On the Maturity of Incremental Corporate Debt Issues

Michael J. Highfield*
Mississippi State University

Using a data source extensively researched in the equity IPO literature but not yet examined in the context of corporate debt maturity, we document the maturity of 10,617 corporate debt issues placed by U.S. corporations in public markets between January 1, 1983 and December 31, 1999. We investigate and test various theories from earlier studies regarding optimal debt maturity suggesting that debt maturity is influenced by signaling and asymmetric information, taxes, and agency problems. Our main finding is that firm quality is directly related to debt maturity. Although inconsistent with the signaling theory of debt, this finding does support the notion that risky firms are screened out of the long-term debt market.

Introduction

Firms are not only concerned with the amount of capital raised by a debt issue, but also with the timing of future cash flows that they use to return capital to bondholders. As noted by Guedes and Opler (1996), short-term debt allows firms to take advantage of information as it becomes public. It also can lead, however, to financial difficulty if the debt cannot be extended. Alternatively, long-term debt reduces the risk of liquidation, but it also can provide opportunities for underinvestment and risk shifting.

Using a data source that has been researched extensively in the equity IPO literature but not yet applied to the examination of the maturity of corporate debt, we document the determinants of the maturity of 10,617 corporate debt issues placed by U.S. corporations in public markets between January 1, 1983 and December 31,

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*I am extremely grateful for the numerous contributions to this paper by Brent W. Ambrose. Without him this work would be incomplete. I also thank an anonymous referee, Dwight Anderson, Chris Bollinger, Dan Bradley, John Gonas, Vance Lesseig, George McCabe (editor), William T. Moore, Donald Mullineaux, Ken Roskelley, Sandra Sizer (copy editor), Rohan Williamson, Margo Young (managing editor), Jenny Zhao, and seminar participants at the University of Kentucky, Louisiana Tech University, Mississippi State University, and the 2001 FMA international annual meeting for helpful comments and suggestions. All errors remain mine.

1939-8123/08/1300-0045 $0.250

1999 as recorded in the SDC new issues database. We investigate and test various theories from earlier studies regarding optimal debt maturity suggesting that debt maturity is influenced by signaling and asymmetric information, taxes, and agency problems. Thus, our results serve as a summary and robustness check to prior empirical studies in the area of debt maturity.

Our main finding is that firm quality, as measured by credit rating, is directly related to debt maturity. Although this finding is not consistent with a nonmonotonic structure in credit ratings and the signaling theory of debt, it does support the theory that risky firms are screened out of the long-term debt market. We also find evidence that supports a positive relation between the term structure and the maturity of debt issues, particularly for issues with fixed coupons. Although we do not find consistent results for the role of debt in mitigating agency problems, we do find evidence suggesting that debt maturity is inversely related to firm size. Finally, we find that regulated firms, excluding financial institutions, prefer long-term debt.

Literature Review and Hypotheses

Stiglitz (1974) analyzes the debt maturity question and shows that in a world without imperfections, assuming fully rational investors and managers, there is no optimal debt maturity. Introduction of market imperfections such as asymmetric information and signaling, taxes, or agency problems, however, leads to theories supporting preference for short-, intermediate-, or long-term debt.[1]

Signaling and Asymmetric Information

Flannery (1986) examines the maturity structure of a firm's risky debt using a model of uncertainty, with debt serving as a signal of credit quality. In Flannery's model, short-term debt signals an optimistic evaluation of the firm's prospects by insiders and long-term debt signals pessimism.[2] Also, Flannery's model shows that abnormally high refinancing costs will lead to a pooling equilibrium where high- and low-quality firms both issue long-term debt. Given a reasonable cost of debt issuance, however, a separating equilibrium develops in which low-quality firms self-select into long-term debt to avoid re-evaluation, but high-quality firms issue short-term debt because they can benefit from the refinancing process.

Diamond (1991) suggests that high-quality firms want to use short-term debt but face the risk that refinancing may be unavailable, thus forcing liquidation and loss of control. Diamond's model shows that the optimal maturity structure is decided by a trade-off between the preference for short-term debt due to an expected improvement in the firm's credit rating and greater liquidity risk. The key implication is a non-

[1]Please see Ravid (1996) for a detailed discussion of the debt maturity literature.
[2]Also see the debt maturity signaling models by Robbins and Schatzberg (1986) and Kale and Noe (1990).

monotonic structure in credit ratings. That is, there are two types of short-term borrowers: the high-rated borrowers who use short-term debt to take advantage of the arrival of information and the low-rated borrowers who are screened out of the long-term debt market. Thus, long-term bonds are issued by firms with intermediate ratings.

Diamond (1993) extends his previous work by developing an asymmetric information model where debt seniority is related to debt maturity.[3] Assuming that credit ratings are noisy signals of the quality of a firm's projects, lenders have two possible options: they can liquidate bad projects and deny the firm a chance to extract control rents or they can accept a promised payment at the end of the life of the project in return for pardoning the amount of currently due obligations. As a result, high-quality borrowers utilize short-term debt, because it can be refinanced as positive information is revealed. Low-quality borrowers prefer long-term debt because they hope that lenders will not want to liquidate. To avoid identifying themselves as low-quality borrowers, however, they imitate the high-quality borrowers by issuing debt at both ends of the maturity spectrum.

Under the assumption that firm quality is based on the quality of the firm's projects and that credit ratings serve as a proxy of firm quality, we construct two empirical tests for the relation between firm quality and debt maturity. First, we test the separating equilibrium hypothesis by comparing investment-grade issues with speculative-grade issues. In this case, the signaling hypothesis suggests that investment-grade issues should have shorter maturities than speculative-grade issues. Alternatively, the asymmetric information model suggests no differences between the bond rating groups.

Second, we test the hypothesis of a nonmonotonic maturity structure in credit ratings by comparing high- and low-rated issues to intermediate-rated issues. The asymmetric information theory suggests that both high- and low-rated issues should have shorter maturities than intermediate rated issues.

Taxes

Brick and Ravid (1985) assume that before-tax payments to bondholders are kept equal across maturity strategies. They suggest that taxes might affect the amount of leverage, but the maturity decision itself is irrelevant to the value of the firm. The introduction of personal taxes causes borrowers to seek accelerated interest payments to maximize the present value of a tax shield, however, but lenders seek to minimize the present value of their tax liability by delaying interest payments. The firm then seeks the optimal debt maturity, given the risk-adjusted term structure of interest rates. As a result, an increasing term structure renders long-term debt optimal because the value of the debt tax shield is highest under this scenario and vice versa.

[3]See Sharpe (1991) for a similar model.

Brick and Ravid (1991) find that a short-term debt maturity strategy is optimal if the effective slope of the term structure is sufficiently negative. A long-term debt strategy is optimal in most other cases, however. Empirically, Guedes and Opler (1996) contradict Brick and Ravid's results and find that the term premium is negatively related to the maturity of new corporate debt issues. We use data from the Federal Reserve Bank of St. Louis to test the theory that a positive relation exists between the term structure premium and the maturity of debt issues.

Agency Problems

Myers (1977) suggests that outstanding debt contracts may create agency problems that lead to either under-investment or risk shifting. Under-investment occurs when managers acting on behalf of shareholders fail to exercise profitable investment options because bondholders enjoy a reduction in the probability of default at the cost of shareholder returns. Given multiple investment opportunities, risk shifting occurs when shareholders prefer a more risky project because they do not bear the losses but accrue all of the gains.

Myers (1977) recommends matching debt and asset maturities to control agency conflicts between shareholders and bondholders. He also suggests that firms with a history of under-investment and a large number of growth opportunities, such as high-tech firms, firms with large market-to-book ratios, and firms with high research and development (R&D) expenditures, should include less debt in their capital structure, place restrictive covenants on debt issues, or shorten maturity of debt issues. Barnea, Haugen, and Senbet (1980) build on Myers' (1977) theory by suggesting that shortening the maturity of corporate debt can discipline firms and eliminate agency problems associated with information asymmetry, risk shifting, and Myers-type foregone growth opportunities.

While some firms struggle with agency problems and need the discipline imposed by short-term debt, other firms such as utilities and financial institutions are monitored by government and industry regulators. In an agency problem framework, Smith (1986) and Barclay and Smith (1995) suggest that regulations reduce managerial discretion and effectively control underinvestment, risk shifting, and asset substitution problems. Citing fewer growth opportunities, Smith (1986), Barclay and Smith (1995), Guedes and Opler (1996) and Krishnaswami, Spindit, and Subramaniam (1999) find that regulated firms issue long-term debt.

Although Johnson (2003) and Billett, King, and Mauer (2006) consider firm size as an exogenous control variable in their examination of leverage and maturity, Guedes and Opler (1996) suggest that small firms face higher business risk and are more likely to experience ratings downgrades.[4] Thus, based on Myers (1977), smaller firms in riskier businesses should attempt to lower and control agency costs

[4]See pages 1813 and 1825 in Guedes and Opler (1996).

of debt by issuing short-term debt. Although Scherr and Hulburt (2001) find that firm size is inversely related to debt maturity, Mitchell (1991), Barclay and Smith (1995), and Stohs and Mauer (1996) find a positive relation between debt maturity and firm size.

We construct three empirical tests for the relation between agency costs and debt maturity. First, we test the theory that firms with high growth opportunities prefer to use short-term debt to control agency problems using three distinct proxies of a firm's growth prospects: high tech firms, market-to-book ratios, and R&D expenditures as a percentage of sales.[5] Second, consistent with Smith (1986) and Barclay and Smith (1995), we test the proposition that regulated firms issue long-term debt. Finally, similar to Barclay and Smith (1995) and Stohs and Mauer (1996), we also test for a direct relation between firm size and issue maturity. This test is based on the suggestion of Myers (1977) and Guedes and Opler (1996) that small firms have more growth opportunities and should issue short-term debt to control agency problems.[6]

Data

We construct our sample from data contained in the Thomson Financial SDC Platinum U.S. Corporate New Issues database (SDC). The SDC database does not include bank debt and commercial paper. To ensure data accuracy, we restrict the sample to observations that are confirmed by Thompson Financial. We limit the sample to nonconvertible, unsecured, public debt offerings with maturities of at least one year, and we eliminate all observations where the issuing firm does not have a Moody's debt rating at the time of issue. We augment the information contained in the debt offerings by collecting annual research and development (R&D) expenditures, annual net sales figures, and market-to-book ratios from Compustat and term-structure data from the FRED® II database at the Federal Reserve Bank of St. Louis.

Table 1 shows the distribution of debt issues in the sample by year of issuance. The period 1983 to 1999 includes a number of changes in the bond market. For example, the high-yield market hardly existed in 1983, but it can be considered as mature by the late 1990s. Moreover, the heaviest volume of new issues in our sample occurred in 1997. This finding corresponds to the drop in interest rates in the late 1990s.

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[5]While controlling for high-tech firms is common as a measure of growth in IPO literature, we are not aware of any such applications to the study of debt maturity. Alternatively, market-to-book and R&D-to-sales ratios routinely have been used in previous debt maturity studies. For example, see Guedes and Opler (1996); Stohs and Mauer (1996); Johnson (2003); Barclay, Marx, and Smith (2003); and Billet, King, and Mauer (2006).
[6]This hypothesis is also consistent with the asymmetric information argument that larger firms are less opaque than their smaller counterparts; therefore, firm size and maturity should be directly related. In addition, other papers, such as Billet, King, and Mauer (2006), simply have considered firm size as a control variable.

Table 1–Time Distribution of Debt Issues

Issue Year	Number of Issues	Mean Maturity in Months		Median Maturity in Months	Minimum Maturity in Months	Maximum Maturity in Months
1983	28	49.11	(87.75)	24.00	12.00	144.00
1984	51	37.75	(79.71)	24.00	12.00	144.00
1985	82	44.21	(106.60)	24.00	12.00	240.00
1986	113	47.43	(117.68)	24.00	12.00	180.00
1987	72	38.60	(73.39)	36.00	12.00	144.00
1988	57	44.39	(83.91)	24.00	12.00	240.00
1989	226	66.79	(126.45)	24.00	12.00	602.00
1990	153	67.64	(151.91)	24.00	12.00	600.00
1991	364	95.25	(137.54)	84.00	12.00	480.00
1992	671	115.74	(148.31)	119.00	12.00	1,201.00
1993	781	137.88	(172.09)	120.00	12.00	1,206.00
1994	578	127.41	(160.04)	119.50	12.00	1,210.00
1995	1,003	141.06	(173.20)	120.00	12.00	1,206.00
1996	1,413	138.04	(172.70)	120.00	12.00	1,211.00
1997	2,067	151.86	(187.87)	120.00	12.00	1,212.00
1998	1,889	134.31	(168.14)	120.00	12.00	1,211.00
1999	1,069	137.18	(176.06)	120.00	12.00	1,212.00
Total	10,617	130.68	(170.47)	120.00	12.00	1,212.00

The sample contains 10,617 debt instruments placed in U.S. markets between January 1, 1983 and December 31, 1999. The table gives the total number of issues per year, mean maturity in months, median maturity in months, minimum maturity in months, and maximum maturity in months for each year and for the total sample. Means for the given year excluding debt issued by financial institutions (non-financial firms only) is shown in parentheses.

Interestingly, Guedes and Opler (1996) find that average maturities decline during their 12-year sample from approximately 204 months (17 years) in 1982 to about 120 months (10 years) by 1993. They postulate that this finding might reflect substitution away from short-term bank borrowing to short-term public borrowing. We find the opposite result for our 17-year sample. Instead, the mean maturity for our sample is just under 131 months (11 years), ranging from an average of just under 38 months (three years) in 1984 to a little less than 152 months (13 years) in 1997. For example, the average maturity for the first 12 years of our sample (1983–1994) is just over 73 months, far less than the 144-month average reported by Guedes and Opler (1996).[7]

Several issues may play a role in explaining the difference between our sample means by year and those reported by Guedes and Opler (1996). First, our requirement that all new issue information is confirmed by SDC dramatically reduces our sample size in the 1980s. Second, Guedes and Opler include nonregistered issues made in the Euro-Markets; thus, these bonds are not included in our sample due the requirement that the bond be issued in U.S. markets. Finally, Guedes and Opler do not include debt issues of financial institutions. The initial sample in this study does

[7]The average maturity for the last five years of our sample (1995–1999) is approximately 140 months.

include financial institutions, and the average maturity for financial institutions for the 12-year period from 1983 to 1994 is only 36 months versus 108 months for non-financial firms. Due to this large discrepancy and to maintain consistency with previous research, we repeat all regression analysis with a sub sample excluding financial institutions.

Table 2 presents the distribution of debt issues by maturity across Moody's bond ratings.[8] As expected for new bond issues, the sample contains relatively few high-yield rated bonds compared to the number of investment-grade bonds. The sample does not contain any observations with Ca, C, or D ratings. In general, as bond ratings decline, the mean term to maturity declines. Of the 8,958 bonds with an investment-grade rating, we find that 2,844 (32 percent) have maturities of 60 months or less, and 1,757 (20 percent) have maturities of 240 months or greater. Of the 1,659 bond issues with a speculative-grade rating, we find that 46 (3.0 percent) have maturities of 60 months or less, and 29 (2.0 percent) have maturities of 240 months or greater. Assuming that credit ratings serve as a proxy of firm quality, these findings are consistent with the notion that debt maturity is positively related to firm quality. Table 3 provides descriptive statistics for the sample.

Methods and Empirical Evidence

Although the debt maturity decision is one of several financial decisions that a firm determines simultaneously, as in MacKie-Mason (1990), our model can be justified by using a weak revealed preference restriction: conditional on borrowing from the public, each firm will select the debt maturity that contributes the most value to the firm.

The incremental approach is based on new bond issues as opposed to all liabilities on the firm's balance sheet. This approach is not well suited to test theories that relate debt maturity to the properties of the firm's assets because the maturity of an individual debt issue may be vastly different from the average maturity of the firm's other liabilities. Ravid (1996) notes, however, that most debt maturity theories were developed in a model in which a firm or entrepreneur decides to issue short- or long-term bonds to finance a project. For cases like this, the incremental approach is most appropriate. In addition, the incremental approach is suitable for testing theories that rely on state variables that either fluctuate substantially over time or tend to be issue-specific. Examples include signaling and term structure-based tax models; therefore, we use the incremental approach to test the debt maturity structure hypotheses outlined in the previous section using the following empirical models:

[8]Because there is a high correlation between Moody and S&P ratings, we focus our attention on Moody's ratings, but we note that the results are robust to the specification of credit agency.

$$\begin{aligned} \text{MATURITY}_i = \beta_0 &+ \beta_1 \text{ M-INVEST} + \beta_2 \text{ TERM}_i \\ &+ \beta_3 \text{ (HIGHTECH}_i \text{ or MBRATIO or RDRATIO)}_I \\ &+ \beta_4 \text{ REGULATE}_i + \beta_5 \text{ LNTCAP}_i + \text{Control Variables} \\ &+ \varepsilon_i, \end{aligned} \tag{1}$$

and

$$\begin{aligned} \text{MATURITY}_i = \beta_0 &+ \beta_1 \text{ M-HIGHRATE}_i + \beta_2 \text{ M-LOWRATE}_i \\ &+ \beta_3 \text{ TERM}_i + \beta_4 \text{ (HIGHTECH or MBRATIO or RDRATIO)}_i \\ &+ \beta_5 \text{ REGULATE}_i + \beta_6 \text{ LNTCAP}_i \\ &+ \text{Control Variables} + \varepsilon_i. \end{aligned} \tag{2}$$

We measure maturity (*MATURITY*) as an integer in terms of the number of months from the date of issue until final maturity. As used in equation 1, the proxy for firm quality is *M-INVEST*, a binary variable equal to one for bonds issued by firms with a Moody's Investment grade credit rating at the time of issue and zero otherwise. Turning to equation 2, we now proxy for firm quality using *M-HIGHRATE*, a binary variable equal to one for bonds issued by firms with a Moody's rating of Aaa, Aa, or A at the time of issue and zero otherwise, and *M-LOWRATE*, a binary variable equal to one for bonds issued by firms with a Moody's rating of B or Caa at the time of issue and zero otherwise. The inclusion of the *M-HIGHRATE* and *M-LOWRATE* variables allow for comparison to intermediate-rated bonds with Moody's ratings of Baa or Ba. *TERM* is difference between the yield on the 30-year Treasury bond and the one-year Treasury bill as of the date of issue.

To evaluate the impact of growth opportunities on debt maturity, we employ three variables. First, *HIGHTECH* is a binary variable equal to one for bonds issued by firms Thompson Financial considers to be in technologically advanced industries or zero otherwise. Second, *MBRATIO* is the natural logarithm of the issuing firm's market-to-book ratio at the time of issue. Third, *RDRATIO* is the ratio of research and development (R&D) expenditures to net sales in the year of issue as reported by Compustat expressed as a percentage. Turning away from growth measures, *REGULATE* is a binary variable equal to one for bonds issued by firms in government-regulated industries and zero otherwise. *LNTCAP* is the natural logarithm of the total capitalization of the issuing firm.

Table 2–Distribution of Debt Issues by Maturity across Moody's Bond Ratings

Maturity Range	Moody's Investment Grade Ratings				Moody's High Yield (Speculative) Grade Ratings						Total
(Months)	Aaa	Aa	A	Baa	Ba	B	Caa	Ca	C	D	
$12 \leq X < 24$	6	301	762	106	3	0	0	0	0	0	1,178
$24 \leq X < 60$	29	436	797	407	29	14	0	0	0	0	1,712
$60 \leq X < 84$	8	168	536	349	75	43	1	0	0	0	1,180
$84 \leq X < 120$	7	126	299	330	159	213	9	0	0	0	1,143
$120 \leq X < 240$	30	382	1,191	931	314	697	23	0	0	0	3,568
$240 \leq X < 360$	7	60	232	167	33	27	1	0	0	0	527
$360 \leq X$	30	257	577	427	17	1	0	0	0	0	1,309
Total	117	1,730	4,394	2,717	630	995	34	0	0	0	10,617
Mean Maturity in Months	177.62	125.77	124.07	148.07	119.32	122.97	120.47	–	–	–	130.68
S.D. of Maturity in Months	178.65	153.09	134.65	139.44	65.29	35.43	31.32	–	–	–	130.97

The sample contains 10,617 debt instruments placed in U.S. markets between January 1, 1983 and December 31, 1999. The table shows the distribution of the debt issues by Moody's bond rating across a series of maturity ranges. Maturity is expressed in terms of months from the time the bond is issued. We show the mean and standard deviation (S.D.) of maturity for each Moody's bond rating in months. The table also gives the total number of observations, sample mean maturity, and sample standard deviation of maturity for the entire sample.

Table 3–Sample Descriptive Statistics

Variable	Obs.	Mean (Binary=1)	Median	Minimum	Maximum	Std. Dev.
MATURITY	10,617	130.884	120.000	12.000	1,212.000	130.970
M-INVEST	10,617	0.844 (8,958)	1.000	0.000	1.000	–
M-HIGHYIELD	10,617	0.156 (1,659)	0.000	0.000	1.000	–
M-HIGHRATE	10,617	0.588 (6,241)	1.000	0.000	1.000	–
M-MIDRATE	10,617	0.315 (3,347)	0.000	0.000	1.000	–
M-LOWRATE	10,617	0.097 (1,029)	0.000	0.000	1.000	–
TERM	10,617	1.357	1.040	–0.560	4.370	1.001
HIGHTECH	10,617	0.119 (1,263)	0.000	0.000	1.000	–
MBRATIO	6,780	0.216	0.169	–4.913	11.166	0.941
RDRATIO	7,344	0.552	0.000	0.000	27.853	1.856
REGULATE	10,617	0.634 (6,731)	1.000	0.000	1.000	–
LNTCAP	10,617	8.664	8.749	–2.303	14.583	1.851
BANKING	10,617	0.428 (4,544)	0.000	0.000	1.000	–
FIXED	10,617	0.812 (8,621)	1.000	0.000	1.000	–
COUPON	8,618	7.395	7.000	0.000	17.500	1.809
MTN	10,617	0.357 (3,790)	0.000	0.000	1.000	–
SINKFUND	10,617	0.036 (382)	0.000	0.000	1.000	–
CALLABLE	10,617	0.217 (2,304)	0.000	0.000	1.000	–
PUTTABLE	10,617	0.027 (287)	1.000	0.000	1.000	–
SHELF415	10,617	0.809 (8,589)	1.000	0.000	1.000	–
MULTIPLE	10,617	0.668 (7,092)	0.000	0.000	1.000	–
YEAR (83–94)	10,617	0.299 (3,174)	0.000	0.000	1.000	–
YEAR (95–99)	10,617	0.701 (7,443)	1.000	0.000	1.000	–

Note: The sample contains 10,617 debt instruments placed in U.S. markets between January 1, 1983 and December 31, 1999. The table presents the descriptive statistics for the sample as the variable name, number of observations, mean, median, minimum, maximum, and standard deviation (S.D.). For each binary variable we provide the number of observations equal to one in parenthesis beside the mean. MATURITY is the final maturity of the bond issue in months. TERM is difference between the yield on the 30-year Treasury bond and the one-year Treasury bill in percentage points as of the date of issue. MBRATIO is the natural logarithm of the market-to-book ratio of the issuing firm at the time of issuance. RDRATIO is the ratio of research and development (R&D) expenditures to net sales in the year of issue as reported by Compustat expressed as a percentage. LNTCAP is the natural logarithm of the total capitalization of the issuing firm in millions. COUPON is the stated coupon rate for fixed-coupon bonds. M-INVEST and M-HIGHYIELD are binary variables equal to one for bonds issued by companies with Moody’s speculative-grade credit ratings, zero otherwise. M-HIGHRATE is a binary variable equal to one for bonds issued by firms rated as Aaa, Aa, or A by Moody’s at the time of issue, zero otherwise. M-MIDRATE is a binary variable equal to one for bonds issued by firms with a Moody’s rating of Baa or Ba at the time of issue, zero otherwise. M-LOWRATE is a binary variable equal to one for bonds issued by firms rated as B or Caa by Moody’s at the time of issue. HIGHTECH is a binary variable equal to one for bonds issued by firms Thompson Financial considers to be in technologically advanced industries. REGULATE is a binary variable equal to one for bonds issued by firms in government-regulated industries. BANKING is a binary variable equal to one for bonds issued by banking or financial firms. FIXED is a binary variable equal to one for fixed-coupon bonds, zero otherwise. MTN is a binary variable equal to one for medium-term notes. SINKFUND is a binary variable equal to one for issues with sinking-fund provisions. CALLABLE is a binary variable equal to one for callable bonds. PUTTABLE is a binary variable equal to one for puttable bonds. SHELF415 is a binary variable equal to one for shelf-registered issues. MULTIPLE is a binary variable equal to one for multiple issues from the same company during the sample period. The YEAR (XX–XX) variables are binary variables equal to one if the bond issue occurred during the labeled years, zero otherwise.

For each model we present results for subsamples unrestricted by coupon type (All Issues) and another subsample restricted to fixed-coupon issues (Fixed-Coupon Issues). We use a binary variable to control for differences between fixed- and variable-rate coupons (*FIXED*) for the All Issues sample. When we limit the analysis to bonds with fixed-coupons we include the coupon rate on the bond (*COUPON*) as a control variable. We also present results for a subsample unrestricted by issuer (All Issuers) and a subsample restricted to only nonfinancial firms (Nonfinancial Issuers) for both the All Issues and Fixed-Coupon Issues subsamples.

We use several control variables to control for structural differences in our data. For example, one would expect that Rule 415 issues will have longer maturities than non-shelf-registered issues; therefore, we include a binary variable (*SHELF415*) equal to one for shelf-registered issues and zero otherwise. As suggested by Bodie and Taggart (1978), almost all long-term bonds are given call provisions; thus, 2e also control for debt issued with embedded options using binary variables equal to one for the embedded option (*CALLABLE, PUTTABLE*) and zero otherwise.

Mitchell (1991) examines call, sinking fund, and maturity for a sample of 265 bonds issued from 1982 to 1986. In her sample she finds that 112 bonds have a sinking fund provision, and 95 of those bonds have a maturity of at least 20 years and only one had a maturity of less than 10 years. With this in mind, we control for issues with sinking-fund provisions using a binary variable (*SINKFUND*) equal to one if the bond has a sinking fund and zero otherwise. Mullineaux and Roten (2002) find that medium-term notes (MTNs) have much shorter maturities (6.0 years) than ordinary notes (8.8 years) and bonds (24.5 years); thus, we control for MTNs by including a binary variable (*MTN*) equal to one if the issue is an MTN issue and zero otherwise. We also control for multiple issues by the same firm using a binary variable (*MULTIPLE*) for repeat borrowers during the sample period. Finally, for the reasons discussed earlier, we include a binary variable (*YEAR (95–99)*) equal to one for bonds issued during the last half of the 1990s and zero otherwise.[9]

Due to the discrete nature of our dependent variable, we employ the negative binomial estimation method.[10] Because the coefficients for a negative binomial regression have no direct interpretation, we provide the marginal effects for each variable in our tables. We use White's (1980) heteroskedasticity-consistent standard errors (HCSEs) when determining statistical significance.

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[9]With the exception of *YEAR (95–99),* the coefficients for these control variables will be suppressed in our presentation of the results.

[10]The Poisson estimation method often is employed in cases where the dependent variable is a discrete integer or count variable. The Poisson goodness of fit test for our data, however, is significant using both the deviance statistic and the Pearson statistic, a result consistent with overdispersion. Thus, we rely on the negative binomial estimation method. The findings presented here are robust to the estimation method employed and consistent with the results obtained using an ordinary least squares (OLS) estimation method.

Signaling and Asymmetric Information

Equation 1 allows us to test the separating equilibrium hypothesis. We compare investment-grade issues to speculative-grade issues by including a binary variable for investment grade issues (*M-INVEST*). Table 4 provides these results. The signaling hypothesis is confirmed if investment-grade issues have shorter maturities than speculative-grade issues.

Unlike Stohs and Mauer (1996), we do not find evidence supporting Flannery's (1986) signaling hypothesis, nor do we find evidence supporting Diamond's (1993) asymmetric information model. Instead, our results suggest that investment-grade firms issue debt with maturities significantly longer than their high-yield counterparts. For example, the *M-INVEST* coefficient estimate for the full sample indicates that investment grade bonds have maturities that are approximately 50 months longer than high-yield bonds. Consistent with Guedes and Opler (1996), we do not find evidence that bond issuers trade their desire for short-term debt to avoid refinancing risk. Instead, the firms least susceptible to refinancing risk, such as highly rated firms, are the ones issuing long-term debt.

Equation 2 allows us to examine Diamond's (1991) hypothesis that a nonmonotonic maturity structure exists in credit ratings. We compare high- and low-rated issues to intermediate-rated issues by including *M-HIGHRATE,* a binary variable that denotes bonds rated as Aaa, Aa, or A at the time of issue, and *M-LOWRATE,* a binary variable that denotes bonds rated as B or Caa at the time of issue.[11] These results are provided in Table 5. We find that on average, high-rated firms tend to issue debt with maturities longer than debt issued by middle-rated companies, and low-rated firms tend to issue debt with maturities shorter than debt issued by middle-rated companies. For example, the results for the full sample show high-rated debt issues have maturities that are 10.6 months longer than mid-rated debt issues, and low-rated bond maturities are 40.4 months shorter than mid-rated bonds.

This direct relation between credit ratings and term to maturity is not consistent with the hypothesis that there is a nonmonotonic structure in credit ratings, nor is it consistent with the signaling hypothesis. Our evidence supports the hypothesis that risky firms are screened out of the long-term debt market.

Taxes

We examine the theory that maturity varies with the term structure by including the difference between the yield on the 30-year Treasury bond and the one-year Treasury bill as of the date of issue (*TERM*). As mentioned previously, this hypothesis is based on the implicit assumption that the Treasury yield curve is an acceptable proxy for the corporate yield curve.

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[11]Bonds rated as Baa or Ba at the time of issue are the reference category, and the results are robust to alternative specifications; for example, including just Baa or just Ba as the reference.

We assume that the risk premium is either flat or increasing across maturities. By assuming an upward-sloping yield curve, our measurement of the term structure understates the Brick and Ravid (1985) tax effect. Alternatively, under a downward-sloping yield curve, either a constant risk premium or downward-sloping risk premium creates a downward bias in our variable. We note that there are two cases in which our measurement may be inappropriate. The first is an upward-sloping yield curve in the unlikely case that the risk premium is sufficiently large for short-term debt and then declines with maturity, causing a downward sloping corporate term structure. The second is a downward-sloping yield curve where risk premiums increase dramatically across maturities, causing an upward-sloping corporate term structure.[12]

Consistent with Guedes and Opler (1996), the coefficient estimates for *TERM* are positive and significant when we consider all types of issuers. For example, an increase of one percentage point in the term structure leads to a 4.9 month-longer maturity. After removing financial firms from the sample, however, the *TERM* coefficient estimate is only significant when we limit the sample to fixed-coupon issues. For fixed-rate, nonfinancial debt, an increase of one percentage point in the term structure leads to a two-month increase in maturity. Thus, our general finding is that the term structure is important for fixed-coupon issues as opposed to variable-coupon issues.

Agency Problems

We use a binary variable for SDC-classified high-tech firms (*HIGHTECH*) to test the theory that firms with high growth opportunities prefer short-term debt to control agency problems. This variable is similar to the growth firm proxy common to studies in the equity IPO literature.

We find positive and significant coefficient estimates when we consider all types of issuers, but we find negative and significant coefficient estimates once we exclude financial firms. As an alternative specification, based on the work of Barclay, Marx, and Smith (2003) and Billett, King, and Mauer (2006), we also test the agency problem hypothesis with more traditional measure of growth, the market-to-book ratio *(MBRATIO*) and the ratio of research and development (R&D) expendi tures to sales (*RDRATIO*). While we find weak statistical significance for the *RDRATIO* variable in the full sample, the general findings for the market-to-book and R&D-to-sales ratios are generally insignificant in a statistical and economic sense. Results for *MBRATIO* and *RDRATIO* are suppressed in Tables 5 and 6 to conserve space.

[12]The results presented here are robust to the calculation of the term structure premium proxy.

Table 4–Negative Binomial Regression Results for Investment-Grade Ratings as Compared to Speculative-Grade Ratings, 1983–1999

	All Issues						Fixed Coupon Issues					
	All Issuers			Nonfinancial Issuers			All Issuers			Nonfinancial Issuers		
INTERCEPT	5.24**	5.39**	5.39**	4.90**	5.05**	5.07**	5.54**	5.70**	5.61**	4.34**	4.30**	4.41**
	(75.90)	(51.37)	(62.68)	(67.17)	(42.19)	(47.36)	(54.33)	(36.83)	(45.33)	(37.31)	(22.32)	(26.18)
M-INVEST	0.50**	0.52**	0.50**	0.49**	0.53**	049**	0.39**	0.39**	0.39**	0.52**	0.59**	0.53**
	(19.06)	(14.00)	(15.46)	(18.44)	(14.78)	(14.97)	(13.41)	(9.87)	(11.34)	(17.11)	(13.74)	(14.02)
	[49.66]	[45.55]	[50.21]	[71.33]	[71.46]	[72.91]	[42.83]	[39.97]	[44.92]	[78.15]	[80.78]	[80.95]
TERM	0.08**	0.08**	0.06**	0.01	0.01	0.01	0.10**	0.11**	0.09**	0.06**	0.05**	0.04*
	(4.86)	(3.03)	(3.14)	(0.61)	(0.19)	(0.30)	(5.55)	(3.82)	(4.08)	(3.58)	(2.85)	(2.28)
	[9.55]	[8.31]	[7.89]	[1.66]	[0.93]	[1.40]	[12.37]	[12.92]	[12.32]	[7.28]	[6.48]	[6.46]
HIGHTECH	0.14**			-0.05			0.09**			-0.06*		
	(4.79			(-2.02)			(2.65)			(-2.04)		
	[17.70]			[-9.40]			[11.69]			[-10.23]		
MBRATIO		0.02			0.03			0.01			0.03	
		(1.90)			(1.42)			(0.86)			(1.34)	
		[2.59]			[8.19]			[1.38]			[5.09]	
RDRATIO			0.02*			0.01			0.01			0.01
			(2.46)			(1.72)			(1.71)			(1.21)
			[2.01]			[2.02]			[1.60]			[1.62]
REGULATE	-0.27**	-0.33**	-0.28**	0.07**	0.07*	0.07**	0.22**	-0.25**	0.21**	0.07**	0.05**	0.06**
	(-13.18)	(-12.49)	(-11.62)	(3.47)	(2.37)	-2.64	(-9.72)	(-7.97)	(-7.74)	(3.15)	(2.73)	(2.68)
	[-32.52]	[-37.52]	[-35.19]	[11.47]	[11.10]	[12.37]	[-28.03]	[-30.13]	[-28.60]	[11.49]	[8.88]	[11.27]
LNTCAP	-0.09**	-0.11**	-0.09**	-0.05**	-0.04**	-0.03**	-0.06**	-0.06**	-0.06**	-0.05**	-0.02**	-0.02**
	(-13.96)	(-11.85)	(-12.89)	(-4.56)	(-3.35)	(-2.80)	(-8.63)	(-6.19)	(-6.78)	(-4.21)	(-2.98)	(-2.42)
	[-10.63]	[-11.36]	[-11.69]	[-8.30]	[-6.18]	[-4.91]	[-7.60]	[-7.08]	[-7.60]	[-6.85]	[-5.68]	[-4.84]
YEAR (95-99)	0.26**	0.29**	0.24**	0.22**	0.22**	0.22**	0.29**	0.35**	0.30**	0.25**	0.24**	0.07**
	(6.45)	(4.88)	(5.10)	(3.85)	(2.96)	(2.67)	(6.57)	(4.96)	(5.35)	(4.01)	(3.93)	(2.95)
	[29.17]	[23.57]	[28.19]	[14.27]	[13.42]	[12.99]	[35.16]	[39.26]	[37.73]	[18.62]	[17.17]	[15.51]
Observations	10,617	6,780	7,344	6,075	3,738	4,043	8,618	5J98	5,630	5,264	3.138	3,396
Wald Chi-Square	2,396**	1,797**	2,128**	1,136**	522**	591**	2,327**	1,828**	2,026**	1,092**	527**	573**
Pseudo R^2	0.35	0.30	0.31	0.11	0.10	0.09	0.33	0.30	0.28	0.10	0.11	0.09

Note: The sample contains 10,617 debt instruments placed in U.S. markets between January 1, 1983 and December 31, 1999. “All Issues” defines the unconstrained sample of variable and fixed coupons. We define “Fixed-Coupon Issues” as fixed-coupon issues only. “All Issuers” defines all issuers in the sample. We define “Nonfinancial Issuers” as nonfinancial issuing firms. The dependent variable for all regressions is the final maturity of the issue in months. M-INVEST is a binary variable equal to one for bonds issued by firms with a Moody’s Investment grade credit rating at the time of issue, zero otherwise. TERM is difference between the yield on the 30-year Treasury bond and the one-year Treasury bill as of the date of issue. HIGHTECH is a binary variable equal to one for bonds issued by firms Thompson Financial considers to be in technologically advanced industries, zero otherwise. MBRATIO is the natural logarithm of the issuing firm’s market-to-book ratio at the time of issue. RDRATIO is the ratio of research and development (R&D) expenditures to net sales in the year of issue as reported by Compustat expressed as a percentage. REGULATE is a binary variable equal to one for bonds issued by firms in government-regulated industries, zero otherwise. LNTCAP is the natural logarithm of the total capitalization of the issuing firm. YEAR (95–99) is a binary variable set equal to one if the bond issue occurred from January 1, 1995 through December 31, 1999, zero otherwise. The control variables (not presented) consist of binary variables for medium-term notes, for issues with sinking-fund provisions, for callable bonds, for puttable bonds, for shelf-registered issues, and for multiple issues from the same company. We control for fixed-coupon issues in the “All Issues” sample. We control for coupon rates in the “Fixed-Coupon Issues” sample. We calculate the z-statistics for each coefficient estimate, reported in the parentheses, by using White’s (1980) heteroskedasticity-consistent standard errors (HCSEs). The number in brackets is the marginal effect of the variable on MATURITY where we set all dependent variables equal to their means and increase the variable by one unit. For binary independent variables we calculate the marginal effect as the discrete change from zero to one. The table gives the number of observations and Wald Chi-Square statistics for each model. Statistical significance is displayed by the use of one (5%) or two (1%) superscript stars (*).

Table 5-Negative Binomial Regression Results for High- and Low-Rated Firms as Compared to Mid-Rated Firms, 1983-1999

	All Issues						Fixed Coupon Issues					
	All Issuers			Nonfinancial Issuers			All Issuers			Nonfinancial Issuers		
INTERCEPT	5.61**	5.81**	5.79**	5.15**	5.37**	5.39**	5.81	5.97**	5.90**	4.57**	4.54**	4.65**
	(70.18)	(49.10)	(59.27)	(60.21)	(40.71)	(45.72)	(54.19)	(37.52)	(45.49)	(38.01)	(23.25)	(27.03)
M-HIGHRATE	0.09**	0.15**	0.10**	0.25**	0.31**	0.25**	0.07**	0.14**	0.10**	0.27**	0.33**	0.28**
	(4.23)	(5.16)	(3.97)	(10.70)	(10.13)	(9.45)	(3.12)	(4.80)	(3.83)	(10.64)	(9.92)	(9.39)
	[10.61]	[15.50]	[11.76]	[41.92]	[48.89]	[44.48]	[8.84]	[16.54]	[13.20]	[46.66]	[55.11]	[50.89]
M-LOWRATE	-0.40**	0.41**	044**	-0.26**	0.30**	-0.30**	-0.26**	-0.25**	-0.28**	-0.28**	-0.35**	-0.33**
	(-14.17)	(-9.76)	(-11.87)	(-9.98)	(-7.79)	(-8.55)	(-9.26)	(-5.96)	(-7.32)	(-9.35)	(-7.54)	(-7.99)
	[-40.41]	[-37.22]	[-44.54]	[-39.30]	[-42.49]	[-46.81]	[-30.05]	[-26.15]	[-33.73]	[-42.64]	[-50.83]	[-52.42]
TERM	0.08**	0.08**	0.07**	0.02	0.02	0.02	0.10**	0.12**	0.09**	0.04*	0.07*	0.06**
	(4.85)	(3.15)	(3.22)	(1.14)	(0.76)	(0.74)	(5.54)	(3.98)	(4.15)	(2.22)	(1.97)	(2.01)
	[9.63]	[8.78]	[8.21]	[3.16]	[3.73]	[3.55]	[12.50]	[13.69]	[12.75]	[6.59]	[11.21]	[10.20]
HIGHTECH	0.15**			-0.06*			0.09**			-0.07*		
	(4.91)			(-2.23)			(2.68)			(-2.47)		
	[18.27]			[-10.00]			[11.88]			[-12.12]		
REGULATE	-0.26**	-0.32**	-0.27**	0.09**	0.09**	0.08**	-0.20**	-0.24**	-0.20**	0.08**	0.07*	0.08**
	(-12.53)	(-12.11)	(-11.33)	(4.17)	(3.05)	(3.15)	(-9.08)	(-7.68)	(-7.46)	(3.76)	(2.43)	(2.62)
	[-31.23]	[-36.26]	[-34.40]	[14.51]	[14.68]	[15.21]	[-26.53]	[-28.87]	[-27.71]	[14.14]	[12.78]	[13.99]
LNTCAP	-0.09**	0.12**	-0.10**	-0.02**	0.05	-0.04**	-0.06**	-0.07**	-0.06**	-0.04**	-0.04**	-0.03**
	(-14.15)	(-12.48)	(-13.19)	(-2.75)	(-4.53)	(-3.95)	(-8.5 1)	(-6.47)	(-7.05)	(-3.19)	(-2.94)	(-2.65)
	[-11.11]	[-12.47]	[-12.41]	[-3.42]	[-8.48]	[-6.99]	[-7.70]	[-8.02]	[-8.11]	[-4.74]	[-6.21]	[-4.78]
YEAR (95-99)	0.27**	0.31**	0.26**	0.21**	0.20**	0.20**	0.31**	0.38**	0.31**	0.29*	0.24*	0.25*
	(6.67)	(5.14)	(5.34)	(2.69)	(2.66)	(2.66)	(6.73)	(5.23)	(5.54)	(2.07)	(2.00)	(2.06)
	[30.52]	[31.60]	[30.01]	[14.91]	[14.40]	[14.52]	[36.64]	[41.96]	[39.81]	[15.03]	[9.77]	[21.62]
Observations	10,617	6,780	7,344	6,075	3,738	4,043	8,618	5,198	5,630	5,264	3.138	3,396
Wald Chi-Square	2,304	734**	2,056**	1,256**	593**	676**	2,326**	1,818**	1,992	1,197**	567**	624
Pseudo R	0.32	0.29	0.30	0.12	0.12	0.11	0.33	0.29	0.32	0.12	0.11	0.11

Note: The sample contains 10,617 debt instruments placed in U.S. markets between January 1, 1983 and December 31, 1999. “All Issues” defines the unconstrained sample of variable and fixed coupons. We define “Fixed-Coupon Issues” by fixed-coupon issues only. “All Issuers” defines all issuers in the sample. We define “Nonfinancial Issuers” as nonfinancial issuing firms. The dependent variable for all regressions is the final maturity of the issue in months. M-HIGHRATE is a binary variable equal to one for bonds issued by firms with a Moody’s rating of Aaa, Aa, or A at the time of issue, zero otherwise. M-LOWRATE is a binary variable equal to one for bonds issued by firms with a Moody’s rating of B or Caa at the time of issue, zero otherwise. TERM is difference between the yield on the 30-year Treasury bond and the one-year Treasury bill as of the date of issue. HIGHTECH is a binary variable equal to one for bonds issued by firms the SDC considers to be in technologically-advanced industries, zero otherwise. MBRATIO is the natural logarithm of the issuing firm’s market-to-book ratio at the time of issue. RDRATIO is the ratio of research and development (R&D) expenditures to net sales in the year of issue as reported by Compustat expressed as a percentage. MBRATIO and RDRATIO coefficients are not reported to conserve space due to lack of significance in all models considered except one (RDRATIO, All Issues, All Issuers). REGULATE is a binary variable equal to one for bonds issued by firms in government-regulated industries, zero otherwise. LNTCAP is the natural logarithm of the total capitalization of the issuing firm. YEAR (95–99) is a binary variable set equal to one if the bond issue occurred between January 1, 1995 and December 31, 1999, zero otherwise. The control variables (not presented) consist of binary variables for medium-term notes, for issues with sinking-fund provisions, for callable bonds, for puttable bonds, for shelf-registered issues, and for multiple issues from the same company. We control for fixed-coupon issues in the “All Issues” sample, and for coupon rates in the “Fixed-Coupon Issues” sample. We calculate the z-statistics for each coefficient estimate, reported in the parentheses, by using heteroskedasticity-consistent standard errors (HCSEs). The number in brackets is the marginal effect of the variable on MATURITY where we set all dependent variables equal to their means and increase the variable by one unit. For binary independent variables we calculate the marginal effect as the discrete change from zero to one. Statistical significance is displayed by the use of one (5%) or two (1%) superscript stars (*).

Table 6—Negative Binomial Regression Results for High- and Low-Rated Firms as Compared to Mid-Rated Firms, 1990—1999

	All Issues						Fixed Coupon Issues					
	All Issuers			Nonfinancial Issuers			All Issuers			Nonfinancial Issuers		
INTERCEPT	5.65**	5.90**	5.88**	5.17**	5.45**	5.45**	5.74**	6.04**	5.95**	4.42**	4.37**	4.51**
	(61.65)	(44.25)	(52.76)	(55.13)	(38.13)	(42.69)	(45.84)	(34.56)	(41.8)	(33.98)	(20.12)	(24.04)
M-HIGHRATE	0.10**	0.16**	0.11**	0.25**	0.30**	0.25**	0.09**	0.15**	0.11**	0.28**	0.34**	0.29**
	(4.58)	(5.52)	(4.30)	(10.65)	(10.04)	(9.35)	(3.65)	(5.02)	(4.07)	(10.92)	(10.17)	(9.60)
	[12.29]	[17.62]	[13.41]	[42.15]	[48.96]	[44.44]	[11.55]	[19.17]	[15.24]	[48.17]	[57.02]	[52.40]
M-LOWRATE	-0.42**	-0.42**	-0.44**	-0.28**	-0.32**	-0.32**	-0.29**	-0.26**	-0.30**	-0.3l**	-0.40**	-0.37**
	(-15.43)	(-10.01)	(-12.07)	(-10.45)	(-8.10)	(-8.84)	(-9.68)	(-5.71)	-7.46	(-10.39)	(-8.41)	(-8.78)
	[-44.45]	[-40.30]	[-47.42]	[-41.90]	[-45.21]	[-49.45]	[-35.42]	[-29.92]	[-37.92]	[-47.18]	[-57.10]	[-57.73]
TERM	0.04*	0.03*	0.03*	0.02	0.01	0.01	0.10**	0.11**	0.08**	0.04*	0.05*	0.04*
	(2.05)	(2.02)	(2.03)	(0.78)	(0.08)	(0.03)	(5.05)	(3.69)	(3.43)	(2.04)	(1.98	(2.02
	[5.28]	[4.51]	[4.86]	[2.59]	[0.44]	[0.16]	[13.69]	[14.25]	[12.22]	[6.98]	[7.97]	[7.05]
HIGHTECH	0.13**			-0.07*			0.07*			-0.07*		
	(4.44)			(-2.33)			(2.26)			(-2.47)		
	[17.04]			[-10.62]			[13.69]			[-12.25]		
REGULATE	-0.23**	-0.30**	-0.25**	0.09**	-0.10**	0.09**	-0.19**	-0.22**	-0.19**	0.09**	0.08**	0.08**
	(-11.63)	(-11.26)	(-10.54)	(4.23)	(3.27)	(3.33)	(-8.69)	(-7.28)	(-7.06)	(3.94)	(2.71)	(2.90)
	[-30.40]	[-35.24]	[-33.69]	[14.96]	[16.03]	[16.32]	[-26.92]	[-28.92]	[-27.96]	[15.04]	[14.49]	[15.76]
LNTCAP	-0.09**	-0.12**	-0.09**	-0.02*	-0.05**	-0.04**	-0.06**	-0.07**	-0.07**	-0.02*	-0.04**	-0.03*
	(-13.73)	(-12.40)	(-13.07)	(-2.49)	(-4.51)	(-3.89)	(-8.63)	(-6.97)	(-7.26)	(-2.25)	(-2.85)	-2.31
	[-11.50]	[-13.24]	[-12.98]	[-3.40]	[-8.54]	[-6.95]	[-8.46]	[-9.11]	[-8.97]	[-3.98]	[-6.08]	[-4.61]
YEAR (95-99)	0.17**	0.19**	0.15**	0.16**	0.15**	-0.13**	0.29**	0.35**	0.28**	0.10*	0.11*	0.09*
	(3.39)	(2.64)	(2.60)	(3.52)	(3.36)	(2.98)	(5.90)	(4.68)	(4.54)	(2.04)	(2.25)	(1.98)
	[20.47]	[20.47]	[18.78]	[17.32]	[16.25]	[14.58]	[37.68]	[41.94]	[37.52]	[16.78]	[17.41]	[16.22]
Observations	9,988	6,388	6,943	5,936	3,670	3,976	8,066	4,868	5,293	5,152	3,095	3,354
Wald Chi-Square	1,759**	1,341**	1,607	1,250**	583**	669**	1,323**	1,050**	1,168	1,164**	532**	592
Pseudo R	0.38	0.33	0.36	0.29	0.21	0.20	0.37	0.31	0.34	0.24	0.19	0.19

Note: This subsample contains 9,988 debt instruments placed in U.S. markets between January 1, 1990 and December 31, 1999. "All Issues" defines the unconstrained sample of variable and fixed coupons. We define "Fixed-Coupon Issues" as fixed-coupon issues only. "All Issuers" defines all issuers in the sample. We define "Nonfinancial Issuers" as nonfinancial issuing firms. The dependent variable for all regressions is the final maturity of the issue in months. M-HIGHRATE is a binary variable equal to one for bonds issued by firms with a Moody's rating of Aaa, Aa, or A at the time of issue, zero otherwise. M-LOWRATE is a binary variable equal to one for bonds issued by firms with a Moody's rating of B or Caa at the time of issue, zero otherwise. TERM is difference between the yield on the 30-year Treasury bond and the one-year Treasury bill as of the date of issue. HIGHTECH is a binary variable equal to one for bonds issued by firms the SDC considers to be in technologically advanced industries, zero otherwise. MBRATIO is the natural logarithm of the issuing firm's market-to-book ratio at the time of issue. RDRATIO is the ratio of research and development (R&D) expenditures to net sales in the year of issue as reported by Compustat. MBRATIO and RDRATIO coefficients are not reported to conserve space due to lack of significance in all models considered except one (RDRATIO, All Issues, All Issuers). REGULATE is a binary variable equal to one for bonds issued by firms in government-regulated industries, zero otherwise. LNTCAP is the natural logarithm of the total capitalization of the issuing firm. YEAR (95–99) is a binary variable set equal to one if the bond issue occurs between January 1, 1995 and December 31, 1999, zero otherwise. The control variables (not presented) consist of binary variables for medium-term notes, for issues with sinking-fund provisions, for callable bonds, for puttable bonds, for shelf-registered issues, d for multiple issues from the same company. We control for fixed-coupon issues in the "All Issues" sample. We control for coupon rates in the "Fixed-Coupon Issues" sample. We calculate the z-statistics for each coefficient estimate, reported in the parentheses, using heteroskedasticity-consistent standard errors (HCSEs). The number in brackets is the marginal effect of the variable on MATURITY where we set all dependent variables equal to their means and increase the variable by one unit. For binary independent variables we calculate the marginal effect as the discrete change from zero to one. Statistical significance is displayed by the use of one (5%) or two (1%) superscript stars (*).

We also test the theory that regulated firms prefer long-term debt. We do so by using a binary variable for regulated firms (*REGULATE*). We find that regulated firms prefer long-term debt, with one exception: financial institutions. Once we exclude financial institutions, our results indicate that regulated firms tend to issue debt with maturities four months longer than that of nonregulated firms. This finding supports the hypothesis that government regulation effectively can control agency problems such as underinvestment, risk shifting, and asset substitution.

Because small firms have more growth opportunities and should issue short-term debt to control agency problems, we use the natural logarithm of total capitalization (*LNTCAP*) to test for a direct relation between firm size and issue maturity. Regardless of sample selection, we find that larger firms tend to issue short-term debt. For example, in a full sample model we find that an increase of 1.0 percent in firm size leads to a decrease in maturity of 11 months. This finding is not consistent with Myers' (1977) hypothesis.

A Note on the Sample Time Period

During the late 1990s there was an increase in equity issuance and a general increase in the market value of corporate equity coupled with relatively low interest rates. Higher equity prices can affect the bond market in two ways. First, a rise in equity prices can lead a firm to issue debt to maintain a relatively stable debt-to-equity ratio. Second, large increases in equity accounts can lead to an increase in the number of investors who wish to purchase bonds for portfolio diversification.

Because of the changes in the bond market during the late 1990s, we include the binary variable *YEAR (95–99)* to test for maturity changes specifically attributable to the 1995–1999 period. The coefficient estimates for this variable are positive and significant in each model specification. This finding indicates that the bubble of the late 1990s not only contained more issues, but the results from the all issuers model suggests that those issues had maturities 30.5 months longer than bonds issued between 1983 and 1994.

Robustness Issues

Three data issues may bias our analysis. The first involves the data collection process used by SDC. The second concerns the presence of regulated firms in the database, specifically financial firms. The third results from the inclusion of fixed- and floating-rate debt in the sample.

During the 1980s Thompson Financial received all new-issues information from investment banks through paper reports. This format allowed for additional data entry error and made it difficult to confirm new-issues information with either outside sources or the underwriter. In the 1990s most investment banks transferred new-issues information to Thompson Financial in electronic form. Doing so not only increased the speed of data entry into the SDC database, but it also increased the number of observations listed as confirmed in the database. Because we limit our sample to confirmed information, it is possible that the 1980s data are biased in favor of new issues underwritten by larger investment banks. In Table 6 we repeat the estimation of equation 2, this time using only debt instruments issued after January 1, 1990. The results are fundamentally identical to the results presented in Table 5.

A portion of the liabilities of many financial institutions are secured by some form of government insurance to protect from fraud, default, or other failure. Although using Moody's ratings helps alleviate this problem, the differences between nonfinancial firms and financial institutions extend beyond debt ratings. We account for the unique aspects of financial institutions by presenting regression results for all issuers and a sample restricted to nonfinancial firms.

Because Brick and Ravid (1985) base their theory on the corporate term structure, and the term structure going forward is not clear in the case of floating debt, we expect to find weak results for variable rate debt and relatively strong results for fixed rate debt. Thus, we account for differences between fixed rate and variable rate debt issues by presenting regression results for all issues controlling for variable-rate debt and a sub sample restricted to fixed rate issues controlling for the coupon rate of the issue.

Conclusion

Using a data source that has been researched extensively in the equity IPO literature but not yet applied to the examination of the maturity of corporate debt, we document the determinants of the maturity of 10,617 corporate debt issues placed by U.S. corporations in public markets between January 1, 1983 and December 31, 1999 as recorded in the SDC new issues database. We use the incremental debt issue approach and the negative binomial estimation method to test theoretical hypotheses under which debt maturity is influenced by signaling and asymmetric information, taxes, and agency problems.

In examining the relation between firm quality and debt maturity, we find three central results. First, our results do not support the separating equilibrium hypothesis, which suggests that investment-grade firms use shorter maturities as a quality signal. Second, we do not find evidence supporting the hypothesis that low-quality firms emulate high quality firms in their debt maturity choice. Third, we find no evidence supporting the hypothesis that both high- and low-rated issues have shorter maturities than intermediate rated issues. Instead, we find that credit ratings demonstrate a direct relation between debt maturity and firm quality. Thus, our results support the theory that risky firms are screened out of the long-term debt market.

We also test the theory that a positive relation exists between the term structure premium and the maturity of debt issues. The results show that financial firms are more sensitive to the term structure when they issue either fixed- or floating-rate debt, but nonfinancial firms are generally indifferent to the term structure for floating-rate debt. Only fixed-rate debt issued by nonfinancial companies is influenced by the term structure.

Finally, we considered the role of debt maturity in mitigating agency problems. First, we test the theory that firms with high growth opportunities, such as high-tech firms or firms with high market-to-book or R&D-to-sales ratios, use short-term debt to control agency problems. The results indicate that high-tech firms indeed issue short-term debt; however, our results show only a weak positive relation between maturity and R&D-to-sales ratios and no relation between maturity and market-to-book ratios. Second, we test the proposition that regulated firms issue long-term debt due to an absence of typical agency problems. After excluding financial institutions, our results clearly indicate that regulated firms prefer long-term debt. Finally, in contrast to the theory that small firms have more growth opportunities and should issue short-term debt to control agency problems, we find a negative relation between firm size and maturity.

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