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Debt Maturity and Asymmetric Information: Evidence from Default Risk Changes

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Abstract

Asymmetric information models suggest that a borrower's choice of debt maturity depends on its private information about its default probabilities, that is, borrowers with favorable information prefer short-term debt while those with unfavorable information prefer long-term debt. We test this implication by tracing the evolution of debt issuers' default risk following debt issuances. 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 suggest that borrowers' private information about their default risk is an important determinant of their debt maturity choices.

I. Introduction

Asymmetric information models, such as those of Flannery (1986), show that the choice of debt maturity is a trade-off between the information effect of expecting future news to be favorable and the refinancing risk.[1] For borrowers with favorable private information about their future default risk changes, the market assigns a higher likelihood of credit quality deterioration than does the borrower. Consequently, borrowers who 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,

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[1]Diamond (1991) also presents a model of debt maturity choice in which some very low-rated borrowers 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 markets most likely use short-term bank debt.

borrowers with unfavorable private information about their future default risk prefer long-term debt, which eliminates uncertainty about the future refunding costs or exposure to liquidity risks.[2]

If private information about default risk guides a firm's choice of its debt maturity, then we expect borrowers issuing short-term debt to exhibit a decline in their default risk, and those issuing long-term debt to exhibit an increase in their 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 main tests focus on 2 market-based measures of a firm's default risk: asset volatility, which is directly related to a firm's default risk; and distance to default (DTD), which is inversely related to default risk. We also examine rating migrations following debt issues.

Based on a sample of 4,089 debt issues in the United States for the period 1983–2003, we find that short-term debt issuers experience a significant decline in their default risk (i.e., their DTD increases and asset volatility declines in the period following the issue).[3] Firms that issue long-term debt experience the opposite: Their asset volatility increases and DTD declines.

Tests of debt rating migrations yield consistent results: Unexpected rating changes are positive subsequent to short-term issues and negative subsequent to long-term issues. These patterns of default risk changes around debt issues match the predictions of the information asymmetry theories.

These differences in default risks for short- and long-term debt issuers are unlikely to be due to differences in firm policies in the period following the debt issue. In fact, both short- and long-term issuers exhibit similar changes in leverage, asset tangibility, profitability, variability of operating income, leverage, market-to-book assets ratio, and investments in fixed assets in the 2 years following the debt issue.[4]

The regression evidence, in both levels and changes, confirms our basic finding that default risk improves for short-term debt issuers and worsens for long-term issuers. The tests control for initial debt ratings and key firm characteristics, so our evidence of changes in default risk following debt issue cannot be fully attributed to changes in time-varying firm characteristics or ex ante risk information about the borrower as reflected in its risk ratings.

To provide additional evidence in support of information theories, we examine the effect of deviations from predicted maturity on future default risk changes.

[2]This raises the question of whether rational market participants can reliably infer a firm's true quality from its maturity decisions and adjust the rates charged to compensate for differences in default risk. Flannery (1986) shows that with costless financial transactions, the debt market will have a pooling equilibrium and no borrower will choose long-term debt contracts, as these will be significantly more expensive. However, with positive transaction costs there would be a separating equilibrium in which good quality firms issue short-term debt and incur transaction costs of refinancing it.

[3]The call provision provides a firm with an early opportunity to refinance its debt. Robbins and Schatzberg (1986) argue that callable bonds can also signal a firm's better prospects in the presence of asymmetric information. Thus, in defining short- and long-term debt, we employ an adjusted maturity measure that replaces the stated maturity of the bond with the 1st call date for callable bonds.

[4]This weakens support for the alternative view that all information is observable and that creditors offer long-term debt contracts to borrowers that are investing in longer-term fixed assets because they do not want to expose borrowers to refinancing risk.

Through these tests, we address concerns that our results could be explained by agency theories, which argue that firms issuing long-term debt will have greater incentives to engage in riskier investments and consequently increase the risk of their assets. In particular, we distinguish between 2 types of long-term debt issuers: those that were predicted to issue long-term debt and those that were predicted to issue short-term debt. The question is whether issuers who choose maturities that are different from those predicted based on standard models of maturity exhibit larger changes in default risk than do those issuers whose choices are consistent with those predicted by the model. If so, then the results are more consistent with the private information theories.

To perform these tests, we first predict debt maturities using observable firm characteristics at the time of issue. These control for several key firm characteristics that the agency theories have indicated as important determinants of a firm's maturity choice. We then examine future default risk changes of issuers classified by the deviation between predicted maturity and actual maturity.

The tests show that firms that were predicted to issue short-term debt but actually issue long-term debt had a much larger deterioration in default risk than other long-term debt issuers. Conversely, firms that were predicted to issue long-term debt but actually issued short-term debt had a much larger improvement in default risk measures following debt issues. Overall, changes in default risk of issuers are related to the deviation between actual and predicted maturity, even after controlling for time-varying firm characteristics and initial credit ratings of issuers. These findings confirm that asymmetric information is a key factor in determining debt maturities of new issues.

The paper is organized as follows: Section II presents a brief review of previous studies. Section III describes our methodology for estimating default risk. Section IV presents data, sample description, and univariate analysis. We show our key multivariate results in Section V. In Section VI we examine default risk changes for issuers whose debt maturity choices differ from those based on standard maturity models. Section VII presents results on debt rating migrations around debt issues. Section VIII concludes.

II. Background

Tests of information models of debt maturity choice typically relate debt maturity to risk ratings in a cross-sectional setting. The tests implicitly assume that a firm's choice of debt maturity allows its creditors to infer some of what was previously firm-specific private information. Creditors then use this information in assigning risk ratings. The implication is that firms issuing short-term debt will have higher ratings, while those issuing long-term debt will have lower ratings. Barclay and Smith (1995) test this prediction and find that for firms with rated debt, maturity declines with bond ratings (i.e., lower-rated firms employ more long-term debt than do higher-rated firms). However, Barclay and Smith also find that nonrated firms (typically, small firms with low credit standing) employ more short-term debt. As nonrated debt is mostly private, it is unclear whether the nonmonotonicity is driven by factors other than a firm's credit risk. This nonmonotonicity is also observed in other studies such as Stohs and Mauer (1996).

Other studies use accounting measures of default risk and examine whether they are associated with variations in debt maturity structures. Scherr and Hulbert (2001), for example, use Altman's Z-score as a measure of default probability (an increase in Z-score corresponds to a reduction in default probability) and find that short-maturity debt is more common among both low-default-risk (higher Z-score) firms and high-default-risk (lower Z-score) firms. Accounting-based measures of risk are problematic in that the information they contain is backward-looking. In addition, the accounting measures do not account for the volatility of a firm's assets, which is considered an important factor affecting default risk.

The existing literature's focus on the maturity of the stock of debt that has been built up over time does not allow one to distinguish the maturities of new debt from the remaining time on the stock of existing debt contracts. The maturity of the existing stock of debt reflects decisions made at different historical points and may not correspond to asymmetric information during the sample period. Some studies have therefore examined the maturity of new debt issues. But the results in these studies often conflict with each other. For example, Mitchell (1993) finds that issuers with higher bond ratings issue longer-maturity debt. But Guedes and Opler (1996) find that investment-grade firms issue both shorter- and longer-term debt, while noninvestment-grade firms issue intermediate-maturity debt. Berger, Espinosa-Vega, Frame, and Miller (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 accounting measures of risk and find that firms rated as low risk issue longer-maturity debt.

Yet other studies test signaling models by including variables that reflect the degree to which a firm's ex ante information is favorable or unfavorable. Barclay and Smith (1995), Stohs and Mauer (1996), and Johnson (2003) include future abnormal earnings in debt maturity regressions. While the evidence reported in these papers is consistent with the predictions of information models, the economic magnitudes of these effects are small. An 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. There is also 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 future positive abnormal earnings.

As this brief review suggests, most of the previous studies have examined implications of asymmetric information models in a cross-sectional framework, relating debt maturity choices to risk ratings and their interactions with ex ante information asymmetry measures. Few studies have tested the time-series predictions of the models. The exceptions are studies that test the models using post-issuance stock returns and ratings. Spiess and Affleck-Graves (1999) document long-run underperformance of firms following long-term debt issuance. Covitz and Harrison (1999) develop a recursive model of debt rating migrations and show that debt issuance provides a negative signal of rating migration and the signal becomes stronger with economic downturns and debt maturity.

In contrast to much of the previous literature, we test the information theories of debt maturity choice by tracking time-series changes in 2 market-based measures of default risk: DTD and asset volatility. These measures improve upon the accounting measures of default risk such as the Z-score in Altman (1968) or the conditional logit model in Ohlson (1980) as has been done in previous studies.

III. Estimating Default Risk

We measure default risk using DTD, which is defined as the number of standard deviations the value of the firm is away from the default boundary at the forecasting horizon. There are 3 main drivers of DTD: the value of assets, volatility of assets, and firm leverage. Our estimation method closely follows the procedure used by Moody's KMV, which in turn is based on Merton (1974).[5]

The KMV-Merton method exploits the fact that equity can be viewed as a call option on the underlying value of the firm with a strike price that is equal to the face value of the firm's debt. The market value of the firm's underlying assets follows a geometric Brownian motion of the form

$$dV_A = \mu V_A dt + \sigma_A V_A dZ, \tag{1}$$

where V_A is the total value of the firm, μ is the expected continuously compounded return on V_A, σ_A is the volatility of firm value, and dZ is a standard Weiner process. With these assumptions, the market value of equity, V_E, can be expressed as a function of the total value of the firm according to the Black and Scholes (1973) formula,

$$V_E = V_A \mathrm{N}(d_1) - Ke^{-rT}\mathrm{N}(d_2), \tag{2}$$

where

$$d_1 = \frac{\ln(V_A/K) + (r + \frac{1}{2}\sigma_A^2)T}{\sigma_A\sqrt{T}}, \qquad d_2 = d_1 - \sigma_A\sqrt{T},$$

K is the face value of the firm's debt, r is the risk-free rate, T is the forecast horizon, and N is the cumulative standard normal distribution function.

The risk-free rate, r, is the 1-year Treasury constant maturity rate obtained from the Federal Reserve Board. The market value of equity, V_E, is calculated as the product of the firm's outstanding shares and its current stock price. The forecast horizon, T, is 1 year, as we are interested in annual default probabilities. The default boundary, K, is estimated as the debt in current liabilities plus ½ of long-term debt following Vassalou and Xing (2004), Bharath and Shumway (2008), and Duffie (2011). It is common to include some long-term debt in K to account for the fact that the default point is somewhere between a firm's short-term debt and total debt. Crosbie and Bohn (2003) argue that a firm's ability to roll over its

[5]This estimation method has also been adopted in several recent studies (see, e.g., Vassalou and Xing (2004), Guner (2006), and Acharya, Bharath, and Srinivasan (2007)). For a more detailed account, refer to Crosbie and Bohn (2003).

short-term debt depends on the size of its long-term debt. In particular, interest payments on long-term debt are part of a firm's short-term obligations. We find that our results are not sensitive to whether we include ½ of the long-term debt or the full amount. In unreported tests, we reestimate DTD with short-term debt plus full long-term debt and obtain qualitatively similar results to those reported here.

The 2 remaining variables in the Black and Scholes equation (the total value of the firm, V_A, and the volatility of the firm value, σ_A) are estimated through an iterative procedure. We start by estimating σ_E, or the annualized standard deviation of stock returns, using daily data from the previous year. This σ_E estimate serves as an initial estimate of σ_A, and together with the market value of equity of that day and other inputs, the Black-Scholes equation is used to recover daily values of V_A for the previous year.

With the estimated values of V_A, we compute the implied log return on assets each day for the past 12 months and use that return series to generate new estimates of σ_A. Each new estimate of σ_A is used in the next iteration until the values of σ_A from 2 consecutive iterations converge (i.e., when the absolute difference in consecutive σ_As is less than 10^{-3}). For most firms, it takes only a few iterations for consecutive σ_As to converge. The converged values of σ_A are used to estimate V_A through the Black and Scholes equation (equation (2)). Once daily values of V_A are estimated, we compute the drift μ by calculating the mean change in $\log(V_A)$. With these inferred values, the DTD can be calculated as

$$\text{(3)} \qquad \text{DTD}_{i,t} = \frac{\ln(V_{A_{i,t}}/K_{i,t}) + \left(\mu_{i,t} - \frac{1}{2}\sigma^2_{A_{i,t}}\right) T}{\sigma_{A_{i,t}}\sqrt{T}}.$$

The average DTD for the sample of debt issuers is about 7, which is greater than the average DTD for the broader population of Compustat firms.[6] In our view, this difference reflects the relatively better credit quality of public debt issuers.

In addition to DTD, we use asset volatility (σ_A) as an alternative measure of default risk. Asset volatility varies directly with default risk. It also has the advantage of not being affected by leverage ratios, which may evolve differently for short- and long-term debt issuers. As before, we find that the asset volatility exhibited by debt issuers in our sample is lower than that reported for a broader population of Compustat firms by Vassalou and Xing (2004).

[6]As an illustration, based on the average K of 0.18, the average drift $\mu_{i,t}$ of 0.10, and the average asset volatility σ_A of 0.27, the average distance to default,

$$\text{DTD} = \frac{\ln(1/0.18)+\left(0.10-\frac{1}{2}0.27^2\right)1}{0.27\sqrt{1}} = 6.59.$$

Several other studies use a simple approximation (e.g., Sundaram and Yermack (2007)) that estimates DTD as $(V-K)/(\sigma V)$. This approximation results in a substantially lower DTD value based on the average parameter values for our sample.

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IV. Data, Sample, and Univariate Results

A. Data and Sample Description

We obtain a sample of public straight debt issues by U.S. firms from the Securities Data Company (SDC) New Issues database. The sample period is from 1983 to 2003. The financial statement data are from Compustat, and the daily market equity values and stock returns are from the Center for Research in Security Prices (CRSP) daily files. We require issuers to be listed on both CRSP and Compustat in the year before the issue. Financial firms (6000–6999), financial leasing firms (7359), and utilities (4910–4940) are excluded. Debt issues with missing maturities and issue amounts are also excluded.

Table 1 presents the time-series and cross-sectional distribution of the sample debt issues. The sample consists of 4,089 debt offerings made by 647 firms. Panel A indicates that debt issues in the 1980s are significantly less numerous than in the 1990s and the early 2000s. Column (2) reports the average issue amount (in

TABLE 1

Average Stated and Adjusted Debt Maturities by Year

Panel A of Table 1 reports the annual frequency of debt issues, the average principal amount, and the stated and adjusted maturities for a sample of 4,089 issues during the period 1983–2003. The principal amount (in millions of $) is expressed in constant year 2000 dollars. Stated maturity is the debt maturity indicated 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 the Compustat and converted to a numerical score as described in Appendix A.

Panel A. Frequency of Debt Issues

Year	*N* (1)	Principal ($million) (2)	Stated Maturity (3)	Callable (%) (4)	Adjusted Maturity (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	9.7	72.2	3.4
Average		179.1	12.2	37.1	8.1

Panel B. Debt Characteristics by Maturity Class

Maturity Class	Short-Term Debt ($N = 1,168$)	Medium-Term Debt ($N = 1,094$)	Long-Term Debt ($N = 1,827$)
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

constant dollars as at the year 2000) by year. Over the entire period, the average issue size is about $179 million. The next column reports the stated debt maturity, which on average is about 12 years, and which appears to have declined in the more recent period.

Almost ⅓ of our debt issues are callable, with call dates concentrating around 5, 7, and 10 years from the date of issuance. The call provisions provide firms with an opportunity to redeem their bonds at the 1st call date and allow them to effectively determine the earliest opportunity for refinancing their existing debt (King and Mauer (2000)). Therefore, we use adjusted maturities, which replace the maturity of callable bonds with time to 1st call.[7] The adjusted maturity is on average about 8 years and shows a pattern similar to that of stated maturity.

Panel B of Table 1 presents debt characteristics classified by adjusted maturity. Following Barclay and Smith (1995) and Guedes and Opler (1996), we classify debt as short term if the adjusted maturity is less than or equal to 3 years, as medium term if it is between 3 and 7 years, and as long term if it exceeds 7 years. 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 than does medium-term debt.

We present the rest of our analyses using a weighted average term to maturity for issuers that offer multiple debt securities in a given month, with weights reflecting the amount issued. This collapsed sample consists of 2,829 observations, where multiple issues by a firm in a given month are replaced by a single observation that aggregates these multiple issues.

Table 2 reports average pre-issue borrower characteristics for different maturity classes. Short-term debt issuers are larger than medium- and long-term debt issuers. 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.

TABLE 2

Issuer Characteristics by Debt Maturity

Table 2 presents average values of lagged characteristics of debt issuers grouped by the maturity of their debt offering. The sample of debt issues is collapsed to construct a weighted average term to maturity for issuers that offer multiple debt securities in any given month where the weights reflect the amount issued. This table uses the collapsed sample of 2,829 issues. We classify debt as short-term if the maturity is less than or equal to 3 years, as medium-term if it is between 3 and 7 years, and as long-term if it exceeds 7 years. The variables are defined in Appendix A. Columns (4)–(6) report *p*-values from 2-tailed tests of the null hypothesis of there being no differences in firm characteristics across debt maturities.

	Short-Term Debt Issuers ($N = 783$)	Medium-Term Debt Issuers ($N = 751$)	Long-Term Debt Issuers ($N = 1,295$)	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-to-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
Profitability	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

[7]To check robustness, we replicate our results using stated maturities and find similar results.

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B. Changes in Default Risk: Plots and Univariate Results

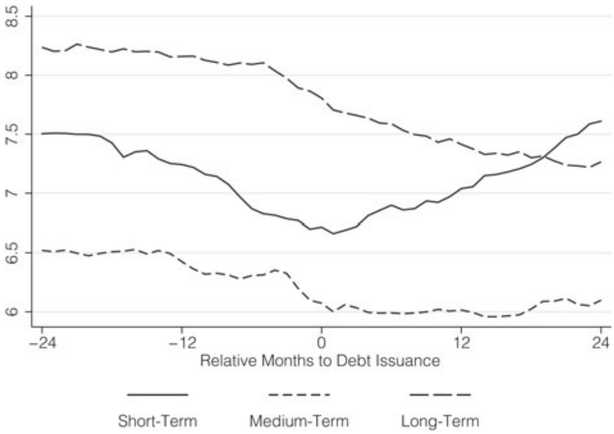
To examine how default risk evolves for short- and long-term debt issuers, we start by plotting the 2 default risk measures for the 4-year period surrounding the debt issue for different maturity classes. Graph A of Figure 1 plots the evolution of DTD, while Graph B plots the evolution of asset volatility. As predicted, the plot shows that short-term debt issuers experience a large increase in DTD in the 2 years after the issue. By contrast, long-term debt issuers experience a significant decline. Asset volatility varies directly with default risk, so we expect an opposite pattern from the plots of asset volatility. Graph B shows that, indeed,

FIGURE 1

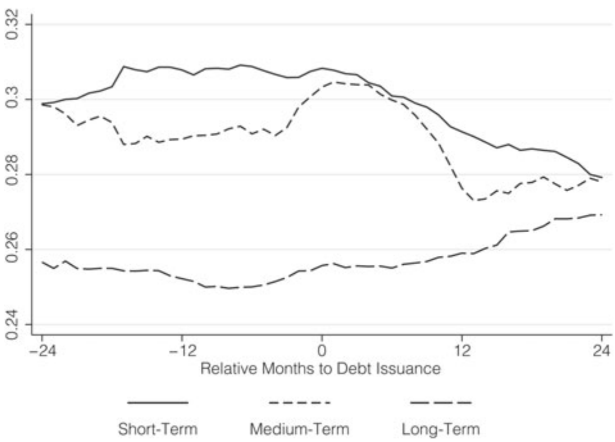
Default Risk Changes around Debt Issuances

Graph A of Figure 1 displays the plot of issuer distance to default (DTD), and Graph B displays the asset volatility for the 4-year period surrounding the issue for firms classified by the adjusted maturity of their debt issue. We classify debt as short-term if the adjusted maturity is less than or equal to 3 years, as medium-term if it is between 3 and 7 years, and as long-term if it exceeds 7 years.

Graph A. DTD for Issuers Sorted by Maturity



Graph B. Asset Volatility for Issuers Sorted by Maturity



short-term issuers exhibit a large decline in asset volatility, while long-term debt issuers experience a large increase. Overall, these figures tell a consistent story: Default risk declines after short-term issues and increases after long-term issues.

More formal comparisons of default risk measures in the pre- and post-period are presented in Table 3. Panel A reports the average DTD for the year before the issue in column (1), the month of the issue in column (2), 1 year after the issue in column (3), and 2 years after issue in column (4).

TABLE 3

Default Risk Changes around Debt Issues

Table 3 presents the average distance to default (DTD) in Panel A and asset volatility (σ_A) in Panel B for a sample of debt issuers in the period surrounding the issue. We report the averages for the 12-month period prior to the debt issue in column (1), for the month of issuance in column (2), for the year after the issuance in column (3), and for 2 years after the issue in column (4). Debt issues are classified as short-term if the adjusted maturity is less than or equal to 3 years, as medium-term if the maturity is between 3 and 7 years, and as long-term if the maturity is more than 7 years. Column (5) reports the differences in default risk measures between the month of issuance and 2 years after issuance, while column (6) reports the difference in default risk from the year before the issuance to 2 years after issuance. The corresponding *p*-values from a 2-tailed *t*-test of the null hypothesis of there being no differences in default risks over time are presented in parentheses.

	Year Relative to Offer Year					
	−1	0	1	2	Year 0 to Year 2 (*p*-value)	Year −1 to Year 2 (*p*-value)
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. DTD						
Short-term ($N = 783$)	6.987	6.685	6.831	7.241	0.555 (0.00)	0.254 (0.18)
Medium-term ($N = 751$)	6.315	6.056	6.010	5.996	−0.060 (0.76)	−0.319 (0.10)
Long-term ($N = 1{,}295$)	8.072	7.792	7.550	7.280	−0.513 (0.00)	−0.793 (0.00)
Test for the difference in changes Short versus long (*p*-value)					(0.00)	(0.00)
Panel B. Asset Volatility (σ_A)						
Short-term ($N = 783$)	0.308	0.308	0.302	0.288	−0.020 (0.00)	−0.020 (0.00)
Medium-term ($N = 751$)	0.293	0.303	0.297	0.280	−0.023 (0.00)	−0.013 (0.05)
Long-term ($N = 1{,}295$)	0.252	0.255	0.256	0.267	0.011 (0.00)	0.014 (0.00)
Test for the difference in changes Short versus long (*p*-value)					(0.00)	(0.00)

For the short-term issuers, the average DTD increases from 6.69 in the issue month to about 7.24 2 years later (the difference is significant with a *p*-value of 0.00). By contrast, the long-term issuers experience a decline in their DTD, from 7.79 in the month of issue to 7.28 2 years later (this difference is also significant with a *p*-value of 0.00). We further test whether there is a difference between the change in DTD experienced by short- and long-term debt issuers in the next 2 years. These tests (reported at the bottom of Panel A of Table 3) show that the increase in DTD for short-term issuers is indeed significantly larger than is the decline in DTD for long-term issuers (the *t*-test for the difference in changes between short- and long-term debt has a *p*-value of 0.00).

To judge the economic significance of the changes in DTD, we map them to changes in default probabilities.[8] We accomplish this by generating an empirically observed distribution of defaults as a function of a firm's DTD. We first estimate DTD for all Compustat firms with rated debt for the period from 1985 to 2006. These estimates are then sorted into 7 bins based on average annual DTDs. We also identify all defaults in Compustat using Standard & Poor's (S&P) default ratings "D" or "SD" and supplement this information with that obtained from Moody's Default and Debt Recovery database.[9] To complete the mapping, we estimate the number of defaults over the next year by firms in a given DTD category and then average them over all years. This results in a mapping of DTD categories to the empirical distribution of observed default frequencies.

Most of the defaults are concentrated in the lowest 2 categories of DTD. Debt issuers, by contrast, are relatively low-risk firms. With an average DTD of about 7.0 for the debt issuers in our sample, the observed defaults over the next year are roughly 5.9 basis points (bp).

We have shown that for short-term issuers, the DTD increases from 6.69 in the issue month to 7.24 2 years later. This translates into a drop in default likelihood from 6.7 bp to 5.4 bp (a decline of 1.3 bp or a 19% decrease in default likelihood over 2 years). Long-term debt issuers, by contrast, experience a decline in DTD, and consequently an increase in their default probabilities of roughly the same magnitude. Another way to judge if these are meaningful changes in default risk is to map the DTDs to credit ratings. A decline in DTD of this magnitude translates into almost a 1-notch change in credit rating.[10] Such changes in default risk have substantive effects on the cost of debt financing.

Consistent with the patterns that we observe for changes in DTD, in Panel B of Table 3 we find that asset volatility declines for short-term issuers (from 0.308 at the time of issuance to 0.288 in year 2) and increases for long-term issuers (from 0.255 to 0.267). Both of these changes are statistically significant at the 1% level. Additional tests show that the decline in asset volatility for short-term issuers is significantly different from the increase in asset volatility for the long-term issuers.

C. Changes in Factors Affecting Default Risk

The time-series changes in default risk for short- and long-term issuers documented above are consistent with information asymmetries about future default risks affecting debt maturity choices of firms. However, the question is whether these changes in DTD are due to the market updating of beliefs about a firm's default risk or firms adopting different policies depending on their maturity choice.

[8]Previous studies such as Vassalou and Xing (2004) use the normal distribution to transform DTD into a default probability. As pointed out by Crosbie and Bohn (2003), the problem with this method of transformation is that the empirical distribution of defaults has a much wider tail than the normal distribution.

[9]The overall annual default probability is 1.58%, similar to that reported by Moody's for the period 1983–2008. See Moody's Special Comment: Corporate Default and Recovery Rates, 1920–2008 (Feb. 2009).

[10]The mapping between DTD and S&P long-term issuer ratings show that a change in DTD from 8 to 7 implies a 2-notch rating change, from A+ to A−.

We therefore examine the evolution of the 3 main elements that affect the DTD: K/V (leverage), σ_A (asset volatility), and μ (drift in firm value). Table 4 reports the average value of K/V, asset volatility, and drift for the quarter of debt issuance and for the subsequent 8 quarters for short- and long-term issuers separately.

TABLE 4

Changes in Firm Characteristics Driving Distance to Default

Table 4 reports average values of K/V, asset volatility (σ_A), and drift in asset value (μ) for short- and long-term issuers at quarterly frequency. K/V is estimated as the ratio of short-term debt plus ½ long-term debt to firm value. Asset volatility σ_A is estimated through an iterative procedure using the Black and Scholes (1973) model. Drift in asset values (μ) is the mean of the change in log(V_A), where V_A is estimated through an iterative procedure using the Black-Scholes model. The bottom part of the table reports p-values from tests of the null hypothesis that the average values of these variables in the 2nd, 4th, and 8th quarters are similar to their values in the debt issuance quarter. We also report p-value from tests that compare changes over time in these variables for short- and long-term issuers.

	K/V		Asset Volatility (σ_A)		Drift in Asset Values (μ)	
	Short-Term Issuer	Long-Term Issuer	Short-Term Issuer	Long-Term Issuer	Short-Term Issuer	Long-Term Issuer
Quarter Since Issuance	(1)	(2)	(3)	(4)	(5)	(6)
0	0.169	0.176	0.308	0.257	0.092	0.139
1	0.167	0.176	0.305	0.256	0.091	0.119
2	0.170	0.178	0.302	0.257	0.088	0.106
3	0.169	0.179	0.297	0.258	0.068	0.089
4	0.169	0.179	0.292	0.260	0.046	0.066
5	0.168	0.178	0.287	0.264	0.036	0.071
6	0.171	0.180	0.289	0.267	0.043	0.064
7	0.171	0.182	0.291	0.269	0.052	0.058
8	0.171	0.181	0.280	0.270	0.046	0.059
p-value for t-test Q2 = Q0	0.58	0.12	0.01	0.81	0.59	0.00
p-value for t-test Q4 = Q0	0.52	0.04	0.00	0.19	0.00	0.00
p-value for t-test Q8 = Q0	0.22	0.02	0.00	0.00	0.00	0.00
p-values for t-test of the difference in changes between short-term and long-term debt issuers						
Change from Q0 to Q2	0.59		0.02		0.02	
Change from Q0 to Q4	0.51		0.00		0.13	
Change from Q0 to Q8	0.60		0.00		0.06	

Columns (1) and (2) of Table 4 report time-series averages of the K/V ratio (which is the ratio of short-term debt plus ½ the long-term debt to firm value) for short- and long-term issuers, respectively. The ratio shows very little change over the next 2 years. For the short-term issuers, it does not change much over time. For the long-term issuers, it shows only a slight increase. Importantly, the tests reported at the bottom of the table suggest that the changes in K/V between short- and long-term issuers are not significantly different from each other. In unreported tests, we also examine a broader definition of leverage estimated as the ratio of total debt to firm value. The time-series changes in this measure of leverage are also similar for the 2 sets of issuers.

Columns (3) and (4) of Table 4 examine the evolution of asset volatility for debt issuers over the 8 quarters following the issue. We find large and significant changes in asset volatility, which declines for short-term issuers and increases for long-term issuers. These results confirm the plots and results in Table 3. Tests further show that the changes in asset volatility for short- and long-term issuers are significantly different from each other.

Columns (5) and (6) of Table 4 examine the drift in firm value (μ) over the next 8 quarters for short- and long-term issuers. We find that μ drops for both short- and long-term issuers over the 8 quarters after issuance. However, we find no significant difference in changes in μ between short- and long-term issuers during the 1st year after the issuance. Beginning in the 2nd year after issuance, the difference widens but the statistical significance remains weak.

Overall, these results confirm that the changes in DTD are not driven by differences in how leverage evolves for short- and long-term debt issuers. Leverage changes are in fact similar for both sets of issuers. It appears that much of the difference in how DTD evolves for short- and long-term issuers is due to changes in asset volatility.

D. Changes in Other Firm Characteristics Following Debt Issues

While we have shown that leverage and drift in asset values evolve similarly for short- and long-term issuers, it is still possible that other firm characteristics change differently for them. The question is whether issuers adopt different corporate policies in the period following the debt issue based on their maturity choices.

Table 5 examines profitability, variability of earnings ($CV(OI)$), cash holdings, the market-to-book assets ratio, tangibility, and capital expenditure for short- and long-term issuers in the period surrounding the issue. The variables are defined in Appendix A.

Panel A of Table 5 reports profitability of short- and long-term issuers and shows that profitability declines for both types of issuers. Tests show no significant differences in how profitability changes between the 2 groups. Panel B, which reports the variability of operating income ($CV(OI)$), shows increases in earnings variability for both groups. Tests reveal no significant differences in changes in variability of earnings between the short- and long-term issuers. Panel C shows that short-term issuers increase cash balances by significantly larger amounts than do long-term issuers. Panel D examines the market-to-book assets ratio, which exhibits small and mostly insignificant changes for both short- and long-term debt issuers. The changes themselves are not significantly different from each other. Panel E reports average tangibility (defined as the ratio of net property, plant, and equipment to assets) for short- and long-term issuers in the period surrounding debt issues. Both types of issuers experience a declining trend in tangibility. But, again, we do not find differences in tangibility changes for the 2 groups of issuers. Finally, Panel F examines capital expenditures. Investment declines for both short- and long-term issuers in the 2 years subsequent to issue. However, we do not find strong evidence of differences in how capital expenditures change after the issuance.

Overall, the picture that emerges from this table is that changes in most firm characteristics do not differ significantly between short- and long-term debt issuers with the exception of the cash-to-assets ratio. Thus, the different patterns in default risk measures that we have observed are unlikely to be due to maturity-specific differences in firm characteristics.

TABLE 5

Changes in Other Financial Characteristics

Table 5 reports the time-series averages of profitability, *CV* (*OI*), the cash-to-assets ratio, the market-to-book assets ratio, tangibility, and capital expenditure around debt issues. The variables are defined in Appendix A. We classify the debt issues as short-term if the adjusted maturity is less than or equal to 3 years, and as long-term if the adjusted maturity is more than 7 years.

	Year Relative to Offer Year					
	−1	0	1	2	Year 0 to Year 2 (*p*-value)	Year −1 to Year 2 (*p*-value)
Panel A. Profitability						
Short-term issuer	0.164	0.158	0.155	0.151	−0.007 (0.00)	−0.012 (0.00)
Long-term issuer	0.157	0.150	0.148	0.147	−0.003 (0.05)	−0.010 (0.00)
Test for the difference in changes					(0.11)	(0.47)
Panel B. CV (OI)						
Short-term issuer	0.944	0.945	0.954	0.960	0.016 (0.00)	0.014 (0.00)
Long-term issuer	0.946	0.949	0.962	0.970	0.021 (0.00)	0.025 (0.00)
Test for the difference in changes					(0.30)	(0.08)
Panel C. Cash/Assets Ratio						
Short-term issuer	0.044	0.046	0.049	0.053	0.008 (0.00)	0.009 (0.00)
Long-term issuer	0.039	0.041	0.042	0.043	0.002 (0.19)	0.004 (0.01)
Test for the difference in changes					(0.00)	(0.02)
Panel D. Market-to-Book Assets Ratio						
Short-term issuer	1.587	1.545	1.511	1.509	−0.040 (0.16)	−0.082 (0.01)
Long-term issuer	1.287	1.294	1.282	1.283	−0.010 (0.56)	−0.010 (0.60)
Test for the difference in changes					(0.33)	(0.04)
Panel E. Tangibility						
Short-term issuer	0.397	0.393	0.389	0.382	−0.011 (0.00)	−0.015 (0.00)
Long-term issuer	0.468	0.464	0.457	0.452	−0.011 (0.00)	−0.015 (0.00)
Test for the difference in changes					(0.97)	(0.98)
Panel F. Capital Expenditure						
Short-term issuer	0.073	0.069	0.064	0.059	−0.008 (0.00)	−0.014 (0.00)
Long-term issuer	0.088	0.083	0.078	0.074	−0.012 (0.00)	−0.016 (0.00)
Test for the difference in changes					(0.08)	(0.45)

V. Regression Results

A. Main Results

Table 6 examines the changes in DTD and asset volatility around debt offerings. These tests are conducted on a panel where for each issuer month in the sample, we examine the risk measures in the year before the month of issuance, the month of the issue, 1 year after the issue, and 2 years after the issue.

Thus, we have 4 observations per issue. As indicated earlier, we use the collapsed issuance data, where we replace multiple issues made by a firm in a month with a single aggregated issue.[11]

TABLE 6

Default Risk Changes and Debt Maturity

Table 6 reports regression results from specifications that regress the 2 default risk measures on indicator variables for the period before and after debt issue, firm characteristics, and interest rate variables. The accounting variables are from the fiscal year that ends immediately before the period in which distance to default (DTD) and asset volatility are measured. The regressions include industry fixed effects and rating indicators (the coefficients are suppressed to save space). Numbers in parentheses are standard errors adjusted for heteroskedasticity and clustered at the issuer year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Panel A. DTD			*Panel B. Asset Volatility*		
	Short-Term Debt	Medium-Term Debt	Long-Term Debt	Short-Term Debt	Medium-Term Debt	Long-Term Debt
	(1)	(2)	(3)	(4)	(5)	(6)
I_{-1}	0.664***	0.471***	0.459***	−0.009	−0.022***	−0.009***
	(0.163)	(0.147)	(0.118)	(0.006)	(0.007)	(0.003)
I_{+1}	0.448***	0.254*	−0.138	−0.013**	−0.021***	0.004
	(0.172)	(0.151)	(0.116)	(0.006)	(0.007)	(0.004)
I_{+2}	0.910***	0.329*	−0.240*	−0.019***	−0.017**	0.016***
	(0.238)	(0.169)	(0.134)	(0.007)	(0.007)	(0.004)
Firm size	−0.180**	0.329***	0.130*	−0.010**	−0.018***	−0.006***
	(0.087)	(0.057)	(0.068)	(0.004)	(0.003)	(0.002)
Market-to-book assets	−0.067	0.160	−0.094	0.027***	0.013***	0.026***
	(0.129)	(0.169)	(0.115)	(0.004)	(0.005)	(0.004)
Leverage	−8.772***	−7.846***	−8.497***	−0.127***	−0.173***	−0.156***
	(0.648)	(0.476)	(0.507)	(0.027)	(0.021)	(0.019)
Profitability	5.617**	6.020***	8.527***	−0.384***	−0.230***	−0.277***
	(2.643)	(1.345)	(1.813)	(0.103)	(0.075)	(0.069)
Tangibility	1.768***	2.080***	1.116**	−0.045**	−0.049***	−0.021
	(0.544)	(0.431)	(0.452)	(0.019)	(0.019)	(0.013)
CV (*OI*)	0.629	−0.193	−0.307	−0.045	0.043	−0.007
	(0.964)	(0.497)	(0.682)	(0.033)	(0.039)	(0.029)
Treasury	0.775***	−0.183***	−0.335***	−0.017***	0.004*	0.009***
	(0.084)	(0.045)	(0.048)	(0.003)	(0.002)	(0.002)
Baa spread	−0.933***	0.088	−0.419***	0.020***	0.003	0.010***
	(0.106)	(0.072)	(0.084)	(0.004)	(0.003)	(0.002)
F-test statistics ($I_{-1} = I_{+2}$)	1.04	0.73	25.24***	1.58	0.66	27.45***
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	3,020	2,822	4,941	3,020	2,822	4,941

In Table 6, 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 offering month. For example, I_{-1} takes a value of 1 if the observation pertains to 1 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 1 if the observation pertains to the 12 months following the offer month and picks up default risk increases in the 1st year relative to the offer month; I_{+2} takes a value of 1 if the observation is for months 13–24 following the offer

[11]Survivorship bias should not affect our findings, as there is not much attrition in our sample over the 4-year period.

month and picks up default risk increases in the 2nd year. The missing indicator is the offer month indicator (I_0).

The tests control for firm size, leverage, market-to-book assets, profitability, asset tangibility, operating-income variability, and term structure variables such as the Treasury rate and the spread of Baa bond yield over the 1-year Treasury yield. We control for firm size because larger firms are more diversified and so face lower default risk. Leverage is included because it directly affects default risk. Profitability is considered because profitable firms are less risky, and their higher margins contribute to internal equity, thus reducing default risk. We include the coefficient of variation of operating income because firms with greater income variability are expected to have higher default risk.

Asset tangibility reduces information asymmetry, as tangible assets are easier for outsiders to value. Tangibility also makes it difficult for managers to increase the risk of the firm. We include the ratio of market-to-book assets to control for growth opportunities.[12] Higher-growth firms have higher default risk. In addition, managers of high-growth firms can more easily increase the risk of their assets.

In addition, interest rate variables that act as a proxy for the variation in aggregate default risk over time are included. These include short-term interest rates and default spreads. 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 because, as argued in the literature, debt issued in an environment where default spreads are generally high will have higher default risk.

Finally, we control for debt ratings at the time of issue. The ratings reflect observable risk characteristics and control for credit risk of issuers at the time of debt issuance. 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 3 time-period indicator variables included (I_{-1}, I_{+1}, and I_{+2}) detect changes in default risk that are not reflected in time-varying firm characteristics or in the debt ratings at the time of issue. We also include the industry indicator variables (based on the Fama and French (1997) 38 industry classifications) to control for industry fixed effects. We report robust standard errors that are clustered at the issuer-year level to account for multiple debt issues in a given year.

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 DTD 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.

The results reported in Table 6 are consistent with our predictions. Columns (1)–(3) report results from regressions of DTD on the time-period indicators after controlling for firm characteristics, industry fixed effects, and debt ratings at the time of issue. The coefficient estimates on the time-period indicators suggest that in the 2-year period following issue, firms issuing short- and medium-term debt

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

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experience a significantly higher DTD than in the issuance month. The increase in DTD of 0.91 for the short-term issuers in the 2-year period after issue is roughly equal to an increase in default likelihood of 2.5 bp (this translates into a 42% jump in default probability given the mean default likelihood of 5.9 bp for an average issuer in the month of issue). Further confirming our predictions, the table shows that firms issuing long-term debt experience a marginal decline in the DTD in the 2 years following the issue.

The results for the asset volatility regressions reported in columns (4)–(6) of Table 6 are consistent with those for the DTD regressions. The asset volatility declines significantly in the 2-year period after issuance for the short-term debt issuers and increases significantly for the long-term debt issuers.

The coefficient estimates on control variables mostly confirm our expectations. Firm size is negatively related to asset volatility and positively to DTD (except for short-term issuers). The market-to-book assets ratio is unrelated to DTD but positively related to asset volatility. Leverage negatively affects both DTD and asset volatility. Profitability is positively related to DTD and negatively related to asset volatility. Tangibility positively affects DTD 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 the Treasury rate and the credit spread increase, default risk rises. The coefficient estimates on rating indicator variables are not reported in the table, but the results confirm that as ratings worsen, DTD declines while asset volatility rises.

B. Estimations in Changes

We test the robustness of the results by reestimating default risk regressions in changes. The advantage of change regressions is that the effects of time-invariant omitted firm characteristics can be removed. These results are reported in Table 7. The dependent variable in column (1) is the change in DTD 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) of Table 7, the coefficient on the short-term debt indicator is positive and significant at the 1% level. Relative to medium-term debt, which is the benchmark category, firms that issue short-term debt experience a change in DTD that is higher by 0.90 (this translates into a decline in default likelihood of about 2.5 bp relative to a mean value of 5.9 bp, a 42% reduction in default likelihood). Also consistent with earlier results, we find that the coefficient on long-term debt is significantly negative (with an increase in default likelihood that is roughly ½ the magnitude of the decline that short-term debt issuers face in the subsequent 2 years). In terms of changes in firm characteristics, only leverage changes appear to be related to changes in DTD. A decline in leverage leads to a significant increase in DTD. The interest rate variables such as changes in Treasury spreads and Baa spreads also affect changes in the DTD.

TABLE 7

Changes in DTD, σ_A, and Maturity Choice

Table 7 reports results from regressions of changes in default risk measures on the short- and long-term indicator variables, changes in firm characteristics, NBER recession indicator and its interaction with maturity, and changes in interest rate variables. In columns (1) and (5), the dependent variable is the change in distance to default (DTD). In columns (2) and (6), the dependent variable is the change in 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 1 if the change in DTD is positive. Similarly, in columns (4) and (8), the dependent variable equals 1 if σ_A is positive. The independent variables are changes from the fiscal year in which debt was issued to 2 years after. The NBER recession dummy is equal to 1 if debt is issued in years 1990, 1991, 2001, and 2002, and 0 otherwise. The probit coefficients are marginal effects. Standard errors reported in parentheses are adjusted for heteroskedasticity and firm-year clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	OLS		Probit		OLS		Probit	
	Dependent Variable							
	ΔDTD	$\Delta\sigma_A$	ΔDTD >0	$\Delta\sigma_A>0$	ΔDTD	$\Delta\sigma_A$	ΔDTD >0	$\Delta\sigma_A>0$
	Model							
Independent Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Short-term	0.899***	–0.019**	0.103***	–0.083***	0.428*	–0.003	0.086**	–0.020
	(0.249)	(0.009)	(0.032)	(0.032)	(0.246)	(0.011)	(0.037)	(0.038)
Long-term	–0.466**	0.022***	–0.026	0.049*	–0.585***	0.029***	–0.028	0.070**
	(0.187)	(0.007)	(0.030)	(0.028)	(0.191)	(0.009)	(0.032)	(0.030)
NBER recession					1.570***	–0.030**	0.245***	–0.247***
					(0.428)	(0.013)	(0.059)	(0.054)
NBER recession × short-term					1.257**	–0.049***	0.017	–0.230***
					(0.546)	(0.015)	(0.074)	(0.060)
NBER recession × long-term					0.900**	–0.043***	0.029	–0.161**
					(0.448)	(0.014)	(0.070)	(0.064)
ΔFirm size	–0.011	0.058***	0.124**	0.257***	–0.039	0.058***	0.118**	0.267***
	(0.321)	(0.021)	(0.059)	(0.052)	(0.300)	(0.020)	(0.057)	(0.050)
ΔMarket-to-book assets	0.456	0.008	0.012	0.077***	0.523*	0.007	0.022	0.068**
	(0.308)	(0.007)	(0.028)	(0.026)	(0.301)	(0.007)	(0.029)	(0.027)
ΔLeverage	–10.953***	0.020	–1.954***	0.234**	–9.917***	–0.007	–1.830***	0.058
	(0.758)	(0.047)	(0.154)	(0.111)	(0.750)	(0.049)	(0.152)	(0.113)
ΔProfit	2.185	–0.138*	–0.005	–0.149	2.335	–0.141*	0.042	–0.207
	(1.687)	(0.074)	(0.282)	(0.211)	(1.627)	(0.073)	(0.280)	(0.207)
ΔTangibility	–1.054	–0.116*	0.202	–0.161	–1.268	–0.109*	0.154	–0.134
	(1.695)	(0.066)	(0.244)	(0.226)	(1.570)	(0.064)	(0.237)	(0.220)
Δ*CV* (*OI*)	–0.679	0.040	0.022	–0.094	–0.943	0.048	–0.012	–0.038
	(0.982)	(0.054)	(0.124)	(0.096)	(1.101)	(0.057)	(0.137)	(0.096)
ΔTreasury	–1.159***	0.031***	–0.140***	0.121***	–0.736***	0.020***	–0.097***	0.057***
	(0.098)	(0.004)	(0.014)	(0.015)	(0.088)	(0.004)	(0.015)	(0.015)
ΔBaa spread	–1.724***	0.043***	–0.194***	0.174***	–1.485***	0.036***	–0.174***	0.144***
	(0.139)	(0.005)	(0.019)	(0.019)	(0.124)	(0.005)	(0.019)	(0.019)
F-test/χ^2 statistics (Short-term = Long-term)	33.86***	33.70***	22.42***	20.35***	19.41***	14.31***	13.11***	7.39***
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	2,602	2,602	2,602	2,602	2,602	2,602	2,602	2,602

In column (2) of Table 7, we report the results from regressions on changes in asset volatility. The coefficient estimates suggest that the change in asset volatility for short-term issuers is 1.9% lower than that for medium-term debt issuers. But for the long-term issuers, the change in asset volatility is 2.2% higher than that for the medium-term issuers. These results are consistent with a decline in default risk for the issuers of short-term debt and an increase for the issuers of long-term debt.

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Column (3) of Table 7 reports results from probit estimates in which the dependent variable takes a value of 1 if the change in DTD is positive over the 2 years following the debt issue, and 0 otherwise. Consistent with the ordinary least squares (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 1 if asset volatility increases in the 24-month period following debt issuance, and 0 otherwise. 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 and the χ^2 statistics on the equality of short- and long-term debt dummy variables are significant at the 1% level in all 4 regressions, suggesting that default risk changes following short-term debt issues differ from those following long-term debt issues.

In columns (5)–(8) of Table 7, we control for macroeconomic cycles by including a recession dummy variable that is equal to 1 if the debt security is issued during the National Bureau of Economic Research (NBER) recession years. The literature shows that maturity of aggregate debt issues varies with macroeconomic conditions, and that there is a more pronounced increase in short-term debt issuances during recessions.[13] 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 nonrecessionary 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 with respect 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 5 years, medium-term debt as debt with maturity between 5 and 10 years, and long-term debt as debt with a maturity above 10 years. The results remain unchanged. We also examine the robustness of our results with respect to our definition of modified maturity. We use stated maturity instead of the adjusted maturity and find qualitatively identical results. We also redefine 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). These results show that default risk falls following short-term debt issues and rises after long-term debt issues.

VI. Predicted Maturity versus Actual Maturity

The debt maturity literature shows that debt maturity choices are related to observable firm characteristics. If firms prefer certain maturities based on their observable firm characteristics, then the signaling implications will be relatively more significant when a firm adopts a maturity that is different from what is predicted.

[13] See Kaplin and Levy (2001) and Baker, Greenwood, and Wurgler (2002).

Thus, we examine whether the changes in default risk following issuances are greater when a firm chooses a debt maturity that is contrary to the maturity expected of it based on its characteristics. We start by focusing on 2 firm characteristics that have been shown to affect debt maturity in the previous literature: firm size and growth opportunities. According to the debt maturity literature, small high-growth firms are more likely to borrow short-term debt, while large low-growth firms are more likely to borrow long-term debt. Thus, we expect default risk changes to be significantly larger when, for example, large low-growth firms issue short-term debt or when small high-growth firms issue long-term debt. In these cases, it is likely that the firm's maturity choice is guided by its private information about its default risk. We define large firms as those with assets above the sample median, and small firms as those with assets below the sample median. We define high-growth firms as those with market-to-book assets ratios greater than the median for the sample. We classify the remaining firms as low-growth firms.

In unreported tables, we find that default risk measures exhibit a relatively larger increase when small firms issue long-term debt than when other firms issue long-term debt. Conversely, when large firms issue short-term debt, the default risk measures show a larger drop than when other firms issue short-term debt. The results are consistent when we classify firms based on growth opportunities.

We extend these tests by including other determinants of debt maturity choice in a multivariate setting. The models of debt maturity such as those of Barclay and Smith (1995), Guedes and Opler (1996), and Stohs and Mauer (1996) suggest that debt maturity is a function of leverage, market-to-book assets, firm size, firm size squared, asset maturity, abnormal earnings, the coefficient of variation of operating income, term spread, an indicator variable for regulatory firms, and rating indicator variables. We therefore estimate debt maturity as a function of these variables and present the results in Table B1 in Appendix B. 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 and compare them with actual maturities chosen by the sample firms. Table 8 presents the average DTD (in Panel A) and asset volatility (in Panel B) for the 4 groups of issuers, based on predicted and actual maturities. When the data predict that firms will issue short-term debt but instead they issue long-term debt, the DTD declines significantly from 9.331 in the month of issue to 8.102 in the 2nd year after the issue (the p-value for the change is 0). However, when the predicted and actual maturities are both long, the decline in DTD is significantly smaller (from 7.869 in the month of the issue to 7.390 2 years later). The differences in changes between these 2 groups of issuers are significant with a p-value of 0.02. This suggests that firms choosing maturities different from that predicted face a greater change in DTD than do those whose predicted and actual maturities are the same.

We also examine the converse situation. When firms are predicted to issue long-term debt but instead issue short-term debt, the DTD increases significantly from 6.743 in the month of the debt issue to 7.585 2 years later (p-value equals

TABLE 8

Default Risk Changes for Issuers with Different Predicted and Actual Maturities

Table 8 reports the average values of distance to default (DTD) and asset volatility (σ_A) for subsamples of issuers based on their predicted and actual maturity choices. The predicted maturities are based on results reported in Table B1. Columns (5) and (6) report *p*-values from a 2-tailed *t*-test of the null hypothesis that default risk measures between year 2 and year 0 and between year 2 and year −1 are similar.

	Year Relative to Offer Year					
	−1	0	1	2	Year 0 to Year 2 (*p*-value)	Year −1 to Year 2 (*p*-value)
Predicted and Actual Maturity	(1)	(2)	(3)	(4)	(5)	(6)
Panel A. DTD						
Predicted short and actual long (1) ($N = 118$)	9.651	9.331	8.544	8.102	−1.229 (0.00)	−1.548 (0.00)
Predicted long and actual long (2) ($N = 1{,}021$)	8.234	7.869	7.683	7.390	−0.479 (0.00)	−0.844 (0.00)
p-value of difference in changes (1) versus (2)					(0.02)	(0.04)
Predicted long and actual short (3) ($N = 497$)	7.144	6.743	7.026	7.585	0.842 (0.00)	0.441 (0.04)
Predicted short and actual short (4) ($N = 194$)	7.379	7.213	7.150	7.461	0.248 (0.00)	0.082 (0.04)
p-value of difference in changes (3) versus (4)					(0.08)	(0.34)
Panel B. Asset Volatility (σ_A)						
Predicted short and actual long (5) ($N = 118$)	0.283	0.288	0.294	0.310	0.022 (0.07)	0.027 (0.03)
Predicted long and actual long (6) ($N = 1{,}021$)	0.249	0.253	0.254	0.264	0.011 (0.00)	0.015 (0.00)
p-value of difference in changes (5) versus (6)					(0.25)	(0.24)
Predicted long and actual short (7) ($N = 497$)	0.289	0.292	0.284	0.275	−0.017 (0.00)	−0.014 (0.01)
Predicted short and actual short (8) ($N = 194$)	0.342	0.332	0.329	0.316	−0.016 (0.08)	−0.026 (0.02)
p-value of difference in changes (7) versus (8)					(0.95)	(0.29)

0.00). However, the change in DTD when both predicted and actual maturities are short is relatively small, although statistically significant. The changes in DTD between predicted long and actual short maturity and predicted short and actual short maturity are statistically different (with a *p*-value of 0.08).

Panel B of Table 8 examines changes in asset volatility for issuers whose maturity choice differs from what was predicted and for those who follow the predicted maturity choice. Firms that issue long-term debt when they were predicted to issue short-term debt experience an increase in their asset volatility (from 0.288 in the month of issuance to 0.310 2 years later). By contrast, when firms issue long-term debt and were predicted to issue long-term debt, we observe smaller increases in asset volatility. However, the differences in asset volatility for predicted short and actual long maturity versus predicted long and actual long maturity are not statistically different from each other. Firms that issue short-term debt experience a decline in their asset volatility. But again, we find no differences in changes in asset volatility for firms based on differences in their predicted maturity choices.

Overall, when firms issue debt with actual maturity that is different from the predicted choice, they experience a relatively larger change in DTD than they would if the actual maturity matches the predicted maturity. Similar patterns are observed for changes in asset volatility, but their statistical significance remains weak.

Table 9 extends these findings to a multivariate setting. We construct a new variable, *Actual − Predicted*, as an ordinal variable that takes a value between −2 and +2. It is the difference between actual maturity choice (1 = short-term, 2 = medium-term, and 3 = long-term) and predicted maturity choice, where the predicted maturity is estimated from a prediction model presented in Table B1. The predicted maturity choice also takes 3 values, 1 for short-term, 2 for medium-term, and 3 for long-term. Higher values of *Actual − Predicted* suggest that actual debt was of longer maturity even though the firm was predicted to issue shorter-maturity debt, and vice versa. The table shows that after controlling for changes in firm characteristics and interest rates, the difference between actual and predicted

TABLE 9

Deviations from Predicted Maturity and Default Risk Changes

Table 9 reports estimates from regressions of changes in default risk on the difference between actual and predicted maturity choice, changes in firm characteristics, and changes in interest rates. In columns (1) and (3), the dependent variable is the change in distance to default (DTD). In columns (2) and (4), the dependent variable is the change in asset volatility. Both changes are measured from the month of issuance to 24 months following issuance. The changes in firm characteristics similarly reflect changes from the fiscal year in which debt was issued to 2 years after. *Actual − Predicted* is the difference between actual maturity (1 = short-term, 2 = medium-term, and 3 = long-term) and predicted maturity. The predicted maturity is estimated from a prediction model presented in Table B1 and it also takes 3 values (1 = short-term, 2 = medium-term, and 3 = long-term). The probit coefficients are marginal effects. The standard errors reported in parentheses are corrected for heteroskedasticity and are clustered at the firm-year level. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	OLS		Probit	
	Dependent Variable			
	ΔDTD	$\Delta\sigma_A$	ΔDTD	$\Delta\sigma_A$
	Model			
Independent Variable	(1)	(2)	(3)	(4)
Actual − Predicted	−0.466***	0.011***	−0.049***	0.043***
	(0.113)	(0.003)	(0.012)	(0.013)
ΔFirm size	−0.193	0.059**	0.091	0.285***
	(0.370)	(0.024)	(0.066)	(0.062)
ΔMarket-to-book assets	0.356	0.012*	0.009	0.091***
	−0.271	−0.007	−0.028	−0.032
ΔLeverage	−11.223***	0.040	−1.938***	0.271**
	(0.762)	(0.056)	(0.162)	(0.112)
ΔProfit	2.104	−0.151**	0.066	−0.146
	(1.768)	(0.075)	(0.286)	(0.228)
ΔTangibility	−1.937	−0.096	0.183	−0.13
	(2.712)	(0.077)	(0.259)	(0.243)
Δ*CV* (*OI*)	−1.981**	0.110**	−0.215	−0.021
	(0.965)	(0.054)	(0.151)	(0.146)
ΔTreasury	−1.096***	0.032***	−0.130***	0.122***
	(0.122)	(0.004)	(0.016)	(0.017)
ΔBaa spread	−1.578***	0.042***	−0.175***	0.173***
	(0.150)	(0.005)	(0.018)	(0.021)
Industry fixed effects	Yes	Yes	Yes	Yes
Rating indicators	Yes	Yes	Yes	Yes
R^2/Pseudo-R^2	0.33	0.12	0.20	0.08
N	2,468	2,468	2,468	2,468

maturity choice is strongly related to issuer default risks in the next 2 years. When actual debt maturity is longer than predicted, DTD declines and asset volatility increases, suggesting that the market perceives significant increases in the firm's default risk in those cases. Conversely, when actual debt maturity is shorter than predicted, there is a substantial decline in the default risk.

VII. Debt Rating Migrations around Debt Issuances

This section examines debt rating migrations around debt issues for short- and long-term debt issuers. Since a firm's default risk is reflected in its ratings, any changes in default risk following debt issues should result in rating migrations. Asymmetric information models predict that firms issuing short-term debt will experience an improvement in their default risk, so their ratings should improve. By contrast, firms issuing long-term debt will experience a worsening in their default risk, so their ratings should decline.

However, it is also possible that ratings do not adjust completely even though default risk is changing. Several commentators claim that bond ratings are a noisy estimate of a firm's likelihood of default (see, e.g., Vassalou and Xing (2004)). Ratings are known to adjust slowly because rating agencies generally adopt a through-the-cycle approach, a policy that is aimed at avoiding excessive rating reversals. Thus, rating agencies disregard short-term fluctuations in default risk and only partially adjust rating to the actual level of the permanent component of default risk (see discussion in Cantor and Mann (2003), and Altman and Rijken (2004)). Furthermore, small changes in borrowers' financial default risk are unlikely to affect ratings because ratings follow a grid. Thus, we expect rating adjustments following debt issues to be less complete than adjustments in default risk based on DTD and asset volatility.

In evaluating rating migrations, we focus on unexpected migrations, that is, rating changes that are beyond those expected based on changes in firm characteristics and existing ratings (used as predictors of future rating changes). We implement this test in 2 steps. In the 1st step, we estimate expected rating changes by estimating a regression model of rating changes as a function of contemporaneous changes in firm characteristics, lagged firm characteristics, rating dummy variables, and year dummy variables. Then, in the 2nd step, we estimate and compare residuals, or unexpected rating migrations, for short- and long-term debt issuers.

To estimate expected rating migrations, we use S&P's long-term domestic issuer credit rating from Compustat for the period 1986–2005 for all rated firms. Rating scales are coded from 1 to 20, with 1 indicating a "CC/C" rating and 20 indicating an "AAA" rating. The higher the rating score, the lower the default risk. We remove financial firms (SIC codes 6000–6999) and utilities (codes 4900–4999) from the sample and then model rating migrations by estimating a rating change model that employs changes in firm characteristics, lagged values of firm characteristics, rating dummies, and year dummies as explanatory variables.

We expect changes in firm size to affect rating changes positively, since firms become more diversified as they get larger. Similarly, changes in profitability and cash holdings should also affect rating changes positively because default probabilities decline as profitability increases and as firms build up cash balances. Conversely, changes in leverage should affect rating changes negatively because leverage increases default risk. We also expect increases in the market-to-book assets ratio to affect ratings adversely, since growth firms have greater opportunities to increase risk. In addition, prior research suggests that existing ratings are significant determinants of future rating distributions and that the higher the current rating, the more likely it is for the issuer to stay in its current grade. Year dummy variables are included because macroeconomic conditions are expected to affect rating changes.

Table B2 in Appendix B presents results from regressions that examine changes in ratings over both 1- and 2-year horizons. The standard errors are clustered and adjusted for heteroskedasticity. The results show that the changes in firm characteristics are significantly related to changes in ratings and have the expected sign, with the exception of the changes in market-to-book assets ratio and the cash-to-assets ratio, which are generally insignificant. In particular, the regressions show that increases in firm size and profitability improve ratings, while increases in leverage make them worse.

We use the coefficient estimates from these regressions to estimate expected rating changes over 1- and 2-year horizons based on changes in firm characteristics, lagged firm characteristics, existing ratings, and year of issue. With these predicted rating changes, we estimate unexpected rating changes, or the residuals, as the difference between the actual rating change and the expected rating change for the debt issuers in our sample. We report both the actual and residual rating changes for short- and long-term issuers in Table 10. The table shows that actual rating changes are negative for both short- and long-term debt issuers in the post-issuance period. This confirms the well-documented fact that ratings have become more conservative over time (see Blume, Lim, and MacKinlay (1998), Baghai, Servaes, and Tamayo (2011)).[14] Importantly, the results suggest a relatively less

TABLE 10

Actual and Residual Rating Changes for Debt Issuers

Panel A of Table 10 presents actual and unexpected migrations for short- and long-term debt issuers for the period from the fiscal year before the issuance to the year of the issuance. Panel B presents migrations over the 2-year period (i.e., from the year before the issuance to the year after the issuance). Unexpected rating migrations are defined as the difference between actual and predicted rating changes, where predicted migrations are estimated from the rating change model presented in Table B2. The last column reports *p*-values from the tests of the null hypothesis of there being no difference in rating changes between short- and long-term issuers.

Maturity Class	Short-Term ($N = 727$)	Long-Term ($N = 1,107$)	Tests of Difference *p*-Value
Panel A. Rating Migration from 1 Year before Issuance to Issuance Year			
Actual rating change	−0.068	−0.139	0.03
Unexpected rating change	0.067	−0.056	0.00
Panel B. Rating Migration from 1 Year before Issuance to 1 Year after Issuance			
Actual rating change	−0.201	−0.246	0.33
Unexpected rating change	0.076	−0.086	0.00

[14]One-year migration rates over the period 1985–2006 for the broader sample of Compustat firms are −0.11, on average. This is consistent with earlier studies, which show that more firms have gotten downgraded than upgraded over time.

negative rating migration for short-term issuers than for long-term issuers over a 1-year horizon.[15]

The main focus of the test is on the residual, or unexpected, rating migrations. Over a 1-year horizon (from the year before the issuance to the year of issuance), short-term debt issuers experience relatively positive rating changes. The residual migration for short-term issuers is on average about 0.067 compared with −0.056 for the long-term issuers. In other words, the rating changes experienced by short-term issuers are substantially less negative than those predicted by a statistical model of rating change. On the contrary, the rating changes experienced by long-term debt issuers are substantially more negative than those predicted by such a model. The difference in the residual migrations between short- and long-term issuers is also statistically significant at the 1% level.

Panel B of Table 10 reports actual and unexpected migrations over a 2-year horizon, i.e., from the year before the issuance to the year after the issuance, and yields similar conclusions (residual migration of 0.076 for short-term issuers and −0.086 for long-term issuers). The differences in rating changes around issuances between short- and long-term debt issuers are also economically meaningful when compared with the average net migration of −0.11 for a broader sample of Compustat-rated firms. Overall, the results on rating migrations are consistent with the evidence reported earlier on DTD and asset volatility changes around debt issuances.

VIII. Conclusion

In this study 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 based 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 because firms expect to roll over this debt at a price that reflects the firm's condition at the time of refinancing. Thus, firms with favorable private information prefer short-term debt, and those with unfavorable private information prefer long-term debt. The key testable implication of these models is 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 2 market-based default risk measures, asset volatility and DTD, 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 default risk in the period immediately following the debt issue. In addition, the results on debt rating migrations show that short-term issuers experience positive residual rating changes, while long-term issuers experience negative residual rating changes.

[15]A tabulation of downgrades and upgrades of S&P's long-term issuer ratings for the sample of debt issuers shows a significantly greater frequency of downgrades among long-term debt issuers than among short-term debt issuers. Upgrades are less common and do not differ significantly among debt issuers classified by debt maturity.

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This study also examines 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 who were predicted to issue long-term debt. This decline is larger for this group of issuers than for the broader population of short-term debt issuers. We also find that default risk increases for long-term debt issuers who were predicted to issue short-term debt. Again, this increase is larger for this group of issuers than for the broader population of long-term debt issuers. Overall, our evidence strongly supports the predictions of the asymmetric information models of debt maturity choice.

Appendix A. Variable Definitions

DISTANCE TO DEFAULT (DTD): DTD = $[\ln(V_A/K) + (r - ½\sigma_A^2)T]/(\sigma_A\sqrt{T})$, where V_A is the value of assets, K is the short-term debt plus ½ of the long-term debt, r is the 1-year Treasury constant maturity rate, σ_A is the volatility of assets, and T is the forecast horizon taken to be 1 year. The estimation procedure is described in Section III.

σ_A: Volatility of asset values, estimated from the Black-Scholes (1973) model through an iterative procedure following Vassalou and Xing (2004).

FIRM SIZE: The natural logarithm of assets (item 6), where assets are deflated to constant year 2000 dollars.

LEVERAGE: Total debt/market value of assets estimated as the ratio of book value of debt (item 9 + item 34) to market value of assets (MVA), where 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).

MARKET-TO-BOOK ASSETS: Estimated as the ratio of market value of assets (MVA) to book value of assets (item 6).

PROFITABILITY: The ratio of operating income before depreciation (item 13) to assets (item 6).

TANGIBILITY: Estimated as the ratio of net property, plant, and equipment (item 8) to total assets (item 6).

CV(OI): The coefficient of variation of operating income (item 13) measured over a 3-year period using annual income statement data.

RATING: S&P's long-term issuer ratings (from Compustat). Numerical values are mapped to credit ratings as follows: 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.

TREASURY YIELD: Yield on a 1-year Treasury bill (source: http://www.federalreserve.gov/).

Baa SPREAD: The difference between yield on Baa-rated bonds and Aaa-rated bonds (source: http://www.federalreserve.gov/).

Appendix B. Debt Maturity Choice and Rating Migrations

In Appendix B, we report estimates from regressions predicting debt maturity choice and rating migrations. Table B1 reports estimates from a multinomial logit regression of debt maturity choice on leverage, the market-to-book assets ratio, firm size, asset maturity, abnormal earnings, income volatility, term spread, and regulatory industry indicator. Table B2 reports results from regressions that examine changes in ratings over 1- and 2-year horizons.

TABLE B1

Multinomial Logit Regressions Predicting Debt Maturity Choice

Table B1 reports estimates from a multinomial logit regression of debt maturity on leverage, the market-to-book assets ratio, firm size, firm size squared, asset maturity, abnormal earnings, income volatility, term spread, and regulatory industry indicator. The dependent variable is the debt maturity choice with long-term debt as the omitted category. Asset maturity is defined as the ratio of gross property, plant, and equipment (item 7) to depreciation (item 125). Abnormal earnings are 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 1 for firms in railroads (SIC code 4011), trucking (codes 4210 and 4213) through 1980, airlines (code 4512) through 1978, telecommunication (codes 4812 and 4813) through 1982, and gas and electric utilities (codes 4900 and 4939), and 0 otherwise. We define term spread as the difference between 1-year interest series and 10-year interest series (source: http://www.federalreserve.gov/). Other variables are defined in Appendix A. The regression also includes rating indicators, the coefficient estimates of which are suppressed. Numbers in parentheses are standard errors adjusted for heteroskedasticity and firm-year clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Independent Variable	Dependent Variable: Debt Maturity Class
Panel A. Short-Term Debt	
Leverage	−0.210
	(0.620)
Market-to-book assets	0.441***
	(0.115)
Firm size	−2.150***
	(0.575)
Firm size^2	0.138***
	(0.033)
Asset maturity	−0.025*
	(0.013)
Abnormal earnings	0.550
	(0.359)
CV (*OI*)	0.437
	(0.542)
Term spread	−0.057
	(0.056)
Regulatory industry	−0.195
	(0.326)
Panel B. Medium-Term Debt	
Leverage	2.092***
	(0.527)
Market-to-book assets	0.320***
	(0.104)
Firm size	−2.662***
	(0.428)
Firm size^2	0.149***
	(0.026)
Asset maturity	−0.030**
	(0.012)
Abnormal earnings	0.536
	(0.390)
CV (*OI*)	0.602
	(0.495)
Term spread	0.092
	(0.057)
Regulatory industry	−0.317
	(0.257)
Rating indicator variables	Yes
Pseudo-R^2	0.10
N	2,627

TABLE B2

Rating Migrations and Firm Characteristics

Table B2 reports estimates from a regression of rating migration on lagged firm characteristics in levels and in differences, rating indicators, and annual indicator variables. The rating migration is the change in S&P long-term issuer ratings obtained from Compustat, numerically mapped to a scale of 1–20 as described in Appendix A. The firm characteristics included are firm size, leverage, profit, market-to-book assets ratio, and cash-to-assets ratio. The sample period is 1986–2005. Numbers in parentheses are standard errors adjusted for heteroskedasticity and firm-year clustering. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

	Migration Over 1 Year	Migration Over 2 Years
	(1)	(2)
ΔFirm size	0.543***	0.718***
	(0.048)	(0.046)
ΔLeverage	−1.976***	−2.519***
	(0.111)	(0.122)
ΔProfitability	0.928***	1.418***
	(0.319)	(0.284)
ΔMarket-to-book assets	−0.020	−0.005
	(0.015)	(0.018)
ΔCash-to-assets	−0.054	−0.303*
	(0.136)	(0.180)
Firm size	−0.071***	−0.149***
	(0.006)	(0.012)
Leverage	−0.107**	0.088
	(0.042)	(0.081)
Profitability	0.757***	0.954***
	(0.144)	(0.235)
Market-to-book assets	0.010	0.030*
	(0.010)	(0.017)
Cash-to-assets	0.486***	0.938***
	(0.077)	(0.142)
Rating indicators	Yes	Yes
Year indicators	Yes	Yes
N	18,218	15,534
Adj. R^2	0.19	0.27

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