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An Empirical Examination Of A Commercial Bank

Loan Offer Function

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AN EMPIRICAL EXAMINATION OF A COMMERCIAL BANK
LOAN OFFER FUNCTION

By

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CHAPTER 1

THEORY OF THE LOAN OFFER FUNCTION

On June 29, 1960, commercial banks in the United States had approximately 115 billion dollars of loans outstanding and were the largest source of short term funds for business. These credits were extended to a wide variety of borrowers and the terms of loans varied considerably among borrowers. Despite the obvious importance of bank lending, economists have not concerned themselves with a theory to explain this activity in detail. The present thesis proposes a theory of bank lending and introduces supporting statistical evidence. Implications of the theory for monetary policy are considered in the final chapter.

This thesis considers only the terms at which loan applicants may obtain loans from commercial banks. It abstracts from bank choices among bonds, loans, and cash, except to the extent that these choices appear to influence the terms at which a bank will lend.¹ Services of banks as consultants or sources of information are ignored in this analysis of bank lending.² The deposit structure, equity, management,

¹Cf. Richard C. Porter, "A Model of Bank Portfolio Selection," unpublished thesis, Yale University, 1957; Roland I. Robinson, The Management of Bank Funds, New York, McGraw-Hill Book Company, Inc., 1951; and David Chambers and Abraham Charnes, Inter-temporal Analysis and Optimization of Bank Portfolios, O.N.R. Research Memorandum No. 27, The Technological Institute, Northwestern University, 1960.

²Cf. George Katona, Business Looks at Banks, Ann Arbor, University of Michigan Press, 1957.

etc., of any particular bank are assumed to be fixed. The loan market is assumed to be imperfect.

A loan offer function is a relation which specifies the terms at which a bank with particular characteristics is willing to lend to a borrower with a known profit, balance sheet, and credit history and particular prospects for the future. It is a generalized supply function for loans in the sense that, instead of merely having the amount of loans determined by a set of exogenous variables, it has a set of loan terms including the amount of loans determined by the set of exogenous variables.

Any loan application may be characterized by a set of terms of lending, $\underline{t} \in \underline{T}$, where \underline{T} is the set of all imaginable sets of terms of lending. Thus \underline{t} might refer to a loan of one million dollars, possessing a maturity of one year, payable quarterly, having an interest rate of five percent, etc. A potential borrower has balance sheets, income statements, and a credit rating which will be denoted by the set $\underline{v} \in \underline{V}$, where \underline{V} is the set of all imaginable sets of information about borrowers. A lending bank has a set of characteristics, $\underline{u} \in \underline{U}$, where \underline{U} is the set of all imaginable sets of characteristics of lending banks. Thus \underline{u} might include a bank's deposit instability, its loan experience, the present state of its portfolio, rates of interest on competing assets available to it, etc. Abstractly, a loan offer function may be expressed:¹

¹Lawrence Ritter, in an interview, brought my attention to a manuscript by J. M. Guttentag. Mr. Guttentag's paper contained a description of bank lending behavior which was somewhat similar to the

$$1 - 1) \quad F(t; u, v) = 0 .$$

Chapter 1 develops a theory of bank lending in terms of expression 1 - 1. The exposition is facilitated by considering each of the sets \underline{T} , \underline{V} , and \underline{U} individually. Section 1 of Chapter 1 argues that in general there is no unique set of terms at which a borrower summarized by \bar{v} may borrow from a bank characterized by \bar{u} . Rather there exists a subset $\underline{T}' \in \underline{T}$ which contains all \underline{t} 's which this bank will consider favorably in connection with this particular loan applicant. Section 1 suggests how banks view alternative $\underline{t} \in \underline{T}'$.

Section 2 of Chapter 1 argues that if \bar{u} and \bar{t} are specified in advance, then there exists a set $\underline{V}' \in \underline{V}$ which contains all \underline{v} 's which in the bank's estimation permit it to grant the loan. Section 2 suggests how banks view alternative $\underline{v} \in \underline{V}'$.

Section 3 argues that if \bar{v} and \bar{t} are specified in advance, then there exists a set $\underline{U}' \in \underline{U}$ which contains all \underline{u} 's from which banks the loan applicant can obtain the loan. Section 3 suggests how alternative $\underline{u} \in \underline{U}'$ affect the loan applicant's chances of receiving the loan.

Section 4 summarizes the three prior sections and develops the notion that substitution between sets \underline{U} and \underline{V} is possible. It con-

loan offer function. Although I had already developed the notion of a loan offer function when I first saw his manuscript, it is possible that my subsequent thinking was influenced by his draft. He presented no detailed statistical evidence. Cf. J. M. Guttentag, "Credit Availability, Interest Rates, and Monetary Policy," The Southern Economic Journal, XXVI (January 1960), pp. 219-228.

tains a digression on the availability of credit doctrine. Subsequently more detailed mathematical forms of 1 - 1 are suggested which permit empirical examination of the theory.

Chapters 2 - 5 present empirical evidence on this theory. Chapter 6 summarizes the analysis and comments on its policy implications.

In Sections 1 - 1 through 1 - 3, the discussion is considered to be suggestive rather than exhaustive. Other terms of lending, characteristics of borrowers, and characteristics of banks can be imagined. Similarly, quotations are intended to be illustrative rather than an exhaustive study of opinion in the banking literature.¹ Finally, the argument in these sections frequently is derived from interviews which I held with numerous bank officers.

1 - 1. Analysis of Terms of Lending

It is assumed throughout 1 - 1 that a loan applicant summarized by $\bar{v} \in \underline{V}$ applies for a loan from a bank summarized by $\bar{u} \in \underline{U}$. It will be convenient to introduce the analysis of terms of lending by considering a relation implicit in the production function, the production possibility curve.

A production possibility curve may be defined to be the efficient set of outputs obtainable from a given set of inputs. The co-ordinates of this curve are measured in units of the goods which could possibly be produced. In the case of the loan offer function, the analogue of

¹Despite the prescriptive appearance of some of the quotations, it is believed that the authors intended their statements to be essentially descriptive.

this curve is the efficient set of terms $t^* \in T'$ obtainable from given sets of characteristics, \bar{u} and \bar{y} . The co-ordinates are measured in units which are applicable to each term; thus maturity might be measured in months.

Efficiency in the sense of Pareto optimality implies that no more output of any good can be obtained from a particular set of inputs without reducing the output of some other good. Similarly, efficiency in the case of the analogous loan offer curve implies that a bank will not grant a more liberal loan from the point of view of one term or condition without worsening other terms. The notion of liberal terms of lending is considered below.

Terms of loans include the size; rate of interest; maturity; schedule of repayments; guarantees; other collateral; restrictions on dividends, working capital, salary increases, plant and equipment acquisitions, retained earnings, and personnel loans; and subordination of outstanding debts. Other terms include commitment fees charged by the bank, costs of audits, penalties for early repayments which come from other borrowing, verbal agreements on future balances, etc. Space considerations limit the discussion to four principal terms which are analyzed empirically in Chapters 3 - 5. These are the rate of interest, the size of the loan, the maturity of the loan, and whether or not the loan is secured.

The following statements are conjectures about a bank's view of each of the four terms of lending, assuming the remaining three terms are established. If a term is more liberal, it is less preferable from the point of view of the bank.

Obviously loans which are made at higher rates of interest are preferred by banks. It is assumed that a bank's marginal utility of income is always positive.¹

Banks also prefer relatively short term loans. This is partly attributable to the potential short term character of their demand deposit liabilities. Further, banks view default risk as a function of exposure time (maturity).²

Banks do not desire to make extremely short maturity loans (say one hour). The costs of investigating borrowers can not ordinarily be covered by the interest on the loan. However, this is not an important qualification because few borrowers desire one hour loans.

Banks prefer to lend moderate amounts rather than very large or small sums. Small loans have high handling charges relative to the interest on the loan. The analysis is restricted to loans where handling costs are relatively small.³

¹Donald Hodgman has observed that higher loan rates of interest may not be preferable if they increase the probability of default or only partial repayment by a borrower. This result hinges on an assumption that interest payments on a loan are not collected continuously. No contradiction exists between Hodgman's argument and the statement in the text. It is quite possible that banks prefer not to lend to a poor risk when interest rates rise. It is only argued that if a loan is to be granted, banks will be made better off (or no worse off) by increasing the loan rate of interest. Cf. Donald Hodgman, "Credit Risk and Credit Rationing," The Quarterly Journal of Economics, LXXIV (May 1960), pp. 258-278.

²"For any given credit rating, a longer term loan should have a higher rate if for no other reason than that the liquidity differential in favor of short-term credits is bound to be worth something. The greater errors which are bound to creep into long-term credit judgments merit some differential." Robinson, op. cit., p. 197.

³Roland I. Robinson places considerably more emphasis on the costs associated with bank lending. "A big borrower seeking a small accommoda-

Large loans are more risky in two ways. First, a borrower who obtains a large loan will have a higher debt-asset ratio after the loan has been consummated and, thus, will have a larger default risk. Second, banks will not be able to diversify their loan portfolio optimally if equal risk borrowers get loans of different amounts.¹

If all other terms of lending are specified and if borrowers are charged the costs of providing collateral, banks prefer to make secured loans. Collateral reduces the default risk of the loan. Frequently borrowers do bear the costs of providing collateral.

In conclusion, bankers attempt to make loans which have high interest rates, short maturities, moderate amounts, and which are secured. Borrowers attempt to get more favorable terms by seeking low rates of interest, no security, and frequently larger amounts and longer maturities. If borrowers are effective bargainers, banks will end up on their offer frontiers.² An important aspect of this description of lending is that both bankers and borrowers may alter

tion can get a better rate than a small borrower, but he will have to pay more than he would have to pay for a larger sum, presumably still within the credit capacity of the borrower." Ibid., p. 119.

¹This statement assumes that the probability of an individual borrower defaulting on his loan is independent of the probabilities of default of other equal risk borrowers. Cf. Harry M. Markowitz, Portfolio Selection, New York, John Wiley and Sons, Inc., 1959.

²It is assumed that a bank's loan offer function is invariant with respect to the course of negotiations.

any of the terms of lending during negotiations.¹

Despite the restrictive assumptions which have been imposed to develop these notions, evidence of the relationships among terms of lending can be found in the banking literature:

We find it difficult to do more than generalize on rate. It is of course elementary to say that the rate should vary with the risk and is affected by general and sectional money market conditions. Correspondingly, it is elementary to say that the longer the period the higher the average rate should be.²

The use of security in extending business credit is a common practice among banks in the United States. The main purpose of collateral or other security is to limit the bank's risk of loss and facilitate collection in the event the borrower is unable or unwilling to repay the loan at maturity. While banks generally insist on collateral where circumstances do not justify their making an unsecured loan, they still depend for repayment in large part on the good faith of the borrower. In some cases where the bank would be willing to extend unsecured credit, the borrower may find it advantageous to use security to obtain a larger loan, a longer maturity, or a lower rate of interest.³

¹Henry Wallich observes that banks may adjust the terms of lending for certain classes of borrowers: "Moreover, the premium which the less-than-gilt-edged borrower must pay may take forms other than interest, such as an inconveniently short maturity, or surrender of a share of control." "The Changing Significance of the Interest Rate," The American Economic Review, LVI (December 1946), p. 766.

²"Report of the Committee on Longer Term Loans, Bulletin of the Robert Morris Associates, Supplement, November 1937, p. 5.

³Caroline H. Cagle, "Security Pledged on Business Loans at Member Banks," Federal Reserve Bulletin, XLV (September 1959), pp. 1115.

1 - 2. Analysis of Borrower Characteristics

It is assumed throughout 1 - 2 that a loan applicant requests a loan with terms $\bar{t} \in \mathbb{T}$ from a bank summarized by $\bar{u} \in \mathbb{U}$. It is again convenient to introduce the topic by first considering a derivative of the production function.

Isoquants of production functions show what minimum combinations of inputs to a production process are necessary to obtain a particular set of outputs. Borrower isoquants of a loan offer function show what minimum combinations of characteristics (if any) of a borrower, $\underline{v} \in \mathbb{V}$ are necessary in order that the bank be willing to lend at terms \bar{t} .

It is elementary to observe that banks desire information about prospective borrowers in order to reduce the likelihood of making loans which will not be repaid.¹ But what information should banks collect?

Clearly the kind of information should not be independent of the terms of the loan request. Very small loans or very short maturity loans do not generate sufficient revenue to offset expensive data collection and analysis. Long term loans require emphasis on future earnings rather than the current position of the firm.² Collateral

¹Roland I. Robinson has emphasized the importance of avoiding default risks: "The arithmetic of lending and loan interest is impressive. The average rate of return on member bank loans in 1948 was 3.8 percent. About two-thirds of this amount was absorbed in expenses leaving only slightly more than 1 percent for losses on loans and profits for stockholders. An average loss ratio of 1/2 of 1 percent would have meant that the profit rate was halved; it disappeared if average losses went to 1 percent of outstanding loans." Robinson, op. cit., p. 102.

²"...obviously, in general, short term credit is repaid from seasonal movements, while term loans depend upon realization of projected earnings in the majority of cases...." "Term Loans," Bulletin of the Robert Morris Associates, Supplement, July 1957, p. 11.

may well obviate the necessity for a detailed credit investigation.

Nevertheless, it is possible to list information to which bankers frequently refer when judging loan applications. If applications for loans with different terms are received, the signs of the relationships between the various terms of lending and the following variables remain unchanged; only the weights placed on the variables may be altered. Important information about loan applicants¹ includes the present and past size of his current assets, liquid assets, working capital, current ratio, inventories, total assets, outstanding debt, net worth, profits, sales, and deposit balances; the age of his inventories, plant, and equipment; the stability of demand for his products; and certain qualitative information, the purpose of the loan, the business of the borrower, the integrity and competence of management, the labor relations of the borrower, etc.

Some indication of the significance of each piece of information can be inferred from standard works on statement analysis by Wall, Foulke, and Guthmann.² Although comprehensive systems of statement analysis have been developed, none is infallible. Different credit

¹Robinson, op. cit., Ch. 8, and Benjamin H. Beckhart, ed., Business Loans of American Commercial Banks (New York, The Ronald Press Company, 1959), Ch. 4.

²Alexander Wall, How to Evaluate Financial Statements, 1st ed., New York, Harper and Brothers Publishers, 1936; Roy A. Foulke, Practical Financial Statement Analysis, 1st ed., New York, McGraw-Hill Book Company, Inc., 1945; and Harry G. Guthmann, The Analysis of Financial Statements, rev. ed., New York, Prentice Hall, Inc., 1936.

men do not place the same emphasis on each of the above or other pieces of information. The remainder of this section considers certain of the above variables which can easily be subjected to quantitative examination.

The expected after-tax profits of a loan applicant is a critical variable to banks for three reasons. First, a future stream of profits yields a cash flow which may be used to repay loans or meet future unforeseen emergencies. Second, the firm may grow as a result of the profitability of the business which implies that the bank may be able to obtain larger deposit balances and profitable loans in the future. Finally, banks may believe that profits are evidence of the competence of an applicant's management.

The current ratio, working capital, current assets, and liquid assets are all measures of a firm's ability to withstand immediate temporary adverse business fluctuations.¹ Different analysts place different emphasis on each of the measures. These variables are particularly important for loans of short maturity. Trends in these variables may reveal developing credit weaknesses.

Uncontrolled inventories are evidence of impending bankruptcy.² If an applicant's inventories are rapidly growing or particularly

¹Robinson, op. cit., pp. 138-140.

²Ibid., pp. 140-142.

high, banks are cautious when extending credit. The ratio of inventories to sales for a firm relative to its industry is a measure of whether inventories are controlled. Over time the firm's ratio may reveal a highly cyclical character of its demand. Fluctuations in demand may prevent a borrower from repaying his loan on schedule.

Net worth is a measure of the solvency of a firm. Obviously default risks rise as loan applicants become less solvent. High ratios of debt to net worth may portend a decline in the firm's solvency at some future date.¹

Finally, a bank is less willing to reject loan applications from firms carrying large deposit balances with it. From interviews with bankers, I inferred that they believe good present balances imply good future balances. In effect, firms carrying large idle balances with commercial banks pay higher interest rates on a loan with terms \bar{t} . However, the privilege of borrowing more frequently and perhaps larger sums may compensate these firms for the effective rate differential.²

¹ Interpretation of the level of net worth as a measure of default risk is a bit treacherous. Net worth must be compared with the magnitude of misfortunes which a firm might have to face in order to be a realistic measure of default risk. The crude generalization in the text implicitly assumes that all firms may be expected to experience more or less similar unforeseen losses.

² An excellent discussion of the role of deposit balances of borrowers may be found in a recent article by George Garvy. One implication of Garvy's argument is that banks desire balances in order to reduce their deposit instability, a factor which will be considered in section 1 - 3. George Garvy, "Structural Aspects of Money Velocity," The Quarterly Journal of Economics, LXXIII (August 1959), pp. 443-446.

Also, firms with large total assets frequently have many banking connections.¹ Individual banks may find their bargaining position slightly weakened by this greater competition, and consequently accept loans from larger firms, even though other features of their balance sheets are not as sound.

In Section 1 - 1, it was observed that banks try to make loans of moderate amounts, of short maturity, with high rates, and with collateral. Loan applicants also attempt to extract terms favorable to themselves. If the loan market is relatively competitive, banks and borrowers move each other to efficient frontiers. It was implied that the position of the bank's offer frontier is a function of characteristics of an applicant, summarized by \bar{v} , and characteristics of the bank, summarized by \bar{u} . If the frontier was not completely determined by \bar{u} , then some minimum credit standards exist for some point on the frontier.

The standards may be interpreted to be some minimum restrictions on some or all of the above variables. But obviously two borrowers need not possess identical balance sheets, incomes statements, etc., in order to be regarded as similar credit risks. Some trade-off among the above variables exists in the minds of credit analysts (banks). This trade-off is considered empirically in the subsequent chapters.

¹Cf. Katona, op. cit.

1 - 3. Analysis of Bank Characteristics

Characteristics of banks also influence their willingness to grant loans. A bank isoquant of a loan offer function shows the minimum combination of characteristics which a bank must have before it will be willing to make loans with terms \bar{t} to borrowers with characteristics \bar{v} . It is a completely analogous concept to the borrower isoquant considered in Section 1 - 2.

The following characteristics of banks and their environment are believed to influence their willingness to lend: a bank's deposit level and stability, equity, and growth in deposits; the proportion of a bank's portfolio in loans and the distribution of its loans among industries; the maturity structure of its security holdings; the aggressiveness and specialization of a bank's lending officers; the interest rates on competing assets; the legal restrictions on its actions; the demand for a bank's loans; and the structure of its competition.

Banks are less willing to lend when their deposits are unstable. This behavior derives from banks' aversion to discounting, criticism by bank examiners, and emergency reserve adjustments. The probability that a given excess reserve position will be insufficient to meet weekly fluctuations is an increasing function of deposit instability. Consequently, banks suffering from very unstable deposits prefer a

more liquid portfolio. Further, the average maturity of loans of these banks tend to be shorter.¹

In appendix A it is demonstrated with relatively weak assumptions that the ratio of variance of deposits to the level of deposits is an increasing function of bank size. Thus large banks are expected to be less willing to lend than small banks, if banks are averse to a high deposit variance.² Bank aversion to high deposit variance implies that this variable is an argument in a bank's utility function. It is assumed that a bank's expected utility is a function of the rate of return on its assets, the standard deviation of rates of return, and the variance of its deposits. A second conclusion from that appendix is that growing or declining banks experience a smaller deposit variance than banks whose deposits are unchanging.

Because time deposits are more stable in the short run than demand deposits, banks which have larger proportions of time deposits are expected to have larger proportions of loans in their portfolios.

¹In response to the question, "If you feel it is proper to make term loans, are any limitations suggested in your mind as to the desirable percentage of this type of loan as compared with the aggregate of all commercial loans within the bank?", one lending officer responded: "There is no rule of thumb as to what the desirable percentage should be. Obviously for a bank with no time deposits and very volatile or seasonal demand deposits, the percentage should approach zero." "Term Loans," Bulletin of the Robert Morris Associates, Supplement, July 1957, p. 7.

²The argument is not relevant for very large banks who have access to the federal funds market. However, for other banks the analysis suggests that larger banks will have a smaller and more conservative loan component in their portfolios.

Bank examiners and regulations frequently specify that a bank must maintain a certain proportion of its portfolio in liquid assets. Also, a bank often is not permitted to lend sums in excess of 10% of its equity to any one borrower.¹

Considerations of portfolio balance also influence the willingness of a bank to lend. It is not wise for banks to have 100% of their portfolios in loans nor would they be prudent to put all their loans in one industry. Diversification reduces default risks.² But the aggressiveness and specialization of a bank's lending officers modify the concept of portfolio balance. Unfortunately, none of these factors can be quantified.

If a bank is a monopoly, then it may be able to discriminate among loan applicants. In this case the loan offer function is not independent of the demand for loans. Because an analysis of the demand for loans is beyond the scope of this thesis, the present theory is relevant only for banks which have close competitors.

Banks are less willing to lend at terms \bar{t} when interest rates on competing assets rise. One reason is simply that banks as profit maximizing institutions prefer to substitute higher yielding bonds for loans

¹Indeed, as the following quotation suggests, banks may prefer not to lend even this maximum amount: "A bank should not take term loans from any customer in an amount so great that its legal lending limit or its appraisal of the borrower's credit worthiness will make it unable or unwilling to handle its proper share of the customer's short term credit needs." George S. Moore, "Term Loans and Interim Financing," Beckhart, ed., op. cit., p. 253.

²Cf. Markowitz, op. cit., Chs. 2, 4.

with unchanged yields. Other reasons have been suggested by writers concerned with the "availability" of credit.

Wallich¹ and Musgrave² have suggested that when bond interest rates rise, banks' expectations about the ability of borrowers to repay loans are altered:

First there is the familiar point that central bank action directed at a rate increase tends to be an indication that the boom has run its course.³

Roosa⁴ and Scott⁵ have suggested that changes in bond interest rates increase uncertainty in the minds of bankers about yields on assets. Because banks dislike uncertainty, they will be less willing to lend in periods of changing rates.⁶

Roosa⁷ and Musgrave⁸ believe that banks prefer not to sell bonds which are selling below their acquisition price. This

¹Wallich, op. cit., p. 765.

²Richard A. Musgrave, "Credit Controls, Interest Rates, and Management of the Public Debt," Income, Employment, and Public Policy: Essays in Honor of Alvin H. Hansen, (New York, W. W. Norton and Company, 1948), pp. 221-254.

³Ibid., pp. 227-228.

⁴R. V. Roosa, "Interest Rates and the Central Bank," Money, Trade, and Economic Growth: In Honor of John Henry Williams, (New York, MacMillan, 1951), pp. 270-295.

⁵Ira O. Scott, Jr., "The Availability Doctrine: Theoretical Underpinnings," The Review of Economic Studies, XXV (October 1957), pp. 41-48.

⁶"But the potency of such changes comes from the impact of 'uncertainty' upon markets dominated by sensitive investors." Roosa, op. cit., p. 284.

⁷Roosa, op. cit., p. 290.

⁸Musgrave, op. cit., p. 228.

aversion¹ to recording capital losses means that banks attempt to rebuild their secondary reserves, if bonds become "frozen in." Consequently, banks' willingness to lend is reduced.

Finally, Samuelson² and Kareken³ have observed that increases in bond interest rates temporarily reduce the market value of a bank's holdings of bonds. If banks had previously held a desired volume of secondary reserves(perhaps relative to their deposit variance), they may attempt to increase their security holdings when rate increases occur. This action reduces their willingness to lend.

Banks with different characteristics lend to borrowers summarized by \bar{v} on terms \bar{t} . Bank isoquants are considered empirically in Chapters 4 and 5.

1 - 4. Some Final Points

The endogenous and exogenous variables of the loan offer function have been introduced in Sections 1 - 1 through 1 - 3. It has been observed that banks substitute among endogenous variables and among each of the two classes of exogenous variables. Banks also substitute

¹Cf. "Bank Reactions to Security Losses," Monthly Review of the Federal Reserve Bank of Kansas City, June 1960, pp. 9-16.

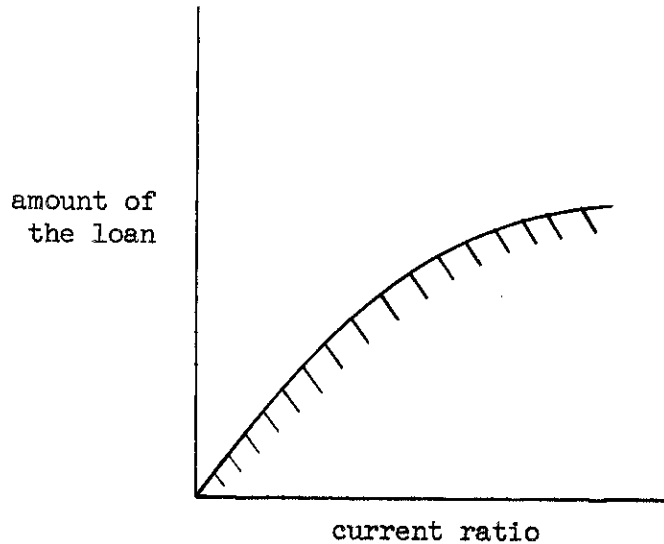
²Paul A. Samuelson, "Statement," U. S., Congress, Joint Committee on the Economic Report, Monetary Policy and the Management of the Public Debt, 82nd. Congress, 2nd. Session, 1952, Patman Hearings, pp. 691-698.

³J. Kareken, "Lenders' Preferences, Credit Rationing, and the Effectiveness of Monetary Policy," The Review of Economics and Statistics, XXXIX (August 1957), pp. 292-302.

between these three groups of variables. For example, a bank is willing to alter one term of lending, say the amount of the loan, if a loan applicant can improve one of his balance sheet variables, perhaps his current ratio.

Diagram 1 - 1 suggests that banks grant larger loans to borrowers with higher current ratios, if all other relevant variables are held constant. This curve is a complete analogue of the transformation curve in the theory of production.

Diagram 1 - 1



Similarly, substitution between sets U and V is easily imagined.

It is desirable to digress at this point and interpret the availability of credit doctrine with the loan offer function. In Section 1 - 3 it was observed that Wallich, Musgrave, Scott, Samuelson, Kareken, and Roosa were concerned with the impact of changes in government security interest rates on bank lending. By interpreting their arguments, it is possible to test this doctrine.

First, it should be observed that, with the exception of Samuelson whose argument is dynamic, there is some doubt whether these authors are concerned with the rate of change in interest rates or simply the level of interest rates. I am not able to determine from their articles

which is the variable that they believe causes changes in bank lending. If they are concerned with the rate of change of interest rates, then a dynamic argument must be made explicit and must be incorporated in the loan offer function. Development of this argument is beyond the scope of the present thesis. For this reason and because the subsequent empirical work is best directed towards analyzing the impact of different interest rate levels, arguments of these authors are interpreted in terms of the impact on bank lending of different levels of competing asset (bond) interest rates.

For various reasons, the above authors believe that the loan market is not cleared by loan interest rates alone, if interest rates on competing assets rise. Some believe that the supply schedule of loans is inelastic with respect to the loan rate of interest.¹ Others believe that loan interest rates are quite inflexible, and thus, although the interest elasticity of the supply schedule may not be negligible, it is not given a chance to work.² Usury ceilings may prevent interest rates from clearing markets. Finally, Professor Wallich has observed:

At any time there is a more or less conventional range of rates on loans, negotiable and otherwise, which limits the maximum risk premiums that can be arranged for. Banks and investors usually prefer not to become involved in dubious situations, even if they believe their actuarial risk to be adequately compensated for.³

¹Ira O. Scott, Jr., "The Availability Doctrine," The Canadian Journal of Economics and Political Science, XXIII (November 1957), p. 536.

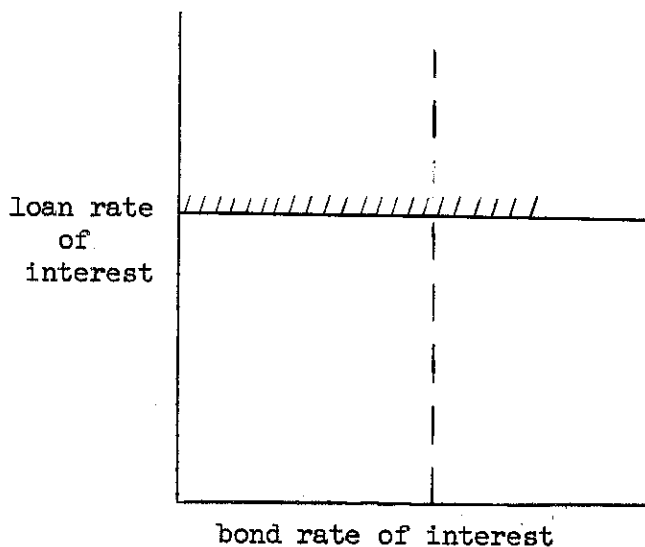
²Kareken, op. cit., p. 295.

³Wallich, op. cit., p. 768.

If banks associate dubious situations with high loan interest rates, regardless of rates on competing assets, again nonrate terms are clearing the market.

With the exception of the inelastic supply case, the above reasons are exhibited in an extreme form by the solid line in diagram 1 - 2. The dotted line shows that the loan rate is indeterminate from the supply side if supply is interest inelastic.

Diagram 1 - 2



Somehow the loan market must be cleared. Advocates of the availability doctrine have suggested that "credit rationing" takes place. Apparently credit rationing implies (1) that a higher percentage of loan applications are rejected and (2) that of those loans which are granted to borrowers characterized by \bar{v} , the amounts are smaller, the maturities are shorter, and the collateral requirements are greater. The notion of credit rationing can be seen in the following quotations:

...the allocation of funds is guided by the banker's desire to allocate quotas to different uses of funds so as to obtain the right combination of risk and liquidity in his asset portfolio.... When a bank's lending capacity is

curtailed, the quota available for each group of borrowers will be cut somewhat, but the quota for risk loans will tend to fall more sharply than that for credit to prime borrowers.¹

A change in interest rates may make itself felt less by affecting profit calculations, and through them the demand for funds than by affecting the behavior of financial institutions which lend the funds or act as intermediaries between the borrowers and the ultimate lenders. ...As far as commercial banks are concerned a substantial drop in the official discount rate (accompanied by an increase in the liquidity of banks and a fall in the rates which they charge customers) may induce them to 'comb the market' more thoroughly than before.... Thus they may be more ready than before to lend to entrepreneurs who wish temporarily to finance the installation of new equipment by short-term credits with the intention of funding the credits later through security issues, or of repaying them out of working profits.... They may lower their requirements with respect to the 'current ratio' which is so frequently used as an index of the credit-worthiness of customers, and resort to other devices for creating an outlet for their funds.... The reverse applies more forcefully...commercial banks will not only tighten the conditions under which they themselves grant credit to business, but they will also often resort to credit rationing.²

Diagram 1 - 3 attempts to represent credit rationing graphically.

Let there be a borrower characterized by \bar{v} who applies to banks which are identical, except that some have opportunities to invest in higher yielding securities (which are assumed to be riskless). Assume that all terms of lending but the rate of interest and the loan maturity are settled. There are two cases: (1) loan interest rates are flexible and the supply is elastic and (2) loan interest rates are

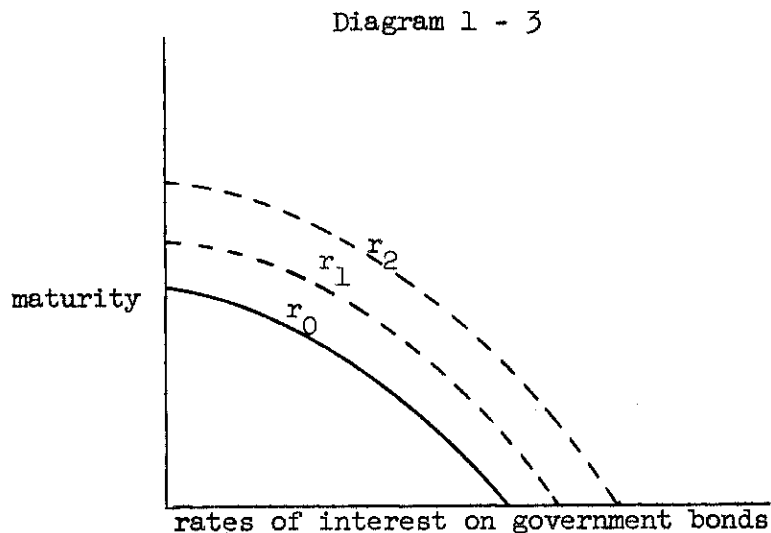
¹Musgrave, op. cit., p. 230.

²F. A. Lutz, "The Interest Rate and Investment in a Dynamic Economy," The American Economic Review, XXXV (December 1945), pp. 828-829.

inflexible and/or the supply is inelastic. In case 1, nothing can be said about the ability of the borrower to get long term credits from the banks which can invest in higher yielding bonds. This is because at a sufficiently high level of loan interest rates, applicants will be able to compensate these banks for the inconvenience of long term loans. The curve in 1 - 3 will shift out to the dotted lines when loan interest rates rise.

In case 2, however, changes in loan interest rates can be ignored. The solid curve in diagram 1 - 3 then implies that when competing rates are high, loan applicants will be unable to get certain long maturity loans.¹ Formulating lending behavior in terms of a loan offer function permits an empirical test of whether terms of lending do exhibit this hypothesized response to high rates of interest on government securities.

The form of the loan offer function must be made explicit if the theory is to be subjected to empirical test, so we return to the main argument.



¹To place Musgrave properly in this interpretation, one must assume that longer maturity loans are more risky.

Let:

R = the loan rate of interest (in percent).

M = the maturity of the loan (in months).

A = the amount of the loan (in dollars).

S = 1 if the loan is secured, 0 otherwise.

W_i = the i th relevant characteristic of loan applicants,
 $i = 1, 2, \dots, I$.

Z_j = the j th relevant characteristic of lending banks,
 $j = 1, 2, \dots, J$.

If no other terms of lending are relevant to a bank, 1 - 1 may be written as:

$$1 - 2) \quad F(R, M, A, S) = G(W_1, W_2, \dots, W_I; Z_1, Z_2, \dots, Z_J) .$$

Can F and G be expressed simply? It is not likely that they are linear in the variables. In the case of G, a firm could achieve an infinite current ratio by paying off its current liabilities, but banks do not lend large sums of money for extended periods simply because of this transaction. Similarly, firms with very large net earnings are not able to obtain loans at arbitrarily low rates of interest. The fact that a firm regularly earns one million dollars greatly influences a bank's appraisal of its credit worthiness, but the bank will not be as greatly impressed by the difference between regular earnings of ten or eleven million dollars. Similar arguments can be constructed for F.

For these reasons non-linear (polynomial or logarithmic) formulations of F and G are more appealing.¹ If F and G are polynomial, the theory should specify the order of the polynomial and the character of the interactions between the various arguments of the function. Some broad conjectures about the relationships can be made.

If equations are written expressing each of the terms as functions of Z 's and W 's, ignoring the other terms of lending, a test of the goodness of fit of competing functional forms can be made. Ignoring other terms of lending clearly weakens the test, but no better alternative procedure is obvious. In appendix B, a hypothesis that regressions of terms of lending on W 's and Z 's are quadratic in some of the arguments was rejected. A similar hypothesis that these regressions are logarithmic in the arguments could not be rejected, as reported in that appendix. Throughout the remainder of this thesis, it is therefore assumed that F and G are logarithmic in their arguments.² The restrictive properties of logarithmic forms can be found in calculus books. The theory of the loan offer function does not preclude F and G having logarithmic forms.

¹These non-linear forms are not totally satisfactory in the case of the loan rate of interest. Because of the existence of a prime rate, a kink in the offer frontier will occur when borrowers are sufficiently powerful to begin to borrow at prime. Empirically, this problem may be avoided by using probit regression techniques of estimation. If this elaboration is ignored, the misspecification is probably not very serious. Cf. James Tobin, "Estimation of Relationships for Limited Dependent Variables," Econometrica, XXVI (January 1958), pp. 24-36.

²It is necessary to redefine S if logarithms of that variable are to be taken. If $S = 1$, it was set equal to 10; if $S = 0$, it was set equal to 1.

In order to determine whether equation 1 - 1 or the regressions mentioned in the preceding paragraph (hereafter called partial loan offer functions) are indentifiable, it is necessary to consider the demand for terms of lending. By an argument quite analogous to the theory of bank lending, loan applicants are believed to have desires for certain rates of interest, maturities, amounts, collateral requirements, etc. Each borrower possesses some function, a loan asking function, which characterizes his desires in terms of his needs. The functions differ substantially among applicants. By an argument presented by E. J. Working,¹ identification is possible if the variance of the stochastic terms in the supply function (loan offer function) is substantially smaller than the corresponding variance in the demand function (loan asking function). Identification is easier if different borrowers have different asking functions.

What basis can there be for assuming that the stochastic terms in the asking function (or partial asking functions) are much larger than those in the offer function (or partial offer functions)? First, a borrower desires loans for reasons which are related to seasonal or cyclical fluctuations in his industry. Second, treasurers of different firms are requesting loans and there is no compelling reason for these individuals to behave similarly. Finally, many of the factors with which banks are concerned (an applicant's credit position or a bank's deposit instability) are unrelated to a firm's desire for terms of lending.

¹E. J. Working, "What do Statistical 'Demand Curves' Show?" Readings in Price Theory, (Chicago, Richard D. Irwin, Inc., 1952), pp. 97-118.

A given bank, however, forces its lending officers to follow certain common techniques of credit analysis. Greater experience with processing loan applications on the part of these officers results in precision (smaller stochastic variance) in lending. Finally all commercial banks are subjected to more similar external forces than are a sample of borrowers drawn from a wide range of industries. It is therefore possible to ignore demand or the loan asking function.

A loan offer function may be estimated directly by the method of canonical correlation. This technique involves defining two canonical variates:

$$q_1 = (\text{Log } R)' + k_1(\text{Log } M)' + k_2(\text{Log } A)' + k_3(\text{Log } S)' + u \cdot^1$$
$$q_2 = \sum_{i=1}^I a_i(\text{Log } W_i)' + \sum_{j=1}^J a_{I+j}(\text{Log } Z_j)' + v \cdot$$

The stochastic variable u is assumed to be independent of the terms of lending, but not independent of characteristics of the borrower and lending bank. Similarly, v is assumed to be independent of those characteristics, but not independent of the terms of lending.

The computational procedure yields those a 's and k 's which maximize the correlation between q_1 and q_2 subject to the constraint that q_1 and q_2 have unit variance.² The results of applying this technique to five samples of loans are reported in Chapter 5.

¹Primes (') on variables indicate that they are defined as deviations from their means.

²Harold Hotelling, "Relations Between Two Sets of Variates," Biometrika, XXVIII (December 1936), pp. 321-377.

Unfortunately, it is not possible to obtain standard errors for the a's and k's . But some basis is necessary for testing which characteristics of banks and applicants are relevant in lending decisions. A test, which is by no means ideal, is whether characteristics of banks and borrowers are significantly related to each of the terms of lending. In Chapters 3 and 4 partial loan offer functions are estimated from five samples of loans in order to make this test.

It should be observed that if there is no substitution between terms of lending, then the partial loan offer functions completely characterize bank lending behavior. The only difference between the partial loan offer function and the loan offer function is that the latter permits substitution among terms of lending.

Prior to these econometric investigations, it is useful to examine the results of a survey of bankers conducted by the American Bankers Association. This is done in Chapter 2.

CHAPTER 2

OBSERVATIONS FROM AN ATTITUDINAL SURVEY

The discussion in the preceding chapter was supported by interviews which I conducted with representatives of banks and by answers of bankers in response to an American Bankers Association questionnaire.¹ Both sources proved useful in suggesting hypotheses, but neither these interviews nor the American Bankers Association survey permit sharp tests of hypotheses.

The A. B. A. survey, conducted in May 1957, examined the impact of monetary policy on bank lending. Although results of this survey have been reported elsewhere, their relevance to a loan offer function and particularly the availability doctrine justifies the following observations.²

The bankers were asked if their lending policies had become more liberal, more selective, or were unchanged during the previous two years for each of five broad categories of loans: business loans, consumer loans, FHA and VA mortgages, other real estate loans, and agricultural loans. They reported that in the period 1955 to 1957 they had become substantially more selective in granting mortgage and other real estate

¹I am indebted to Dr. E. S. Adams of the A. B. A. for permitting me to inspect the bankers' answers.

²E. S. Adams, "Monetary Restraint and Bank Credit," Banking, L (September 1957), pp. 68-142.

loans than in granting any of the three remaining categories of loans. There are two apparent reasons for being more restrictive in granting FHA mortgages. First, rates of interest on these loans were pegged and had gotten out of line with other rates. Second, mortgages tend to be rather long term investments and therefore less preferable to commercial banks. Both reasons conform well to the interpretation of the availability doctrine presented in Chapter 1.

Similarly, real estate loans are generally less liquid, of longer maturity, subject to severe cyclical instability, and require a rather specialized lending officer to insure against loss.¹ If real estate loan interest rates were relatively inflexible, then again the availability arguments present a plausible explanation for the bankers' behavior.

Large banks more frequently reported being more selective than did small banks. This may be attributable to a much greater increase in loan demand by customers of these institutions than by those of smaller banks. Another explanation related to the argument in appendix A is that all banks experienced a given percentage increase in demand, but large banks were less willing to increase loans proportionately. The right answer must be determined empirically.

In response to the question: "What were the chief reasons for the changes (in lending policy)?", the article by Mr. Adams² reported 44% checked "concern over economic trends," 44% checked "decline in your

¹Robinson, op. cit., chapter 12.

²Adams, op. cit., p. 69.

bank's liquidity position," and 15% checked "decline in bond prices." If it can be assumed that bankers who mentioned a decline in bank liquidity but did not mention a decline in bond prices were not concerned with bond prices, then the results tend to support the Wallich-Musgrave expectations version of the availability doctrine.

Bankers mentioning a decline in bank liquidity may have been referring to the growing proportion of loans in bank portfolios during the period 1955-57.¹ If interest rates were inflexible, then banks would be less willing to increase loans at the margin in 1957 than in 1955. Unfortunately, inflexibility of interest rates can not be measured. Finally, there is some evidence that bankers who reported greater selectivity in granting real estate and mortgage loans placed more emphasis on a decline in bank liquidity than those who were more selective in granting other types of loans.

When asked in what ways they had become more selective,

...about two-thirds of the banks that have become more selective, state that this involved stricter credit review. Other respects in which banks have modified their practices are as follows: 'More consideration of past relationships with loan applicants' 57%; 'Willingness of applicants to maintain good balances' 42%; 'Faster repayment schedules' 38%; 'Scaling down of loan requests' 25%.²

The first three answers suggest that the loan offer frontier of banks' loan offer function had shifted in with respect to all terms.

¹Ratios of loans to total deposits for all banks in December 1955 and December 1957 were 45.5% and 49.4% respectively. Federal Reserve Bulletin, XLIV (April 1958), p. 448; XLV (September 1959), p. 1156.

²Adams, op. cit., p. 70.

The fourth answer suggests that banks became less willing to grant long maturity loans. The fifth suggests that they were less willing to grant large loans.

Despite these statements, the great majority of bankers believed that they had only slightly curbed the increase in bank loans with greater selectivity. The subsequent more detailed analysis sheds light on the quantitative importance of the availability doctrine.

CHAPTER 3

ANALYSIS OF TERM LENDING

This chapter presents statistical results of an analysis of commercial bank term lending. Data were collected from a small number of large banks on individual term loans granted during the period January 1955 through October 1957. The data include information about terms of lending, the credit position of the loan applicant, and previous relationships between the bank and the applicant. Sampling problems and techniques are reported in appendix C.¹

Section 1 of this chapter defines term lending and presents reasons for studying such loans. Section 2 contains definitions of the variables and hypotheses about a loan offer function. Section 3 reports empirical findings, and conclusions of the term loan study are summarized in Section 4.

3 - 1. Properties of Term Loans

A term loan is a loan transaction which has a final maturity exceeding one year, which may or may not be secured and which usually specifies repayment in monthly, quarterly, semi-annual, or annual payments.

¹I am most indebted to the co-operating banks for their very considerable advice and labor while making these data available. Their over-worked credit departments made substantial contributions to this research effort. Although it is inappropriate to reveal the names of the co-operating institutions, their interest in academic research is a tribute to themselves and the banking industry.

Moreover, it is evidenced by a note or notes embodying the terms and conditions of the loan, or is subject to a separate formal agreement between the borrower and the lender.¹

Term lending became popular among bankers in the United States during the depression when demand for loans was low. Because of the sharp break with traditional "seasonal" financing, an extensive discussion of this method of lending evolved in the contemporary banking literature and has continued to the present day. Bankers have been cautious in granting term loans and have kept detailed statistical records of their experience with them.

Current interest in term lending and superior statistics about past term lending are compelling reasons for studying this class of loans.² Term loans have additional desirable properties. They are frequently large, which permits an investigator to ignore costs of lending. Terms of individual term loans vary substantially. Borrowers with considerably different credit positions are accorded term loan financing. Large commercial banks grant a sufficiently large number of term loans to permit within-bank analyses.

The quantitative significance of term lending at large banks in New York City may be seen in Table 3 - 1.

¹American Bankers Association, Term Lending by Commercial Banks, Credit Policy Commission, (New York, American Bankers Association, 1957), p. 5.

²A. Hayes, "A Breathing Spell for Monetary Policy," Monthly Review of The Federal Reserve Bank of New York, XLIII (June 1960), pp. 100-104.

Table 3 - 1

Business Loans at Large New York City Banks
on Selected Dates¹
(in billions of dollars)

	10/5/55	10/16/57	10/14/59	10/12/60
All business loans	7.4	10.4	10.0	10.2
Term loans	3.5	5.2	5.7	5.6

¹Monthly Review of The Federal Reserve Bank of New York, XLIII (February 1961), p. 31.

Differences in term lending behavior among large commercial banks may be attributable to differences in bank preferences for term loans, differences in their portfolio positions at the time of lending, differences in bank deposit structure, etc. The relevance of results in this chapter to other banks depends upon the sensitivity of the estimated parameters to these omitted variables. Because the banks which are considered were not drawn in a random fashion, generalization of what follows to the population of banks is hazardous.

3 - 2. Hypotheses

Costs of data collection limited the volume of information about a borrower which could be obtained. In particular, no information was obtained about a borrower's net worth, inventories, liquid assets, or debt. Among the variables which were recorded are the following:

P_m = average losses of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant experienced net losses over that period, $P_m = 1$ otherwise. (in dollars per year)

P_p = average net profits of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant experienced net profits over that period, $P_p = 1$ otherwise. (in dollars per year)

C = current ratio (ratio of current assets to current liabilities) of the applicant at the close of the applicant's fiscal year immediately preceding the loan.

E = average demand deposit balances of the applicant at the lending bank during the year before the loan, $E = 1$ if no balances existed. (in dollars)

Y = number of years which the applicant had continuously maintained a demand deposit relationship with the bank at the time of the loan, $Y = 1$ if there was no continuous relationship. (in years)

\bar{R} = prime rate of interest at the time of the loan. (in percent)

W_m = negative of the average working capital of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant reported negative average working capital over that period, $W_m = 1$ otherwise. (in dollars)

W_p = average working capital of the applicant over the 3 to 5 years immediately preceding the loan (5 if available) if the applicant reported positive average working capital over that period, $W_p = 1$ otherwise. (in dollars)

$\left(\frac{dP}{dt}\right)_m$ = negative of the average annual change in the applicant's profits over the past 3 to 5 years (5 if available) if the change was negative, $\left(\frac{dP}{dt}\right)_m = 1$ otherwise. (in dollars per year per year)

$\left(\frac{dP}{dt}\right)_p$ = average annual change in the applicant's profits over the past 3 to 5 years (5 if available) if change was positive, $\left(\frac{dP}{dt}\right)_p = 1$ otherwise. (in dollars per year per year)

$\left(\frac{dW}{dt}\right)_m$ = negative of the average annual change in the applicant's working capital over the past 3 to 5 years (5 if available) if change was negative, $\left(\frac{dW}{dt}\right)_m = 1$ otherwise. (in dollars per year)

$\left(\frac{dW}{dt}\right)_p$ = average annual change in the applicant's working capital over the past 3 to 5 years (5 if available) if change was positive, $\left(\frac{dW}{dt}\right)_p = 1$ otherwise. (in dollars per year)

H = total assets of the applicant at the close of the fiscal year immediately preceding the loan. (in dollars)

V_p = variance of the applicant's annual profits over the 5 years immediately preceding the loan. (in dollars squared per year squared)

A_o = the amount of loans obtained from other banks (their participation) in the term loan transaction, if more than one bank is involved. The variable is not defined for loans involving only one bank. (in dollars)

E_a = amount of deposit balances carried by some affiliates of the applicant with the lending bank. (in dollars)

It was necessary to define two variables to represent mean profits, mean working capital, and trends in profits and working capital because of the decision to use logarithms reported in Chapter 1. Similarly, null values of balances, years of relationship, etc., had to be redefined. This is because logarithms of non-positive numbers are undefined.¹

The following hypotheses may be inferred from the discussion in Chapter 1. Subsequently the hypotheses are defended in terms of the rate of interest. It is hypothesized that each of the following cause the rate of interest on the loan to increase, and/or the maturity of the

¹The procedure is definitely not ideal. There is no reason to believe that bankers regard zero as a particularly significant number. It may be that loans to firms with profits less than ten thousand dollars have a different profit elasticity than loans to firms with profits above ten thousand dollars. Then logs should be taken of profits minus ten thousand. Although this problem is generally intractable, C. I. Bliss verbally suggested an iterative scheme for those cases where "log zero values" are below the minimum profit figure contained in the sample. His method was developed for estimating α and β in the following equation: $\text{Log } y = \alpha \text{ Log } (x - \beta) + u$. Unfortunately, the multivariate extension of this technique did not converge and it became necessary to adopt the above convention.

loan to decrease, and/or the amount of the loan to decrease, and/or likelihood of security to increase.¹

- 1) Ceteris paribus, an increase in an applicant's average losses P_m or a decrease in his average profits P_p .
- 2) Ceteris paribus, a decrease in an applicant's current ratio C .
- 3) Ceteris paribus, a decrease in an applicant's average deposit balance E .
- 4) Ceteris paribus, a decrease in the length of time Y over which the applicant has continuously maintained deposits with the bank.
- 5) Ceteris paribus, an increase in the prime rate \bar{R} .
- 6) Ceteris paribus, an increase in an applicant's average negative working capital W_m or a decrease in his average positive working capital W_p .
- 7) Ceteris paribus, an increase in an applicant's average annual decline in profits $\left(\frac{dP}{dt}\right)_m$ or a decrease in his average annual growth in profits $\left(\frac{dP}{dt}\right)_p$.
- 8) Ceteris paribus, an increase in an applicant's average annual decline in working capital $\left(\frac{dW}{dt}\right)_m$ or a de-

¹Because S is a dummy variable, statements involving S require some interpretation. If regression equations predict a value of S close to unity, it is believed that banks are more likely to insist upon security. Interpretations about the variance of residuals of regressions involving S are also ambiguous. Throughout this thesis it is assumed that regressions involving S can be analyzed as if S is a continuous variable.

crease in his average annual growth in working capital

$$\left(\frac{dW}{dt} \right)_p .$$

- 9) Ceteris paribus, a decrease in an applicant's total assets H .
- 10) Ceteris paribus, an increase in the ratio of losses to assets P_m/H or a decrease in the ratio of profits to assets P_p/H .
- 11) Ceteris paribus, an increase in an applicant's borrowings from other banks (participations) A_o .
- 12) Ceteris paribus, an increase in the variance of an applicant's profits V_p .
- 13) Ceteris paribus, a decrease in balances of affiliates of the applicant E_a .

Hypothesis 1 states that if there are two firms, identical in every essential respect except that one earned larger after tax profits in recent years, applying to a bank for a loan, then the firm with larger profits will be charged a lower rate of interest. The rationale for hypothesis 1 was presented in Chapter 1. Average profit figures of the applicant were employed rather than profits in the most recent year in order to avoid undue noise in the equations and because the credit literature¹ advocates the use of average profit figures.²

¹American Bankers Association, op. cit., pp. 9-10.

²The fact that continuous profit figures were reported for only three years in some cases may create some confusion about the estimated profits coefficients. In the case of two firms who experienced an identical level

Hypothesis 2 states that if two firms, identical in every essential respect except that the current ratio differs between the firms, apply to a bank for a loan, then the firm with the larger current ratio will be charged a lower rate of interest. The current ratio is particularly significant because current liabilities may be viewed as a measure of expected short term future outpayments which a firm will have to make. The ratio of current assets to current liabilities is therefore a measure of the extent to which these outpayments can be covered without recourse to outside borrowings.

The current ratio and other variables to be considered in this chapter should be adjusted for the character of an applicant's business. Thus firms with a large current ratio may be more prone to bankruptcy than firms with a smaller current ratio, simply because the current liabilities of the former are more volatile. Some adjustment for

of profits P_0 five years ago and who experienced the same rate of growth of profits g , the following shows that average profits will appear to be higher if a firm only reports profits for 3 years preceding the loan rather than 5.

$$1) P_t = (1 + g)^t P_0 .$$

$$2) P_5 = \sum_{t=1}^5 (1 + g)^t P_0 / 5 .$$

$$3) P_3 = \sum_{t=1}^3 (1 + g)^t \cdot (1 + g)^2 P_0 / 3 .$$

Now if $g > 0$, then it will be true that the lowest two terms in summation (2) will be $(1 + g)P_0$ and $(1 + g)^2 P_0$. The summation in (3) contains only the other three terms in the summation of (2), therefore $P_5 < P_3$. However, wide variations in profits seriously qualify the importance of this observation. Bankers may well place more emphasis on the most recent years than the simple arithmetic average implies. No attempt has been made to correct estimated mean profits.

interindustry differences is made by banks which use techniques advocated by the Robert Morris Associates.¹ These techniques involve comparing a firm's current ratio with the average current ratio of similar firms in the same industry. No attempt was made to utilize such techniques in this chapter because industrial classifications are ambiguous and the typical term loan borrower had few comparable firms within his "industry."

A second inadequacy of the current ratio (and also working capital) is that current assets include inventories. If a firm's inventories are large, his current ratio may be large; but he may be close to bankruptcy. If the hypothesis is to have the indicated sign, it is necessary to assume that inventories are controlled. A more detailed analysis would include inventories as a separate variable.

Hypothesis 3 states that if two firms, possessing identical income statements and balance sheets and differing only in that one firm maintains a larger demand deposit balance with the lending bank than the other, apply to a bank for a loan, then the bank will charge a lower rate to the holder of the larger balance. One reason for this behavior is that firms carrying larger deposit balances are expected to do so in the future and thus in order to charge both applicants the same effective rate a bank must act in accordance with the hypothesis. A more interesting argument is associated with the fact that applicants who keep idle balances with a bank perform a favor for the bank by

¹Cf. Robert Morris Associates, 1958 Statement Studies, Philadelphia, Robert Morris Associates, 1959.

reducing its deposit instability. Banks may prefer to charge such firms a slightly lower rate rather than risk the loss of their accounts.

Measurement difficulties obscure the significance of E , the applicant's previous year average balance. Information about activity of balances could not be obtained. If a great number of checks were drawn on the account, bookkeeping expenses and excessive deposit instability may negate the desirability of a large balance. This qualification is not likely to be too serious because bankers impose service charges after a certain level of activity.

A second problem arises because it was not possible to obtain statistics about an applicant's current or previous short term borrowings. The argument for hypothesis 3 is concerned with an applicant's deposit balance net of other borrowings. Use of E therefore unavoidably involves a misspecification of the loan offer function. Despite these objections, it is important to note that banks keep records of gross deposit balances rather than net deposit balances and from comments by bankers I infer that E is a reasonable proxy for net balances.

A final problem relates to the complexity of organization of contemporary borrowers. A corporation may have five or six affiliated concerns, each of which carry deposit balances with the bank. Hypothesis 13 represents a crude attempt to take this factor into account. In the case of certain loans, the banks voluntarily reported "conspicuous" affiliated balances which were factors in the bank's decision to lend. Needless to say, reporting of such affiliated balances represented an arbitrary judgment. It is quite difficult to associate balances of a

huge complex with any particular firm. Empirical examination of affiliated balances is at best hazardous.

Hypothesis 4 states that if two firms, possessing identical income statements, balance sheets, and being similar in every other essential respect except that one had maintained a deposit account with the bank for a longer period, apply to a bank for a loan, then the bank will charge a lower rate of interest to the applicant with the longer account relationship. The reasoning is that banks have more knowledge of old customers and their businesses. Greater knowledge reduces uncertainty associated with a loan. Banks ordinarily compensate for uncertainty by charging higher interest rates.

It is of course true that merely carrying a deposit with a bank for an extended period need not increase a bank's knowledge of an applicant. Previous loans to the applicant, however, would have conveyed information to the bank. It is assumed that old depositors are more likely to have borrowed in the past.¹

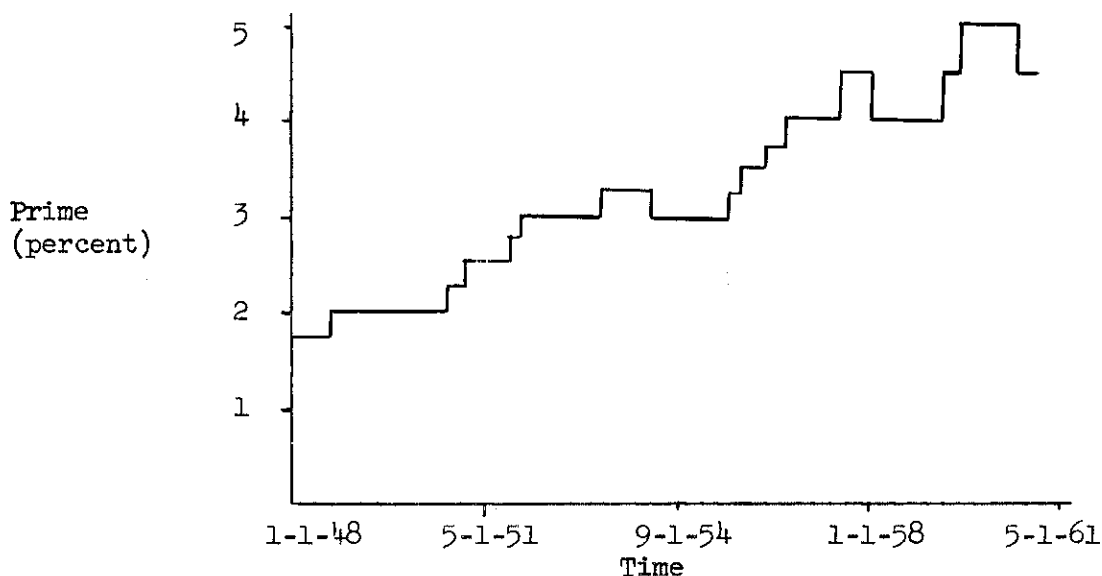
Hypothesis 5 states that if two identical firms apply to a bank for a loan at two different points in time at which the bank is in the same position except that the prime rate of interest has risen, then the bank will charge a higher rate when prime is higher. This is because banks regard prime as a floor for loan interest rates and tend to set rates at

¹An alternative hypothesis implies an opposite relationship between years of deposit relationship and terms of lending. This would follow if banks compete for new accounts by offering low rates of interest. Old depositors, due either to inertia or unwillingness to change banks because of other bank services, are charged slightly higher rates. A priori, this explanation does not seem likely and the conjecture is not tested.

prime plus some differential for more risky borrowers. Because prime is essentially a convention among large banks, the hypothesis does not apply to smaller banks.

The reader may object that movements in the prime rate have little relevance to the amount or maturity of a loan. Large banks move prime relatively frequently as can be seen in diagram 3 - 1. In interviews, however, lending officers in commercial banks concede that interest rates above prime are somewhat less flexible. If banks are initially in equilibrium and higher loan rates are less flexible when prime rises, banks may be expected to ration credit¹ with respect to other terms of lending in order to clear the loan market.

Diagram 3 - 1²



¹This argument is consistent with the availability of credit doctrine.

²Data necessary to construct diagram 3 - 1 were secured from a confidential inter-office memorandum in a large commercial bank. A similar chart appeared in The Wall Street Journal, August 29, 1960.

A second argument which does not require inflexibility of certain rates is that banks prefer to substitute less risky loans at higher levels of market interest rates. Empirically, it is not possible to discriminate between these explanations.

Hypothesis 6 states that if two firms, with identical income statements, etc., and with balance sheets which are identical in every essential respect except that one has larger working capital (current assets minus current liabilities), apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm with larger working capital. This hypothesis is quite similar to hypothesis 2 and is an alternative way of formulating the current position of a firm. Net working capital differs from the current ratio in that it does not show the relative magnitudes of current assets and current liabilities.

Hypothesis 7 states that if two firms, identical in every essential respect except that one has been experiencing a larger average annual growth in net profits or a smaller average annual shrinkage in net profits, apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm whose profits have been growing most or declining least. Firms with growing profits are excellent prospects for future balances and loan business. Banks may interpret growth in profits as evidence of superior management. A growing stream of profits, which is expected to continue growing, provides an increasing safety margin against unanticipated setbacks in a firm's business.

The variables $\left(\frac{dP}{dt}\right)_m$ and $\left(\frac{dP}{dt}\right)_p$ were obtained by regressing each borrower's profits on time.¹ The resulting slopes are the variables.

Hypothesis 8 is perfectly analogous to hypothesis 7 except that it refers to annual changes in working capital rather than annual changes in profits. The variables $\left(\frac{dW}{dt}\right)_m$ and $\left(\frac{dW}{dt}\right)_p$ were again obtained as slopes of regressions. Growth in working capital may result from growth in inventories, payment of accounts payable, collection of accounts receivable or from growth in cash assets attributable to profit flows, depreciation flows and reductions in investment, dividends, etc. If working capital is improving over time and is expected to continue to grow, again an increasing safety margin against unanticipated setbacks in the firm's business exists.

Hypothesis 9 states that if two firms, identical in every essential respect except that one possesses larger total assets, apply to a bank for a loan, then the bank will charge a lower rate to the firm with larger total assets. The reason for this behavior is that large firms have more banking connections and thus are in a superior bargaining position.²

Hypothesis 10 argues that if two firms, identical in every essential respect except that one possesses a higher ratio of average

¹The equation of the regression is $P = a + bt + \epsilon$.

²Total assets is correlated with many other balance sheet variables which have been omitted from this analysis. Assets might be viewed as a proxy for net worth, debt, current assets, etc. Unfortunately, these variables do not affect a bank's willingness to lend in the same way and thus the sign of the relationship becomes ambiguous.

profits to assets or a lower ratio of average losses to assets, apply to a bank for a loan, then the bank will charge a lower rate to the applicant possessing the greater profit rate. This hypothesis differs from hypothesis 1 in that it asserts that banks are concerned with the "efficiency" with which firms utilize their assets rather than with dollar flows. In future research, a more meaningful profit rate might be expressed as the ratio of profits to net worth.

Hypothesis 11 states that if two firms, identical in every essential respect except that one is simultaneously obtaining loans from other banks, apply to a bank for a loan, then the bank will charge a lower rate to the firm which is not simultaneously borrowing from other banks. The reason is that simultaneous borrowings increase the ratio of debt to equity of the applicant thereby increasing the probability of default.

Hypothesis 12 states that if two firms, identical in every essential respect except that one experiences greater variance of profits over time, apply to a bank for a loan, then the bank will charge a lower rate of interest to the firm with the lower profit variance. The reason is that future instability of earnings may imply increased probability of bankruptcy and it may cause a delay in loan repayment (not necessarily associated with bankruptcy).

This variable is the residual variance about the regression line from which $\left(\frac{dP}{dt}\right)_m$ and $\left(\frac{dP}{dt}\right)_p$ were obtained. It was only computed for those observations containing five consecutive annual profit figures. In interviews, bankers reported that variability of profits was an

undesirable feature of loan applicants, but were unable to specify what measure of variability they employed. Variance of yearly profits is assumed to be an appropriate measure.

Hypothesis 13 states that if two firms, identical in every essential respect, both having affiliates or subsidiaries which carry balances with a bank, apply to that bank for a loan, then the firm with larger affiliated balances will be charged a lower rate of interest. The reason for this hypothesis was presented while discussing hypothesis 3.

3 - 3. Empirical Results

Partial loan offer functions were estimated from data on term loans for each of three large commercial banks. Term loan information collected from smaller commercial banks was either incomplete or of insufficient quantity to permit analysis. Hypotheses 1 through 10 were tested by examining coefficients of estimated partial loan offer functions. Hypotheses 11 through 13 were tested by examining residuals of the estimated partial offer functions.¹

Use of partial loan offer functions for tests of the above hypotheses is not without objection. A variable may be insignificant in each of the partial offer functions and yet be significantly related to some linear combinations of terms of lending. It is arbitrarily assumed that, if any

¹A_o, E_a, and V_p were reported for smaller number of loans than were the other variables. It was assumed that coefficients associated with these other variables in each of the four partial offer functions were independent of the reporting and magnitude of A_o, E_a, and V_p. The assumption permits estimation of these other coefficients with all observations.

hypothesis is significant in more than one of the estimated partial offer functions, the hypothesis is accepted.¹ Tests of coefficients are one tailed tests and a coefficient is judged significantly greater or less than zero if the probability of the event occurring when the null hypothesis is true is less than .025.

Table 3 - 2 reports regressions of the loan rate of interest on profit and profit rate variables, the current ratio, applicant's balances, years as a depositor, and the prime rate for each of the three banks. Tables 3 - 3 through 3 - 5 contain the corresponding regressions of maturity, amount, and the security dummy variable.

All regressions in the following tables are significant at the .05 level. The number of observations ranges from 60 to 130.²

¹A decision rule is necessary because the banks were not selected randomly. With twelve partial offer functions, the probability of a random variable being significant at the .025 level at least once is approximately .26. The probability of a random variable being significant in two or more regressions is approximately .035.

The reader might question why a simple pooling of "t" ratios would not be a more elegant test than the procedure reported in the text. The difficulty with pooling is that a variable may only (1) be strongly related to one term of lending or (2) be significant in the case of one bank. It is quite possible that such variables would not prove significant when pooled. It is my view that these two cases should not be ignored. The alternative is to consider each of the three banks separately, a procedure which would unduly extend this thesis.

²The reader is cautioned that the sample of loans mentioned in appendix B is included in regressions of bank 1. Approximately 50 percent of the observations from bank 1 were used to determine the appropriate functional form. A purist would insist that these observations not be included in subsequent tests. In fact, regressions estimated from the fifty percent which were previously used and from the other half of the sample were not very different.

TABLE 3 - 2¹

Regressions of Logarithm of Loan Rate
of Interest

	Bank 1	Bank 2	Bank 3
R ²	.768	.801	.740
Constant	.29799 (.03879)	.22819 (.07617)	.50641 (.05441)
Log P _m	-.021376 (.010546)	.0077583 (.0126343)	-.048994 (.02144)
Log P _p	-.028141 * (.003764)	-.026016 * (.007273)	-.051199 * (.005624)
Log (P _m /H)	.013766 (.035608)	.17353 * (.06243)	.044202 (.039758)
Log (P _p /H)	-.0040334 (.0120053)	.0000387 (.0192769)	.019266 (.012640)
Log C	-.0035993 (.0094913)	.0050930 (.0152388)	.027917 (.011215)
Log E	-.0022438 (.0022897)	-.0012317 (.0035640)	.0057964 (.0038054)
Log Y	.0013883 (.0081666)	.011829 (.012885)	-.041044 * (.013261)
Log \bar{R}	.88445 * (.04975)	.94109 * (.07117)	.82513 * (.07837)

¹Number in parentheses are the standard errors of the coefficients in this and subsequent tables.

* implies significance at .025 level.

TABLE 3 - 3
 Regressions of Logarithm
 of Loan Maturity

	Bank 1	Bank 2	Bank 3
R^2	.300	.507	.252
Constant	2.7423 (.2805)	2.4538 (.4948)	1.9245 (.3262)
Log P_m	.022349 (.076251)	.077759 (.082036)	.089841 (.128551)
Log P_p	-.01642 (.2722)	.097984 * (.047225)	.061644 (.033717)
Log (P_m/H)	.087133 (.257463)	-.39020 (.40538)	.033918 (.238343)
Log (P_p/H)	.13893 (.08780)	-.0091561 (.1251702)	-.069556 (.075777)
Log C	.25379 * (.06863)	.23589 * (.09895)	.21279 * (.06724)
Log E	.0099599 (.0165557)	-.027579 (.023142)	-.014139 (.022814)
Log Y	-.001404 (.0590489)	.10170 (.08367)	.019700 (.079500)
Log \bar{R}	-1.6371 * (.3597)	-2.4696 * (.46213)	-1.1492 * (.4698)

* implies significance at .025 level.

TABLE 3 - 4
 Regressions of Logarithm
 of Amount of Loan

	Bank 1	Bank 2	Bank 3
R^2	.436	.536	.479
Constant	3.8782 (.3947)	3.4590 (.6300)	2.7861 (.6623)
Log P_m	.34318 (.10730)	.44928 (.10451)	.62381 (.26101)
Log P_p	.30118 * (.03830)	.34179 * (.06016)	.44388 * (.06846)
Log (P_m/H)	-.23291 (.36231)	.31845 (.51641)	-.060286 (.483947)
Log (P_p/H)	-.22484 (.12216)	-.0209343 (.159452)	-.29203 (.15386)
Log C	-.11031 (.09658)	-.074821 (.1260521)	-.17331 (.13652)
Log E	.071128 * (.023298)	.064824 * (.029481)	.052576 (.046322)
Log Y	-.082879 (.083096)	.0024384 (.1065818)	-.059843 (.161421)
Log \bar{R}	-.24783 (.50619)	.40405 (.58871)	-.22943 (.95400)

* implies significance at .025 level.

TABLE 3 - 5

Regressions of Logarithm
of Security "Dummy" Variable

	Bank 1	Bank 2	Bank 3
R^2	.238	.264	.222
Constant	.64815 (.42578)	-.14593 (.82473)	.64072 (.61148)
Log P_m	.31561 * (.11575)	.20416 (.13680)	.23161 (.24098)
Log P_p	-.097139 * (.041314)	.0032402 (.0787505)	-.071817 (.063206)
Log (P_m/H)	1.0529 * (.3908)	-.15262 (.67600)	.43284 (.44680)
Log (P_p/H)	-.24308 (.13177)	-.55109 * (.20873)	-.23919 (.14205)
Log C	-.10298 (.10418)	.10804 (.16500)	-.20391 (.12604)
Log E	.0050158 (.0251320)	.0076621 (.0385914)	.076944 (.042767)
Log Y	-.12322 (.08964)	-.10592 (.13952)	-.31464 * (.14903)
Log \bar{R}	-.055012 (.54604)	-.79358 (.77063)	-.51984 (.88077)

* implies significance at .025 level.

Hypothesis 1 is accepted because the profit variable P_p is significant in eight of twelve regressions and the loss variable P_m is significant in one. Unfortunately, had the hypothesis about the loss variable been of the opposite sign, that variable would have been significant in five of the regressions. In other words, the results suggest that firms which experience large losses or profits are lent money on easier terms than firms with small net profits. The loss paradox apparently derives from misspecification.

One explanation is that profits are highly correlated with scale variables, total assets and net worth. Doubt is cast on this explanation by the credit literature¹ on term loans which emphasizes earnings rather than net worth. When total assets is added to the above regressions, the fit is not improved. Nevertheless, P_m coefficients might change sign if the right scale variable were employed.

A second explanation which seems more plausible derives from the observation that firms which lose substantial sums of money for periods of three to five years are exceptional firms. They are even more exceptional when commercial banks will lend them money for a period of years. Their exceptional characteristics may include development of new products, particularly capable management, etc. Had these characteristics been included in the regressions, perhaps P_m would have coefficients of a different sign.

Concentrating on the P_p coefficients, the estimated profit elasticity of the loan rate of interest varies between .026 and .051 and

¹American Bankers Association, loc. cit.

differs significantly between the banks. Thus a tenfold increase in a firm's profits will permit it to borrow term money at a rate of interest which is lower by approximately one fourth to one half of a point.

In the case of bank 2, increases in a firm's profits induce that bank to lend at longer maturities. A similar statement does not characterize the other banks.

All three banks grant larger loans when an applicant's profits rise. Profit elasticities with respect to amount vary from .30 to .44 and the coefficients differ significantly between the banks.

In the case of bank 1, increases in a firm's profits and decreases in a firm's losses are associated with increased likelihood of security. Similar statements do not apply to the other banks.

Hypothesis 2 is accepted because coefficients of C are significant in each bank's maturity regression. Banks lend further into the future as an applicant's current ratio improves. The current ratio elasticity of maturity varies from .21 to .25, a difference well within the standard errors of each of the estimates. The coefficient of C has the wrong sign in the rate regression of bank 3. There is no obvious reason for this and it is assumed to be spurious.

Hypothesis 3 is accepted because coefficients of E are significant in the amount regressions for banks 1 and 2. Firms holding larger balances at these banks tend to be granted larger loans. Balance elasticities in both cases are approximately .07.

Hypothesis 4 is accepted although significant coefficients of Y appear only in regressions involving bank 3. Old depositors are able to secure loans at lower rates of interest and more frequently without security.

Hypothesis 5 is accepted. Coefficients of \bar{R} are significant in the interest rate and maturity regressions for all three banks. The prime rate elasticities of the loan rate of interest are .88, .94, and .83 for banks 1, 2, and 3, respectively. The lower two elasticities are significantly different from unity. This should not necessarily be interpreted as evidence of credit rationing. Bankers frequently express loan rates to borrowers as prime, prime plus a quarter, prime plus a point, etc. The logarithmic formulation assumes that differentials from prime increase proportionately with the level of prime. Consequently, if many loans are made at rates above prime and the differentials are independent of prime, the coefficient of \bar{R} would be expected to be less than unity.

Coefficients of \bar{R} in the case of the maturity regressions are revealing. Increases in the prime rate tend to shorten the maturity of new loans.¹ The result suggests that loan interest rates did not or could not rise sufficiently above prime to induce banks to grant very long maturity term loans. Because movements in the prime rate are correlated with movements in bill rates, discount rates, bond rates, etc.; one implication of restrictive credit policies by monetary authorities may be a reduction in the willingness of banks to grant longer term loans. This result might also derive from the Wallich-Musgrave interpretation of the availability doctrine if it is believed

¹The coefficient of \bar{R} in the case of the maturity regression for bank 2 is misleading. A sampling difficulty described in appendix C caused the coefficient to be negatively biased. The conclusion in the text would probably still hold if this bias could be eliminated.

business expectations are inversely related to the level of interest rates. Other coefficients of \bar{R} are not significantly different from zero.¹

When working capital, W_m and W_p , change in working capital $\left(\frac{dW}{dt}\right)_m$ and $\left(\frac{dW}{dt}\right)_p$, change in profits $\left(\frac{dP}{dt}\right)_m$ and $\left(\frac{dP}{dt}\right)_p$, and total assets H were individually added to the above regressions, fits of the regressions were not significantly improved. Therefore, hypotheses 6, 7, 8, and 9 are rejected.

Hypothesis 10 is accepted. The coefficient of the negative profit rate $\frac{P_m}{H}$ in the interest rate regression of bank 2 is significant.

Firms which have negative profit rates are forced to pay higher interest rates. In the case of bank 1, the coefficient of $\frac{P_m}{H}$ in the security equation is significantly positive implying that more negative profit rates increase the likelihood of security. For the same equation of bank 2, the coefficient $\frac{P_p}{H}$ is significantly negative implying that higher profit rates decrease the likelihood of security. Other coefficients of $\frac{P_m}{H}$ and $\frac{P_p}{H}$ are not significantly different from zero.

¹One banker suggested that this result reflected a diminution of demand for these funds. His argument is equivalent to saying that the partial loan offer function was not identified. Such arguments are not convincing unless reasons for lack of identification can be suggested.

Hypotheses 11, 12, and 13 are rejected. Residuals of the above regressions were regressed on A_o , V_p , and E_a individually. Only those observations containing nonzero values of the independent variable (A_o , V_p , or E_a) were included in each of the calculations. Infrequent reporting of affiliated balances limited empirical examination of hypothesis 13 to one bank. None of the four slopes were significantly different from zero.¹

Two banks reported the volume of participations A_o . In both cases no coefficients were significant. Interestingly, had the hypothesis implied opposite signs and the rejection regions been .05, both coefficients in the amount (residuals) equations would have been significant. In other words, simultaneous outside borrowing seems to increase the amount of term money a bank will lend to a borrower. One possible explanation is that confidence in a borrower grows in the mind of a banker if other bankers concur in his decision to lend. A second explanation, verbally supported by an officer in a bank, is that active participation in loan syndicates is a matter of prestige and a show of competitive strength. Further empirical work is necessary before these explanations can be accepted.

Variance of an applicant's profits was analyzed for each of the three banks and none of the coefficients were significant.

Two additional tests were performed on the term loan samples. The first examined the hypothesis that all three banks could be

¹It should be recalled that reporting of E_a was voluntary. More systematic data collection might conceivably alter the conclusion.

characterized by the same partial loan offer functions rather than separate functions for each bank. Employing the F test, the hypothesis is rejected at the .05 level in the cases of the rate of interest and maturity regressions. The ability of an applicant to obtain certain rates of interest and certain maturities clearly depends upon the bank to which he applies. The hypothesis is accepted in the cases of the amount and dummy security variables.

The second test examined the hypothesis that if the sample for each bank were split in two sections, loans granted from January 1955 through May 1956 and loans granted from June 1956 through October 1957, the estimated partial loan offer functions would not be significantly different from the equations reported in tables 3 - 2 through 3 - 5. Again employing the F test, the hypothesis is accepted in all four regressions of each of two banks. However, for a third bank, the hypothesis is rejected in the maturity and dummy security regressions at the .05 level.

In a comparison of the first and second half of the period, the following statements apply to that bank. Firms were required to have a higher current ratio in order to be granted a loan of a particular maturity. The bank became even less willing to grant long maturity loans as prime rose. A higher current ratio was necessary in order to achieve a particular probability of a collateral requirement. Further, the bank made fewer loans to firms which experienced mean losses over the preceding three to five years. A subsequent conversation with an officer of this bank confirmed that there was a sharp change in lending policy early in 1956. This change included

a greater unwillingness to make term loans. It is of interest to observe that this tightening did not involve a change in the interest rate regression.

3 - 4. Summary

In Chapter 3, partial loan offer functions were estimated from data on term loans collected from three large commercial banks. The regressions suggest that a borrower's profits are significantly related to all terms of lending. Apparent misspecification of the loan offer function prevented a borrower's losses from being significant. Firms with higher ratios of recent profits to assets borrow more frequently without collateral and at lower rates of interest.

A borrower's current ratio is positively related to the loan maturity which he obtains. In the case of two of the banks, larger past deposit balances permit applicants to obtain larger loans. An older depositor may borrow at lower interest rates and more frequently without collateral from one of the banks.

For all three banks, increases in the prime rate result in increases in loan interest rates and declines in willingness to grant long maturity term loans. The latter might be interpreted as evidence of credit rationing.

There are significant differences in the rate and maturity regressions of the three banks. In the case of one bank, the loan offer function appeared to change in the second half of the 1955-57 period.

CHAPTER 4

ANALYSIS OF COMMERCIAL AND INDUSTRIAL LENDING

This chapter reports results of statistical tests performed on samples from the 1955 and 1957 surveys of business loans collected by the Board of Governors of the Federal Reserve System.¹ The surveys contain information on loans of various amounts and maturities, in contrast to the large, long maturity term loans considered in Chapter 3.

Data gathered in the surveys permit examination of the relevance of a few borrower characteristics to the loan offer function. More importantly, tests of hypotheses about the effects of some bank characteristics on bank lending can be made, because the data were collected from a large number of banks. Finally, tests of the impact of increased bond interest rates on bank lending can be performed. The last set of tests is possible because samples collected in 1955 and 1957 were drawn at points of time when interest rates were respectively low and high.

¹I am most grateful to the Board for making available summaries of these surveys. Valuable comments and assistance were obtained from Mr. Edward P. Snyder of the Banking Section of the Board's Division of Research and Statistics.

Section 4 - 1 considers the data, variables, and hypotheses concerning the loan offer function at a point in time. Section 4 - 2 presents results of empirical tests of these hypotheses. In Section 4 - 3 hypotheses and empirical results about the impact of higher bond interest rates on the loan offer function are reported. Section 4 - 4 summarizes the analysis of the Federal Reserve surveys.

4 - 1. Hypotheses

A description of the surveys and their sampling techniques may be found in the April 1956¹ and the April 1958² Federal Reserve Bulletins. For reasons of cost, only data relating to one district of the Federal Reserve System could be processed. Apparent balance in terms of industry, size of banks, and demand for loans suggested the Cleveland district and it was selected.

The surveys collected information on individual loans granted by a sample of member banks. Four conditions had to be met by the loans in the surveys if they were to be included in the present study:

- (1) They must have been granted to firms in the United States (1955 only).
- (2) They must have had maturities (when granted) of not more than ten years.

¹James B. Eckert, "Business Loans to Member Banks," The Federal Reserve Bulletin, XLIII (April 1956), pp. 337-340.

²James B. Eckert, "Member Bank Lending to Small Business, 1955-7," The Federal Reserve Bulletin, XLIV (April 1958), pp. 393-394 and pp. 410-411.

- (3) They must have been granted or approved in the month immediately preceding the date of the survey.
- (4) All variables considered in this chapter had to have been reported.

The following new variables were reported in the 1955 survey:

D = the level of deposits of the lending bank in June of the year of the survey. (in dollars)

L = ratio of lending bank's commercial and industrial loans to its total assets, as of the survey date. (in percent)

B = 10 if borrower was located in the same metropolitan area as the lending bank, B = 1 otherwise.

Both surveys reported H , the total assets of the borrower; R , effective loan rate of interest; M , the maturity of the loan when granted; A , the amount of the loan; and S , the dummy security variable. Unfortunately, the 1957 survey did not collect information on L and B .

Variables D , L , H , and M were recorded in class intervals. Thus the level of deposits of a lending bank might be reported in the interval of ten to twenty million dollars. If an observation fell into an interval, it was arbitrarily assigned the midpoint. If the class interval had an open end, an estimate of its mean was obtained from other sources. These sources are described in appendix D. This procedure may bias the results, but in most cases a sufficient number of classes existed to reduce this bias to negligible proportions. An exception was the loan ratio L where only four classes were available.

The theory developed in Chapter 1 assumed that loans were sufficiently large or of sufficiently long maturity that costs of lending could be ignored. In view of the fact that nearly forty percent of the loans in the Fed. samples were to borrowers with total assets under \$50,000. and ninety percent for periods of less than one year, this assumption may not be valid. Small loans and loans with short maturities will be relatively less desirable than would be true if lending were costless. With this qualification,¹ the following hypotheses may be inferred from the theory:

- (1) Ceteris paribus, as the total assets of a borrower increases, the rate of interest on the loan decreases and/or the maturity of the loan increases and/or the amount of the loan increases and/or the likelihood of security decreases.
- (2) Ceteris paribus, as the level of deposits of a lending bank increases, the rate of interest on the loan increases and/or the maturity of the loan decreases and/or the likelihood of security increases.
- (3) Ceteris paribus, as the loan ratio of the bank increases, the rate of interest on the loan increases and/or the maturity of the loan decreases and/or the amount of the loan decreases and/or the likelihood of security increases.

¹This qualification is probably not serious. Small loans earn small sums, but their credit analysis is also simple and cheap.

- (4) Ceteris paribus, if the borrower resides in the same city as the lending bank, the rate of interest on the loan is lower and/or the maturity of the loan is longer and/or the amount of the loan is larger and/or the likelihood of security is smaller.

Supporting arguments for these hypotheses are developed in terms of R . The remaining relationships in the hypotheses may be inferred, mutatis mutandis, because R is believed to be a complement of M and A and a substitute for S .

Hypothesis 1 states that if two firms apply for a loan, then the firm with larger total assets will be charged a lower rate of interest. It may be defended on the grounds that bankers believe the probability of default is smaller when a borrower's assets are larger.

The fact that coefficients of borrower's assets were insignificant in Chapter 3 should not discourage use of the variable in this chapter. Profits and assets are highly correlated and coefficients of profits were significant in Chapter 3. Information on a borrower's income was not obtained in the Federal Reserve surveys; total assets is viewed as a proxy for an applicant's profits.

Hypothesis 2 states that if identical firms apply to banks, differing only in size, then larger banks will charge higher rates of interest. This hypothesis is derived from three assumptions:

(1) banks are averse to deposit instability, (2) a bank's utility function is quadratic with respect to changes in the level of its deposits, and (3) the analysis in appendix A characterizes banks in the real world.

The hypothesis makes no statement about the relationship between the amount of the loan and the level of deposits of the lending bank. However, the relationship is probably positive because commercial banks are not permitted to lend sums in excess of ten percent of their net worth. Traditional bank examination standards require the level of a bank's deposits and its equity to be positively correlated.

Hypothesis 3 states that if identical commercial firms apply to banks, differing only in their business loan ratios, then banks with higher ratios of commercial and industrial loans to deposits will charge higher rates of interest.¹ This hypothesis utilizes the notion of portfolio balance. These banks have some common optimum portfolio; if the proportion of business loans is low, they lower rates to encourage more business lending. Rates will be raised if the banks have too many business loans.²

Specialization of lending may operate to offset this hypothesis. If some banks specialize in agricultural loans, they may feel quite inexperienced when lending to manufacturers or shopping centers. This lack of experience induces such banks to be conservative commercial and industrial lenders. Following the same line of reasoning, some

¹The reader may object that lending by banks during the month prior to the survey date may influence the loan ratio at the time of the survey. The ideal loan ratio for the purposes of this hypothesis is that existing a month prior to the survey date. However, this ideal statistic is not available and it is reasonable to assume that the ratio existing at the time of the survey had not been appreciably altered during the preceding month.

²Cf. James Tobin, "Liquidity Preference as Behavior Towards Risk," The Review of Economic Studies, No. 67 (February 1958), pp. 65-86.

banks may view themselves essentially as lending institutions while others prefer to be regarded as depositories. The former institutions are systematically more aggressive lenders. Their loans to borrowers of given means are at lower interest rates, of longer maturities, of larger amounts, and with lower probability of collateral. The latter banks are more conservative lenders.

The question of whether a common portfolio balance or specialization best describes the real world is important for appraising the ease of obtaining credit in certain communities where banks have high business loan ratios. There is no theoretical basis for selecting which of the two hypotheses is right. Empirical tests will doubtless reflect both patterns of behavior.

Hypothesis 4 states that if a bank receives two loan requests from borrowers identical in every respect, except that one of them is located in a different city than that in which the bank and the other borrower reside, then the bank will charge a higher rate of interest to the first borrower. Among the reasons which support this hypothesis are: (1) higher costs of processing and checking distant borrowers, (2) a belief that the elasticity of demand for loans is greater in the bank's own city, and (3) greater ease of surveillance of the borrower.

4 - 2. Empirical Results

Partial loan offer functions were estimated from a sample of approximately 3000 loans. Hypotheses 1, 2, and 4 are one tailed tests of parameters and again the .025 level of significance was selected. Hypothesis 3 is a two tailed test and coefficients of L are tested at the .05 level.

As in Chapter 3, statistical tests of parameters in partial loan offer functions are not ideal tests of the theory. Hypotheses are again judged to be accepted if at least two coefficients are significant.¹ Table 4 - 1 reports the estimated partial loan offer functions.

All multiple regressions in Table 4 - 1 are significant at the .01 level. Hypothesis 1 is accepted. Coefficients of total assets H are significantly different from zero in all four regressions. The asset elasticity of the rate of interest is .066. Thus if a firm had previously borrowed at eight percent and suddenly expanded its assets tenfold, it could expect to borrow at about seven percent.² Banks apparently do view a borrower's total assets as a measure of expected default risk. The reader should recall that total assets is a proxy for other income and balance sheet variables which were not recorded.

Hypothesis 2 is accepted; larger banks charge higher rates of interest to and are more likely to insist upon collateral from borrowers of a particular size. The failure of the hypothesis in the case of the maturity regression is a bit puzzling. One explanation is that small banks do not in practice make loans with long maturities. There is probably a tendency to issue short maturity notes with the implicit understanding that these notes will be renewed if conditions

¹The probability of a random variable being significant at the .025 level in at most one regression is .997.

²The statement obviously makes the usual static cross-section assumption that differences between borrowers at a point in time are analytically identical to differences in a given borrower at different points in time.

TABLE 4 - 1

Partial Loan Offer Functions Estimated From the
1955 Federal Reserve Survey of Business Loans

Dependent Variable	R ²	Constant	Log D	Log L	Log H	Log B
Log R	.287	1.04771	.0054857 * (.0023484)	-.012094 (.0064626)	-.066186 * (.0020187)	-.010048 * (.0047189)
Log M	.009	.19964	-.021283 (.013009)	.11413 ** (.035799)	.022868 * (.011182)	-.074805 (.026140)
Log A	.513	-.056965	.060246 * (.014878)	.088687 ** (.040943)	.63398 * (.012789)	-.012915 (.029896)
Log S	.018	.55192	.042968 * (.013516)	.010879 (.037194)	-.081928 * (.011618)	-.099366 * (.027158)

* implies significance at .025

** implies significance at .05

of the borrower do not change drastically. Larger banks, on the other hand, may prefer to make term loans because of the lower average legal and administrative costs associated with the larger loans which they grant. The failure of the coefficient to be significant may result from a failure of the survey to measure the effective maturity of loans of small banks.

Unfortunately, if L and B are omitted from the regressions, the coefficient of D is not significant in the interest rate equation. As is usually true when multicollinearity appears, the meaning of this second result is unclear. The hypothesis is still accepted on the basis of the significant coefficients, but further research is necessary before doubt is extinguished.

Hypothesis 3 is rejected in favor of the specialization hypothesis discussed above. The coefficient of the business loan ratio is significantly positive in the maturity and amount regressions and narrowly misses being significant in the interest rate regression. Banks with high business loan ratios make new business loans which have longer maturities and larger amounts to borrowers of any particular size. This result contradicts a view that banks have some common optimum portfolio toward which they constantly adjust.

An explanation for the failure of the hypothesis in the interest rate and dummy security variable regressions is that aggressive banks prefer to compete only with certain terms of loans, i.e., maturity and amount. This explanation is consistent with statements sometimes encountered in the banking literature concerning the undesirability of interest rate competition.¹

¹Beckhart, op. cit., pp. 305-7.

Hypothesis 4 is tentatively accepted because of significant coefficients of B in the interest rate and dummy security variable regressions. The coefficient of B possesses the wrong sign in the case of the maturity and amount regressions. Indeed if the hypothesis had predicted that the coefficient in the maturity regression be negative, the coefficient would have been significantly different from zero. No single explanation for the failure of the hypothesis in these regressions is obvious. Further research on the relationship of location to bank lending is needed.

4 - 3. The Impact of High Interest Rates

Higher interest rates on competing assets influence the terms at which firms may obtain loans. Analysis of the impact of different levels of interest rates on the willingness of commercial banks to lend can only be accomplished by examining bank lending at different points in time. If the effect of competing interest rate changes is to be identified, other variables which influence the willingness of a bank to lend must be considered at the various points in time. A brief discussion of factors influencing the loan offer function in October 1955 and October 1957 follows. It may be seen that, if anything, the net effect of these other factors would tend to discourage bank lending in 1957.

Both Federal Reserve surveys were conducted in early October, thus permitting seasonal determinants of lending to be ignored. Although a modest increase in unemployment was occurring in the fall of 1957, business expectations were by no means bleak. They were

probably more pessimistic than in October 1955 when the economy was prospering. This change in the economic picture probably induced bankers to be more cautious when granting loans. In both periods, discount rates had risen one half point in the two months preceding the survey dates. Very similar patterns were exhibited by the prime rate and bill rates in the same two month periods.

The most important difference in the loan market on the two survey dates was higher interest rates in 1957. Between October 1955 and October 1957 new issue bill rates jumped from 2.23 to 3.58, prime rose from 3.50 to 4.50, rates on banker's acceptances rose from 2.23 to 3.75, and rates on United States Government long term bonds rose from 2.89 to 3.73.¹

Another difference was that the ratio of loans to deposits of most commercial banks was higher in the second period. This change in bank portfolios would be expected to make banks more cautious when granting loans.

The following hypotheses may be inferred from the theory presented in Sections 3 and 4 of Chapter 1.

- (5) Ceteris paribus, when rates of interest on competing assets are higher, borrowers of any particular size --
- (a) pay a higher rate of interest on their loans.
 - (b) receive loans with shorter maturities.
 - (c) receive smaller loans.
 - (d) are more frequently required to provide security.

¹Federal Reserve Bulletin, XLIII (April 1956), p. 365, and Federal Reserve Bulletin, XLIV (April 1958), p. 457.

- (6) Ceteris paribus, when rates of interest on competing assets are higher, the deposit coefficient (elasticity) of --
- (a) the loan rate of interest is more positive.
 - (b) the maturity of the loan is more negative.
 - (c) the amount of the loan is more negative.
 - (d) the likelihood of security is more positive.

Part (a) of hypothesis 5 is consistent with the conventional theory that loan rates of interest clear loan markets. It may also be consistent with the "levels" version of the availability of credit doctrine which does not always prohibit movements in loan interest rates. But as observed earlier, supporters of that doctrine believe that these movements are insufficient to clear loan markets. Parts (b), (c), and (d) of the hypothesis reflect their view that credit rationing is necessary to clear loan markets when interest rates reach higher levels.

Credit rationing may also be achieved by increasing the number of loan rejections instead of altering terms of lending. No direct test of this form of credit rationing is possible in the present thesis because information on rejections is not available. However, it seems strange that bankers would not ration credit both by increasing rejections and modifying terms of lending. If only the former technique is employed, then banks must behave in the following fashion. If a firm seeks a two year loan of \$10,000, the banker simply says "yes" or "no." He does not attempt to scale down the firm's request or to extract a faster repayment schedule. In fact, he behaves contrary to the answers by bankers in the American Bankers Association survey reported in Chapter 2.

Hypothesis 6 implies that an increase in competing interest rates causes large banks to be even less willing to lend than small banks. Part (a) of this hypothesis reflects the conventional view that increased aversion to lending results in higher interest rates. Parts (b), (c), and (d) reflect the corresponding credit rationing arguments.

Table 4 - 2 reports multiple regressions of each of the terms of lending on the level of deposits of the lending bank, total assets of the borrower, and a shift constant. For purposes of testing the hypothesis, separate slopes were estimated for the variables in each of the two surveys. The total number of observations is on the order of 5000 and all regressions are significant at the .01 level.

Part (a) of hypothesis 5 is accepted. Inspection of the loan rate of interest regression reveals that in 1957 borrowers had to pay higher rates of interest. This conclusion is true because the coefficient of the shift constant is significantly positive and the asset elasticity of the loan rate of interest is significantly less negative. The change in asset elasticity implies in addition that the interest rate differentials between small and large borrowers were smaller in 1957. Acceptance of part (a) of hypothesis 5 is consistent with the conventional theory of the loan market and the availability of credit doctrine.

Parts (b), (c), and (d) of hypothesis 5 are rejected. First, coefficients of C_{57} are not significantly different from zero in the case of the maturity and dummy security variable regressions. In the amount regression, the coefficient of C_{57} is significantly positive

TABLE 4 - 2

Partial Loan Offer Functions Estimated From the
1955 and 1957 Federal Reserve Surveys of Business Loans¹

Dependent Variable	R ²	Constant	C ₅₇	Log D ₅₅	Log D ₅₇	Log H ₅₅	Log H ₅₇
Log R	.255	1.31579 .97374	.089367 * (.0054164)	.0033392 (.0021005)	-.0013864 (.0023366)	-.065526 * (.0019706)	-.037387 * (.0018213)
Log M	.007	1.3639 .066015	.052545 (.031816)	-.0031113 (.012339)	-.0006963 (.013726)	.033151 * (.011565)	.029188 * (.010698)
Log A	.591	5.49229 -.24335	.22165 (.034309)	.074922 * (.013306)	.070752 * (.014801)	.63757 * (.012483)	.68951 * (.011537)
Log S	.018	7.7280 .50698	.0006333 (.030988)	.043566 * (.012018)	.023140 (.013368)	-.071970 * (.011274)	-.076586 * (.010420)

* implies significance at the .025 level.

¹Definitions of the independent variables in Table 4 - 2 are as follows. A loan made in 1955 would have D₅₅ = D, D₅₇ = 1, H₅₅ = H, H₅₇ = 1, and C₅₇ = 0. Similarly, a loan made in 1957 would have D₅₅ = 1, D₅₇ = D, H₅₅ = 1, H₅₇ = H, and C₅₇ = 1.

implying that at least some borrowers could obtain larger loans in 1957, contrary to the availability argument.

Second, none of the three asset elasticities changed in such a way as to bear out the hypothesis. The 1957 asset elasticity of maturity is not significantly different from the corresponding 1955 elasticity. The asset elasticity of amount is significantly higher in 1957 than in 1955, contrary to the availability doctrine. A borrower of a given size could obtain larger loans in 1957 than in 1955. The asset elasticity of the dummy security variable is not significantly different in the two periods.

As observed previously, business conditions were deteriorating in October 1957. This deterioration should have changed the coefficients of C_{57} and H in precisely the direction suggested by the doctrine. The failure of the levels version of the availability doctrine is thus even more conspicuous.^{1,2}

In Chapter 2, it was observed that bankers believed that credit rationing had not appreciably reduced the growth in their loans. Their view is consistent with the outcome of tests of hypothesis 5.

¹The regressions in Table 4 - 2 suggest that the trade-offs between the loan interest rate and other terms of lending changed between the two surveys. Table 5 - 3 in the subsequent chapter reports that nonrate terms were relatively more important in 1957. But if all borrowers obtained credit at the same or better terms (with the exception of the loan rate of interest), this observation is of little value as an explanation of the effectiveness of monetary policy.

²Professor Henry Wallich has verbally suggested an explanation of the above results consistent with the availability of credit doctrine. He argues that bankers normally tend to become more liberal lenders as the economy moves further away from a previous recession. If banks were unusually conservative lenders in 1955 because of the 1953-54 recession, then the arguments in the text must be qualified. I do not share this view.

Hypothesis 6 is also rejected. No deposit elasticity changed significantly in the two year period. In other words, there is no evidence that borrowers from large or small banks bear the burden of higher competing (bond) interest rates more heavily.

4 - 4. Summary

The analysis presented in Chapter 4 differs from that in the preceding section in two essential respects: (1) it was not limited to a consideration of term loans and (2) differences in lending policies between banks could be described to some extent.

Total assets of the borrower is positively related to the maturity and amount of a loan and negatively related to the loan rate of interest and the security dummy variable. Borrowers who reside in the same metropolitan area as the lending bank apparently borrow at lower rates of interest and with a smaller frequency of security than other borrowers. Some doubt about the meaning of borrower location is introduced by a negative relationship between B and loan maturity. Further research on the significance of borrower location is needed.

The level of deposits of the lending bank is positively related to the loan rate of interest and the security dummy variable. This behavior is associated with the greater relative deposit variance of larger banks. Banks are assumed to derive disutility from high deposit variance.

An interesting result is that the business loan ratio is positively related to the maturity and size of new business loans. Apparently, differences in bank specialization are more important for

describing lending behavior than are notions of portfolio balance. Because of the imprecision of the measure of the loan ratio, this conclusion should be verified in another study.

Higher levels of interest rates on competing assets are associated with higher loan rates of interest. Contrary to one version of the availability of credit doctrine, higher rates of interest on competing assets are not associated with certain forms of credit rationing, i.e., shorter loan maturities, smaller sized loans, or an increased likelihood of security. There is no evidence that borrowers from large banks or small banks bear the burden of higher competing interest rates more heavily.

CHAPTER 5
ESTIMATION OF THE LOAN OFFER FUNCTION
WITH CANONICAL CORRELATION

This chapter reports attempts to estimate directly a commercial bank loan offer function with canonical correlation.¹ Substitution between terms of lending is explicitly considered when this technique is employed. One measure of the degree to which substitutability exists among terms of lending is the amount by which the canonical correlation exceeds the largest multiple correlation of the previous partial offer functions. Unfortunately, no probability statement can be made about whether the difference between these two correlations is significantly greater than zero.²

The theory in Chapter 1 suggests that for similar borrowers the loan rate of interest should increase as the amount or maturity of a

¹See p. 27.

²The reader may object that this rather elaborate statistical procedure is just a ruse; examination of the partial correlation coefficients of the residuals of the partial offer functions would be equally satisfactory. The error in this objection is that partial correlation coefficients are not jointly determined with other parameters, as the theory requires. The signs of estimated partial correlation coefficients will depend critically on whether the function has been properly specified. Variables such as net worth and debt of a borrower have been omitted, thereby misspecifying the function. In fact, partial correlation coefficients were estimated for regressions reported in tables 3 - 2 through 3 - 5 and table 4 - 1. The signs of the coefficients were not in accordance with a priori expectations.

loan increases and should be lower if security is supplied. Also, for similar borrowers the maturity of a loan should be shorter if the amount of the loan is larger and should be longer if security is offered. Finally, the amount of money a bank will be willing to lend to a particular borrower should increase if security is proffered.¹

Table 5 - 1 reports canonical correlations for each of the three banks considered in Chapter 3.²

The hypotheses about terms of lending are supported by the reported coefficients (canonical weights) with the exception of the dummy security variable. That variable has limited economic meaning and it is not surprising that its canonical weight did not always possess the predicted sign.

The coefficients suggest that if a borrower with given characteristics requests a longer maturity loan, a more than proportionate reduction in amount will be necessary to compensate the bank, given other terms of lending. On the other hand, requests for either longer maturity loans or larger loans may be compensated for with a relatively small increase in the loan rate of interest. The rankings of the three coefficients are identical in the case of each of the three banks.

¹The theory is informally tested in this chapter by the degree of conformity of signs of canonical weights to these a priori expectations.

²Numbers in tables 5 - 1, 5 - 2, and 5 - 3 differ from those in true canonical equations by a constant of proportionality. As the analysis only concerns ratios of coefficients, comparisons will be more easily made if the equations are normalized. The value of the canonical correlation is invariant to such transformations.

TABLE 5 - 1

Canonical Correlations From Samples of Term Loans

Variable ¹	Bank 1	Bank 2	Bank 3
(Log R)'	1.0000	1.0000	1.0000
(Log M)'	-.053203	-.086959	-.070112
(Log A)'	-.012387	-.052804	-.032025
(Log S)'	-.015547	.000069	-.0013735
Canonical Correlation (Squared)	.799	.852	.796
(Log P _m)'	-.031719	-.022617	-.075585
(Log P _p)'	-.029489	-.052602	-.069635
(Log C)'	-.014137	-.011387	.018826
(Log E)'	-.0037316	-.0022580	.0049976
(Log Y)'	.0044043	.0027871	-.040074
(Log \bar{R})'	.97548	1.12284	.91374
(Log P _m /H)'	-.0043322	.060639	.043162
(Log P _p /H)'	-.0049697	.0015566	.033827

¹Primes (') on variables indicate that they are defined as deviations from their means.

Among the borrower characteristics, only profit variables have the same sign for all three banks. Coefficients of bank 1 and bank 2 have identical signs with the exception of the profit rate variables. Table 3 - 5 reports that the latter are significantly related to S . The coefficients of S have different signs for the two banks.

In the cases of banks 1 and 2, coefficients of negative profits P_m and years as a depositor Y have signs which are not consistent with the previous hypotheses. Difficulties with P_m are again believed to be associated with misspecification. Coefficients of Y are not significant in the regression analysis for banks 1 and 2 and are interpreted to be spurious.

For bank 3, the coefficient of Y possesses the hypothesized sign, confirming the significance of this variable in the regression analysis. Because profit rates and balances are not significant in regressions for this bank, wrong signs are not surprising. The sign of the coefficient of the current ratio apparently derives from the fact that the coefficient of C is positive in table 3 - 2. Because rate equations tend to dominate the coefficients in table 5 - 1, the positive coefficient in table 3 - 2 outweighs the corresponding coefficient of C in table 3 - 3. No plausible explanation of the sign of this coefficient is obvious.

The squared canonical correlations exceed the largest previous R^2 by .031, .051, and .056 for banks 1, 2, and 3 respectively.

Table 5 - 2 reports canonical correlation results for the 1955 sample of loans collected by the Board of Governors of the Federal Reserve System.

TABLE 5 - 2

Canonical Correlations From Cleveland '55 Sample

Variable	Weight
(Log R)'	1.0000
(Log M)'	-.036209
(Log A)'	-.38171
(Log S)'	.066075
Squared Canonical Correlation	.547
(Log D)'	-.013906
(Log L)'	-.049349
(Log H)'	-.31442
(Log B)'	-.0089774

The table demonstrates that all a priori predictions about trade-offs between terms of lending are verified. Again the coefficient of S should be regarded with some skepticism.

In the case of the Federal Reserve sample, increases in requested loan maturity by borrowers of a particular size are associated with less than proportionate decreases in loan amount, given other terms of lending. Apparently the reason for the difference between this result and the preceding term loan coefficients exists because the average business loan has a very short maturity. Doubling of average commercial

and industrial loan maturities might involve extending maturities six months. In the case of term loans, however, a doubling of loan maturities might extend loans one to five years.

A substantial rise in the loan rate of interest is associated with requests for larger loans by borrowers of a particular size. This contrasts with the previous term loan result. Apparently interest rate differentials are more frequently used to compensate bankers for large risks in the commercial and industrial loan market than in the more restricted market for term loans. One reason for this behavior may be that term borrowers are relatively large firms having access to other sources of financing if bank rates rise too high. Consequently, banks obtain safety by reducing the maturity of loans to individual term borrowers. Other conditions of borrowing also compensate banks which do not charge large interest rate risk differentials. Term loan agreements usually require borrowers to keep some minimum level of working capital.

As in the case of term lending, only modest increases in interest rates are needed to compensate banks for increases in loan maturity, given borrower size and other terms of lending.

The coefficients of bank and borrower characteristics possess the hypothesized signs with the exception of deposits of the lending bank D . As explained in the previous chapter, D is necessarily correlated with A because of maximum legal lending limits established by bank inspectors. Because the amount regression tends to dominate the canonical equation, the coefficient of D has the negative sign.

The increase in the squared canonical correlation over the R^2 of the amount regression was .034.

TABLE 5 - 3

A Comparison of Canonical Correlations Computed From
Cleveland 1955 and Cleveland 1957 Samples

Variable	Weights	
	1955	1957
(Log R)'	1.00000	1.00000
(Log M)'	-.033975	.011718
(Log A)'	-.38626	-1.67200
(Log S)'	.065991	.46584
Squared Canonical Correlations	.546	.664
(Log D)'	-.041459	-.170110
(Log H)'	-.58216	-1.90516

Table 5 - 3 presents comparable canonical equations estimated from Cleveland district member banks in the 1955 and 1957 Federal Reserve surveys. There appear to have been three interesting changes between the two surveys. First, the weight placed on the loan interest rate relative to other terms of lending declined, consistent with the change in the asset elasticity reported in table 4 - 2. I suspect that some advocates of the availability of credit doctrine perceived

this relative change and inferred that this was the mechanism by which monetary policy became effective. However, as reported in Section 4 - 3, this inference is incorrect because there is no evidence that any size of borrower was forced to accept either a smaller loan, a shorter loan,¹ or a higher frequency of security in 1957 than in 1955. Possible explanations of this change include proximity of rates to maximums specified by usury laws, growing criticism of high loan rates, etc.

Second, the canonical correlation was substantially higher in 1957 than in 1955. Lending behavior of banks could be more precisely predicted in 1957 from a knowledge of an applicant's total assets and a bank's level of demand deposits. One possible explanation of this greater precision is that as interest rates rose and loan portfolios grew, banks made fewer loans for noncredit reasons--i.e., loans motivated by competition for a new customer or loans to old "friends of the bank," etc.

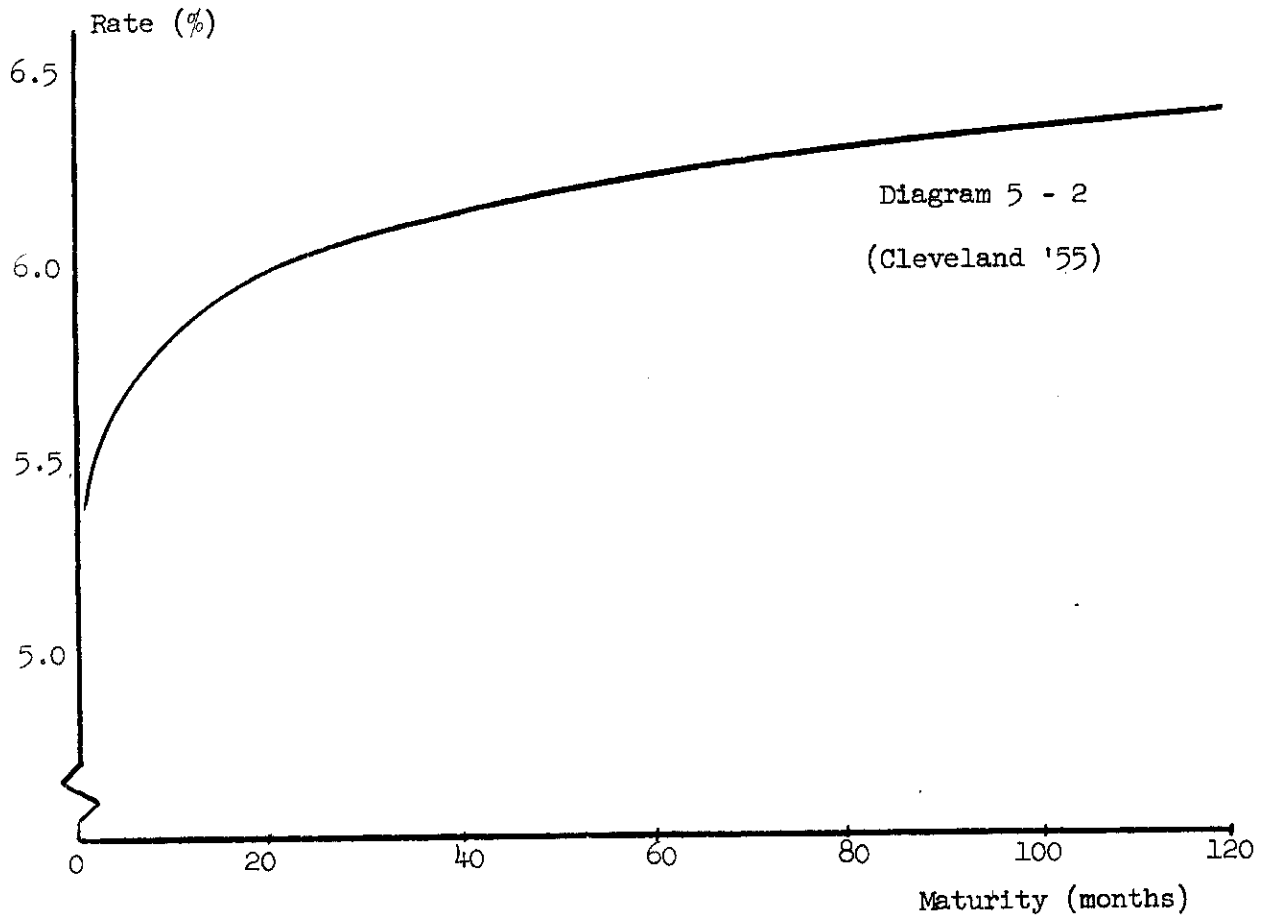
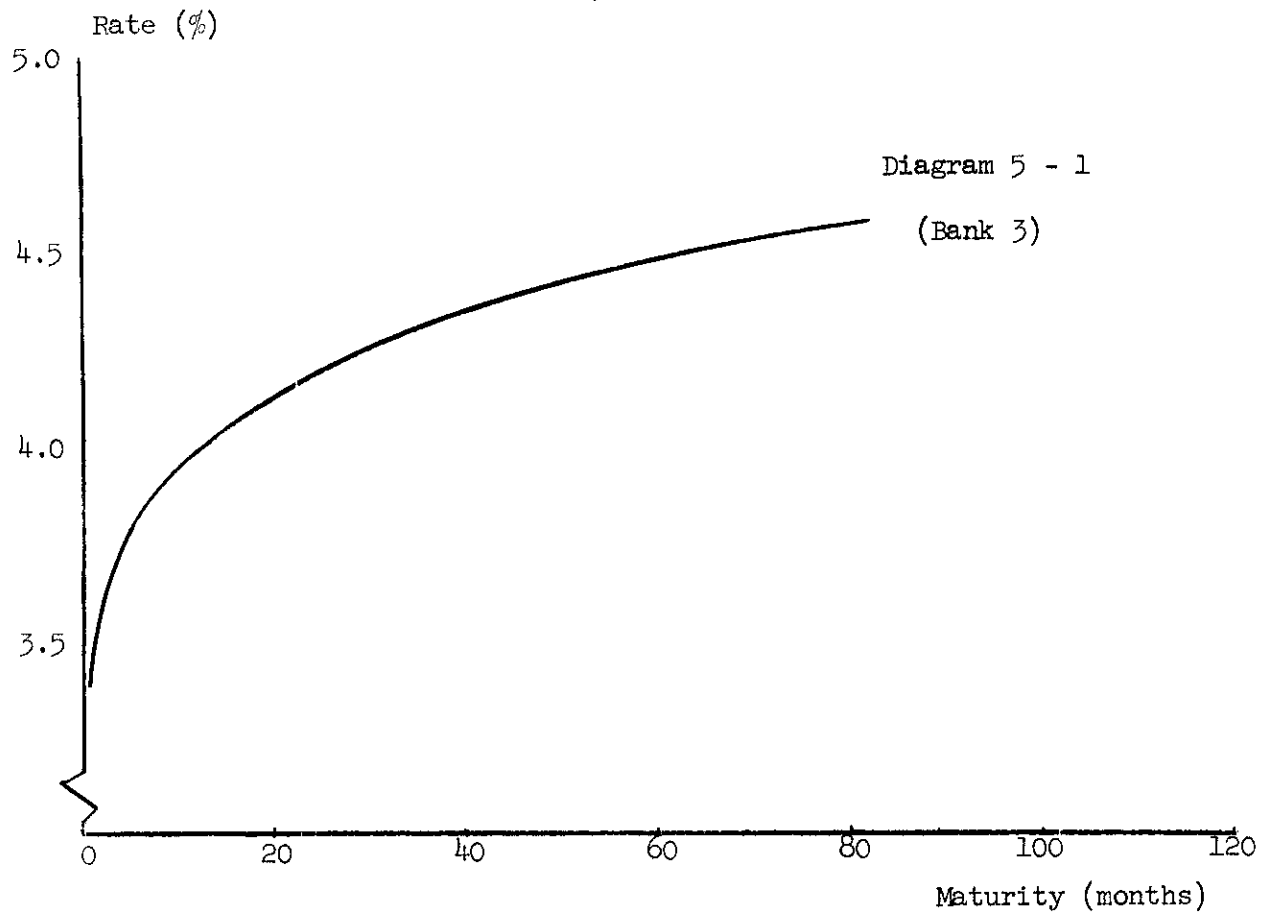
Finally, the weight on loan maturity changed signs. As the weight on this variable in both equations is very small, this result probably should not be regarded too seriously. If the change actually occurred, it implies that banks viewed maturity as a desirable property. One explanation is that if banks expected loan interest rates to drop in the near future, they could improve their future earnings by lending at longer maturities. Further evidence is necessary before this conjecture can be accepted.

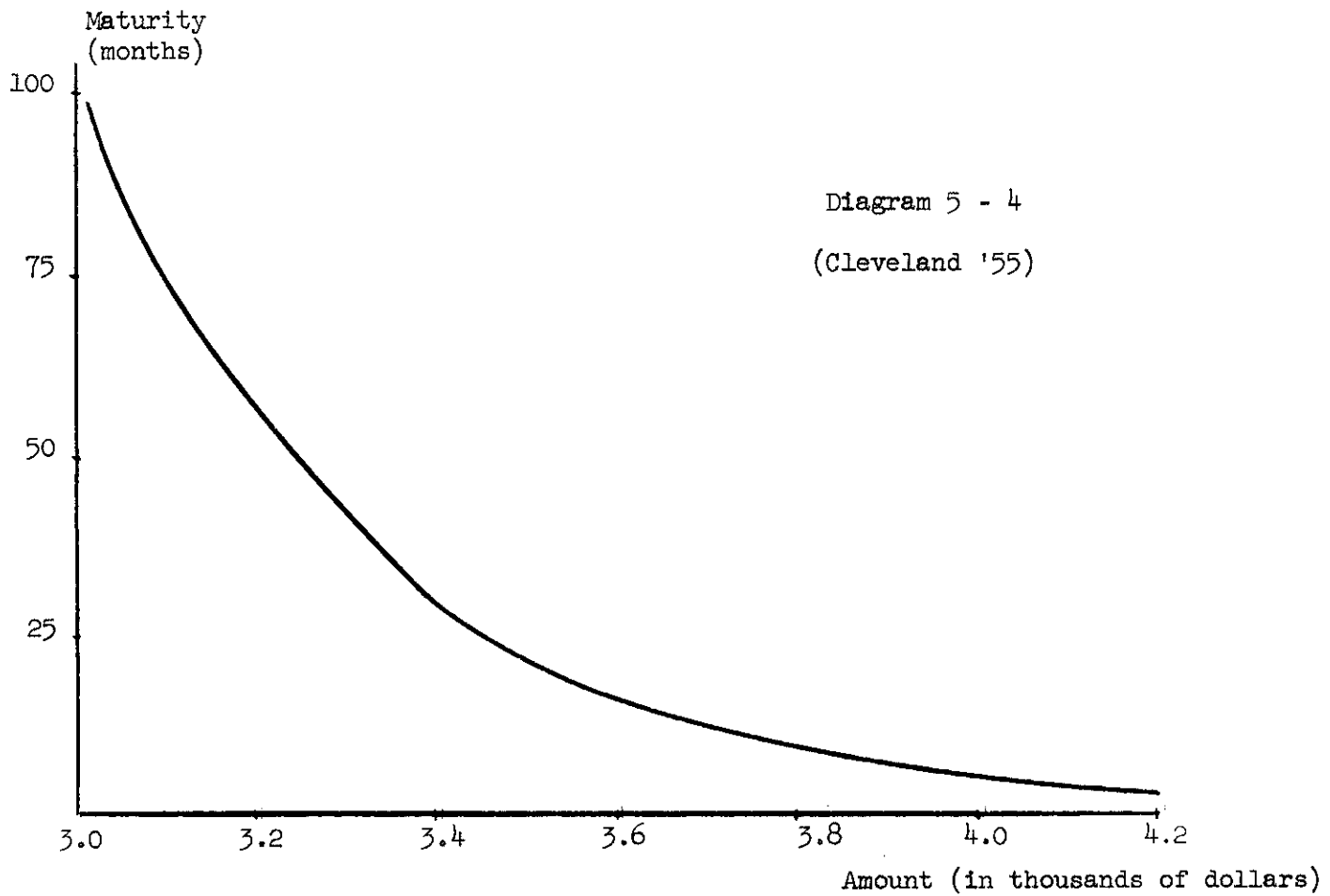
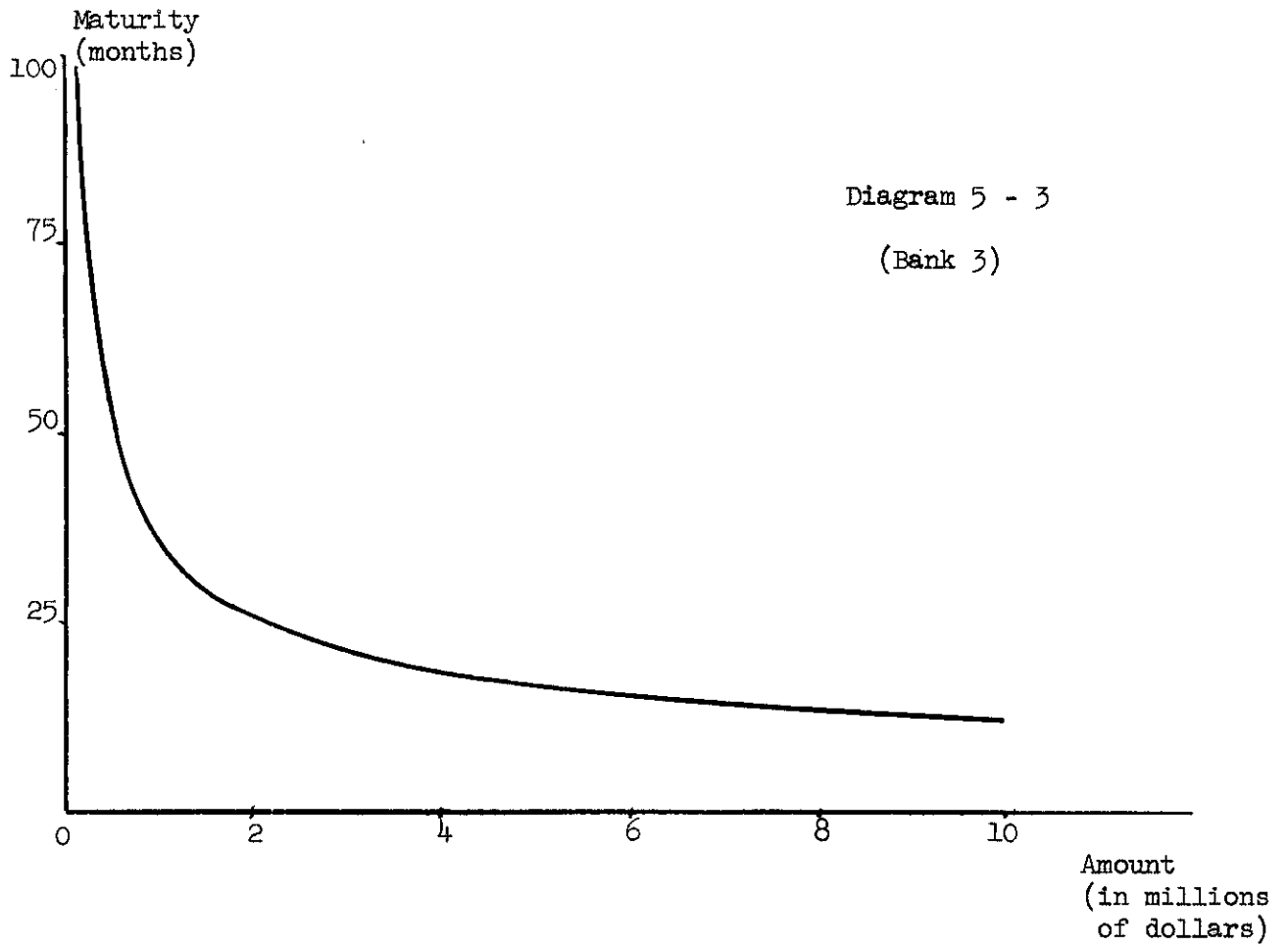
¹The coefficient of \bar{R} in maturity regressions in Chapter 3 is an exception. This point is considered again in Section 6 - 3.

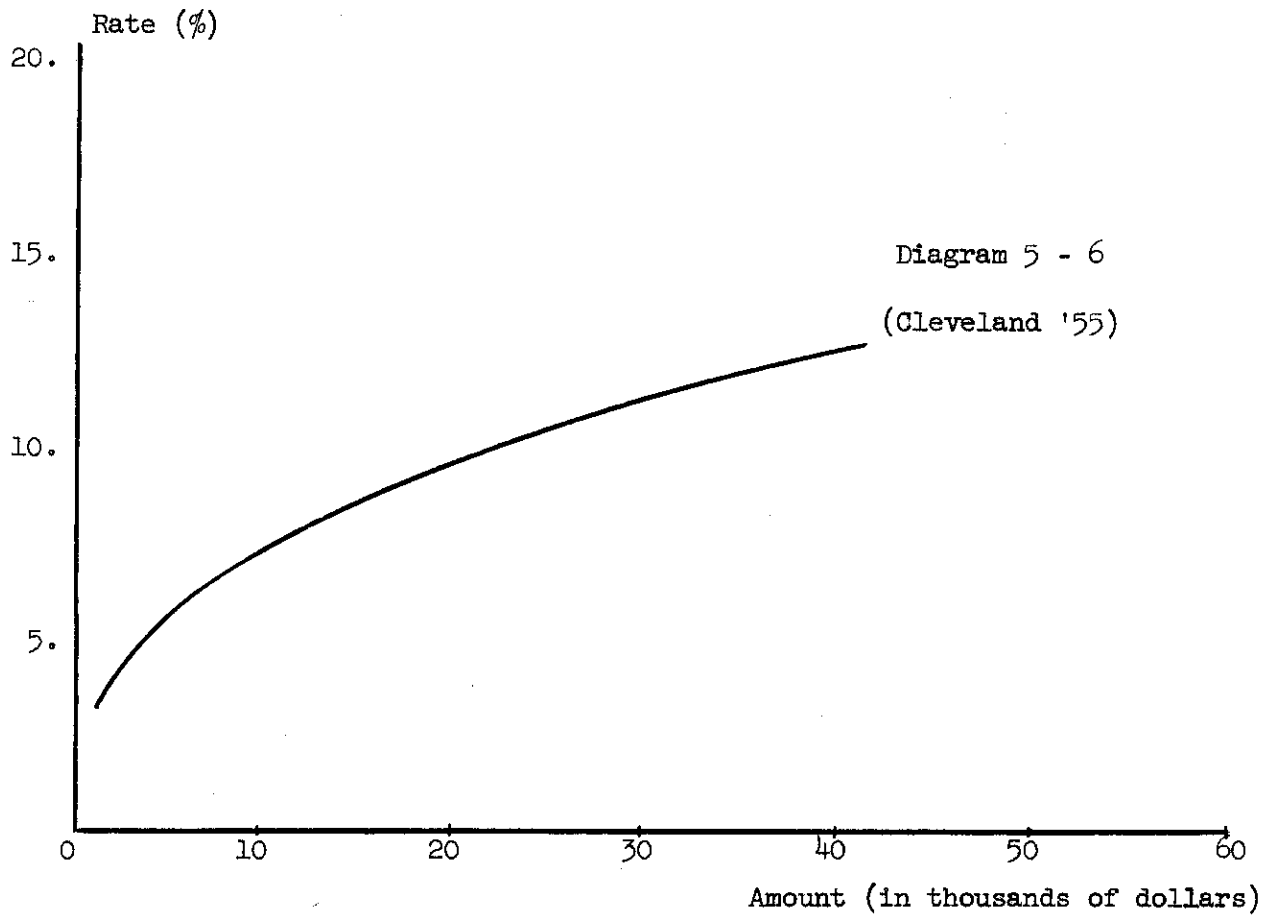
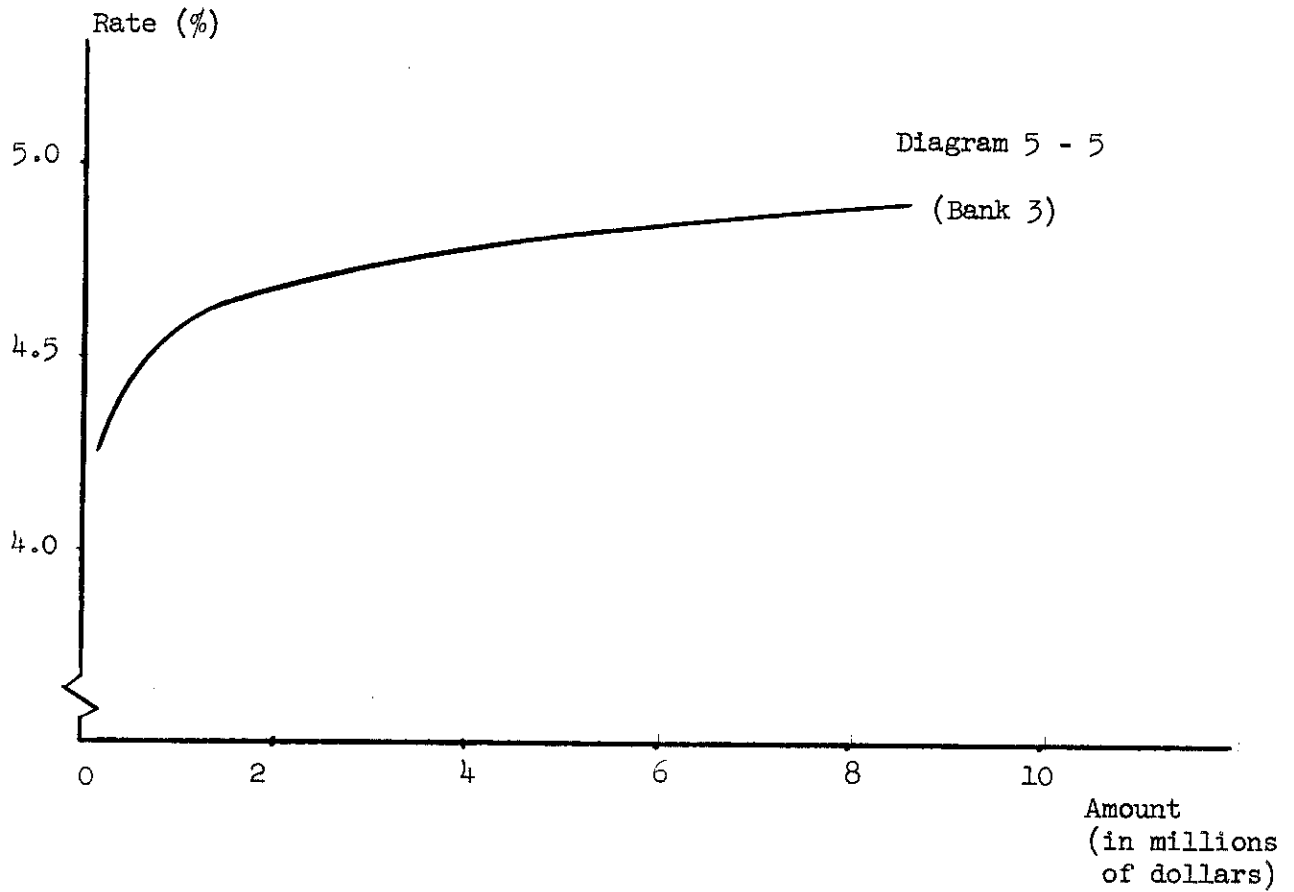
The squared canonical correlations exceeded the corresponding R^2 of the amount regressions by .034 and .018 in 1955 and 1957 respectively.

Diagrams 5 - 1, 5 - 3, and 5 - 5 show the trade-off between the loan rate of interest, maturity, and amount when all other variables are valued at their sample means for the canonical equation of bank 3 in table 5 - 1. Diagrams 5 - 2, 5 - 4, and 5 - 6 demonstrate the corresponding trade-offs for the equation reported in table 5 - 2.

In conclusion, Chapter 5 has presented estimates of commercial bank loan offer functions. The signs and magnitudes of reported coefficients are, in general, consistent with a priori expectations and tend to verify the reasoning in Chapter 1. The coefficients reflect forces revealed in multiple regressions reported in Chapters 3 and 4. The magnitude of increase in the canonical correlation over the largest previous multiple correlation is on the order of .04 and suggests that some substitution among terms of lending is permitted by bankers.







CHAPTER 6

SUMMARY AND POLICY IMPLICATIONS OF THE ANALYSIS

This chapter summarizes research reported in this thesis in Section 1. Policy implications of the analysis are reported in Section 2, and Section 3 reports on the relevance of the findings to the availability of credit doctrine.

6 - 1. Summary of the Analysis

In Chapter 1 a theory was proposed to explain the terms at which a bank with particular characteristics would lend to a loan applicant.

Certain simplifying assumptions were made in order to develop the theory. First, it was assumed that broad asset choices between bonds, loans, and cash could be generally ignored. Second, it was assumed that the services of banks as consultants or sources of information could be ignored. Third, deposit structure, equity, management, etc. of any bank were assumed to be fixed. Finally, the loan market was assumed to be imperfect.

A loan offer function was defined to be a relation which specifies the terms at which a bank with particular characteristics will be willing to lend to a borrower with a known profit, balance sheet, and credit history and particular prospects for the future.

It was then possible to speak of characteristics of an applicant and characteristics of a bank defining some maximum or efficient set of terms of lending. Four principal terms of lending were considered: (1) the loan rate of interest, (2) the loan maturity, (3) the amount of the loan, and (4) the likelihood of security. Effective bargaining by borrowers was assumed to force bankers to this efficient frontier. Banks were hypothesized to be willing to substitute among terms of lending. Thus longer maturity loans might be obtained by paying higher interest rates and/or accepting smaller amounts of money and/or by offering security. Relationships between various borrower and bank characteristics and terms of lending were hypothesized.

The various hypotheses were tested with multiple regression and canonical correlation analysis. Five samples of data were analyzed in addition to descriptive material obtained from a survey by the American Bankers Association. Three of the samples were drawn from term loans granted by three large commercial banks during the period from January 1955 through October 1957. Two other samples were extracted from the massive commercial and industrial loan surveys conducted by the Board of Governors of the Federal Reserve System in October 1955 and again in October 1957.

An applicant's profits, the ratio of his current assets to current liabilities, his deposit balances, the number of years which he was a depositor at the bank, his profit rate, and perhaps his total assets appear to influence significantly the terms at which banks will lend. The size of banks (a proxy for deposit variance), the bank's ratio of commercial and industrial loans to deposits, and the level of the prime rate of

interest also affect the terms at which banks will lend.

Chapter 5 reported that with canonical correlation analysis, it appears that banks do trade off terms of lending in the manner specified by the theory. When a borrower with particular characteristics seeks a longer maturity loan, he must expect either to pay a higher rate of interest and/or receive a smaller amount. The trade-off between these terms of lending and the dummy security variable was not consistently in the direction specified by the theory. In part this failure is associated with the crudeness of the security measure.

6 - 2. Implications of the Analysis for Monetary Policy

Policy implications of the analysis are considered from two points of view: (1) economic efficiency at a point in time and (2) the impact of monetary policy.

It is assumed economic efficiency implies that banks employ their funds so as to obtain a high rate of return and a low probability of bank failure. It is trite to observe that uncertainty of future deposit levels and uncertainty of loan repayment complicates this maximization problem.

There is no a priori reason for doubting that statistics such as a borrower's level of profits, his current ratio, and his profit rate successfully discriminate between safe and risky loans. Further, if the future rate of return of investments can be predicted by past profit and profit rate variables, banks which use these criteria cause capital to flow into high-yielding investments.

Recent proposals have been made to permit commercial banks to pay interest on demand deposits.¹ It has been argued in Chapter 3 that balances have the dual properties of increasing effective interest rates and reducing deposit variance. Amount regressions in Chapter 3 support this argument. The size of term loans granted by banks 1 and 2 to a borrower are an increasing function of his past demand deposit balances. If banks prefer to hold smaller deposit balances as a result of being forced to pay interest on demand deposits, they will not care to make as many large term loans. The proposal must be considered from this perspective also.

It is not obvious that the number of years which a borrower has carried deposits with a bank is a socially desirable criterion for lending. Why is this variable considered? Information about borrowers is not costless. If borrowers supply more information to banks by maintaining a relationship, they have reduced a bank's cost. Criticism of this inertia by bankers is more a criticism of imperfect information flows than a comment on bank efficiency. Eliminating personal relationships between banks and borrowers is not desirable unless some other method of conveying information can be demonstrated to be cheaper.

Although no appraisal of the effectiveness of monetary policy on the level of economic activity can be attempted, the analysis does permit some discussion of the impact of monetary policy on bank lending.

¹Cf. James Tobin, "Towards Improving the Efficiency of the Monetary Mechanism," The Review of Economics and Statistics, XLII (August 1960), pp. 276-278.

Results in Chapter 3 suggest that increases in the prime rate of interest are associated with a shortening maturity of new term loans. Because prime tends to move with other interest rates in the economy, this implies that when monetary authorities permit rates to rise, they are in fact sanctioning a reduction in long term loans. If capital markets are imperfect, these long term borrowers may delay or may not be willing or able to carry out their projects. There arises a definite question as to whether such changes in the capital market are consistent with the objectives of monetary policy.

The American Bankers Association survey reported that real estate and FHA and VA mortgages were decidedly tighter in 1957 than in 1955. This behavior by banks derived partly from rises in interest rates on competing assets while the FHA maintained a ceiling on mortgage rates. The less desirable maturity features of these assets may also have contributed to a reduction in bank ownership. Again a question about the desirability of these portfolio changes must be answered by monetary authorities.

Analysis of the commercial and industrial loan samples in Chapter 4 indicated that although interest rates on these loans rose with other interest rates over the period 1955-57, no other terms of lending were made more restrictive. It was observed that the asset elasticity of the loan rate of interest became significantly less negative over the period. Again a change in capital markets resulted when other interest rates were permitted to rise.

The point of these comments is that monetary policy does alter the composition of flows through the capital market. Until recently,

very little attention has been directed to the character of these changes. The distinction between monetary policy and discretionary governmental controls is not very sharp. Decisions to employ monetary weapons rather than discretionary controls must be evaluated in terms of both the changes in the allocation of resources and the resulting reduction or expansion in aggregate demand.

6 - 3. Implications of the Analysis for the
Availability of Credit Doctrine

The availability literature¹ suggests that either rising or high levels of interest rates will result in credit rationing. No test of short term changes in interest rates could be made in this study. Because the level of interest rates was substantially higher in 1957 than in 1955, the comments of this thesis pertain to the "level" rather than "change" versions of the availability doctrine.

There is some evidence that banks are less willing to grant long maturity term loans when interest rates are higher. Because long maturity loans are inherently more risky, this result might be interpreted as credit rationing. Whether this behavior derives from changes in competing interest rates, higher levels of competing interest rates, or simply a growing proportion of loans in a bank's portfolio can not be discerned.

Analysis of commercial and industrial loans revealed that borrowers of any particular size could obtain loans of at least the same maturity, the same amount, and with the same likelihood of security in 1957 as in 1955.

¹See Chapter 1, Section 4.

If risk is associated with longer maturity, greater amount, or no security, we have the result that identically risky loans could be obtained by borrowers of given means, measured by their total assets, regardless of the level of competing interest rates. There was no credit rationing!¹

This behavior is not consistent with the "level" version of the availability of credit doctrine unless bankers behave in the following peculiar fashion. When a man comes to a bank with a loan request, the banker simply says "yes" or "no"; there is no substitution among terms of lending.

In order to test the availability doctrine ultimately detailed information on loan rejections must also be studied. Unfortunately, this is difficult because a loan rejection is not well defined.

It has been observed earlier, with respect to the American Bankers Association survey, that most bankers felt increased selectivity of lending had not appreciably restricted growth of their lending. This conclusion is supported by a study of large samples of commercial and industrial loans reported in Chapter 4. Although some evidence in support of availability arguments was exhibited in the rather specialized case of term lending, it is doubtful that great reliance can or should be placed on credit rationing.

¹As reported in Chapter 5, there is evidence that bankers were less willing to substitute between the loan rate and other terms of lending. But this change in the relative roles of terms of lending is not an explanation of the effectiveness of monetary policy.

APPENDIX A

An important factor in predicting bank lending is the instability of bank demand deposits. An empirical conclusion of this appendix is that the ratio of the variance of demand deposits to the level of deposits is an increasing function of bank size. Further, growing banks or declining banks will have a smaller ratio than banks which are of unchanging size. Three assumptions are necessary to demonstrate these conclusions.

First, assume that the rate at which transactions (deposits and withdrawals) occur can be represented as a non-linear function of the level of a bank's demand deposits.

$$(1) \quad \frac{dn}{dt} = \alpha D^\gamma \quad \alpha, \gamma > 0 .^1$$

¹Very recently, some evidence has been published suggesting that $\gamma = 1$. If so, the conclusion of this appendix is considerably strengthened. $\gamma = 1$ permits the conclusion that the ratio of the standard deviation of deposit level to the level of deposits is an increasing function of bank size. Then hypotheses in the text of this thesis may be restated in terms of the standard deviation of deposit level instead of variance of deposit level. Cf. "Interpretation of Size-Cost Relationships in Banking," Monthly Review of the Federal Reserve Bank of Kansas City, March 1961, pp. 8 - 9.

where:

$\frac{dn}{dt}$ = number of transactions per unit time.

D = a bank's demand deposits net of interbank and government deposits.

Second, assume that the size of the average transaction is independent of whether it is a deposit or withdrawal and that it is also a non-linear function of the level of demand deposits.

$$(2) \quad s = \beta D^\delta \quad \beta, \delta > 0 .$$

where:

s = the size of the average transaction.

Finally, assume that transactions are distributed according to the binomial distribution with p = the probability that the next transaction will be a deposit, $1 - p$ = the probability that it will be a withdrawal. Growing banks have $p > .5$, declining banks have $p < .5$.

The expected value of the level of deposits at the close of a period T units long is:

$$(3) \quad D_{t+T} = D_t + (2p - 1) \alpha \beta D^{\delta+1} \cdot T .$$

The variance of the distribution of changes in deposits is given by:

$$(4) \quad \sigma^2 = 4T \cdot (p - p^2) \alpha \beta^2 D^{\gamma+2\delta} .$$

A number relevant to this discussion is the turnover rate of demand deposits. In terms of the above, we must express the expected turnover as:

$$(5) \quad R = (1 - p) \alpha \beta D^{\gamma+\delta-1} \cdot T .$$

$$(6) \quad \frac{\partial R}{\partial D} = (1 - p) \alpha \beta (\gamma + \delta - 1) D^{(\gamma+\delta-2)} \cdot T .$$

Because T , $(1 - p)$, α , and β are positive, a necessary and sufficient condition for this derivative to be positive is:

$$(7) \quad \gamma + \delta > 1 .$$

Multiplying (4) by $1/D$ and differentiating with respect to deposits yields:

$$(8) \quad - \frac{\partial \frac{\sigma^2}{D}}{\partial D} = 4(p - p^2) \alpha \beta^2 (\gamma + 2\delta - 1) D^{\gamma+2\delta-2} \cdot T .$$

Because $(p - p^2)$, α , and T are positive, a necessary and sufficient condition for (8) to be positive is that $\gamma + 2\delta > 1$. Because $\delta > 0$, if (7) holds the result is proven.

TABLE 1

Average Demand Deposit Turnover Rate, 1956 *

Banks in	R
(a) New York City	45.8
(b) 6 other centers **	28.8
(c) 337 other reporting centers	21.8

*The Federal Reserve Bulletin, XLIV (April 1958), p. 446.

**Boston, Philadelphia, Chicago, Detroit, Los Angeles, San Francisco.

It is well known that the average bank size in New York City, in terms of volume of deposits, is the largest in the United States. It is also quite clear that the average bank size in the six other large centers exceeds that in 337 other reporting centers. Assuming all other things are equal,¹ this implies that (7) holds.

Consequently, the first result is demonstrated. The second result follows directly from (8) because $(p - p^2)$ will be a maximum when $p = .5$.

Introducing stochastic terms in equations (1) and (2) does not seem to qualify seriously the conclusion of the appendix. The result will depend upon the sign and magnitude of the covariance of these terms. There does not appear to be an obvious a priori reason for rejecting the assumption that their covariance is zero.

Finally, no cognizance of the important retention rate of transactions by a bank has been made in this appendix. If the bank being considered is a monopoly bank, then all the withdrawals will later appear as deposits and the instability of deposits reduces to fluctuations in the bank's float. On the other hand, if the bank expects that all checks drawn on it will never again appear as deposits, then variance of deposits

¹In particular, it is assumed that there are no aggregation effects in the consolidated turnover statistics. This means that a bank of a particular size in New York will have the same turnover experience as a similar sized bank in another city. There is no obvious way to test this assumption without additional evidence.

is critical. It is assumed that size of bank is not correlated with the retention rate of transactions.

APPENDIX B

This appendix reports procedures used to determine the appropriate functional form of a loan offer function. Partial loan offer functions were estimated from loans made by bank 1 in the period January 1, 1955 through May 31, 1956. Three functional forms were attempted: (1) linear, (2) quadratic, and (3) logarithmic.

Independent variables included in the linear test were the borrower's mean profits, profit rate, years as a depositor, assets, balances at the bank, and current ratio. Dependent variables were $R - \bar{R}$, M , A , and S . When residuals of each of the dependent variables were arrayed according to increasing mean profits, they exhibited a nonrandom character and the linear form was rejected.

Independent variables included in the quadratic test were the borrower's mean profits, mean profits squared, current ratio, assets, years as a depositor, balances at the bank, and profit rate. Dependent variables were the same as in the linear case. When residuals of each dependent variable were arrayed according to increasing mean profits, they again exhibited a nonrandom character and the quadratic form was rejected.

Independent variables included in the logarithmic test were logarithms of P_m , P_p , H , C , Y , \bar{R} , and E . Dependent

variables were logarithms of R , M , A , and S (redefined). When residuals of each dependent variable were arrayed according to increasing values of each of the independent variables, no deviations from randomness were apparent.

On the basis of these results, the loan offer function is assumed to be logarithmic in its arguments.

APPENDIX C

This appendix reports the methods by which the sample of term loans was collected. With letters of introduction from the American Bankers Association, interviews were arranged with officers of a number of commercial banks in the New England and Middle Atlantic states. Of these, six banks agreed to provide data about their loan transactions with unidentified borrowers completed in the period January 1955 through October 1957. Information about term loans was obtained from five of the banks. Only three of the five banks made a sufficient number of loans to permit within bank analysis.

In each of the three banks, an attempt was made to secure information on all term loans granted during the three year period. This was conceptually possible in the cases of banks 1 and 3 where detailed records of all term loan transactions were kept. It proved to be impossible in practice for two reasons: (1) certain files were being used by lending officers at the time of the survey and (2) other files were being revised at the time of the survey. Both kinds of files were unavailable. In both banks, it is estimated that eighty-five percent of the total number was included. It is believed that the omitted loans are not from a different

population than those in the sample.

In the case of bank 2, only records of outstanding term loans were readily available. This implies that loans granted in 1955 which matured before the time of the survey, December 1959, are not generally included in the sample. Similarly, two year term loans granted in 1957 are not generally included. This sampling deficiency makes bank 2 appear to have reduced its willingness to grant long term loans over the course of the three year period. There appears to be no reason for believing that the sample from this bank is distorted in other ways. Information was collected on perhaps sixty percent of the term loans made by bank 2.

The three banks provided data about unidentified borrowers from their credit files and in one instance from standard published sources. The data include information about the financial position of the borrower at the time of the loan, terms of the loan, balances, the borrower's industry, etc.

If the loan rate of interest was tied to prime, it was assigned the rate corresponding to the level of prime when the loan was made. When the rate of interest was graduated, a weighted dollar average rate was assigned.

Of the loans which were reported by the three banks, only about two-thirds were suitable for the regression analysis described in Chapter 3. Observations were discarded when any of the variables were not available in the bank files or if less than three year profit and working capital figures were reported. Firms which were less than three years old were thus automatically excluded. In addition, two other loans were rejected on the basis of being extraordinary in some detail. On a few occasions,

a firm borrowed twice in the three years. In these cases the two loans were averaged together. This screening of observations reduced the number of loans to about 280, with no bank reporting fewer than 60 loans.

APPENDIX D

This appendix reports the intervals within which the variables D , M , H , and L were recorded in the Federal Reserve surveys. Midpoints of the intervals and values assigned open intervals are indicated in the right hand column.

Table 1
Bank Deposits D

Intervals (millions of dollars)	Midpoints (millions of dollars)
2,500 -	4,634 ¹
1,000 - 2,500	1,750
500 - 1,000	750
250 - 500	375
100 - 250	175
50 - 100	75
20 - 50	35
10 - 20	15
2 - 10	6
0 - 2	1

¹For banks having total deposits D equal or greater to 2 1/2 billion dollars, the estimated midpoint was obtained as an arithmetic average of all U. S. banks having deposits in excess of 2 1/2 billion on December 31, 1956. "The Fortune Directory," Supplement, Fortune, LVI (July 1957), p. 24.

TABLE 2

Commercial and Industrial Loan Ratio L

Intervals (percent)	Midpoints (percent)
0 - 10	5
10 - 20	15
20 - 30	25 ¹
30 -	35

¹For banks indicating loan ratios over .30, L was arbitrarily assigned the value .35. Few banks in 1955 had average gross loan to asset ratios in excess of .50. On average, probably .50 of gross loans were made for commercial and industrial purposes. It was estimated that .80 would be a quite high proportion of gross loans to be made for commercial and industrial purposes. The minimum of the interval was .35, the estimated maximum was $.50 \times .80 = .40$, hence the midpoint of .35.

TABLE 3

Total Assets of Commercial and Industrial Firms H

Intervals (thousands of dollars)	Midpoints (thousands of dollars)
100,000 - (1955)	478,000 ¹
500,000 - (1957)	1,367,500 ¹
100,000 - 500,000 (1957)	300,000
25,000 - 100,000	62,500
5,000 - 25,000	15,000
1,000 - 5,000	3,000
250 - 1,000	625
50 - 250	150
0 - 50 (1955)	25
25 - 50 (1957)	38
0 - 25 (1957)	12

¹For firms having total assets equal or greater to 100 million (1955) or 500 million (1957) dollars, the estimated midpoint was obtained as an arithmetic average of all industrial corporation in the United States with total assets greater than 100 or 500 million dollars respectively in December 1956. Ibid., pp. 2-19.

TABLE 4

Maturity of the Loan M

Intervals	Midpoints (months)
1 day - 1 month	.5
1 - 3 months ¹	1.5
3 - 6 months	4.5
6 - 9 months	7.5
9 months - 1 year	10.5
1 - 2 years	18.0
2 - 3 years	30.0
3 - 4 years	42.0
4 - 5 years	54.0
5 - 10 years	90.0

¹A computer programming error caused the midpoint of this interval to be assigned the incorrect value 1.5 instead of 2. This error is not believed to have seriously biased the statistical analysis. The use of midpoints is probably a more serious source of error.

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