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Lending relationships in line-of-credit and nonline-of-credit loans: Evidence from collateral use in small business

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Abstract

Lender–borrower relationships facilitate monitoring in small business loans. We investigate how the duration and scope of the bank–borrower relationship affect the decision to secure line-of-credit and nonline-of-credit loans. We find that the likelihood of collateralizing a line of credit decreases with the length of the bank–borrower relationship. For nonline-of-credit loans, however, the incidence of collateral pledge decreases with the number of lender-provided financial services used by the borrower. Our finding indicates that the mechanism through which banks obtain private information depends on the type of the loan. Pooling across loan types may dilute the impact of both the duration and scope on the terms of a loan.

Keywords: Lending relationship; Small business finance; Collateral

JEL classification: G21; M21

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1. Introduction

Collateralization is believed to be a useful tool in resolving problems associated with both asymmetric information and moral hazard in business and consumer lending. However, since the nature of the bank–borrower relationship can be expected to affect the severity of both moral hazard and adverse selection problems, we can also expect collateral usage to be affected by the nature of this relationship. The purpose of this paper is to empirically examine how the nature of the bank–borrower relationship affects the use of collateral in loan contracts.

Stiglitz and Weiss (1981) proposed that asymmetric information can cause credit rationing and Bester (1985) showed that credit-rationing problems could be circumvented if banks compete by choosing collateral requirements and the rate of interest to screen the risk of various investors. Besanko and Thakor (1987a) developed a model in which credit contracts with inversely related interest rates and collateral requirements allow banks to sort out borrowers into risk classes, reducing the problem of adverse selection.[1]

Collateral can also be used to lessen some of the moral hazard related monitoring issues in business lending. Boot and Thakor (1994) show a direct connection between moral hazard and its impact on collateral. In a setting with repeated credit market interaction, they show that collateral in the early period serves as a tax on the borrower that can be lifted after the borrower achieves its first success. A long-term bank–borrower relationship enables the bank to efficiently tax and subsidize the borrower over time and hence reduces the use of collateral. Boot et al. (1991) show that, even after accounting for the cost of repossessions, banks may use collateral to reduce moral hazard problems when lenders are able to take unobservable *ex post* actions that affect project payoffs. Rajan and Winton (1995) show the importance of collateral in a model with moral hazard, monitoring, and pre-contract asymmetric information. In their model, collateral gives banks incentives to monitor because the information gathered by banks is more useful to them than to other parties when loans are collateralized or contracted with covenants.

From a theoretical perspective then, there are good reasons to believe that collateral can reduce inefficiencies due to both informational asymmetry and moral hazard, and there also seems to be consensus that the need for collateral declines with the duration of the bank–borrower relationships.

In addition to duration, the scope of the bank–borrower relationship—as measured by the number of bank-provided services used by the borrower—may also affect collateral use. The reason is that relationship scope may also affect the amount and type of credit-relevant information generated for the bank, and this information may be different from that generated by relationship duration. This view is consistent with previous thinking in that "[i]n addition to interaction over time, relationships can be built through interaction over multiple products" (Petersen and Rajan, 1994). While both the *length* of the bank–borrower relationship and the *number* of bank services used can predict the strength of a bank–borrower relationship, these measures are nonetheless non-substitutable and

[1] Unlike Bester (1985), however, collateral availability does not necessarily eliminate rationing in Besanko and Thakor's (1987a) framework, given constraints on collateral availability, unless loan size is added as a sorting variable as in Besanko and Thakor (1987b).

are proxies for distinct information-gathering processes. In particular, duration and scope will generally lead to different amounts of "hard" and "soft" credit information being generated. Recent work by Stein (2002) provides clues as to why different types of information (soft vs. hard) may be important in modeling the role of the bank–borrower relationship. Stein (2002) argues that the type of information a firm collects and processes may be key to the way it organizes. For example, large hierarchical firms will perform better if key business information can be easily quantified, processed, and transmitted with little or no cost. Stein's model predicts that large banks may be less efficient at making loans that require "soft" monitoring. The key implication of these papers is that banks may rely on different aspects of the bank–borrower relationship to generate different kinds of information. Recent work (e.g. Petersen, 2002, Petersen and Rajan, 2002, Stein, 2002; and Uzzi, 1999) provides important insights into how the duration and scope aspects of bank–borrower relationships serve distinct information-generation functions.

Banks extend credit primarily through letters credit (L/C) loans and non-L/C loans. These two categories of loans are quite distinct. In particular, the information required to monitor L/C and non-L/C loans differs markedly and lenders rely on different aspects of their relationship with a borrower to collect, process, and verify relevant information. A closer look at terms of loan indicates that L/C and non-L/C loans constitute two broad loan categories with distinct features. Unlike non-L/C loans, most L/C loans have credit card like attributes that make them a more liquid and flexible form of financing. Like credit card loans, borrowers can draw on their credit lines whenever they need funds and lenders are (usually) committed to lending over the course of the contract. These loans are neither standardized nor tied to a specified investment and the borrower usually exercises significant discretion on how they are used. The similarities, however, between relationship-driven L/C loans and credit card loans—which are priced on a transactional basis (Ausubel, 1991)—are very deceptive. The key difference between L/C loans and credit card loans is the size of the loan. In our sample, an average L/C loan is $1.5 million, which is significantly higher than any credit card loan limit. The size of the loan also reduces the number of L/C loans a bank can issue compared to credit card loans, lowering an issuer's ability to hedge risk of default. Furthermore, the credit scoring system used in consumer finance has been used longer and hence perhaps is better developed than credit scores used to evaluate a small business. Hence, a bank's informational needs to issue and maintain L/C loans are quite different from those required for credit card loans.

Quantifying risks from L/Cs by a simple credit score may be quite difficult and inadequate since the borrower usually exercises significant discretion on how these loans are used. "Soft" information, such as a borrower's honesty, work ethic, or reputation, may be particularly important for assessing credit risks for such loans.[2] Such information can be produced only over time, through frequent and long-term association. Therefore, one should expect the duration of a lending relationship to play a more important role than credit scores in determining the terms of L/C loans.

[2] For a detailed discussion on the distinction between soft and hard information, see Petersen (2002) and Stein (2002).

Non-L/C loans, on the other hand, are typically illiquid and often nonrenewable. These loans are used to finance the purchase of a specific long-term asset and have fairly standard contracting features and approval criteria (credit scores, for example). Unlike L/C loans, the information required in processing a non-L/C loan is often based on "hard" information—information that is quantifiable, and interpreted without the value judgments of an intermediary associated with the data collection process. Such information can also be purchased, verified, and analyzed. Providing multiple banking services to a non-L/C borrower significantly reduces the cost to a bank of producing, verifying, and continually monitoring such information.[3]

The above observations motivate the question that we empirically examine in this paper: how do the duration and scope of the bank–borrower relationship affect collateral requirements in L/C and non-L/C loans? We address this question by using the 1993 (National Survey of Small Business Finance) NSSBF database to provide the first direct evidence that the duration and scope of bank–borrower relationships affect decisions to secure L/C loans differently from non-L/C loans.

Our findings indicate that scope of bank–borrower relationship significantly reduces the need for collateral in non-L/C loans, and has no impact on collateral usage in L/C loans. The duration of bank–borrower relationship seems not to affect the incidence of collateral for non-L/C loans, but it reduces collateral usage for L/C loans. As expected, the pooling of both types of loans dilutes the explanatory power of both the length of bank–borrower relationship and number of bank-provided services used with regard to the incidence of collateral.

Evidence also indicates that the importance of "soft" information does not reduce with the increased availability of public information about the firm. For example, for L/C loans, the impact of duration of relationship on the incidence of collateral does not diminish with the age of the firm.[4] Similar findings follow for non-L/C loans, where the number of bank-provided services is the primary mechanism used to monitor the loans. The impact of the number of financial services used by a borrower on the incidence of collateral is unaffected by the age of a firm. The value of the information generated from financial services for non-L/C loans is independent of firm age.

Empirical findings on the role of relationship lending in collecting "soft" information have important implications on the availability of credit for small business, especially considering the current spate of reorganization in the banking industry. Consolidation has greatly shrunk the number of small banks over the last decade. If small banks have a comparative advantage in collecting "soft" information, then smaller firms may be more

[3] It is possible that a lender may use the information gathered for one type of loan to process another type of loan. The data set indicates that 13.7 percent of recent L/C loan borrowers and 36.3 percent of non-L/C loan borrowers had borrowed another type of loan from the same bank. The main statistical results are not affected when these firms are excluded from the sample.

[4] While the results with age proxying for public information are robust, the interpretation may not always be accurate. At best, age is a crude proxy for public information; and it is possible that this proxy may be picking up omitted variables that might be important such as growth effect or survival effects.

credit constrained in the new regime.[5] Risky loans to small businesses with little reputation or verifiable accounting practices (perhaps better monitored by relationship building) may seem even more risky, requiring higher rates and more collateral. Given the focus on collateralization, this may accentuate the problem already faced by small businesses. The 1993 NSSBF reports that insufficient collateral resulted in 15 percent of denied loans. More importantly, 11 percent of discouraged borrowers cited inability to meet the collateral requirement as their primary reason for not even applying for a business loan.

This paper controls for the possible sample selection bias inherent in estimating the collateral relationship, a topic ignored in previous papers. Incidence of collateral can be observed only when the borrower succeeds in securing a loan. This may pose a serious econometric problem if variables (size, age, leverage, etc.) that affect a bank's decision to accept a loan application also influence its decision to secure a loan. This sample selection bias was tested using selection-corrected maximum likelihood estimates and we do not find evidence of selection bias in our sample.

The remainder of this paper is organized as follows. Section 2 provides a brief overview of the relevant existing empirical work on relationship lending. Section 3 describes our data and the methodology applied. Section 4 presents estimation results. Concluding remarks are provided in Section 5. Appendix A provides tests for selectivity bias.

2. Existing empirical work on relationship lending and loan collateralization

Beyond theoretical predictions, empirical evidence on the impact of different aspects of the bank–borrower relationship (duration and scope) on securing different kinds of loans is scant.[6] Direct evidence on how a bank's comparative advantage in processing "hard" information affects lending practices is beginning to emerge.[7]

In recent years a substantial amount of evidence on relationship banking and collateral decisions has emerged from European data. None of these studies, however, explicitly distinguish between L/C loans and non-L/C loans. For example, analyzing German data, Machauer and Weber (1998) find that borrowers with a small number of bank relationships provide more collateral and get more credit. Harhoff and Korting (1998) note that firms with more concentrated and long-lasting bank relationships have less stringent collateral requirements. Elsas and Krahnen (1999) also report that certain aspects of relationship lending affect the incidence of collateral in loan contracts. These findings suggest that when the bank–borrower relationship is valuable (it can lower the cost of monitoring loan performance), one should expect a negative association between the strength of the relationship and the incidence of collateral.

[5] Jayarantne and Wolken (1999) provide empirical evidence on how large banks may not be good at small business tasks.

[6] An excellent review of the literature on relationship lending is provided by Boot (2000).

[7] Petersen and Rajan (2002) provide some indirect evidence on this issue by analyzing the distances between borrowers and lenders. Liberti (2003) provides some direct evidence on the processing of soft information from the changes in the hierarchical structure of foreign commercial banks in Argentina.

Degryse and Cayseele's (2000) findings from European data also indicate that duration and scope of relationship impact both the cost of credit and the incidence of collateral. They find that a longer relationship increases the cost of borrowing but that use of bank-provided financial services (scope of the loan) has the opposite effect. They also find that collateral requirements decrease with the duration of relationship and increase in its scope.

Petersen and Rajan (1994) and Berger and Udell (1995) provide the first US evidence that both the duration and scope of lending relationships affect credit availability and the design of loan contracts for small businesses. Although the authors use the same data set, as previously noted, their conclusions are sharply different. For example, Berger and Udell (1995), using the 1987 NSSBF data, find that *both* the incidences of collateral and credit costs fall with the length of the bank–borrower relationship for line of credit ("L/C") loans.[8] Surprisingly, Petersen and Rajan (1994), working with both L/C and non-L/C loans from the *same* survey, find that *neither* the length of the bank–borrower relationship nor the nature of the bank-provided services has any statistically significant effect on the cost of credit.[9] The differences in the conclusions of these two papers may be because of differences in loan type.

This research highlights the distinction between the two types of loans (L/C and non-L/C loans) and between two often-used proxies for strength of relationship—duration and scope of relationship. Results indicate that these two proxies are not always substitutable and may represent sharply distinct information-gathering processes. Our findings are consistent with the view that monitoring L/Cs requires more "soft" information, which is primarily collected via a long lending relationship with the borrower.[10]

3. Methodology and data

The 1993 NSSBF, conducted by the Federal Reserve Board and the Small Business Administration, was targeted primarily on non-financial, non-farm businesses with fewer than 500 employees in operation as of year-end 1992. Employment size, location, and census regions stratify the respondents so that the final data constitute a representative sample of about 5 million small businesses operating during the same period. The final data set contains 4637 firms.

In addition to balance sheets and income statements, the NSSBF provides detailed information on the types and sources of credit and financial services used by firms. Relationships with financial institutions, including both duration of relationship and number

[8] Their findings, however, are non-uniform over the entire sample. The length of the lending relationship affects loan rates only for firms that have assets over $500,000.

[9] In their paper, Petersen and Rajan find that the duration of the relationship has a significant impact on the availability of trade credit.

[10] Petersen and Rajan (2002) find support for the hypothesis that changes in the use of information technology used in modern banking may have reduced the role of "soft" information. Lenders who do not have good "soft" information about a borrower can reduce their risk of lending by relying on more timely and extensive "hard" information generated by modern technology. They note that the use of modern informational tools may change "the very nature of lending from an emphasis on strict ex ante screening and costly ex post monitoring, to frequent ex post monitoring and quick intervention."

of financial services used, are recorded. The data also contain detailed information on the most recent loans, including types and terms of the loans and whether the loans are secured and by which assets. Unlike the 1991 NSSBF survey, this survey also provides information about the credit history of a firm and its owner.

A total of 1676 firms provided information on their most recent loans, most of which were from banks. Seventy-two percent of these firms pledged collateral for the most recent loans. The variables that may affect the decision to secure a loan are from the same survey and are grouped into three categories: relationship, risk, and governance. Due to obvious reporting errors, the dataset contains some outliers that are very unrealistic and may distort the econometric results of this study. Those outliers were deleted and 1632 firms were then included in the analysis. Table 1 provides summary statistics of the independent variables used in this paper. Two proxies are used to measure the strength of the bank–borrower relationship. The first proxy is the duration of relationship (i.e., the number of years the firm has conducted business with the lender).[11] We assume longer relationships, and the consequent repeated interactions between a borrower and a lender are keys to generating "soft" information about a borrower. As such, loans that are better monitored with "soft" information should then be less likely to be collateralized for borrowers with long banking relationships.[12] The duration of a relationship also controls the degree of moral hazard. Boot and Thakor (1994) show that collateral is used to resolve moral hazard in the early periods of a long-term relationship, and is lifted after the borrower achieves its first success. It implies that the longer the relationship, the more likely the borrower has achieved its first success and the less likely he is required to provide collateral.

The other measure of relationship is the number of financial services that a borrower purchases from its lender. Lenders have access to private information when borrowing firms use non-borrowing financial services (such as checking accounts, savings accounts, or other financial services). This information can easily be quantified, transmitted, and combined with other publicly available information to effectively monitor different aspects of the borrowers' business.[13] Increases in the use of lender-provided services should reduce the need for securing loans that can be better monitored through such "hard" information.

In addition to checking and saving accounts, other financial services reported by NSSBF include transaction services, cash management services, credit-related services, trust and pension services, and brokerage services. Brokerage services are not included as information-producing services since they provide little information relevant to monitor-

[11] Given the way the data is collected in the NSSBF, lender in our analysis always refers to the lender associated to the most recent loan.

[12] Since the marginal impact on collateral of an additional relationship year may diminish with the length of the relationship (Cole, 1998), we us the length of the relationship in the log form (i.e., the log of the length of the relationship in years) in estimating our model. Elsas (2005) points out how information access to banks and influence on borrowers' management may be more important than duration of relationship in relationship lending—especially if the average duration of relationship is relatively high. Fortunately, the median duration of our sample (5.2 years) is significantly lower than their study (15.04 years). Bodenhom (2003) points out that frequency of bank–borrower contracting may be as important as the duration of lending relationship. Unfortunately, it is not possible to capture this aspect of relationship in our data set.

[13] Mester et al. (2001) provide evidence to suggest that checking account information is used to monitor collateral, and that such monitoring is useful in detecting problem loans.

Table 1
Summary statistics of borrower characteristics[a]

(1) Variable	(2) Firms extended loans	(3) Firms pledged collateral	(4) Firms did not pledge collateral	(5) t-ratios[c]
Number of firms	1632	1179	453	
Relationship proxies				
Length of relationship (years)	8.075	7.581	9.362	−3.736***
	(8.380)	(8.164)	(8.795)	
Number of financial services[b]	1.574	1.523	1.706	−2.631***
	(1.284)	(1.296)	(1.124)	
Number of borrowing sources	1.831	1.940	1.547	5.886***
	(1.339)	(1.398)	(1.123)	
Firm age (years)	16.36	15.69	18.08	−2.796***
	(14.43)	(13.70)	(16.08)	
Risk proxies				
Log of total assets (million)	13.34	13.47	13.00	4.149***
	(2.055)	(2.034)	(2.072)	
Debt-to-assets ratio	0.392	0.423	0.312	3.935***
	(0.537)	(0.549)	(0.496)	
Return on assets	0.340	0.298	0.449	−2.192**
	(1.022)	(0.845)	(1.375)	
Business delinquencies	0.536	0.601	0.366	4.015***
	(1.103)	(1.157)	(0.929)	
Owner delinquencies	0.213	0.230	0.170	1.412
	(0.726)	(0.750)	(0.658)	
Owner bankruptcy	0.019	0.020	0.015	0.518
	(0.137)	(0.141)	(0.123)	
Judgment	0.038	0.044	0.022	1.907*
	(0.191)	(0.205)	(0.147)	
Governance proxies				
Regular corporation	0.470	0.481	0.430	1.837*
	(0.499)	(0.500)	(0.496)	
S-corporation	0.278	0.282	0.267	0.623
	(0.448)	(0.450)	(0.443)	
Partnership	0.075	0.070	0.091	−1.361
	(0.264)	(0.254)	(0.287)	
Proprietorship	0.179	0.167	0.212	−2.003**
	(0.384)	(0.373)	(0.409)	

[a] Means, and standard deviations (in parentheses).
[b] Financial services include checking account, savings account, cash management services, credit-related services, transaction services, and trust and pension services.
[c] t-ratios are for differences in the means of the firms that pledged and did not pledge collateral.
* The differences of the two means in columns (3) and (4) are statistically different from zero at the 10% level.
** Idem., 5%.
*** Idem., 1%.

ing a business. Hence, the maximum number of lender-provided financial services that a borrower can use is six. The survey shows that, on average, a borrower uses 1.57 lender-provided financial services.[14] Also borrowers that did not pledge collateral on their loans used more lender-provided financial services than those who pledged collateral (1.669 versus 1.516 with a t-statistics of 2.688).

Arguably, the length of relationship and number of financial services are related to the effects of a borrowing firm's age, since older firms are more likely to have longer relationships with banks and may use more bank-provided services.[15] However, as Berger and Udell (1995) point out, there is an important distinction between a firm's age and the strength of the lending relationship. In the context of information gathering, the age of a business also indicates greater availability of public information about I (the older the firm, the more information available to the public).[16] Thus, banks do not necessarily have reliable private information about older firms unless they develop strong bank–borrower relationships through repeated transactions and provision of multiple services.

To account for the potentially confounding effect of a firm's age (providing both private and public information on the use of collateral), the firm's age is included as a control variable in the regression. If a firm's age proxies for private information, the econometric specification should reduce the statistical significance of the relationship variables. Including age as an independent variable also controls for the severity of moral hazard and the default risk of a firm. There is strong evidence to suggest that older firms are less likely to go bankrupt. Thus, it is expected that a firm's age will negatively correlate to the incidence of collateral. Like the length of the relationship, firm age is entered in log form in the regression.

Firms also use services from multiple lenders. This lack of exclusivity may reduce the quality of private information gathered through the lending relationship, prompting lenders to require added security. However, the number of borrowing sources may also proxy for the firm's quality. Firms with uncertain prospects are often forced to go to multiple lenders in order to meet their credit goals.[17] Since both these effects predict a positive association between number of borrowing sources and collateral use, it is not possible to distinguish one effect from the other.

Preliminary evidence indicates that expectations regarding all four measures of the relationship are borne out by the data. Table 1 shows that the average length of the relationship,

[14] This is the average number of financial services that a firm purchased from its most recent loan lender. Just like a firm has multiple borrowing sources, the firm may use financial services provided by multiple institutions. Therefore, the average number of financial services used by a firm should be higher than 1.57. However, this paper does not try to test whether or not the financial services the firm purchased from *all* institutions affect the collateral requirement of the most recent loan.

[15] The correlation coefficients between firm age and the duration of relationship and between age and the number of financial services are respectively 0.47 and 0.11.

[16] Ongena and Smith (2001) point out that any measure of duration of relationship is limited by the age of the firm in the survey and by the survey year and both of these may induce inconsistent estimates. An excellent review of cross country evidence of the number of bank–borrower relationship is presented in Ongena and Smith (2000).

[17] Foglia et al. (1998) report that borrowers with multiple banking relationships are considered more risky. Farinha and Santos (2002) also find poor performers in Portugal are more likely to initiate multiple relationships. Degryse and Ongena (2001) find that firms with bilateral relationships are more profitable.

the number of non-borrowing financial services, and age are significantly lower for firms that pledge collateral. As expected, firms that do *not* pledge collateral have a lower average number of borrowing sources.

We use leverage (ratio of debt to total assets), profitability (returns on assets), and size (book value of total assets) to control for the firm's observable risk. Firms with higher leverage and lower profitability have higher probabilities of default and, therefore, are more likely to pledge collateral. The effect of size on collateral is unclear. Larger firms tend to be more diversified and established, less prone to bankruptcy and moral hazard, and thus should pledge collateral less frequently than smaller firms. Yet firms also have incentives to pledge collateral in order to receive favorable rates and larger firms are more capable of doing so. Therefore, firm size may be positively related to the incidence of collateral.

Lenders frequently use information on the credit histories of both the owner and business to assess default risk. We use four variables: the number of delinquencies on different obligations within the past three years of the firm and its owner, whether the owner has declared bankruptcy within the past seven years, and whether any judgments have been rendered against the owner. We expect collateral pledge to be correlated positively with each of these variables.

The governance characteristics describe the legal form of the firm: proprietorship, partnership, S-corporation, and (regular) C-corporation. As the degree of conflicts of interest among owners, managers, and lenders differs by organizational form, borrowers' incentives to take risks and disclose information may also vary. Industry dummy variables are used to control for industry wide differences. Eight dummies are created according to the firm's one-digit standard industrial classification. Given that the marketability and intangibility of assets vary by industry, we expect that the frequencies with which firms provide collateral will likely vary by industry.

To investigate how relationships affect the requirement of collateral, we use probit regression to estimate the probability of a loan being secured. The binary variable *COL* takes a value of *one* if the loan is secured and a value of *zero* otherwise. The probability of a loan being secured is given by:

$$\text{Prob}(COL = 1) = \int_{-\infty}^{\beta' x} \phi(t)\,\mathrm{d}t = \Phi(\beta' x) \tag{1}$$

where Φ is the standard normal distribution function. X is a vector of explanatory variables, including proxies for different measures of the strength of the bank–borrower relationship and control variables to proxy for a firm's creditworthiness, as well as governance characteristics, including industry dummies.

4. Estimation results

Theory suggests that lending relationships should generate valuable private information about a borrower. This ability to generate private information should reduce the risk of issuing loans and, consequently, reduce the need for securing loans. In this section, we discuss new empirical findings on this issue, concentrating on two measures of the strength

of the bank–borrower relationship: the duration of the relationship and the number of bank-provided financial services used.

Table 2 provides probit estimates that address our central question: How does the bank–borrower relationship affect collateral use for loans? Table 3 presents contract characteristics that distinguish L/C and non-L/C loans. To illustrate the problems associated with pooling across loan types, we divide our sample into L/C and non-L/C loans in Table 4. The results highlight the importance of loan type in quantifying the impact of a lending relationship on decisions to secure a loan.

4.1. Full sample results

Table 2, specification (1), reports probit estimates for the full sample with no control for credit history. To emphasize the impact of credit history on the relationship variables, specification (2) includes credit control variables.

Among the relationship variables, the estimate for the coefficient on the number of financial services used is negative and is statistically significant at the 1 percent level.[18] If a firm uses one more bank-provided service than the average number of services used, the probability of pledging collateral decreases by 2.9 percent. The estimate for the coefficient on the length of the relationship is negative, as expected, but is not statistically significant.

There are two possible explanations for the finding that the duration of the lending relationship does not affect the decision to secure a loan. First, the duration of the relationship may not capture the lender's ability to produce reliable private information. Second, only for certain kind of loans long business associations may be necessary to generate private information. Pooling across different categories of loans might then dilute the impacts of the length of the relationship. These possibilities are investigated in the next subsection.

We find that a firm's age (a proxy for public information) is inversely related to the incidence of collateral.[19] Older firms are less likely to pledge collateral because they have longer track records and exhibit fewer and less significant information problems than younger firms. This result is consistent with the predication by Boot and Thakor (1994) that collateral is less likely to be required for older, more established firms. The marginal probability in specification (1) of Table 2 shows that a firm's probability of pledging collateral falls by 5.1% if the firm's age increases by one standard deviation from the mean age of the sample.

The estimate for the coefficient on the number of borrowing sources is both positive and significant. Specification (1) indicates that a firm's probability of pledging collateral increases by 2.6% if a firm has one more source of borrowing than the sample average.

[18] The economic significance of the estimate is given by the marginal probability in column 2 of specification (1).

[19] Petersen and Rajan (2002) identify four other variables to proxy for public information: (i) use of business credit cards, (ii) availability of financial records at the time of the survey, (iii) information on franchising, and (iv) the equity owned by the largest shareholder. We included each of these as a measure of public information but none of these variables was significant in our sample nor did any of them change the qualitative nature of the results reported.

Table 2
Incidence of collateral and role of relationship in the full sample

Variable	(1)		(2)	
	Coefficient estimates	Marginal probability	Coefficient estimates	Marginal probability
Log length of relationship (years)	−0.087	−0.029	−0.075	−0.025
	(1.61)		(1.47)	
Number of financial services	−0.088***	−0.029	−0.087***	−0.028
	(2.95)		(2.90)	
Number of borrowing sources	0.078***	0.026	0.066**	0.022
	(2.57)		(2.16)	
Log of firm age (years)	−0.133**	−0.044	−0.141***	−0.050
	(2.33)		(2.45)	
Log of total assets	0.096***	0.032	0.099***	0.032
	(4.27)		(4.32)	
Debt-to-assets ratio	0.241***	0.079	0.239***	0.078
	(3.29)		(3.25)	
Return on assets	−0.024	−0.008	−0.018	−0.006
	(0.73)		(0.55)	
Business delinquencies			0.101***	0.033
			(2.73)	
Owner bankruptcy			−0.056	−0.019
			(0.21)	
Judgment			0.297	0.088
			(1.45)	
Owner delinquencies			−0.016	−0.005
			(0.30)	
R-corporation	0.053	0.017	0.059	0.019
	(0.50)		(0.56)	
S-corporation	−0.001	−0.003	0.022	0.007
	(0.01)		(0.20)	
Partnership	−0.143	−0.049	−0.131	−0.044
	(0.96)		(0.87)	
Constant	−0.455		−0.517*	
	(1.63)		(1.83)	
Observations	1632		1632	
Log likelihood	−909.4		−903.7	
Pseudo R^2	0.057		0.063	
χ^2	109.1		120.5	

The dependent variable is set to one if a firm pledged collateral for the most recent loan. Asymptotic t-statistics for the probit estimates are reported in parentheses. In addition to the variables reported, each regression also includes seven industry dummies based on one-digit SIC codes.
Key message: In the full sample—where L/C and non-L/C loans are pooled—duration of relationship does not affect collateral use. Pooling across loan types may dilute the impact of the relationship variable.
* Statistical significance in a two-tailed test at the 10% level.
** Idem., 5%.
*** Idem., 1%.

This suggests that firms with lower credit ratings borrow from multiple sources. Petersen and Rajan (1994) also find that borrowing costs are higher for firms that borrow from multiple banks.

The coefficient estimate on the debt-to-assets ratio is positive and significant, while the return-on-assets estimate is negative but insignificant. This result indicates that highly leveraged and less profitable firms will more likely be required to pledge collateral.

Size of the firm, measured by the log of total assets, is positively and significantly associated with the probability of pledging collateral. Berger and Udell (1995) find similar results for L/C loans. This result may seem puzzling, since larger firms are relatively safe and should be asked to pledge collateral less often. Larger firms, however, are more likely to pledge collateral to obtain better terms on their loans. Using sales and employment to proxy for firm size yielded no statistical significance in the model, indicating that in our specification of total assets may be a reliable proxy for collateralizable assets available to a small business.

Specification (2) of Table 2 includes credit history variables as additional explanatory variables. Adding the public information on a firm's creditworthiness does not change the coefficient estimates of the relationship variables. Among the credit history variables, only business delinquency is significantly positive. This indicates that if a firm has repayment problems, it is more likely to pledge collateral. The owners' credit histories do not appear to be relevant to the incidence of collateral.

4.2. Is the bank–borrower relationship less important for non-L/C loans?

Like Petersen and Rajan (1994), we find that longer relationships do not benefit borrowers in the full sample when both L/C and non-L/C loans are pooled.[20] Berger and Udell (1995) attribute this finding to the difference between L/C and non-L/C loans. They argue that reputation and information effects are substantially less important for non-L/C loans. Pooling across loan types may then reduce the significance of the duration of the relationship for the full sample.

Without suitable empirical evidence, it may be premature to conclude that information effects are less important for non-L/C loans. Nevertheless, Berger and Udell (1995) make a strong case to explain why contracting features and the proposed use) of loan might determine how a that loan is monitored.[21] In this section, we discuss the difference between L/C and non-L/C loans in terms of contracting features, and provide the first evidence that different aspects of the bank–borrower relationship can affect the use of collateral for both types of loans.

The survey reports six types of "most recent" loans. They are line-of-credit, capital leases, mortgage, motor vehicle, equipment, and other loans. Line of credit and nonline-of-credit loans constitute two broad loan types. Contract characteristics for L/C loans and non-L/C loans are available in Table 3.

[20] In their model, however, they include percentage of trade credit to capture indirectly the availability of bank loans and to find that longer relationships do positively affect availability of trade credit.

[21] Berger and Udell (1995) did not analyze the effects of the relationship on the terms of credit for non-L/C loans.

Table 3
Contract characteristics of line-of-credit and nonline-of-credit loans

	L/C loans	Non-L/C loans	t-ratios[a]
Number of observations	983	649	
Loan size (million)	1.483	0.707	3.253***
Interest rate on the loan	6.426	6.321	1.560
Maturity (months)	22.86	64.36	−14.59***
Finance working capital	0.718	0.27	20.01***
Secured loan	0.618	0.87	12.42***
Secured by inventory	0.373	0.11	13.35***

Key message: L/C loans are larger, less secured, have smaller maturity and are generally used to finance working capital. Monitoring these loans may be need different kinds of information relative to more secure non-L/C loan.
[a] t-ratios are for differences in the means between L/C loans and non-L/C loans.
*** The differences of the two means in columns 2 and 3 are statistically different from zero at the 1% level.

A line-of-credit loan is one that a firm borrows from its lender through a line-of-credit account. Like a credit card account, a line of credit account allows the borrower to draw funds from the account, up to a pre-approved limit. Since L/C loans are used mainly to finance working capitals (72 percent versus 27% for non-L/C loans) instead of a specific asset, L/C loans have short terms (23 months on average versus 64 months for non-L/C loans) and large loan sizes ($1.48 millions versus $0.71 millions for non-L/C loans).[22] Without being tied to a specific investment, the contract characteristics of L/C loans provide the borrower with incentives for asset substitution and force the lender to be more aware of the borrower's overall performance and creditworthiness. To assess the a lender has to heavily rely on "soft" information that cannot be quantified and cannot be directly verified by anyone other than the agent who produces it (Stein, 2002). Such information is obtained primarily through a long association with the borrower.

Non-L/C loans are used to finance a long-term assets and typically have longer maturities and fairly standard contracting features and approval criteria (e.g., credit scores). Unlike L/C loans, the information required in processing a non-L/C loan is often based on "hard" information—information that can be verified and monitored at a cost. Providing multiple banking services to a non-L/C borrower significantly reduces the cost of producing, verifying, and continually monitoring such information. Often, the unique information acquired through long association (and prior loan rearrangements) is not necessary to evaluate and process these loans. Non-L/C loans are usually one-time, transaction-driven loans. The fact that these loans will not be renegotiated reduces the benefits from having long relationships with the borrowers. Therefore, for non-L/C loans, the number of financial services used is a better indicator of the importance of private information for lenders.

To test whether the two primary proxies for the bank–borrower relationship have different impacts on the use of collateral, we split the sample into L/C and non-L/C loans. Columns (2) and (3) in Table 4 report the results of the probit regression for the two sub-samples. For L/C loans, the coefficient estimate on relationship length is negative and

[22] The NSSBF survey directly reports if the primary use of the most recent loan or line of credit is working capital.

Table 4
Incidence of collateral and role of relationship for L/C and non-L/C loans

Variable	(1)	(2)	(3)	
	L/C loans	Non-L/C loans	L/C	Non-L/C
Log length of relationship (years)	−0.111*	0.041	−0.139**	0.085
	(1.67)	(0.41)	(2.20)	(0.96)
Number of financial services	0.037	−0.149**	0.044	−0.171***
	(0.97)	(2.30)	(1.22)	(2.76)
Number of borrowing sources	0.062	0.072	0.067***	
	(1.60)	(1.13)	(2.05)	
Log of firm age (years)	−0.226***	−0.061	−0.167***	
	(3.06)	(0.52)	(2.75)	
Log of total assets	0.171***	0.098**	0.141***	
	(5.57)	(2.26)	(5.75)	
Debt-to-assets ratio	0.361***	0.158	0.289***	
	(3.82)	(1.12)	(3.70)	
Return on assets	0.028	−0.114**	−0.019	
	(0.61)	(2.00)	(0.55)	
Business delinquencies	0.132***	0.004	0.102***	
	(2.86)	(0.06)	(2.62)	
Owner delinquencies	0.021	−0.010	−0.004	
	(0.29)	(0.196)	(0.08)	
Owner bankruptcy	−0.257	0.459	−0.040	
	(0.77)	(0.73)	(0.145)	
Judgment	0.212	0.628	0.301	
	(0.81)	(1.33)	(1.36)	
Constant	−1.912***	−0.224	−1.615***	−0.644**
	(5.06)	(0.40)	(5.12)	(1.96)
Observations	983	649	1632	
Log likelihood	−580.6	−212.6	−808.3	
Pseudo R^2	0.110	0.123		
χ^2	143.9	59.5		

The dependent variable is set to one if a firm pledged collateral for the most recent loan. Asymptotic t-statistics for the probit estimates are reported in parentheses. In column (3), the intercept, coefficients on the length of relationship, and number of financial services differ by L/C and non-L/C loans. In addition to the variables reported, each regression also includes seven industry dummies based on one-digit SIC codes and three governance dummies (R- or S-corporation or partnership).

Key message: For L/C loans, only duration of relationship reduces the likelihood of collateralization. For non-L/C loan only the number financial services used by the borrower affects the incidence of collateral. "Soft" information may be more important to L/C loans that are more difficult to monitor than non-L/C loans.

* Statistical significance in a two-tailed test at the 10% level.
** Idem., 5%.
*** Idem., 1%.

significant, and the estimate on the number of financial services is not significantly different from zero. The coefficient estimates for the remaining variables are similar to the full sample results.

For the non-L/C loans, the coefficient estimate for the number of financial services is negative and significant at the 5 percent level, while the coefficient on the length of the relationship is not significantly different from zero. The estimates on other variables have lower statistical significance because of the smaller size of the sample. One noticeable difference is that the return-on-assets estimate is now significant and also has the predicted sign.

To formally test whether the coefficients on the proxies for relationships are statistically different across L/C and non-L/C loans, we estimate the probit regression in which the intercept and the coefficients on the length of the relationship and the number of financial services differing by type of loan. The results reported in column 3 show that the estimate for the coefficient on the length of the relationship is negative and significant at the 5 percent level for L/C loans but is insignificant for non-L/C loans. The difference of the two estimates is −0.224, with a standard error of 0.101 and a t-ratio of −2.219, indicating the two coefficients are significantly different from each other at the 5 percent level. The estimate for the coefficient on the number of financial services is negative and significant at the 1 percent level for non-L/C loans but is not significant for L/C loans. The t-ratio for the difference of the two estimates is 3.041, strongly rejecting the hypothesis that the two coefficients are equal. The estimates for the coefficients on other variables are similar to those reported in Table 2.

The above results indicate that non-L/C loans are less likely to be collateralized if borrowers use more services. Given the fact that banks provide more services than non-banks,[23] a hypothesis for the association between collateral and services is that collateral requirements are different for banks and non-banks, and financial services in our regressions merely proxy for the lender type. To test this hypothesis, two collateral regressions with non-L/C loan samples are estimated. The first regression includes a dummy variable for commercial banks as an additional explanatory variable. The second regression is the same as the collateral regression of non-LC loans in Table 4, column (2), but is estimated with the bank loan sample only. The estimates of the two regressions are reported in Table 5. The estimates of the first regression reported in column (1) indicate that the commercial bank dummy was statistically insignificant while the estimate for the coefficient of the number of financial services is still significant at the 5 percent level. The estimates of the second regression show that even when non-bank loans are excluded, the relationship between collateral incidence and the number of financial services as shown in column (2) remains significant. The results indicate that characteristics of the source of lending do not drive the results.

These results are consistent with our hypothesis that the bank–borrower relationship affects the incidence of collateral for both L/C and non-L/C loans. The findings also suggest that both measures of lending relationship—the length of a relationship and number of services used—are not equally important for securing L/C and non-L/C loans. It is, therefore, not surprising that pooling these loans distorts the impacts of both the relationship proxies.

Like previous studies, the estimates of the collateral regression in this paper are subject to possible sample selection bias because the firms in our sample are the firms that received

[23] On average, a firm purchases 1.66 financial services from the most recent lender if the lender is a bank and 0.16 if the lender is a financing company.

Table 5
Incidence of collateral and role of relationship for non-L/C loans

Variable	(1) All non-L/C loans	(2) Bank non-L/C loans
Log length of relationship (years)	0.034 (0.34)	0.055 (0.52)
Number of financial services	−0.167** (2.34)	−0.135** (1.99)
Number of borrowing sources	0.076 (1.18)	0.098 (1.42)
Log of firm age (years)	−0.057 (0.48)	−0.056 (0.44)
Log of total assets	0.099** (2.28)	0.098** (2.14)
Debt-to-assets ratio	0.155 (1.10)	0.132 (0.89)
Return on assets	−0.114** (1.99)	−0.089 (1.51)
Business delinquencies	0.004 (0.06)	−0.004 (0.06)
Owner delinquencies	−0.007 (0.07)	−0.018 (0.16)
Owner bankruptcy	0.478 (0.77)	0.451 (0.70)
Judgment	0.624 (1.32)	0.590 (1.21)
Commercial bank	0.127 (0.61)	–
Constant	−0.325 (0.56)	−0.304 (0.51)
Observations	649	561
Log likelihood	−212.4	−197.3
Pseudo R^2	0.123	0.113
χ^2	59.8	50.5

The dependent variable is set to one if a firm pledged collateral for the most recent loan. Asymptotic t-statistics for the probit estimates are reported in parentheses. In addition to the variables reported, each regression also includes seven industry dummies based on one-digit SIC codes and three governance dummies (R- or S-corporation or partnership).
Key message: Banks provide significantly more services than non-banks. Even for non-bank loans, the number of services used by the borrower (and not the duration of relationship) affects collateral use. Source of lending does not drive our results.
** Statistical significance in a two-tailed test at the 5% level.

loan approval (and therefore may not constitute a random sample). To correct for the possible selection bias, we jointly estimate a loan approval and collateral use equations using the maximum likelihood procedure as shown in the appendix. The estimation of the model indicates that the sample selectivity does not bias the results for our model.

5. Conclusion

Our findings indicate that the bank–borrower relationship can be a valuable source of private information that can reduce uncertainty and, ultimately, the need to secure a small business loan. Both the duration of the relationship and the number of bank-provided services affect the decision to secure a loan. These two dimensions of the relationship are not substitutable because they tend to generate different kinds of information. Duration of bank–borrower relationships is more important to securing L/C loans because it generates "soft" information through repeated interactions that are particularly valuable to assess the risk of an L/C loan. Longer relationships give the lender access to valuable private information that reduces the risk and, consequently, the need for securing these loans. Duration of the bank–borrower relationship may be less important for nonrecurring standardized non-L/C loans. Instead, a bank's ability to extract information through financial services that it provides reduces the risk and, ultimately, the propensity to secure such loans. Our results also indicate that pooling across loan types dilutes the impact of both length and scope (number of bank-provided services used) on the terms of a loan.

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Appendix A. Testing for selectivity bias

The 1993 NSSBF reports that, in the previous three years, 2,007 firms applied for loans, 312 of which were denied. Because loan applications were not denied on a random basis, firms that received loan approval may not constitute a random sample. It is quite possible that the characteristics that barred firms from securing loans were correlated with the incidence of collateral. We provide the first estimates that explicitly control for this selection bias.

Before approving a loan, lenders usually assess the probability that the prospective borrower will default. It is possible that this process is subjective, and that non-financial factors affect the probability of an application being approved. Using the 1993 NSSBF, Blanchflower et al. (1999) find that black-owned firms are more likely to be denied a loan than white-owned firms. Cole (1998) finds that a potential lender is more likely to extend credit to a borrower with which it has a preexisting borrowing relationship. Both studies suggest that serious selection bias may exist if one does not explicitly control for the firms that were denied loans.

The sample selection bias problem arises when the error terms in the loan approval equation (a probit or logistical model) and the collateral use equation contain some common

omitted variables (i.e., the correlation coefficient between the two error terms is not zero). This selection bias will yield inconsistent estimates for the collateral use equation. Selection bias can be corrected by using Heckman's two-step procedure or by jointly estimating the loan approval and collateral use equations using the maximum likelihood procedure. We use the latter procedure, which is more efficient than the two-step procedure because it uses the information on the correlation coefficient between the two error terms. We use maximum likelihood estimation to jointly estimate the loan approval and collateral use equations to correct for sample selection bias.

Because the 1993 NSSBF does not record the types of loans that are denied, we are unable to estimate the model separately for L/C loans and non-L/C loans. Consequently, we assume that a lender's decision to approve or deny a loan application is independent of the type of loan. This allows us to jointly estimate a specification where the loan approval equation is the same for both types of loans, but the specification of the collateral use equation differs for each type of loan.[24]

Following Blanchflower et al. (1999), we use a probit model to explain the loan approval decision:

$$\text{Prob}(APP_i = 1) = W_i\alpha + \mu_i, \tag{A.1}$$

where APP_i is an indicator variable for loan approval for firm i, and W is a vector of explanatory variables that includes firm characteristics as well as the race and gender of the firm's owner. The collateral use equations for L/C loans and non-L/C loans are:

$$\text{Prob}(COL_i = 1) = X_i\beta + \nu_i, \tag{A.2a}$$

$$\text{Prob}(COL_i = 1) = X_i\gamma + \omega_i. \tag{A.2b}$$

Assuming that μ and ν, μ and ω are bivariate standard normally distributed with correlation coefficients ρ_1 and ρ_2 respectively, the likelihood function of the system is:

$$\begin{aligned} L = {} & \subseteq_{\substack{APP_i=1\\COL_i=1\\LC_i=1}} \Phi_2(X_i\beta, W_i\alpha; \rho_1) < \subseteq_{\substack{APP_i=1\\COL_i=0\\LC_i=1}} \Phi_2(-X_i\beta, W_i\alpha; -\rho_1) \\ < {} & \subseteq_{\substack{APP_i=1\\COL_i=1\\LC_i=0}} \Phi_2(-X_i\gamma, W_i\alpha; \rho_2) < \subseteq_{\substack{APP_i=1\\COL_i=0\\LC_i=0}} \Phi_2(X_i\gamma, W_i\alpha; -\rho_2) \\ < {} & \subseteq_{APP_i=0} \Phi_1(-W_i\alpha) \end{aligned} \tag{A.3}$$

where Φ_2 and Φ_1 are the bivariate and the standard cumulative normal distribution functions, respectively; indicator $LC_i = 1$ if the loan is an L/C loan, 0 otherwise; $COL_i = 1$

[24] Alternatively, we can assume that the correlation coefficients between the error terms of the loan approval regression and the collateral regressions for L/C and non-L/C loans are the same. This assumption will simplify the likelihood function but imposes more restrictions.

Table A.1
Incidence of collateral and role of relationship: maximum likelihood estimates with sample selection correction

Variable	(1) Line-of-credit	(2) Nonline-of-credit	(3) Selection equation
Log length of relationship (years)	−0.126**	0.035	−0.042
	(2.00)	(0.30)	(0.68)
Number of financial services	0.020	−0.167**	0.146***
	(0.57)	(2.04)	(3.45)
Number of borrowing sources	0.083**	0.119*	0.009
	(2.10)	(1.79)	(0.30)
Business delinquencies	0.152***	0.026	−0.180***
	(3.48)	(0.28)	(4.73)
Owner delinquencies	0.071	0.038	−0.099**
	(1.025)	(0.28)	(2.11)
Owner bankruptcy	−0.125	0.424	−0.466***
	(0.40)	(0.51)	(2.58)
Judgment	0.232	0.319	−0.286*
	(0.91)	(0.70)	(1.77)
Log of firm age	−0.239***	−0.110	0.235**
	(3.37)	(0.90)	(3.45)
Log of total assets	0.121***	0.113**	0.139***
	(3.64)	(2.05)	(5.73)
Debt-to-assets ratio	0.011	−0.005	0.009
	(0.33)	(0.09)	(0.41)
Return on assets	0.027	0.000	0.002
	(1.28)	(0.00)	(0.18)
Black			−0.617***
			(5.16)
Asian			−0.482***
			(3.05)
Indian			0.352
			(0.47)
Hispanic			0.043
			(0.25)
Female-owned			−0.026
			(0.25)
Constant	−0.982***	−0.328	−0.959**
	(2.18)	(0.38)	(3.21)
ρ	−0.671	−0.108	
	(1.49)	(0.13)	
Log likelihood = −1518.5			

The dependent variable is set to one if a firm pledged collateral for the most recent loan. Asymptotic t-statistics for the probit estimates are reported in parentheses. Each regression also includes seven industry dummies based on one-digit SIC codes and three governance dummies.
Key message: Likelihood ratio tests (on ρ) indicate that selection bias does not affect our results.
* Statistical significance in a two-tailed test at the 10% level.
** Idem., 5%.
*** Idem., 1%.

if the loan is secured, 0 otherwise. The system is identified because the race and gender variables of the firm's owners are contained in W_i but not in X_i.[25]

Table A.1 presents the maximum likelihood estimates of Eq. (A.3). The results in columns (1) and (2) show that the two primary relationship proxies (length of relationship and number of financial services) have similar effects on the use of collateral. This is similar to the results reported in Table 4. The coefficient estimate of relationship length is negative and significant for L/C loans but is not statistically different from zero for non-L/C loans. On the contrary, the coefficient estimate of the number of financial services is negative and significant for non-L/C loans but is not statistically different from zero for L/C loans.[26]

The estimates for the loan-approval selection equation (column (3)) suggest that black- and Asian-owned businesses are less likely to be extended credit than are white-owned businesses. This is consistent with the finding of Blanchflower et al. (1999). The estimates also suggest that larger firms, firms with better credit history, and firms that use more lender-provided financial services are more likely to receive credit.

The correlation coefficient estimates ρ_1 and ρ_2 are both negative and statistically insignificant. We can use a likelihood ratio test to determine whether ρ_1 and ρ_2 are jointly equal to zero, i.e., H_0: $\rho_1 = \rho_2 = 0$. From Eq. (A.3), the log likelihood of the system under the null is equal to the sum of the log likelihood of the loan-approval probit model and the collateral probit models for L/C and non-L/C loans. The negative of twice the difference between the log likelihood under the null and the log likelihood reported in Table A.1 is 3.27. This is distributed χ^2 with two degrees of freedom, indicating that the null cannot be rejected, and the sample selectivity is not important for our specification.

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[25] We tested if race and gender variables have any impact on the use of collateral. We estimated a probit model that included these variables and found none of the coefficients to be statistically significant.

[26] However, unlike in Table 4, the estimates for the coefficients on the debt to asset ratio and return on asset are insignificant in both L/C and non L/C loan equations. It is probably because both variables are measured with great noises and the non-linear estimation makes the relationship between the collateral requirement and the two variables less significant.

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