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Performance Pricing of Farm Loans Under Risk:

Methods & Implementation

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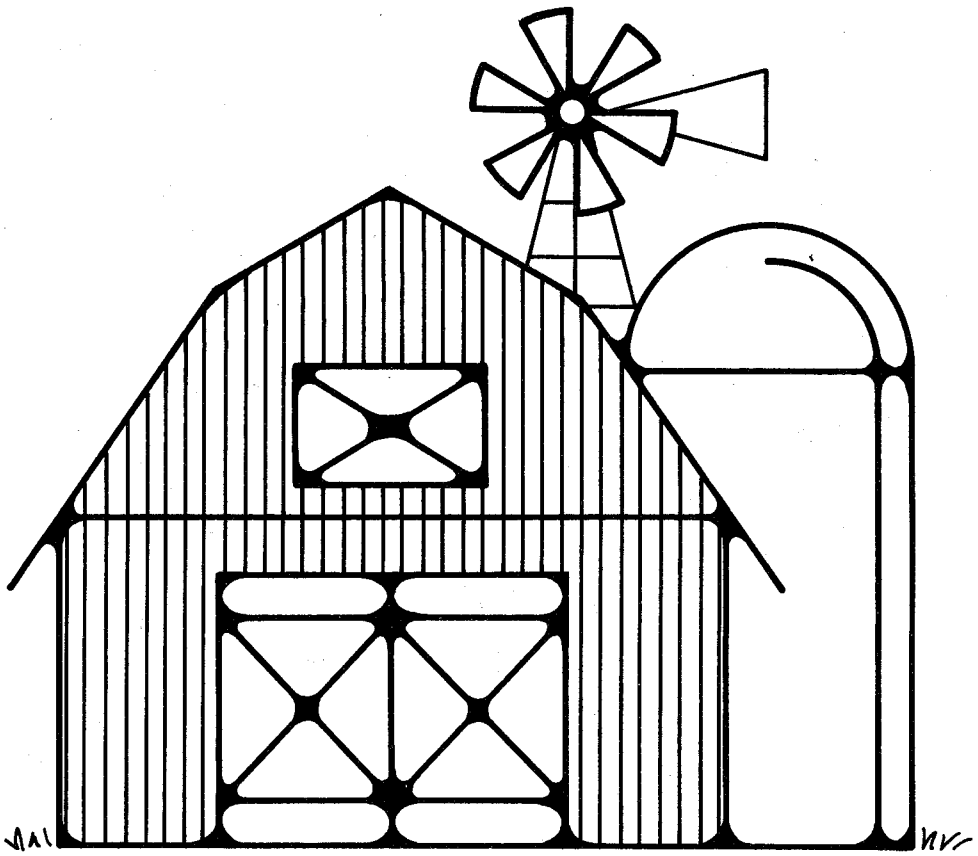

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FOREWORD

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Highlights

Farm loans are generally regarded by rural agricultural banks as high quality assets. Two aspects of loan quality are loan profitability and risk. Both characteristics vary over time due to changing farm financial and commodity market conditions. Rural banks are adapting to these changes by adjusting loan maturities, writing variable rate loans, and pricing individual loans to account for risk and projected loan profitability. Deregulation of banks and competing financial institutions will escalate the pace at which financial innovations will be developed and adapted. This report focuses on one such innovation--namely, individual pricing of farm loans.

Farm loan pricing and review is correctly viewed as a continuous process which considers the whole bank-customer relationship. Loan pricing is illustrated with the use of a source and use of funds worksheet. Projected customer deposit and loan balances are used to project the need for purchased funds. The costs of the various components of funds are built into the interest rate estimate along with the bank's desired rate of return on allocated equity capital.

A procedure is developed for objective credit scoring of farm borrowers to jointly consider credit and liquidity risk characteristics. The objective credit scoring model is illustrated by estimating a credit risk equation and partitioning the farm loan portfolio of a rural bank into three risk classes. Individual farm interest rates are then estimated using the loan pricing worksheet to generate a target rate of return on bank capital.

PERFORMANCE PRICING OF FARM LOANS UNDER RISK: METHODS AND IMPLEMENTATION

Glenn D. Pederson and Douglas G. Duncan*

Farm loans have traditionally been regarded by rural agricultural banks as high quality loans. Evidence of this quality has been provided by recent studies which indicate relatively profitable farm loans (LaDue, Moss, and Smith, 1978; Moore and Hardy, 1980) and by agricultural bankers' survey responses which reveal a perception of low associated credit risk (Moore and Hardy, 1980). Yet, loan profitability and credit risk are aspects of agricultural lending that vary both with financial market forces, which affect the cost, availability, and demand for loanable funds, and with the creditworthiness of farm borrowers. Market forces have confronted rural agricultural banks with increased growth in farm credit demand, declining growth in deposits (a traditional source of loanable funds), highly variable cost of purchased funds, and deteriorating creditworthiness of some farm customers. As a result, rural banks have been placed in a riskier position which has complicated the process of pricing farm loans while remaining competitive with other agricultural lenders.

Lenders have two credit responses to changes in profitability and risk of farm loans: price (interest rate) response and nonprice responses. Interest rates on nonreal estate loans seldom vary significantly among individual borrowers within the same lending institution (Barry et al., 1981). Typically, rate differences which do exist are attributable to loan size and costs of lending, not borrower risk. Nonprice credit responses to creditworthiness are practiced more frequently (e.g., adjustment of loan

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maturities, loan supervision, security requirements, and loan limits). Rural bank measurement of credit risk is an important but neglected dimension of monitoring changes in the relative profitability of farm loans to achieve a desired risk/return result as economic conditions change. The lack of explicit risk pricing by farm lenders has also hampered such measurement in the past.

Pricing farm loans is a bank management problem which is complicated by conditions of risk. This report investigates the risk and return dimensions of the farm loan pricing problem faced by agricultural banks and suggests methods for implementation of performance pricing. Performance pricing of farm loans is a strategy for achieving target yields on loaned funds and/or bank equity capital. Implementation of various pricing strategies is considered and discussed along with some important limitations. Objectives of this report can be summarized in three areas: first, to briefly explore problems of a more recent nature which are associated with farm lending under conditions of risk; second, to present a pricing framework which incorporates borrower risk characteristics in establishing target yields and interest rates for individual borrowers; third, to present an application of the loan pricing approach to a rural agricultural bank to indicate how such a pricing method could be implemented.

The Loan Pricing Problem

Many facets of the problem of pricing farm loans under risk can be identified. An analysis of the problem begins with a brief review of 1) changes in the composition of loanable funds and variability in the costs of those funds and 2) variability in farm profitability and credit risk.

Sources and Costs of Funds

Annual growth rates of farm credit demand and commercial bank deposits were fairly similar in the past. That situation no longer exists. Table 1 presents growth rates for farm debt in North Dakota and the U.S. for the period

TABLE 1. ANNUAL GROWTH RATES OF AGRICULTURAL DEBT IN NORTH DAKOTA AND THE U.S., 1967-1980

Period	North Dakota			United States		
	Real Estate	Nonreal Estate	Total	Real Estate	Nonreal Estate	Total
	- - - -	percent - - - -		- - - -	percent - - - -	
1967-1980	9.85	15.22	12.31	10.25	10.29	10.27
1967-1972	7.05	9.16	7.89	6.70	4.48	5.81
1973-1976	7.82	23.48	14.72	10.55	12.36	11.32
1977-1980	15.59	20.64	18.22	13.20	16.20	14.55

SOURCE: North Dakota Crop and Livestock Statistics, ERS.

1967-1980. A 9.85 percent average growth rate on real estate debt in North Dakota translates into a doubling of real estate debt capital requirements every eight years. More significant for rural banks has been the escalating growth of nonreal estate debt. The 15.22 percent average growth rate during 1967-1980 suggests that nonreal estate indebtedness doubled every five years in the state. A comparison of North Dakota with the national trend indicates that North Dakota farmers expanded their total indebtedness at a faster rate. This is largely attributable to the significantly higher growth which occurred in the nonreal estate category in North Dakota.

While aggregate deposits at North Dakota banks grew significantly, total deposits exhibited a high degree of variability. Table 2 provides a comparison of annual mean growth rates of total bank deposits across substate regions. Variability of deposits is characteristic of all four state regions. A closer look at the source of deposit variability is provided in Table 3, where total deposits are broken down into demand deposits and time and savings deposits. Growth of demand deposits (a traditional low cost source of loanable funds) declined across the state throughout the period. Time and saving deposits grew faster and at a highly variable annual rate. The 1973-1976 period illustrated a marked increase in time deposit funds, apparently as individuals attempted to shift money balances to higher interest-bearing forms such as money market certificates. Volatility in the growth of total deposits, therefore, resulted from the changing composition of deposits over time.

Comparison of the rate of growth of farm debt in Table 1 with the rate of growth of deposits in Table 3 reveals that farm credit demand shifted outward faster than the supply of total deposit funds. Demand for farm debt grew at an annual rate of 12.31 percent while aggregate deposits increased at an annual rate of 10.03 percent. The discrepancy between growth rates was especially noticeable during 1977-1980, when farm debt expanded at a rate 2.25 times

TABLE 2. ANNUAL GROWTH RATES OF COMMERCIAL BANK AGGREGATE DEPOSITS BY REGION IN NORTH DAKOTA, 1966-1979

Year	Western	West Central	East Central	Red River Valley
1966-1979	10.59	11.11	10.75	9.76
1966-1972	8.50	9.24	9.90	8.82
1973-1976	12.73	15.69	13.61	12.18
1977-1979	11.92	8.76	8.62	8.40

SOURCE: Federal Deposit Insurance Corporation.

TABLE 3. ANNUAL DEPOSIT AND CAPITAL GROWTH RATES OF INDIVIDUAL INSURED COMMERCIAL BANKS IN NORTH DAKOTA AND THE U.S., 1967-1980

Period	North Dakota				United States			
	Demand Deposits	Time and Saving Deposits	Total Deposits	Total Capital	Demand Deposits	Time and Saving Deposits	Total Deposits	Total Capital
	- - - - - - percent - - - - - -				- - - - - - percent - - - - - -			
1967-1980	5.67	12.60	10.03	11.01	5.16	10.88	8.30	8.72
1967-1972	6.62	12.20	9.71	9.56	6.73	11.22	8.94	8.68
1973-1976	4.38	15.22	11.03	15.32	1.56	8.91	5.70	6.61
1977-1980	3.36	11.28	8.10	9.46	4.48	11.27	8.63	10.67

SOURCE: Federal Deposit Insurance Corporation.

faster than bank deposits. Equally significant was the shift of banks to higher-cost deposit liabilities such as time deposits. Since commercial banks could not rely on customer deposits to offset loan demand, they shifted toward purchased funds with higher, more volatile interest rates.

Reasons can be cited for these higher and more-volatile interest rates. First, interest rates are generally considered to reflect two components--a real rate of time preference and an inflation premium. As the expected rate of inflation increases, holding the real rate constant, the nominal rate of interest must eventually rise to reflect the expected loss of future purchasing power. As expectations of investors concerning the rate of inflation have fluctuated, nominal market interest rates have risen and become more volatile. The late 1970s and early 1980s have been characterized by high and unpredictable changes in the rate of inflation.

Second, interest rates have been allowed to freely adjust in national money markets up until October 1979. Since that time the Federal Reserve Board has been following a policy of controlling the quantity of bank reserves and allowing the price of those reserves to fluctuate. The change of policy was an attempt by the Fed to gain better control of the rate of growth of money supply and indirectly affect the course of market interest rates. Soon after the change in Federal Reserve policy, the Depository Institutions Deregulation and Monetary Control Act of 1980 was signed into law. That legislation provided for the scheduled elimination of Regulation Q and the gradual decontrol of interest rates paid on customer deposits.[1]

Competition and Borrower Risk

Rural banks typically operate within a competitive market environment which limits the ability to discriminately price farm loans. Rural agricultural banks face direct competition from the Farm Credit banks in providing loans to farmers. Additionally, they compete with other commercial banks whose market

areas are adjacent or overlapping. Interbank competition surfaces in several forms: competition for customer deposits, loans, and bank services. The level of competition in pricing loans between local competitors may establish an upper limit on the range of interest rates which farmers and other borrowers consider to be acceptable.

Risk of default is an important component of borrower risk, but rural banks have not priced loans according to individual borrower risk. Rather, they typically set an interest rate spread above their marginal cost of funds (referred to as the base rate) and apply that pricing procedure to all farm borrowers. As the base rate changes over time, the rate charged on additional loans changes. Charging all borrowers the same interest rate is, in effect, a subsidization of high risk borrowers by low risk borrowers across the total bank loan portfolio.[2]

Competitive price theory suggests that the individual who is efficiently priced with respect to risk would pay a rate premium if he presents a relatively higher default risk or receive a rate discount for a relatively lower risk of default. Since the default risk premium is considered a component of the nominal interest rate charged (along with the real rate for pure time preference, a rate for transaction costs, and a premium for money risk), loan rates charged borrowers with different risk characteristics should vary. As a practical matter, the ability of rural banks to price borrowers at different rates may be limited by the reluctance of high risk borrowers to accept interest rates higher than those received by lower risk borrowers. Pricing borrowers at different risk levels also requires that loan officers be able to accurately assign borrower risk when working with dairy, livestock, grain, or diversified operations. Farmer acceptance of rate differentials may well be favorable, if a legitimate, understandable and uniform method of pricing can be implemented.

Agricultural banks are faced with the dual problem of 1) wanting additional information on borrowers and on their own banking operations to improve the profitability of their farm lending activities but 2) not having implemented a system to acquire the necessary information and expertise in its use. Characteristics of rural agricultural banks along with changes in loan demand and sources of funds confront these banks with the need to calculate costs and returns on a flexible basis in order to maintain adequate margins and sustain profits. Traditional methods of fixed-rate farm loans over an extended period of time are quite inflexible. Once the loan contract is executed, the bank has lost its ability to make adjustments in reaction to changing cost of funds and market conditions until the loan matures.

Loan Pricing and Review

In response to changing financial market conditions, banks have increasingly adopted more flexible pricing schemes such as fixed rate notes with significantly shorter maturities, variable-rate notes, and variable-rate revolving lines of credit. Each of these lending strategies requires more frequent review of the loan and should logically consider the borrower-lender relationship in its broader context.

A recent national survey of commercial banks indicated that bank pricing and lending policies are in transition (Calvert and Barry, 1982). Results of the survey indicated that: only 4 percent of the agricultural banks separately account for farm lending activity, 22.6 percent use marginal cost loan pricing, 34.4 percent use a pooled cost of funds, 37.6 percent use floating interest rates, 46.9 percent vary maturities on farm loans, 47 percent charge different farm customers different interest rates, and only 12.6 percent use Customer Profitabiliy Analysis to analyze their loan portfolio. In contrast, over 70 percent of the small agricultural banks plan to utilize floating

interest rates in the future, and similar increases are planned by small banks in the use of compensating balances, charging of fees, and use of Customer Profitability Analysis.

Development of a Profitability Approach to Farm Loan Pricing

Mason (1979) revised the account profitability method used by large banks to facilitate the evaluation of a customer's entire relationship with a bank. Profitability analysis of individual loans was illustrated as a practical tool for both post-loan evaluation and loan price determination.

Development of Mason's approach begins with a review of the sources and uses of funds for an individual bank customer. The bank's balance sheet for the ith customer can be represented symbolically as follows:

Assets	Liabilities
C_i	D_i
L_i	T_i
	K_i

In this notation, bank assets and liabilities assigned to the customer include: D_i, the expected average collected deposit balance held by the customer at the bank which can be used by the bank to support the loan request; C_i, the reserves which the bank is required to hold for its investable balances and purchased money; L_i, the average expected outstanding debt over the loan period; T_i, additional funds which need to be purchased to completely fund the loan; and K_i, the amount of bank capital which is allocated to support the loan. Deposit balances which are considered to support a loan may vary depending on bank practices.

Projected amounts and composition of deposit balances influence the level of reserves which the bank expects to maintain during the loan contract. Required reserves on average deposit balances and purchased funds can be projected as follows:

$$(1)\quad C_i = R_D D_i + R_T T_i$$

where, R_D is the reserve requirement for compensating balances which is required on loaned funds (expressed as a weighted average of several types of customer deposits) and R_T is the average requirement on purchased funds. A more accurate computation of the cost of funds supporting the loan was accomplished by weighting component sources of funds by dollar volume.

Equation 1 allows for a comparison of bank lending practices. Traditional bank lending was partially motivated by the ability to require compensating balances on loans and thereby generate deposits. Modern banking practice emphasizes loan pricing to a greater degree. The loan is made first, next it is funded (to the extent possible) using the customer's deposit balances, and finally supplemented using purchased funds. Customer deposits substitute for higher-cost purchased funds. Consequently, the mix of deposit and purchased funds is a bank policy choice which affects the average cost of funds and the volume held in reserve. Preference exists for the latter modern approach for two reasons. First, banks have relied less on interest-free demand deposits and more on interest-bearing accounts and rate-sensitive purchased funds over time. Second, loans are viewed as a revenue-generating activity which requires that greater precision be achieved both in loan pricing and acquisition of funds.

Projected customer deposit balances, D_i, can be related directly to the anticipated average loan balance, L_i, as

$$(2)\quad D_i = d\, L_i$$

where, d is the average projected collected balance as a percentage of the loan. The percentage figure used may represent an historical relationship between deposit balance and outstanding loan balances on an individual customer basis, or more typically on all farm net borrower accounts as determined from bank records. In an analogous manner the projected allocation of bank capital, K_i, can be expressed as

(3) $K_i = k\ L_i$

where, k is the proportion of bank capital which is committed to support the loan in accordance with bank policy. One candidate allocation percentage is the proportion of total farm loans or total loans which bank capital comprises. Again, the percentage of bank capital which is allocated to an individual loan or loan class is a bank policy decision. Alternative allocation schemes will be suggested in a later section.

At this point it is possible to determine the amount of purchased funds which will be required by the loan using the balance sheet identity and substituting from the above equations. The balance sheet equation requires that

(4) $C_i + L_i = D_i + T_i + K_i$

Substitution from Equation 1 allows us to write

(5) $(R_D\ D_i + R_T\ T_i) + L_i = D_i + T_i + K_i$

Combining terms provides Equation 6

(6) $(1 - R_T)\ T_i = L_i - K_i - (1 - R_D)\ D_i$

But, Equation 6 can be rewritten using Equations 2 and 3 as follows:

(7) $(1 - R_T)\ T_i = L_i - k\ L_i - (1 - R_D)\ d\ L_i$

The final step in determining the volume of purchased funds involves simplification of Equation 7 to yield,

(8) $$T_i = \frac{L_i - k\ L_i - (1 - R_D)\ d\ L_i}{(1 - R_T)}$$

or,

(8') $$T_i = \frac{(1 - k - (1 - D_D)\ d)\ L_i}{1 - R_T}$$

The preceding sources and uses of funds is next combined with information on net loan expenses to derive a net income expression on the ith customer's loan. Using r as the interest rate symbol, r_L^i, r_0^i, and r_k^i represent the average interest rates paid on loans, compensating deposit balances, and the required rate of return on allocated capital, respectively. The income statement can be shown as follows:

Returns:	
Interest Revenue on Loan Balances	$= r_L^i * L_i$
Expenses:	
Interest Cost on Deposit Balances	$= r_D^i * D_i$
Net Noninterest Cost of Deposits	$= NCD_i * D_i$
Interest Cost on Purchased Funds	$= r_T * T_i$
Net Noninterest Cost on Loan Activity	$= (E_i - F_i) * L_i$
Net Noninterest Cost on Other Bank Services	$= NCO_i$
Net Returns (to bank capital):	$= r_k^i * K_i$

In the above statement E_i represents the ratio of loan-related, noninterest expenses to the average outstanding loan balance and F_i represents the ratio of fees charged on the loan to the average loan volume. At this point the income statement can be written in equation form to solve for the interest rate on the loan with the desired net return on bank capital as part of the expression:

$$(9) \quad r_L^i = \frac{r_D^i D_i + NCD_i D_i + (E_i - F_i) L_i + NCO_i + r_k^i K_i + r_T T_i}{L_i}$$

In Equation 9 total interest on customer deposits equals $r_D^i D_i$, cost of equity capital is $r_k^i K_i$, cost of purchased funds equals $r_T T_i$, and the remaining terms in the numerator are the noninterest costs associated with the customer relationship. Substituting from Equation 8' the loan pricing equation in final form is

$$(10) \quad r_L^i = r_D^i d + NCD_i d + E_i - F_i + \frac{NCO_i}{L_i} + r_k^i K_i + r_T \frac{(1 - k - (1 - R_D) d)}{(1 - R_T)}$$

Computationally, the loan pricing equation can be formatted as a worksheet which can be used on the individual borrower account as shown in Table 4.

As an illustration of how the worksheet facilitates the computation of the loan interest rate, the following hypothetical values are used:

Customer Account Item	Projected Value
Average Loan Balance (L_i)	$50,000
Bank Capital/Total Loans Ratio (k)	.10
Collected Balance/Loan Balance Ratio (d)	.20

TABLE 4. LOAN PRICING WORKSHEET

Borrower:

Date:

Loan Period:

Sources and Uses of Funds:

1. Average Projected Loan Balance _____
2. Projected Average Customer Balances _____
3. Bank Capital Allocation _____
4. Projected Purchased Funds _____

Expenses:

5. Interest on Average Customer Deposit Balances _____
6. Noninterest Cost of Services (net of fees)
   a. Deposits _____
   b. Loan _____
   c. Other Services _____
   d. Total _____
7. Cost of Purchased Funds _____
8. Cost of Bank Capital _____
9. Total Expenses _____

Interest Rate:

10. (Total Expenses/Average Projected Loan Balances)*100 _____

Interest Rate on Customer Deposit Balances (r_D)	.0
Average Cost of Purchased Funds (r_T)	.10
Average Cost of Equity Funds (r_k^i)	.25
Reserve Requirement on Deposit Balances (R_D)	.05
Reserve Requirement on Purchased Funds (R_T)	.02
Loan Fees/Loan Balance Ratio (F_i)	.02
Noninterest Loan Expense Ratio (E_i)	.04
Net Noninterest Deposit Expense Ratio (NCD_i)	.14
Net Noninterest Expenses (Other Services) (NCO_i)	$200

Table 5 illustrates the computation of the amounts of each source of funds in support of the loan, the expenses incurred by each source, and the interest rate required to cover the expenses and provide the desired rate of return to bank capital. Using Equation 10, the same result can be found in terms of the assumed rates and ratios.

$$r_L = 0 + .14(.20) + (.04 - .02) + (100/50{,}000) + .25\,(.10) + .10[(1 - (1 - .05)\,.20 - .10/(1 - .02)]$$
$$= .028 + .02 + .004 + .025 + .0724 = .1494$$

Methods for Estimating Loan Pricing Variables

Alternative methods could be employed to derive values for several of the variables which were used in the above estimating equation. Those variables are discussed in order of their appearance in the pricing worksheet.

Average Loan Balance. Several loan arrangements are possible, each providing a different estimate of the projected loan balance. First, the current individual loan request, on which the full amount is loaned and later repaid, is the simplest of all possible loans. Each loan request has a specific interest rate. Second, a credit commitment may be established under which borrowings and repayments are prearranged at the time the credit is approved. The average anticipated level of use of this credit facility over the commitment period is the appropriate loan balance. Third, when a revolving line of credit

TABLE 5. LOAN PRICING WORKSHEET EXAMPLE

Borrower:			
Date:			
Loan Period:			
Sources and Uses of Funds:			
1.	Average Projected Loan Balance		$50,000.00
2.	Projected Average Customer Balances	$50,000*d *(1-$R_D$)	9,500.00
3.	Bank Capital Allocation	50,000 * k	5,000.00
4.	Projected Purchased Funds (50,000 - 9,500 - 5,000)/(1-R_T)		36,224.49
Expenses:			
5.	Interest on Average Customer Deposit Balances		0
6.	Noninterest Cost of Services (net of fees)		2,600.00
	a. Deposits	(10,000 * NCD) 1,400.00	
	b. Loan	50,000 * (E - F) 1,000.00	
	c. Other Services	200.00	
	d. Total	2,600.00	
7.	Cost of Purchased Funds		3,622.45
8.	Cost of Bank Capital		1,250.00
9.	Total Expenses		7,472.45
Interest Rate:			
10.	(Total Expenses/Average Projected Loan Balances)*100		14.94

is provided to a customer, the expected average use of that maximum line during the loan period can be used. That expected average use could be a time-weighted (e.g., months) outstanding balance.

Customer's Investable Balances. Choice among the various types of deposits which constitute investable funds in support of the loan request is a bank policy decision. In recent years the variety of such deposits has proliferated to include: 1) transactions accounts (including, no-interest demand deposits, NOW accounts, and automatic savings transfers); 2) savings accounts with no minimum balances; 3) time deposits with specified maturities and minimum deposit requirements, and fixed or variable interest rates (e.g., small-saver CDs, 6-month Money Market Certificates, 30-month CDs, All-Savers Certificates); and 4) other deposits (primarily repurchase agreements). Investable balances reduce the amount of purchased funds required to support the customer's loan. If purchased funds are acquired at a higher cost than paid on investable balances, the interest rate on the loan is expected to be reduced by these balances. Conversely, costs of investable balances exceeding the cost of purchased funds are expected to raise the loan interest rate. This latter situation is increasingly likely when interest rates are declining and investors have locked in higher rates on time deposits.

Alternative methods could be employed to estimate the amount of investable balances provided by the individual customer. Calvert and Barry (1982) refer to these methods as the compensating balance, the proportion of commitment, the proportion of loan outstanding, and a combination method. A compensating balance requires borrowers to maintain noninterest bearing deposits in support of their loan. This compensating balance could be used to approximate investable balances assuming the customer maintains only the required amount during the loan period. If the bank provides a credit commitment or a revolving line of credit, the required balance, either as a percentage of the loan

commitment or as a percentage of the maximum allowed credit outstanding, could be used. Compensating balance requirements have become less useful as a method for determining investable balances. Introduction of new, higher interest-bearing savings instruments has forced banks to discontinue widespread use of compensating balances. As a practical matter, rural banks have typically encountered problems in estimating the investable balances of their farm customers due to seasonal demands for cash balances and the unpredictability of farm cash flow. An alternative method to those identified above is to compute the historical ratio of average investable balances to average loan balances from bank records.

Bank's Equity Capital. Bank capital is a component of the source of funds, therefore, the cost of equity capital is included in the pricing formulation. Two approaches to the allocation of capital can be identified. Bank capital could be assigned to all loans based on the bank's ratio of total equity to total assets (Mason). As loan size increases, allocation of equity rises, proportionately. As an alternative, bank capital could be allocated on the basis of perceived loan risk. Riskier farm loans are allocated reltively more equity capital (Knight). In using either of these allocation methods, the corresponding cost of equity capital is typically regarded as a constant. Under the former allocation scheme it is necessary to impute a borrower's risk premium into the cost of equity if the lender desires compensation for increased risk. The second allocation scheme is implicitly compensated through the higher interest rate which would be charged on all funds loaned to higher risk borrowers. Whether bank equity capital is allocated as a constant (across borrowers) with a risk premium on unit costs or allocated in proportion to increased borrower risk with a constant unit cost of equity requires the difficult process of evaluating borrower risk. Subjective and objective methods of evaluating borrower risk are presented in a later section.

Interest on Deposit Balances. Several types of deposits may represent investable balances on an account as suggested above. For that reason, it is likely that a weighted average interest rate which reflects the types, maturities, amounts, and costs of these various balances is appropriate. Most of these factors would be available from bank records. However, costs of these balances represent a problem since rates on time deposits will vary and must be predicted with the aid of financial forecasts. Stability of rates on interest bearing transactions accounts will be reduced beginning in 1986 as interest rate ceilings are removed. Once the weighted cost of deposit balances has been determined it is simply multiplied by the average size of the customer's aggregate deposits over the loan period.

Deposit Activity Costs. Cost of deposit services provided (net of fees charged) can be estimated as the projected noninterest deposit activity expense less the projected service charges on deposits. Those service charges include: charges on transactions accounts (for minimum and overdrawn checking accounts), charges associated with frequency of savings withdrawal activities, and penalties for early withdrawal on time deposits and repurchase agreements. Noninterest expenses on deposit activity are those costs associated with collecting and servicing the balances and administering service charges. Since these are allocated costs, it is useful to first review the frequency of deposit account transactions (but not the dollar amounts) and then consider the bank's current and projected costs on deposits as a function of the frequency of use. Once this is done, the borrower's past deposit activity level can be used and assigned a cost.

Loan Activity Costs. Net costs of loan activity can be estimated by deducting projected loan fees from the total noninterest cost of loan services. Charging fees on loans represents an alternative to interest charges in pricing farm loans, and several fee options exist depending on the type of loan

agreement. When a note is used, the fee is a stated percentage (FN_i) of the loan balance. When credit commitments and revolving lines of credit are provided, two types of fee arrangements are possible (Mason, p. 302-303). Under both arrangements the projected average loan balance is estimated first.[3] One option is to charge a fee at the beginning of the year as a percentage of the total commitment. The ratio of derived revenue to the average loan balance can be computed as follows:

$$FC_i = \frac{C(1 + r_t)}{U}$$

where, C is the percentage of the total commitemnt which will be charged by the bank, $(1 + r_t)$ is the opportunity cost of the prepaid fee if invested by the bank, and U is the ratio of the average loan balance to the total borrower committment. Logically, the above equation shows that an increase in the projected average loan balance is reflected as a decrease in the rate earned on the loan.

A second fee arrangement is to assess a usage fee on the unused part of the commitment. In this instance, the ratio of fee revenues to the average loan balance can be shown as follows:

$$FU_i = \frac{b(1 - u)}{u}$$

where, b is the percentage of unused commitment which will be charged at the end of the commitment period. Since the unused proportion of the loan (u) carries a negative sign in the above equation, an increase in the unused portion of the loan commitment again results in a decrease in the fee revenue ratio. Total loan fees for the ith borrower is the sum of the above fees ($F_i = FN_i + FC_i + FU_i$), if more than one fee arrangement is used. The component fee rates are fixed at levels determined by bank management.

Noninterest costs of loans (E_i) are allocated costs of the bank and include administration, clerical, computer, and several other associated bank services. Estimation and allocation of these costs are made complex by the

necessity to bundle certain costs when an efficient cost accounting system is lacking. When past bank records are available, costs can be allocated on the basis of average loan volume and historical expenses associated with those loans. The historical cost-volume relationship can be summarized as a ratio of noninterest expenses to average loan volume. Simply multiplying the cost-volume ratio by the borrower's loan amount disregards loan size, loan type, and lending cost relationships. Therefore, flexibility of the ratio could be achieved by establishing a schedule of such ratios to reflect management's estimate of the variation of costs by loan size and type (e.g., repayment frequency).

Other Bank Activity Costs. When a borrower's banking activity includes services in addition to loans and deposits (such as administration of payroll, computer services, lock boxes, and wire transfers of funds), the associated net costs should be estimated. Service charges based upon frequency of use can be added to noninterest costs of these activities.

Cost of Purchased Funds. Purchased funds may be funds already in the bank, or they may represent a need for acquiring additional funds. Due to the variety of potential sources of purchased funds, two pooled-pricing concepts are often involved--average cost pricing and marginal cost pricing. When funds are already in the bank an average interest cost can be computed as the weighted average of the component costs of funds. If it is necessary to supplement existing funds with additional purchased funds to support the loan, the weighted component costs of the various acquired funds represent a marginal cost pricing approach. In either case the pricing of purchased funds uses a weighted average cost approach, where the weights equal the proportion which each funding component comprises of the combined sources. Component costs for funds in the bank are usually available from bank records for the previous period. Costs of funds yet to be acquired must be estimated from financial projections, interest

rate ceilings, and the bank's past policies on types of acquired funds. When combining the average cost of in-bank purchased funds with the marginal cost of purchased funds, the two types of funds are again weighted by the proportions of each used to fund the loan. The concept of a pool of funds could include all bank liabilities or a selected set of liabilities. Banks often exclude certain liabilities because they are not used, or the bank matches maturities on assets and liabilities and uses an asset allocation scheme rather than a pool of funds.

Noninterest costs related to the acquisition of purchased funds should be included with the above average interest cost estimate. These costs are estimated as a rate by dividing each cost estimate by the associated pool of funds (i.e., total of in-bank purchased funds, or the total of anticipated additional purchased funds).

Cost of Bank (Equity) Capital. Cost of bank capital is the required rate of return and is comprised of a base rate of return (a desired rate of return over all farm loans), plus a premium to reflect the level of credit (borrower) risk, liquidity risk, or risk of loan loss due to competition. While the base rate of return is determined by the bank's management on the basis of its loan profit objectives, risk factors are traditionally evaluated by the loan officer on an individual borrower basis.

Conceptually, credit (borrower) risk is the perceived likelihood that the loan will not be repaid if it is approved. Credit risk factors include: borrower credit history, character of the borrower, borrower financial strength, collateral provided, loan size, and the purpose of the loan.

Liquidity risk can be defined as the likelihood that a bank will be unable to satisfy demands for cash as they occur. Significant changes which occur in the level of sources and uses of funds are typically reflected in cash demands (e.g., higher than anticipated loan demands or deposit withdrawals). Banks typically allow for liquidity risk by maintaining additional cash, credit reserves,

and readily marketable securities, or by matching maturities on assets and liabilities. Liquidity risk of individual customers can be measured by the degree of variability of loan and deposit balances.

Finally, an attempt could be made to assign a risk of loan loss to a borrower's loan request if it is determined that a significant probability exists for the borrower to transfer to another lender. Once the loan officer has reviewed borrower risk characteristics, the difficult problems which remain are those of assigning borrowers to risk classes and determining the associated interest premiums.

The preceding section on loan pricing and review provides a flexible method for organizing information on the sources and uses of funds related to farm loans, and estimating interest rates for individual loans. Interest and noninterest costs can be incorporated into a total cost expression according to several suggested methods to achieve a desired yield on loaned funds. The remaining section of this report suggests a method for incorporating borrower risk characteristics into the pricing framework.

Credit Scoring of Farm Borrowers

Farm loan pricing is based on the premise that individual farm loan customers will generate sufficient bank profits to compensate the bank for its costs of loan administration and funding and reflect the underlying credit, liquidity, and loan loss risks of the borrower. Following Schramm (1980) gross loan profits can be functionally defined as follows:

$$(11) \quad P = f(A, F, C, L, O)$$

where, A is a measure of administrative costs; F is the nonequity costs of funding the loan; C is a measure of credit or lending risk; L is a measure reflecting liquidity risk of the farm borrower; and E is the estimated probability of loan loss due to competition. Loan profits net of administration and funding costs can than be written as

(12) $N = P - f(A, F)$

which can be rewritten as

(13) $N = f(C, L, E)$

Net farm loan profits are thus a function of loan risks. If the likelihood of loan loss due to competition can be considered negligible or constant across all farm borrowers, net loan profitability is related to just the assignable credit and liquidity risks:

(14) $N = f(C, L)$

To achieve a desired rate of return on equity capital, a bank must operationalize the above net profit expression. One method for doing so is to group farm borrowers according to characteristics which reflect credit and liquidity risks, and then set risk premiums according to the chosen risk classes. Methods for defining risk classes and then assigning borrowers to those classes are of two general types--subjective and objective.

Subjective Credit Scoring

Schramm (1980) suggests that a matrix approach be used to assign customers to risk groups based on lender judgment. Schematically, this is illustrated as follows:

Credit Risk \ Liquidity Risk	Low	High
Low	1	2
High	3	4

Using the bank's existing records on each loan applicant, the loan officer subjectively determines the appropriate risk group. Once all farm borrowers have been arranged according to the above matrix, three risk classes are defined:

Class I: Prime customers having low liquidity risk and low credit risk (Cell 1).

Class II: Base customers having either low liquidity risk and high credit risk (Cell 3), or those with high liquidity risk and low credit risk (Cell 2).

Class III: Premium customers having high liquidity and high credit risks (Cell 4).

According to this scheme of risk assessment, different criteria could be employed as measures of credit risk and liquidity risk. Schramm selected the farm customer's debt-to-equity ratio (financial leverage) as the factor most often used to quantify the level of credit risk. Higher leverage positions were found to be significantly and directly related to the required rate of return on equity. The weighted average coefficient of variation (WACV) between customer deposit and loan balances was selected as the measure of liquidity risk.[3] A higher WACV indicates greater variability in the sources and uses of funds associated with a customer's deposit and loan balances and, therefore, a higher required rate of return on equity. While the above subjective method has the desirable characteristics of flexibility and capability of incorporating numerous qualitative and quantitative factors for individual borrowers, it has the important limitation of being difficult to quantify and explain when more than a single borrower characteristic is included. For this reason it may be preferable to utilize an objective method which maintains some flexibility and adapts a quantitative approach.

Objective Credit Scoring

Objective credit scoring employs discriminant analysis, which is a computer-assisted, statistical technique. Discriminant analysis allows the loan analyst to partition the agricultural loan portfolio of the bank into acceptable loans and problem loans. Figure 1 illustrates how the discriminant function is estimated and used to discern between these major loan categories.

The discriminant function is a linear combination of these borrower characteristics which are selected to reflect significant risk factors common to

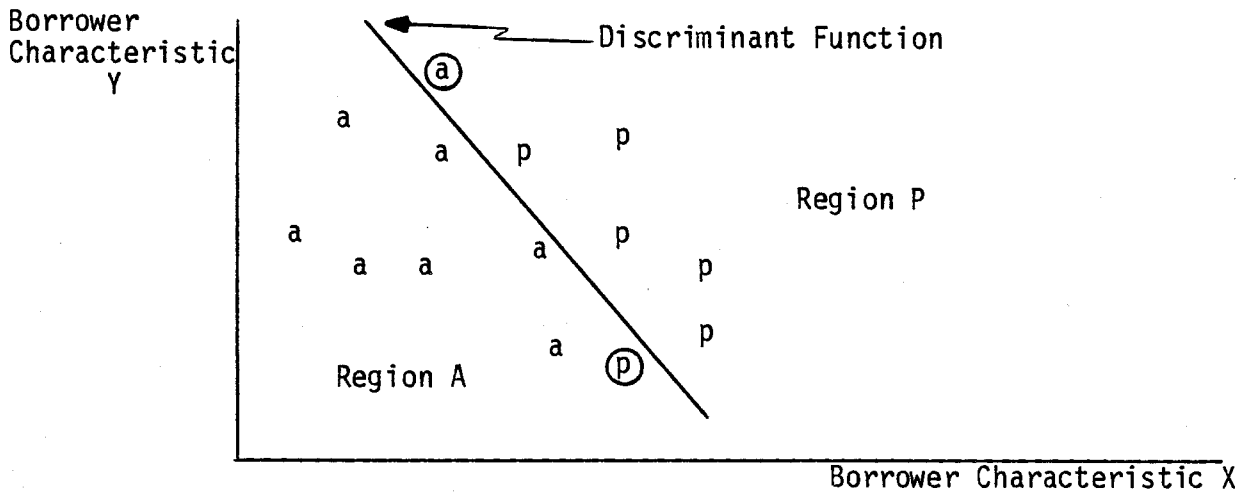

Figure 1. Use of a Discriminant Function to Partition a Hypothetical Portfolio of Loans Into Acceptable Loans (Region A) and Problem Loans (Region P)

all agricultural loans. While the discriminant function is estimated in such a way as to maximize the distances between the acceptable and problem loan observations, the technique may misclassify a loan (as illustrated in Figure 1) when a borrower's characteristics do not conform with those of other borrowers within the same loan category. A desirable discriminant function is one which minimizes misclassification.

Previous loan evaluation studies have used discriminant analysis for the purpose of reviewing new agricultural loan applications to predict the eventual success of those loans (Reinsel, 1963; Bauer and Jordan, 1971; Dunn and Frey, 1976; and Weed and Hardy, 1980). Other studies have used data from existing loans to identify those that have a high potential for success (Johnson, 1973; Evans, 1971). Table 6 reports those factors (ratio and nonratio) which were found to be significant in discerning between successful and unsuccessful agricultural loans. The application of credit scoring which is reported in this study is different from previous studies in two ways. First, this study applies discriminant analysis to a single agricultural bank's agricultural loan portfolio, while prior studies have been applied to loan applications from a cross-section of loans at several Production Credit Associations or Farmer's

TABLE 6. SUMMARY OF BORROWER CHARACTERISTICS WHICH WERE FOUND SIGNIFICANT IN DISCRIMINATING BETWEEN SUCCESSFUL AND UNSUCCESSFUL AGRICULTURAL LOANS IN SIX MAJOR STUDIES

Borrower Characteristics (as reported in the study)	Reinsel (PCA)	Reinsel (FHA)	Bauer and Jordan (PCA)	Johnson (PCA)	Evans (PCA)	Evans (FHA)	Dunn and Frey (PCA)	Weed and Hardy (PCA)
1. Number of Acres in Farm	x						x	
2. Years of Farming Experience	x							
3. Annual Increase in Net Worth After Age 20 and Before First PCA Loan	x							
4. Ratio of Nonreal Estate Debt to Total Debts	x	x				x		
5. Number of Creditors	x							
6. Farm Ownership	x							
7. Ownership of Life Insurance		x					x	
8. Health Insurance		x						
9. Annual Average Increase in Net Worth After Age 20 and Before First PCA Loan								
10. Size of Family		x	x		x			
11. Ratio of Combined Interest and Principle Payments to Net Income		x						
12. Level of Family Living Expenses	x							
13. Family Living Expenses as Percent of Total Farm and Family Expenses			x					
14. Debt to Asset Ratio			x	x	x		x	x
15. Farm Value			x					
16. Magnitude of Total Liabilities			x					
17. Marital Status			x					
18. Current Asset to Current Liability Ratio			x	x				
19. Repayment Index				x				
20. Debt to Net Worth Ratio				x	x			
21. Gross Income to Current Debts Ratio				x				
22. Net Worth to PCA Commitment Ratio				x				
23. Costs of Operation					x	x		
24. Poor Production Records					x	x		
25. Ratio of Nonreal Estate Debt to Value of Nonreal Estate Assets						x		
26. Ratio of Net Worth to Total Assets Owned						x		
27. Expected Income as a Percentage of the Previous Year's Income			x					
28. Amount of PCA Note to Net Cash Farm Income							x	
29. Anticipated Loan Repayment to Total Assets								x

Home Administration offices. Second, this study will attempt to illustrate how the results of the credit scoring model can be utilized by loan officers to establish interest rates on farm loans which incorporate borrower risk considerations.

An Application of Objective Scoring to a Farm Loan Portfolio

Data on 83 existing borrowers were obtained from the 1980 loan records of a southeast North Dakota bank for the purpose of analyzing the rate of return to bank equity capital and total bank funds (Duncan, 1982). Although the data set is not extensive in terms of the number of financial ratio and nonratio variables which could be considered, the data do allow for an application of the underlying methodology and an illustration of how it can be used in loan pricing. The bank loan officer provided a subjective ranking of each of the 83 borrowers by assigning a rating of 1 to the lowest risk agricultural borrowers, a rating of 5 to the highest risk agricultural borrowers, and ratings of 2, 3, and 4 for borrowers with intermediate but increasing levels of risk. Ratings of 1, 2, or 3 were interpreted in this study as acceptable loans and ratings of 4 or 5 were interpreted as problem loans.

Variables which were analyzed using correlation methods were the debt/asset ratio, total acres farmed, type of farm (cash grain, dairy, or mixed enterprises), tenure (percentage of acres owned), and form of business organization. Two variables were found to be significantly correlated with the subjective categorization of loans into acceptable or problem loans: the debt/asset ratio and the total number of acres farmed. Data on the 83 borrowers were then separated into 67 borrowers for estimation of the discriminant function and 16 borrowers (as a holdout group) for later testing of the discriminant function.[4]

Estimation of a single discriminant function required a three-step procedure since the statistical package used reports two sets of coefficients (one for the acceptable loan class and one for the problem loan class). The three steps were 1) run the discriminant analysis of loan class against the debt/asset ratio and the acres farmed, 2) project the discriminant score (loan rating) for each borrower using the appropriate estimated discriminant function coefficients, then 3) fit a regression equation to the projected discriminant score using the debt/asset ratio and the acres farmed as predictors. The resulting regression equation was

$$(15) \quad R = -2.73437 + 6.8699\ X_1 + .00137\ X_2$$

where R = the projected discriminant score which distinguishes between acceptable and problem loans;

X_1 = the debt/asset ratio; and

X_2 = total acres farmed.

Table 7 presents summary statistics for the two loan groups which resulted from the initial discriminant analysis. Mean and standard deviation values indicate that problem loans have generally higher discriminant scores and greater variability of those scores than the acceptable loan class.

TABLE 7. COMPOSITE GROUP MEANS AND STANDARD DEVIATIONS FOR DISCRIMINANT FUNCTIONS

Loan Group	Group Mean	Standard Deviation
Acceptable Loans	1.75	1.93
Problem Loans	2.16	2.88
All Loans	1.86	2.21

A critical credit score can be calculated for the purpose of separating high-risk, problem loans from low-risk, acceptable loans. This cut off value of R is calculated using the following formula:

$$(16) \quad R_c = \frac{S_p \bar{R}_a + S_a \bar{R}_p}{S_p + S_a}$$

where S_p = standard deviation of discriminant scores for problem loans (2.88);

S_a = standard deviation of discriminant scores for acceptable loans (1.93);

$\overline{R}_a$ = mean discriminant score for acceptable loans (1.75);

$\overline{R}_p$ = mean discriminant score for problem loans (2.16).

The calculated cut off score is 1.91. Using the cutoff score to classify the 16 holdout borrower cases revealed that the discriminant function correctly classified eight borrowers and misclassified eight borrowers (Table 8). The

TABLE 8. RESULTS OF CLASSIFICATION TEST OF THE DISCRIMINANT FUNCTION ON THE HOLDOUT SAMPLE

Subjective Loan Group	Classified As		
	Problem	Acceptable	Total
Problem	3	1	4
Acceptable	7	5	12
Total	10	6	16

results of the holdout sample test can be interpreted in two ways. First, the subjective loan groupings may not have adequately distinguished between risk classes of loans, and the problem is one of lack of correlation between subjective groupings and the objective credit scoring approach. Alternatively, the discriminant function may be poorly specified. In this situation other financial ratios or nonratio variables should be incorporated into the credit scoring model. Variables relating to borrower liquidity position, loan repayment, anticipated cash farm income, and insurance of each borrower could be evaluated.

Borrower Classification Using Measures of Credit and Liquidity Risk

The credit scoring model presented above provides an objective method for classifying borrowers according to credit risk. Yet, rural agricultural banks are also concerned with the associated liquidity risk of the customer. To incorporate both credit and liquidity risk of individual borrowers into a performance

pricing framework, it is possible to use Schramm's matrix approach and classify farm borrowers. The revised classification scheme can now be represented as,

Discriminant Score (Credit Risk)	WACV (Liquidity Risk) Low	WACV (Liquidity Risk) High
Low	1	2
High	3	4

In this approach the predicted discriminant score provides an objective measure of individual borrower credit risk. A low credit score is again one which lies below the cut off value (1.91). An objective measure of borrower liquidity risk is the weighted average coefficient of variation (WACV) between a customer's deposit and loan balances. A low WACV is one which is less than the average value across all 67 farm loans (.487). Using the above two-way classification scheme and interpreting group class numbers as suggested above, three general classes of customers were identified for loan pricing (Table 9). Comparison

TABLE 9. TWO-WAY CLASSIFICATION RESULTS FOR GROUPING BORROWERS ACCORDING TO MEASURES OF RISK

Subjective A Priori Loan Class	Classified As Prime	Base	Premium	Total (Subjective)
Prime	1	5	0	6 (9%)
Base	14	22	7	43 (64%)
Premium	5	9	4	18 (27%)
Total (Objective)	20 (30%)	36 (54%)	11 (16%)	67

of the total number of borrowers in the three loan classes as subjectively ranked by the bank loan officer with the rankings generated by the objective classification scheme reveals that a significant amount of reclassification occurs. The objective method classified a greater number of borrowers as prime (low risk) customers and fewer borrowers as base or as premium (high risk)

borrowers. An implicit assumption in the above classification of borrowers is that the bank is equally concerned with credit risk and liquidity risk. An alternative classification would result if different cut off rates were used for the liquidity risk or credit risk measures.

Use of Borrower Classification in Performance Pricing

The premise of this approach to loan pricing is that individual farm borrowers should be priced at levels which cover the costs of administering and funding the loan, as well as compensate the lender for the borrower's current and anticipated risk position. Objective credit scoring provides a means of classifying borrowers by two major risk characteristics. The next step is to use the loan pricing worksheet for the purpose of explicitly pricing borrowers by risk class and allowing the bank to achieve target returns on its overall farm loan portfolio.

Farm loan pricing and allocation of bank capital are logically related when a bank attempts to achieve a target yield. Rates of return on bank capital or loan assets are two performance measures which can be used to establish, and later evaluate, specific loan targets. Capital can be allocated to farm loans according to a fixed proportion of loan size independent of risk asset class or according to a schedule which is dependent on the risk class of the customer. Fixed allocation and scheduled allocation both allow the bank to determine a risk-adjusted interest rate on loan balances for individual borrowers. Theoretically, both methods can lead to the same interest rate for a given customer; however, they involve different approaches and require different supporting bank data. A fixed allocation scheme allows allocation of a uniform percentage of capital to all loan classes but charges a different target cost of equity capital for each loan risk class. The cost of equity enters as an expense item on the loan pricing worksheet. Risk is reflected in the interest rate. Scheduled allocation allows the percentage of capital allocated to farm loans

to vary by risk class to achieve a uniform rate of return on allocated capital. As a result, the return on loan assets varies by risk class. By allowing the cost of allocated capital to remain constant and the percentage of capital to vary, the resulting interest rate is adjusted for risk. A scheduled allocation approach to risk requires that the bank know the desired rate of return on capital and the risk composition of its loan portfolio. Examples which follow provide illustrations of these two capital allocation schemes.

The following analyses illustrate a formal and objective approach which is useful in the determination of an appropriate interest rate. Other qualitative factors which are not directly incorporated into the method (e.g., bank competition, liquidity, and reserve situation) may change the actual rate which is charged.

Pricing Under a Fixed Allocation Strategy

To receive a yield that is commensurate with loan risk classification, the desired cost of equity capital is varied. An approximate average rate of return on equity capital of 30 percent was reported on "commercial and other loans" among banks with less than $50 million in deposits in the 1978 and 1979 Functional Cost Analysis reports of the Ninth Federal Reserve District (1979, 1978). The illustrations which follow are based upon a target yield on bank capital of 20 percent for prime agricultural borrowers, 30 percent for base borrowers, and 40 percent for premium borrowers.

It is assumed that the case bank allocates equity to farm loans at a rate equal to the bank's total capital/total assets ratio, which is 8.7 percent. A 1 percent increase in the loan interest rate results in a 1 percent increase in the rate of return on loan assets. However, that same increase in the interest rate raises the rate of return on allocated equity capital by 11.5 percent (interest rate increase divided by the capital/asset ratio). The 20 percent spread on target yields between loan risk classes results in interest

rate premiums and discounts of .87 percent to premium and prime customers from the base customer rate, or an overall spread of 1.74 percent between premium and prime customers.

Table 10 illustrates loan pricing for a Class I borrower (Farmer A) and a Class III borrower (Farmer B) assuming a fixed allocation strategy, a 3 percent reserve requirement on purchased funds and a 9.47 percent projected average cost of purchased funds for the bank. Farmer A operates 1,355 acres of which he owns 14 percent. He has a debt/asset ratio equal to .35 and provides 44 percent of his loan balance in the form of investable balances. Farmer A's credit score is 1.53 and his liquidity score (WACV) is .29; both factors qualify him as a low-risk borrower. Farmer B operates 1,280 acres, all of which is owned. He has a debt/asset ratio equal to .51 and provides 27 percent of his loan balance in the form of investable balances. Farmer B's credit score is 2.52 and his WACV is .57. Both factors are greater than the mean values for all borrowers and qualify Farmer B as a high-risk borrower. The larger investable balances and higher loan class of Farmer A results in a lower interest rate (14.34 percent) than that charged to Farmer B (14.87). The relatively small interest rate spread between the loans (.53 percent) is due to the fact that both customers had significant amounts of contributed balances, which reduced the need for allocated capital and purchased funds.

Pricing Under a Scheduled Allocation Strategy

When a scheduled allocation of capital is employed, the bank can charge a uniform cost of allocated capital and still price borrowers according to risk class (Mason, Ch. 10). In order to earn a uniform rate of return on capital, a greater proportion of capital must be allocated to a high-risk loan than to a low-risk loan. Table 11 illustrates how an allocation can be scheduled.

TABLE 10. LOAN PRICING WORKSHEET FOR A LOWRISK (CLASS I) BORROWER AND A HIGHRISK (CLASS III) BORROWER USING A FIXED CAPITAL ALLOCATION STRATEGY

		Farmer A	Farmer B
	Acct. No.	4	62
	Loan Class	I	III
I.	SOURCES AND USES OF FUNDS (Projected)		
1.	Average Loan Balance	$38,317	$12,812
2.	Average Transactions Balance	12,167	3,354
	a. Investable Balance (net of reserves, float)	10,317	2,844
3.	Average Savings and Time Balances	6,779	596
	a. Investable Balance (net of reserves)	6,575	578
4.	Total Investable Balances	16,893	3,422
5.	Allocated Capital	3,334	1,115
6.	Free Purchased Funds	18,090	8,275
7.	Total Purchased Funds (gross of reserves)	18,649	8,531
II.	LOAN EXPENSES (Projected)		
8.	Interest on Customer Balances	1,125	32
9.	Cost of Services Provided (net of fees)		
	a. Cost of Loan Balance	1,408	471
	b. Cost of Deposit balance	528	148
10.	Cost of Purchased Funds	1,766	808
11.	Cost of Allocated Capital	667	446
12.	Total Expenses	5,494	1,905
III.	INTEREST RATE		
13.	Total Expenses/Average Loan Balance * 100	14.34	14.87

TABLE 11. DETERMINATION OF SCHEDULED CAPITAL ALLOCATION TO ACHIEVE A TARGET YIELD ON THE FARM LOAN PORTFOLIO

Loan Class	Farm Loans	Allocated Capital	Capital as Percent of Loans	Profit Before Taxes	Return on Loan Assets	Return on Capital
	(Col. 1)	(Col. 2)	(Col. 3)	(Col. 4)	(Col. 5)	(Col. 6)
I	$2,250,000	$138,750	6.17%	$41,625	1.85%	30%
II	3,750,000	311,250	8.30	93,375	2.49	30
III	1,500,000	202,500	13.50	60,750	4.05	30
Total	7,500,000	652,500	8.70	195,700	2.61	30

The bank plans to write $7.5 million in farm loans in the next year. Loans are classified as above and the total loan portfolio is allocated according to historical loan demands, relative yields, and the return that bank management desires to earn. The management desires a 30 percent return on capital, which corresponds to a 2.61 percent return on total loan assets. Expected rates of return on the various loan classes (Col. 5) are next determined through the normal bank budgeting process. Profit before taxes (Col. 4) is the product of the return on loans (Col. 5) and anticipated farm loans (Col. 1). Allocated capital (Col. 2) is the profit before taxes (Col. 4) divided by the desired return on capital (Col. 6). Finally, the percentage allocation of capital (Col. 3) for each loan class is the ratio of allocated capital to total farm loans (Col. 2/Col. 1).

Table 12 presents the results of pricing a low-risk borrower and a high-risk borrower using the above capital allocation percentages. The resulting interest rate charged Farmer A increases to 14.70 percent. This increase results from a reduced allocation of capital but an offsetting increase in the cost of allocated capital (from 20 percent up to 30 percent). Farmer B's interest rate rises to 14.97 percent, primarily because the effect of an increased allocation of capital more than offsets the reduction in the cost of capital (from 40 percent down to 30 percent). The interest rate spread is reduced, although the

TABLE 12. LOAN PRICING WORKSHEET FOR A LOW-RISK (CLASS I) BORROWER AND A HIGH-RISK (CLASS III) BORROWER USING A SCHEDULED CAPITAL ALLOCATION STRATEGY

		Farmer A	Farmer B
	Acct. No.	4	62
	Loan Class	I	III
I.	SOURCES AND USES OF FUNDS (Projected)		
1.	Average Loan Balance	38,317	12,812
2.	Average Transactions Balannce	12,167	3,354
	a. Investable Balance (net of reserves, float)	10,317	2,844
3.	Average Savings and Time Balances	6,779	596
	a. Investable Balance (net of reserves)	6,575	578
4.	Total Investable Balances	16,893	3,422
5.	Allocated Capital	2,364	1,730
6.	Free Purchased Funds	19,060	7,660
7.	Total Purchased Funds (gross of reserves)	19,649	7,897
II.	LOAN EXPENSES (Projected)		
8.	Interest on Customer Balances	1,125	32
9.	Cost of Services Provided (net of fees)		
	a. Cost of Loan Balance	1,408	471
	b. Cost of Deposit Balance	528	148
10.	Cost of Purchased Funds	1,861	748
11.	Cost of Allocated Capital	709	519
12.	Total Expenses	5,631	1,918
III.	INTEREST RATE		
13.	Total Expenses/Average Loan Balance * 100	14.70	14.97

spread could have increased for a different set of loans and under different budgeted returns on loan funds by risk class.

The above loan pricing examples illustrate a method for determining rates which will yield the bank a desired yield on capital if all variables remain at the projected levels. However, if the cost of purchased funds changes or the actual investable balances provided by the customer varies significantly from the anticipated levels, repricing is required to maintain loan yields on target. In periods of rapid changes in cost of funds or deteriorating farm incomes the frequency of repricing farm loans may be increased. A loan pricing policy which allows for variable or floating rates and incorporates the above loan pricing approach would allow for periodic repricing when necessary.

Conclusions and Implications

Rural agricultural banks have traditionally considered farm loans to be of generally high quality. However, the quality of farm loans is not uniform and varies over time as changes occur in farm risk and profitability. The combined effects of increased risk in farming, expanded demand for loanable funds, the increased need for purchased funds, and recent variability in the cost of those funds place rural agricultural banks in an increasingly risky position. In order to manage risk in the farm loan portfolio and maintain the desired yield on bank capital, it is necessary that the bank evaluate individual borrower risk and price loans accordingly.

A recent survey of U.S. commercial banks revealed that rural banks are quite interested in adopting lending and pricing practices which will allow them to respond to changing financial market and agricultural sector conditions. Those practices include: 1) accuracy in determining the cost of purchased funds, 2) determining a target rate-of-return on equity capital for individual customers, 3) use of compensating balances, fees on loans, credit commitments

or lines-of-credit, 4) use of floating interest rates, 5) adjusting maturities, and 6) using Customer Loan Profitability Analysis for post-loan evaluation. This report presents a procedure which can be used by rural banks to price and evaluate farm loans on an individual borrower basis. The procedure allows the loan officer to incorporate information on the entire relationship between the bank and the customer.

Greater precision in pricing individual farm loans will result in increased predictability of bank loan profits. To achieve a target yield on farm loans, rural banks need to achieve greater expertise in 1) predicting the costs of alternative sources of loanable funds and the associated impacts on their average cost of funds and 2) evaluation of borrower risk characteristics.

Borrower risk can be separated into credit risk and liquidity risk. Objective credit scoring can be used to measure credit risk as a function of several borrower characteristics. The particular credit scoring equation which was estimated in this study is unique to the case bank which was selected and could be greatly improved with more extensive data. Other credit scoring equations can be readily estimated from bank data on financial and nonfinancial characteristics of individual borrowers. The credit scoring equation must be re-estimated periodically as borrower characteristics change to retain its usefulness as a tool for evaluating credit risk. Liquidity risk can be evaluated at the individual borrower level by estimating the weighted average coefficient of variation of deposit and loan balances. Bank records which provide balances on a frequent cycle during the year can be used to compute that measure of liquidity risk. End-of-month balances should not be used as a measure of collected balances and a minimum of 18 balances should be used during a one-year period.

A major implication of this method for explicitly pricing farm loans according to risk is that the rural agricultural bank must maintain adequate

records on individual farm borrowers and on its own banking operations. Selected farm-borrower characteristics can be maintained relatively easily and updated whenever the borrower contacts the bank for additional financing. Internal bank records on the cost of services provided are a more significant problem. A performance pricing approach may require that the bank adopt a cost accounting information system to estimate the rates to charge for services provided. If the bank participates in Federal Reserve Functional Cost Analysis, some of that information is available for broad functional categories. A major problem with those functional cost estimates is that they are developed and reported on a complete full-absorption basis. As a result, estimation of unit marginal costs for pricing analysis is difficult.

Although most rural agricultural banks do not have a formalized internal service costing system, rural commercial banks can develop useful systems. One such system would estimate hours of clerical work which are normally spent on bank services, and allocate bank overhead and administrative expenses to service functions in proportion to labor hours.

Agricultural banks are aware of and are responding to the problems of loan pricing, profitability, and competition in the new financial environment which is evolving. To fully implement the innovative practices which have been used by larger commercial banks and other farm lenders for some time, rural banks may have to wait for further progress in the development of more easily applicable computer systems to make them cost effective. However, progress can be made toward greater control over financial performance by 1) adopting available methods (such as the manual method presented in this study), 2) training loan personnel, and 3) educating farm customers about customer-based pricing.

Footnotes

[1]Regulation Q of the Federal Reserve prescribes the maximum rates of interest which may be paid by member banks on time and savings deposits. Under the Depository Institutions Deregulation and Monetary Control Act of 1980, those limitations are to be phased out gradually and eliminated by 1986.

[2]The coefficient of variation (CV) for a customer's deposit balances is equal to the standard deviation of deposit balances (as computed from periodic bank deposit records) divided by the average level of deposit balances. The CV for loan balances is computed in an analogous manner. The weighted average coefficient of variation (WACV) is computed by weighting each CV by the proportion of the combined balances comprised by deposits and loans, respectively, then summing the products.

[3]The 16 hold-out cases were drawn proportionately from the five original subjective loan ranking classes provided by the bank.

[4]Commercial banks which practice individual loan pricing frequently use a range up to 3 percent as a spread between their highest quality and lowest quality loan customers.

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