-0.466[a]	0.022[a]	-0.064	0.123[c]	-0.585[a]	0.029[a]	-0.071	0.177[b]
	(0.176)	(0.007)	(0.066)	(0.063)	(0.177)	(0.008)	(0.073)	(0.072)
NBER recession					1.570[a]	-0.030[b]	0.641[a]	-0.664[a]
					(0.415)	(0.013)	(0.160)	(0.157)
NBER recession × short-term					1.257[b]	-0.049[a]	0.044	-0.632[a]
					(0.603)	(0.015)	(0.187)	(0.189)
NBER recession × long-term					0.900[c]	-0.043[a]	0.074	-0.428[b]
					(0.479)	(0.014)	(0.185)	(0.203)
Δ Size	-0.011	0.058[a]	0.310[b]	0.647[a]	-0.039	0.058[b]	0.296[b]	0.677[a]
	(0.362)	(0.022)	(0.157)	(0.145)	(0.333)	(0.022)	(0.149)	(0.136)

Δ Market/book asset	0.456	0.008	0.029	0.194[a]	0.523[c]	0.007	0.056	0.171[b]
	(0.323)	(0.008)	(0.073)	(0.073)	(0.310)	(0.007)	(0.075)	(0.070)
Δ Leverage	-10.953[a]	0.020	-4.903[a]	0.591[b]	-9.917[a]	-0.007	-4.593[a]	0.147
	(0.826)	(0.054)	(0.406)	(0.277)	(0.802)	(0.056)	(0.399)	(0.275)
Δ Profit	2.185	-0.138[c]	-0.013	-0.376	2.335	-0.141[c]	0.106	-0.523
	(1.776)	(0.076)	(0.724)	(0.561)	(1.688)	(0.074)	(0.713)	(0.546)
Δ Tangibility	-1.054	-0.116[c]	0.508	-0.405	-1.268	-0.109	0.388	-0.338
	(1.871)	(0.070)	(0.630)	(0.590)	(1.683)	(0.067)	(0.604)	(0.545)
Δ CV (OI)	-0.679	0.040	0.056	-0.237	-0.943	0.048	-0.029	-0.097
	(0.979)	(0.054)	(0.309)	(0.261)	(1.072)	(0.056)	(0.333)	(0.244)
Δ Treasury	-1.159[a]	0.031[a]	-0.352[a]	0.305[a]	-0.736[a]	0.020[a]	-0.245[a]	0.145[a]
	(0.101)	(0.004)	(0.038)	(0.039)	(0.084)	(0.004)	(0.039)	(0.039)
Δ Baa spread	-1.724[a]	0.043[a]	-0.487[a]	0.440[a]	-1.485[a]	0.036[a]	-0.436[a]	0.365[a]
	(0.139)	(0.005)	(0.046)	(0.050)	(0.120)	(0.005)	(0.046)	(0.050)
Constant	-0.715	-0.149[b]	5.263[a]	-6.117[a]	-1.362	-0.138[c]	4.668[a]	-6.075[a]
	(0.944)	(0.063)	(0.348)	(0.592)	(1.541)	(0.076)	(0.393)	(0.642)
F-test / Chi-squared statistics (Short-term = Long-term)	27.70[a]	28.62[a]	20.72[a]	15.78[a]	20.37[a]	13.67[a]	12.55[a]	6.01[b]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rating indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2 / Pseudo R^2	0.35	0.14	0.21	0.08	0.39	0.16	0.23	0.14
N	2602	2602	2602	2602	2602	2602	2602	2602

Table 8

Default risk changes and debt maturity for firm classes

The dependent variables are the changes in distance-to-default and changes in asset volatility, both changes measured from the month of issuance to 24 months after issuance. The independent variables are changes from the fiscal year in which debt was issued to two years after. Small firms are those whose assets are below the median for the sample. Large firms have assets which are above the median for the sample. Similarly, high- and low-growth firms are defined relative to the median market-to-book ratio for the sample. In parentheses are standard errors adjusted for heteroskedasticity and firm clustering. [a], [b], and [c] denote significance at the 1%, 5%, and 10% levels, respectively.

	Small firms		Large firms		High-growth firms		Low-growth firms	
	Δ DTD	Δ σ_A	Δ DTD	Δ σ_A	Δ DTD	Δ σ_A	Δ DTD	Δ σ_A
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short-term	0.100	-0.018	1.223[a]	-0.022[b]	1.123[a]	-0.028[b]	0.632[b]	-0.004
	(0.323)	(0.020)	(0.327)	(0.009)	(0.346)	(0.012)	(0.267)	(0.016)
Long-term	-0.549[b]	0.038[a]	-0.331	0.007	-0.257	0.019[c]	-0.425[b]	0.019[b]
	(0.257)	(0.014)	(0.240)	(0.006)	(0.297)	(0.010)	(0.195)	(0.009)
Δ Size	0.607	0.023	-0.711	0.109[a]	-0.064	0.066[b]	0.407	0.027
	(0.345)	(0.034)	(0.702)	(0.029)	(0.570)	(0.027)	(0.410)	(0.035)
Δ Market/book asset	0.278	0.009	0.407	0.012	0.197	0.017[a]	1.568[a]	-0.023
	(0.388)	(0.010)	(0.380)	(0.010)	(0.304)	(0.006)	(0.593)	(0.049)
Δ Leverage	-10.175[a]	0.035	-11.616[a]	0.012	-12.788[a]	0.145[b]	-8.907[a]	-0.061
	(0.990)	(0.099)	(1.175)	(0.050)	(1.432)	(0.069)	(0.905)	(0.099)
Δ Profit	1.028	-0.137	8.712[b]	-0.255[b]	2.674	-0.087	2.084	-0.128
	(1.387)	(0.098)	(3.866)	(0.129)	(2.186)	(0.087)	(2.239)	(0.134)

Δ Tangibility	0.186	-0.183[c]	-4.971	0.049	0.438	-0.251[b]	-0.795	-0.032
	(1.688)	(0.102)	(3.586)	(0.094)	(2.966)	(0.111)	(1.651)	(0.082)
Δ CV (OI)	-2.311[a]	0.116[c]	1.081	-0.028	-1.897	0.049	0.594	-0.008
	(0.876)	(0.068)	(0.954)	(0.051)	(1.331)	(0.068)	(0.843)	(0.064)
Δ Treasury	-0.760[a]	0.025[a]	-1.515[a]	0.040[a]	-1.598[a]	0.038[a]	-0.763[a]	0.026[a]
	(0.113)	(0.006)	(0.159)	(0.005)	(0.170)	(0.006)	(0.102)	(0.005)
Δ Baa spread	-1.314[a]	0.047[a]	-2.062[a]	0.047[a]	-2.210[a]	0.044[a]	-1.208[a]	0.042[a]
	(0.167)	(0.009)	(0.200)	(0.006)	(0.209)	(0.007)	(0.139)	(0.008)
Constant	-0.447	-0.119	-1.133	-0.034	0.972	-0.120[a]	2.239[b]	0.013
	(1.399)	(0.074)	(0.809)	(0.048)	(1.393)	(0.044)	(1.060)	(0.031)
F-test statistics (Short-term = Long-term)	4.13[b]	16.44[a]	21.84[a]	11.80[a]	21.52[a]	26.39[a]	16.93[a]	4.12[b]
Industry fixed effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Rating indicators	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
R^2	0.33	0.14	0.39	0.21	0.39	0.23	0.38	0.13
N	1009	1009	1593	1593	1343	1343	1259	1259

Table 9

Default Risk Changes for Issuers with Different Predicted and Actual Maturity

This table reports the average values of distance-to-default and asset volatility (σ_A) in the period surrounding debt issues for subsamples of issuers based on their predicted and actual maturity choices. The predicted maturities are based on results reported in the Appendix. Columns (5) and (6) report p-values from a two-tailed t-test of the null hypotheses that default risk measures between year 2 and year 0, and between year 2 and year -1 are similar.

		Year relative to offer					
Predicted and actual maturity	Default risk measure	-1	0	1	2	Yr. 2 - Yr. 0 p-value	Yr. 2 - Yr. -1 p-value
		(1)	(2)	(3)	(4)	(5)	(6)
Predicted=Short and Actual=Long	Distance-to-default	8.948	8.599	7.923	7.508	0.00	0.00
(N=127)	σ_A	0.278	0.284	0.291	0.304	0.10	0.03
Predicted=Long and Actual=Long	Distance-to-default	8.051	7.729	7.527	7.268	0.00	0.00
(N=1092)	σ_A	0.250	0.255	0.255	0.264	0.00	0.00
Predicted=Long and Actual=Short	Distance-to-default	6.991	6.632	6.917	7.462	0.00	0.02
(N=560)	σ_A	0.293	0.297	0.288	0.278	0.00	0.00
Predicted=Short and Actual=Short	Distance-to-default	7.182	7.000	6.800	6.957	0.87	0.42
(N=186)	σ_A	0.352	0.344	0.341	0.315	0.01	0.00

Appendix

Probit regression predicting debt maturity

The table reports estimates from an ordered probit regression of debt maturity on leverage, the market/book assets ratio, firm size, firm-size squared, asset maturity, abnormal earnings, income volatility, term spread, and regulatory industry indicator. The dependent variable takes a value of one if the issue is short-term, two if the issue is medium term and three if the issue is long term. Asset maturity is defined as the ratio of gross PP&E (item 7) to depreciation (item 125). Abnormal earnings is estimated as the difference between this year's earnings per share (item 57) and last year's earnings per share divided by last year's share price (item 199). The regulatory industry indicator variable takes a value of one for firms in railroads (SIC code 4011) through 1980, trucking (4210 and 4213) through 1980, airlines (4512) through 1978, telecommunication (4812 and 4813) through 1982, and gas and electric utilities (4900 and 4939), and zero otherwise. We define term spread as the difference between one-year interest series and ten-year interest series (Source: http://www.federalreserve.gov/release). Other variables are defined in Table 1.The regression also includes rating indicators, the coefficient estimates of which are suppressed. Numbers in parentheses are standard errors adjusted for heteroskedasticity and firm clustering. [a], [b], and [c] denote significance at the 1%, 5%, and 10% levels, respectively.

Variables	Coefficient estimates
Leverage	-0.108
	(0.230)
Market/book assets	-0.214[a]
	(0.049)
Firm size	0.863[a]
	(0.158)
Firm size^2	-0.056[a]
	(0.010)
Asset maturity	0.013[b]
	(0.006)
Abnormal earnings	-0.095[b]
	(0.044)
CV(OI)	-0.167
	(0.186)
Term spread	0.025
	(0.027)
Regulatory industry	0.130
	(0.162)
Rating indicator variables	Yes
Pesudo R^2	0.03
N	2,627