Advances in Quantitative Analysis of Finance and Accounting

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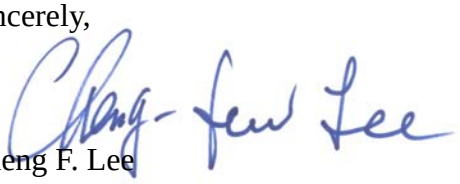
Dear Prof. Aron A. Gottesman,

It is my pleasure to inform you that your paper entitled "Corporate Loan Spreads, Market Power, and the Default-Free Rate" has been accepted for publication for the Advances in Quantitative *Analysis of Finance and Accounting* (AQAFA).

Sincerely,



Cheng F. Lee

Corporate Loan Spreads, Market Power, and the Default-Free Rate

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Abstract:

The relation between corporate loan spreads and the default-free rate is investigated to determine whether lenders of corporate loans influence prices through increasing loan spreads as the default-free rate decreases, exploiting borrowers' rate relief. The Loan Pricing Corporation DealScan database is employed to create large samples of revolving and term loans, which are independently estimated using techniques that overcome simultaneous equation bias. We find evidence to support the contention that lenders of revolving loans influence loan spreads through increasing commitment fees as the default-free rate decreases. We do not find any evidence that lenders of term loans influence loan spreads.

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Corporate Loan Spreads, Market Power, and the Default-Free Rate

Abstract

The relation between corporate loan spreads and the default-free rate is investigated to determine whether lenders of corporate loans influence prices through increasing loan spreads as the default-free rate decreases, exploiting borrowers' rate relief. The Loan Pricing Corporation DealScan database is employed to create large samples of revolving and term loans, which are independently estimated using techniques that overcome simultaneous equation bias. We find evidence to support the contention that lenders of revolving loans influence loan spreads through increasing commitment fees as the default-free rate decreases. We do not find any evidence that lenders of term loans influence loan spreads.

Corporate Loan Spreads, Market Power, and the Default-Free Rate

Are lenders of corporate loans competitive price takers, or do they engage in price influencing behavior? To test the market structure of the corporate loan market, this paper examines the relation between corporate loan spreads (rates and fees net of the default-free rate) and the level of the default-free rate. In competitive markets lenders are price takers, hence any decrease in the default-free rate should be bid away and flow fully to the borrower, and loan spreads should not change as the default-free rate changes. But when there are barriers to entry lenders will take advantage of their market power and increase loan spreads as the default-free rate decreases, exploiting borrowers' rate relief. Conversely, loan spreads will decrease as the default-free rate increases, reversing the exploitation, as loan spreads return to the original optimal levels. Hence, loan spreads should be inversely related to the default-free rate if lenders influence prices.

In our data both the values of the changes in the default-free rate, LIBOR, and the change in loan spreads are observable in our tests. Through relating loan spreads to changes in LIBOR, we directly observe whether lenders engage in price influencing behavior. If loan spreads are neutral to changes in LIBOR, then lenders are price takers. But if loan spreads are inversely related to changes in LIBOR, then lenders are price influencers. This permits analysis of market structure without relating the Herfindahl index to the level of prices. Using the Loan Pricing Corporation DealScan database, we create and independently estimate large samples of revolving and term loans. Our samples include measures of loan spread and loan manager participation, as well as controls for quantity, borrower, and loan characteristics. Following earlier work, the key measures of spread are "all in spread drawn" and "commitment fee." All in spread drawn is the basis point coupon spread over LIBOR plus the annual fee and upfront fee, spread over the life of the loan, while the commitment fee is the annual fee charged on unused portions of the loan. We recognize that even without market power considerations, loan spreads can be affected by changes in risk-free rates. Hence to attribute changes in credit spreads to the market power of the lender, we must account for changes in loan spreads that occur absent market power through controlling for other

determinants of credit spreads that vary as the risk-free rate changes. Our control variables are discussed in detail in Section I.

Any test that relates loan contract terms must also account for simultaneity. Because many loan contract term choices are made simultaneously, attempting to use ordinary least squares estimation techniques results in simultaneous equation bias if some of the independent variables are endogenous.[1] As Dennis, Nandy, and Sharpe (2000) note, the loan contract terms literature includes two distinct approaches towards overcoming the simultaneous equation bias issue. One approach is to exclude endogenous contract terms as independent variables, resulting in reduced form equations in which ordinary least squares estimation does not result in simultaneous equation bias. A second approach is to include endogenous contract terms as independent variables, and use estimation techniques such as two stage least squares to overcome simultaneous equation bias.[2] Acknowledging the simultaneity in the choice of contract terms, we first estimate a system of reduced form equations in which there are no endogenous contract terms as regressors. We then estimate a system of simultaneous equations to model the simultaneous nature of the choice of contract terms, and use two stage least squares estimation to overcome simultaneous equation bias.

Our analysis demonstrates that the commitment fees that lenders charge for revolving loans are inversely related to the level of LIBOR, supporting the contention that lenders influence prices in the market for revolving loans, but we do not find evidence that spreads are otherwise related to the level of LIBOR. For the term loan sample, estimations of both the reduced form equations and the system of simultaneous equations provide evidence that the commitment fee is positively related to LIBOR, supporting the contention that lenders do not influence prices in the term loan market.

We also test whether there is a relation between manager participation and LIBOR. Change in LIBOR is not tainted by the time restriction issue hence these tests allow us to deduce conclusively whether

[1] For example, Lin and Yi (2005) demonstrate how a bank's optimal loan rate and its rate-taking loan amount are jointly determined by a number of factors.

[2] Examples of studies that utilize reduced form equation estimation include Berger and Udell (1995) and Guedes and Opler (1996), while examples of studies that utilize simultaneous equation estimation include Dennis et al. (2000), Coleman, Esho, and Sharpe, (2002), and Lee, Lin, and Chen (2010).

manager participation is a function of price influencing behavior. Estimation using reduced form equations tests the relation between measures of manager participation and LIBOR, while estimation of the system of simultaneous equations tests the relation between measures of manager participation and loan spreads. We find evidence that the proportion of managers and the share of the loan held by managers are positively related to LIBOR.

The idea that changes in loan spreads can be used to test for market power comes from Foster (1989). Foster examines the introduction of shelf registration in 1982, which resulted in cost reduction for underwriting syndicates, but also added time restrictions. Foster does not relate loan spreads to the cost reduction associated with shelf registration, because the cost reduction is unobservable. Instead, Foster estimates changes in measures of loan manager participation, including the size of syndicates, the number of managers, and the proportion of the issue underwritten by managers. He argues that if the decrease in loan spreads is less than the cost reduction associated with shelf registration, then powerful banks should increase their participation to take advantage of the inflated net of costs spreads. Foster finds that underwriting syndicates have fewer members following shelf registration, suggesting increased commitment and price influencing behavior. However, Foster notes that the decreased size of syndicates could be a function of time restrictions associated with shelf registration, not deeper commitment, and therefore may not intimate price influencing behavior.

The need to identify the market structure of the corporate loan market is heightened by the Covitz and Heitfield (1999) theoretical model, which relates market structure to loan rates and bank risk. Covitz and Heitfield (1999) argue that when lending markets encompass high borrower moral hazard and limited lender moral hazard, banks with market power charge lower loan rates than competitive banks. This conclusion suggests that estimating market power through measuring the level of rates, as suggested by Berger and Hannan (1989) and Hannan (1991, 1997), is problematic. The conventional tests use measures of concentration such as the Herfindahl index and relate them to the level of prices. Covitz and Heitfield's (1999) result suggest that measuring market concentration through relating the Herfindahl index to prices is of questionable relevance. Hence, the structure of the corporate loan market remains unidentified.

The rest of this study is organized as follows. Section I discusses control variables. Section II details the method through which the data is extracted. Section III presents the estimation of the reduced form equations, while Section IV presents the estimation of the system of simultaneous equations. Section V offers conclusions.

I. Control Variables

To attribute changes in credit spreads to the market power of the lender, we control for other determinants of credit spreads that vary as the risk-free rate changes. The most important such determinant of credit spread is the borrower's credit risk; we must clearly control for the borrower's riskiness. But simply using the borrower's credit rating is insufficient, as ratings are measures of long-run average credit risk that are poorly related to changes in short- and medium- term default risk. Because the relationship between ratings and risk varies systematically with the business cycle, ratings overstate risk when the macro-economy is performing well and understate risk when the macro-economy is performing poorly. At the same time, the typical policy reaction associated with a deteriorating macroeconomy is to reduce the level of the risk-free rate. Hence, using ratings to control for risk can result in the identification of a negative relation between spreads and the risk-free rate that is due to the increased credit-risk, unrelated to market power.[3] Other measures such as earnings variance are similarly troublesome. In this paper, we use an options-theoretic approach to estimate the implied default probability on the date of loan initiation based on Merton (1974), as detailed in Allen and Peristiani (2004).[4] We first use Newton's nonlinear approximation technique to solve the following system of two nonlinear equations for borrower *i*'s asset value and asset volatility at time *t*, V_{Ait} and σ_{Ait}, as follows:

$$V_{Eit} = V_{Ait} N(DD_{it}) - e^{-r_t T} L_{it} N(DD_{it} - \sigma_{Ait}\sqrt{T}) \tag{1}$$

$$\sigma_{Eit} = \frac{V_{Ait}}{V_{Eit}} N(DD_{it}) \sigma_{Ait} \tag{2}$$

[3] See Standard and Poor's (2004) and Treacy and Carey (1998).
[4] See Chapter 4 of Saunders and Allen (2002) for a general discussion of options-theoretic approaches.

where $DD_{it} = \left[\ln(V_{Ait} / L_{it}) + T(r_t + 0.5\sigma^2{}_{Ait})\right] / \sigma_{Ait}\sqrt{T}$; V_{Eit} is the market value of borrower *i*'s equity at time *t*; L_{it} is the borrower's debt; r_t is the risk free rate; σ_{Eit} is borrower *i*'s equity volatility at time *t*; *T* is the period, and *N*( ) is the normal distribution. We then calculated the implied default probability as $N(-DD_{it})$. Allen and Peristiani note that the implied default probability does not correspond to the actual probability due to the normality assumption, but argue that this measure is time-consistent and reflects variations in the probability of default. These characteristics of the implied default probability suggest that it is a superior measure of credit risk than traditional measures such as credit rating or earnings variance.

Another determinant of credit spread that can vary as the risk-free rate changes is the quantity of loans. A shortcoming associated with earlier papers that relate loan spreads to other contract terms is that they do not control for the relation between loan spreads and the quantity of loans written in the supply and demand equilibrium. Controlling for quantity effects is particularly vital when relating loan spreads to the risk-free rate, as changes in the risk-free rate can trigger changes in the equilibrium level of quantity. We control for quantity through creating an index that represents the total dollar amount of loans written during every month in our sample.

In addition to risk and quantity, tests relating spreads to the default-free rate must take other potentially confounding factors into consideration. Estimation is performed independently for term and revolving loans. As noted in Coleman, Esho, and Sharpe (2002), differences in borrower and lender characteristics between term and revolving loans suggest that empirical tests should be performed independently for these two samples. Term to maturity is controlled, as there is evidence that longer maturity loans are associated with higher spreads (Helwege and Turner (1999) and Coleman et al. (2002)) or lower spreads (Strahan (1999) and Dennis et al. (2000)). There is also evidence that the inverse relation between maturity and spread exists because lenders allocate longer-term loans to lower risk borrowers, but individual borrowers face a positive relation (Gottesman and Roberts (2003)) and that more flexible and stronger firms use short-term debt (Jun and Jen (2003)). Securitization is controlled, as there is

evidence that loan spreads and bond yields are higher for secured debt (Berger and Udell (1990, 1995), Dennis et al. (2000), and John, Lynch, and Puri (2002)). While lending officers at financial institutions require security from riskier borrowers (Orgler (1970), Hester (1979), Berger and Udell (1990, 1995), Carey, Post and Sharpe (1998), and Harhoff and Korting (1998), there is evidence that unsecured loans are associated with lower spreads even after controlling for risk (Dennis et al. (2000)). Finally, the tests control for the calendar date, loan size, and borrower size.[5]

II. Data extraction

We use the Loan Pricing Corporation DealScan database to extract syndicated loan deals to US borrowers initiated between January 1, 1988 and December 31, 1999. Typically, a loan deal consists of a number of dissimilarly designed loans, designated "facilities," made to the same borrower on a given date. The tests are performed independently for term and revolving loans, based on the DealScan database categorization of loans as term or revolving. Regression estimation techniques are employed to determine the relations between LIBOR, spreads, and measures of loan manager participation, while controlling for quantity, borrower, and loan characteristics. LIBOR is the monthly US dollar one month LIBOR, from the British Bankers' Association. The LIBOR values represent the average of the daily rate for the month.

Measures of loan spreads include RATEAISD and COMFEE. RATEAISD is the basis point coupon spread over LIBOR plus the annual fee and upfront fee, spread over the life of the loan. COMFEE is the commitment fee charged on unused portions of the loan.

Measures of manager participation include NUMBSYN, PERCMAN, and SHAREMAN. NUMBSYN is the number of lenders in the syndicate. PERCMAN is the proportion of lenders categorized as managers. SHAREMAN is the share of the loan held by managers.

Measures of quantity include QTYREVO and QTYTERM. QTYREVO is a monthly index of the quantity of revolving loans. It is calculated as the natural logarithm of the sum of the dollar amount of all

[5] A control variable for seniority was also considered, as senior debt is less risky than subordinated debt, ceteris paribus, and should therefore be associated with lower spreads. However, the vast majority of our sample is senior debt, hence we exclude seniority as a control variable.

revolving loans reported in the DealScan databases that are written in the same month as the loan under consideration. Hence, there is a unique value of QTYREVO associated with each of the 144 months in the sample. QTYTERM is a monthly index of term loans written. It is calculated similar to QTYREVO, but for the term loan sample. Table I provides descriptive statistics of the monthly values of LIBOR and measures of quantity.

TABLE I HERE

Borrower characteristics include PROBDEF and FIRMSIZE. PROBDEF is the implied default probability, estimated using the methodology detailed in Section 1. As discussed in Section 1, the implied default probability is a function of the risk free rate, the volatility of the borrower's daily equity returns, market value, and debt. The risk free rate is the T-bill constant maturity 1-year rate from the *Federal Reserve Bank Reports* database on the date of loan initiation. Volatility is the standard deviation of the borrower's daily returns, extracted from CRSP, for a minimum of 30 and a maximum of 100 trading days before the date of the loan initiation. The borrower's market value is the shares outstanding multiplied by the closing price or bid/ask average on the date of facility initiation, and extracted from CRSP. Debt is the value of the borrower's long-term debt as reported on COMPUSTAT for the fiscal year that ends in the same year as the loan initiation. FIRMSIZE is the natural logarithm of the borrower's market value.

Loan characteristics include MATURITY, LOANSIZE, DATE, and measures of securitization. MATURITY is the maturity of the loan, measured in months. LOANSIZE is the natural logarithm of the loan size. DATE is the natural logarithm of the date on which the loan begins. A value of one is assigned to January 1, 1988, and higher values in increments of one are assigned to each incrementally later date. The DealScan database only specifies whether the loan is securitized for approximately 47.6% and 59.7% of revolving and term loans initially extracted, respectively. We create three indicator variables, YESEC, NOSEC, and MISEC, that are equal to unity if the securitization status is secured, unsecured, or missing, respectively.[6]

[6] Dennis et al. (2000) note that excluding observations for which securitization is missing can bias estimates. Securitization is a dependent variable in Dennis et al.'s (2000) tests, hence the use of multiple indicator variables to

To permit comparison across results, we eliminate any loan for which any variable is missing. Based on the above, we extract 4,024 revolving and 1,419 term loans. Table II provides descriptive statistics for the term and revolving loans samples used in the tests. As well, a difference of means test is performed to compare the two samples. There are statistically significance differences between the revolving and term loan samples for all but one variable (QTYTERM), justifying the use of independent estimation.[7]

TABLE II HERE

We perform two types of estimations. First, we estimate a system of reduced form equations, in which there are no endogenous contract terms as regressors. This system allows us to estimate the impact that changes in LIBOR have on measures of spread and manager participation, while controlling for quantity, borrower, and loan characteristics. Second, we estimate a system of simultaneous equations, to model the simultaneous nature of the choice of the two measures of spread, RATEAISD and COMFEE, as well as the three measures of manager participation, NUMBSYN, PERCMAN, and SHAREMAN.

III. Estimation of reduced form equations

The purpose of this section is to determine the relations between LIBOR, loan spreads, and measures of manager participation through estimating a system of reduced form equations that exclude endogenous contract terms as regressors. The exclusion of endogenous contract terms permits ordinary least squares estimation without introducing simultaneous equation bias. The dependent variables in the regression tests are RATEAISD, COMFEE, NUMBSYN, PERCMAN, and SHAREMAN. To test the core relation, all of the regressions use LIBOR as an independent variable. If lenders are price takers, then loan spreads and manager participation should not change as LIBOR changes. But if lenders influence prices, then we

measure securitization would be inappropriate. Their approach is to limit the use of the sample that excludes the missing securitization observations to reduced form and structural estimates of securitization status.

[7] One notable difference between the two samples is the difference in the values for the COMFEE variable, valued at 20.89 and 2.47 basis points for the revolving and term loan samples, respectively. The reason for this difference is that the value of COMFEE is greater than zero for only approximately 5.8% of the term loans, while approximately 63.1% of the revolving loans have COMFEE values greater than zero. Of the observations with COMFEE values greater than zero, the average value for COMFEE is 33.08 and 42.24 basis points for the revolving and term loan samples, respectively.

expect an inverse relation between LIBOR and all of the dependent variables except NUMBSYN, for which we expect a positive relation with LIBOR. Other independent variables are used to control for quantity, borrower, and loan characteristics. The regression model with RATEAISD as the dependent variable is specified as follows:

$$\begin{aligned} \text{RATEAISD} = {} & \alpha_0 + \alpha_1 \text{ x LIBOR} + \alpha_2 \text{ x QTYREVO} + \alpha_3 \text{ x QTYTERM} + \alpha_4 \text{ x FIRMSIZE} \\ & + \alpha_5 \text{ x PROBDEF} + \alpha_6 \text{ x MATURITY} + \alpha_7 \text{ x DATE} + \alpha_8 \text{ x YESEC} \\ & + \alpha_9 \text{ x NOSEC} + \alpha_{10} \text{ x LOANSIZE} + e, \end{aligned} \tag{3}$$

where α_k for k = 1 to 10 are the coefficients associated with the independent variables, and e is the residual. The regression models with COMFEE, NUMBSYN, PERCMAN, and SHAREMAN as dependent variables share the same independent variables as specified in Eq. (1) above. QTYREVO and QTYTERM are included as control variables for both the revolving and term loan sample estimations, to allow for the possibility that demand for one type of loan can influence the price of the other type of loan. Note that while Dennis et al. (2000) treat maturity and security as jointly determined endogenous variables, they model a unidirectional relation from the maturity and security joint decision to the RATEAISD and COMFEE joint decision, hence treating these variables as exogenous variables is justified.

We estimate the regression model specified in Eq. (1) using three methods, with each method imposing different restrictions. The first method tests the relation between the dependent variable and both LIBOR and measures of quantity (QTYREVO and QTYTERM) exclusively. The second method adds controls for borrower characteristics (FIRMSIZE and PROBDEF). The third method adds controls for loan characteristics (MATURITY, DATE, YESEC, NOSEC, and LOANSIZE) to the previous method.

III.A. Revolving loan sample

The results for the revolving loan sample are presented in Panel A of Table III. We find strong evidence that the COMFEE component of loan spreads are inversely related to LIBOR, supporting the contention that lenders influence prices in the market for revolving loans, but only find weak evidence that RATEAISD is inversely related to LIBOR. When RATEAISD is the dependent variable, the coefficients associated with LIBOR are valued at –0.98, –2.3, and –1.06 for regressions one through three, respectively. The coefficient is only significant for regression two, at the 1% level. When COMFEE is the dependent variable, the coefficients associated with LIBOR are valued at –0.81, –0.86, and –1.38 for regressions one through three, respectively, significant at the 1% level. For both the RATEIASD and COMFEE cases, adjusted R^2 is highest for regression three, valued at 0.51 and 0.14, respectively.

TABLE III HERE

We do not find evidence to support the existence of a positive relation between the size of the syndicate and LIBOR for the revolving loan sample. Of the regressions in which NUMBSYN is the dependent variable, none are associated with a significant coefficient for the LIBOR variable.

We do not find any evidence to support the existence of an inverse relation between LIBOR and either the proportion of the syndicate composed of managers or the share of the loan held by managers for the revolving loan sample. Instead, we find evidence of a positive relation between these dependent variables and LIBOR. Of the regressions in which PERCMAN is the dependent variables, regressions one and three are associated with significant coefficients for the LIBOR variable at the 10% and 1% levels, respectively, with coefficients valued at 0.77 and 1.84. Similarly, of the regressions in which SHAREMAN is the dependent variables, regressions one and three are associated with significant coefficients for the LIBOR variable at the 10% and 1% levels, respectively, with coefficients valued at 0.64 and 1.80. For both the PERCMAN and SHAREMAN cases, adjusted R^2 is highest for regression three, both valued at 0.48.

III.B. Term loan sample

The results for the term loan sample are presented in Panel B of Table III. We do not find evidence of a negative relation between spreads and LIBOR. Instead, the relation between RATEAISD and LIBOR is insignificant. Further, when COMFEE is the dependent variable, the coefficients associated with the LIBOR independent variable are significantly positive for regressions one through three, with coefficient values of 0.98, 1.04, and 0.69, respectively. These results are significant at the 1% level. Adjusted R^2 is highest for regression three, valued at 0.10.

We do not find any evidence to support the existence of a positive relation between the size of the syndicate and LIBOR for the term loan sample. Of the regressions in which NUMBSYN is the dependent variable, all coefficients associated with the LIBOR variable are insignificant. As we found for the revolving loan sample, we find evidence for the term loan sample of a positive relation between the LIBOR independent variable and both the proportion of the syndicate composed of managers and the share of the loan held by managers. Of the regressions in which PERCMAN is the dependent variable, regressions one through three are associated with significantly positive coefficients for the LIBOR variable, valued at 1.64, 1.11, and 1.14, respectively, significant at the 10% level. Of the regressions in which SHAREMAN is the dependent variable, regressions one is associated with significant positive coefficients for the LIBOR variable, valued at 1.13, and significant at the 10% level. For both the PERCMAN and SHAREMAN cases, adjusted R^2 is highest for regression three, valued at 0.36 and 0.38, respectively.

III.C. Control variables

The estimation tests indicate that measures of spread are inversely related to the QTYREVO control variable for the revolving loan sample. This result supports the argument that tests of contract terms must control for quantity effects. For the term loan sample, there is some evidence of a negative relation between COMFEE and QTYREVO, but no evidence that RATEAISD and QTYREVO are related, suggesting that there is limited overlap in the demand for loans in the revolving and term loan markets.

Interestingly, the estimation tests provide strong evidence that loan spreads are positively related to the QTYTERM control variable, with the exception of the RATEAISD case in the term loan sample.

Measures of manager participation are generally inversely related to QTYREVO, with the exception of NUMBSYN, which is positively related. The results also suggest that significant coefficients relating QTYTERM to measures of manager participation are positive.

Our estimation indicates that all dependent variables are inversely related to the FIRMSIZE control variables, with the exception of COMFEE for the term sample, and NUMBSYN for both samples, which are positively related to FIRMSIZE. This suggests that manager participation decreases as borrower size increases, as more lenders are included in the syndicate, a lower proportion of the lenders are managers, and managers hold a lower share of the loan as borrower size increases.

RATEAISD is positively related to PROBDEF, while the relation between RATEAISD and COMFEE is insignificant. This supports the prediction that lenders require higher spreads to compensate them for lending to riskier borrowers. NUMBSYN is positively related to PROBDEF, while PERCMAN and SHAREMAN are generally inversely related to PROBDEF, with some exception. Our estimation indicates that RATEAISD is inversely related to the MATURITY control variables for both the revolving and term loan samples. PERCMAN, and SHAREMAN are inversely related to MATURITY, and COMFEE and NUMBSYN are positively related to MATURITY, for the revolving loan sample. COMFEE is inversely related to DATE for both samples, which suggests that commitment fees have decreased over the time period studied. For the revolving loan sample, there is evidence that PERCMAN and SHAREMAN are positively related to DATE while NUMBSYN is negatively related, which suggests that manager participation has increased over the time period studied. However, there is also evidence that NUMBSYN is positively related to DATE and PERCMAN is negatively related to DATE for the revolving loan sample.

Our estimation indicates that measures of spread are positively related to YESEC and inversely related to NOSEC, though this relation is insignificant in the COMFEE case for the term loan sample. This supports the finding that secured loans are associated with higher spreads than unsecured loans, even

after controlling for risk. Measures of manager participation are generally positively related to both measures of security, suggesting that the level of manager participation is greater for borrowers for which the securitization status is available on the database than it is for borrowers for which securitization is missing. Finally, our estimation indicates that RATEAISD, PERCMAN, and SHAREMAN are inversely related to the LOANSIZE control variables, while COMFEE and NUMBSYN are positively related.

IV. Estimation of simultaneous equations

In the previous section, a system of reduced form equations that exclude endogenous contract terms as regressors is used to test the relation between LIBOR, spreads and measures of manager participation. While reduced form equations permit estimation of the core relation without introducing simultaneous equation bias, a disadvantage is that the reduced form equations do not fully reflect the richness of the interdependence between loan contract terms.

In this section, we estimate a system of simultaneous equations. We model the choice of RATEAISD and COMFEE as a joint decision. This joint decision is then modeled as a determinant in the choice of NUMBSYN, PERCMAN, and SHAREMAN, which is modeled as a joint decision as well. Hence, we assume a unidirectional relation from the RATEAISD and COMFEE joint decision to the NUMBSYN, PERCMAN, and SHAREMAN joint decision. The system of simultaneous equations that we model is specified as follows:

$$\text{RATEAISD} = \gamma_{RC} \text{ x COMFEE} + \beta'_1 X_1 + e_1, \quad (4)$$

$$\text{COMFEE} = \gamma_{CR} \text{ x RATEAISD} + \beta'_2 X_2 + e_2, \quad (5)$$

$$\text{NUMBSYN} = \gamma_{NR} \text{ x RATEAISD} + \gamma_{NC} \text{ x COMFEE} + \gamma_{NP} \text{ x PERCMAN} + \gamma_{NS} \text{ x SHAREMAN} + \beta'_3 X_3 + e_3, \quad (6)$$

$$\text{PERCMAN} = \gamma_{PR} \text{ x RATEAISD} + \gamma_{PC} \text{ x COMFEE} + \gamma_{PN} \text{ x NUMBSYN} + \gamma_{PS} \text{ x SHAREMAN} + \beta'_4 X_3 + e_4, \quad (7)$$

$$\text{SHAREMAN} = \gamma_{SR} \text{ x RATEAISD} + \gamma_{SC} \text{ x COMFEE} + \gamma_{SN} \text{ x NUMBSYN} + \gamma_{SP} \text{ x PERCMAN} + \beta'_5 X_3 + e_5, \quad (8)$$

where γ_{ij} are the coefficients of the interdependence effects, β_k for k = 1 to 5 are the coefficients of the exogenous independent variables, and e_k are the residuals. We define X_1, X_2, and X_3, the vectors of exogenous independent variables, as follows:

X_1 = [Constant, LIBOR, QTYREVO, QTYTERM, FIRMSIZE, PROBDEF, MATURITY, YESEC, NOSEC, LOANSIZE], (9)

X_2 = [Constant, LIBOR, QTYREVO, QTYTERM, PROBDEF, MATURITY, DATE, YESEC, NOSEC, LOANSIZE], (10)

X_3 = [Constant, QTYREVO, QTYTERM, FIRMSIZE, PROBDEF, DATE, LOANSIZE] (11)

The idea that the choice of RATEAISD and COMFEE is a joint decision is based on Dennis et al. (2000). Dennis et al. also model the choice of maturity and security as a joint decision. In our model, we treat maturity and security as exogenous variables, as they are not the focus of this paper. As noted in the previous section, Dennis et al. model a unidirectional relation from the maturity and security joint decision to the RATEAISD and COMFEE joint decision, hence treating these variables as exogenous variables is justified.

In addition to the inclusion of endogenous variables as explanatory variables, we also refine the relation between LIBOR and the endogenous variables. The equations with measures of spread as dependent variables include LIBOR as a regressor, while LIBOR is omitted from the equations with manager participation as dependent variables. Hence, we assume that manager participation is only indirectly a function of LIBOR, but is directly a function of spreads.

We estimate the system of simultaneous equations using two stage least squares estimation, to overcome the simultaneous equation bias associated with endogenous regressors that vary systematically with the residual. Two stage least squares estimation overcomes simultaneous equation bias through replacing endogenous regressors with fitted values. In the first stage of the estimation, fitted values are estimated using instrumental regressions in which the endogenous regressors are regressed against the set of instrumental variables, which are the exogenous variables. In the second stage, the system of simultaneous equations is estimated with the endogenous regressors replaced with the fitted values estimated in the first stage.[8]

IV.A. Revolving loan sample

The results for the revolving loan sample are presented in Panel A of Table IV. We find evidence that the commitment fee is inversely related to LIBOR, supporting the contention that lenders influence prices in the market for revolving loans through manipulating COMFEE as LIBOR changes. The coefficient associated with the LIBOR independent variable is valued at –1.25, significant at the 1% level, in the regression in which COMFEE is the dependent variable. The coefficient associated with the LIBOR independent variable is insignificant in the regression in which RATEAISD is the dependent variable. These results are similar to the result by the reduced form equation ordinary least squares regressions for the revolving loan sample. The key result of both tests is that lenders exploit their borrowers' rate relief following decreases in LIBOR, suggesting that lenders influence prices in the revolving loan market.

TABLE IV HERE

We find evidence of two interdependencies between endogenous variables: between RATEAISD and COMFEE, between PERCMAN and SHAREMAN, and between NUMBSYN and SHAREMAN. In the regression in which RATEAISD is the dependent variable, the coefficient associated with the fitted

[8] See Greene (1997) for a detailed review of two stage least squares estimation. Further, note that the value for R^2 can be negative for regressions estimated using two stage least squares estimation, and does not imply that the estimates are weak. See Sribney, Wiggins, and Drukker (2003) for a detailed review of the interpretation of R^2 in the context of two stage least squares.

COMFEE regressor is valued at 0.58, significant at the 1% level. Correspondingly, in the regression in which COMFEE is the dependent variable, the coefficient associated with the fitted RATEAISD regressor is valued at 0.03, significant at the 10% level. In the regression in which PERCMAN is the dependent variable, the coefficient associated with the fitted SHAREMAN regressor is valued at 1.03, significant at the 1% level. Correspondingly, in the regression in which SHAREMAN is the dependent variable, the coefficient associated with the fitted PERCMAN regressor is valued at 0.84, significant at the 1% level. We also find evidence of interdependence between NUMBSYN and SHAREMAN. In the regression in which NUMBSYN is the dependent variable, the coefficient associated with the fitted SHAREMAN regressor is valued at –0.03, significant at the 1% level. Correspondingly, in the regression in which SHAREMAN is the dependent variable, the coefficient associated with the fitted NUMBSYN regressor is valued at –0.08, significant at the 1% level.

IV.B. Term loan sample

The results for the term loan sample are presented in Panel B of Table IV. We find evidence that RATEAISD is insignificantly related to LIBOR, while COMFEE is positively related to LIBOR. The coefficient associated with the LIBOR independent variable is valued at 0.67, significant at the 1% level, in the regression in which COMFEE is the dependent variable. This result is equivalent to our finding for the reduced form equation ordinary least squares estimation for the term loan sample, and represents evidence against the contention that lenders influence prices in the term loan market.

We find evidence of interdependence between PERCMAN and SHAREMAN, similar to our finding for the revolving loan sample. In the regression in which PERCMAN is the dependent variable, the coefficient associated with the fitted SHAREMAN regressor is valued at 1.05, significant at the 1% level. Correspondingly, in the regression in which SHAREMAN is the dependent variable, the coefficient associated with the fitted PERCMAN regressor is valued at 0.81, significant at the 1% level. We also find evidence of interdependence between NUMBSYN and PERCMAN. In the regression in which NUMBSYN is the dependent variable, the coefficient associated with the fitted PERCMAN regressor is

valued at –0.04, significant at the 1% level. Correspondingly, in the regression in which PERCMAN is the dependent variable, the coefficient associated with the fitted NUMBSYN regressor is valued at –0.21, significant at the 1% level.

IV.C. Control variables

There is evidence of an inverse relation between QTYREVO and both measures of spread, and a positive relation between QTYTERM and both measures of spread, for the revolving loan sample. There is evidence of a positive relation between COMFEE and QTYTERM for the term loan sample. These relations between loan spreads and measures of quantity are broadly similar to the relations identified following the estimation of the reduced form equations, and similarly support the argument that tests of contract terms must control for quantity effects.

There is evidence of an inverse relation between RATEAISD and the FIRMSIZE control variable for both samples. For the revolving loan sample, there is also evidence of an inverse relation between SHAREMAN and FIRMSIZE. For both samples, there is evidence of positive relations between FIRMSIZE and both NUMBSYN and PERCMAN. For both samples, there is evidence of a positive relation between RATEAISD and PROBDEF, and there is weak evidence of a positive relation between NUMBSYN and PROBDEF for the revolving loan sample.

There is evidence that RATEAISD is inversely related to MATURITY for both samples, while COMFEE is positively related for the revolving loan sample. For both samples, the dependent variable COMFEE is inversely related to DATE. YESEC is positively related to both measures of loan spread for the revolving loan sample, and positively related to RATEAISD for the term loan sample. NOSEC is inversely related to RATEAISD and COMFEE is the revolving and term loan samples, respectively. Finally, there is evidence of an inverse relation between RATEAISD and LOANSIZE, while there is evidence of a negative relation between RATEAISD and LOANSIZE, and a positive relation between COMFEE and LOANSIZE, for both samples.

V. Conclusions

This paper empirically tests whether loan spreads are inversely related to the level of the default-free rate, LIBOR. If lenders of corporate loans are competitive price takers, any decrease in the default-free rate should be bid away and flow fully to the borrower, hence loan spreads should not change as the default-free rate changes. But when there are barriers to entry, lenders will take advantage of their market power and increase loan spreads as the default-free rate decreases, resulting in an inverse relation. Using the Loan Pricing Corporation DealScan database, we create and independently estimate large samples of revolving and term loans. Our samples include measures of loan spreads and loan manager participation, as well as controls for quantity, borrower, and loan characteristics.

Acknowledging earlier research that identifies simultaneity in the choice of contract terms, we perform two types of estimations to relate both loan spreads to LIBOR, while avoiding simultaneous equation bias. First, we estimate a system of reduced form equations, in which there are no endogenous contract terms as regressors. Second, we estimate a system of simultaneous equations to model the simultaneous nature of the choice of contract terms, and use two stage least squares estimation to overcome simultaneous equation bias. For our sample of revolving loans, we find that the commitment fees are inversely related to the level of LIBOR, supporting the contention that lenders influence prices in the market for revolving loans, though we do not find evidence of a significant relation between LIBOR and the spread. For the term loan sample, estimations of both the reduced form equations and the system of simultaneous equations provide evidence that the commitment fee is positively related to LIBOR. This supports the contention that lenders do not influence prices in the term loan market.

We also relate measures of manager participation to LIBOR and loan spreads net of LIBOR. Measures of manager participation include the size of syndicates, the proportion of the syndicate composed of managers, and the share of the loan held by managers. Estimations of reduced form equations test the relation between measures of manager participation and LIBOR, while estimations of the system of simultaneous equations test the relation between measures of manager participation and

spreads. We find evidence that the proportion of managers and the share of revolving loans held by managers are positively related to LIBOR.

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Table I: Descriptive statistics of monthly values of LIBOR and measures of quantity. Statistics include the average monthly value, standard deviation, and the correlations between the variables. The average monthly values are also reported for each year. LIBOR is the monthly US dollar one month LIBOR. QTYREVO and QTYTERM are the natural logarithms of the sum of the dollar amount of all revolving and term loans initiated each month, respectively.

	LIBOR	QTYREVO	QTYTERM
Average monthly values:			
1988	7.81	23.23	22.52
1989	9.28	23.19	22.86
1990	8.26	23.01	22.03
1991	5.93	23.28	21.74
1992	3.75	23.55	22.14
1993	3.19	24.00	21.99
1994	4.46	24.32	22.45
1995	5.97	24.52	22.57
1996	5.45	24.74	22.62
1997	5.64	24.91	23.10
1998	5.57	24.39	23.36
1999	5.24	24.05	23.30
All months	5.88	23.93	22.56
Standard Deviation:	1.78	0.73	0.64
Correlations:			
QTYREVO	-0.44		
QTYTERM	0.12	0.47	

Table II: Descriptive statistics, revolving and term loan samples. Statistics include the mean value and standard deviation of each variable. The T-statistic associated with a difference of means test between the two samples is also reported. RATEAISD is the basis point coupon spread over LIBOR plus the annual fee and upfront fee, spread over the life of the loan. COMFEE is the commitment fee charged on unused portions of the loan. NUMBSYN is the number of lenders in the syndicate. PERCMAN is the proportion of lenders categorized as managers. SHAREMAN is the share of the loan held by managers. LIBOR is the monthly US dollar one month LIBOR. QTYREVO and QTYTERM are the natural logarithms of the sum of the dollar amount of all revolving and term loans initiated each month, respectively. FIRMSIZE is the natural logarithm of the borrower's market value. PROBDEF is the implied default probability. MATURITY is the maturity of the loan, measured in months. DATE is the natural logarithm of the date on which the loan begins, where a value of one is assigned to January 1, 1988, and higher values in increments of one is assigned to each incrementally later date. YESEC, NOSEC, and MISEC are indicator variables that are equal to unity if the securitization status is secured, unsecured, or missing, respectively. LOANSIZE is the natural logarithm of the loan size. We use ***, **, and * to indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

		Revolving		Term		Dif. of means test
Variable	Type	Mean	Std. Dev.	Mean	Std. Dev.	T-Stat
RATEAISD	Basis Point	190.41	129.78	262.00	139.95	-17.5***
COMFEE	Basis Point	20.89	19.96	2.47	10.66	33.13***
NUMBSYN	Number	5.63	7.48	4.22	6.48	6.31***
PERCMAN	Percent	62.33	37.00	71.64	35.84	-8.22***
SHAREMAN	Percent	67.18	33.24	74.87	32.02	-7.57***
LIBOR	Percent	5.74	1.63	6.06	1.84	-6.14***
QTYREVO	Dollar	24.15	0.72	23.98	0.76	7.31***
QTYTERM	Dollar	22.62	0.61	22.59	0.64	1.54
FIRMSIZE	Dollar	18.94	1.82	18.18	1.68	13.86***
PROBDEF	Percent	0.95	4.07	1.74	5.38	-5.71***
MATURITY	Months	37.14	22.03	56.11	30.73	-24.97***
DATE	Assigned	7.56	0.83	7.36	0.94	7.56***
YESEC	Indicator	0.53	0.50	0.74	0.44	-13.83***
NOSEC	Indicator	0.19	0.39	0.06	0.24	11.64***
MISSSEC	Indicator	0.28	0.45	0.20	0.40	5.8***
LOANSIZE	Dollar	17.41	1.78	16.40	1.85	18.23***
Sample size		4,024		1,419		

Table III: Ordinary least squares estimation of reduced-form equations. Estimation results are reported for the revolving (Panel A) and term (Panel B) loan samples. RATEAISD is the basis point coupon spread over LIBOR plus the annual fee and upfront fee, spread over the life of the loan. COMFEE is the commitment fee charged on unused portions of the loan. NUMBSYN is the number of lenders in the syndicate. PERCMAN is the proportion of lenders categorized as managers. SHAREMAN is the share of the loan held by managers. LIBOR is the monthly US dollar one month LIBOR. QTYREVO and QTYTERM are the natural logarithms of the sum of the dollar amount of all revolving and term loans initiated each month, respectively. FIRMSIZE is the natural logarithm of the borrower's market value. PROBDEF is the implied default probability. MATURITY is the maturity of the loan, measured in months. DATE is the natural logarithm of the date on which the loan begins, where a value of one is assigned to January 1, 1988, and higher values in increments of one is assigned to each incrementally later date. YESEC, NOSEC, and MISEC are indicator variables that are equal to unity if the securitization status is secured, unsecured, or missing, respectively. LOANSIZE is the natural logarithm of the loan size. We use ***, **, and * to indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Panel A: Revolving loan sample

Dependent Variable:	RATEAISD			COMFEE			NUMBSYN			PERCMAN			SHAREMAN		
Regression:	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Constant	780.44***	1118.2***	1356.95***	97.49***	108.9***	262.82***	-38.61***	-62.54***	-36.67***	157.36***	257.68***	4.20	132.58***	225.71***	-92.72*
LIBOR	-0.98	-2.30**	-1.06	-0.81***	-0.86***	-1.38***	0.06	0.11	-0.05	0.77*	0.52	1.84***	0.64*	0.40	1.80***
QTYREVO	-31.94***	-12.92***	-10.73***	-3.77***	-3.10***	-2.52***	1.89***	0.93***	0.51***	-5.97***	-1.73*	-2.11**	-4.46***	-0.53	-1.91**
QTYTERM	8.27**	10.08***	8.92***	0.85	0.92	1.62**	-0.08	-0.13	0.08	1.97	2.22**	0.26	1.71	1.94**	-0.33
FIRMSIZE		-43.94***	-21.26***		-1.53***	-2.76***		2.53***	0.73***		-10.89***	-0.90**		-10.10***	-1.48***
PROBDEF		1.96***	2.61***		0.09	-0.09		0.18***	0.06***		-0.58***	0.03		-0.54***	-0.02
MATURITY			-0.37***			0.14***			0.02***			-0.12***			-0.11***
DATE			-45.89			-22.3***			-2.92*			35.67***			45.27***
YESEC			69.94***			7.55***			0.76***			1.92*			1.68*
NOSEC			-2.21			-5.34***			0.88***			3.75***			3.60***
LOANSIZE			-16.81***			2.58***			2.34***			-12.88***			-11.11***
Adj. R^2	0.02	0.41	0.51	0.01	0.03	0.14	0.03	0.38	0.54	0.01	0.28	0.48	0.01	0.29	0.48

Panel B: Term loan sample

DependentVariable:	RATEAISD			COMFEE			NUMBSYN			PERCMAN			SHAREMAN		
Regression:	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3
Constant	593.84***	832.86***	1367.28***	8.58	1.09	125.01***	-42.1***	-58.88***	-91.29***	170.06***	240.24***	449.22***	159.52***	225.38***	330.34***
LIBOR	0.66	-1.75	-1.04	0.98***	1.04***	0.69***	-0.05	0.07	0.09	1.64**	1.11*	1.14*	1.13*	0.64	0.86
QTYREVO	-11.65	-0.62	-2.22	-1.55***	-1.82***	-0.59	0.96***	0.52*	0.28	-3.20*	-1.24	-0.86	-2.54	-0.69	-1.06
QTYTERM	-2.50	7.77	10.06	1.12**	0.82	1.35**	1.04***	0.44	0.11	-1.40	1.17	3.12**	-1.35	1.06	2.47*
FIRMSIZE		-39.86***	-22.87***		1.12***	0.60**		2.21***	0.90***		-9.42***	-0.46		-8.87***	-0.73
PROBDEF		2.17***	2.58***		-0.01	-0.05		0.11***	0.01		-0.40**	0.24		-0.36**	0.23*
MATURITY			-0.71***			0.00			0.00			0.02			0.03
DATE			-70.32			-17.77***			4.42*			-26.18*			-11.93
YESEC			60.80***			0.99			0.94***			2.21			0.65
NOSEC			-27.36*			-1.35			0.59			9.00**			7.74**
LOANSIZE			-12.37***			0.76***			1.67***			-11.15***			-10.27***
Adj.R^2	0.00	0.25	0.33	0.06	0.09	0.10	0.03	0.33	0.44	0.02	0.19	0.36	0.01	0.21	0.38

Table IV: Two stage least squares estimation of the system of simultaneous equations. Estimation results are reported for the revolving (Panel A) and term (Panel B) loan samples. RATEAISD is the basis point coupon spread over LIBOR plus the annual fee and upfront fee, spread over the life of the loan. COMFEE is the commitment fee charged on unused portions of the loan. NUMBSYN is the number of lenders in the syndicate. PERCMAN is the proportion of lenders categorized as managers. SHAREMAN is the share of the loan held by managers. LIBOR is the monthly US dollar one month LIBOR. QTYREVO and QTYTERM are the natural logarithms of the sum of the dollar amount of all revolving and term loans initiated each month, respectively. FIRMSIZE is the natural logarithm of the borrower's market value. PROBDEF is the implied default probability. MATURITY is the maturity of the loan, measured in months. DATE is the natural logarithm of the date on which the loan begins, where a value of one is assigned to January 1, 1988, and higher values in increments of one is assigned to each incrementally later date. YESEC, NOSEC, and MISEC are indicator variables that are equal to unity if the securitization status is secured, unsecured, or missing, respectively. LOANSIZE is the natural logarithm of the loan size. We use ***, **, and * to indicate statistical significance at the 0.01, 0.05, and 0.1 levels, respectively.

Panel A: Revolving loan sample

Dependent Variable:	RATEAISD	COMFEE	NUMBSYN	PERCMAN	SHAREMAN
Fitted RATEAISD		0.03***	0.01***	0.01***	0.00
Fitted COMFEE	0.58***		-0.03***	-0.03***	0.01
Fitted NUMBSYN				-0.01	-0.08***
Fitted PERCMAN			0.00		0.84***
Fitted SHAREMAN			-0.03***	1.03***	
Constant	976.29***	210.90***	-49.23***	96.65***	-83.63***
LIBOR	0.29	-1.25***			
QTYREVO	-11.53***	-2.35***	0.62***	-0.14	-0.18
QTYTERM	6.66**	1.24*	0.01	0.54*	-0.22
FIRMSIZE	-19.65***		0.72***	0.66***	-0.62***
PROBDEF	2.65***	0.00	0.04*	0.04	-0.04
MATURITY	-0.45***	0.15***			
DATE		-20.97***	-1.57	-11.06***	13.11***
YESEC	65.11***	6.69***			
NOSEC	0.47	-5.48***			
LOANSIZE	-18.38***	1.71***	2.41***	-1.21***	-0.21
Adj. R^2	0.14	0.52	0.55	0.93	0.93

Panel B: Term loan sample

DependentVariable:	RATEAISD	COMFEE	NUMBSYN	PERCMAN	SHAREMAN
FittedRATEAISD		0.00	0.00	0.00	0.00
FittedCOMFEE	-0.09		0.03**	0.00	-0.04
FittedNUMBSYN				-0.21***	-0.02
FittedPERCMAN			-0.04***		0.81***
FittedSHAREMAN			-0.01	1.05***	
Constant	868.44***	125.96***	-73.73***	89.16**	-24.32
LIBOR	0.32	0.67***			
QTYREVO	-7.18	-0.53	0.21	0.17	-0.35
QTYTERM	7.75	1.40**	0.35	0.84	-0.03
FIRMSIZE	-22.98***		0.86***	0.50*	-0.31
PROBDEF	2.56***	-0.08	0.03	0.00	0.03
MATURITY	-0.71***	0.00			
DATE		-17.38***	3.50	-13.57***	7.99*
YESEC	59.73***	0.90			
NOSEC	-28.82**	-1.26			
LOANSIZE	-12.22***	1.06***	1.17***	-0.03	-1.14***
Adj.R^2	0.10	0.33	0.48	0.91	0.91