STUDIES OF SMALL BUSINESS FINANCE

Loan Rates, Operating Costs and Size of Loan: The Evidence From Cross-Section Data

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THE INTERAGENCY TASK FORCE ON SMALL BUSINESS FINANCE

Board of Governors of the Federal Reserve System
Federal Deposit Insurance Corporation
Office of the Comptroller of the Currency
Bureau of the Census
Small Business Administration
Loan Rates, Operating Costs 
and Size of Loan: The Evidence 
From Cross-Section Data

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Paper completed December 1981.

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This study was prepared for the Interagency Task Force. Funding was provided by the Small Business Administration. The views expressed are those of the author and not necessarily those of the Board of Governors of the Federal Reserve System, Federal Deposit Insurance Corporation, Office of the Comptroller of the Currency, Bureau of the Census or the Small Business Administration.
LOAN RATES, OPERATIONAL COSTS AND SIZE OF LOAN:

THE EVIDENCE FROM CROSS-SECTION DATA

Introduction

The dispersion in loan rates among size class of loan and size class of borrower is a matter of some concern for public policy. However, the appropriate policy is related to the reasons for any observed dispersion. That is, if smaller firms tend to pay higher rates, it is important to determine whether this arises from lenders exploiting market power or merely reflects systematic differences in operating costs or risks. If market power is being exploited, increasing competition would be an appropriate response. If observed differences are explained by cost and risk, then the result is what would be expected in a competitive market, and some other policy would be necessary if the status of small business is still a matter of concern.

The purpose of this paper is to report on two empirical investigations. The first is an examination of the relationship of business loan rates and size of loan, holding constant the influence of other loan terms. The second is a study of the relationship of operating cost to loan size. For each segment, a model is developed, data sources are described and results are presented. The results suggest that during the time period of the studies cost differentials explain a substantial portion of observed interest rate differences.
I. Loan Rates and Loan Size: The Model

The dispersion of loan rates to various size classes of borrowers has been a matter of public policy concern throughout most of U.S. history. This concern is institutionalized in the income tax system, in loan guarantee programs and in other Federal Government programs. The belief that small firms pay higher rates is generally accepted. However, loan rates are only one aspect of the complex relationship between lender and borrower. The statistical model developed in this paper is designed to incorporate complex non-price terms that enter into the loan agreement between lender and borrower. The model is a single equation with the effective rate of interest as the dependent variable. The independent variable is the term to maturity on the loan. The relationship between maturity and rate is a complex one, depending on expectations regarding future rates and risk. Generally, a bank considers different factors for "term loans", those exceeding a year in maturity. In such loans, more emphasis is given to the earnings growth over time than such shorter run considerations like current and quick ratios. Also, the term structure of interest rates has been positively sloped most of the time in the past 30 years, suggesting a higher opportunity cost for longer term commitments. Both considerations lead to the expectation that maturity has a positive relationship with loan rate.

In recent years, interest volatility has increased, and the risk
of lending at long maturities has also risen. This is especially true as a greater proportion of bank liabilities bear market yields to depositors. This has resulted in a large proportion of loans bearing a floating rate, usually priced in relation to the bank's prime rate. Prime rates have also become very sensitive to market rates. Thus, the bank removes interest rate risk by pricing loans with floating rates, and this should be reflected in the rate quoted to the borrower, all other factors held constant.

Of course, the bank is also interested in reducing credit risk and may impose terms to do so. One such method is to require collateral to be pledged by the borrower. Unfortunately, the data used in this study do not permit a refined analysis of the impact of collateral on loan pricing. For example, the ratio of the value of collateral to loan size is not calculated nor is the type of collateral specified. Presumably a bank would prefer government securities to inventory or accounts receivable. However, the existence of collateral is known, and its impact on rates is calculated.

Some loans have a repayment time determined by the bank and are known as "demand loans". These loans have an indefinite maturity and can be called by the bank when it is convenient from a rate or credit risk standpoint. Demand status is expected to have an inverse relationship on loan rates.

Many loans are made on the basis of an agreement to lend, or a commitment. Presumably, this commitment has value and will be reflected in either balances, the loan rate, or commitment fees. As
most of the loans do not have commitment fees, it would be expected that the value of the commitment to the borrower (and the cost to the lender of extending funds regardless of the financial environment) would be reflected in the loan rate. Unfortunately, balance data are not available.

With the above variables included to hold constant non-price terms, the partial impact of loan size and rate can be computed. In this paper, the logarithm of dollar size of the loan balance is the independent variable included. A case could be made for utilizing the size of the commitment because that measures the potential risk exposure to the bank, but the information is not available. The expected partial relationship between loan rates and size of loan is inverse.

The model may be formulated as follows:

1) \[ I = a + b_1 \log SZ + b_2 \text{MAT} + b_3 \text{DEM} + b_4 \text{COM} + b_5 \text{COLL} + b_6 \text{FL} \]

The variables are described in Table I.

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1 It is assumed that size of loan is an effective proxy for size of firm.
<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Effective Interest Rate</td>
</tr>
<tr>
<td>SZ</td>
<td>Face Amount of Loan</td>
</tr>
<tr>
<td>MAT</td>
<td>Maturity, in Months x 10</td>
</tr>
<tr>
<td>DEM</td>
<td>Demand Status, Equals 1 for Demand Loans, Zero for All Others</td>
</tr>
<tr>
<td>COLL</td>
<td>Collateral Status, Equals 1 if Loan is Collateralzed, Zero for All Others</td>
</tr>
<tr>
<td>COM</td>
<td>Commitment Status, Equals 1 if Loan made under Commitment, Zero for All Others</td>
</tr>
<tr>
<td>FL</td>
<td>Floating Status, Equals 1 if Floating Rate, Zero if Fixed</td>
</tr>
</tbody>
</table>
II. Loan Rates and Loan Size: Empirical Results

The relationship between rates and loan size has been empirically investigated in several previous studies. The relationship between the size of a loan and the interest rate charged was extensively investigated in 1958 in a report prepared by the Federal Reserve System for a major Congressional inquiry (1958). Although the focus of the study was on the extent to which loan size is related to default risk, the results are useful in analyzing the relationship between the size of loans and interest rates. The study compared loans extended to small firms with loans extended to larger firms under the presumption that loans to small firms will on the average be smaller than loans to large firms. Comparison of default rates between small and large loans showed that small firms have more financial difficulty, worse financial ratios, even during periods of economic expansion, and higher default rates. The data on default rates showed that banks lending only to small firms on the average had larger losses than other banks. The higher credit risk accepted by banks lending only to small firms was, however, off-set by a higher gross interest on loans.

In a part of a study by Jacobs (1971), regression analysis was used to determine the impact of services provided to customers and market structure on interest rates. The regression analysis was performed on all business loans in the sample, non-collateralized business loans, and business loans 100 percent, or more collateralized. Jacobs found that while interest rates are determined through package
arrangements that are determined by the customer's relationship with the bank, the size of the loan significantly affects the interest rate charged. The relationship between interest rates and loan size is, however, not as strong for collateralized loans as for uncollateralized loans.

In an empirical examination between loan rates and loan size from a 1972 Federal Reserve survey of bank lending terms, Hester found that larger firms obtained larger loans at lower interest rates than smaller firms (1979).

The Federal Reserve System conducts the quarterly Survey of Terms of Bank Lending (STBL) during the first full business week of the middle month of each quarter. A stratified random sample of about 340 member and non-member banks report on lending terms, including interest rates and loan sizes, on approximately 22,000 individual commercial, industrial, construction, and farm loans. As a part of a report on a 1977 quarterly survey, Boltz and Campbell found an inverse relationship between loan size and interest rates with larger loans being priced at prime or below prime and small loans being priced above prime (1979).

These previous empirical analyses into the relationship between interest rates and loan size show that the relationship is significant and consistent in sign over time (1958, 1971, 1972, 1977).

For this study, the models were estimated utilizing STBL data collected in August 1979; that survey yielded information on 21,669 loans.\textsuperscript{2}

\textsuperscript{2}For a complete description of the STBL, see Boltz [3].
Ordinary least squares is utilized to estimate Equation I, and the results are shown in Table II. The overall goodness of fit is not high, although the null hypothesis of no relationship is not accepted. For purposes of this study, the coefficient for the logarithm of loan size is most interesting. As expected, the coefficient is negative and statistically significant. In order to determine the effect of a change in loan size on rates, the mean value of maturity for floating rate, collateralized loan made on a commitment basis (essentially setting DEM equal to zero and COM, COLL and FL equal to one) is utilized to hold constant the impact of those variables. Loan size is then varied, and the results are shown in Chart I. While the regression coefficient is negative, the impact on rates is not large. Moving from a loan size of $100,000 to $100,000,000 results in a reduction of only 62 basis points. An earlier study by Murphy (1973) shows graphically that average rates on large loans were much more responsive to money market rates from 1968 to 1973. Thus, there is reason to believe that the coefficient for the loan size variable is sensitive to the interest rate cycle.
Table II

Regression Results for Cross-Section Analysis of Determinants of Loan Rates,
Dependent Variable is Effective Interest Rate

<table>
<thead>
<tr>
<th>Variable</th>
<th>log SZ</th>
<th>MAT</th>
<th>DEM</th>
<th>COM</th>
<th>COLL</th>
<th>FL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>-.2057</td>
<td>-.0006</td>
<td>-.9829</td>
<td>-.0378</td>
<td>-.1614</td>
<td>-.7185</td>
</tr>
<tr>
<td>Standard Error</td>
<td>.0138</td>
<td>.0001</td>
<td>.0272</td>
<td>.0224</td>
<td>.0207</td>
<td>.0225</td>
</tr>
<tr>
<td>&quot;t&quot; Statistic</td>
<td>14.9144</td>
<td>8.114</td>
<td>36.1606</td>
<td>1.6911</td>
<td>7.8142</td>
<td>31.9143</td>
</tr>
</tbody>
</table>

R² = .08873
F = 351.544
df = 21,662
CHART I
Interest Rate and Size of Loan, Holding Constant the Influence of Other Variables

The curve is calculated by placing appropriate values of the non-size variables in the equation and changing the size variables.
III. Loan Rates and Loan Size: Summary

The relationship between loan size, firm size and interest charges has been a matter of some interest for those concerned with the viability of small business. However, the complexity of the bank-business relationship must be considered in examining loan rates and firm size. In this paper, a very large sample of individual loans serves as the data for an empirical study of the loan size-interest rate relationship holding constant the impact of other variables. The results indicate an inverse relationship as expected. However, the quantitative dimensions are not particularly large. Other studies suggest large loan rates are interest sensitive, small loan rates being less responsive to open market rates. This leads to the possibility that the estimated coefficient in the model in this paper is affected by the business cycle. The model can be replicated for previous periods back to 1977 to test both performance of the model and interest sensitivity of the loan size coefficient.
IV. Costs and Size of Loan: The Model

Business lending is viewed as a production process within the bank in which physical resources are combined to make, administer and collect business loans. The model is a cost function in which total direct cost is related to the number of loans, the mix of loans, the average size of loans, the wage rate and the branching configuration. This model has been developed by Benston (1965) and Bell and Murphy (1968) and re-estimated by Murphy (1973) and Longbrake (1974). The form of the function is exponential:

\[ C = aN^{b_1} M^{b_2} X^{b_3} L^{b_4} Z^{b_5} \]

The variables are defined in Table III.

The data for the study were gathered from banks participating in the Federal Reserve's Functional Cost Analysis Program in 1978. This is a voluntary program in which member banks work with the Federal Reserve in developing functional breakdowns (approximating production processes) within the bank. Procedures for allocating costs are developed, and each bank receives a comparative report with substantial cost detail. As the program is voluntary and involves some effort, it is believed that participating banks report accurately, or they would find the reports to be of limited management use and would simply drop out of the program. In 1978, 788 banks provided information on their commercial lending function. The sample has a high representation of medium and large banks and a low representation of very small banks.
Table III

Variables for Regression Analysis

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>C</td>
<td>Total Direct Cost of Commercial Lending Function</td>
</tr>
<tr>
<td>K</td>
<td>Average Number of Commercial Loans</td>
</tr>
<tr>
<td>AMX</td>
<td>Proportion of Total Loans in the Form of Agricultural Loans</td>
</tr>
<tr>
<td>LSZ</td>
<td>Average Size of Loan</td>
</tr>
<tr>
<td>W</td>
<td>Average Wage Rate</td>
</tr>
<tr>
<td>OFS</td>
<td>Number of Full Service Offices</td>
</tr>
</tbody>
</table>
V. Costs and Size of Loan: Statistical Results

After logarithmic transformation, the results are shown in Table IV. The overall goodness of fit is quite good with an $R^2$ of .84. As expected, the scale variable is the most important determinant of costs. There are substantial and statistically significant economies of scale as the number of accounts increases, holding constant the influence of all other variables. For purposes of this study, the size variable is also highly significant and exhibits even stronger "size" economies. That is, holding constant the impact of other variables, a 10% increase in loan size increases costs by approximately 7.9%. Thus, the average cost per dollar of loan declines with loan size.

Other variables with significant impacts on cost are the mix of loans and the number of full service offices. Apparently, agricultural loans are marginally less expensive to analyze, administer, and collect. Furthermore, the impact of branching is consistent with the results of previous studies.

For purposes of this study, the total cost function is manipulated to derive average cost functions. Specifically, the average operating cost per dollar of loan is calculated for a group of loan sizes, holding constant the value of other variables.\(^3\) As the value of LSZ is

\[^3\text{The procedure is to derive the average cost function by dividing both sides of the equation by N. This gives the average cost per loan, and the cost per dollar is then determined by dividing through by LSZ. For variables other than LSZ, the geometric mean value is inserted in the equation. The value of LSZ is then varied and expected cost is calculated.}\]
### Table IV
Regression Results for Commercial Lending
Cost Function, 1978, Dependent Variable in Total Direct Cost
(All Variables in Natural Logarithms)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Constant</th>
<th>N</th>
<th>AMX</th>
<th>LSZ</th>
<th>W</th>
<th>OFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Coefficient</td>
<td>-.8003</td>
<td>.8324</td>
<td>-.0231</td>
<td>.7885</td>
<td>-.0724</td>
<td>.1418</td>
</tr>
<tr>
<td>Standard Error</td>
<td>.6906</td>
<td>.0240</td>
<td>.0080</td>
<td>.0263</td>
<td>.0795</td>
<td>.0222</td>
</tr>
<tr>
<td>&quot;t&quot; Statistic</td>
<td>-1.16</td>
<td>34.67</td>
<td>-2.86</td>
<td>29.93</td>
<td>-.91</td>
<td>6.40</td>
</tr>
</tbody>
</table>

\[ R^2 = .8385 \]

\[ F = 811.94 \]

\[ N = 788 \]
varied, the cost per dollar of a loan that size is calculated, and the
results are shown in Table V and Chart II. It can be seen that for relatively
small loans the operating costs exceed 2% of the average balance. For
larger loans, exceeding $500,000, the average cost per dollar is below
1%. In a competitive market, it would be expected that loan price
differentials would reflect cost, and the results of this study suggest
that differences in cost are substantial.
TABLE V
Average Cost per Dollar of Commercial Loan and Size of Loan, 1978*

<table>
<thead>
<tr>
<th>Average Cost per $ of Loan</th>
<th>Size of Loan</th>
</tr>
</thead>
<tbody>
<tr>
<td>.0220</td>
<td>10,000</td>
</tr>
<tr>
<td>.0206</td>
<td>13,600</td>
</tr>
<tr>
<td>.0174</td>
<td>50,000</td>
</tr>
<tr>
<td>.0135</td>
<td>100,000</td>
</tr>
<tr>
<td>.0116</td>
<td>200,000</td>
</tr>
<tr>
<td>.0096</td>
<td>500,000</td>
</tr>
</tbody>
</table>

*The procedure for this calculation is to hold constant all other variables at their geometric mean value, allowing loan size to vary.
CHART II
Average Operating Cost Per Dollar of Commercial Loan and Average Size of Loan

Average Operating Cost Per Dollar of Commercial Loan

*The curve is estimated by utilizing geometric mean values for variables other than loan size, variable loan size, and calculating expected average cost.
VI. Cost and Size of Loan: Summary

The relationship between cost and loan size was investigated in this paper. Using detailed data on the production characteristics of a sample of banks participating in the Federal Reserve's Functional Cost Analysis Program, a cost function was estimated to determine the existence of scale economies for both the number of loans and the average size of loan. Statistically, significant scale economies were found for both situations. The equation was then manipulated to compute the effect of changing loan size, holding constant the impact of all other variables. The results suggest a substantial reduction in cost as loan size increases.

Of course, many factors influence the operating cost per dollar of loans. These factors are related to loan characteristics and typically influence the amount of relatively expensive labor time involved in analyzing and servicing the loan. The next step is to obtain cost estimates on a cross-section of loans and relate cost to loan size holding constant the influence of other variables.
VII. Loan Rates, Operating Costs, and Size of Loan: Summary and Conclusion

The purpose of this paper is to examine the relationship of loan rates, loan costs, and loan size. Two cross-section statistical analyses were conducted to determine the relationship of loan size to interest rate on the one hand and the relationship of cost to loan size on the other. The results of the studies indicate that there is a negative relationship between loan rates and size of loan. However, the magnitude of that relationship was modest in the time period studied. Further studies should be undertaken to determine the cyclical aspect of the relationship.

The operating costs of business lending are systematically related to loan size as expected. Indeed, the differential in operating costs per dollar exceed those of the difference in rates.
REFERENCES


