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The Determinants of Contract Terms in Bank Revolving Credit Agreements

Steven Dennis, Debarshi Nandy, and Ian G. Sharpe*

Abstract

The paper examines the determinants of contract terms on bank revolving credit agreements (revolvers) of medium/large publicly traded companies. We model the duration (maturity), secured status, and pricing decisions within a simultaneous decision framework, thereby overcoming the biased and inconsistent estimates in prior single equation studies of debt contract terms. We find strong interrelationships between contract terms with significant bi-directional relationships between duration and secured status and between the all-in-spread and commitment fees and a unidirectional relationship from both duration and secured status to all-in-spread. We also illustrate how several single equation studies of contract terms draw incorrect conclusions because of their (inappropriate) assumption that other contract terms and leverage were exogenous. Finally, our results support the hypothesis that the setting of contract terms plays an important role in alleviating contracting problems.

I. Introduction

While the theory and empirical analysis of capital structure initially focused on the choice between debt and equity, recently the discussion has broadened to incorporate issues relating to the structure of a firm's debt. Those issues include the choice between public and private debt, and the structure of debt contract terms. A common theme has been the effect of asymmetric information, agency costs, taxes, credit quality, reputation, and strength of the borrower/lender relationship on the choice of debt type and contract terms (see Chan and Thakor (1987), Diamond (1989), (1991a), (1991b), and (1993), and Rajan (1992)).

* Dennis, College of Business, Ball State University, Muncie, IN 47306; Nandy and Sharpe, School of Banking and Finance, University of New South Wales, Sydney, NSW 2052 Australia. An earlier version of this paper was presented at the Australian Graduate School of Business, Monash University at Clayton, University of Technology-Sydney, The University of New England, The University of Western Australia, the 1998 AAANZ Conference, the 1998 FMA Meetings in Chicago, and the Banking Research Study Group at the University of New South Wales. The authors would like to thank participants at these presentations and Neil Esho, Mark Flannery, Benton Gup, Warren Hogan, Paul Kofman, Kerry Pattenden, Jian-Xin Wang, Jonathan Karpooff (the editor), and Elazar Berkovitch (the referee) for their helpful comments. The financial support of the Australian Research Council is also recognized.
The empirical studies that have examined the determinants of debt structure are of two types. One group uses balance sheet data of firms to study debt structure at a moment in time (see Barclay and Smith (1995a), (1995b), and (1996), Houston and James (1996), Stohs and Mauer (1996), and Johnson (1997)). It is often difficult in these studies to reliably distinguish public from private debt and bank from non-bank private debt, and to accurately identify debt features such as maturity and secured status. The second group of studies relates incremental financing decisions to characteristics of borrowing firms at the time of the financing decision. Incremental data are well suited for examining the determinants of debt structure decisions as the type of debt and contract terms are more readily identified. Moreover, incremental data overcome the problem of averaging financing decisions over time that is implicit in balance sheet studies.

Incremental debt structure studies have, however, focused on the determinants of a single contract feature. For example, Guedes and Opler (1996) examine the maturity of debt, Leeth and Scott (1989) and Berger and Udell (1995) the secured status of debt, and Petersen and Rajan (1994), Berger and Udell (1990), and Saunders (1996) the pricing of debt contracts. Focus on a single contract feature raises econometric issues about the treatment of other contract terms that may be determined simultaneously and are related to a common set of exogenous explanatory factors. For example, the agency costs that arise from asset substitution or underinvestment in the presence of asymmetric information may be limited by, among other factors, requiring security provisions or by shortening the maturity of debt contracts (Myers (1977)). Thus, debt maturity and secured status should be modeled as substitute mechanisms for controlling agency costs. Another example is the potential effect of maturity and secured status on the pricing of debt, where both maturity and secured status are also related to credit quality (see Smith and Warner (1979) and Diamond (1991b)). Debt structure studies have generally ignored these endogeneity and/or simultaneity problems and, thus, may have biased estimates of the relationships (see Leeth and Scott (1989), Berger and Udell (1990), and Saunders (1996)).

An alternative estimation approach in single contract feature studies is not to include other debt contract terms as explanatory variables so the estimate is interpreted as a reduced form where OLS is unbiased. This approach is adopted in Berger and Udell’s (1995) study of the pricing of small business loans and Guedes and Opler’s (1996) study of the maturity of public debt issues. While this approach is perfectly valid, a somewhat richer alternative would be to estimate a simultaneous equation model incorporating the interdependencies between contract terms. This approach was used by Shockley and Thakor (1997), who examine the simultaneity between the usage fee and drawn all-in-spread on bank credit lines. However, the estimates are potentially biased as they assume that maturity and secured status are exogenously determined.

A further limitation of prior studies of debt contract design and pricing is that they have examined either public issues made by medium and large firms or

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1However, Berger and Udell (1995) also reports an OLS regression, including the endogenous contract terms as explanatory variables and incorrectly concludes on the basis of the insignificance of these potentially biased coefficients that collateral does not affect loan risk or pricing, a result that is also inconsistent with that in Berger and Udell (1990).
bank loans to small businesses. While small businesses generally do not make public debt issues, many medium and large firms utilize bank loans. Houston and James (1996) report that, in their sample of 250 publicly traded firms, only 46% had public debt outstanding and that "private" debt (that is, bank loans and private placements) averaged 70% of total debt outstanding. Moreover, much of banks' commercial and industrial lending takes the form of bank commitment lines that play an important role in banking relationships.

We address these shortcomings by estimating a simultaneous model of debt contract terms that incorporates the important linkages between contract features. Of particular interest are hypotheses linking the choice of contract features to motives such as the need to control perverse investment incentives (e.g., asset substitution and underinvestment), and to signaling, tax, and credit quality explanations. We test the model on incremental data of bank floating rate revolving credit agreements (revolvers) obtained from Dealscan and linked to Compustat annual report data of the borrower. Revolvers establish a revolving credit line over a period referred to as the duration of the commitment. The credit line may be secured, and typically involves a complex fee structure including an up-front fee, a fixed interest rate markup on drawn funds, and a usage or commitment fee based on undrawn funds.

Our focus on revolvers reflects a number of considerations including their significance in bank commercial and industrial lending, and their importance in fostering the bank-customer relationship. Moreover, given that the contracting problems generating perverse investment incentives are related to the riskiness of debt and that firms frequently utilize several types of debt, it is important to study debt issues that are risky and relatively large vis-à-vis the firm's total debt. In our sample, the mean revolver facility size is approximately 40% of the firm's total debt at the prior balance sheet close period and the mean all-in-spread is 157 basis points above Libor. Furthermore, the contract terms on revolvers of risky firms differ from those of less risky firms. For example, revolvers of the 37 firms with AA S&P senior debt ratings have a mean duration of 1018 days, all-in-spread of 30 basis points, while only 5% were secured. In contrast, the 145 revolvers of BB firms had means of 1266 days, 149 basis points, and 41%, respectively. Thus, our revolver sample appears an appropriate vehicle for examining the role of contract terms in controlling investment incentives.

In Section II, we specify a simultaneous model explaining four features of revolvers: i) Duration or original time to expiry of the commitment; ii) Secured status, an indicator variable taking the value of unity if the facility is secured or zero otherwise; iii) the drawn All-in-Spread, defined as the basis point coupon spread over Libor plus the annual fee and plus the upfront fee spread over the duration of the revolver; and iv) the commitment fee on undrawn funds, Comfee. Section III then examines the source and main features of the revolver sample and describes the systems estimation with discrete, censored, and continuous dependent variables. The regression results presented in Section IV provide strong support for the hypothesis that debt contract features are interrelated. We find significant bi-directional relationships between Duration and Secured and between

\footnote{If a Libor spread is not quoted, Dealscan uses the minimum spread and then applies a Libor differential, depending on the spread used (see Loan Pricing Corporation (1994), p. 19).}
All-in-Spread and Comfee, and uni-directional relationships from both Duration and Secured to All-in-Spread. The significant interdependencies appear to be driven by asymmetric information, contracting problems that produce perverse investment incentives, and/or credit risk. By comparing the simultaneous equation estimates with biased single equation estimates, we then show how the results of several prior studies may be explained by their implicit, though inappropriate assumption, that other contract terms and leverage are exogenously given. For example, in their single equation balance sheet study, Stohs and Mauer (1996) find that contracting problems do not influence debt maturity choice but that there is a significant direct relationship between leverage and maturity. We find a similar result for revolvers when single equation estimates are used. But when contract terms and leverage are modeled endogenously, the results are consistent with the contracting hypothesis and there is an inverse relationship between leverage and duration. Consequently, the simultaneous treatment of contract terms and leverage is critical in testing contracting hypotheses of the choice of debt terms.

We also find that revolver duration is related to liquidity risk in a non-monotonic manner as predicted in Diamond (1991b) with revolver durations of both high and low risk firms being shorter than for medium risk firms. Moreover, the pricing results are consistent with Merton’s (1974) option pricing model for risky debt with all-in-spread directly related to interest volatility and the borrower’s leverage and inversely related to revolver duration.

II. Model Specification

Melnik and Plaut (1986) characterize bank commitment contracts as providing a package of n-contract terms that cannot be split and traded separately. Banks then offer borrowers an n-dimensional array of bundles from which to choose their desired contract features and, in making their choice, borrowers will trade off loan characteristics. However, only \( n - 1 \) of the contract features may be independently chosen. Reflecting this independence feature, we jointly model the choice of Duration and Secured status and then model All-in-Spread and Comfee as being determined by the choice of Duration and Secured status. While we assume uni-directional relationships from both Duration and Secured to All-in-Spread and Comfee, we allow bi-directional relationships between All-in-Spread and Comfee and between Duration and Secured. The model takes the following form,

\[
\begin{align*}
\text{Duration} &= \gamma_{DS} \text{Secured} + \beta'_1 X_1 + e_1, \\
\text{Secured} &= \gamma_{SD} \text{Duration} + \beta'_2 X_2 + e_2, \\
\text{All-in-Spread} &= \gamma_{AD} \text{Duration} + \gamma_{AS} \text{Secured} \\
&\quad + \gamma_{AC} \text{Comfee} + \beta'_3 X_3 + e_3, \\
\text{Comfee} &= \gamma_{CD} \text{Duration} + \gamma_{CS} \text{Secured} \\
&\quad + \gamma_{CA} \text{All-in-Spread} + \beta'_4 X_4 + e_4,
\end{align*}
\]

where Secured is a dichotomous [1,0] variable, Comfee is censored from below at zero, \( \gamma_{ij} \) are coefficients of the interdependence effects between contract terms.
i and j, X_k for K = 1 to 4 are vectors of the other explanatory variables with \( \beta_k \) representing the sensitivity of contract terms to those variables, and \( e_k \) the residuals. In Sections II.A and II.B, we examine hypotheses relating to determinants of revolver contract terms, that is, the \( X_k \) vectors while, in Section II.C, we examine the interdependence effects linking the contract terms.

A. Contract Design

A range of theories has been proposed to explain the borrower’s choice of Duration and Secured status, which we jointly refer to as debt contract design. We focus on contracting or agency costs, signaling, liquidity risk, tax, and relationship hypotheses.

1. Contracting Hypotheses

Agency costs of debt generate asset substitution and underinvestment problems as managers of firms with risky debt have an incentive to undertake relatively more risky projects and/or to underinvest in low risk, positive NPV projects. These incentives are greatest for small, risky firms with growth options but may be reduced by the firm shortening debt maturity and/or by issuing claims with high priority, such as secured debt (see Myers (1977), Smith and Warner (1979), Stulz and Johnson (1985), and Chan and Thakor (1987)). As a proxy for growth opportunities, we utilize the firm’s market to book value, Market/Book. Variable definitions and data sources are summarized in the Appendix.

2. Signaling

Signaling models draw on the observation that long-term and/or unsecured debt is more sensitive to changes in firm value than short-term and/or secured debt. With transaction costs associated with costly liquidation, high quality firms signal their superior loan quality to the market by issuing short-term and/or secured debt (see Chan and Kanatas (1985), Flannery (1986), Kale and Noe (1990), Harris and Raviv (1991), and Diamond (1993)). As in Barclay and Smith (1995a), (1995b), Guedes and Opler (1996), and Stohs and Mauer (1996), we use the unexpected change in future earnings, Unexpected Earnings, to proxy firm quality.

3. Tax Hypotheses

There are several hypotheses relating the choice of debt maturity to taxes. Where there are tax advantages of debt, more volatile earnings result in the firm rebalancing its capital structure more frequently and a lower optimal debt maturity. Thus, Duration is inversely related to the firm’s marginal effective tax rate, which we proxy by the ratio of taxes paid to assets, Tax/Assets, and to the variability of its earnings, Earnings Variance (see Kane et al. (1985), p. 494). Moreover, because of the time value of the tax advantage, Duration is expected to be directly related to the slope of the yield curve, proxied by Term Premium, and to Interest Volatility (see Brick and Ravid (1985) and Mauer and Lewellen (1987)).
4. Credit Quality

Because short-term debt exposes firms to costly liquidation when debt matures, Duration is inversely related to borrower credit quality. However, Diamond (1991b) argues that the relationship is non-monotonic as low credit quality firms may be rationed out of the long-term debt market due to extreme adverse selection problems. Borrower risk may also affect Secured status of debt, though the sign of the relationship is uncertain\(^3\) (see Berger and Udell (1990)). Borrower credit quality is proxied by Altman’s Z-Score while the quadratic term Z-Squared captures the non-monotonic relationship.

5. Relationship Hypothesis

Boot and Thakor (1994) show that collateral is useful in the early stages of a banking relationship in resolving moral hazard problems. As the relationship strengthens and the borrower demonstrates success in undertaking investment projects, the bank then reduces the collateral requirements. This suggests an inverse relationship between strength of the bank-customer relationship and Secured. Petersen and Rajan ((1994), p. 10) note that one measure of the bank-customer relationship is concentration of the firm’s borrowing across lenders. In the absence of data on the firm’s total borrowings from the particular bank lender, we proxy relationship strength by Loan Concentration, defined as the amount of borrowings in the deal relative to the borrower’s total debt.

6. Controls

In testing theories of contract design, we control for leverage, asset maturity, firm size, and the change in bank capital requirements in December 1992. As agency costs of underinvestment may be limited by reducing leverage as well as shortening maturity or requiring collateral, we expect an inverse relationship between Leverage and Duration and a direct relationship with Secured (see Myers (1977) and Leeth and Scott (1989)). The agency costs may also be mitigated by firms matching debt maturity with that of its assets, suggesting a direct relationship between Duration and Asset Maturity (also see Barclay and Smith (1995a) and Diamond (1991b)). Firm size may influence contract design through risk diversification and reputation effects (see Diamond (1989), (1991a)). Our proxy, Firm Size, is the natural log of the market value of the firm. When introduced in December 1992, the risk-based capital adequacy requirements distinguished between undrawn commitments with original duration of less than a year and those one year or more. The former were given a zero risk weighting and the latter a 50% weighting. Hence, we introduce a dummy variable, denoted Capital Adequacy, for facilities granted in 1993 or subsequent years. Finally, we include a set of Loan Purpose and Deal Structure controls. The revolvers are parts of loan deals that vary in composition from those involving a single revolver facility, those with multiple revolver facilities, and those with mixes of revolver and term loan facilities. Moreover, the lender may be a single bank or a syndicate of banks.

\(^3\)An empirical study of collateral in small business loans by Berger and Udell (1990) provides support for the positive relationship of the “sorting-by-observed risk paradigm.”
Hence, we include three indicator variables, Multiple Revolvers, Term Loans, and Syndicate.

The $X_1$ and $X_2$ vectors of the determinants of Duration and Secured, respectively, and the expected signs of the variables are summarized in equations (5) and (6),

\begin{align*}
(5) \quad X_1 &= \left[ \begin{array}{c}
-ve \\
-ve \\
+ve \\
+ve \\
+ve \\
+ve \\
+ve \\
+ve \\
-ve \\
-ve \\
\end{array} \right] \begin{array}{c}
\text{Constant, Market/Book, Unexpected Earnings,}
\text{Tax/Assets, Earnings Variance, Term Premium,}
\text{Interest Volatility, Z-Score, Z-Squared, Leverage,}
\text{Asset Maturity, Firm Size, Capital Adequacy,}
\text{Loan Purpose, Deal Structure}
\end{array} \\
(6) \quad X_2 &= \left[ \begin{array}{c}
+ve \\
+ve \\
+ve \\
+ve \\
+ve \\
+ve \\
\end{array} \right] \begin{array}{c}
\text{Constant, Market/Book, Unexpected Earnings,}
\text{Z-Score, Leverage, Firm Size, Loan Concentration,}
\text{Loan Purpose, Deal Structure}
\end{array}
\end{align*}

B. 
Revolver Pricing

Three theoretical frameworks have been suggested to explain the pricing of risky commitments: option pricing; strength of the banking relationship; and asymmetric information/information monopoly.

1. Option Pricing

Merton's (1974) model for pricing default risk on corporate debt suggests the All-in-Spread is positively related to the borrower’s Leverage, to the risk-free interest rate on the Debt, which we proxy by Libor, and to the variance of the value of the underlying assets of the borrower (proxied by Interest Volatility and the firm’s Z-Score). It is also related to Duration of the debt, though the sign is uncertain.

2. Relationship Strength

As relationships develop, borrowers may gain a reputation for not defaulting. This reduces agency costs associated with adverse selection and moral hazard, thereby lowering the All-in-Spread and/or Comfee (see Diamond (1989), (1991a), Petersen and Rajan (1994), and Boot and Thakor (1994)). Alternatively, loan pricing may be used to develop banking relationships by offering lower spreads in the early stages of the relationship (see Greenbaum et al. (1989) and Sharpe (1990)). Hence, the sign of the relationship proxy, Loan Concentration, in both the All-in-Spread and Comfee equations is uncertain.4

4Recent empirical studies of small business lending suggest an inverse relationship (see Berger and Udell (1995) and Blackwell and Winters (1996)).
3. Information Monopoly/Asymmetric Information

While bank debt provides financing flexibility, it gives informed lenders an information monopoly that may be used to alter the division of surplus between the lender and borrower, depending on the bargaining power of each party (Rajan (1992)). With market power of the borrower inversely related to the level of asymmetric information relating to its activities and to its growth opportunities, the All-in-Spread is expected to be directly related to the borrower’s Market/Book ratio and Unexpected Earnings. Moreover, recent theoretical research into the optimal design of loan commitment contracts suggests the presence of usage or commitment fees is directly related to the level of asymmetric information and credit risk (see Berkovitch and Greenbaum (1991) and Shockley and Thakor (1997)). Thus, Comfee is expected to be inversely related to the firm’s Z-Score and directly related to Market/Book, Unexpected Earnings, and Leverage.

4. Controls

As loan risk premiums may be related to the slope of the yield curve, we incorporate Term Premium in the All-in-Spread equation. The Capital Adequacy dummy is included in the Comfee equation to capture the effect of the introduction in December 1992 of a capital requirement on undrawn commitments with original durations of one year or more. With the addition of Loan Purpose and Deal Structure controls, the $X_3$ and $X_4$ vectors for All-in-Spread and Comfee are then

\begin{align}
X_3 &= \begin{bmatrix}
\text{Constant, Leverage, Libor, Interest Volatility,}
\text{Z-Score, Loan Concentration, Market/Book,}
\text{Unexpected Earnings, Term Premium, Loan Purpose,}
\text{Deal Structure}
\end{bmatrix}, \\
X_4 &= \begin{bmatrix}
\text{Constant, Loan Concentration, Z-Score,}
\text{Market/Book, Unexpected Earnings,}
\text{Leverage, Capital Adequacy,}
\text{Loan Purpose, Deal Structure}
\end{bmatrix}.
\end{align}

C. Interdependence Effects

The eight interdependence terms and their $\gamma_{ij}$ coefficients may reflect several influences. If borrower utility is directly related to duration and inversely related to secured status and the revolver price, then borrowers may trade off the provision of collateral to increase the duration of the revolver and/or to reduce its cost. Hence, the tradeoff model predicts positive relationships between Duration
and each of Secured, All-in-Spread, and Comfee and inverse relationships between Secured and both All-in-Spread and Comfee, and between All-in-Spread and Comfee (see Melnik and Plaut (1986)). On the other hand, under the sorting-by-observed-risk paradigm, riskier borrowers more often pledge collateral than safer borrowers. If recourse against that collateral does not fully offset borrower risk, then there will be positive relationships between Secured and both All-in-Spread and Comfee. Moreover, if risky borrowers are limited to short duration financing, then we could observe an inverse relationship between Duration and both All-in-Spread and Comfee (see Berger and Udell (1990)). Finally, the use of a multiple-fee structure on a revolver contract may mitigate the underinvestment problem and generate a positive relationship between All-in-Spread and Comfee (see Shockley and Thakor (1997)). Thus, while a positive relationship is expected between Duration and Secured, so that \( \gamma_{DS} > 0 \) and \( \gamma_{SD} > 0 \), the signs of the remaining six interdependence terms are uncertain.

### III. Data and Estimation

#### A. The Revolver Sample

The revolver sample was obtained from the Loan Pricing Corporation’s (LPC) Dealscan Database, which includes detailed market information on more than U.S.$2 trillion of large corporate and middle market commercial loans and private placements. The majority of the borrowers on Dealscan are publicly held companies that are required to file 13Ds, 14Ds, 13Es, 10Ks, 10Qs, 8Ks, and Registration Statements with the Securities and Exchange Commission. The remaining data are obtained by the LPC from direct research of private loan portfolios of banks. The data are arranged in deals, each of which contains one or more facilities. Deals range in size from $100,000 to $13 billion.

This study focuses on confirmed transactions involving at least one floating rate bank revolver or 364-day facility, with a deal date between January 1987 and December 1995. All fixed rate loans, private placements, and non-bank loans were excluded, as were facilities where the borrower’s ticker, SIC code, or annual sales figure was missing on Dealscan. Furthermore, as Dealscan provides relatively little detail relating to the borrower’s financial position and our econometric model requires annual report data to use as proxies for many of the independent variables, it was necessary to link the revolver facility data to the borrower’s annual report data on Compustat. Approximately 40% of the revolver facilities were matched to annual report data on Compustat by using the borrower’s stock exchange ticker as recorded on Dealscan. This effectively restricted the sample to revolvers of publicly traded companies. Finally, a small number of revolvers

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5 In the agency cost approach, shortening maturity and requiring collateral are alternative or substitute mechanisms for containing the underinvestment problem. As substitutes, duration and secured status will be positively related as in the tradeoff theory.

6 In Dealscan, a revolver is defined as “an unfunded commitment that the borrower may drawdown, repay and reborrow under” (Loan Pricing Corporation (1994), p. 18).

7 In most cases, the deal date of the revolver was matched to the annual report data with fiscal year-end data immediately preceding the deal date. However, for revolvers where both the deal date and the borrower’s fiscal year end date were in the second half of the calendar year, the deal date was
were removed from the sample where data for key variables were missing in Compustat or when data filtering indicated extreme values likely to be associated with data reporting or recording errors. This left a sample of 2634 bank revolver facilities of medium/large publicly traded companies.

The distribution of real facility size in January 1987 dollars is somewhat skewed, with a mean of $144.38m and median of $32.26m. Similar skewness is evident in the distribution of real firm size (real market value of assets) with a mean of $1918.05m and median of $309.60m. Half of the borrowers in the sample are manufacturing firms, with the remainder predominantly spread across SIC codes for services, mining, retail trade, utilities, transport and communications, and wholesale trade. The purpose of the revolver is described as either general corporate purposes or working capital in 66% of the sample, while 18% of the loans relate to debt repayment or consolidation, and 11% for takeover acquisition, leveraged buyout, or general acquisitions programs.\(^8\)

Descriptive statistics of the four revolver contract features of interest to this study are included in the first four rows of Table 1. The revolvers have a mean (median) duration of 2.91 (2.90) years, all-in spread of 157 (125) basis points, and commitment fee of 22 (25) basis points. Information on whether the revolver is secured or not is provided in almost half of the sample, and 73% of those are secured.\(^9\) Table 1 also includes descriptive statistics for the independent variables in the model while the correlation matrix of the dependent and independent variables is depicted in Table 2.

B. Estimation Technique

A difficulty in estimating the simultaneous four equation system of contract terms is that the dependent variables include a mix of continuous (Duration and All-in-Spread), discrete choice (Secured), and censored from below at zero (Commitment Fee) variables. Our approach is to apply Nelson and Olson's (1978) two-stage estimation procedure for simultaneous equation models with limited dependent variables. In the first stage, we estimate a reduced form model for each of the endogenous variables. These may be written as

\[
\begin{align*}
\text{Duration} &= \Pi_1 X + \epsilon_1, \\
\text{Secured} &= \Pi_2 X + \epsilon_2, \\
\text{All-in-Spread} &= \Pi_3 X + \epsilon_3, \\
\text{Commitment Fee} &= \Pi_4 X + \epsilon_4,
\end{align*}
\]

where \(X\) is the set of all exogenous variables in the \(X_K\) vectors, and \(\epsilon_K\) are the reduced form residuals.

\(^8\)For estimation purposes, we identify four loan purpose categories, Working Capital, Repayment/Recap., Acquisitions, and Other Purposes but, to avoid singularity, exclude Working Capital from the regressions.

\(^9\)In Saunders' (1996) sample of highly leveraged transaction loans, the revolvers have an average maturity of 4.3 years, while only 22% are secured. Saunders appears to have assumed that a blank secured status field is an unsecured loan.
TABLE 1
Descriptive Statistics for Dependent and Independent Variables\(^a\)

<table>
<thead>
<tr>
<th>Variable(^b)</th>
<th>Median</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration (in years)</td>
<td>2.90</td>
<td>2.91</td>
<td>1.83</td>
<td>0.13</td>
<td>11.98</td>
</tr>
<tr>
<td>Secured</td>
<td>0.00</td>
<td>0.73</td>
<td>0.44</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>All-in-Spread (%)</td>
<td>1.25</td>
<td>1.57</td>
<td>1.16</td>
<td>0.13</td>
<td>7.55</td>
</tr>
<tr>
<td>Commitment Fee (%)</td>
<td>0.25</td>
<td>0.22</td>
<td>0.20</td>
<td>0.00</td>
<td>1.25</td>
</tr>
<tr>
<td>Market/Book</td>
<td>1.31</td>
<td>1.58</td>
<td>0.92</td>
<td>0.40</td>
<td>11.92</td>
</tr>
<tr>
<td>Leverage</td>
<td>0.21</td>
<td>0.23</td>
<td>0.16</td>
<td>0.00</td>
<td>0.86</td>
</tr>
<tr>
<td>Unexpected Earnings</td>
<td>0.01</td>
<td>0.03</td>
<td>0.41</td>
<td>-3.24</td>
<td>12.38</td>
</tr>
<tr>
<td>Z-Score</td>
<td>1.99</td>
<td>2.06</td>
<td>1.18</td>
<td>0.00</td>
<td>8.53</td>
</tr>
<tr>
<td>Tax/Assets</td>
<td>0.02</td>
<td>0.03</td>
<td>0.03</td>
<td>-0.15</td>
<td>0.26</td>
</tr>
<tr>
<td>Earnings Variance</td>
<td>0.03</td>
<td>0.04</td>
<td>0.04</td>
<td>0.00</td>
<td>0.52</td>
</tr>
<tr>
<td>Term Premium (%)</td>
<td>1.77</td>
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\(^a\) Number of observations is 2634 except for Secured where \(N = 1303\).
\(^b\) All variables as defined in the Appendix, except Firm Size, which is in levels form.

Because Secured is a dichotomous variable, we can only estimate \((\Pi_2/\sigma_2)\), where \((\sigma_2)^2\) is the variance of \(\epsilon_2\). If we define

\[ \text{Secured}^* = \frac{\text{Secured}}{\sigma_2}, \quad \text{then} \]

\[ \text{Secured}^* = \left(\frac{\Pi_2}{\sigma_2}\right)X + \left(\frac{\epsilon_2}{\sigma_2}\right) = \Pi_2^*X + \epsilon_2^*. \]

Thus, in the first stage, we estimate equations (9), (14), (11), and (12) using OLS, MLE (logit), OLS, and MLE (tobit), respectively, thereby accounting for the discrete and censored nature of the Secured and Comfee variables. From these estimates, we obtain reduced form fitted values for each of the endogenous variables,\(^a\)

\[ \text{Duration} = \tilde{\Pi}_1X, \]

\[ \text{Secured}^* = \tilde{\Pi}_2^*X, \]

\[ \text{All-in-Spread} = \tilde{\Pi}_3X, \]

\[ \text{Comfee} = \tilde{\Pi}_4X. \]

From equation (13), the underlying structural model may be rewritten as

\[ \text{Duration} = \gamma_{DS}\sigma_2\text{Secured}^* + \beta_1^1X_1 + e_1, \]

\[ \text{Secured}^* = \left(\gamma_{SD}/\sigma_2\right)\text{Duration} + \left(\beta_2^1/\sigma_2\right)X_2 + \left(\epsilon_2/\sigma_2\right), \]

\[ \text{All-in-Spread} = \gamma_{AD}\text{Duration} + \gamma_{AS}\sigma_2\text{Secured}^* + \gamma_{AC}\text{Comfee} + \beta_3^1X_3 + e_3, \]

\[ \text{Comfee} = \gamma_{CD}\text{Duration} + \gamma_{CS}\sigma_2\text{Secured}^* + \gamma_{CA}\text{All-in-Spread} + \beta_4^1X_4 + e_4. \]
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**Table 2**

Correlation Matrix for Listed Variables<sup>a</sup>

---

<sup>a</sup>Number of observations is \( N = 2634 \), except for correlations involving Secured, where \( N = 1303 \).

<sup>b</sup>All variables as defined in the Appendix.
The second stage estimates then involve the substitution of reduced form fitted values for the endogenous variables appearing on the right-hand side of equations (19) to (22) and then estimating the respective equations using OLS, MLE (logit), OLS, and MLE (tobit), respectively. The asymptotic covariance matrices for these second stage estimates are then derived following Amemiya (1979),

\[
\text{var} (\gamma_{DS} \sigma_2, \beta'_1) = c_1 (H'X'XH)^{-1} + (\gamma_{DS} \sigma_2)^2 (H'X'XH)^{-1} H'X'X \bar{X} \bar{X}^T (H'X'XH)^{-1},
\]

\[
\text{var} (\gamma_{SD}/\sigma_2, \beta'_2/\sigma_2) = (G'V_2^{-1} G)^{-1} + d_2 (G'V_2^{-1} G)^{-1} G'V_2^{-1} (X'X)^{-1} V_2^{-1} G (G'V_2^{-1} G)^{-1},
\]

\[
\text{var} (\gamma_{AD}, \gamma_{AS} \sigma_2, \gamma_{AC}, \beta'_3) = c_3 (K'X'XK)^{-1} + \gamma_{AC}^2 (K'X'XK)^{-1} K'X'X \bar{X} \bar{X}^T (K'X'XK)^{-1},
\]

\[
\text{var} (\gamma_{CD}, \gamma_{CS} \sigma_2, \gamma_{CA}, \beta'_4) = (F'V_4 F)^{-1} + d_4 (F'V_4 F)^{-1} F'V_4^{-1} (X'X)^{-1} V_4^{-1} F (F'V_4 F)^{-1},
\]

where

\[V_2 = \text{var} \left( \hat{\Pi}_2 \right),\]
\[V_4 = \text{var} \left( \hat{\Pi}_4 \right),\]
\[c_1 = \sigma_1^2 - 2 \gamma_{DS} \sigma_{12},\]
\[c_3 = \sigma_3^2 - 2 \gamma_{AC} \sigma_{34},\]
\[d_2 = (\gamma_{SD}/\sigma_2)^2 \sigma_1^2 - 2 (\gamma_{SD}/\sigma_2) (\sigma_{12}/\sigma_2),\]
\[d_4 = \gamma_{CA}^2 \sigma_3^2 - 2 \gamma_{CA} \sigma_{34},\]
\[\text{cov}(\epsilon_i, \epsilon_j) = \begin{bmatrix} \sigma_i^2 & \sigma_{ij} \\ \sigma_{ij} & \sigma_j^2 \end{bmatrix},\]
\[H = (\Pi_2, J_1),\]
\[G = (\Pi_1, J_2),\]
\[K = (\Pi_4, J_3),\]
\[F = (\Pi_3, J_4),\]

and where \(J_K\) is a matrix consisting of ones and zeroes such that \(XJ_K = X_K\).

This approach was modified to take account of an endogeneity problem with the leverage variable. While leverage is not modeled in this paper, agency theory suggests that leverage, maturity, and secured status are alternative mechanisms for limiting underinvestment and other agency problems in firms. Moreover, the theory of optimal capital structure suggests that leverage is systematically related to other exogenous variables in the model including the proxies for growth opportunities, asymmetric information, taxes, and credit risk. To overcome this problem, we use an instrumental variable approach and estimate a reduced form equation for leverage. Fitted values from this reduced form are then substituted for leverage in the second stage estimates of the four structural equations in the model.

A final issue relating to the estimation of the model is the treatment of approximately half of the sample where the secured status field is blank in Dealscan.
When the data are missing, the revolver has a statistically significant longer duration (3.03 years vis-à-vis 2.78 years), smaller all-in-spread (1.16% vis-à-vis 1.98%), and smaller commitment fee (0.19% vis-à-vis 0.24%) than where the secured status information is available. As excluding the $N = 1331$ blank secured status observations from the sample would bias the estimates of the duration and pricing equations, the following approach was adopted. For the reduced form and structural estimates of secured status, only the $N = 1303$ observations with non-blank secured status field were used, while the duration and pricing equations were estimated using the full $N = 2634$ sample. The secured status reduced form estimates were used to obtain fitted values for the $N = 1303$ within-sample observations and also for the $N = 1331$ out-of-sample blank secured status observations. These fitted values were then used in the second stage structural estimates of the duration and pricing equations for the full $N = 2634$ sample.

IV. Results

With five endogenous variables, Duration, Secured, All-in-Spread, Comfee, and Leverage, the order condition indicates that the Duration equation is exactly identified while the remaining equations are overidentified. Preliminary estimates of the model were very encouraging except for the asymptotic covariance matrix of the second stage estimates of the (exactly identified) Duration equation, which resulted in implausibly low $t$-statistics for the estimated coefficients. Following a recommendation in Greene (1993), p. 590, we eliminated statistically insignificant loan purpose and deal structure indicator variables from each equation resulting in a model where each equation was significantly overidentified.

Although the estimation process involved both reduced form and structural estimates, for space reasons, we report only the structural estimates in Table 3. The relevant $F$ or Wald $X^2$ statistics confirm that we cannot reject the null hypothesis that the coefficients of the eliminated loan purpose and/or deal structure indicator variables in each equation are zero. The adjusted $R^2$ of 0.163 and 0.472 for the Duration and All-in-Spread equations, respectively, are reasonable and consistent with those reported in the incremental debt studies. Moreover, the probit regression for secured status correctly predicts secured status in 78% of the 1303 observations, whereas a naive prediction that all revolvers were secured would have been correct in 73% of the cases.

A. Interdependence

The coefficients of the contract feature interdependence terms, $\gamma_{ij}$, are of considerable interest. These are the coefficients of the fitted contract term variables in the first four rows of the table. There is strong evidence of the choice of contract features being interrelated with six of the eight interdependence terms

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10 In the absence of a specified structural equation for Leverage, it is not possible to apply the rank condition.

11 Variables in the reduced form estimates include: Constant, Market/Book, Unexpected Earnings, Z-Score, Z-Squared, Tax/Assets, Earnings Variance, Term Premium, Interest Volatility, Loan Concentration, Libor, Firm Size, Asset Maturity, Capital Adequacy, Multiple Revolvers, Term Loan, Syndicate, Repayment/Recap, Acquisitions, and Other Purpose. All variables as defined in the Appendix.
### TABLE 3

Two-Stage Estimates of Structural Model<sup>a</sup>

<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Duration</th>
<th>Secured&lt;sup&gt;b&lt;/sup&gt;</th>
<th>All-in-Spread</th>
<th>Comfee&lt;sup&gt;d&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitted Duration&lt;sup&gt;c&lt;/sup&gt;</td>
<td>0.536</td>
<td>-0.675</td>
<td>-6.82***</td>
<td>0.020</td>
</tr>
<tr>
<td></td>
<td>(2.28)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitted Secured&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.893</td>
<td>0.166</td>
<td>(2.48)**</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(4.99)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitted All-in-Spread&lt;sup&gt;d&lt;/sup&gt;</td>
<td>0.063</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.01)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitted Comfee&lt;sup&gt;d&lt;/sup&gt;</td>
<td>1.677</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.12)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-1.519</td>
<td>1.387</td>
<td>2.166</td>
<td>-0.133</td>
</tr>
<tr>
<td></td>
<td>(-1.47)</td>
<td>(2.29)**</td>
<td>(5.40)***</td>
<td>(-1.47)</td>
</tr>
<tr>
<td>Market/Book</td>
<td>-0.192</td>
<td>0.386</td>
<td>0.091</td>
<td>0.023</td>
</tr>
<tr>
<td></td>
<td>(-1.91)**</td>
<td>(3.36)***</td>
<td>(1.47)</td>
<td>(1.54)</td>
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<tr>
<td>Unexpected Earnings</td>
<td>-0.178</td>
<td>0.212</td>
<td>0.015</td>
<td>0.014</td>
</tr>
<tr>
<td></td>
<td>(-0.90)</td>
<td>(1.04)</td>
<td>(0.24)</td>
<td>(0.95)</td>
</tr>
<tr>
<td>Z-Score</td>
<td>0.576</td>
<td>-0.061</td>
<td>-0.046</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(2.26)**</td>
<td>(-0.59)</td>
<td>(-1.52)</td>
<td>(-0.87)</td>
</tr>
<tr>
<td>Z-Squared</td>
<td>-0.090</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.20)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tax/Assets</td>
<td>-3.545</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>(-1.13)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Earnings Variance</td>
<td>-6.227</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.86)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term Premium</td>
<td>0.178</td>
<td>0.160</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.90)**</td>
<td>(2.50)**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest Volatility</td>
<td>0.969</td>
<td>0.734</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.99)**</td>
<td>(4.71)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fitted Leverage&lt;sup&gt;c&lt;/sup&gt;</td>
<td>-3.905</td>
<td>6.694</td>
<td>2.203</td>
<td>0.615</td>
</tr>
<tr>
<td></td>
<td>(-2.97)**</td>
<td>(3.19)***</td>
<td>(2.08)**</td>
<td>(2.22)**</td>
</tr>
<tr>
<td>Libor</td>
<td>0.049</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loan Concentration</td>
<td>0.232</td>
<td>0.334</td>
<td></td>
<td>0.055</td>
</tr>
<tr>
<td></td>
<td>(0.81)</td>
<td>(3.26)***</td>
<td></td>
<td>(1.82)*</td>
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<tr>
<td>Firm Size</td>
<td>0.595</td>
<td>-0.648</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(6.45)***</td>
<td>(-5.60)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Asset Maturity</td>
<td>0.080</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.81)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Capital Adequacy</td>
<td>0.408</td>
<td>-0.041</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.34)**</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Multiple Revolvers</td>
<td>-0.060</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.96)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Term Loan</td>
<td>-0.170</td>
<td>0.044</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.34)**</td>
<td>(2.64)***</td>
<td></td>
<td></td>
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<tr>
<td>Syndicate</td>
<td>-0.311</td>
<td>0.073</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.90)***</td>
<td></td>
<td></td>
<td>(3.03)***</td>
</tr>
<tr>
<td>Repayment/Recap.</td>
<td>0.204</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.93)*</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Acquisitions</td>
<td>0.499</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(3.74)***</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other Purpose</td>
<td>-0.345</td>
<td></td>
<td></td>
<td>-0.070</td>
</tr>
<tr>
<td></td>
<td>(-0.95)</td>
<td></td>
<td></td>
<td>(-2.19)**</td>
</tr>
<tr>
<td>#Observations</td>
<td>2634</td>
<td>1303</td>
<td>2634</td>
<td>2634</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.163</td>
<td>0.472</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Zero Restrictions&lt;sup&gt;e&lt;/sup&gt;</td>
<td>$F(5,2614) = 0.40$</td>
<td>$\chi^2(6) = 3.38$</td>
<td>$F(2,2616) = 0.60$</td>
<td>$\chi^2(2) = 3.43$</td>
</tr>
</tbody>
</table>

<sup>a</sup> $t$-statistics in parentheses while ***, **, and * indicate significance at 10%, 5%, and 1%, respectively.

<sup>b</sup> Estimated using logit estimator.

<sup>c</sup> Estimated using tobit estimator.

<sup>d</sup> Treated endogenously—using predicted values from reduced form estimate.

<sup>e</sup> Tests of zero restrictions on loan purpose and loan type controls.
being statistically significant at the 95% confidence level or higher. Moreover, we find significant bi-directional relationships between Duration and Secured ($\gamma_{DS}$ and $\gamma_{SD}$) and between All-in-Spread and Comfee ($\gamma_{AC}$ and $\gamma_{CA}$). These results provide support for the underlying premise of our study that choices of various debt contract features are interrelated and attempts to model the choices should recognize this feature.

Turning to the specific interdependence effects, we find significant positive relationships between Duration and Secured. These are consistent with the agency/contracting cost hypothesis in which shortening debt maturity and pledging collateral are alternative mechanisms for resolving asset substitution and underinvestment problems. It is also consistent with the Melnik and Plaut (1986) tradeoff model when the borrower's utility is directly related to Duration and inversely related to the need to provide collateral.

While our model imposes the assumption that revolver pricing does not influence the duration and secured status decisions, the results indicate that Duration has a strong negative influence on All-in-Spread ($\gamma_{AD} < 0$), while Secured has a positive influence on the All-in-Spread ($\gamma_{AS} > 0$). In each case, the sign of the relationship is inconsistent with the tradeoff hypothesis. However, the positive relationship between secured status and spread is consistent with the results of Berger and Udell (1990) and Saunders (1996) and suggests that higher risk borrowers are required to both pledge security and to pay higher revolver spreads. On the other hand, the negative relation between duration and spread is possible in Merton's (1974) option pricing model for default risk, which predicts an uncertain sign of this relationship. Another possibility is that the inverse relationship reflects credit risk, with higher risk borrowers being limited to shorter durations while paying higher spreads. In contrast with these results, there is no significant direct influence of either Duration or Secured status on Comfee.

The significant positive bi-directional relationship between the All-in-Spread and Comfee ($\gamma_{AC} > 0$ and $\gamma_{CA} > 0$) is consistent with the Shockley and Thakor (1997) theoretical prediction and empirical finding of a positive correlation between the pricing components when commitments contain separating fee structures.

B. Contract Design

We find strong evidence for several of the predictions concerning debt contract design as formulated in Section II. The agency/contracting cost hypothesis receives support in both duration and secured status equations, with significant negative and positive coefficients of Market/Book, respectively. Firms with substantial growth opportunities, as proxied by Market/Book, limit underinvestment and other agency problems by borrowing from banks for shorter terms and on a secured basis. Moreover, as reducing leverage is a substitute for pledging collateral as a mechanism for controlling the agency costs, the significant negative coefficient of Leverage in the Duration equation and its positive coefficient in the Secured equation provides further support for this framework.

The tax hypotheses also receive some support in the Duration equation with significant positive coefficients for Term Premium and Interest Volatility and a
negative coefficient for Earnings Variance. These results are consistent with the predictions of Brick and Ravid (1985), Mauer and Lewellen (1987), and Kane et al. (1985), respectively. In contrast, the Tax/Assets variable does not achieve significance.

Coefficients of the credit quality variable, Z-Score, in linear and quadratic form in the duration equation are consistent with Diamond’s (1991b) prediction of a non-monotonic relationship between credit quality and revolver duration. Intermediate credit quality firms borrow for longer duration than either high or low quality firms. While the coefficient of the Z-Score credit quality proxy is insignificant in the secured status equation, this may be attributable to the Leverage and Firm Size control variables capturing this influence. Thus, small and highly leveraged firms, which would generally be lower credit quality, have a significantly higher probability of being required to provide collateral. This is consistent with predictions from Rajan and Winton (1995) and Smith and Warner (1979).

In contrast with the strong support for the contracting cost, tax, and liquidity risk hypotheses, the results provide little support for the signaling and relationship hypotheses. Although Unexpected Earnings has the anticipated sign in both duration and secured status equations, it remains statistically insignificant. Moreover, Loan Concentration has an incorrect positive (though insignificant) coefficient in the secured status equation.

Among the control variables, Firm Size has a strong influence on contract design with large firms obtaining revolvers with significantly longer duration and lower probability of secured status than smaller firms. Moreover, there has been a trend toward longer duration revolvers since the introduction of bank capital requirements on undrawn commitments of more than a year in December 1992. This suggests that any shift toward 364-day facilities to avoid the regulatory tax was offset by extending durations at the long end of the spectrum. Finally, we note that neither asset maturity, loan purpose, nor deal structure are significant determinants of contract design.

C. Revolver Pricing

The pricing regressions in Table 3 generally provide support for the option pricing and relationship hypotheses. Consistent with Merton’s (1974) model for pricing default risk, the All-in-Spread is significantly and directly related to Interest Volatility and Leverage and inversely related to Duration, while the proxies for the risk-free rate, Libor, and variance of the value of the underlying assets of the borrower, Z-Score, each have the correct signs. Moreover, the relationship proxy, Loan Concentration, is positive and significant in each of the pricing equations consistent with the relationship pricing models of Greenbaum et al. (1989) and Sharpe (1990) in which pricing increases as a relationship develops.

Relatively little support is found, however, for the information monopoly/asymmetric information hypotheses of Rajan (1992) and Shockley and Thakor (1997). While firms with greater credit risk, proxied by Leverage, do pay both

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12 As prior studies of debt maturity have found little evidence of tax effects (see Barclay and Smith (1995a), Guedes and Opler (1996), and Stohs and Mauer (1996)), and two of our three significant tax variables have only a time-series dimension, some care needs to be taken in assessing this result.
higher spreads and commitment fees, the proxies for growth opportunities (Market/Book), asymmetric information (Unexpected Earnings), and the alternative proxy for credit risk (Z-Score) do not attain significance (though each has the correct sign).

The loan purpose and deal structure control variables are generally more significant in explaining revolver pricing than contract design. However, the deal structure dummies tend to have offsetting effects across the All-in-Spread and Comfee equations. Where a lending syndicate is involved, the all-in-spread is 31 basis points lower and commitment fees seven basis points higher relative to single bank revolvers. Similarly, where the loan deal also includes a term loan facility as well as the revolver, the spread is 17 basis points lower and commitment fee four basis points higher than in the absence of the term loan facility. If there are multiple revolver facilities in the deal, the commitment fee is six basis points lower than in a single revolver deal. We also find that loans used for repayment/recapitalization and acquisitions have significantly higher all-in-spreads (20 and 50 basis points, respectively) than working capital loans. Finally, the change in capital adequacy regulation in December 1992 relating to undrawn commitments was associated with a reduction in commitment fees. Although the requirement effectively taxed commitments with original duration of one year or more, this positive influence could have been offset by intense competitive pressures in the syndicated loan market during the 1993–1995 period.

D. Single Equation Estimates

A critical aspect of our modeling of the structure of revolvers is the assumption that leverage and loan contract terms are determined simultaneously. Prior studies have often ignored these simultaneity problems and have produced biased and inconsistent estimates of the relationships. As these studies have used somewhat different data and model specifications, it is difficult to compare their results with ours. Consequently, in Table 4, we have re-estimated our model using single stage estimates under the assumption that Leverage and revolver contract terms are exogenous. Effectively, the fitted values of the endogenous variables in Table 3 are replaced by actual values in Table 4.

A comparison of the estimates in Tables 3 and 4 suggests that failure to use simultaneous equation estimation techniques significantly biases the results. For example, failure to model the simultaneity of debt features would have resulted in us incorrectly concluding that there was no significant interrelationship between Duration and Secured, and that Duration and Secured have strong positive effects on Comfee. With respect to the latter, in modeling revolver commitment fees, Shockley and Thakor (1997) assume duration and secured status are exogenous as in Table 4 and find very strong direct and inverse relationships, respectively. Neglect of the simultaneity of contract terms appears to explain their significant results.

Our results also shed light on an empirical debate relating to the effects of agency problems on debt maturity. Barclay and Smith (1995a) find that the degree of contracting problems, proxied by Market/Book, is inversely related to debt maturity. However, when Stohs and Mauer (1996) control for the firm’s leverage,
<table>
<thead>
<tr>
<th>Independent Variable</th>
<th>Duration&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Secured&lt;sup&gt;b&lt;/sup&gt;</th>
<th>All-in-Spread&lt;sup&gt;d&lt;/sup&gt;</th>
<th>Comfee&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duration</td>
<td>0.031</td>
<td>-0.124</td>
<td>0.023</td>
<td>0.248</td>
</tr>
<tr>
<td>Secured</td>
<td>-0.023</td>
<td>0.751</td>
<td>0.070</td>
<td>0.248</td>
</tr>
<tr>
<td>All-in-Spread</td>
<td>(-0.29)</td>
<td>(19.07)***</td>
<td>(5.69)***</td>
<td>(4.29)***</td>
</tr>
<tr>
<td>Comfee</td>
<td>0.735</td>
<td>(7.82)***</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>1.626</td>
<td>2.981</td>
<td>1.202</td>
<td>0.332</td>
</tr>
<tr>
<td>(6.16)***</td>
<td>(8.64)***</td>
<td>(6.20)***</td>
<td>(1.21)</td>
<td></td>
</tr>
<tr>
<td>Market/Book</td>
<td>-0.048</td>
<td>0.152</td>
<td>0.750</td>
<td>-0.004</td>
</tr>
<tr>
<td>(-1.05)</td>
<td>(1.99)***</td>
<td>(3.54)***</td>
<td>(-0.66)</td>
<td></td>
</tr>
<tr>
<td>Unexpected Earnings</td>
<td>-0.020</td>
<td>0.357</td>
<td>0.070</td>
<td>0.192</td>
</tr>
<tr>
<td>(-0.24)</td>
<td>(1.29)</td>
<td>(1.65)</td>
<td>(1.58)</td>
<td></td>
</tr>
<tr>
<td>Z-Score</td>
<td>0.007</td>
<td>-0.174</td>
<td>-0.066</td>
<td>-0.176</td>
</tr>
<tr>
<td>(0.08)</td>
<td>(-2.83)***</td>
<td>(-4.09)***</td>
<td>(-3.66)***</td>
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<td>Z-Squared</td>
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<td>Tax/Assets</td>
<td>1.768</td>
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<tr>
<td>Earnings Variance</td>
<td>-1.637</td>
<td>(-1.92)*</td>
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<tr>
<td>Term Premium</td>
<td>0.004</td>
<td>0.158</td>
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</tr>
<tr>
<td>(0.11)</td>
<td>(3.90)***</td>
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<tr>
<td>Interest Volatility</td>
<td>0.229</td>
<td>0.174</td>
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<td></td>
</tr>
<tr>
<td>(1.09)</td>
<td>(1.66)*</td>
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<tr>
<td>Leverage</td>
<td>1.180</td>
<td>5.612</td>
<td>1.858</td>
<td>0.126</td>
</tr>
<tr>
<td>(4.44)***</td>
<td>(8.20)***</td>
<td>(12.66)***</td>
<td>(2.86)***</td>
<td></td>
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<tr>
<td>Libor</td>
<td>0.578</td>
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</tr>
<tr>
<td>(3.40)***</td>
<td></td>
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<tr>
<td>Loan Concentration</td>
<td>0.414</td>
<td>0.301</td>
<td>0.149</td>
<td>0.149</td>
</tr>
<tr>
<td>(3.50)***</td>
<td>(11.28)***</td>
<td></td>
<td>(1.83)*</td>
<td></td>
</tr>
<tr>
<td>Firm Size</td>
<td>0.159</td>
<td>-0.489</td>
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<td>-0.541</td>
</tr>
<tr>
<td>(7.33)***</td>
<td>(-10.35)***</td>
<td></td>
<td>(-4.62)***</td>
<td></td>
</tr>
<tr>
<td>Asset Maturity</td>
<td>0.056</td>
<td></td>
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</tr>
<tr>
<td>(1.22)</td>
<td></td>
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<tr>
<td>Capital Adequacy</td>
<td>0.175</td>
<td></td>
<td>-0.541</td>
<td></td>
</tr>
<tr>
<td>(2.10)**</td>
<td></td>
<td></td>
<td>(-4.62)***</td>
<td></td>
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<tr>
<td>Multiple Revolvers</td>
<td></td>
<td></td>
<td>-0.058</td>
<td></td>
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<tr>
<td>Term Loan</td>
<td>-0.071</td>
<td>0.064</td>
<td></td>
<td></td>
</tr>
<tr>
<td>(-1.76)*</td>
<td></td>
<td></td>
<td>(5.44)***</td>
<td></td>
</tr>
<tr>
<td>Syndicate</td>
<td>-0.908</td>
<td>0.062</td>
<td></td>
<td>-0.104</td>
</tr>
<tr>
<td>(-20.99)***</td>
<td></td>
<td></td>
<td>(5.07)***</td>
<td>(-4.05)***</td>
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<tr>
<td>Repayment/Recap.</td>
<td>0.070</td>
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<tr>
<td>(1.46)</td>
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<td>Acquisitions</td>
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<td>(1.15)</td>
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<tr>
<td>Other Purpose</td>
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<tr>
<td>(-0.92)</td>
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<td>(-4.05)***</td>
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<td>#Observations</td>
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<td>1303</td>
<td>2634</td>
<td>2634</td>
</tr>
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<sup>a</sup> t-statistics in parentheses while *, **, and *** indicate significance at 10%, 5%, and 1%, respectively.
<sup>b</sup> Estimated using logit estimator.
<sup>c</sup> Estimated using tobit estimator.
<sup>d</sup> Estimated using OLS.
they fail to find a significant relationship between Market/Book and debt maturity, but find a strong direct relationship between Leverage and debt maturity (assuming Leverage is exogenous). Our single equation estimates in Table 4 mirror those of Stohs and Mauer with Market/Book insignificant and Leverage significantly positive. But when contract terms and leverage are modeled endogenously as in Table 3, both Market/Book and Leverage are significantly negative, consistent with the contracting hypothesis and Barclay and Smith's results.  
Thus, the simultaneous treatment of contract terms and leverage appears critical in testing contracting hypotheses because of the substitutability between these mechanisms. Generally, Market/Book is more significant in contract design and less significant in contract pricing when contract terms are modeled endogenously than when modeled exogenously.

A third area where the simultaneous systems modeling has a significant influence is in evaluating the impact of credit quality on contract terms. When leverage and contract terms are exogenous, as in Table 4, the coefficient of Altman's Z-Score is insignificant in the duration equation but significant in the secured and pricing equations, whereas the reverse holds when they are modeled simultaneously.

V. Conclusion

Despite the economic importance of revolving credit lines to medium and large firms, relatively little is known about the design and pricing of these contracts. Our study addresses this gap in the empirical literature by investigating hypotheses relating to how contracting costs, signaling, taxes, credit quality, bank relationships, bank information monopolies, and option pricing theory affect contract terms on a large sample of bank revolvers. Whereas prior studies have examined these hypotheses in relation to a single debt contract feature while assuming other contract terms are exogenously given, the unique contribution of our study is the modeling of contract design and pricing decisions within a simultaneous decision framework. Our results suggest strong interdependencies between debt contract terms that appear to be driven by asymmetric information, contracting costs, and/or credit risk. For example, the positive relationship between duration and secured is consistent with their roles in alleviating asset substitution and underinvestment problems while the positive relationship between all-in-spread and commitment fee is consistent with Shockley and Thakor's (1997) model in which the use of commitment fees within multiple-fee structure contracts resolves underinvestment problems. On the other hand, the relationships between all-in-spread and both duration and secured appear to be associated with credit risk explanations as high risk borrowers are required to pledge collateral and accept shorter duration revolvers.

The interrelated nature of debt contract features has econometric implications for testing hypotheses related to their underlying determinants. Prior studies have often ignored the endogeneity and/or simultaneity problems and, thus, have

13 By omitting Leverage from their regression model, Barclay and Smith (1995a) implicitly assume leverage is endogenous.
produced potentially biased and inconsistent estimates of the relationships. Our results illustrate how those in several prior studies may be explained by their implicit, though inappropriate, assumption that leverage and other contract terms are exogenously given.

We also find that, consistent with the agency/contracting hypotheses, duration is inversely related and secured status directly related to growth opportunities. These results are consistent with the balance sheet studies of Barclay and Smith (1995a), (1995b) and the incremental public debt study of Guedes and Opler (1996). In addition, we find that revolver duration is related to liquidity risk in a non-monotonic manner as predicted in Diamond (1991b) and that firms exploit tax advantages in choosing revolver duration. Finally, our results for revolver pricing are consistent with the option pricing approach of Merton (1974) with the all-in-spread directly related to leverage and interest volatility and inversely with duration. There is also support for the relationship pricing models of Greenbaum et al. (1989) and Sharpe (1990), in which pricing increases as a relationship develops. Little support, however, is found for signaling and information monopoly hypotheses.

A limitation of our study is that, while revolver facilities form a significant part of the total debt of firms in our sample, in many cases, there are alternative financing arrangements in place on which contract terms could also be structured so as to restrict the contracting problems. Moreover, Berkovitch and Kim (1990) show that, under symmetric information, the optimal debt contract is project financing and not a secured debt contract. These important issues suggest the need for studies based on a more comprehensive database of incremental debt issues.

Appendix: Variables—Definitions and Sources

A. Dependent Variables

Duration = Revolver contract length in years. Source: Dealscan.
Secured = Indicator variable for secured status of facility. Equals unity if secured and zero if unsecured. Source: Dealscan.
All-in-Spread = The basis point coupon spread over Libor plus the annual fee and the upfront fee spread over the revolver’s duration. Source: Dealscan.
Comfee = The usage fee charged on the undrawn portion of the revolver expressed in basis points. Source: Dealscan.

B. Independent Variables

Market/Book = Tobin’s Q as proxy for growth opportunities. Defined as (TA+ MKVALF−CEQ)/TA where TA is book value of total assets, MKVALF is market value of firm at fiscal year end, and CEQ is total common equity. Source: Compustat.
Unexpected Earnings = Defined as (EPS_{t+1} − EPS_t)/SP_t where EPS is earnings per share and SP is the share price. If missing data, it is proxied by industry median value. Source: Compustat.
Z-Score = Defined as \((3.3 \times \text{EBIT/Sales} + 1.0 \times \text{Sales/TA} + 1.4 \times \text{RE/TA} + 1.2 \times \text{WC/TA})\) where EBIT is earnings before interest and taxes, RE is retained earnings, and WC is working capital. Z-Score is censored from below at zero. Source: Compustat.

Tax/Assets = Taxes paid for the year scaled by TA. Source: Compustat.

Earnings Variance = Standard deviation of the change in earnings, before interest, taxes, and depreciation, for five years preceding deal date and scaled by average total assets for that period. Source: Compustat.

Interest Volatility = A monthly moving series of the 12-month standard deviation of daily yields on 10-year U.S. T-bonds is averaged over the deal year. Source: Federal Reserve Board.

Term Premium = The 12-month average for the deal year of the yield differential between 10-year and one-year U.S. T-bonds. Source: Federal Reserve Board.

Loan Concentration = Defined as \(\ln(\text{Deal}/(\text{Deal + TD}))\) where Deal is the deal amount and TD is total debt including long-term debt and current liabilities. Sources: Dealscan and Compustat.

Libor = Deal month end Libor rate. Source: Citibank.

Firm Size = Proxy for real firm size defined as \(\ln(100 \times (\text{TA + MKVALF} - \text{CEQ})/\text{CPI})\), where TA is total assets, MKVALF is market value of firm, CEQ is total common equity, and CPI the consumer price index. Sources: Compustat and Federal Reserve Board.

Asset Maturity = Defined as \(\ln(\text{NET PPE}/\text{TA}) \times (\text{NET PPE}/\text{DEPN})\) for firms with non-zero depreciation expense or proxied by industry median for firms with zero depreciation or with missing data where PPE is fixed assets, and DEPN is depreciation expense. Source: Compustat.

Leverage = Defined as \(\text{TD}/(\text{TA+MKVALF} - \text{CEQ})\) where TD is total debt, TA is total assets, MKVALF is market value of firm, and CEQ is total common equity. Source: Compustat.

Capital Adequacy = Indicator variable for change in treatment of undrawn commitments with original durations longer than one year after December 1992. Equals unity if deal date 1993 or later and zero otherwise. Source: Dealscan.

Multiple Revolvers = Indicator variable. Equals unity if more than one revolver in the deal and zero otherwise. Source: Dealscan.

Term Loan = Indicator variable. Equals unity if the deal also includes a term loan and zero otherwise. Source: Dealscan.

Syndicate = Indicator variable. Equals unity if lender is a syndicate of banks and zero otherwise. Source: Dealscan.

Repayment/Recap. = Loan purpose indicator variable. Equals unity if for debt repayment or recapitalization and zero otherwise. Source: Dealscan.

Acquisitions = Loan purpose indicator variable. Equals unity if for an acquisition or leveraged buy out and zero otherwise. Source: Dealscan.
Other Purpose = Loan purpose indicator variable for residual category. Equals unity if not for working capital, general corporate purposes, Repayment/Recap., or Acquisitions, and zero otherwise. Source: Dealscan.

References


12 The Determinants of Corporate Debt Maturity Structure
Mark Hoven Stohs; David C. Mauer
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13 The Maturity Structure of Corporate Debt
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References

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