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Loan Commitment Contracts, Terms of Lending, and Credit Allocation

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ABSTRACT

This paper analyzes the structure of loan commitment contracts and the interrelationships among their component parameters. Lenders offer borrowers a set of loan "packages," from which the latter may choose that "package" found to be most appealing. Borrowers may "trade off" changes in any loan parameter in exchange for other adjustments. The borrower, at this time, may "purchase" a larger credit ration for a price. Supporting empirical evidence is presented.

RECENTLY, RESEARCHERS HAVE BEGUN to study the determinants of loan commitment or line of credit contracts. Such contracts play an extremely important role in bank credit allocation. According to the Federal Reserve Bulletin, over 70% of U.S. commercial and industrial loans are made under loan commitment contracts. Given the central importance of the institution, it is not surprising that it is the subject of a growing literature. Loan commitment contracts have importance both at the micro level, in terms of the bank-customer relationship, and at the marco level, in terms of the channels of operation of monetary policy.

In this paper, we seek to present and test empirically an analytic model of loan commitment contracts. Our paper differs from most previous work in that we include empirical analysis of credit allocation. Moreover, most previous theoretical work on the subject has concentrated on the specific issue of pricing of the contracts, often using an approach based on option theory, and not on the quantity allocation of credit and its determinants. We are particularly interested in the determinants of the quantitative allocation of credit to bank customers, and in the composition of and trade-offs among the various parameters comprising such a loan commitment "package." Our model helps explain how contract terms are established in the market and will illuminate the institutional framework of commercial lending.

A view of the credit contract as a "package of loan terms" has been implied recently in connection with the credit rationing problem.[1] Studies by Azzi and Cox [2], Arzac, Schwartz, and Whitcomb [1] and Koskela [8] show that the

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[1] Over the past two decades, the possibility of quantity restrictions in the credit market has been a leading theme in the literature. In particular, the possibility of nonprice credit rationing has been widely discussed. Such rationing is said to occur when interest rates on bank loans are set below their market clearing rates, resulting in some form of excess demand (see Freimer and Gordon [5]). Recent

demand for credit by a borrower depends not only on the rate of interest, but also on the amount of collateral and on borrower equity. From the lender's viewpoint, the supply of credit to a borrower is an increasing function of the amount of collateral and equity offered by the borrower.[2] While these studies imply the existence of loan characteristic trade-offs, they do so mainly in a price-leverage context. That is, they only explain why additional loans are obtained by borrowers when they offer lower financial leverage or larger collateral.

In what follows, we propose to extend the loan terms "package" concept to a model of loan commitment contracts. The structure of the paper is as follows. First, we provide a brief institutional description of the U.S. loan market. Next, we develop a simple theoretical model of the determination of the "package" of loan terms in loan commitment contracts. In the empirical section that follows, we examine a sample of loan commitment contracts and test our theoretical hypotheses. The paper ends with a section of conclusions.

I. Loan Commitment Contracts: An Institutional Background

Most short- and medium-term commercial and industrial loans in the U.S. are made under loan commitment contracts. Under a typical line of credit contract, a borrower is permitted to take down any amount of credit up to a maximum amount known as the "commitment." For credit taken down, he is charged an interest rate that is contingent on the prime rate prevailing at the time of borrowing, as well as a commitment fee. The loan commitment contract is signed for a fixed period and sometimes includes extension provisions. In addition, the contract may include collateral specifications, compensating balance requirements, restrictive covenants (e.g., dividend payment limitations, minimal liquidity requirements, etc.) and provision for default eventualities.

It is clear that loan contracts are complex agreements negotiated between a bank and its customers. They possess a multidimensional character, where a variety of loan variables enter the contract. The pricing of such loans in the U.S. is generally said to be done according to the "prime loan convention." This convention refers to the pricing of loans through a prime-based formula, containing a floating interest rate (the prime) and a customer-specific risk premium or mark-up.[3]

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works on the subject include Blackwell and Santomero [3], Jaffee and Russell [6], and Stiglitz and Weiss [11]. It is interesting to note that the commitment size under a line of credit contract may be interpreted as a credit ration. Hence, analysis of such commitments illuminates the credit rationing phenomenon.

[2] They emphasize the multi-dimensional nature of loan contracts. A loan term "package" view of credit contracts is offered also by Lam and Boudreaux [9] and by James [7], but in a different context. Lam and Boudreaux consider the trade-off between interest cost and compensating balances. James uses a model where the bank knows that the choice of a combination of interest rate and compensating balances is a self-selection process.

[3] Several contributions that deal with loan commitments have viewed the contract as representing a future loan at some fixed nominal interest rate. In that case, option valuation methods may be applied to the pricing problem. This is the approach of Deshmukh, Greenbaum, and Kanatas [4]. It is not suitable, however, for cases with a floating prime-based interest rate (cf. Santomero [10]). Moreover, as noted by Thakor, Hong, and Greenbaum [13], the option pricing model has difficulty explaining partial loan takedowns.

It appears that such contracts provide a "package" or "bundle" of loan terms, only one of which is the specified interest rate. The components of these "bundles" cannot be split and traded separately. For instance, a bank cannot "purchase" larger collateral or compensating balances without reference to other loan terms. Similarly, the borrower cannot separately obtain exemption from a risk premium without, say, offering a lower leverage ratio. In such a setting, neither the borrower nor the lender will be indifferent as to the composition of the "bundle" of loan terms traded.

The main conclusion reached from reviewing loan commitment contracts is that they represent specific packages of loan terms. Both lenders (banks) and borrowers (nonfinancial firms) have an incentive to negotiate an efficient combination of, say, interest rate, collateral, contract length, and commitment fee. We turn now to the analysis of such combinations.

II. A Model of Loan Term "Packages"

A loan commitment contract may be described by the vector $B[L^*, T, m, k, C]$. Here, L^* is the maximum amount of credit that can be obtained under the contract, T is the time length of the contract, m is a risk premium or markup over prime, k is the loan commitment fee rate, and C is the amount of collateral placed with the lender. Since we focus on a single transaction between a borrower and a lender, the prime interest rate—assumed to be exogenous to the parties—is not included. It becomes part of the contract upon signing, but it is not viewed as negotiable exante by the parties. The risk premium markup is a borrower-specific loan price component, as is the loan commitment fee.[4]

Under the contract, the borrower must decide how large a liability he will have at any period t, $0 \leq t \leq T$. This liability, L_t, is non-negative and must never exceed L^*. In each period, t, the borrower must pay $r_t + m$ in interest on L_t, where r_t is the instantaneous prime rate prevailing at t. The borrower will select L_t based on his own maximizing considerations, which for now will remain nonspecified. L_t will depend on a variety of factors that are unknown at time zero. Specifically, L_t will depend on the state of the world, θ_t, whose probability density function is $f_t(\theta_t)$. θ_t is defined over the range $[0, 1]$.

Our model is based on the point of view of the lender, given expected borrower behavior. We will not specify the borrower's function, but we will note that L_t does depend on L^*. That is, the greater the credit limit under the line of credit, the higher L_t will be for at least some states of the world. This is because in some states of the world, the borrower would like to take down funds in a quantity greater than his limit L^*. It is noted that the probability that L^* will become a binding constraint decreases with L^*.

Since L^* acts as a maximum credit quota, L_t depends on L^*. Lenders and borrowers will negotiate L^*, given their knowledge of how L^* will affect borrowing

[4] The price variable, k, will be treated as paid at the beginning of the contract. This is in line with the theoretical literature (e.g., Blackwell and Santomero [3] and Thakor [12]) that views credit line contracts as instruments that ensure the borrower against possible quantity restrictions in markets without clearing. It is also in line with current pricing practice. In actuality, the commitment fee often consists of a charge on the quota that is not taken down by the borrower.

L_t.[5] Whenever a line of credit is taken down, the borrower pays interest of $r_t + m$ on the outstanding liability in each period t. The lender is assumed to use r_t as the instantaneous discount rate for period, t. r_t may be viewed as an alternative (risk-free) cost to the lender. That is, the lender is assumed to have access to lending in an alternative market where r_t is the riskless rate of return.

The profit of the lender from the loan, given L_t $\{0 \leq t \leq T\}$, and assuming no default, is

$$k + \int_0^T L_t e^{mt}\, dt, \tag{1}$$

where the exponent of e is based on the rate of return $(r_t + m)$ minus the discount rate, r_t.

There exists a probability, π, that the borrower will actually repay the outstanding liability (L_t) and interest payable at time, T, and thus a probability of $1 - \pi$ of default. For simplicity, we will assume default will only be a possibility at time T. Since this is the case, we essentially decompose the uncertainty in the model into two components: one involves the state of the world, θ, before T, whose probability is $f(\theta)$, and the other involves states of the world at T itself, when default occurs with probability $(1 - \pi)$.

While we have not spelled out borrower behavior in detail, we assume that under certain states of the world, the borrower will be unable to repay the loan. The chance of default is assumed to rise with L^* and m, since both variables raise the limit of the borrower's liability at time T. Greater collateral will lower the temptation or "danger" of default, since more of the borrower's assets are set aside to "back" the loan. Default risk is also assumed to increase with T for two reasons. First, as T increases, the limit of the borrower's total liability at T will be higher due to more accumulated interest. Second, the probability that a "default-inducing" state of the world will occur during the life of the contract may be higher when the period covered by the line of credit is longer.

Formally, we let the repayment probability, π, be a function of the parameters of the contract except for k (which we have assumed is paid in advance).

$$\pi = \pi(L^*, T, m, C). \tag{2}$$

π will of course be different for different borrowers. For a given borrower, π rises with C, but falls with all other variables.

Now if default occurs, the lender retains the collateral, C, but loses the outstanding liability, L_T. The expected utility of the lender is, in general,

$$E(U) = \pi\, E_N(U) + (1 - \pi)E_D(U), \tag{3}$$

where $E_N(U)$ is expected utility when default does not occur, and $E_D(U)$ is

[5] Since we focus on a single transaction, feedback effects that lead to industry-wide equilibrium are not considered here. Clearly, a borrower may try to take down funds against L^* when, at the same time, other borrowers may be using their quotas. When many borrowers use their allocations together, the bank will be forced to raise outside funds from more expensive sources. The mechanism that brings about changes in market rates is not considered here. We do, however, consider the possible impact on a single lender. In our model, $f(\theta)$ could capture the risk that a borrower will take down funds at "peak" times.

expected utility when default takes place. Specifically,

$$E_N(U) = \int_0^T \int_0^1 U\{k + L_t e^{mt}\} f_t(\theta_t)\, d\theta_t dt \tag{4}$$

and

$$E_D(U) = \int_0^1 U\left\{k + C - \frac{L_T}{\rho}\right\} f_T(\theta_T)\, d\theta_T, \tag{5}$$

where $\rho = \exp \int_0^T r_t\, dt$. In Equation (4), the value of the loan for the lender is equal to the commitment fee plus the discounted interest income from the loan when no default takes place. In Equation (5), the value of the loan (for the lender) is the commitment fee plus the collateral retained less the value of principal and interest under default at time T.

Lenders are expected to not transact whenever $E(U) < 0$ since $E(U) = 0$ is the utility when no loan commitment contract is signed. On the other hand, competition among lenders is assumed to prevent contracts which lead to $E(U) > 0$. Such contracts will be underbid, and there will be no takers. In effect, the different lines of credit arrangements offered to borrowers may be viewed as a set of credit "packages" where the parameters $[L^*, T, m, k, C]$ produce lender expected utility of zero. The set of all loan packages offered and the interrelationships among loan term variables can be found by examining the five-dimensional indifference surfaces of lenders. The loan term interrelationships define those "packages" that will prevail in any credit market equilibrium.

Formally, these interrelationships are found by substituting (4) and (5) into (3) and taking the total differential of the resulting expression and setting it equal to zero. To interpret this, we must know something about the partial differentials of (3) with respect to the five contract parameters. If, for example, $E(U)$ rises with parameter i, changing contracts by choosing a higher i must also imply some other change in some other parameter j that reduces $E(U)$, *ceteris paribus* [in order for the new contract to leave the lender at a level of $E(U) = 0$].

The partial differentials of (3) with respect to the five parameters are as follows:

$$\frac{\partial E(U)}{\partial k} = E(U'), \tag{6}$$

which must be positive (U' is the first partial of U).

$$\frac{\partial E(U)}{\partial C} = \frac{\partial \pi}{\partial C}\,[E_N(U) - E_D(U)] + (1 - \pi)E_D(U'). \tag{7}$$

Both terms on the right-hand side of (7) are positive. Therefore, (7) is positive.

$$\frac{\partial E(U)}{\partial m} = \frac{\partial \pi}{\partial m}\,[E_N(U) - E_D(U)] + \pi_0 \int_0^T \int_0^1 e^{mt} U'\left[L_t t + \frac{\partial L_t}{\partial m}\right] f_t(\theta_t)\, d\theta_t dt. \tag{8}$$

Since $\partial\pi/\partial m < 0$, the first term in (8) is negative, while the sign of the second term is ambiguous. The sign of (8) is, therefore, ambiguous. If we assume that the borrowers' utility must necessarily fall with m, any range over which

$\partial E(U)/\partial m \leq 0$ will be "inferior," and "dominant" contracts will exist. This is because any decrease in m would raise the utility of both sides to any contract. Thus, we may safely ignore cases where $E(U)$ falls with m. For all relevant line of credit contracts, m is restricted to the range where $\partial E(U)/\partial m > 0$. Since as $m \rightarrow \infty$, default becomes certain, there will exist some maximum m for any set of 3 other loan parameters beyond which lines of credit will never be offered (cf. Stiglitz and Weiss [11]).

$$\frac{\partial E(U)}{\partial T} = \frac{\partial \pi}{\partial T}[E_N(U) - E_D(U)] + \pi E_N U\{k + L_T e^{mT}\} + (1-\pi)\int_0^1 U' \frac{L_T}{\rho} r_T f_T(\theta_T)\, d\theta_T. \tag{9}$$

The first term on the right-hand side of (9) is negative, and the second and third terms are positive. Thus, (9) is ambiguous. T will be relevant only in those ranges where the sign of (9) is opposite the sign of the partial of expected utility with respect to T in the borrower's utility function. In all other ranges, contracts of T will never be offered in the market because they are "inferior." In general, as T increases, π should fall. Therefore, for large T, a negative sign for (9) becomes more likely.

$$\frac{\partial E(U)}{\partial L^*} = \frac{\partial \pi}{\partial L^*}[E_N(U) - E_D(U)] + \pi \int_0^T \int_0^1 U' e^{mt} \frac{\partial L_t}{\partial L^*} f_t(\theta_t)\, d\theta_t dt - (1-\pi)\int_0^1 U' \frac{1}{\rho}\frac{\partial L_T}{\partial L^*} f_T(\theta_T)\, d\theta_T, \tag{10}$$

where $\partial L_t/\partial L^*$ is either zero or one for all $0 \leq t \leq T$. The first and third terms in (10) are negative, while the second is positive, and hence the sign of (10) is ambiguous, although the likelihood of a negative sign increases with L^*. Since the borrower presumably gains from a higher L^*, only those ranges of (10) over which the sign of (10) is negative are relevant. For all other values of L^*, other line of credit contracts exist that will dominate, i.e., lead to higher utility for both parties.

To summarize, we see that the expected utility of the lender increases unambiguously with k and C. In the relevant regions, it increases with m and decreases with L^* and is ambiguously related to T. From this, we may draw conclusions about the interrelationships among loan commitment contract variables. Since $\partial E(U)/\partial k > 0$, contracts with higher commitment fees will also provide for either larger credit limits (higher L^*) or less collateral (smaller C) or a lower risk premium, m. Because $\partial E(U)/\partial C > 0$, lines of credit where more collateral is placed with the lender will generally provide for larger credit rations or for a lower risk premium. The risk premium will generally rise with the size of the credit limit. Changes in T would have an ambiguous effect on other contract variables.

The exact set of loan commitment "packages" offered will be affected by borrower-specific characteristics, and in particular by the probability of repayment, π, and by the $L_t(\theta_t)$ function. Any change in these that would make repayment appear less likely would be associated with appropriate adjustments in the loan package, such as a reduction in commitment size.

We are particularly interested in the size of loan commitments. The discussion above leads to the following hypotheses. A higher credit allocation L^* will be associated with a higher risk premium. Borrowers who pay higher commitment fees or who place greater collateral with the lender will be offered larger loan commitments, L^*.[6] Borrowers may also be able to obtain more favorable loan terms in exchange for appropriate adjustments in the length of the contract, T.

III. Empirical Findings

In the preceding section, we argued that in equilibrium, the set of all loan commitment contract "packages" offered at any time should lie along the contours of a multidimensional bank indifference surface. Borrowers would be able to select from among these various "bundles," and in particular would be able to trade off changes in any single loan variable for compensating changes in some other loan variable. The "credit ration" or loan commitment size would be one of the variables negotiated ex ante between the bank and the borrower in selection of the "package."

We hypothesize that (for a given borrower) a larger loan commitment or credit ration may be obtained in exchange for a higher interest rate, or for a higher commitment fee, or for a larger amount of collateral placed with the bank. The relationship between the commitment size and the time length of the contract is ambiguous. On one hand, a longer contract may involve higher risk. But on the other hand, a longer contract may imply a continuing customer relationship that is awarded more favorable loan terms by the lender. Finally, we expect that any index of credit worthiness (i.e., of lower risk) should be associated with more favorable borrowing terms. As noted in the model, the vector $B\{L^*, T, m, k, C\}$ describes the set of lending terms offered to a given borrower. When making cross-borrower comparisons, differences in borrower attributes, relevant to the asessment of risk, are also important. They will be taken into account by the lender in the determination of the offered set of loan packages.

In order to investigate the determinants of the size of the credit ration as well as the interrelationships among loan variables in the loan commitment contract, we analyzed a sample of loan contracts that were in effect in 1980–1981. The data were collected from corporate borrowers in the U.S. who provided information about commitment size, risk premiums, commitment fees, contract length,

[6] We may note how credit rationing occurs in our model. A borrower who signs a line of credit contract agrees to be "rationed" or limited to a maximum of L^* dollars in credit for all periods within the contract. To borrow more at any time, the borrower will have to find a lender in the spot market, where he or she will be charged considerably more. The credit rationing is not exogenous, but is part of the line of credit agreement the borrower signs. At the time of signing, the borrower is not restricted to any particular credit ration, but may purchase a higher future cutoff or credit ration in exchange for a more expensive contract (higher m or k). In an ex post sense, a borrower may find a situation where the demand for credit exceeds his or her allocation. This will occur only if in the past a borrower decided not to purchase "sufficient" credit, either because of high cost or because the probability of such a contingency is estimated to be small.

collateral requirements, restrictive convenants, etc. In addition to the loan contract data, the respondents provided information on sales, assets, and liability structure as they appear in their financial statements.

The sample was obtained through a questionnaire that was sent out to the chief financial officers of 420 U.S. nonfinancial firms in October 1980. The mailing list was selected at random form the Standard and Poors' register of corporations. The letter, which promised complete anonymity, solicited financial information and asked for documents relating to loan commitment contracts.

Of the 420, 179 responded, of whom 132 provided partial answers, and 101 full answers. Of these 101 full respondents, two-thirds were industrial firms, 22% were in the services, and 10% in construction. The set of loan commitment contracts contained in the sample is described in Table I.[7]

Using this sample, the loan commitment size was regressed on a number of other loan variables. Our hypothesis is that the coefficient of the interest rate markup (m) should be positive, indicating a larger loan commitment in exchange for a higher risk premium. The sign of the coefficient of the time length, T, could be either positive or negative. The coefficient of the commitment rate fee, k, should be positive, indicating a larger loan commitment in exchange for a higher commitment fee rate. Although we did not have data on the amount of collateral placed with the bank, we did have data on whether or not any collateral at all were so placed. The dummy variable, C, is used to indicate whether collateral is required ($C = 1$) or not ($C = 0$) under the contract. We expect the coefficient of C to be positive, indicating that a larger loan commitment may be obtained in exchange for a collateral provision clause.

Several variables indicative of risk were also included in the analysis. First, a dummy variable (S) was included to indicate whether or not a borrower had sales exceeding $200 million. The presumption is that larger firms would be viewed by banks as safer risks, other things equal, and so would be offered more favorable terms for comparable loans.[8] The coefficient of S should, therefore, be positive.

Second, the ratio of current assets to current liabilities (CR) is often used by loan officers as a measure of cashflow and credit worthiness of borrowers. The coefficient of CR should be positive.

The results of three regressions are presented in Table II. The dependent variable is the loan commitment size, measured in thousands of dollars. As can be seen, a larger commitment size is associated with a higher risk premium, m. In fact, the relationship is concave: i.e., for larger loan commitments, the associated risk premium rises more than linearly. This result is in line with Stiglitz and Weiss [11].

The time length of the contract, T, has a small but significant positive association with the commitment. An increase in the contract length by one

[7] The sample included contracts with both additive and multiplicative risk premiums. In the regression, the latter were converted into their additive equivalents using the prime rate prevailing at the time the contract was signed.

[8] We preferred to use a dummy variable due to our belief that the size variable would be discontinuous in the sense that large firms would have access to the national capital market and hence would borrow under different terms from small firms.

Table I

Summary Statistics

Variable	Mean	Standard Deviation
Commitment size, L^* (million \$)	\$ 7.66	\$ 7.10
Contract period, T (months)	29.05	14.26
Risk premium, m (percent)	0.88	0.72
Commitment fee, k (percent)	0.42	0.15
Current ratio	2.44	1.13
Percent with collateral requirement	20.8	
Percent with sales exceeding \$200 million	11.9	

Table II

Loan Commitment Equation: Empirical Results

Version	(1)	(2)	(3)
Intercept	−6,678.5	−3,104.9	−5,096.9
	(−1.816)	(−1.041)	(−1.671)
Risk premium (m)	6,628.0	5,751.8	6,621.9
	(2.364)	(2.070)	(2.367)
Square of premium	−2,311.2	−2,126.0	−2,290.2
(m^2)	(−2.258)	(2.070)	(−2.244)
Time length (T)	82.22	—	75.31
	(1.633)		(1.524)
Commitment fee (k)	3,648.3	2,290.2	—
	(0.775)	(0.489)	
Collateral dummy	4,420.6	4,613.4	4,530.4
(C)	(2.584)	(2.677)	(2.663)
Dummy for large	13,755.3	13,862.3	13,804.5
firms (S)	(6.509)	(6.500)	(6.551)
Current ratio (CR)	1,368.4	1,343.1	1,412.1
	(2.160)	(2.100)	(2.243)
R^2	0.398	0.379	0.394
N	92	92	92

Note: Numbers in parentheses are t-statistics.

month is associated with an increase in the commitment by \$82,000. This may be the "reward" for the borrower's agreeing to a longer customer relationship. Since the coefficient is small, T was not included in Equation (2).

As predicted, the commitment fee rate, k, is positively associated with commitment size. An increase in the fee by ten basis points is associated with an increase in the commitment by \$220,000–360,000. In fact, about half of the contracts in the sample had commitment fee rates of exactly 0.5%. This concentration probably explains the low significance of the coefficient of k. The fee was not included in Equation (3).

The collateral variable, C, is positively associated with the loan commitment size. The inclusion of a collateral clause entitles the borrower to an extra \$4.5 million in commitment. Large firms (with sales exceeding \$200 million) obtained commitments that exceeded those obtained by smaller firms by some $13 million. The current ratio, CR, is positively associated with loan commitment size. An increase in the ratio by 1.0 is associated with an increase in the commitment by $1.4 million approximately, presumably indicating the bank's assessment of borrowers with higher current ratios as being better credit risks.

These variables together account for about 40% of the variance in the size of the commitment. The unexplained variability presumably stems from other unobserved factors that enter into the bank's assessment of riskiness and other aspects of the customer relationship.

IV. Conclusions

In this paper, we have developed a model of the loan commitment contract and its composition. We have argued that such contracts are most properly seen as "packages" of loan terms including the interest rate, the commitment fee, maturity, the credit quota or takedown limit, and collateral arrangements. Lenders are willing to offer a large number of such "packages" from which borrowers may select those that most appeal to them. Borrowers are able to trade off "more favorable" values of some loan variable for "less favorable" values of some other loan variable. In particular, borrowers may "buy" themselves credit commitments in exchange for adjustments in other loan variables.

In the empirical section, we have analyzed a sample of loan commitment contracts in order to investigate the various "trade-offs" among loan parameters that were manifested in the market, and in particular, the determinants of the loan commitment ration. We found that loan commitment size was positively correlated with the risk premium or interest markup, the commitment fee, the length of the contract, the existence of a collateral requirement, higher firm current rations (indicative of a better credit rating), and firm size.

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