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Evidence of jointness in the terms of relationship lending

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Abstract

This paper examines the impact of the borrower–lender relationship on the explicit loan interest rate and collateral, as well as the correlation between loan interest rates and collateral. Using a simultaneous equation approach, we find that collateral has a statistically significant positive impact of 200 to 400 basis points on loan interest rates. We find this positive association to be stronger for personal (or outside) collateral than collateral provided by the firm's assets (or inside collateral). Finally, we find the economic impact of the borrower–lender relationship to be 21 basis points for one standard deviation increase in relationship length.
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0. Introduction

The theoretical financial intermediation literature (Hodgman, 1963; Kane and Malkiel, 1965; Diamond, 1984, 1991; Ramakrishnan and Thakor, 1984; Fama, 1985; Sharpe, 1990; Rajan, 1992; and Padilla and Pagano, 1997; among others) has often argued that banks produce information about borrower firms through their lending relationships, which is otherwise not available to the capital markets. This literature emphasizes the informational advantage reaped by banks generated by repeat-business and the impact of the borrower–lender relationship upon borrowing costs.

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Researchers have, with mixed success, tested the narrower hypothesis that the length of a customer's relationship ("relationship length") significantly reduces the loan interest rate charged on its loans.[1] Empirical studies find mixed evidence for this hypothesis. Using US data, Berger and Udell (1995) find a negative correlation between relationship length and explicit interest rates whereas Petersen and Rajan (1994) find no statistical correlation.[2] The evidence using international data is also mixed. For example, Degryse and Cayseele (2000) find a positive correlation between relationship length and explicit interest rates whereas Harhoff and Korting (1998) find a negative correlation. These results may be reconciled by noting that the theory of borrower–lender relationship does not require that relationship length affect the explicit loan rate only or at all. It suggests instead that relationship value affects the sum of the implicit and explicit (or contractual) interest rates on the loan.[3] *Implicit* interest rates include, for example, additional charges or restrictions imposed on borrowers such as collateral, fees, covenanted duties, and documentation and reporting-frequency requirements. This paper examines the simultaneous impact of borrower–lender relationship upon the explicit loan interest rate and one such implicit component, namely, collateral. Since the existing theoretical and empirical literature[4] has strongly established that the collateral requirement is endogenously determined, we use a simultaneous equation approach for a sample of small business firms that are involved in relationship loans. We find that the length of the relationship does impact upon the probability of posting collateral and the level of loan interest rates. Specifically, we find the economic impact of the borrower–lender relationship to be 21 basis points for one standard deviation increase in relationship length.

Another purpose of the paper is to examine the impact of the collateral upon the level of loan interest rates. The existing literature has regressed loan interest rates on collateral with mixed results. More specifically, Berger and Udell (1995) find no statistical relationship, while Berger and Udell (1990) and John et al. (2003) find a positive relationship. These papers assume that collateral is exogenous. Our simultaneous equation approach endogenizes for collateral using valid instrumental variables that are based upon the existing literature. Using the Hansen–Sargan test (see Gujarati, 2003) we establish that our instrument variables are valid and that our system of equations is well-identified. Consistent with the empirical results of Berger and Udell (1990,

[1] Implicit in their argument is the notion that the lender learns favorable information about the borrower which results in a lower loan rate. Otherwise, the borrower could then switch to another lender that does not have the private unfavorable information.

[2] Other papers that have examined relationships in banking are: Angelini et al. (1998), Bebczuk (2004), Berger et al. (2003), Blackwell and Winters (1997), Bodenhorn (2003), Canovas and Solano (2003), Chakraborty and Hu (2006), Cole (1998), Cole et al. (2004), Conigliani et al. (1997), Cosci and Meliciani (2002), D'Auria et al. (1999), Degryse and Ongena (2005), Dennis et al. (2000), Dietsch (2003), Elsas (2005), Elsas and Krahnen (1998, 2002), Ewert et al. (2000), Ferri and Messori (2000), Guiso (2003), Hao (2003), Harhoff and Korting (1998), Lehmann and Neuberger (2001), Lehmann et al. (2004), Machauer and Weber (1998), Mallett and Sen (2001), Menkhoff and Suwanaporn (2003), Miarka (1999), Pozzolo (2004), Repetto et al. (2002), Scott and Dunkelberg (2003), Streb et al. (2002), Uzzi (1999), Weinstein and Yafeh (1998), and Ziane (2004).

[3] Kane and Malkiel (1965) portray the allocation of relationship benefits as a bilateral bargaining problem, so that benefits should be divided between banks and customers according to their relative bargaining power. A borrower with a longer relationship offers a better risk–return trade-off to the lender and therefore such a borrower can get lower rate, all else equal. At the same time, borrowers may find loan terms from non-relationship banks to be more costly because these banks lack the flow of soft information that an extended relationship generates.

[4] See, for example, Orgler (1970), Hester (1979), Besanko and Thakor (1987a, 1987b), Chan and Kanatas (1985), Bester (1985), Berger and Udell (1990), Boot et al. (1991), Boot and Thakor (1994), Berger and Udell (1995), Rajan and Winton (1995), and John et al. (2003).

1995), among others, we find that the probability of requiring firms to post collateral is positively related to firm risk as proxied by the occurrence of prior firm delinquency.

We find that when collateral is assumed to be exogenous, there is no correlation between loan rates and the probability of posting collateral. However, once we endogenize for collateral use in a simultaneous equation system, the loan rate for firms that are required to post collateral is 200–400 basis points higher than those firms that do not have to post collateral. This result is strongly consistent with John et al. (2003) that secured public debt has a higher yield than unsecured public debt. They theoretically demonstrate that agency issues between managers and lenders can give these results due to imperfections in the ratings of the credit agencies. Given that our sample consists of small non-public firms where managerial problems due to asymmetric information between insiders and external loan creditors might be higher, it is not surprising that our yield differential of collateral loans over non-collateral loan are significantly larger in magnitude than that found by John et al. (2003).

Carey et al. (1998) and Udell and Berger (2005) differentiate between asset-based lending and relationship lending. They argue that asset-based lending is more transactions oriented using "hard" information. The firm's assets, such as accounts receivable and inventory would in these cases be used as a source for collateral (also called inside collateral). In contrast, relationship lending relies on "soft" information to determine borrower risk and involve the use of personal guarantees and personal assets pledged as collateral. In addition, one might view personal collateral (also called outside collateral) as a substitute for equity, because these personal assets could be sold and the proceeds may be then used by the firm to repay the loan. John et al. (2003) examine firm (inside) collateral only, whereas other collateral papers listed in footnote 4 examine personal (outside) collateral. We distinguish between these two types of collateral in our estimation. In doing so, we separately estimate the impact of each type of collateral on the loan rate and on each other. We find that the economic impact of the requirement of posting personal (outside) collateral is greater than posting firm (inside) collateral.

Another implicit price of a loan is the amount of fees charged by lenders. In our sample, we find that the average interest rate for all lines of credit is increased by 83 basis points due to fees. However, for loans that are charged fees (433 out of a total of 766 loans), we find an average increase in the loan interest rate of 1.481% due to fees. We check whether our results are weakened or strengthened due to the inclusion of fees and we do not find that our results are materially altered.[5]

To perform our empirical tests, we use a sample of lines of credit obtained from the 1993 *National Survey of Business Finances*. Berger and Udell (1995) justify focusing on credit lines on the ground that this excludes from the "data set most loans that are 'transaction driven' rather than 'relationship driven'" (p. 353). This is not to say that relationship length has no effect on transactional loans. We focus on lines of credit to take advantage of their relative homogeneity, while recognizing that the characteristics of these loans may vary greatly. We recognize that even with our sample of lines of credit that lenders may use asset-based technology to evaluate the viability of the loan, especially once collateral requirements are imposed. We therefore perform robustness tests by restricting our sample to increase the likelihood that relationship lending based technology becomes more important in evaluating the viability of the loan to assess the

[5] In an earlier version of this paper, we also modeled the amount of fees charged as an endogenous decision. However, we found that our potential instrumental variables were also related to loan interest rates. Therefore, we are unable to accurately identify an instrumental variable for fees, and only examine whether our results are weakened or strengthened due to the inclusion of fees. We thank Jeremy Stein for suggesting this methodology.

economic impact of the borrower–lender relationship upon both the explicit interest rate and the probability of imposing a collateral requirement.

Our empirical results show strong evidence for jointness in the terms of lending. Borrowers and lenders might prefer jointness in loan pricing for two reasons. First, lenders might insist that borrowers pay implicit interest upfront as a way to reduce the lenders' interim loss exposure. The lower are the periodic interest payments, the lower the probability that bank might have to declare default.[6] Second, it might be legally and reputationally advantageous for lending institutions to mask their efforts to shade interest rates to relationship borrowers by exchanging value in implicit ways that other customers, regulators, and litigious parties cannot easily observe.

The paper proceeds as follows. Section 1 describes the data, the simultaneous-equation model that is estimated, and the various proxy and control variables that the tests employ. Section 2 presents and analyzes the empirical findings. Finally, Section 3 summarizes our results.

1. Explanation of data sources, estimation methods, and included variables

Data on borrowers and loan terms come from the 1993 *National Survey of Business Finances* (which we subsequently refer to as the *Survey*). The *Survey* is a cooperative effort of the Board of Governors of the Federal Reserve System and the Small Business Administration. We follow Berger and Udell (1995) in restricting the sample to firms who negotiate a credit line. After deleting observations with missing data, our final sample consists of 766 firms. According to the *Survey*, the initiation dates of the lines of credit range from March 1990 to December 1994. The bulk of these loans took place in 1993 (260 sample points) and 1994 (450 sample points).[7] Two macroeconomic variables are chosen to control for differences in the economic environment at the time the line was opened and are downloaded from the Federal Reserve Bank of St. Louis website (http://research.stlouisfed.org). These variables are defined later in the paper.

1.1. Limitation of survey data

The *Survey* provides only one year of borrower characteristics. This limits our ability to determine whether lenders ask a short-relationship borrower to pay implicit interest upfront as a way to reduce their interim loss exposure, or whether riskier firms borrow at fixed rates. The 1993 *Survey* includes all lines of credit, both new lines of credit and renewals of existing lines, without allowing us to distinguish which lines of credit are loan renewals and which are new initiations.[8] This limitation seems less important today than it did 18 years ago when, extending the work of James (1987), Lummer and McConnell (1989) found that loan renewals generate positive abnormal returns for borrowing firms, but loan initiations do not. Slovin et al. (1993) clarify that either loan decision generates abnormal returns, but only for small firms. Best and Zhang (1993) and Billet et al. (1995) firmly reject the hypothesis that announcement effects differ between loan initiations and renewals.

[6] To test these possibilities would require a time series of loan transactions with their associated loan rates for a specific borrower–lender relationship. This study and the extant empirical literature have not had access to such data.

[7] In addition, 2 loans from 1990, 13 loans from 1991 and 41 loans from 1992 are recorded by the *Survey*.

[8] An early version of the paper also included lines of credit recorded in the 1998 *Survey*. The 1998 *Survey* only included new lines of credit and resulted in a small sample size of 220 firms. Importantly, even in this smaller sample, there was a lot of missing data for inside and outside collateral making us drop the 1998 *Survey* from our sample.

Finally, *Survey* data does not include the name of the lender. Among others, Kashyap et al. (1993), Kashyap and Stein (2000), and Hubbard et al. (2002) argue that characteristics of banks should have an independent impact on loan contract rates. This limitation also prevents us from examining the extent to which financial-institution mergers reduce small-business lending, as documented by Berger et al. (1998) and Sapienza (2002).

1.2. Regression model

Our research compares the single-equation and simultaneous-equation estimates of the sensitivity of loan rates to collateral and the impact of relationship length on collateral and loan interest rates. Our tests will demonstrate that the loan pricing mechanisms are endogenously chosen in our sample, violating the condition needed for OLS estimation. That is because when the endogenous regressors are correlated with the regression errors, OLS estimation can yield biased estimators. Accordingly, we need to specify a simultaneous system of equations.

We begin by regressing each borrower's contract *Loan Rate Premium* on a collection of potential regressors whose relevance is supported by prior studies. We then interpose simultaneous equations for *Firm Collateral* and *Personal Collateral*. The specifications we estimate differentiate between a vector of common control variables $\mathbf{X}$ and a vector of specific instruments $\mathbf{Z}$ for each endogenous variable. The instruments are chosen to satisfy rank and order conditions that identify the following system:

$$\begin{aligned} \textit{Loan Rate Premium} &= \alpha_{\mathrm{LR}} + \beta_{\mathrm{LR}}\textit{FirmCollateral} + \gamma_{\mathrm{LR}}\textit{PersonalCollateral} + \Omega_{\mathrm{LR}}\mathbf{X} \\ &\quad + \lambda_{\mathrm{LR}}\mathbf{Z}_{\mathrm{LR}} + \varepsilon_{\mathrm{LR}}, \end{aligned} \tag{1}$$

$$\begin{aligned} \textit{Firm Collateral} &= \alpha_{\mathrm{FC}} + \beta_{\mathrm{FC}}\textit{PersonalCollateral} + \gamma_{\mathrm{FC}}\textit{LoanRatePremium} + \Omega_{\mathrm{FC}}\mathbf{X} \\ &\quad + \lambda_{\mathrm{FC}}\mathbf{Z}_{\mathrm{FC}} + \varepsilon_{\mathrm{FC}}, \end{aligned} \tag{2}$$

$$\begin{aligned} \textit{Personal Collateral} &= \alpha_{\mathrm{PC}} + \beta_{\mathrm{PC}}\textit{FirmCollateral} + \gamma_{\mathrm{PC}}\textit{LoanRatePremium} + \Omega_{\mathrm{PC}}\mathbf{X} \\ &\quad + \lambda_{\mathrm{PC}}\mathbf{Z}_{\mathrm{PC}} + \varepsilon_{\mathrm{PC}}. \end{aligned} \tag{3}$$

1.3. Definitions and estimators used for endogenous variables

Financial theory suggests that the required return lenders demand from borrowers should be positively related to the loan's default risk. However, borrowers can compensate lenders for risk by various combinations of loan rates and lending fees.[9] Accordingly, we use two definitions of *Loan Rate Premium*, one with fees and one without. Like in Berger and Udell (1995), *Loan Rate Premium* without fees is the difference between the contractual coupon interest set for the credit line and the prime rate for the month when the credit line is approved. *Loan Rate Premium* with fees is the difference between the effective interest rate adjusted for fees less the prime

[9] Loan fees and contract rates might relate negatively because fees can better compensate lenders for repricing options. Brueckner (1994), Dunn and McConnell (1981), Dunn and Spatt (1985), and LeRoy (1996) demonstrate theoretically that points can be used by banks to differentiate those mortgage borrowers with high probabilities of prepayment because they are more mobile from those borrowers with low probabilities of prepayment. Borrowers who are unlikely to prepay would, in equilibrium, select contracts with low interest rates and high loan fees. Borrowers who tend to prepay would select contracts with low loan fees and high interest rates. These papers envision a trade-off that is unrelated to the default risk of the firm.

rate for the month when the credit line is approved. The effective interest rate adjusted for fees is equal to the coupon rate and the ratio of total fees collected by the lending institution to the contractual amount that can be borrowed divided by the maturity denominated in months. *Firm Collateral* is a binary dummy variable that equals one if the firm is required to use its assets as collateral and is zero otherwise. *Personal Collateral* is a binary dummy variable that equals one if the CEO/owner is required to use her personal assets/guarantee as collateral and is zero otherwise. Table 1 lists these measures, along with the control and instrumental variables we employ.

Table 1
Variable definitions

Variables	Definitions
Dependent variables	
Loan Rate Premium (without fees)	the difference between the contractual coupon rate on line of credit and prime rate
Loan Rate Premium (with fees)	the difference between the effective interest rate adjusted for fees (amortized over the life of the loan) and prime rate
Firm Collateral	set to unity if the firm is required to post firm assets as collateral, and zero otherwise
Personal Collateral	set to unity if the CEO/owner is required to post personal assets/guarantee as collateral, and zero otherwise
Control variables	
Debt	ratio of total debt outstanding to level of sales
Profit	ratio of earnings before interest and taxes to sales
Cash	ratio of level of cash holdings to sales
Size	natural logarithm of firm's sales
Company	set to unity if the firm's owners enjoy limited liability protection, and zero otherwise
Term	yield spread between the five-year Treasury note and the three-month Treasury bill
Default	difference between Baa and Aaa bond yields
Relation	number of years the firm has had a relationship with the lending institution
Comp bal	set to unity if the line of credit agreement requires a compensating balance, and zero otherwise
Number	number of lending sources available to the firm
Maturity	number of months the line of credit is outstanding
Fixed	set to unity if the line of credit has a fixed coupon rate, and zero if the coupon rate is a variable rate
Instrumental variables	
For loan rate premium:	
HHI	set to unity if the Herfindahl Index for deposits in the MSA of the firm is greater than 1800, and zero otherwise
Firm age	age of the firm
Inter1	interaction of HHI and Firm age ($HHI \times Firm\ age$)
For firm collateral:	
Fdelinq	set to unity if firm has previously defaulted, and zero otherwise.
For personal collateral:	
Pdelinq	set to unity if the principal owner has defaulted, and zero otherwise
CEO age	age of CEO
CEO share	percentage ownership of firm held by CEO
CEO exp	number of years experience as CEO of the firm

Control variables are chosen to meld the explanatory variables used by Berger and Udell (1995) with those used by Petersen and Rajan (1994, 1995).[10] While the *Loan Rate* regression can be estimated by the conventional least-squares techniques, the other two variables require the use of limited dependent-variable methods. As a binary variable, the range of *Firm* and *Personal Collateral* is restricted to only two values and is therefore estimated by the logistic regression.

1.4. Definition of control variables

Control variables cover four broad dimensions of the negotiation process: borrower characteristics, loan characteristics, and macroeconomic variables. Borrower characteristics are measures of the profitability and risk exposure of the firm:

(a) *Debt* (i.e., leverage), defined as the ratio of outstanding debt to annual sales;
(b) *Profit*, defined as the ratio of earnings before interest and taxes to annual sales;
(c) *Cash* (i.e., liquidity), defined as the ratio of cash holdings to the annual sales of the firm;
(d) *Size*, defined as the logarithm of annual sales;
(e) *Company*, which equals unity if the firm's owners enjoy limited-liability protection and equals zero if the firm is a sole proprietorship or partnership[11];
(f) *Number*, which proxies borrower bargaining power by the number of lending sources available to the firm at the contracting date;
(g) *Relation*, which measures the number of years the firm has dealt with the lending institution; and
(h) industry dummies which represent industry characteristics by the borrower's two-digit SIC code.[12]

Loan Rate Premium should increase with characteristics that increase the bank's exposure to loss and decrease with characteristics that increase the customer's bargaining power. On these grounds, we expect the *Loan Rate* equation to show positive coefficients for *Debt* and *Company* and negative coefficients for *Profit, Cash, Size, Relation*, and *Number*.

Three loan characteristics are also examined.

(a) *Comp Bal* takes on the value of one when the credit line must be supported by a compensating balance and is zero otherwise;
(b) *Maturity* expresses how long the credit line remains open;
(c) *Fixed* is a binary indicator that equals unity if the line of credit has a fixed coupon rate and is zero otherwise.

Macroeconomic variables represent financial conditions in the month and year the deal was completed. Two financial variables are employed:

[10] Although Berger and Udell (1995) test a broad range of potential determinants for borrowers' loan rates, they exclude two macroeconomic variables that Petersen and Rajan (1994, 1995) find to be significant: interest-rate variables and bank concentration ratios. Petersen and Rajan examine a wider variety of loan arrangements than Berger and Udell or ourselves, but their models suppress the role of collateral and fees.

[11] For example, *Company* is set to unity for firms that are classified as an S-Corporation, C-Corporation, Limited Liability Company or Limited Liability Partnership.

[12] To conserve space, we do not report coefficients for the industry controls.

(a) *Term*, the yield spread between the five-year Treasury note and the yield of a three-month Treasury bill;
(b) *Default*, the spread between the yields on Baa and Aaa bonds.

We expect cyclical forces to affect both the risk-free rate and market-wide risk premiums. Consequently, we expect the *Loan Rate Premium* to increase with both variables.

Although all borrower, lender, and loan characteristics are potentially endogenous, the number of endogenous variables one can handle is constrained by the difficulties of identifying a larger system. The case for endogenizing maturity and size is particularly strong (see, for example, Barclay et al., 2003; Berger et al., 2003; Brick and Ravid 1985, 1991; and Dennis et al., 2000). However, it is difficult to conceive of instruments for loan maturity and size that would not also be related to *Loan Rate Premium* and *Collateral* variables. As a robustness test, we show that our estimates of the impact of other variables do not change significantly when *Maturity* is moved into and out of each equation.[13]

1.5. Instrumental variables

Identification is achieved by drawing on prior knowledge about particular model coefficients or about the covariance matrix of the error terms. Ideally, the instrumental variables inserted into any equation should be correlated with that equation's endogenous variable, but uncorrelated with the error term (Bowden and Turkington, 1984). To compare our results with the previous literature on how collateral affects the loan rate premium, our overriding concern is to identify and obtain consistent estimates of parameters of the *Loan Rate Premium* equation (1). This leads us to introduce a large number of candidate instruments (see Chao and Swanson, 2003). Gujarati (2003) suggests that a Hansen–Sargan test for overidentifying restrictions may be used to test the exogeneity of the overall set of instruments. The null hypothesis is that the excluded exogenous variables, the instruments, are uncorrelated to the regression error. If we fail to reject the null, then we can have some confidence in the overall set of instruments used. The test is performed as follows. First we obtain the two-stage least squares residuals by regressing the independent variable against the set of control variables and the fitted values of the other independent variables. Then we regress these residuals on all the control variables and instruments and obtain its R-square. We compute the Hansen–Sargan statistic as R-square times the number observations less the number the number of regressors. The Hansen–Sargan statistic is chi-square distributed with degrees of freedom equal to the difference between the number of instruments and the number of endogenous variables. If the chi-square statistic is not significant then the instrumental variables are valid and our system of equations is well-identified.

The instrumental variables inserted into the *Loan Rate Premium* equation are measures of market power and the age of the borrowing firm. The importance of these variables is emphasized by Petersen and Rajan (1995). They argue that bankers in concentrated markets use their explicit loan rate as a loss leader to secure long-term rents on other relationship business. Petersen and Rajan believe that this strategy of loss-leadership is directed particularly at young firms. In estimating our models, *Firm age* is measured in years and we proxy market power by

[13] A similar robustness test is undertaken when *Size* is moved into and out of each equation. For brevity, results for *size* are available from the authors but not reported.

a zero-one indicator variable, *HHI*. *HHI* equals one if the Herfindahl index for deposits in the borrowers Standard Metropolitan Statistical Area exceeds 1800.[14] If *Loan Rate Premium* functions more strongly as a loss leader in concentrated markets, *HHI* should receive a negative sign. If a firm's bargaining power increases with *Firm age*, relationship rents would decline with *Firm age*, so that it should receive a negative sign. However, if loss leadership is directed especially at young firms, the interacted variable, *Inter1*—defined as the product of *Firm age* and *HHI*—should receive a positive sign.

The literature has also differentiated between personal and firm collateral. *Firm Collateral* rearranges the relative priority of liabilities upon bankruptcy without altering the risk exposure to owners. *Firm Collateral* may actually benefit the firm's owners. John et al. (2003) demonstrate that *Firm Collateral* may actually reduce expected bankruptcy costs resulting in a positive relationship between the use of *Firm Collateral*, firm risk and interest rates. We assume that the likelihood of a lender imposing firm asset collateral requirements would be positively related to whether the firm has defaulted on a previous loan. Hence, the instrumental variable that we use for *Firm Collateral* is *Fdelinq*, a dummy variable that is equal to one if the firm has previously defaulted, and zero otherwise.

Firms that are required to post firm assets as collateral might be engaged in asset-based borrowing as opposed to relationship based lending. The information technology used to evaluate asset-based loans is different from relationship based lending and therefore testing the impact of borrower–lender relationship upon loan interest rate and the probability of imposing collateral may be compromised. Accordingly, we repeat our analysis by dropping from the sample all loans that are required to post firm assets as collateral. In this way, we hope to analyze the impact of the length of the borrower–lender relationship upon a sample of loans that are evaluated primarily using relationship lending technology.

On the other hand *Personal Collateral* is a form of owner's equity and increases risk exposure to owners. The previous literature on collateral assigns it two conceptually distinct functions. On the one hand, collateral may serve to mitigate asymmetric information about borrower quality. In this case, collateral serves as a positive signal about borrower quality that is known to firm managers, but is unobservable to lenders (see, e.g., Besanko and Thakor, 1987a, 1987b; Chan and Kanatas, 1985; and Bester, 1985). On the other hand, collateral can also mitigate against moral hazard, in that it serves as a performance bond against post-loan managerial shirking and risk-taking activities that might shift uncompensated risk to the lender (see, e.g., Boot et al., 1991, and Boot and Thakor, 1994).

The above theoretical models suggest that *Personal Collateral* is used for signaling about borrower quality. To obtain a separating signaling equilibrium, the owner of the lower quality firm cannot afford to mimic the owner of higher quality firm. That is, the signal must be costly to the lower quality borrower. Similarly, *Personal Collateral* may be used to serve as a performance bond against post-loan managerial shirking and risk-taking activities because of the associated costs of managerial shirking and risk taking activities to the owner.

To account for the potential use of *Personal Collateral* as a signal for firm quality and/or as a performance bond, we introduce four instrumental variables into the *Personal Collateral* equation (3). Three of these variables are:

[14] Given that the *Survey* does not identify the lender, we cannot calculate independently the lender's Herfindahl Index. The *Survey* only provides this binary categorization.

(a) *CEO age*;
(b) *CEO share* of the ownership of the firm; and
(c) *CEO exp*, measuring the number of years the CEO has headed the firm.

We suppose that the bonding element loses importance to the lender for older and more-experienced CEOs. In addition, Bitler et al. (2004) examine the association of personal collateral and entrepreneurial wealth in testing agency theory using 2SLS and find that agency costs explain why entrepreneurs concentrate a large fraction of their wealth in their firm's equity. This implies that personal collateral is better than firm collateral to reduce agency costs since the vast majority of CEOs in our sample have less than 100% ownership. Consequently, we add a fourth instrumental variable, *Pdelinq*, a zero-one dummy that equals unity if either the principal owner or the firm has previously defaulted. We assume managerial agency gains importance if its principal owner has a history of default.[15]

Table 2 presents summary statistics for the variables included in this study. Borrower firms paid a mean and median explicit interest rate of 8.00 percent. Loan fees increased the effective rate (*erate*) by a mean of 62 basis points. For the total sample, the average fees is 83 basis

Table 2
Descriptive statistics

Variable	Unit	#	Mean	Median	St. Dev.
Dependent variables					
Loan Rate	percent	766	8.001	8.000	1.508
Erate	percent	766	8.618	8.200	2.244
Prime	percent	766	6.541	6.060	0.710
Loan Rate Premium (with fees)	percent	766	2.077	1.690	2.191
Fees (all L/Cs)	percent	766	0.831	0.065	1.963
Fees (L/Cs where fees charged)	percent	430	1.481	0.724	2.430
Firm Collateral	dummy	766	0.572	1.000	0.495
Personal Collateral	dummy	766	0.661	1.000	0.474
Control variables					
Debt	fraction	766	0.347	0.204	0.601
Profit	fraction	766	0.035	0.025	0.234
Cash	fraction	766	0.083	0.019	0.696
Size	log(Sales)	766	15.211	15.425	1.623
Sales	million	766	11.168	5.000	18.474
Company	dummy	766	0.884	1.000	0.321
Term	basis pts.	766	2.820	2.830	0.328
Default	basis pts.	766	0.700	0.680	0.077
Relation	years	766	8.535	6.000	8.412
Bank	dummy	766	0.952	1.000	0.215
Comp bal	dummy	766	0.098	0.000	0.297
Number	quantity	766	1.210	1.000	0.591
Maturity	months	766	23.548	12.000	29.124
Fixed	dummy	766	0.206	0.000	0.405

(*continued on next page*)

[15] We confirmed that our instrumental variable for *Firm Collateral* (*Fdelinq*) is not statistically related to *Personal Collateral* and our instrumental variables for *Personal Collateral* (*CEO age, CEO share, CEO exp*, and *Pdelinq*) are not statistically related to *Firm Collateral*.

Table 2 (*continued*)

Variable	Unit	#	Mean	Median	St. Dev.
Instrumental variables					
For loan rate:					
HHI	dummy	766	0.495	0.000	0.500
Firm age	years	766	18.341	14.000	16.385
Inter1	interaction	766	9.082	0.000	14.701
For firm collateral:					
Fdelinq	dummy	766	0.184	0.000	0.388
For personal collateral:					
Pdelinq	dummy	766	0.587	0.000	0.235
CEO age	years	766	51.215	50.500	10.331
CEO share	percent	766	60.424	51.000	30.296
CEO exp	years	766	21.509	20.000	10.402

Notes. This table provides summary descriptive statistics of the variables employed in our study for a sample of 766 loans (lines of credits or L/Cs) as reported by 1993 *National Survey of Business Finances*. The *Loan Rate* is the contractual coupon rate on the line of credit. *Erate* is the effective rate of the loan equaling the sum of the coupon rate and the monthly straight-line amortization rate of the fees collected by the lending institution. *Prime* is the prime rate prevailing at the initial period of the loan. *Loan Rate Premium* with fees is the difference between *Erate* and *Prime. Fees* is the ratio of the total fees collected by the lending institution to the total amount borrowed. The other variables are defined as follows: *Firm Collateral*, set to unity if the loan requires the firm to post its assets as collateral, and zero otherwise; *Personal Collateral*, set to unity if the owner is required to post personal assets as collateral, and zero otherwise; *Debt*, ratio of total debt outstanding to level of sales; *Profit*, ratio of earnings before interest and taxes to sales; *Cash*, ratio of the level of cash holdings to sales; *Size*, natural logarithm of firm's sales; *Sales* is the annual level of sales in millions of dollars in the year of the loan initiation; *Company*, set to unity if the firm's owners enjoy limited liability protection, and zero otherwise; *Term*, yield spread between the five-year Treasury note and the monthly three-month Treasury bill; *Default*, difference between Baa and Aaa bond yields; *Relation*, number of years the firm has had a relationship with the lending institution; *Bank*, set to unity if the lender is a bank, savings or thrift institution, and zero otherwise; *Comp bal*, set to unity if the line of credit requires a compensating balance, and zero otherwise; *Number*, number of lending institutions available to the firm; *Maturity*, number of months the line of credit is outstanding; *Fixed*, set to unity if the line of credit has a fixed coupon rate, and zero if the coupon rate is a variable rate; *HHI*, set to unity if the Herfindahl Index for deposits in the MSA of the firm is greater than 1800, and zero otherwise; *Firm age*, age of the firm; and *Inter1*, interaction of HHI and Firm age (HHI × *Firm age*); *Fdelinq*, set to unity if the firms has previously defaulted, and zero otherwise; *CEO age*, age of the CEO; *CEO share*, percentage ownership of firm held by CEO; *CEO exp*, number of years experience as CEO of the firm. *Pdelinq*, set to unity if the principal owner has defaulted, and zero otherwise.

points, but the median effect is only 6.5 basis points. This is because only 430 of the 766 sample borrowers paid fees at all. For the fee-paying firms, the net contribution by fees averaged 148 basis points, with a median of 72.4 basis points. Fully 57.2 percent and 66.1 percent of sample lines of credit included, respectively, firm collateral personal collateral requirements. Borrower sales averaged $11.17 million, while median sales were only $5.0 million. Debt averaged 34.7 percent of sales. Profits averaged 3.5 percent of sales, but the median ratio was only 2.5 percent. Firms held an average of 8.30 percent of their sales in cash.

Across sample dates, the mean prime rate was 6.54 percent, while the median rate was a slightly lower 6.06 percent. The mean monthly-average yield spread (*Term*) between the five-year Treasury notes and Treasury bills averaged 2.82 percent. The yield difference between the Baa and Aaa bonds (interpreted as a market-wide default premium) averaged 0.70 percent. Relationship length (*Relation*) showed a mean of 8.54 years and a median of six years. The mean

age of sample firms is 18.34 years.[16] On average, 95.2 percent of the credit lines were written by deposit institutions and 9.8 percent of lines carried a compensating balance. The mean maturity of sample lines was 23.55 months, with a median maturity of only one year.

Fully 49.5 percent of the firms borrowed from institutions in highly concentrated markets implying that the median firm borrowed in a competitive market. Nearly 20.6 percent of the lines carried a fixed interest rate, which implies that the median firm accepted a variable-rate contract. Firms averaged only 1.21 sources for lines of credit and the median firm showed only one source. The mean CEO is 51 years old, with 21.5 years of experience. The mean (median) share of equity owned by the CEO was 60.42 percent (51 percent). Approximately 18.40 percent of sample firms showed a record of prior default. In contrast, almost 60% of the owners have previously defaulted on a personal obligation.

2. Empirical evidence of the interaction of implicit and explicit loan terms

To establish a benchmark with which to evaluate simultaneous-equation results, Table 3 reports single-equation estimates for two models of the *Loan Rate Premium*. The models differ only in whether or not the loan rate premium is adjusted for fees charged. We also performed the regressions with and without the inclusion of *Maturity* as an independent variable. Although not formally reported, we find that the estimates of the other coefficients and overall model performance are not generally affected by whether or not we include *Maturity*.

Neither single-equation specification provides convincing evidence that loan rates and collateral are correlated. In Table 3, only *Personal Collateral* is even marginally significant (and only when the loan rate premium is not adjusted for fees). Because the dummy variable *Personal Collateral* (and *Firm Collateral*) equals one only if there exists a collateral requirement, the 0.199 coefficient for *Personal Collateral* implies that on loans that require personal collateral the premium runs approximately 20 basis points higher than loans that do not require personal collateral. That is, this single-equation model generates no strong evidence that explicit interest rates and implicit interest rates are correlated, and accordingly no indication that they are jointly determined.

Note that *Profit, Size, Company, Relation, Fixed, Pdelinq* and *Inter1* prove statistically significant when we adjust the *Loan Rate Premium* for fees. *Debt, Profit, Fixed* and *Pdelinq* prove significant at five-percent, while *Debt, Comp bal, Fdelinq, HHI* and *Inter1* are significant at weaker levels. These estimates indicate, as in the previous literature, that smaller borrower firms are charged a higher contract rate. Interestingly, borrowing firms with limited-liability enjoy a 63 basis point savings on loans compared to borrowing firms that do not have limited liability protection. Our results also show that owners of firms who previously defaulted pay an economically significant premium differential of approximately 100 basis points. Unlike Petersen and Rajan (1994, 1995), contract rates do not vary significantly with macroeconomic variables. Our estimates are consistent with those of Berger and Udell (1995) in finding a significant negative association between *Loan Rate Premium* adjusted for fees and the length of the relationship the borrower has had with the lending institution. However, the coefficient is not economically significant (2.5 basis point reduction per year, or 21 basis points reduction for one standard deviation

[16] Note that this average age is somewhat higher than the average age of 14.1 years in the Berger and Udell (1995) sample. However, the average length of relationship in our sample is only 8.54 years, which is well below the Berger–Udell mean of 11.4 years.

Table 3
Single-equation regression of the Loan Rate Premium (all regressors treated as exogenous)

Variable	With fees		Without fees	
	parameter	(p-value)	parameter	(p-value)
Intercept	6.297[a]	(0.001)	4.172[a]	(0.000)
Firm Collateral	0.125	(0.438)	0.076	(0.463)
Personal Collateral	0.217	(0.191)	0.199[c]	(0.063)
Debt	−0.089	(0.550)	−0.173[c]	(0.077)
Profit	−0.687[c]	(0.051)	−0.479[b]	(0.035)
Cash	−0.042	(0.734)	−0.082[b]	(0.035)
Size	−0.229[a]	(0.000)	−0.149[a]	(0.000)
Company	−0.631[b]	(0.017)	−0.214	(0.210)
Term	0.033	(0.888)	−0.038	(0.798)
Default	0.660	(0.507)	−0.282	(0.662)
Relation	−0.025[b]	(0.017)	−0.007	(0.285)
Comp bal	0.023	(0.930)	−0.279[c]	(0.094)
Number	−0.030	(0.821)	−0.033	(0.698)
Maturity	−0.004	(0.124)	0.002	(0.196)
Fixed	0.498[a]	(0.001)	0.416[a]	(0.001)
Fdelinq	0.271	(0.199)	0.262[c]	(0.055)
Pdelinq	1.134[a]	(0.001)	0.933[a]	(0.000)
HHI	−0.351	(0.123)	−0.264[c]	(0.073)
Firm age	−0.001	(0.337)	−0.003	(0.484)
Inter1	0.019[b]	(0.034)	0.011[c]	(0.064)
CEO share	0.004[c]	(0.089)	0.003[c]	(0.097)
CEO age	−0.016	(0.127)	0.003	(0.806)
CEO exp	−0.002	(0.881)	−0.005	(0.421)
Adj. R^2	0.111		0.115	

Notes. This table provides the ordinary-least-squares regression results of *Loan Rate Premium* on all exogenous variables specified in Table 2. The *Loan Rate Premium* without fees is defined as the difference between contractual coupon on the line of credit and the prime rate. The *Loan Rate Premium* with fees increases the coupon rate by adding the monthly straight-line amortization rate of the fees collected by the lending institution as a fraction of the total amount borrowed over the life of the loan. The independent variables are defined as in Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.
[b] Idem, 5%.
[c] Idem, 10%.

increase in relationship length) and is no longer significant when the *Loan Rate Premium* without adjusting for fees is the dependent variable. This last result is consistent with the results of Petersen and Rajan (1994) who find no significant association between relationship length and explicit interest rates.

We next investigate the effects of treating *Personal* and *Firm Collateral* as determined simultaneously with the *Loan Rate Premium*. We begin by assessing the strength of our instrumental variables for our collateral variables in Tables 4 and 5. Tables 4 and 5 report results for two specifications. The first specification measures the explanatory power of the instrumental variables alone. The second specification incorporates the contribution of the instrumental variables and control variables taken together. We assess the strength of our instrumental variables for the *Loan Rate Premium* in Table 6. In this table, we have four specifications. The first specification measures the explanatory power of the instrumental variables alone while the second incorporates the contribution of the instrumental variables and control variables taken together when the

Loan Rate Premium adjusted for fees is the dependent variable. The next two specifications are analogous to the first two, except now the dependent variable is the *Loan Rate Premium* with no adjustment for fees.

Table 4 summarizes the logistic regression for *Firm Collateral*. Depending on its sign, each significant coefficient increases or decreases the probability that the borrower is required to post collateral. The first specification establishes a significantly positive relationship between *Firm Collateral* and *Fdelinq*. The experiment achieves a significant likelihood ratio of 40.21. In the table's second specification, the coefficient of *Fdelinq* remains significant. Many of the control variables are significant. In particular, we find that the probability the lender will impose a requirement that the firm posts assets for collateral increases with firm leverage, firm size and whether the borrower is incorporated. The probability of firm collateral requirement decreases with the length of relationship between the borrower and the lending institution. However, the economic impact is not larges as the odds ratio is close to one, implying that a one-year increase in borrower–lender relationship results in an almost equal probability of posting collateral and not posting collateral.

In parallel fashion, Table 5 assesses the performance of the instruments included in the *Personal Collateral* equation. In the first specification, the instruments *CEO age* and *CEO share* prove significant. When we include control variables in the second specification, the results on *CEO age* and *CEO share* remain statistically significant and a χ^2 test that the instruments are jointly equal to zero is rejected. Among the controls, *Size, Company, Term* and *Fixed* prove significant. In particular, the likelihood of a personal collateral requirement decreases with the

Table 4
Evidence of the validity of instruments for Firm (Inside) Collateral

Variable	Instrumental variables only			Instrumental and control variables		
	parameter	(p-value)	odds ratio	parameter	(p-value)	odds ratio
Intercept	−0.139	(0.382)		−1.797	(0.164)	
Instrumental variable:						
Fdelinq	0.449[b]	(0.026)	1.566	0.470[b]	(0.025)	1.600
Control variables:						
Debt				0.398[b]	(0.015)	1.489
Profit				0.249	(0.492)	1.283
Cash				−0.012	(0.926)	0.989
Size				0.152[a]	(0.005)	1.165
Company				0.731[a]	(0.006)	2.078
Term				−0.181	(0.442)	0.834
Default				−1.151	(0.256)	0.316
Relation				−0.025[a]	(0.008)	0.975
Comp bal				−0.141	(0.590)	0.869
Number				0.143	(0.313)	1.154
Maturity				0.004	(0.152)	1.004
Fixed				−0.164	(0.395)	0.848
Likelihood ratio	40.21[a]	(0.000)		81.17[a]	(0.000)	

Notes. This table provides the logistic regression results explaining the requirement of firm's assets used as collateral to borrowers on lines of credit for a sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.

[b] Idem, 5%.

Table 5
Evidence of validity of instruments for Personal (Outside) Collateral

Variable	Instrumental variables only			Instrumental and control variables		
	parameter	(p-value)	odds ratio	parameter	(p-value)	odds ratio
Intercept	1.503[a]	(0.002)		6.050[a]	(0.000)	
Instrumental variables						
Pdelinq	0.602	(0.110)	1.826	0.522	(0.173)	1.686
CEO age	−0.025[b]	(0.016)	0.975	−0.022[b]	(0.039)	0.978
CEO share	0.009[a]	(0.001)	1.009	0.008[a]	(0.007)	1.008
CEO exp	0.006	(0.534)	1.006	0.012	(0.250)	1.012
Control variables						
Debt				0.076	(0.683)	1.079
Profit				0.272	(0.484)	1.312
Cash				0.202	(0.633)	1.223
Size				−0.205[a]	(0.001)	0.814
Company				0.631[b]	(0.025)	1.879
Term				−0.540[b]	(0.032)	0.582
Default				−0.902	(0.387)	0.406
Relation				−0.012	(0.222)	0.988
Comp bal				0.157	(0.568)	1.170
Number				0.160	(0.276)	1.173
Maturity				−0.001	(0.606)	0.999
Fixed				−0.452[b]	(0.026)	0.636
χ^2-value that instruments are jointly = 0				2.172[c]	(0.099)	
Likelihood ratio	44.301[a]	(0.000)		71.704[a]	(0.000)	

Notes. This table provides the logistic regression results explaining the requirement of owner's assets used as collateral to borrowers on lines of credit for a sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.
[b] Idem, 5%.
[c] Idem, 10%.

size of the firm, is higher if the firm enjoys limited liability status, decreases with the spread between the five-year Treasury note and three-month Treasury Bill and is lower if the coupon rate is fixed. The logistic regression shows a significant likelihood ratio in both specifications. Finally, we do not see a statistical impact of *Relation* on the probability of posting personal collateral.

In Table 6, the instrumental variables for *Loan Rate Premium* prove strongly significant in the first and third specifications, but their significance weakens when control variables are introduced in the second and fourth specifications. Nevertheless, an F-test rejects the hypothesis that instrumental variable coefficients are jointly equal to zero. Several of the control variables prove significant in the second and fourth specifications, including *Profit, Size* and *Fixed*.

In these single-equation experiments, coefficient signs are only partly consistent with the results of Petersen and Rajan (1995). The negative coefficient for *HHI* continues to indicate that banks in more-concentrated markets may charge a lower explicit rate. However, when we include fees, the coefficients for *HHI* are negative but are not significant. In addition, the negative sign for *Firm age* implies—in line with the bargaining-power hypothesis—that older firms receive

Table 6
Evidence of validity of instruments for the Loan Rate Premium

Variable	With fees		With fees		Without fees		Without fees	
	parameter	(p-value)	parameter	(p-value)	parameter	(p-value)	parameter	(p-value)
Intercept	2.766[a]	(0.000)	7.120[a]	(0.000)	1.875[a]	(0.000)	5.186[a]	(0.000)
Instrumental variables								
HHI	−0.286	(0.228)	−0.340	(0.139)	−0.257[c]	(0.096)	−0.271[c]	(0.070)
Firm age	−0.023[a]	(0.001)	−0.010	(0.155)	−0.013[a]	(0.004)	−0.005	(0.297)
Inter1	0.014	(0.156)	0.017[c]	(0.065)	0.010	(0.107)	0.011[c]	(0.077)
Control variables								
Debt			−0.082	(0.587)			−0.149	(0.129)
Profit			−0.703[b]	(0.048)			−0.481[b]	(0.038)
Cash			−0.078	(0.537)			−0.112	(0.173)
Size			−0.287[a]	(0.000)			−0.189[a]	(0.000)
Company			−0.572	(0.031)			−0.164	(0.340)
Term			−0.008	(0.971)			−0.085	(0.577)
Default			0.470	(0.640)			−0.390	(0.552)
Relation			−0.029[a]	(0.005)			−0.010	(0.145)
Comp bal			−0.063	(0.807)			−0.336[c]	(0.048)
Number			0.013	(0.924)			−0.004	(0.961)
Maturity			−0.004	(0.125)			0.002	(0.254)
Fixed			0.512[a]	(0.008)			0.430[a]	(0.001)
F-value that instruments are jointly = 0			2.340[c]	(0.100)			3.360[c]	(0.067)
Adj. R^2	0.017		0.110		0.009		0.076	

Notes. This table summarizes the results of the ordinary-least-squares regression of the *Loan Rate Premium* variable for a sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.

[b] Idem, 5%.

[c] Idem, 10%.

the lowest explicit rates. Finally, the loan rate spread that includes fees is significantly negatively related to *Relation*. However, the coefficient on *Relation* implies that the loan rate decreases by only 3 basis points per additional year of *Relation*.

Table 7 reports two-stage least-squares (2SLS) estimates of the *Loan Rate* equation using the three-equation system. In the first-stage, we regress *Personal* and *Firm Collateral* (logistic regression) on all instrumental variables and control variables. Fitted values from this stage are used as regressors in *Loan Rate* specifications that alternately include and exclude fees.

Finally, we compute the Hansen–Sargan statistic to test the null hypothesis that the excluded exogenous variables, the instrument variables, are uncorrelated to the regression error. The Hansen–Sargan statistic is chi-square distributed with degrees of freedom equal to the difference between the number of instruments and the number of endogenous variables. The last row of Table 7 provides the Hansen–Sargan statistic demonstrating that the instruments are uncorrelated to the regression error, thereby formally confirming the validity of our instrumental variables and that our system of equations is accurately identified.

We observe that the endogenous variable *Personal Collateral* becomes economically significant in the 2SLS regressions. Recall that in Table 2 the interest rate on loans with a personal collateral requirement were only 20 basis points higher than that of loans without personal loan

Table 7
Simultaneous system of equation estimation for the Loan Rate Premium

Variable	With fees		Without fees	
	parameter	(p-value)	parameter	(p-value)
Intercept	−0.991	(0.707)	−0.555	(0.746)
Firm Collateral (fitted)	0.791	(0.538)	0.346	(0.679)
Personal Collateral (fitted)	4.434[a]	(0.001)	3.148[a]	(0.000)
HHI	−0.396[c]	(0.087)	−0.304[b]	(0.044)
Firm age	0.000	(0.996)	0.002	(0.707)
Inter1	0.027[a]	(0.005)	0.018[a]	(0.005)
Debt	−0.153	(0.424)	−0.180	(0.150)
Profit	−0.983[a]	(0.007)	−0.667[a]	(0.005)
Cash	−0.133	(0.294)	−0.152[c]	(0.065)
Size	−0.107	(0.289)	−0.054	(0.414)
Company	−1.188[a]	(0.001)	−0.568[b]	(0.011)
Term	0.502[c]	(0.063)	0.268	(0.126)
Default	1.779[c]	(0.099)	0.485	(0.490)
Relation	−0.024[b]	(0.037)	−0.007	(0.358)
Comp bal	−0.140	(0.596)	−0.397[b]	(0.021)
Number	−0.188	(0.189)	−0.140	(0.132)
Maturity	−0.004	(0.177)	0.002	(0.210)
Fixed	0.960[a]	(0.000)	0.740[a]	(0.000)
Hansen–Sargan χ^2-value that $E(\varepsilon_{LR}, Z) = 0$	9.485	(0.148)	11.19	(0.138)
Adj. R^2	0.099		0.092	

Notes. This table presents the results of the two-stage least-squares (2SLS) regression of *Loan Rate Premium* variables treating *Firm Collateral* and *Personal Collateral* as endogenously determined for a sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.
[b] Idem, 5%.
[c] Idem, 10%.

collateral requirements. With 2SLS, we use the fitted values for our two collateral variables. These fitted values represents the probability that a firm will be required to post collateral and no longer is a dichotomous zero-one variable. We interpret the coefficient on the collateral variables to imply the differential loan rate premium between those loans with a 100% probability of collateral imposition and those loans with a zero percent probability of collateral imposition. We find that the coefficient for *Personal Collateral* implies a differential that is between 315 and 443 basis points. The significantly positive signs that simultaneous modeling assigns to this variable support the hypothesis that posting *Collateral* controls and implicitly prices some (but not all) of the loss exposure lenders face in high-risk loans.

In Table 7, we observe that the coefficients for *HHI* are significantly negative and the coefficients for *Inter1* are significantly positive. The positive sign for the interaction term *Inter1* supports the Petersen–Rajan hypothesis that, in concentrated markets, banks may charge younger firms a lower explicit rate on the grounds they can confidently plan to extract rents from these customers in other ways or at other times. However, when we exclude the interaction term *Inter1* in both specifications we find *HHI* to be positive but not statistically significant and *Firm age* to be positive and significant at the 10% level. None of our other results are affected and therefore

we only report the results with the interaction variable.[17] The negative coefficients for *Profit* and *Company* imply that profitable and limited liability lenders are able to borrow at lower interest rates than their counterparts.

The economic importance of the length of the relationship between the lender and borrower does not become any more important with simultaneous estimation. There are several potential explanations for this. First, Berger and Udell (1995) find that the relationship variable is only significant for larger lines of credit, whereas our sample includes lines of credit as small as $10,000. Small lines of credit loans are very likely to be micro-business loans and/or personal loans that depend more on the entrepreneur's personal credit rather than the length of the relationship between the firm and the lender. Second, lines of credit of very large size and/or long maturities might finance large projects, which may use asset-based lending technology. Third, Berger and Udell (1995) point out that asset-based lending uses hard information, based upon the value of the firm collateral to assess the viability of the loan. In such a case, the length of the borrower–lender relationship becomes less important. Given that more than 60 percent of our borrowers post collateral our tests are biased against finding any significant impact of relationship length. Fourth, our sample includes loans from commercial finance companies that are primarily asset based lenders.

Consequently, to test the robustness of our results, as well as to see if *Relation* becomes more important, we modify our sample to increase the likelihood that the loans in our sample are relationship based. First, we restrict the size of the line of credit to be greater than $250,000 and less than $25 million. Second, we exclude from the sample any loan with maturity greater than one year. Third, we exclude any loan that requires the firm to post collateral. Fourth, we exclude from the sample loans obtained from finance companies. The results of these robustness tests are summarized in Table 8. Since the results we obtain are similar whether or not we adjust for fees, the table only reports the results when the loan rate premium is adjusted for fees.

The first specification of Table 8 reports the results when the sample only includes lines of credit in excess of $250,000 and less than $25 million. Note that this restriction reduces our original sample of 766 firms to 444 firms. In this case, the coefficient for *Relation* is no longer statistically significant. Further note, that the coefficients for both *Personal* and *Firm Collateral* variables are both economically and statistically significant. The second specification adds the restriction that we exclude loans with maturity greater than one year. Note that the sample is further reduced to 325 firm observations. In this case, the coefficient for *Relation* remains statistically insignificant. We observe that the coefficients for *Firm Collateral* is positive but not significant (p-value equal to 11%) whereas *Personal Collateral* remains strongly significant. The third specification keeps the size restriction and excludes all loans that require the firm to post collateral. In this case, we are only simultaneously estimating two equations, the *Loan Rate Premium* and *Personal Collateral* equations. Note that the sample is now 328 firm observations. We see that the *Personal Collateral* variable remains both economically and statistically significant. The *Relation* variable is now significant but it is not economically significant since the results imply that a borrower with a ten-year relationship with the lending institution will find that the loan will carry lower interest rate of 36 basis points compared to a newcomer. In the fourth specification, we exclude loans from finance companies without change in results that we obtained earlier. This is not surprising in that only 37 of the 766 loans of our total sample were originated by finance companies. Finally, in the fifth specification we restrict our sample to lines of credit greater than

[17] The results without the interaction variable are available from the authors upon request.

Table 8
Simultaneous system of equation estimation for the Loan Rate Premium with fees: Robustness Tests

Variable	$N = 444$ Size restriction		$N = 325$ Size restriction and maturity < 1 year		$N = 328$ Size restriction and no firm collateral		$N = 729$ No finance companies		$N = 419$ No finance companies and size restriction	
	parameter	(p-value)	parameter	(p-value)	parameter	(p-value)	parameter	(p-value)	parameter	(p-value)
Intercept	−1.419	(0.586)	−2.177	0.445	−1.222	(0.756)	2.916	(0.272)	0.058	(0.981)
Firm Collateral (fitted)	2.769[b]	(0.017)	1.434	0.107			1.362	(0.270)	1.969[b]	(0.031)
Personal Collateral (fitted)	3.726[a]	(0.000)	2.626[b]	0.013	5.219[a]	(0.012)	2.456[c]	(0.056)	2.751[a]	(0.002)
HHI	−0.654[b]	(0.018)	−0.393	0.173	−0.420	(0.292)	−0.407[c]	(0.067)	−0.465[c]	(0.052)
Firm age	0.006	(0.459)	−0.010	0.225	0.013	(0.336)	−0.004	(0.629)	−0.002	(0.826)
Inter1	0.020[b]	(0.034)	0.021[b]	0.045	0.029[c]	(0.068)	0.025[a]	(0.007)	0.019[b]	(0.023)
Debt	−0.062	(0.781)	−0.045	0.872	−0.190	(0.491)	−0.172	(0.352)	0.031	(0.871)
Profit	−1.558[a]	(0.002)	−0.939	0.126	−1.019[c]	(0.076)	−0.803[b]	(0.019)	−0.825[c]	(0.063)
Cash	0.076	(0.931)	0.155	0.878	0.085	(0.731)	−0.120	(0.314)	−0.261	(0.719)
Size	0.115	(0.274)	0.127	0.338	−0.080	(0.525)	−0.264[b]	(0.013)	0.032	(0.740)
Company	−0.993[b]	(0.037)	−1.089[b]	0.035	−1.229[a]	(0.007)	−1.143[a]	(0.001)	−0.928[b]	(0.020)
Term	0.017	(0.955)	0.253	0.489	0.728[c]	(0.066)	0.374	(0.140)	0.060	(0.817)
Default	−1.684	(0.154)	0.447	0.817	0.488	(0.789)	1.593	(0.118)	−0.874	(0.387)
Relation	−0.009	(0.433)	−0.008	0.528	−0.036[b]	(0.034)	−0.019[c]	(0.085)	−0.007	(0.472)
Comp bal	−0.018	(0.943)	−0.010	0.971	−0.158	(0.731)	−0.087	(0.735)	−0.073	(0.746)
Number	−0.463[a]	(0.009)	−0.409[b]	0.042	−0.514	(0.108)	−0.188	(0.196)	−0.364[b]	(0.023)
Maturity	0.000	(0.962)	–		−0.011[c]	(0.058)	−0.006[b]	(0.044)	−0.001	(0.754)
Fixed	0.955[a]	(0.000)	0.874[a]	0.004	1.175[a]	(0.001)	0.882[a]	(0.000)	0.937[a]	(0.000)
Adj. R^2	0.078		0.072		0.089		0.123		0.105	

Notes. This table presents the results of the two-stage least-squares (2SLS) regression of *Loan Rate Premium* variables treating *Firm Collateral* and *Personal Collateral* as endogenously determined for various sub-samples of the original sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.

[b] Idem, 5%.

[c] Idem, 10%.

$250,000 but less than $25 million, and loans originated by deposit institutions. Again the collateral results are similar to that of the second specification but now the *Relation* variable is no longer significant. The lack of strong results for *Relation* might be explained theoretically by the presence of strong competition among lenders as explained by Padilla and Pagano (1997) and von Thadden (2004).

In the first three columns of Table 9, we examine the impact on *Firm Collateral* when we include the other endogenous variables, *Personal Collateral* and the *Loan Rate Premium*, as regressors.[18] In the final three columns, we estimate the impact on *Personal Collateral* when we include the other endogenous variables, *Firm Collateral* and the *Loan Rate Premium*, as regressors. We find no effect of the explicit *Loan Rate Premium* on both types of collateral. This is not surprising in light of the fact that lenders might set a limit as to the maximum interest rate level that is charged. This rate might be set to reduce lenders' interim exposure because higher interest rates will increase the borrower's probability of default. Instead, high-risk borrowers

Table 9
Simultaneous system of equation estimation for Collateral with fees

Variables	Firm Collateral			Personal Collateral		
	parameter	(p-value)	odds ratio	parameter	(p-value)	odds ratio
Intercept	−3.175	0.190		8.229	(0.011)[b]	
Loan Rate Premium (fitted)	−0.128	0.607	0.880	−0.477	(0.305)	0.621
Firm Collateral (fitted)				3.118	(0.050)[b]	22.602
Personal Collateral (fitted)	1.221	0.310	3.390			
Fdelinq	0.479	0.045	1.614			
Pdelinq				1.191	(0.099)[c]	3.290
Ceo_age				−0.017	(0.189)	0.983
Ceo_share				0.011	(0.004)[a]	1.011
Ceo_exp				0.012	(0.278)	1.012
Debt	0.386	(0.020)[b]	1.471	−0.268	(0.291)	0.765
Profit	0.104	(0.802)	1.110	−0.216	(0.683)	0.806
Cash	−0.032	(0.799)	0.968	0.217	(0.634)	1.242
Size	0.181	(0.042)[b]	1.199	−0.429	(0.006)[a]	0.651
Company	0.511	(0.157)	1.666	−0.148	(0.778)	0.862
Term	−0.048	(0.857)	0.953	−0.393	(0.135)	0.675
Default	−0.835	(0.432)	0.434	0.070	(0.953)	1.072
Relation	−0.025	(0.028)[b]	0.976	−0.009	(0.516)	0.991
Comp bal	−0.177	(0.504)	0.838	0.253	(0.366)	1.288
Number	0.098	(0.508)	1.103	0.064	(0.681)	1.066
Maturity	0.004	(0.208)	1.004	−0.006	(0.129)	0.994
Fixed	0.008	(0.976)	1.008	−0.121	(0.703)	0.886
Likelihood ratio	82.2	(0.001)[a]		75.72	(0.001)[a]	

Notes. This table presents the results of the two-stage least-squares (2SLS) regression of *Firm Collateral* or *Personal Collateral* treating the other two dependent variables as endogenous for a sample of 766 firms as reported by 1993 *National Survey of Business Finances*. For dependent variables, see Table 2. p-values are given in parentheses. Two-digit industry dummies are included, but their coefficients are not reported.

[a] Statistically significant at 1% level.
[b] Idem, 5%.
[c] Idem, 10%.

[18] Table 9 reports only for the *Loan Rate Premium* adjusted for fees. The results are not affected when we do not include fees.

can adequately compensate lenders by posting collateral. Alternatively, it might be legally and reputationally advantageous for lending institutions to mask their efforts to shade interest rates to relationship borrowers by exchanging value in implicit ways that other customers, regulators, and litigious parties cannot easily observe. Consequently, at or near that maximum rate, there will be borrowers who will not need collateral to adequately compensate the lender as well as borrowers who will need to post collateral. Therefore the loan rate does not determine the posting of collateral. We also observe that the economic impact of *Relation* on collateral using simultaneous equations is not any stronger than the results obtained in single-equation framework (Tables 4 and 5).

3. Conclusions

The theoretical financial intermediation literature has often argued that banks produce information about borrower firms through their lending relationships, which is otherwise not available to the capital markets. Researchers have, with mixed success, tested the narrower hypothesis that the length of a customer's relationship ("relationship length") significantly reduces the loan interest rates. In addition the empirical literature finds mixed results with respect to the correlation between collateral requirements and loan interest rates.

These mixed results may be reconciled by noting that the theory of bank–customer relationship does not require that relationship length affect the explicit loan rate only or at all. It suggests instead that relationship value affects the sum of the explicit and implicit interest rates such as the requirement to post collateral. This paper examines the impact of borrower–lender relationship upon the explicit loan interest rate and collateral. Since the existing theoretical and empirical literature has strongly established that collateral requirement is endogenously determined, we use a simultaneous equation approach for a sample of small business firms that are involved in relationship loans. We find that the length of the relationship does impact upon both the probability of posting collateral and the level of the loan interest rates. Specifically, we find the economic impact of the borrower–lender relationship to be 21 basis points for one standard deviation increase in relationship length. We also find that collateral has a statistically significant economic impact of 200 to 400 basis points on loan interest rates, suggesting strong evidence for jointness in the terms of lending. Further, consistent with the moral hazard theories of collateral and the results of Berger and Udell (1990, 1995), we find a positive correlation between observable firm risk variables and posting collateral.

Another implicit price of a loan is the amount of fees charged by lenders. In our sample, more than half of the loans (433 out of a total of 766 loans) are charged fees. Fees should be endogenously determined along with the requirement of posting collateral. However we found that our potential instrumental variables for fees were also related to loan interest rates. Therefore, we are unable to accurately identify an instrumental variable for fees, and only examine whether our results are weakened or strengthened due to the inclusion of fees. We do not find that our results are materially altered by the inclusion or exclusion of fees in our analysis.

Carey et al. (1998) and Udell and Berger (2005) differentiate between asset-based lending and relationship lending. They argue that asset-based lending is more transactions oriented using "hard" information. The firm's assets, such as accounts receivable and inventory would in these cases be used as a source for collateral (also called inside collateral). In contrast, relationship lending relies on "soft" information to determine borrower risk and involve the use of personal guarantees and personal assets pledged as collateral. Further, one might view personal collateral (also called outside collateral) as a substitute for equity, because these personal assets could be

sold and the proceeds may be then used by the firm to repay the loan. We distinguish between these two types of collateral in our estimation. In doing so, we separately estimate the impact of each type of collateral on the loan rate and on each other. We find that the economic impact of the requirement of posting personal (outside) collateral is greater than posting firm (inside) collateral.

Future research might examine the impact of lender characteristics on loan interest rates (as in Kashyap et al., 1993; Kashyap and Stein, 2000; and Hubbard et al., 2002) while taking into account self-selection among the borrowers and lenders. In addition, one might examine the role of foreign banks on loan interest rates, collateral, and fees. Maybe they prefer a different borrower profile from US domestic banks. We leave such issues for future research.

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