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Lending limits and the availability of credit to agricultural borrowers

Dennis Michael Debrecht
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LENDING LIMITS AND THE AVAILABILITY OF CREDIT TO AGRICULTURAL BORROWERS

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Lending limits and the availability of credit to agricultural borrowers

by

Dennis Michael Debrecht

A Dissertation Submitted to the
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TABLE OF CONTENTS

CHAPTER I. INTRODUCTION

Commercial banks are an important source of credit for agricultural borrowers. Over the past three decades, the volume of farm debt held by commercial banks rose from $3.8 billion in 1950 to $53 billion in 1979. Most of this increase took place over the last decade, particularly since 1975, as farm debt owed to banks rose at a 10.5 percent annual rate. However, farm debt owed to all other institutional lenders rose at a 17 percent annual rate since 1975. Because of the slower growth in bank lending, the market share of farm debt owed to banks declined sharply from 40 percent in 1975 to 33 percent in 1979. That is the smallest market share for banks in the post-World War II era. Banks' market share had been as high as 50 percent in the early 1950s.

Part of the loss in market share is due to competitive imbalances that favor other lenders. The Farm Credit System, a prime competitor of agricultural banks in the farm loan market, has a competitive edge because of its exemption from usury ceilings and its tax advantages. Government agencies that lend to farmers (Commodity Credit Corporation, Farmers' Home Administration, and the Small Business Administration) also have those advantages, plus recent mandates from Congress and the Administration provide for special loans to farmers from those government agencies. Loss in market share also is tied to liquidity pressures that began building at banks in the late 1970s, particularly at rural banks. Evidence of liquidity pressures at rural banks usually appears as a rise in loan-to-deposit ratios. Ratios at agricultural banks rose sharply in recent years as banks tried to meet strong loan demand while growth in sources of funds slowed. Loan-to-deposit ratios at agricultural banks averaged 67 percent in 1978, compared with averages of 54 to 56 percent in the early 1970s.

Third, loss in market share is related to the legal lending limits on the maximum that banks can extend to individual borrowers. Legal lending limits differ for nationally and state-chartered banks. For nationally-chartered banks, the legal limit is 10 percent of a bank's capital and surplus account. For state-chartered banks, the limit varies from 15 to 20 percent of a bank's capital and surplus account.

As credit demands of individual borrowers have increased and pressed against lending limits, banks have potentially been restricted in their ability to service those customers. In a recent survey by the Federal Reserve Bank of Chicago, only 4 percent of the agricultural banks in the Seventh Federal Reserve District reported they had fewer customers with credit needs in excess of the bank's lending limit than five years earlier. Nearly 50 percent of the agricultural banks in the Seventh Federal Reserve District had lending limits of $100,000 or less, which would prove quite restrictive for the borrowing requirements of many farmers in the Midwest. A similar study (Riffe, 1979), examined lending limits in Texas, where farm size and borrowing requirements are larger than in the Midwest. The results of that study showed that roughly half of the agricultural banks in Texas had loan limits below $200,000.

The trend of increasing individual borrowing requirements appears as if it will continue in the future. The continuing decline in farm numbers in the 1970s, along with the rapid growth in the prices of purchased inputs, has led to growth in farm debt and to a greater concentration of debt. Preliminary indications (Benjamin, 1980) are that per-farm debt among units with annual sales of $20,000 or more may be close to $200,000. Debt-to-asset ratios also rose from 9.2 percent in 1950 to 18 percent in 1979. With the decline in farm numbers, the average size farm in the United States also increased over this time span, from 216 acres in 1950 to approximately 490 acres in 1979. Thus, fewer farmers farming larger units, inflation in input prices, and a trend to heavier use of debt by farm operators, combine to generate larger credit volume requests by individual borrowers.

Matched against this growth in borrowing requirements is a slower growth in bank capital at rural banks. Growth in rural bank capital has averaged 6 percent annually in the 1970s. Thus, with capital at rural banks growing more slowly than the demand for credit, the increased borrowing needs of agriculture have pressed against the lending limits that banks can extend to individual borrowers.

If a rural bank cannot satisfy agricultural loan demand because of lending limit problems, then typically the rural bank has incorporated loan participations with correspondent banks to meet overline requests. In general, both the rural bank and the correspondent bank carry portions of the loan, with the correspondent bank compensated by demand balances held on deposit by the rural bank. However, several studies (American Banker's Association, Benjamin, Federal Reserve Board of Governors) have shown that these loan participations are costly and detrimental to rural banks in that a net outflow of funds, rather than a net inflow, has resulted. It has been estimated (by the American Banker's Association, 1976) that rural banks hold $4 in balances to every $1 they receive in loan participations from urban banks. The American Banker's Association concludes that because of this outflow of funds, rural banks experienced a decline in their profitability levels when they employed correspondent loans.

With present lending limit regulations, the potential for unsatisfied loan demand by farm customers exists. If so, then rural banks will be engaged in a form of credit rationing over which they have no control. With ever-increasing farm sizes, the credit rationing problem could become even more crucial in the future, especially if that farm size growth is accompanied by slow growth in bank capital.

The purpose of this study is twofold: (1) to develop a simple theoretical market model that incorporates and investigates the effect of legal lending limits on the ability of rural banks to accommodate loan demand; and (2) to provide empirical evidence concerning the effects of lending limits on the availability of credit to agricultural borrowers. The analysis will be confined to an investigation of the ability of banks to internally satisfy loan demand. No formal analysis will be made of the role that external lending arrangements through correspondent balances play in satisfying credit requests of farmers.

Chapter II reviews some of the literature on lending limits, credit rationing, bank capital growth, and trends in farm size that is relevant to the issue of credit accommodations to farm firms, while Chapter III presents a theoretical model that incorporates lending limits, bank capital growth and changes in the size structure of farms. Chapter IV contains an empirical adaptation of the theoretical model developed in Chapter III and Chapter V contains empirical evidence regarding the effects of lending limits on the availability of credit to agricultural borrowers. Finally, Chapter VI provides the conclusions and summary of the study, and offers some insights into possible policy prescriptions for the banking sector.

CHAPTER II. REVIEW OF LITERATURE

In this chapter, a review of the literature on lending limits and their relationship to credit rationing is presented. The first section of this chapter contains a review of the legal basis for lending limits. Then, two Federal Reserve studies which present factual data on lending limits are examined. The last section discusses some topics related to the lending limit problem--credit rationing, farm size growth, and bank capital adequacy. A summary and critique is then presented on the lending limit studies and the other applicable literature.

Legal Statements on Lending Limits

Legal lending limits establish the maximum loan amount that a bank can extend to a single borrower. By fixing ceilings on the amount of credit an individual borrower may receive, bank regulators can cause banks to spread loans among a larger number of borrowers than would be the case without loan limits. The primary purpose of this loan diversification through lending limits is depositor protection.

Lending limits differ for state and nationally chartered banks. The Comptroller of Currency imposes the limits on national banks, while state agencies establish the limits for state banks. Table 2.1 shows the variations in basic legal lending limits for banks in Seventh-Federal-Reserve-District states. For example, Table 2.1 shows that for state chartered banks in Iowa, the legal lending limit is 20 percent of a bank's common stock, preferred stock, and surplus account. The dollar amount of lending limits is found by multiplying the applicable percentage by the dollar value of a bank's eligible capital account. The applicable percentage and the accounts that can qualify as part of a bank's capital base vary with the regulatory agency.

There are exceptions and additions to the basic lending limits given in Table 2.1. For example, at national banks, loans guaranteed by government agencies such as Farmers Home Administration or Federal Housing Administration are exempted from lending limits. In terms of additions which can be made to the basic lending limits, national banks can lend the equivalent of up to a fourth (rather than a tenth) of their eligible capital base to a single borrower, provided the funds are used to buy feeder livestock and the livestock securing the loan is worth at least 15 percent more than the loan. Similar provisions are available for loans on commodities, such as grain, that are secured by warehouse receipts.

Table 2.1. Variations in Basic Legal Lending Limits for Banks in Seventh-Federal-Reserve-District states[a] (Benjamin, 1981, p. 21)

	Applicable percentage	Eligible capital accounts
Nationally chartered banks	10	Common stock, preferred stock, surplus, subordinated notes and debentures,[b] undivided profits, one-half of reserve for loan losses, reserve for contingencies
State chartered banks Illinois	15	Common stock, preferred stock, surplus
Indiana	15	Common stock, preferred stock, surplus, subordinated notes and debentures[b]
Iowa	20	Common stock, preferred stock, surplus
Michigan	20[c]	Common stock, preferred stock, surplus, subordinated notes and debentures[b]
Wisconsin (the higher of)	15	Common stock, preferred stock, surplus, subordinated notes and debentures[b]
	or 20	Common stock, surplus

[a]The legal lending limit is equal to the applicable percentage times the sum of the dollar value of the eligible capital accounts.

[b]Subordinated in right of payment to the claims of depositors.

[c]With the approval of two-thirds of the bank's board of directors, otherwise it's 10 percent.

Empirical Evidence on Lending Limits

There has been little work on developing and empirically testing models that incorporate the effects of lending limits on credit allocation in rural areas. Although empirical analyses are lacking, some work has been completed which brings to light the problems that rural banks have faced because of legal lending limits. One study concerning rural banking problems in the Seventh Federal Reserve District[1] was conducted by Gary Benjamin (1980) at the Federal Reserve Bank of Chicago. Another study on rural banking problems in Texas was undertaken at the Federal Reserve Bank of Dallas by Don Riffe (1979).

Benjamin study

Benjamin (1980) addresses the problem of legal lending limits for banks in the Seventh Federal Reserve District. He also considers other problems facing agricultural banks, such as liquidity problems.

Benjamin states that developments during the decade of the 1970s support the view that individual legal lending limits have increasingly handicapped rural banks in their efforts to finance farmers. He cites a 1978 survey conducted

[1]The Seventh Federal Reserve District includes Iowa and most of Illinois, Indiana, Michigan and Wisconsin.

by the Federal Reserve Bank of Chicago which shows that only four percent of the agricultural banks in the Seventh Federal Reserve District reported they had fewer customers with credit needs in excess of the bank's lending limit at years end 1977 than at years end 1972. More than half of the agricultural banks in the district reported they had more farm-loan customers with credit needs exceeding the bank's lending limit in 1977 than in 1972.

Two of the factors which have contributed to this credit shortfall are the continuing increase in farm size in the 1970s and the rapid growth in farm debt. Those two factors led to a much greater concentration of farm debt, causing borrowing needs to press against lending limit ceilings.

To show how lending limits have increasingly handicapped bankers in financing agricultural loan demand, Benjamin presents a distribution of agricultural banks in the Seventh Federal Reserve District, by legal lending limits, for December 1972 and December 1977. This distribution is given in Table 2.2. For example, in Iowa, at the end of 1977, 1.9 percent of the agricultural banks had legal lending limits of $25,000 or less. Benjamin points out that despite considerable growth in lending limits from 1972 through 1977, nearly 14 percent of the agricultural banks in the district in December 1977 had basic lending limits of

$50,000 or less. Over a third of the banks operated at limits from $51,000 to $100,000, while nearly a fourth had limits from $100,000 to $150,000.

Table 2.2 also shows differences among states in lending limits. Illinois and Iowa tended to have the lowest lending limits in the district, largely because of differences in banking structure. More than half the agricultural banks in Illinois and over three-fifths in Iowa had lending limits of $100,000 or less at the end of 1977, while by contrast, only three-tenths of the agricultural banks in Indiana, one-sixth in Michigan, and two-fifths in Wisconsin had limits of $100,000 or less.

Benjamin then shows how easily the borrowing requirements of many farmers in the Midwest could exceed a legal lending limit of $100,000. He cites USDA budgets for 1978, which showed, for example, that grain farmers in the Midwest had variable per acre costs (excluding labor and interest) of roughly $36 for soybeans and $82 for corn. For a 500 acre farm raising equal amounts of corn and soybeans, that would amount to roughly $30,000 in operating costs that had to be financed either by equity or debt. If half the farm was cash rented at $100 per acre, another $25,000 would be added to current operating costs.

Purchase of a major item of machinery such as a tractor

Table 2.2. Distribution of agricultural banks in the Seventh Federal Reserve District, by legal lending limits, December 1972 and 1977 (Benjamin, 1980, p. 22)

	Percent of banks, by loan limit categories							
	Legal lending limit (thousand dollars)							
	25 or less	26 to 50	51 to 75	76 to 100	101 to 150	151 to 200	201 to 30	301 to more
Illinois								
1972	9.6	42.1	25.7	10.0	7.9	1.8	2.1	0.7
1977	1.4	17.5	22.9	10.0	28.2	9.3	6.1	4.6
Indiana								
1972	4.6	27.8	28.7	9.3	17.6	4.6	5.6	1.9
1977	0.9	6.5	10.2	13.9	29.6	13.0	15.7	11.1
Iowa								
1972	5.2	40.3	25.0	16.9	9.1	2.3	1.0	0.3
1977	1.9	13.0	21.4	25.0	17.5	12.0	6.8	2.3
Michigan								
1972	0.0	8.9	16.5	19.0	27.8	10.1	10.1	7.6
1977	0.0	0.0	2.5	13.9	24.1	20.3	19.0	20.3
Wisconsin								
1972	4.6	27.2	21.9	21.2	16.6	7.3	1.3	0.0
1977	1.3	12.6	12.6	13.9	25.8	15.2	13.9	4.6
Seventh Federal Reserve District								
1972	5.9	34.6	24.4	14.8	12.5	3.9	2.7	1.2
1977	1.3	12.4	17.5	16.4	24.1	12.5	9.8	5.9

or combine could add $50,000 or more in borrowing needs. If more land were purchased, say 40 acres, then borrowing requirements might increase from $30,000 to $85,000. Numerous other expenditures, such as real estate improvements, could further boost credit needs well beyond the legal lending limits of many agricultural banks.

Benjamin concludes that rural banks will have to increase their capital base to offset the resulting pressure on lending limits. The decline in farm numbers and concomitant increase in farm size are expected to continue and operating farm debt will very likely continue to be held by ever fewer farmers. He notes that these trends may cause rural banks to look to branch banking and multibank holding companies as a means of expanding their capital base.

Riffe study

The Dallas Fed study by Riffe (1979), examines the capacity of rural Texas banks to make large farm loans. Riffe points out that the use of loan participation by rural Texas banks with other lenders to accommodate borrowers with overline loan requests may actually be unprofitable to rural banks in periods of tight money, when loan participations may be needed most. The compensating balances required by correspondents in loan participations may be very costly for rural banks in tight monetary conditions. Because loan participations may be especially unprofitable to a rural bank in periods of tight money, a rural bank's capacity to make large loans may become more severely restricted in tight money periods than in easy money periods.

In the early 1970s, the lending capabilities of many rural Texas banks were thought to be inadequate to keep pace with growing farm credit demands. However, Riffe states that an examination of annual changes in maximum loan limits at agriculturally-oriented rural banks since 1970 indicates that loan limits have, on average, at least kept pace with increases in farm loan size. But, he states, overall growth in credit requirements of individual farmers may have outpaced growth in bank loan limits in particular years.

Riffe analyzes changes in loan limits at agriculturally-oriented Texas banks by selecting a group of banks with at least one-fourth of their loan portfolios in agricultural loans. The information was obtained from the December reports of condition of each year from 1970 through 1978 for 388 banks. The sample includes 211 state banks and 177 national banks.

Results of the loan limit computations are shown in Tables 2.3 and 2.4. Table 2.3 shows loan limits of selected agricultural banks in Texas from 1970 to 1978, inclusive. The lower and upper loan limits for national banks refer to the 10 percent rule for national banks and the important exception

Table 2.3. Loan limits of selected agricultural banks in Texas, 1970-1978 (Riffe, 1979, p. 2) (dollar amounts in thousands)

December 31	State banks		National banks[a]		
	Average limit	Percent change from prior year	Average lower limit	Average upper limit	Percent change from prior year[b]
1970	$ 72.9	-	$ 79.4	$198.4	-
1971	78.9	8.0	85.4	214.5	8.1
1972	87.2	10.0	94.0	234.9	9.6
1973	101.8	16.7	108.6	271.4	15.5
1974	117.2	15.1	123.0	307.5	13.3
1975	127.3	8.6	137.0	342.5	11.4
1976	141.2	10.9	149.1	372.7	8.8
1977	162.1	14.8	168.5	421.1	13.0
1978	181.1	11.7	195.2	488.0	15.9

[a]Lower limit calculated as 10 percent of qualifying capital base; upper limit, as 25 percent.

[b]May not exactly correspond to changes in both lower and upper limits because of rounding.

Table 2.4. Distribution of selected agricultural banks in Texas, by loan limits, 1970-1978 (Riffe, 1979, p. 3)

December 31	Percent[a] of banks, by loan limit categories								
	Under $100,000			$100,000 to $200,000			Over $200,000		
		National banks[b]			National banks[b]			National banks[b]	
	State banks	Lower limit	Upper limit	State banks	Lower limit	Upper limit	State banks	Lower limit	Upper limit
1970	39	35	14	13	9	16	2	2	15
1971	37	35	12	15	9	15	3	2	18
1972	36	32	10	15	10	15	3	3	21
1973	32	27	6	17	14	14	5	5	25
1974	29	23	5	18	16	13	8	6	28
1975	24	21	4	21	18	12	9	7	29
1976	23	20	3	21	16	11	10	10	31
1977	20	18	2	23	14	11	12	13	32
1978	17	14	2	22	15	9	15	16	35

[a]Percentages may not add up to 100 because of rounding.

[b]Lower limit calculated as 10 percent of qualifying capital base; upper limit, as 25 percent.

where 25 percent may be extended for a livestock loan, respectively. State banks may lend up to 25 percent of their qualifying capital base, but their qualifying capital base is more narrowly defined than that of national banks. Between 1970 and 1978, the average loan limit for the selected group of banks more than doubled, increasing at an average annual rate of 11.9 percent for national banks and 12.1 percent for state banks. Table 2.3 shows that the average loan limit for state banks increased from $162,100 in 1977 to $181,100 in 1978, an 11.7 percent increase. The average upper loan limit for national banks increased from $421,100 in 1977 to $488,000 in 1978, a 15.9 percent increase.

Table 2.4 shows the distribution of selected agricultural banks in Texas, by loan limits, for 1970 to 1978. Although the average loan limit more than doubled between 1970 and 1978, Table 2.4 points out that at least 19 percent of the selected banks could not make a loan above $100,000 at the end of 1978. By looking beneath the "under $100,000" loan limit category in Table 2.4, it is noted that 17 percent of the selected banks were state banks which could not make a loan above $100,000 at the end of 1978, whereas two percent of the sample were national banks which could not make a loan for more than $100,000 even with the 25 percent allowance for livestock loans. In the $100,000 to $200,000 category, 22 percent of the selected banks were state banks, whereas 9 percent of the sample were national banks at the upper loan limit. By adding up the percentages in the "under $100,000" and the $100,000 to $200,000 loan limit categories for state banks and national banks at the upper loan limit, it is seen that at least half of the selected banks had loan limits below $200,000.

Because direct information on farm loan size or number of farm borrowers was not available for commercial banks, Riffe used information from another major source of farm credit--Production Credit Associations (PCAs). PCAs are second only to banks as suppliers of farm credit in Texas. On the average, PCA loans tend to be larger than bank loans to farmers, but Riffe assumed that year-to-year changes in the size of the bank loans were reasonably similar to changes occurring at PCAs. Table 2.5 shows loans outstanding at PCAs in Texas from 1970 to 1978.

Riffe notes that the average size of PCA loans to Texas farmers increased from $25.1 thousand to $60.6 thousand between 1970 and 1978--an average annual rate of about 12.2 percent. However, annual increases fluctuated greatly, ranging from almost zero to nearly 28 percent, indicating that the overall growth in farm loan size was actually slow in a number of years relative to the growth in bank loan limits. On the average, the growth rates of loan size and loan limits

Table 2.5. Loans outstanding at production credit associations in Texas, 1970-1978 (Riffe, 1979, p. 4) (dollar amounts in thousands)

December 31	Average loan size	Loans over $100,000			
		Percent change from prior year	Percent of total borrowers	Percent of total loans	Average loan size
1970	$25.1	5.5	n.a.[a]	n.a.	n.a.
1971	32.1	27.9	n.a.	n.a.	n.a.
1972	35.5	10.6	n.a.	n.a.	n.a.
1973	41.1	15.8	9.3	66.6	$293.9
1974	44.7	8.8	10.1	63.0	277.7
1975	45.9	4.1	10.7	63.8	274.1
1976	50.4	9.8	12.1	65.4	272.5
1977	50.5	0.2	13.1	65.0	250.1
1978	60.6	20.0	15.5	69.6	272.1

[a]n.a. - not available.

were very similar. Riffe points out that relatively large loans are the only ones likely to grow enough to exceed a bank's loan limit. From the loan limit computations, Riffe concludes that farm borrowers with credit needs as low as $100,000 are "bumping" loan limits at many rural banks. A classification of Texas PCA borrowers by size of loan since 1973 shows that the number of borrowers with loans of more than $100,000 outstanding increased 50 percent from 1973 to 1978.

The PCA data in Table 2.5 indicate that a small proportion of relatively large borrowers account for a large share of total agricultural loan dollars at PCAs. At the end of 1973, for example, those in the group with loans over $100,000 represented only 9.3 percent of all Texas PCA borrowers but accounted for 66.6 percent of the total PCA dollar loan volume. At the end of 1978, this group comprised 15.5 percent of all borrowers and accounted for 69.6 percent of loan volume. Although bank borrowers may not be distributed among loan-size categories in the same porportions as PCA borrowers, the PCA data likely reflect similar trends occurring at rural banks. Thus, Riffe states, there appears to be some need for banks to keep raising loan limits and/or find more effective methods of handling overline loans.

Riffe concludes that despite the appearance that loan limits were keeping pace with the growth in farm loan size in the seventies, it may be increasingly difficult for small rural banks to handle the growing number of larger farm loans as farm growth and inflation continue to boost farm loan size.

Critique

The Benjamin and Riffe studies present some statistics on lending limits in their respective Federal Reserve Districts. Both studies note the possible need to increase capital bases at rural banks to keep pace with growing farm loan size. But other than presenting and summarizing data on lending limits, no rigorous analysis is performed. Neither article presents theoretical or empirical work on the effects of lending limits on credit allocation to farmers. To study the impact of lending limits on credit allocation to agriculture, theoretical linkages between lending limits and farm size and input costs are necessary. Then empirical analyses of those linkages are required.

Related Topics

Credit rationing

Credit rationing is said to occur if the demand for loans exceeds the supply of loans at the quoted interest rate. That is, banks are either unwilling or unable to supply all of the credit demanded at the stated rate. Because lending limits may cause banks to be unable to supply the level of credit demanded, lending limits may be the cause of a form of credit rationing.

The subject of credit rationing has received a great deal of attention in the literature, but for the most part, the focus of this attention has been on credit rationing to business firms. To directly measure credit rationing, data for both the demand and supply functions of each customer of a bank are required. In practice, these data are not available, and thus indirect measurement of credit rationing has been undertaken. The studies which employ indirect measurement of credit rationing can be divided into those that test for the existence of credit rationing and those that test for evidence of discrimination against small borrowers. In this section, some of the major empirical studies on credit rationing are briefly examined. No attempt is made to present an exhaustive summary of all articles pertaining to credit rationing.

Studies of the existence of credit rationing Studies of the existence of credit rationing attempt to determine whether or not credit rationing occurs. The data used in those studies include time-series data, survey data, and proxy measures.

Time-series studies estimate demand and supply functions for loans over time with explicit allowance for the existence of credit rationing. Typically, those studies estimate aggregate demand and supply schedules and the extent of rationing in disequilibrium markets. Sealey (1979) presents an econometric analysis that is representative of such time-series studies.

The loan data Sealey uses were obtained from an unpublished series available from the Federal Reserve Board and covers the second quarter of 1952 through the third quarter of 1977. Sealey's results indicate that loan demand is negatively related to the difference between the observed loan rate and the Aaa corporate bond rate (a measure of the rate on alternative external financing), and positively related to the Federal Reserve's index of industrial production in the previous period, undistributed corporate profits in the previous period (a measure of the volume of alternative internal, short-term financing), and a structural change dummy variable for the 1973-1975 period. Of particular note is the positive relationship between loan demand and undistributed corporate profits. The positive relationship indicates that despite undistributed corporate profits serving as an alternative source of funds (in which case, loan demand and undistributed corporate profits are negatively related), institutional constraints imposed by banks that part of the investment should be financed by profits has caused loan demand and undistributed corporate profits to be positively related. Loan supply was found to be positively related to the difference between the observed loan rate and the Treasury-bill rate, total bank deposits, cost per dollar of deposits, and the Federal Reserve's index of industrial production in the previous period.

Sealey uses his loan demand and loan supply functions to measure the extent of credit rationing in disequilibrium market models. His results indicate that in two-thirds of the time periods from the second quarter of 1952 through the third quarter of 1977, loan demand exceeded loan supply, thus pointing out the existence of credit rationing.

In survey studies, officers of commercial banks or business firms are questioned as to the existence and amount of credit rationing. An example of such survey studies is the Quarterly Survey of Changes in Bank Lending Practices conducted by the Federal Reserve System since 1964. Although the survey does not directly identify excess demand for loans, evidence is collected on the severity of various lending policies at commercial banks. Harris (1974), in analyzing the survey for the time period 1964III to 1970II, concluded that noninterest-rate terms of lending were used by banks to clear the loan market and thus, such action implied excess demand for loans at the going market rates.

Another category of survey studies are those that survey reactions of business managers to high interest rates and credit rationing. One such survey, undertaken jointly by the Federal Reserve-M.I.T. econometric model project and Donaldson, Lufkin and Jenrette, Inc., New York investment bankers, was conducted to determine the firms' adjustments to the tight money conditions of 1966. Two of the findings of the survey were that the smallest firms experienced relatively more rationing than larger firms, as would be expected, and that the small firms had about as much success as the large firms in obtaining bank credit after being rationed at one bank. Another survey of the effects of tight money conditions during 1966 was undertaken by the Office of Business Economics (OBE) of the Department of Commerce. This survey was undertaken to study the effects of credit rationing on the fixed capital investment of business firms. An evaluation of the OBE survey by Crockett, Friend, and Shavell (1967) estimated that the monetary tightness in 1966 resulted in a reduction in annual fixed capital investment of about $500 million. Their estimates include not only the effects of rationing, but also other monetary conditions such as high interest rates and the decline in the stock market, that occurred during this period.

In proxy-measure studies, variables expected to be highly correlated with credit rationing are used as measures of the actual phenomenon. Two of the studies employing this approach are Hand (1968) and Jaffee (1971). Hand develops a list of 24 variables which in principle might be highly correlated with credit rationing. From these variables, which include measures of bank tightness and characteristics of loan customers, he attempts to construct a summary index measure as a proxy for the actual amount of credit rationing.

Hand employs the methods of principal components and factor analysis to determine the set of these variables which might be taken as indicators of credit rationing. However, he runs into problems in trying to identify any resulting factors as clearly representing purely credit rationing phenomena. These factors could indicate general credit tightness and general economic activity, not specifically credit rationing.

Jaffee (1971) also experiences problems in identifying an appropriate credit rationing proxy. His study attempts to measure the existence and magnitude of credit rationing within a fully specified model of the commercial loan market, but his results are dependent on the degree to which the proxy actually reflects the degree of credit rationing. Although the degree of association between the proxy measure and those variables thought to be related to rationing is in most cases high, the credit rationing proxy is found to be not significantly related to loan demand. This lack of significance may reflect some inadequacies on the part of Jaffee's proxy measure.

Studies of the existence of discrimination against small borrowers Studies of the existence of discrimination against small borrowers examine the differential effects of tightening monetary conditions on large and small borrowers. Most of the studies have employed bank cross-section data to analyze bank loan supply functions over periods of differing monetary tightness for evidence of credit rationing in the tight-money periods. The primary source of cross-section data has been the Federal Reserve's sample surveys of commercial and industrial loans made by member banks in October 1955 and October 1957. A stratified probability sample of about 2,000 banks which included all banks with deposits over $50 million and declining proportions of smaller banks was taken. Information collected included such variables as the size of the loan, the interest rate, and the maturity of loans granted or approved in the month preceding the survey. The Federal Reserve data were used in the cross-section studies of Bach and Huizenga (1961), Hester (1962), and Silber and Polakoff (1970).

Bach and Huizenga (1961) classify banks, for the period

October 1955 to October 1957, into three groups: loose, redium, and tight. A bank classified as loose had a relatively high ratio of free reserves and government bills and certificates to total deposits in October 1955 and a high growth in deposits over the period relative to other banks'.

The hypothesis to be tested held that tight money leads to discrimination, that is credit rationing, against small firms in the availability of loan funds. Assuming the demand for loans remains constant across banks, Bach and Huizenga felt that the credit rationing of small firms should show up as a relatively slow growth in loans granted to small firms at the tight banks compared to the medium and loose banks.

The results of the Bach and Huizenga study indicated that loans to large firms increased more rapidly than loans to small firms for all categories of banks. The relative growth rate of loans to small firms was greatest, however, at the tight banks, thus leading Bach and Huizenga to reject the hypothesis of discrimination, or credit rationing, against small firms.

Hester (1962) uses the Federal Reserve survey data in his study of commercial bank loan offer functions. He examines the effects of tightening monetary conditions between 1955 and 1957 on credit rationing by considering several hypotheses. One hypothesis deals with the effects of a *ceteris paribus* increase in interest rates on competing assets on borrowers' interest rates on their loans. Other hypotheses deal with the existence of credit rationing, such as the effect of *ceteris paribus* increase in interest rates on competing assets on the amount of the loan extended to a borrower.

Rather than using the full sample from the Federal Reserve survey, Hester uses pooled observations from the survey for banks in the Cleveland Federal Reserve district to test his hypotheses. Individual loans are used as the unit of observation. Hester's results lead him to accept the hypothesis that a *ceteris paribus* increase in interest rates on competing assets increases the interest rate paid by borrowers on loans, and to reject all the other hypotheses, which are concerned with the existence of credit rationing.

Silber and Polakoff (1970) base their model on Hester's specification of the commercial bank loan offer function, but rather than using individual loans as the unit of observation, the individual bank is used. Another difference from the Hester study is that, whereas Hester used data from the Cleveland Federal Reserve district, Silber and Polakoff use data from the New York Federal Reserve district. Silber and Polakoff fit regressions for the supply of loans disaggregated into five asset size classes for the years 1955 and 1957. The independent variables include the deposits of the bank, interest rates on loans, maturities of the loans, and security requirements on the loans.

Silber and Polakoff base their test for discrimination on the ratio of the deposit variable coefficients between 1955 and 1957 for each of the asset categories. They hypothesize that if discrimination against small firms occurred between 1955 and 1957, then the ratio of the 1955 to the 1957 deposit variable coefficient should decline for larger asset size classes. The results of their test indicate that, except for the smallest asset class (assets less than one-quarter million dollars), the ratio of deposit coefficients does decline for larger asset classes. Furthermore, the ratio of deposit coefficients declines somewhat dramatically at the middle asset size class (assets $1 to $5 million). Thus, Silber and Polakoff conclude that discrimination against small firms does occur, particularly against those firms with assets of $5 million or less.

Farm size growth

Another topic related to lending limit problems and credit allocation to agriculture is that of farm size growth and the increased need for farm capital and credit. As noted earlier, the increase in farm credit requirements brought about, among other things, by farm size growth, has not been met by increases in dollar lending limits. A report by the American Bankers Association (1973) on the ability of individual rural banks to finance farmers found that, although rural banks should be able to meet farm loan demand in the aggregate in the future, the capital resources of the average-sized rural bank are not growing fast enough to keep pace with farm loan demand on an individual level. This situation, they note, has occurred with increasing frequency as the size of farm units has increased.

Melichar (1973) points out another problem--that of increased debt expansion on a per-farm basis. The increased use of debt, rather than internal financing, by the farming sector has placed an added burden on the ability of rural banks to service their farm loan customers. Because nearly all rural banks are small, this debt-financing problem is not easily solvable. Furthermore, smaller banks play an important role in financing agriculture, supplying a major share of total bank lending to agriculture. A study by Hamblin (1975) states that in 1974, small banks in the U.S. (banks with less than $25 million in deposits) held 55 percent of the agricultural loans held by all banks.

Some studies have attempted to measure the impact of farm size growth on the credit requirements for agriculture. One study by Harris and Nehring (1976) measures the impact of farm size on the bidding potential for agricultural land. Other studies, such as Boehlje and White (1969), view farm firm growth not in a size context, but in changes in net worth and disposable income, looking at the investment and production decisions the farm firm makes in the growth process. Whether growth is measured as an increase in the size of the farm firm or as an increase in net worth, an increased need for farm credit results. This makes it potentially difficult for rural banks to service their farm loan customers.

Bank capital adequacy

A third topic related to lending limits and credit allocation to agriculture is bank capital adequacy. With a fixed percentage lending limit, bank capital must grow in order for dollar lending limits to increase. But concerns about bank capital adequacy over the past fifteen years have raised doubts as to whether the growth of bank capital is sufficient to meet increased loan demand. Factors such as bank failures, declining capital-to-asset ratios, and decreasing profitability levels have heightened interest in the bank capital adequacy issue.

Most empirical studies, such as Cotter (1966) and Vojta (1973), on the topic of bank capital adequacy are concerned with the relationship between capital positions and bank failure. Although no significant relationship has been found between bank capital positions and bank failure, bank regulators feel that bank capital positions are an important input in determining the soundness, or safety, of the banking system.

In order to determine an "adequate" amount of capital for a bank, bank regulators employ capital adequacy formulas. Capital adequacy formulas attempt to assign specific weights to various portfolio factors to generate a dollar amount of adequate capital. These formulas are designed to estimate adequate capital for the typical bank and are to be used as guidelines for the bank examiner.

One of these formulas is that based on adjusted risk-assets, that is, total assets minus all assets with no default risk--basically cash, U.S. government securities, and loans guaranteed by agencies of the federal government. The excess of loan valuation reserves over estimated loan losses is then added to adjusted risk-assets. Adequate capital equals one-sixth of the resulting sum.

Another formula is that developed by the Federal Reserve Bank of New York. This formula takes account of the different money-market risks of default-free assets by assessing different capital requirements against different portfolio items. For example, no capital is required against cash and short-term (under five years) governments, and five percent is needed against long-term government and other "minimum risk assets" (for example, guaranteed loans and mortgages, and money-market loans). The ratio of these capital requirements to "good" capital--that is, total capital, including valuation reserves, less losses--is then formed. A ratio of 1.0 is considered a minimum requirement in that all other circumstances must be exceptionally favorable for a bank to be permitted so little capital. A more "adequate" ratio would be 1.25.

A third formula is that used by the Board of Governors of the Federal Reserve System. It is similar to the formula of the Federal Reserve Bank of New York in that it assigns variable weights to the portfolio items, but it attempts, in addition, to quantify other factors, such as bank size, trust operations, and liquidity, which might otherwise be left to the examiner's judgment. One of the quantifications of these other factors is that of a requirement of $40,000 (in bank capital) per loan portfolio (somewhat scaled down for portfolios under $500,000), which is designed to force small banks, with their more concentrated risks, to have higher capital-deposit ratios.

These attempts by bank regulators to determine an "adequate" amount of bank capital have been met with skepticism as to their effectiveness. Several studies, including Peltzman (1970) and Mayne (1972), have shown that regulatory guidelines regarding capital adequacy are largely ignored by banks. Other studies such as Kreps and Wacht (1971) and Mingo (1975) show that bankers treat deposit insurance as a substitute for bank capital. Still other studies, such as Pringle (1974) and Santomero and Watson (1977) suggest that an "optimal" capital position, rather than an "adequate" capital position that's arbitrary, should be determined.

Despite all the discussion and debate on bank capital adequacy, the lending limit problem appears to be more severe than the bank capital adequacy issue, as the Chicago and Dallas Federal Reserve studies discussed earlier point out. A bank may be able to maintain an "adequate" amount of bank capital to satisfy bank regulators, and still not be able to meet its loan demand because of lending limits, which are tied to bank capital. This problem of solving capital needs is even more severe for smaller banks than for larger banks, as Chaps (1975) points out. Chaps states that the external funding mechanisms that are available to the large banks have little or no applicability to the small banks. Furthermore, he states that retained earnings, the most important source of bank capital, won't supply the need for new capital to small banks in the future. Because it is estimated that banks will be able to generate only about 50 percent of their capital requirements internally, Chaps asserts that banks are going to be faced with the need for external financing if they are to continue to grow.

Summary and critique of related topics

The topics of credit rationing, farm size growth, and bank capital adequacy are all related to lending limits and credit availability to agricultural borrowers. The credit rationing literature attempts to determine the existence and amount of credit rationing or the existence of discrimination against small borrowers. Lending limits may lead to credit rationing, but that rationing, because of limits on the amount of credit a bank can extend to an individual borrower, deals with rationing of large borrowers.

Furthermore, the credit rationing studies, though presenting the differential impacts of credit rationing on large and small firms, are concerned with business firms, not farm firms. Although there are similarities between business and farm firms, differences, such as the credit system for agriculture, exist between them which cause analyses of the two to differ. More importantly, however, the key distinction between the literature on credit rationing and the lending limit problem is that credit rationing studies do not investigate the source of excess demand for loans. Credit rationing studies deal with whether or not excess loan demand exists. A more fundamental question is asked in the study of lending limits--if excess demand for loans exists, as is indicated by 50 percent of the banks in the Chicago Federal Reserve survey, to what extent is that excess demand caused by lending limits in conjunction with other factors?

Similarly, the topic of farm size growth is related to lending limits. Farm credit requirements are an important consideration for studies in farm size growth. Studies on lending limits must also examine farm credit requirements. But, whereas studies of farm size growth and farm credit requirements are concerned with loan demand, the topic of lending limits is concerned with both loan demand and loan supply.

Bank capital adequacy is also related to the topic of lending limits. The bank capital adequacy issue looks at the problem of maintaining a "safe" amount of bank capital with which to insure soundness of the banking system and safety for depositors. The lending limit problem also concerns itself with an "adequate" amount of bank capital, but in this case, "adeqate" means sufficient to satisfy a bank's loan customers.

Thus, the topics of credit rationing, farm size growth, and bank capital adequacy are related to the lending limit problem, but do not explicitly consider it. Although each of the related topics contributes towards an understanding of the lending limit problem, a direct analysis of lending limits is required to study its impact on credit availability to agricultural borrowers.

CHAPTER III. A THEORETICAL EXAMINATION OF LENDING LIMITS

In the review of the literature on lending limits, it was noted that little theoretical work has been done to determine the impact of lending limits on availability of credit to agricultural borrowers. The purpose of this chapter is to present a graphical and mathematical analysis of the effects of lending limits on an individual bank's ability to satisfy its loan customers. A graphical analysis is given in the next section, with a simple mathematical model developed and analyzed in the following section.

A Graphical Analysis of the Effects of Lending Limits

A graphical analysis of the effects of lending limits on the loan market is presented under the situations of flexible, fixed, and sticky interest rates. The discussion begins with the case of flexible interest rates and no lending limits. Next, the situation of flexible interest rates and lending limits is developed. Then, the cases of fixed interest rates with and without lending limits are given. Finally, the situations of sticky interest rates with and without lending limits are presented.

Throughout this discussion, it is assumed that there are m identical banks operating in a banking market and each bank has n identical customers. Market demand is thus the summation of individual customer demands at the m identical banks.

Flexible interest rates and no lending limits

In the presence of flexible interest rates and in the absence of lending limits, the loan market attains equilibrium. As Figure 3.1 illustrates, equilibrium initially occurs where the loan demand (L_0^D) and loan supply (L_0^S) curves intersect. The term r_0 is the equilibrium interest rate of the bank and L_0 is the equilibrium loan amount.

Suppose an increase in loan demand occurs, causing the loan demand curve to shift from L_0^D to L_1^D. In this situation, in the absence of lending limits, no excess loan demand occurs because interest rates adjust to clear the market. The new equilibrium interest rate is r_1 and L_1 is the new equilibrium loan amount. Both values are greater than initial equilibrium levels.

Flexible interest rates and lending limits with the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

With the inclusion of lending limits, the market loan supply curve becomes kinked. The maximum that can be loaned by all banks in the market will be the product of the individual

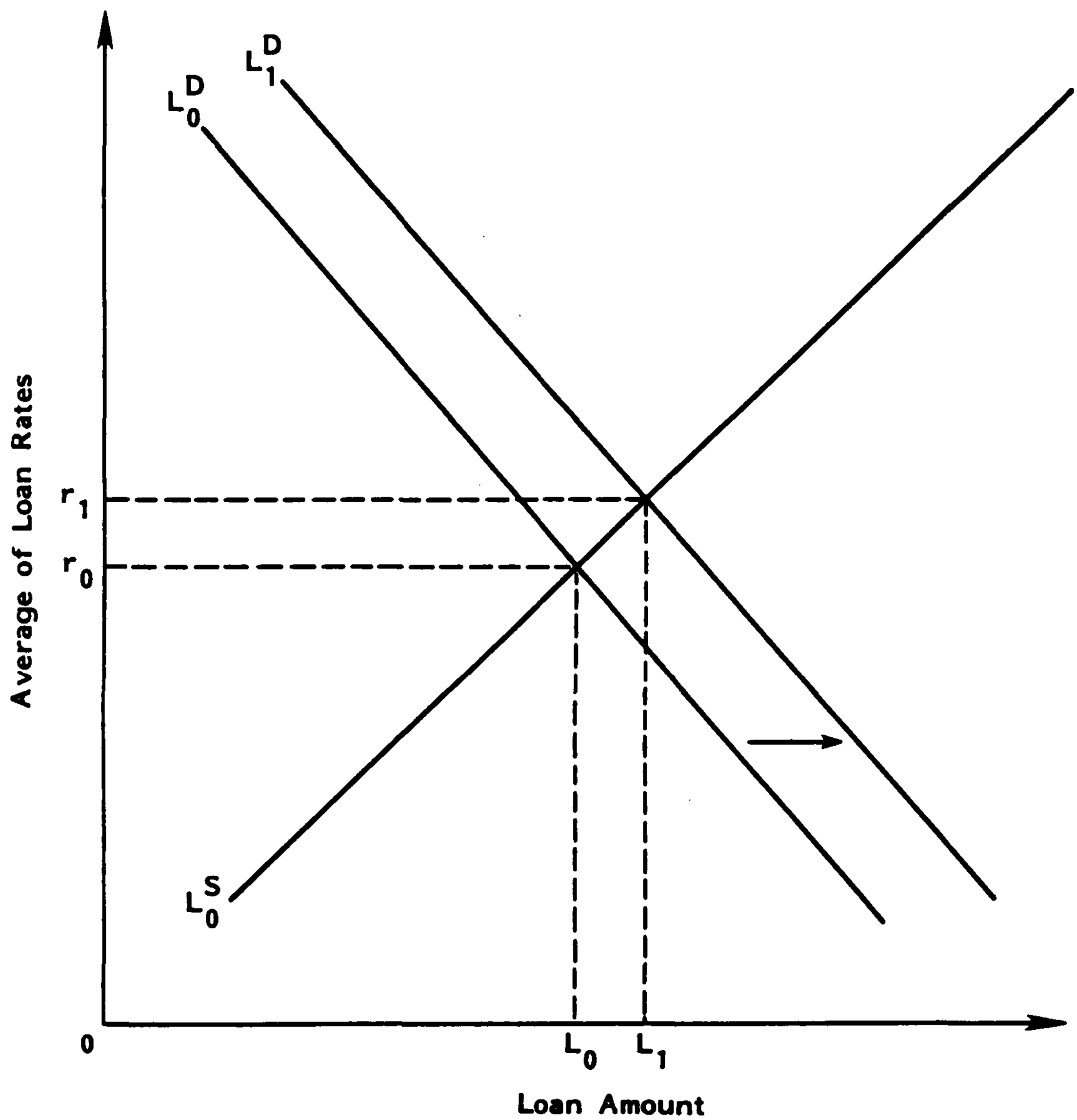

Figure 3.1. Credit availability under flexible interest rates with no lending limits

customer lending limits times the number of customers times the number of banks in the market. Beyond the kink, loan supply is perfectly inelastic with respect to interest rates. With flexible interest rates, however, equilibrium can be attained, as Figure 3.2 indicates.

Because of the imposition of lending limits, the loan supply curve is L_L^S rather than L_0^S, as shown in Figure 3.2. The maximum amount that all banks can lend is denoted by L_M. With flexible interest rates and the loan demand curve (L_0^D) intersecting the lending limit supply curve (L_L^S) above its kink, equilibrium is attained at higher interest rates ($r_L > r_0$) and a lower loan amount ($L_M < L_0$) than in the absence of lending limits. In the present case of the loan demand curve intersecting the loan supply curve above its kink, loan demand determines interest rates but has no effect on loan amount, which is fixed by regulation.

Suppose loan demand increases, causing the loan demand curve to shift from L_0^D to L_1^D. If the loan supply curve remains at L_L^S, then interest rates rise from r_L to r_1 with no change in the loan amount. Similarly, with the loan demand curve L_0^D, for a decrease in loan supply which results in a leftward shift in the loan supply curve from L_L^S to $L_{L'}^S$, interest rates rise from r_L to $r_{L'}$. However, the maximum loan amount decreases from L_M to $L_{M'}$ because of the decrease

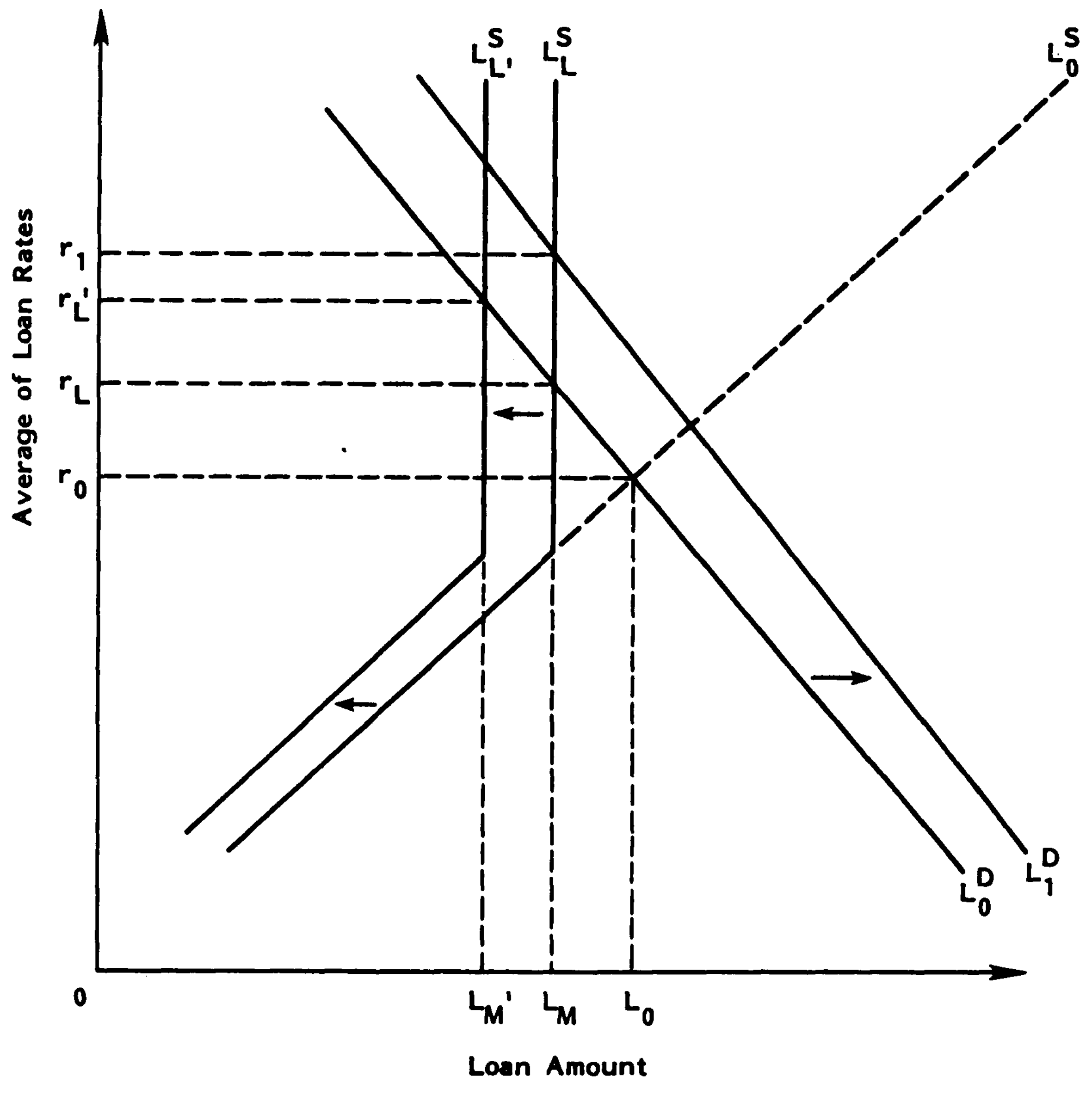

Figure 3.2. Credit availability under flexible interest rates and lending limits with the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

in loan supply. The point of this discussion, whether loan supply or loan demand shifts, is that equilibrium can be attained despite the scenario of lending limits if interest rates are flexible. But, in the absence of lending limits, interest rates are lower and the loan amount higher than in the situation where lending limits exist.

<u>Flexible interest rates and lending limits with the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve</u>

If the loan demand curve intersects the loan supply curve below the kink in the loan supply curve, as shown in Figure 3.3, lending limits create no problems. In this situation, the equilibrium loan amount is less than the maximum amount banks can lend. Also, as shown in Figure 3.3, interest rates are both demand and supply determined, not only demand determined as in Figure 3.2.

Initially, with loan supply curve L_L^S and loan demand curve L_0^D, equilibrium is attained at the r_0 level of interest rates and loan amount L_0. As in the previous cases, suppose a rightward shift in the loan demand curve occurs from L_0^D to L_1^D with no change in the loan supply curve. Then, both the equilibrium level of interest rates and the equilibrium loan amount rise to r_1 and L_1, respectively. In this situation, unlike the case presented in Figure 3.2, the shift in the loan demand curve causes a rise in the loan amount as well as

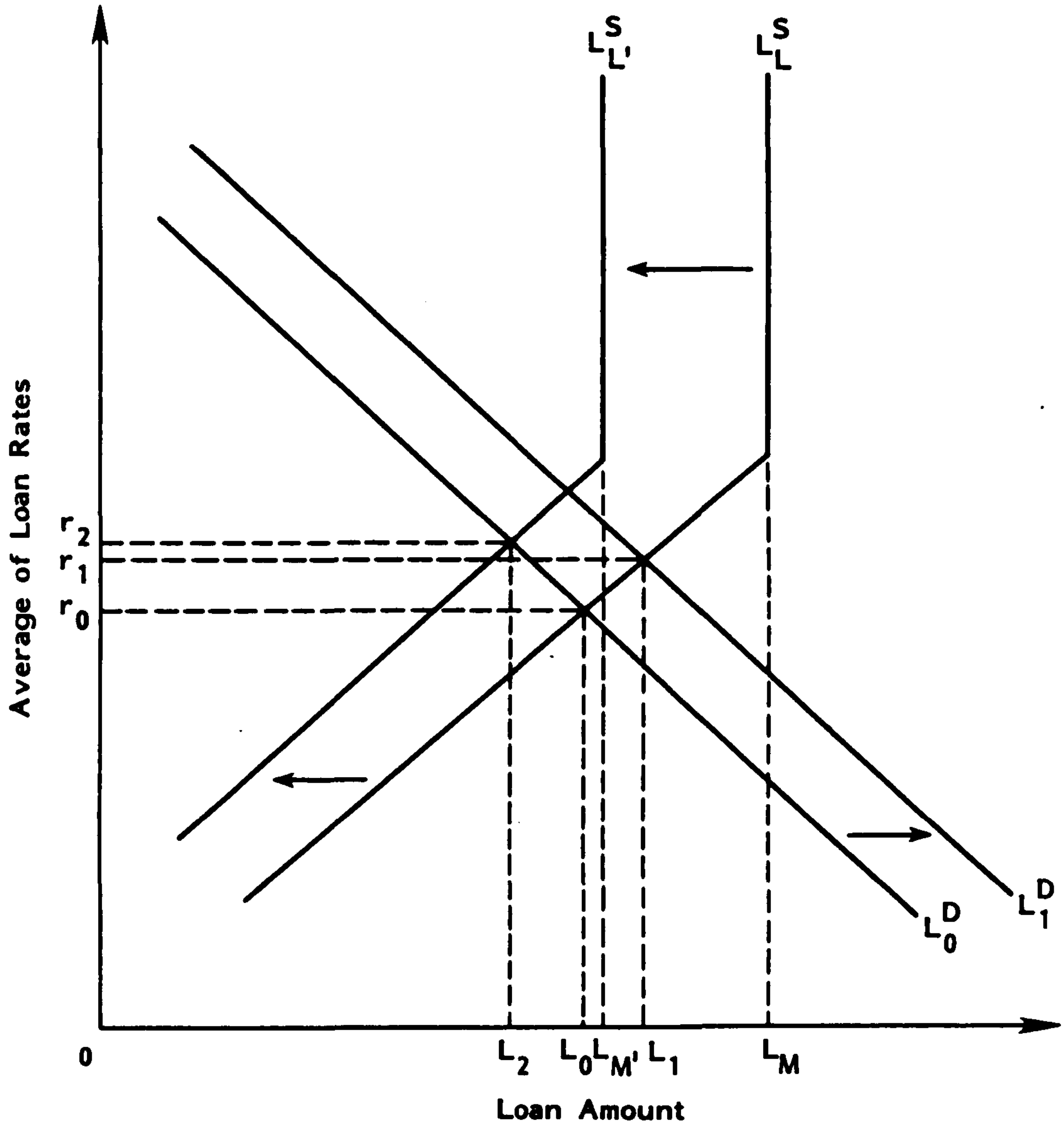

Figure 3.3. Credit availability under flexible interest rates and lending limits with the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

a rise in interest rates. Lending limits are not a constraint in this case.

Similarly, for a leftward shift in the loan supply curve from L_L^S to $L_{L'}^S$, and the loan demand curve at L_0^D, lending limits do not constrain the attainment of equilibrium in the loan market. The equilibrium interest rate rises from r_0 to r_2 while the equilibrium loan amount falls from L_0 to L_2.

Fixed interest rates and no lending limits

Turning now to fixed interest rates, the possibility of disequilibrium in the loan market occurs. With interest rates fixed exogenously, no adjustments toward equilibrium are possible. The only way for equilibrium to be attained in the loan market under fixed interest rates is if interest rates are set such that the loan market clears.

In Figure 3.4, three possible interest rates are considered: r_0, r_E, and r_1. With loan demand curve L_0^D and loan supply curve L_0^S, if interest rates are established at the r_0 level, then excess demand of L_0-L_1 occurs. Because interest rates are fixed, if no other adjustments in the market take place, then permanent credit rationing of the amount L_0-L_1 occurs. If it just so happens that interest rates are set at r_E, then equilibrium in the loan market occurs. Finally, if rates are set at the r_1 level, then excess supply of

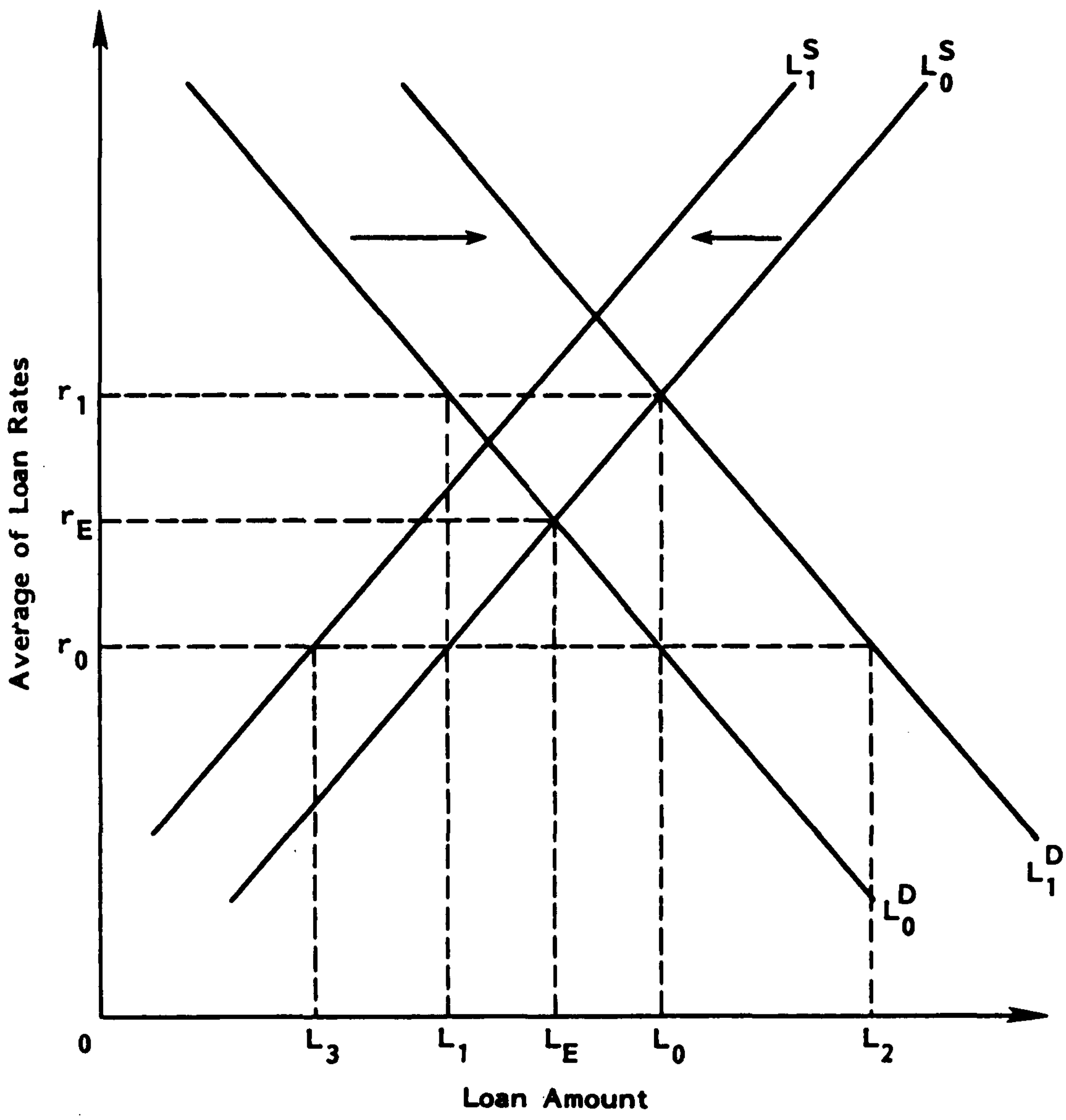

Figure 3.4. Credit availability under fixed interest rates with no lending limits

L_0-L_1 exists.

Now, suppose rates are fixed at r_0. With loan supply curve L_0^S, a shift in the loan demand curve L_0^D to L_1^D causes excess demand to increase to L_2-L_1. Similarly, with loan demand curve L_0^D, for a decrease in loan supply which causes the loan supply curve to shift from L_0^S to L_1^S, excess demand increases to L_0-L_3. In either case, whether the loan demand curve shifted outward or the loan supply curve shifted inward, equilibrium is not attained because of fixed interest rates.

Fixed interest rates and lending limits with interest rates set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

In the situation of fixed interest rates with lending limits, a greater excess loan demand may occur than in cases without lending limits. As shown in Figure 3.5, interest rates are fixed (at $\bar{r}$) below the kink in the loan supply curve whereas the loan demand curve intersects the loan supply curve above its kink.

Assume initially that the loan supply curve is L_L^S and the loan demand curve is L_0^D. With interest rates set below the kink in the loan supply curve, the loan amount supplied is less than the maximum allowed under lending limits. Excess loan demand is of the amount L_0-L_1. With no change in loan supply, suppose loan demand increases, causing the loan demand curve to shift from L_0^D to L_1^D. Then, excess loan

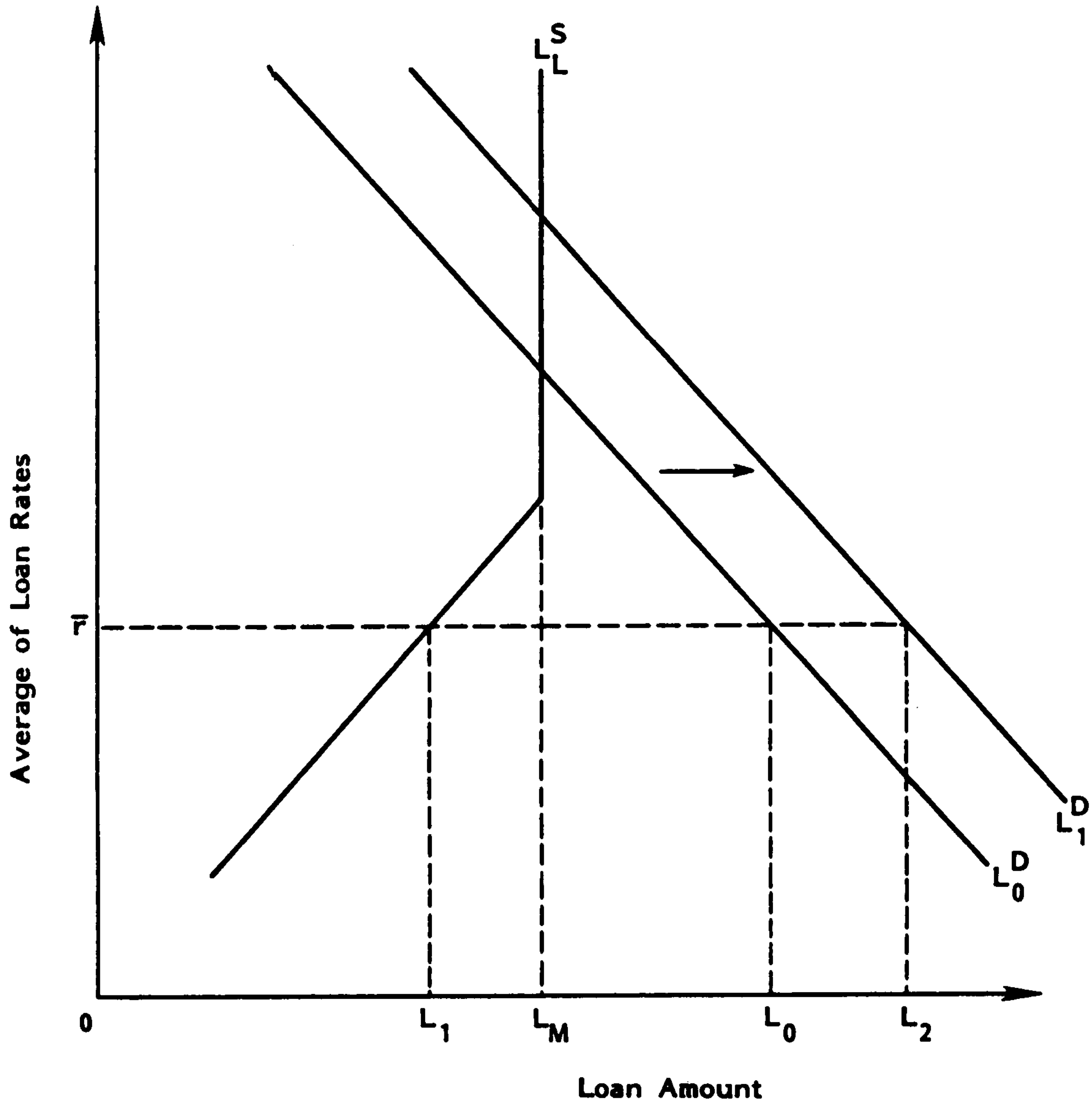

Figure 3.5. Credit availability under fixed interest rates and lending limits with interest rates set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

demand increases to L_2-L_1. Excess loan demand would also increase for the case of a leftward shift in the loan supply curve with loan demand curve L_0^D.

<u>Fixed interest rates and lending limits with interest rates set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve</u>

With interest rates fixed and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve, the remote possibility of equilibrium occurs. As illustrated in Figure 3.6, this possibility occurs with loan demand curve L_2^D, which intersects the loan supply curve at the $\bar{r}$ level of fixed interest rates.

Suppose initially the loan demand curve is L_0^D. With interest rates fixed at the $\bar{r}$ level, excess loan demand of L_0-L_2 exists. If loan demand increases, shifting the loan demand curve rightward to L_1^D, then with no other changes occurring, excess loan demand increases to L_1-L_2. If loan demand decreased so that L_2^D was the relevant loan demand curve, then equilibrium would by chance exist despite the presence of fixed interest rates and lending limits.

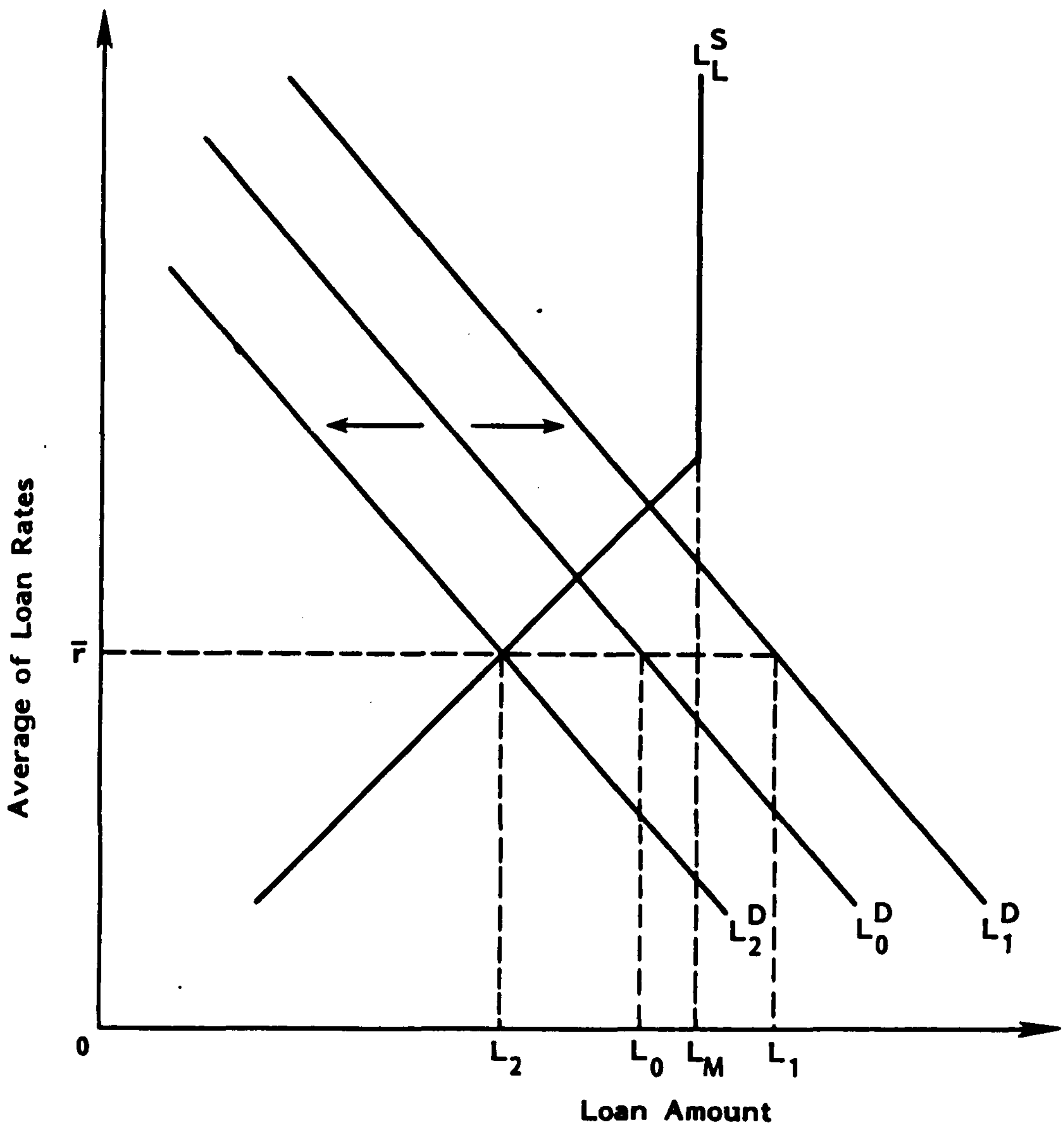

Figure 3.6. Credit availability under fixed interest rates and lending limits with interest rates set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

<u>Fixed interest rates and lending limits with interest rates set, and the loan demand curve intersecting the loan supply curve, at the kink in the loan supply curve</u>

Another possible way to attain equilibrium under fixed interest rates and lending limits occurs when both the loan demand curve and the level of fixed interest rates, by chance, intersect the loan supply curve at the kink in the loan supply curve. This situation is shown in Figure 3.7, with $\bar{r}$ and L_M the equilibrium level of interest rates and equilibrium loan amount, respectively. The loan amount L_M is also the maximum which can be lent under lending limits.

<u>Fixed interest rates and lending limits with interest rates set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve</u>

It is also possible to attain equilibrium if both the loan demand curve and fixed interest rates intersect the loan supply curve above the kink in the loan supply curve. As Figure 3.8 illustrates, equilibrium can occur by chance with loan demand curve L_2^D and fixed interest rate, $\bar{r}$.

Suppose initially the loan demand curve is L_0^D in Figure 3.8. Then, excess loan demand of L_0-L_M exists. If a <u>ceteris paribus</u> increase in loan demand occurs, then the loan demand curve shifts rightward from L_0^D to L_1^D. Excess loan demand also increases, from L_0-L_M to L_1-L_M. If loan demand decreased so that L_2^D was the relevant loan demand curve, then,

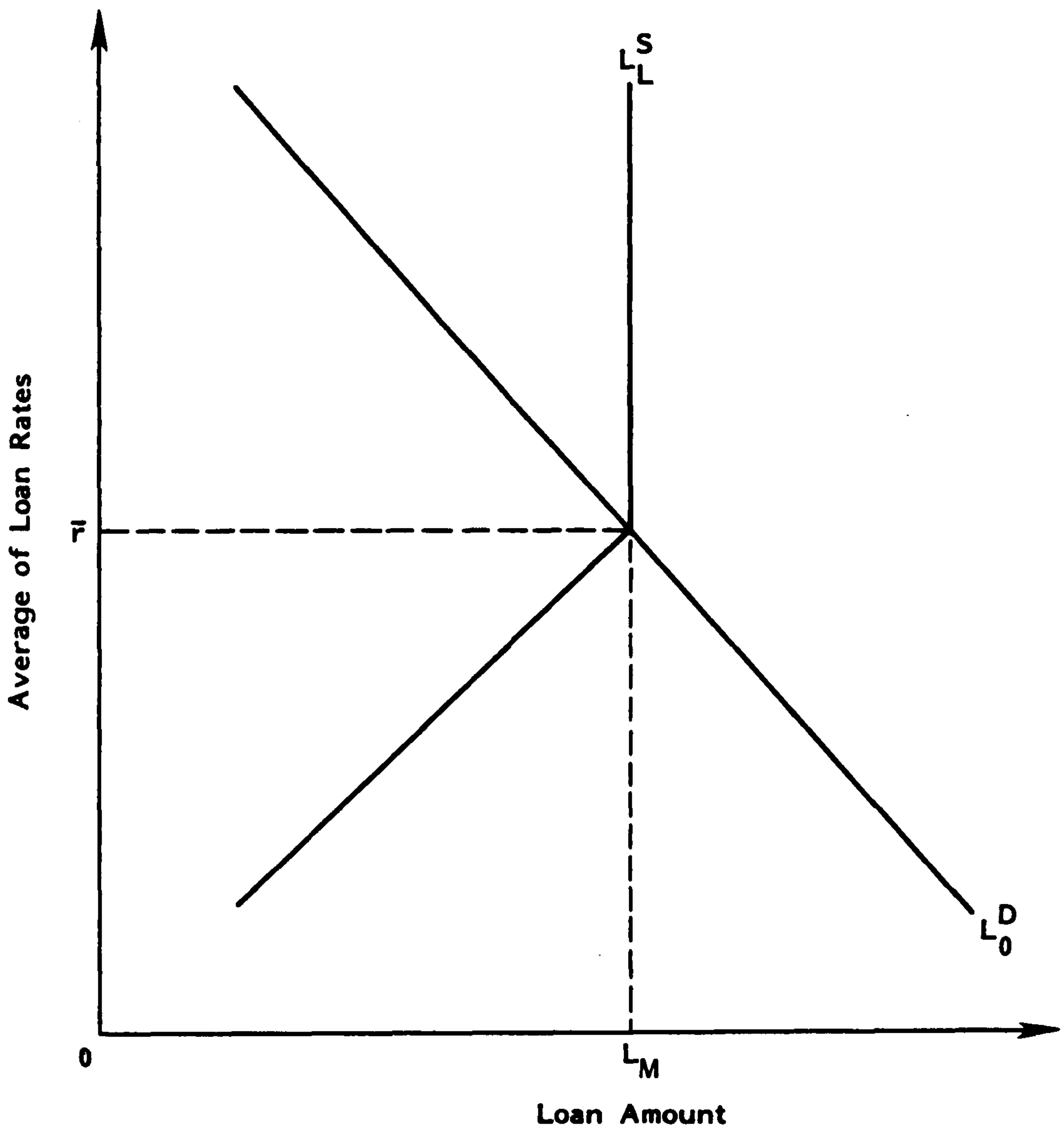

Figure 3.7. Credit availability under fixed interest rates and lending limits with both the loan demand curve and the fixed level of interest rates intersecting the loan supply curve at the kink in the loan supply curve

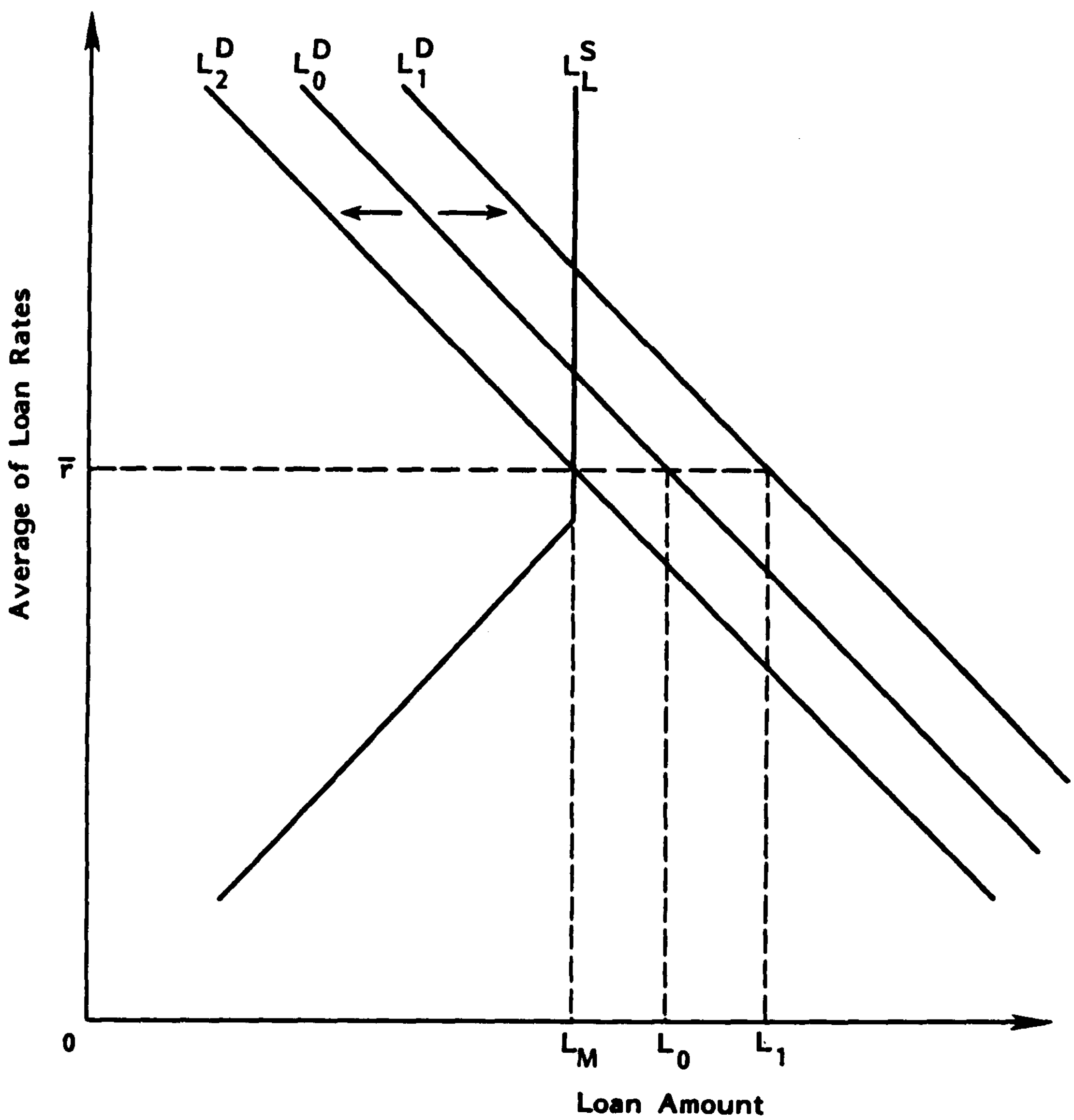

Figure 3.8. Credit availability under fixed interest rates and lending limits with interest rates set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

as discussed in the preceding paragraph, equilibrium would exist. For further leftward shifts in the loan demand curve (to the left of L_2^D but intersecting the loan supply curve above its kink), excess loan supply exists.

Fixed interest rates and lending limits with interest rates set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

In the case of the loan demand curve intersecting the loan supply curve below its kink and interest rates fixed above the kink in the loan supply curve, excess loan supply occurs. For instance, as in Figure 3.9, if the loan demand curve is L_0^D, then excess loan supply of L_M-L_0 exists. For a rightward shift in the loan demand curve from L_0^D to L_1^D caused by an increase in loan demand, excess loan supply still exists but decreases to L_M-L_1.

Sticky interest rates

The situations in which sticky interest rates occur represent intermediate cases between those of flexible and fixed interest rates. Initially, interest rates are set as in the cases of fixed interest rates, but unless the rates are established such that equilibrium prevails, the rates, over time, can adjust so that equilibrium is attained, as in the cases of flexible interest rates. However, under sticky interest rates, the process of reaching equilibrium

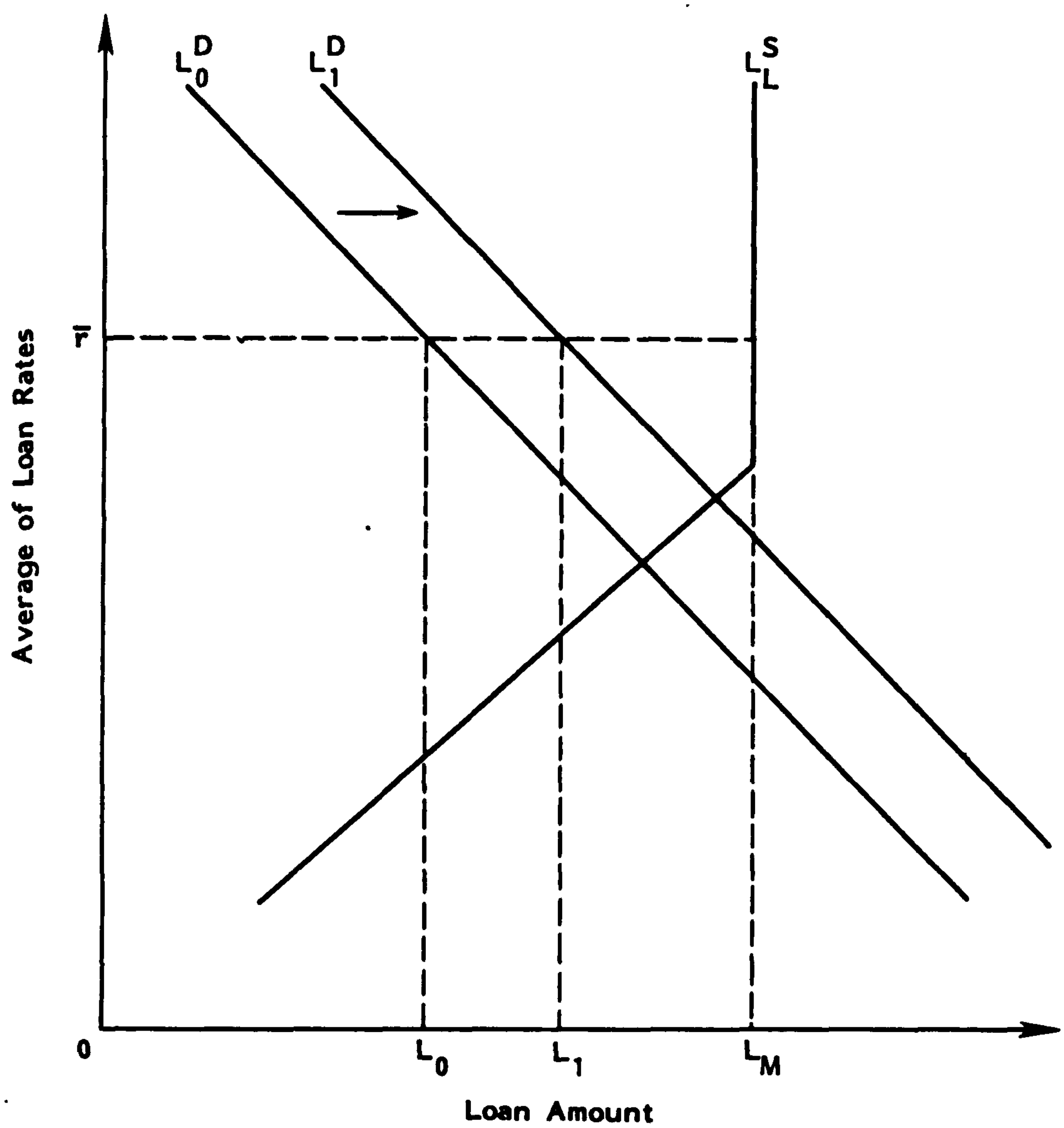

Figure 3.8. Credit availability under fixed interst rates and lending limits with interest rates set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

takes longer than under flexible interest rates because of a slower adjustment process. As under fixed interest rates, institutional factors may be the cause of this restricted adjustment toward equilibrium, or "temporary" credit rationing. Following along the lines of the discussion of flexible and fixed interest rates, sticky interest rates will be examined both with and without lending limits.

Sticky interest rates and no lending limits

As in the case of fixed interest rates without lending limits, the scenario of sticky interest rates without lending limits may cause excess loan demand to occur. But, unlike the fixed-interest-rates case, the excess loan demand is not permanent. Given sufficient time for adjustment, equilibrium can be attained under sticky interest rates.

Assume, as shown in Figure 3.10, that interest rates are initially established at the r_1 level. Then, excess loan demand of L_0-L_1 occurs. But, because interest rates are "sticky" as opposed to fixed, adjustments in the rates are possible. The first adjustment in interest rates might set the rates at r_2. Assuming no shifts in the loan demand and loan supply curves, excess loan demand then decreases to L_2-L_3. Similar adjustments in interest rates lead to further declines in excess loan demand until equilibrium is reached with r_E and L_E the equilibrium level of interest rates and

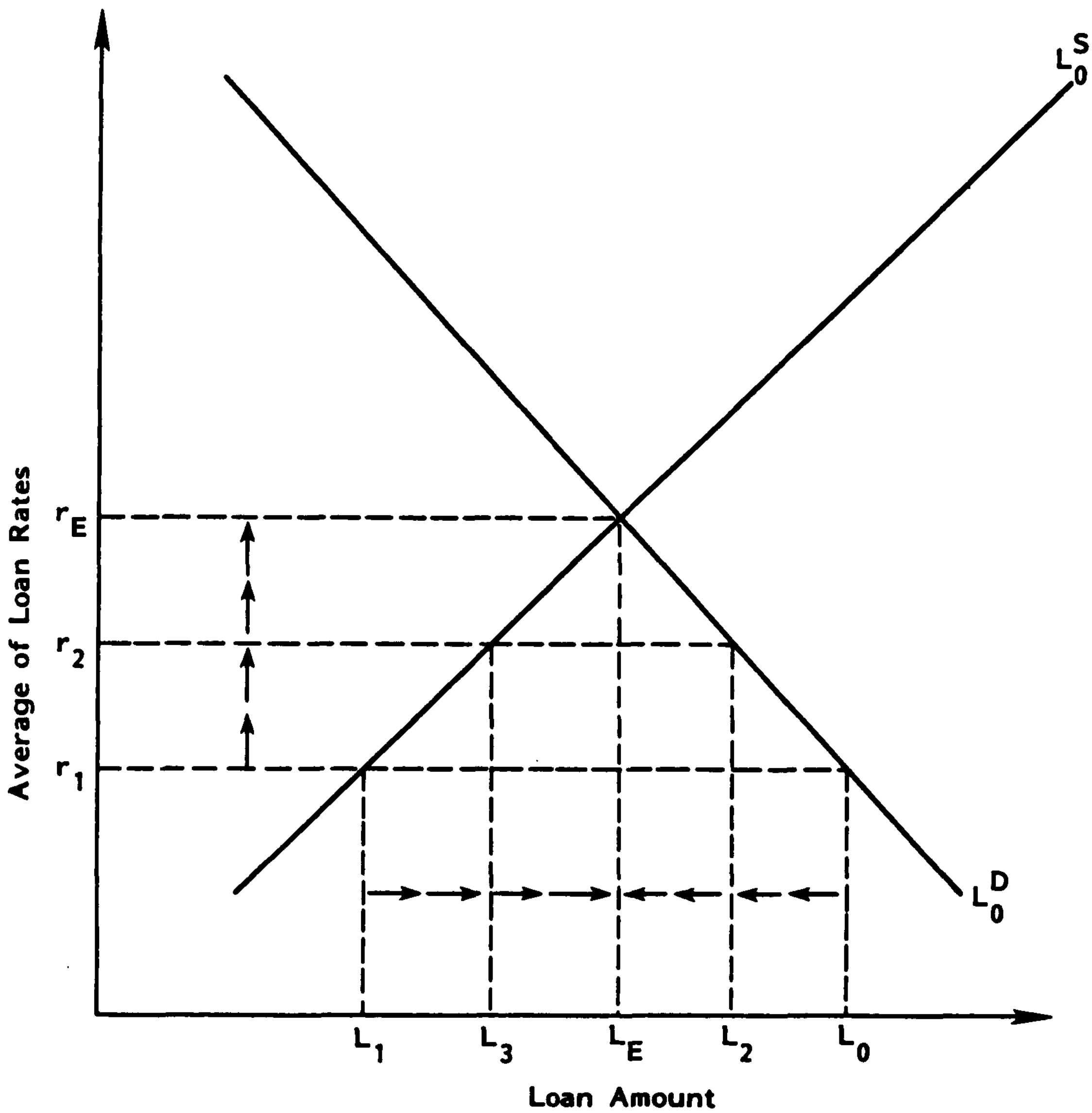

Figure 3.10. Credit availability under sticky interest rates with no lending limits

loan amount, respectively. Thus, temporary excess loan demand exists until interest rates adjust to clear the market. Through the adjustments in interest rates, the amount rationed decreases over time and is thus temporary.

<u>Sticky interest rates and lending limits with interest rates initially set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve</u>

As in the situation of sticky interest rates and no lending limits, the case of sticky interest rates and lending limits permits excess loan demand to decrease over time. As shown in Figure 3.11, suppose initially that interest rates are set at the r_1 level. Then, excess loan demand of the amount L_0-L_1 exists. As interest rates adjust to clear the market, intermediate rates such as r_2 may occur, in which case excess loan demand decreases to L_2-L_M. Becuase excess loan demand still exists at r_2, interest rates continue to rise, eventually reaching r_E where equilibrium is attained. The equilibrium loan amount is L_M, the maximum loan amount allowed by lending limits.

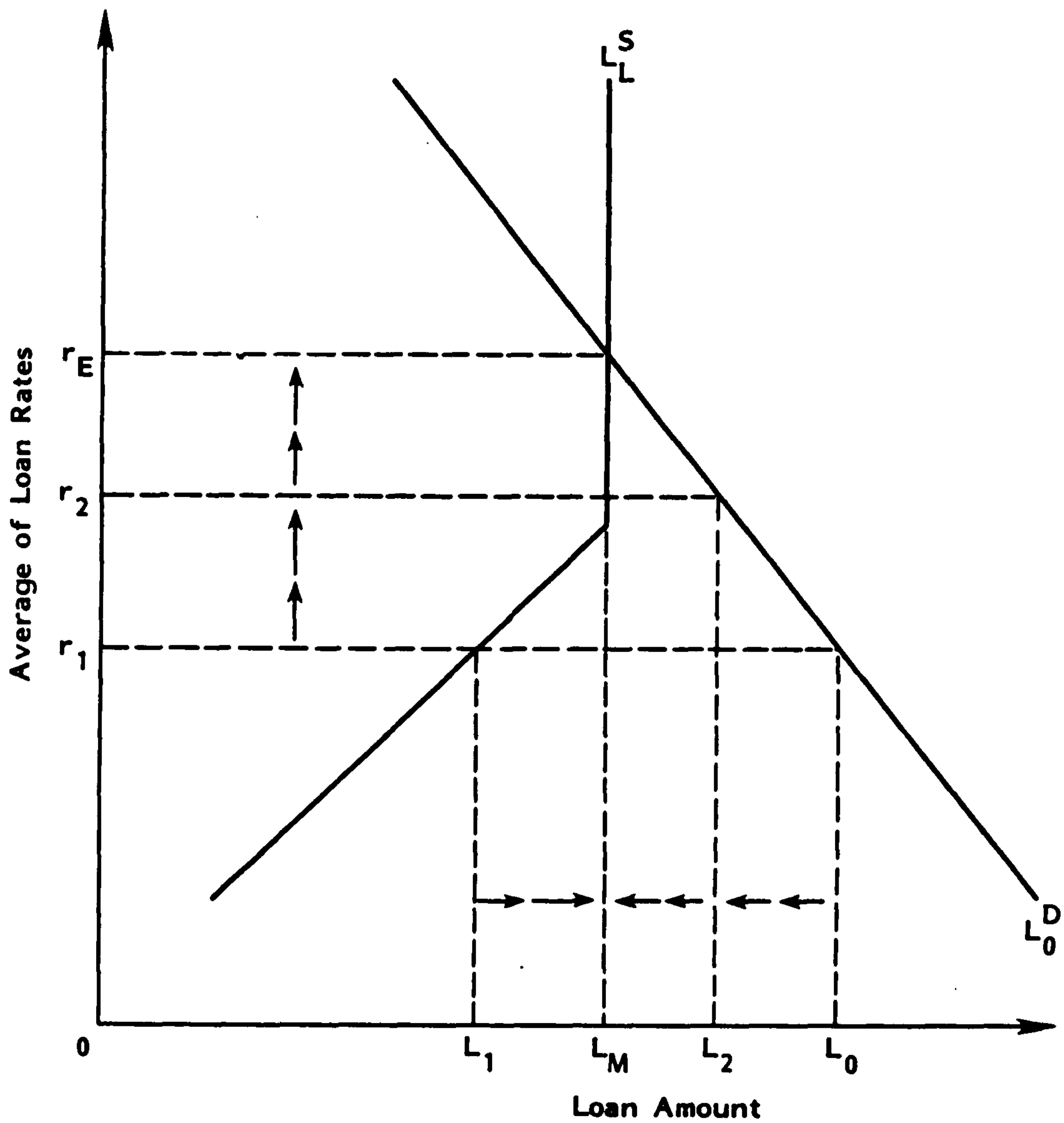

Figure 3.11. Credit availability under sticky interest rates and lending limits with interest rates initially set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

Sticky interest rates and lending limits with interest rates initially set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

In the case of the loan demand curve and the level of interest rates intersecting the loan supply curve below the kink in the loan supply curve, excess loan demand may again occur. This situation is depicted graphically in Figure 3.12. Assume initially that interest rates are fixed at r_1. Then, an excess loan demand of L_0-L_1 exists. After a time, interest rates may rise to r_2, causing excess loan demand to decrease to L_2-L_3. Further adjustments in interest rates eventually lead to equilibrium at interest rate level r_E and loan amount L_E. Note that lending limits have not interfered with the attainment of equilibrium in this case because the loan demand and loan supply curves intersect at a loan amount below the maximum amount, L_M, allowed by lending limits.

Sticky interest rates and lending limits with interest rates initially set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

Unlike the previous two graphs in which interest rates were initially set below the kink in the loan supply curve, Figure 3.13 shows interest rates initially set above the kink in the loan supply curve L_L^S. Assuming that the interest rates are set at r_1, excess loan demand is L_1-L_M. Because of the excess loan demand at r_1, the sticky interest rates

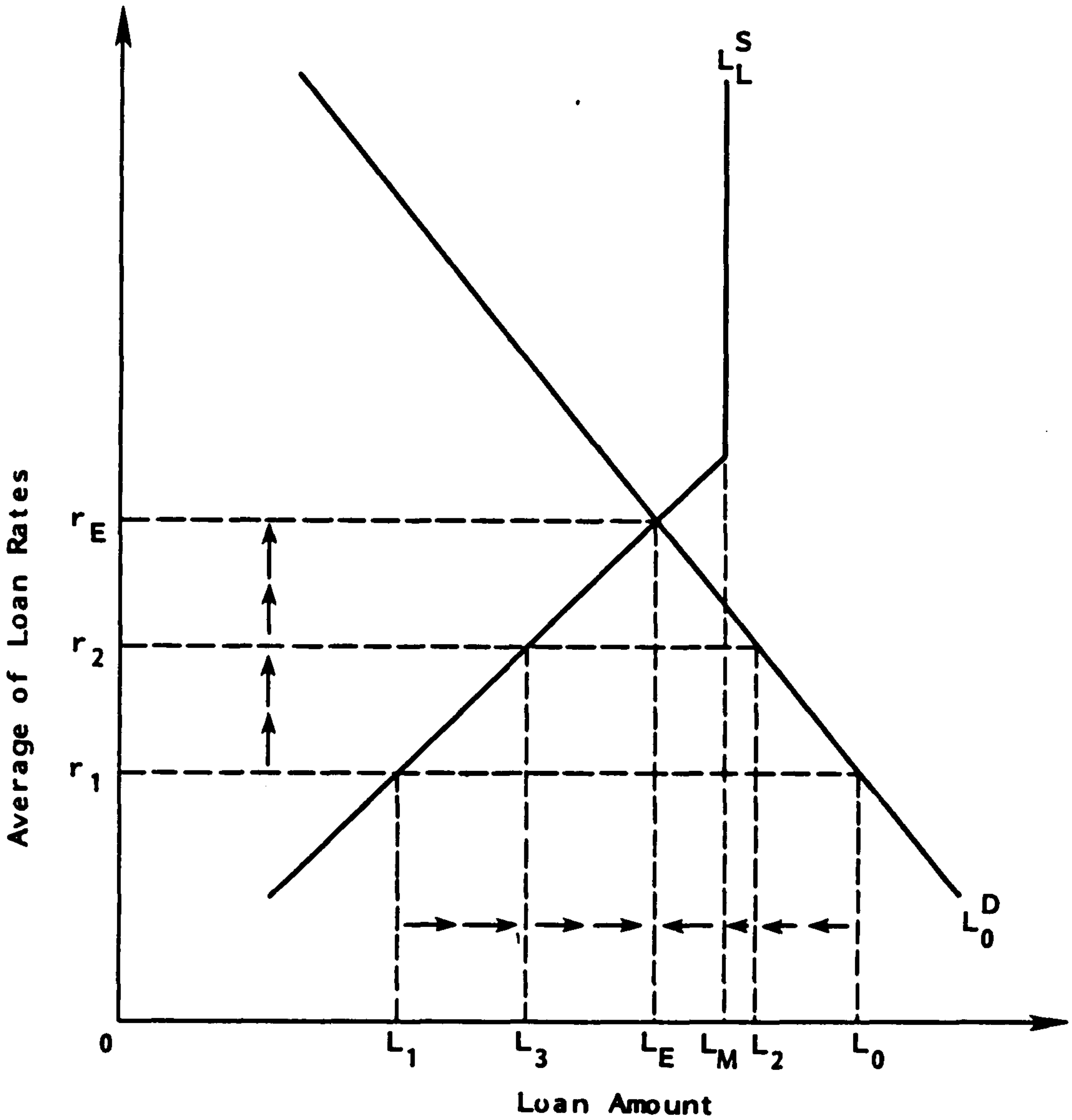

Figure 3.12. Credit availability under sticky interest rates and lending limits with interest rates initially set below the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

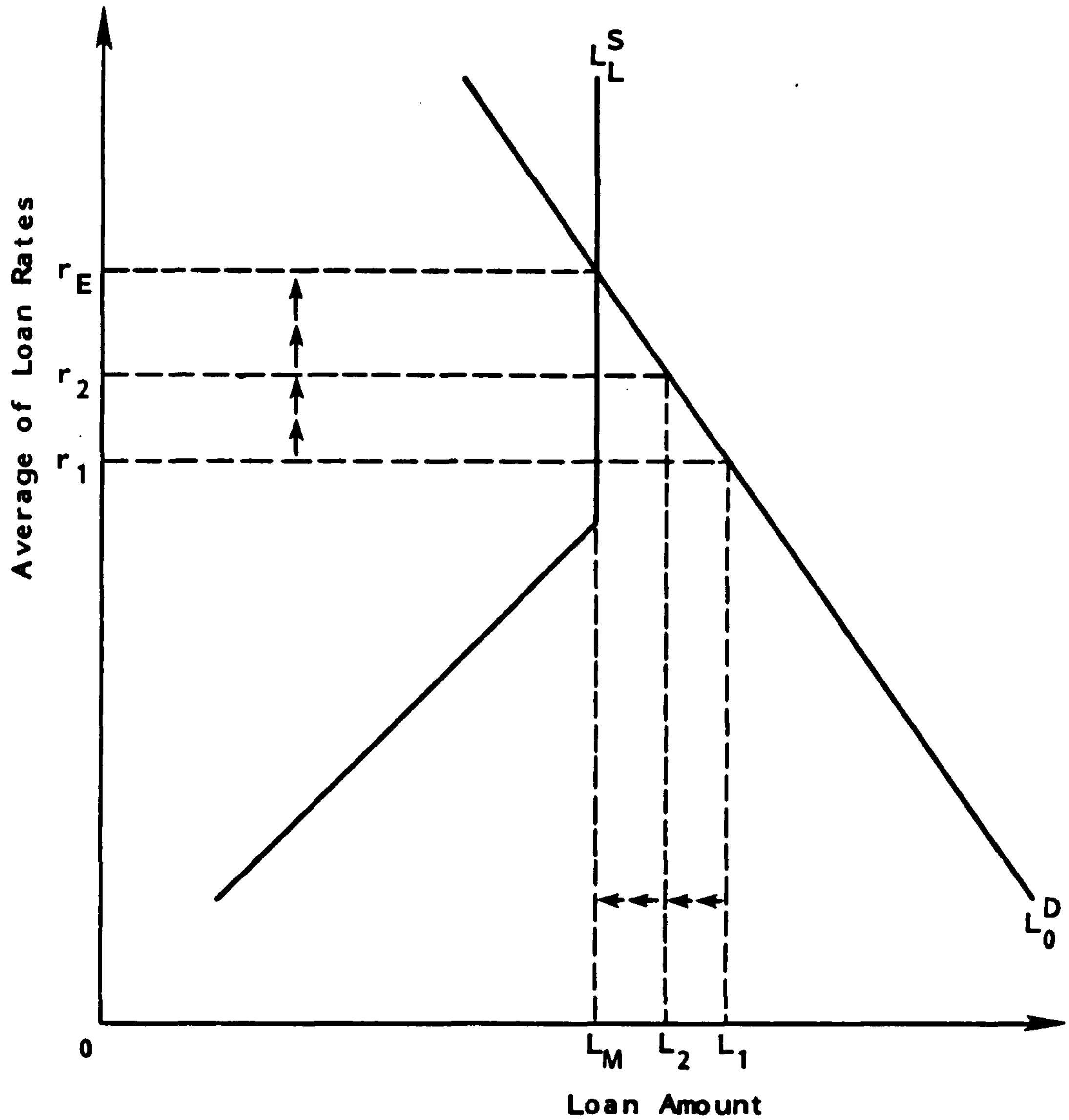

Figure 3.13. Credit availability under sticky interest rates and lending limits with interest rates initially set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve above the kink in the loan supply curve

rise, perhaps to r_2. At r_2, however, excess loan demand still exists, but of a smaller amount, L_2-L_M, than at r_1. Eventually, interest rates adjust to r_E at the intersection of the loan demand and loan supply curves with L_M the equilibrium loan amount. This loan amount is also the maximum amount allowed by lending limits.

Sticky interest rates and lending limits with interest rates initially set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

With interest rates initially set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve, excess loan supply exists as shown in Figure 3.14. Assume initially that interest rates are set at r_1. Then, excess loan supply of L_M-L_1 exists. Because of the excess loan supply, a decline in interest rates occurs to, for instance, r_2. At r_2, excess loan supply decreases to L_M-L_2. Eventually, interest rates fall to r_E, where the adjustment to equilibrium is complete. The equilibrium loan amount is L_E, which is less than the maximum loan amount allowed by lending limits, L_M.

Summary

A graphical analysis of the effects of lending limits under flexible, fixed, and sticky interest rates was presented. It was shown that the existence of lending limits

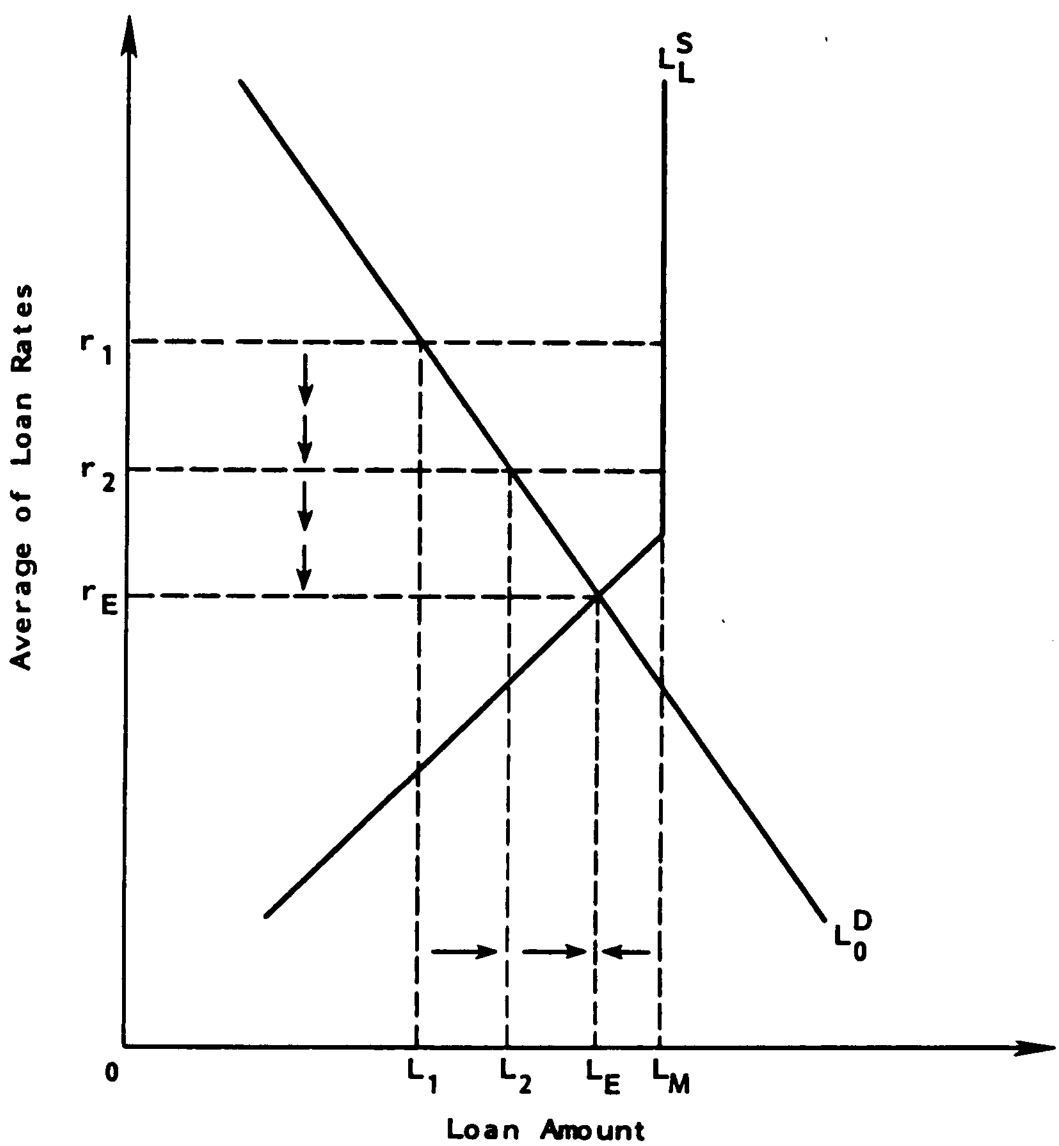

Figure 3.14. Credit availability under sticky interest rates and lending limits with interest rates initially set above the kink in the loan supply curve and the loan demand curve intersecting the loan supply curve below the kink in the loan supply curve

causes the loan supply curve to kink at the point where the maximum loan amount allowed by law is attained. Whether the loan demand curve intersects the loan supply curve above or below its kink determines the existence of excess loan demand.

The amount and persistence of excess loan demand were shown to depend on whether the interest rates were flexible, fixed, or sticky. For flexible interest rates, no excess loan demand exists because rates are allowed to adjust to clear the market regardless of the presence of lending limits. If fixed interest rates are present, then excess loan demand may exist. Further, the excess loan demand will persist unless changes in the interest rates, loan supply, or loan demand functions occur. If no changes in the variables occur, then excess demand will have to be accommodated through external sources such as correspondent loans. "Permanent" credit rationing occurs if no market variables change and external sources of credit are not available.

In the case of sticky interest rates, excess loan demand may occur, but the credit rationing is temporary. Interest rates are allowed to adjust over time so that the excess loan demand is eliminated. How quickly equilibrium is attained depends upon the speed of adjustment of interest rates.

A Mathematical Model of the Effects of Lending Limits

Although graphical analysis allows an examination of the impacts on equilibrium values of shifts in loan demand or loan supply, no explicit insight is given as to why the loan demand or loan supply functions might shift. No specific exogenous variables are linked to the ultimate changes in equilibrium interest rate and loan size variables.

In this section, a mathematical model is developed to establish the linkages between legal lending limits and other variables and the availability of credit to agricultural borrowers. The model consists of an aggregate loan demand equation and an aggregate loan supply equation for a rural banking market. An excess loan demand equation is derived and the comparative statics of the model are analyzed. The mathematical analysis is confined to those cases in which loan supply is perfectly inelastic as a result of legal lending limits. That is, it is assumed that the loan demand curve intersects the loan supply curve above the kink. Also, only the cases involving flexible and fixed interest rates are examined. The situations involving sticky interest rates require a dynamic analysis and are beyond the scope of this study.

A simple market loan demand equation is employed, where loan demand is a decreasing function of the average of interest rates on farm loans charged by banks in the market:

$$L^D = e - Br; \; e, B > 0 \qquad (3.1)$$

where:

L^D = dollar quantity of agricultural loans demanded in the rural banking market,

e = intercept term, and

r = average of interest rates on farm loans.

The intercept term is assumed to include the effects of such factors as farm input prices and prices received for farm products. As such, "e" is a shift parameter accounting for parallel shifts in agricultural loan demand caused by changes in (among other factors) prices paid and prices received by the farm sector. For simplicity, it is also assumed that the rural banks' customers are identical in farm size so that individual loan demands are identical.

In this model, because loan supply in the market is assumed to be pressing up against the lending-limit ceiling, loan supply is no longer a function of an interest rate term. With this assumption, loan supply is:

$$L^S = mn\, l_o K \qquad (3.2)$$

where:

L^S = dollar quantity of agricultural loans supplied in the rural banking market,

m = number of banks in the market,

n = number of farm customers serviced by each bank,

l_o = percentage legal lending limit, and

K = individual bank's eligible capital account.

Note that the term l_oK represents the maximum loan supply to an individual borrower at a particular bank. Aggregate loan supply is then m, the number of banks, multiplied by n, the number of farm customers, multiplied by l_oK, the maximum.

It is further assumed that the total farm acreage in the rural banking market is constant over time and can be expressed as:

$$\bar{A} = mna \qquad (3.3)$$

where:

$\bar{A}$ = total farm acreage in the rural banking market, and

a = average farm size in the rural banking market.

Solving (3.3) for mn, and substituting in (3.2) yields:

$$L^S = \frac{\bar{A}}{a} l_oK. \qquad (3.4)$$

Equation (3.4) represents the maximum loan supply in the banking market under lending limits.

The excess loan demand equation in this simple model can be formulated by subtracting (3.4) from (3.1):

$$X = L^D - L^S = e - Br - \frac{\bar{A}}{a} l_oK \qquad (3.5)$$

where:

X = excess loan demand.

In Equation (3.5), the variables e, a, and K are exogenous, while r and X are endogenous. To ascertain the effects of changes in the variables on excess loan demand in Equation (3.5), the total differential of (3.5) is taken:

$$dX = de - Bdr + \frac{\bar{A}}{a^2} l_o K\, da - \frac{\bar{A}}{a} l_o\, dK. \qquad (3.6)$$

Equation (3.6) can be examined under the cases of flexible and fixed interest rates. The situation of equilibrium under flexible interest rates is undertaken first. Then, the case of equilibrium under fixed interest rates is discussed. Finally, the situation of disequilibrium under fixed interest rates is presented.

<u>Equilibrium under flexible interest rates</u>

In the case of flexible interest rates, it is assumed that $dr \neq 0$. Interest rates can adjust to exogenous shocks to preserve equilibrium and cause $dX = 0$. Thus, with flexible interest rates,

$$de - Bdr + \frac{\bar{A}}{a^2} l_o K\, da - \frac{\bar{A}}{a} l_o\, dK = 0. \qquad (3.7)$$

It is possible to look at the effects of changes in e, a, and K on r. Assume first that $da = 0$ and $dK = 0$ in Equation (3.7) to analyze the effect of a change in e on r.

This yields:

$$\frac{dr}{de} = \frac{1}{B} > 0. \qquad (3.8)$$

Thus a _ceteris paribus_ increase (decrease) in the shift parameter, e, due to say an increase (decrease) in farm input prices, raises (lowers) the loan rate term, r. As farm input prices rise (fall), loan demand increases (decreases). With loan supply remaining constant, and loan demand increasing (decreasing), the loan rate term increases (decreases). This is the case shown in Figures 3.2 and 3.3, where the loan demand curve shifts with no change in the loan supply curve.

Similarly, by letting de = 0 and dK = 0, it is possible to determine the effect of a change in a on r. This yields:

$$\frac{dr}{da} = \frac{\bar{A}\, l_o K}{a^2 B} > 0. \qquad (3.9)$$

Equation (3.9) states that a _ceteris paribus_ increase (decrease) in average farm size, a, increases (decreases) the loan rate term, r. As the average farm size increases (decreases), the number of farm customers decreases (increases) and thus loan supply decreases (increases). With loan demand remaining constant and loan supply decreasing (increasing), the loan rate term increases (decreases). This is the situation depicted in Figures 3.2 and 3.3, where the loan supply curve shifts with no change in the loan demand curve.

Finally, letting de = 0 and da = 0, the effect of a change in K on r can be analyzed. This result is:

$$\frac{dr}{dK} = - \frac{\bar{A}\ l_o}{aB} < 0. \qquad (3.10)$$

Equation (3.10) shows that an inverse relationship exists between K and r; that is, a ceteris paribus increase (decrease) in a bank's eligible capital account, K, lowers (raises) the loan rate term, r. This result occurs because loan supply increases (decreases) as a bank's eligible capital account increases (decreases). With loan demand unchanged, an increase (decrease) in loan supply causes a decrease (increase) in the loan rate term. This also is the case shown in Figures 3.2 and 3.3, where the loan supply curve shifts while the loan demand curve is unchanged.

Equilibrium under fixed interest rates

Because of institutional constraints, interest rates may be fixed. This requires setting dr = 0 in Equation (3.7). It is possible that equilibrium can be attained in a fixed-rate scheme, that is, dX = 0. The effects of changes in e, a, and K can then be investigated to determine equilibrium conditions under fixed interest rates. Assume first that dK = 0, so that the changes in e and a can be analyzed. This yields:

$$da = - \frac{a^2}{\bar{A}\ l_o K}\ de. \qquad (3.11)$$

Because all the variables in the fixed-interest-rate case are exogenous, the equations in this section are in differential form. Derivatives are not used because a change in one exogenous variable does not cause a change in another exogenous variable.

Equation (3.11) stated that a ceteris paribus increase (decrease) in e, due to say, an increase (decrease) in farm input prices must be accompanied by a proportional decrease (increase) in average farm size, a, for excess loan demand to be satisfied. By what factor a must change in order to offset a change in e depends upon the value of the coefficient of de. If farm input prices increase (decrease) causing loan demand to increase (decrease), then with interest rates and a bank's eligible capital account fixed, the only way for excess loan demand to be eliminated in the model is through a decrease (increase) in average farm size. With legal lending limits, a decrease (increase) in average farm size causes loan supply to increase (decrease) by increasing (decreasing) the number of farm customers. With interest rates fixed, an increase (decrease) in loan demand must be exactly offset by an increase (decrease) in loan supply for excess loan demand to be satisfied. In the present case, where only a and e are allowed to change, this means that a must change in proportion to e as set out in Equation (3.11). Graphically, in terms of Figures 3.6 and 3.8, the increase (decrease) in e causes the loan demand curve to shift rightward (leftward). In order to compensate for this rightward (leftward) shift in the loan demand curve, a decreases (increases), causing the loan supply curve to shift rightward (leftward).

Assume next that da = 0, so that an analysis of changes in e and K can be made. This result is:

$$dK = \frac{a}{\bar{A}\ l_o}\ de \ . \qquad (3.12)$$

Equation (3.12) says that a <u>ceteris paribus</u> increase (decrease) in e must be accompanied by a proportional increase (decrease) in a bank's eligible capital account, K, in order for excess loan demand to be satisfied. The size of the coefficient of de determines by what factor K must change in order to offset a change in e. With fixed interest rates and fixed average farm size in the model, as farm input prices increase (decrease) causing loan demand to increase (decrease), a bank's eligible capital account must increase (decrease) causing loan supply to increase (decrease) so that excess loan demand is met.

Further, with just K and e allowed to change, an increase (decrease) in farm input prices must be matched by the proportional increase (decrease) in a bank's eligible capital account as set out in Equation (3.12).

This situation can be shown graphically in terms of Figures 3.6 and 3.8. For the rightward (leftward) shift in the loan demand curve caused by an increase (decrease) in farm input prices, a compensating rightward (leftward) shift in the loan supply curve caused by, in this case, an increase (decrease) in a bank's eligible capital account is needed to attain equilibrium at the fixed level of interest rates.

Finally, assume that de = 0 in order that an analysis of changes in a and K may be made. This yields:

$$dK = \frac{K}{a} da. \tag{3.13}$$

Equation (3.13) states that a _ceteris paribus_ increase (decrease) in average farm size, a, must be accompanied by a proportional increase (decrease) in a bank's eligible capital account, K. for excess loan demand to be satisfied. The size of an increase (decrease) in K needed to offset the increase (decrease) in a depends upon the size of the coefficient of da. With interest rates and farm prices received and paid fixed, as average farm size increases (decreases) and causes a decrease (increase) in loan supply, a bank's eligible capital account must proportionally increase (decrease) to cause loan supply to increase (decrease), thereby offsetting the effect of the change in average farm size. If these changes in a and K are attained as set out in Equation (3.13), then excess loan demand will be zero.

Graphically, the situation may be seen by use of Figures 3.5, 3.6, 3.7, 3.8 and 3.9. Although none of the figures shows a shift in the loan supply curve, a shift in the initial loan supply curve could be drawn. Suppose a leftward (rightward) shift in the loan supply curve occurs because of an increase (decrease) in average farm size. Then to get the loan supply curve back to its original position, a proportional increase (decrease) in a bank's eligible capital account must occur, causing the loan supply curve to shift rightward (leftward) to its initial level.

Under the analysis of fixed interest rates, one point to note is that, in each case, if the changes in the exogenous variables as stated in Equations (3.11), (3.12), and (3.13) are not met exactly by changes in other exogenous variables, permanent credit rationing may occur. If no further adjustments take place, then farm customers will have to look to other sources to satisfy their demand for credit.

Disequilibrium under fixed interest rates

In this section, disequilibrium is allowed to occur so that excess demand for loans (credit rationing) can be linked to the exogenous variables in the model. The disequilibrium case will be analyzed under the situation of fixed interest rates only. As shown above, if interest rates are flexible, then the rural banking market can adjust farm loan rates so that no excess demand exists in the market for loans.

With the inclusion of excess demand and fixed interest rates, the total differential of Equation (3.6) becomes:

$$dX = de + \frac{\bar{A}}{a^2} l_o K\, da - \frac{\bar{A}}{a} l_o dK. \qquad (3.14)$$

Assume first that da = 0 and dK = 0, so that the changes in e and X can be analyzed. This yields:

$$\frac{dX}{de} = 1 > 0. \qquad (3.15)$$

It is seen from Equation (3.15) that a *ceteris paribus* increase (decrease) in the shift parameter, e, causes a corresponding increase (decrease) in excess demand. Thus, credit rationing is increased. With no increase in loan supply provided by the rural bank and fixed interest rates, any increase in loan demand brought about by an increase in farm input prices leads to increased credit rationing.

Graphically, an increase in farm input prices causes the loan demand curve to shift to the right. Figures 3.5, 3.6 and 3.8 show this situation.

Similarly, to analyze the effects of changes in a and X, let de = 0 and dK = 0. This result is:

$$\frac{dX}{da} = \frac{\bar{A}\ l_o K}{a^2} > 0. \qquad (3.16)$$

Equation (3:16) states that a *ceteris paribus* increase (decrease) in average farm size, a, causes a proportional increase (decrease) in excess demand. As average farm size increases, the number of farm customers decreases, and because of lending limits, loan supply in the banking market decreases. The loan supply curve shifts leftward for increases in average farm size, and with no shifts in the loan demand curve, increased credit rationing occurs.

Finally, assume that de = 0 and da = 0, so that changes in K and X can be analyzed. This yields:

$$\frac{dX}{dK} = - \frac{\bar{A}\ l_o}{a} < 0. \qquad (3.17)$$

Equation (3.17) says that a *ceteris paribus* increase (decrease) in a bank's eligible capital account, K, causes a proportional decrease (increase) in excess demand. As banks' eligible capital accounts increase (decrease), loan supply in the banking market increases (decreases), with no shifts in the loan demand curve, excess demand decreases (increases). Thus, under fixed interest rates, disequilibrium in the loan market (credit rationing) may occur.

Summary

A mathematical model was developed to investigate the effects of lending limits on the availability of credit to rural borrowers. Under the case with flexible interest rates on farm loans, no problems of meeting changes in loan demand were encountered in the rural banking market, as interest rates adjusted to clear the loan market. But for the situation of fixed interest rates, the possibility of credit rationing existed. It was further seen that in order for changes in excess loan demand to be satisfied under fixed interest rate conditions, certain proportional and simultaneous changes in exogenous variables had to be fulfilled. If these changes were not met, then disequilibrium in the loan market occurred and credit rationing existed.

CHAPTER IV. AN EMPIRICAL ADAPTATION OF THE THEORETICAL MODEL

In the development of the theoretical model, an excess loan demand equation was derived, in which excess loan demand depended upon a shift parameter (which included the effect of such factors as prices paid by the farm sector), the average of interest rates on farm loans, the average farm size in the rural bank market area, and the size of the rural banks' eligible capital accounts. The total differential of the excess loan demand equation was derived as:

$$dX = de - Bdr + \frac{\bar{A}}{a^2} l_o K\, da - \frac{\bar{A}}{a} l_o\, dK, \qquad (4.1)$$

and the comparative statics of the model were analyzed. To investigate the relationships among the variables of the mathematical model, it is necessary to quantify the variables and select an appropriate statistical model for the analysis.

An empirical measurement of the excess demand for loans is presented first and then the statistical model and an empirical measurement of factors affecting excess demand for loans is given. Next, an explanation of the use of probit analysis with multiple regression is presented. Finally, a discussion of the expected signs of the independent variables, as implied from theory, is given.

Empirical Measurement of Excess Demand for Loans

A problem with an empirical analysis of the theoretical excess demand construct is that information on individual loans is unavailable. Furthermore, proxy measures of excess loan demand, as was noted in the discussion of the credit rationing literature, are difficult to develop and may be inadequate.

One source of data that is available to analyze excess loan demand is a survey of agricultural banks[1] in the Seventh Federal Reserve District[2] by The Federal Reserve Bank of Chicago. As in the discussion of the mathematical model, which incorporated the effect of legal lending limits at the individual bank level, the Chicago Fed survey asks about banks' individual legal lending limits in relationship to customer credit needs. The following question was asked of the banks in the survey: "Compared to five years ago (end of 1974 compared to end of 1979), is the number of actual or potential farm customers in your area whose credit needs exceed your bank's individual legal lending limit higher,

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[1]Agricultural banks, in this survey, are banks that have 50 percent or more of their total loans in farm loans.

[2]The Seventh Federal Reserve District includes Iowa, and parts of Illinois, Indiana, Michigan, and Wisconsin.

lower, or unchanged?" The survey was answered by 526 banks, of which 276 banks reported more farm customers, 39 banks reported fewer farm customers, and 211 banks reported no change in the number of farm customers from 1974 to 1979 whose credit needs exceeded their bank's individual legal lending limit. Because very few banks responded that they had fewer farm customers in their area whose credit needs exceeded their individual legal lending limit in 1979 than in 1974, it was decided to combine the banks reporting no change in the number of farm customers with those banks reporting fewer farm customers. Thus, the responses show that 276 banks reported more farm customers in their area whose credit needs exceeded their bank's individual legal lending limit in 1979 than in 1974, and 250 banks reported not more (either less or no change in the number of) farm customers in their area whose credit needs exceeded their bank's individual legal lending limit in 1979 than in 1974.

The responses from the Chicago Fed survey can be used as an indicator of excess demand for loans. If a bank reported that it had more farm customers in its market area in 1979 than in 1974 whose credit needs exceeded the bank's individual legal lending limit, then a greater excess demand for loans, in terms of legal lending limits, occurred at the bank in 1979 than in 1974. Conversely, if a bank reported that it had fewer, or the same number of, farm customers in its market area in 1979 than in 1974 whose credit needs exceeded the bank's individual legal lending limit, then excess demand for loans, in terms of legal lending limits, remained the same or decreased over the 1974 to 1979 time interval.

For modelling purposes, the responses were categorized as 0, 1 variables, where:

Response = 0 if the bank reported not more farm customers in its area whose credit needs exceeded the bank's individual legal lending limit in 1979 than in 1974, and;

Response = 1 if the bank reported more farm customers in its area whose credit needs exceeded the bank's individual legal lending limit in 1979 than in 1974.

Because this response is an indicator of changes in excess demand for loans, it is treated as the dependent variable in the statistical model.

Empirical Measurement of Factors Affecting Excess Demand For Loans

In the discussion of the empirical measurement of factors affecting excess demand for loans, the statistical model will first be presented. Then an explanation of each independent variable of the model will be given.

Statistical model

Because the dependent variable measures a reponse that indicates a change in lending difficulty (in terms of a bank's individual legal lending limit) from 1974 to 1979, the independent variables used to explain this response are also expressed as differenced variables over the same time period. The statistical model to be fit is as follows:

$$Y_i = \alpha + B\Delta AFS_i + \gamma\Delta MV_i + \rho\Delta APE_i + \psi\Delta U_i + \tau\Delta K_i + \delta D_i + \varepsilon_i, \quad i = 1,\ldots,526 \qquad (4.2)$$

where:

Y_i = response variable of rural bank "i";

α = intercept term;

AFS_i = average farm size in the area serviced by rural bank "i";

MV_i = per-acre market value of agricultural products sold in the area serviced by rural bank "i";

APE_i = per-acre agricultural production expenses in the area serviced by rural bank "i";

U_i = utilization of capacity of farmland in the area serviced by rural bank "i", measured as total cropland/total land in farms;

K_i = eligible capital account of rural bank "i";

D_i = dummy variable for bank type, where

D_i = 0 if rural bank "i" is a unit bank,

D_i = 1 if rural bank "i" is a branch bank;

ε_i = error term, assumed to be uncorrelated with the independent variables; and the Δ's indicate changes in the independent variables. The independent variables MV_i, APE_i, and U_i can be thought of as scale variables, as represented by the variable "e" of the loan demand equation in the mathematical model. The independent variables K_i and D_i represent the bank capital variables and reflect the size and type of bank. The dummy variable for bank type enters into the analysis because of its relationship to bank capital stock. If a bank is part of a branching system, then the capital base applicable for lending limits is that for the entire branching system and not just for the individual bank.

Independent variables in the model

Average farm size The average size of farm, measured in acres, is taken from the Census of Agriculture reports for 1974 and 1978.[1] The data are on a county basis. The farms used in this study had sales of $2,500 or more, because the farms with larger operations are the farms likely to have borrowing requirements exceeding a rural bank's individual legal lending limit.

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[1]The Census of Agriculture reports normally come out once every five years, which would have meant a census in 1979. An extrapolation of the farm data to 1979 was not performed because of the lack of observations from previous censuses.

Market value of agricultural products sold   The market value of agricultural products sold, which is a measure of farm income, is denominated in dollars per-acre and is also taken from the Census of Agriculture county reports. It includes the value of crops, livestock and livestock products, and poultry and poultry products.

Agricultural production expenses   Agricultural production expenses are also measured in dollars per-acre and again are taken from the Census of Agriculture county reports. These production expenses include livestock and poultry purchases, feed purchases for livestock and poultry, animal health costs, seeds, bulbs, plants, and trees purchased, commercial fertilizer and other agricultural chemical costs, hired farm and contract labor costs, customwork and machine hire costs, and gasoline and other petroleum products purchased.

Utilization of capacity of farmland   The utilization of capacity of farmland is defined as the ratio $\frac{\text{total cropland}}{\text{total land in farms}}$. Total cropland and total land in farms are measured in acres. The data are taken from the Census of Agriculture county reports.

Eligible capital account The eligible capital account, to which dollar lending limits are related, varies for state and national banks. For the state banks in the Seventh Federal Reserve District, the eligible capital account varies from 15 to 20 percent of a bank's common stock, preferred stock, surplus, and subordinated notes and debentures. For national banks, the eligible capital account is 10 percent of a bank's common stock, preferred stock, surplus, subordinated notes and debentures, undivided profits, one-half of reserve for loan losses, and reserve for contingencies. Table 2.1 shows the eligible capital accounts for national and state banks in the Seventh Federal Reserve District in detail. Data for capital accounts were taken from Call Reports of the Board of Governors of the Federal Reserve System.

Dummy variable for bank type To capture differences in responses between unit and branch banks, a dummy variable for bank type was included in the model. For a unit bank, the dummy variable is set equal to zero, and for a branch bank, the dummy variable is set equal to one. Data for the dummy variable for bank type were obtained from the Federal Reserve Bank of Chicago.

Adjustment for market areas

Each of the farm variables (AFS, MV, APE, and U) should be measured for the area which a rural bank services. The farm data obtained from the Census of Agriculture are given on a county basis. However, the market area a rural bank services and the county in which the bank is located may not be one and the same. Thus, some adjustment to county data is appropriate to capture the nature of banking markets. The following arbitrary scheme was devised:

If a rural bank is close (a distance of ten miles or less), to a neighboring county, then that county's farm data is assumed to exert an influence on the rural bank's loan demand. The county in which a rural bank is located, however, is assigned a greater weight than neighboring counties. Specifically, a weight $\frac{2}{n+1}$, where n is the number of counties (including the county containing the rural bank) exerting an influence on the rural bank's loan demand is assigned to the county in which the rural bank is located, and a weight $\frac{1}{n+1}$ is assigned to each neighboring county exerting an influence on the rural bank's loan demand.

As an example, suppose that a rural bank is located in the corner of county A such that counties B, C, and D are within ten miles of the bank. Thus, n = 4. Then the data of county A is assigned a weight of two-fifths and the data of counties B, C, and D are each given a weight of one-fifth.

Use of Probit Analysis with Multiple Regression

In most cases in which an analysis of economic survey data is performed, the dependent variable can take on a large number of possible values along a natural scale. For dependent variables of this type, the theory of multiple regression provides an appropriate statistical model. However, if the dependent variable is dichotomous, that is, it can take on only two values (usually 0 and 1), then the use of multiple regression is inappropriate. By definition, the expected value of a dichotomous dependent variable must always fall in the interval (0, 1), regardless of the values of the independent variables. In multiple regression, however, because the expected value of the dependent variable is assumed to be a linear combination of the independent variables, the expected value of the dependent variable could fall outside the (0, 1) interval. That would violate the condition of the (0, 1) interval for the expected value of a dichotomous dependent variable.

Probit analysis provides an appropriate model to constrain the expected value of the dichotomous dependent variable to the (0, 1) interval. The probit analysis model has a long history in biometrics (see, for example, Finney, 1971). In biological assay, probit analysis is used to determine the relationship between the probability that organisms will be killed to the strength of the dose of poison administered to them. The dependent variable, for each organism in the sample, is dichotomous: killed or not killed. Moreover, each organism is assumed to have a dosage threshold, such that a stronger dose will kill that organism and a weaker dose will not. Over the population of organisms of a given kind, the logarithms of these dosage thresholds are assumed to be normally distributed, with mean and standard deviation estimated from the data by maximum likelihood.

In econometrics, the probit analysis model is relatively new. Farrell (1954) applied probit analysis to economic survey data to analyze the relationship between ownership of automobiles and income. In Farrell's application, the dependent variable is defined by whether or not the household owned a car of a given age or younger. Each household is assumed to have an income threshold, such that if its income is larger than the critical value, the household owns a car, while if its income is below the threshold, the household does not own a car. The logarithms of the income thresholds are assumed to be normally distributed. The parameters of the distribution are estimated by maximum likelihood from data giving the number of sample households observed to own and not to own a car at various income levels.

In Farrell's application, there is only one independent variable, income, to which the dependent variable, probability of car ownership, is related. Typically, economic relationships involve two or more independent variables to which the dependent variable is related. Tobin (1955) defines the maximum likelihood estimators and shows an iterative estimation procedure for the application of multivariate probit analysis to economic survey data. Tobin develops an index I, which is a linear combination of the independent variables, that determines whether the dependent variable has the value 0 or 1. He then establishes a critical value for the index. If the actual value of the index equals or exceeds the critical value for the index, then, the dependent variable will be 1; if the actual value of the index is less than the critical value for the index, then the dependent variable will be 0.

The critical values of the index are assumed to be normally distributed over the population. Then Tobin determines the probability that, given the index I, the dependent variable for each element of the population will be equal to 1, and the probability that, given the index I, the dependent variable for each element of the population will be equal to 0. Tobin then determines the maximum likelihood estimates and shows an iterative estimation procedure for the model.

Probit analysis thus yields an estimate of the probability that the dependent variable occurs, given the thresholds of the independent variables. As applied to this study, probit analysis gives an estimation of the probability that a rural bank had more farm customers whose credit needs exceeded the bank's individual legal lending limit in 1979 than in 1974, given the thresholds of the various independent variables of the model.

To illustrate the application of probit analysis to bank survey response, let I be an index which is a linear function of the regressors: $I_t = X_t'B$, let I* be a N(0, 1) variable, and let the value of y_t be determined as follows:

$$y_t = 1 \quad \text{if} \quad I_t \geq I_t^*$$
$$y_t = 0 \quad \text{if} \quad I_t < I_t^*. \qquad (4.3)$$

Each y_t is thus a function of the X_t's (via I_t) and of I_t^*. The I_t^*'s, which play the role of disturbances, may be interpreted as critical values of the index. If, for example, "y" = bank survey response, and "x" = change in agricultural production expenses from 1974 to 1979 in the area serviced by a bank, an individual bank with a high I* would respond that it had more farm customers whose credit needs exceeded its individual legal lending limit in 1979 than in 1974 only if the change in agricultural production expenses from 1974 to 1979 is so high that $I_t \geq I_t^*$. An analogous interpretation can be given for the other independent variables in the model.

Letting $F(z)$ = value of the standard normal cumulative distribution at z yields:

$$\text{Prob}\{y = 1/I\} = \text{Prob}\{I^* \leq I/I\} = F(I) \tag{4.4}$$

and

$$\text{Prob}\{y = 0/I\} = \text{Prob}\{I^* > I/I\} = 1-F(I), \tag{4.5}$$

in view of the fact that I* is N(0, 1). The fact that I, and hence the probabilities, is a function of the B's suggests maximum likelihood estimation of the B's. Without loss of generality, suppose the survey sample is ordered so that the first S observations have y = 1, and the remaining T-S observations have y = 0. Then the likelihood of the sample is:

$$H = F(I_1) \ . \ . \ . \ F(I_s) \cdot [1-F(I_{s+1})] \ . \ . \ . \ [1-F(I_T)] \tag{4.6}$$

with logarithmic likelihood:

$$L = \sum_{t=1}^{s} \log F(I_t) + \sum_{t=s+1}^{T} \log[1-F(I_t)] \tag{4.7}$$

in which each term is a function of the B's:

$$F(I_t) = (2\pi)^{-\frac{1}{2}} \int_{-\infty}^{X_t'B} e^{-u^2/2}\, du. \tag{4.8}$$

Setting the derivatives of the logarithmic likelihood equation with respect to the B's equal to zero gives the normal equations determining the maximum likelihood estimators, the B's. The normal equations are, of course, nonlinear.

In the probit model, the conditional expectation is given by:

$$E(y_t/I_t) = \text{Prob}\ \{y_t = 1/I_t\} = F(I_t), \qquad (4.9)$$

the ordinate of the cumulative normal distribution, which necessarily falls in the unit interval, and which forms an S-shaped curve. The estimated expectation is $\hat{y}_t = F(\hat{I}_t) = F(X_t'\hat{\beta})$, which has the same properties. Through the use of the standard normal cumulative distribution developed earlier and the density function for the standard normal random variable, the coefficients of the probit equation are transformed so that an interpretation of the coefficients, similar to those obtained in ordinary least squares regression, is obtained.

Hypothesized Signs of the Independent Variables

From the theoretical model, the hypothesized sign of the average-farm-size variable is positive. This means that the larger the increase in average farm size in the area serviced by a rural bank, the more likely it is that more farm customers' borrowing requirements exceed the bank's individual legal lending limit.

The sign on the variable market value of agricultural products sold is ambiguous. If the sign is negative, then the larger the increase in the market value of agricultural products sold, the less likely it is that more farm customers' credit needs exceed the bank's individual legal lending limit. Because the market-value variable is a farm-income variable, a negative sign indicates that farm income is being used as a substitute for borrowing. If the sign on the market-value variable is positive, then the larger the increase in the market value of agricultural products sold, the more likely it is that the rural bank has more farm customers with credit needs exceeding its individual legal lending limit. In this case, the market-value variable and loan demand are complements. That is, as the market-value of agricultural products sold increases, loan demand increases, perhaps because the farm operation is expanding. The results of Sealey (1979) indicate that the sign on the market-value variable is positive.

The expected sign on the agricultural-production-expenses variable is positive. The larger the increase in agricultural production expenses in the area serviced by a rural bank, the more likely it is that the rural bank has more farm customers with credit needs in excess of its individual legal lending limit.

The sign on the utilization-of-capacity variable is expected to be positive. This indicates that the more intensively farmland is cultivated in the area serviced by a rural bank, the more likely it is that the rural bank has more farm customers with borrowing requirements exceeding its individual legal lending limit.

The expected sign on the eligible-capital-account variable is negative. That is, the larger the increase in a rural bank's eligible capital account, the less likely it is that the rural bank has more farm customers whose credit needs exceed its individual legal lending limit.

The expected sign on the bank-type-dummy variable is negative. Because a branch bank has a larger eligible capital account to draw from than does a unit bank, a branch bank should be less likely to have more farm customers with credit requirements in excess of its individual legal lending limit than a unit bank.

CHAPTER V. EMPIRICAL RESULTS

Introduction

In Chapter IV, it was hypothesized that the variables of average farm size, a bank's eligible capital account, agricultural production expenses, market value, utilization of capacity of farmland, and bank type (branch or unit) were significant variables in an explanatory model of banks' survey responses to whether or not their banks had more farm customers whose credit requirements exceeded their legal lending limits in 1979 than in 1974. A multivariate probit model was formulated as follows to estimate the parameters involved in these relationships:

$$Y_i = \begin{cases} 0, & \text{if } I_i < I_i^*, \text{ for all } i, i=1,2,\ldots,526 \\ 1, & \text{if } I_i \geq I_i^* \end{cases} \quad (5.1)$$

where:

Y_i = the response of the ith bank,

$I_i = \alpha + B_1\Delta AFS_i + B_2\Delta EKA_i + B_3\Delta APE_i + B_4\Delta MV_i + B_5\Delta UC_i + B_6D_i,$

I_i^* = the threshold level of the ith bank,

AFS_i = average farm size in the market area serviced by the ith bank,

EKA_i = eligible capital account of the ith bank,

APE_i = agricultural production expenses in the market area serviced by the ith bank,

MV_i = market value of agricultural products sold in the market area serviced by the ith bank,

UC_i = utilization of capacity, that is, the ratio of total acres of cropland to total acres in farmland, in the market area serviced by the ith bank, and

D_i = dummy variable for bank type of the ith bank, where

D_i = 0 if the ith bank is a unit bank,
= 1 if the ith bank is a branch bank.

The Δ's indicate changes in the variables from 1974 to 1978.

In the next section, a presentation of the statistical results is given. The parameter estimates for the full data set, as well as for partitions of the data set are presented. Also, the results for selected deposit size classes are given.

Statistical Results

The statistical model was first estimated using the full data set. Then, because of the differences in farming operations, the model was run for the Corn-Belt states (Illinois, Indiana, and Iowa) and for the states of Michigan and Wisconsin. The results of the three models are presented in Table 5.1. The correlation coefficient matrices for the independent variables of the models are given in the Appendix, and do not give evidence of multicollinearity.

As Table 5.1 shows, the variables of eligible capital account and dummy variable for bank type are highly

Table 5.1. Probit estimates for Seventh District states (Full) model, Corn-Belt states (C-B) model,[a] and Michigan-Wisconsin (M-W) model[b]

Independent variables	Models		
	Full	C-B	M-W
Constant term	.0775	.0903	.1436
	(.78)[c]	(.48)	(.25)
Average farm size	-.0039	-.0044	.007
	(.58)	(.18)	(.13)
Eligible capital account	-.0013	.0007	-.0006
	(.01)	(.01)	(.02)
Agricultural production expenses	.0116	.018	-.0116
	(.09)	(.01)	(.03)
Market value of agricultural products sold	-.0036	-.0019	.0031
	(.30)	(.26)	(.20)
Utilization of capacity of farmland	-10.43	-5.69	.9847
	(.09)	(.12)	(.76)
Dummy variable for bank type	-.3229	-.1492	-.0162
	(.01)	(.01)	(.86)

[a]Includes the parts of Illinois, Indiana, and Iowa that are located in the Seventh Federal Reserve District.

[b]Includes the parts of Michigan and Wisconsin that are located in the Seventh Federal Reserve District.

[c]Figures in parentheses indicate levels of significance for the coefficients.

significant in explaining banks' survey responses for the Full model. The variables of agricultural production expenses and utilization of capacity of farmland are also significant (at the 10 percent level) in explaining banks' survey responses, but the sign on the utilization-of-capacity-of-farmland variable is not as hypothesized. On the other hand, the variables of market value of agricultural products sold and average farm size performed poorly. The negative sign on the coefficient of the market-value-of-agricultural-products-sold variable indicates that an increase in farm income is associated with banks reporting that they had fewer farm customers in 1979 than in 1974 whose credit needs exceeded legal lending limits. However, the coefficient of the market-value-of-agricultural-products-sold variable is insignificant in explaining banks' survey responses.

The performance of the average-farm-size variable is particularly disappointing. Not only is the average-farm-size variable highly insignificant in explaining banks' survey responses, it is also of the wrong sign.

The Corn-Belt states (C-B) Model also exhibits highly significant coefficients on the eligible-capital-account and bank-type-dummy variables. However, the sign on the eligible-capital-account variable is wrong. This is puzzling, given that an increase in a rural bank's eligible capital account should serve to decrease the number of farm customers exceeding a bank's legal lending limit.

The performance of the agricultural-production-expenses variable in the C-B Model is better than in the Full Model. The coefficient on the agricultural-production-expenses variable exhibits the postulated sign (positive) and a high level of significance (1 percent level).

The coefficients of the average-farm-size and market-value-of-agricultural-products-sold variables in the C-B Model show a higher level of significance than the coefficients of the Full Model, but are still below the 10 percent significance level. The sign on the coefficient of the average-farm-size variable is also incorrect. Similarly, the sign on the coefficient of the utilization-of-capacity-of-farmland variable is incorrect.

The Michigan-Wisconsin (M-W) Model shows the coefficient on the eligible-capital-account variable to be highly significant and of the correct sign. The coefficient on the bank-type-dummy variable, however, is highly insignificant. On the other hand, the sign on the coefficient of the agricultural-production-expenses variable is incorrect, but registers significance at the 3 percent level.

The sign on the coefficient of the average-farm-size variable is correct in the M-W Model and approaches the 10 percent level of significance. Both the coefficients of the market-value-of-agricultural-products-sold variable and the utilization-of-capacity-of-farmland variable have positive signs, but are insignificant.

To determine if differences exist in banks' survey responses because of variations in bank size (as measured by the level of total deposits), the model was estimated for three deposit size classes: banks with less than $15 million in deposits (as of year end 1979); banks with deposits greater than or equal to $15 million and less than or equal to $50 million; and, banks with deposits greater than $50 million. The results of the three models are presented in Table 5.2. The correlation coefficient matrices for the independent variables of the three models are given in the Appendix and do not show evidence of multicollinearity.

The results of the model for the smallest deposit size class in Table 5.2 indicate a high level of significance for the bank-type-dummy variable. The sign on the coefficient of the eligible-capital-account variable is correct, but the coefficient of the eligible-capital-account variable barely misses significance at the ten percent level. Similarly, the sign on the coefficient of the agricultural-production-expenses variable is correct, but the significance level of the coefficient falls beyond the 10 percent level.

Table 5.2. Probit estimates for selected deposit size (DS) classes of Seventh Federal Reserve District states[a] (in millions of dollars)

Independent variables	Models DS<15	15≤DS≤50	DS>50
Constant term	.2012 (.20)[b]	.1609 (.23)	.1901 (.26)
Average farm size	-.0067 (.21)	.0017 (.68)	-.0026 (.57)
Eligible capital account	-.0028 (.13)	-.0002 (.74)	.0004 (.07)
Agricultural production expenses	.0064 (.14)	.0038 (.37)	-.0005 (.93)
Market value of agricultural products sold	-.0036 (.09)	-.0015 (.48)	.0022 (.43)
Utilization of capacity of farmland	-14.51 (.01)	1.54 (.88)	-6.24 (.12)
Dummy variable for bank type	-.3066 (.01)	-.1662 (.01)	.0031 (.98)

[a]Deposit size as of yearend 1979.

[b]Figures in parentheses indicate levels of significance for the coefficients.

The coefficients of the market-value-of-agricultural-products-sold variable and the utilization-of-capacity-of-farmland variable are significant at the 10 percent level. However, the sign on the coefficient of the utilization-of-capacity-of-farmland variable is incorrect. The average-farm-size variable again performs poorly, with its coefficients exhibiting a lack of significance and the incorrect sign.

The model for the medium deposit size class also shows a high level of significance for the bank-type-dummy variable. None of the other variables exhibits significance at the 10 percent level, but the coefficients of all variables, including average farm size, are of the correct sign.

None of the coefficients of the variables in the model for the large deposit size class are of the correct sign. Only one of the variables (eligible capital account) has a coefficient significant at the 10 (or less) percent level. Of particular note is the extremely high insignificance level of the coefficient on the bank-type-dummy variable.

CHAPTER VI. SUMMARY AND CONCLUSIONS

Summary

The purpose of this study has been to investigate the effects of lending limits on the availability of credit to agricultural borrowers. A graphical and simple theoretical analysis incorporating the effects of lending limits on agricultural credit were developed. The theoretical model related excess demand for loans in a rural banking market to average farm size, size of banks' eligible capital accounts, and a shift parameter.

A statistical model was developed to modify the simple theoretical model by employing bank survey responses. The survey responses were to a question asking if a bank had more (or less) farm customers in 1979 than in 1974 whose credit requirements exceeded the bank's lending limit. The survey sample included 526 banks from those parts of Illinois, Indiana, Iowa, Michigan, and Wisconsin in the Seventh Federal Reserve District.

The bank survey responses were used as an indication of excess loan demand. Bank survey response was taken as the dependent variable and was regressed on average farm size, agricultural production expenses, market value of agricultural products sold, utilization of capacity of farmland, a bank's eligible capital account, and a dummy variable for bank type. Separate estimations were made for six different models--a Full Model which included the full data set, a model for the states of Illinois, Indiana, and Iowa, a model for the states of Michigan and Wisconsin, and three models for selected deposit size classes.

The empirical results show that the eligible-capital-account and bank-type-dummy variables are highly significant in explaining bank survey responses in the Full Model. The agriculture-production-expenses variable is also found to be significantly related to bank survey response in the Full, as well as in the Corn-Belt states, Model. The average-farm-size and the utilization-of-capacity-of-farmland variables performed poorly in all of the models. The market-value-of-agricultural-products-sold variable, though not exhibiting signifiance in the models, is of the hypothesized sign.

Conclusions

The results of the models show that bank survey responses are more highly influenced by "bank structure" variables, that is, eligible-capital-account and bank-type-dummy variables, than by the "farm" variables of average farm size, agricultural production expenses, market value of agricultural products sold, and utilization of capacity of farmland. This phenomenon is not too surprising, given that the lending limit problem from the banking sector's point of view is more closely tied to variables under its control than to variables outside its supervision.

In terms of the theoretical model, however, those variables reflecting agricultural credit requirements play an important role in the lending limit problem also. The only variable reflecting agricultural credit requirements that exhibits the correct sign and is significant in explaining bank survey responses is the agricultural-production-expenses variable. This result most likely occurs because agricultural production expenses more closely measure farm credit requirements than do the other "farm" variables.

The variable "market value of agricultural products sold", though not significantly related to bank survey response, has a negative sign, as expected, in most of the models. This indicates that farm income, via the proxy measure "market value of agricultural products sold", may serve as a substitute for farm credit. That is, farmers may use equity as a substitute for debt in supporting their operations. As the market value of agricultural products sold increases, the probability that banks will have more farm customers whose credit requests exceed their legal lending limit decreases, thus indicating a decrease in excess farm loan demand. This result is contrary to the findings of Sealey (1979), who found a positive relationship between income and loan demand.

Sealey, however, used data from business firms.

The performance of the utilization-of-capacity-of-farmland and average-farm-size variables is poor. In most of the models, not only do these variables show a lack of significance in explaining bank survey response, they also have the incorrect sign. These results are particularly surprising for the average-farm-size variable. Previous studies by Benjamin (1980) and Riffe (1979) indicate that the growth in average farm size is an important factor in the lending limit problem.

Perhaps the poor performance of the average-farm-size variable, and the utilization-of-capacity-of-farmland variable, can be explained by the short time period used in this study. The four-year time frame may have been too brief to indicate the effects of changes in these long-run structural variables on bank survey response.

Another possible explanation for the poor performance of the average-farm-size and utilization-of-capacity-of-farmland variables is that their effect on bank survey response may be picked up by the agricultural-production-expenses variable. Agricultural production expenses are probably more closely related to farm credit requests than average farm size and utilization of capacity of farm land. Thus, the effect of agricultural production expenses on bank survey response may overshadow the effects of average farm size and utilization of capacity of farmland.

The performance of the bank-type-dummy variable, on the other hand, is very good in most of the models. The negative sign on the bank-type-dummy variable indicates that branch banks have less trouble in satisfying large farm loan customers than do unit banks. That is because the capital base applicable to lending limits is that for the entire branching system and not just for the individual bank.

This evidence that branch banks have less difficulty in servicing [redacted] implications for the [redacted] banking controversy [redacted] on the [redacted] banks [redacted] unit banks [redacted] in [redacted] loan [redacted]

[redacted] tions of [redacted] bank-type-dummy [redacted] small unit banks than [redacted] large farm loans. For banks [redacted] size less than or equal and utilization of capacity of farmland.

The performance of the bank-type-dummy variable, on the other hand, is very good in most of the models. The negative sign on the bank-type-dummy variable indicates that branch banks have less trouble in satisfying large farm loan customers than do unit banks. That is because the capital base applicable to lending limits is that for the entire branching system and not just for the individual bank.

This evidence that branch banks have less difficulty in servicing agricultural loan requests has implications for the banking sector in the unit versus branch banking controversy. In terms of the effects of lending limits on the availability of credit to agricultural borrowers, banks that are part of a branching system have less trouble in servicing large farm loan requests than do unit banks. This implies that branching laws could be relaxed in states where branching is restricted or prohibited, particularly in those states where large individual farm loan requests are prevalent.

Furthermore, when the model is estimated using partitions of the data set according to deposit size, the bank-type-dummy variable indicates more difficulty for small unit banks than for large unit banks in servicing large farm loans. For banks with deposit size less than or equal to $50 million, the bank-type-dummy variable is highly significant in explaining bank survey response and is correct in sign. On the other hand, for banks with deposit size greater than $50 million, the bank-type-dummy variable is highly insignificant in explaining bank survey response and is incorrect in sign. Large unit banks have a broader capital base with which to satisfy large farm loans than do small unit banks. Thus, in terms of lending limits and the availability of credit to agricultural borrowers, small unit banks could benefit from branching.

Some Suggestions for Future Research

One of the drawbacks of this study is the lack of farm loan data for individual borrowers at banks. Though in practice it's impossible to obtain these data, a more detailed survey of agricultural banks regarding lending limits could provide useful insight into solutions for the lending limit problem. Information, such as whether the loans exceeding individual lending limits are for livestock or grain, could be collected to better understand the credit requirements for different types of loans at individual banks.

Another suggestion is to modify the model to better reflect farm credit requirements. Data on the purchase of machinery and information on land values could be included in the model to help explain bank survey response. Lastly, the market area serviced by an agricultural bank could be defined more precisely so that the effects of variables indicative of agricultural credit requirements on bank survey response can be better ascertained.

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APPENDIX

Correlation coefficient matrix--Full Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	-.03	-.07	-.02	-.04	.26
AFS	-.03	1.00	-.34	-.13	-.31	-.16
MV	-.07	-.34	1.00	.58	.01	-.02
APE	-.02	-.13	.58	1.00	-.03	.03
UC	-.04	-.31	.01	-.03	1.00	.14
D	.26	-.16	-.02	.03	.14	1.00

Correlation coefficient matrix--Corn-Belt States Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	-.01	-.03	-.04	-.07	.24
AFS	-.01	1.00	-.26	-.24	-.05	-.21
MV	-.03	-.26	1.00	.67	.06	.06
APE	-.04	-.24	.67	1.00	.07	.11
UC	-.07	-.05	.06	.07	1.00	.17
D	.24	-.21	.06	.11	.17	1.00

Correlation coefficient matrix--Michigan-Wisconsin Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	-.06	-.14	.03	-.01	.36
AFS	-.06	1.00	-.42	.03	-.47	.02
MV	-.14	-.42	1.00	.45	-.09	-.27
APE	.03	.03	.45	1.00	-.12	-.10
UC	-.01	-.47	-.09	-.12	1.00	.01
D	.36	.02	-.27	-.10	.01	1.00

Correlation coefficient matrix--Smallest Deposit Size Class Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	.01	-.13	-.12	.05	.07
AFS	.01	1.00	-.45	-.27	-.13	-.04
MV	-.13	-.45	1.00	.52	.08	.01
APE	-.12	-.27	.52	1.00	.08	-.06
UC	.05	-.13	.08	.08	1.00	-.03
D	.07	-.04	.01	-.06	-.03	1.00

Correlation coefficient matrix--Medium Deposit Size Class Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	.09	-.12	-.09	-.15	.06
AFS	.09	1.00	-.44	-.17	-.09	-.09
MV	-.12	-.44	1.00	.63	.08	-.02
APE	-.09	-.17	.63	1.00	.06	.05
UC	-.15	-.09	.08	.06	1.00	.14
D	.06	-.09	-.02	.05	.14	1.00

Correlation coefficient matrix--Largest Deposit Size Class Model:

	EKA	AFS	MV	APE	UC	D
EKA	1.00	.04	-.10	.07	-.12	-.01
AFS	.04	1.00	-.14	.03	-.58	-.30
MV	-.10	-.14	1.00	.57	-.11	.01
APE	.07	.03	.57	1.00	-.20	.18
UC	-.12	-.58	-.11	-.20	1.00	.16
D	-.01	-.30	.01	.18	.16	1.00