AN ANALYSIS OF FACTORS THAT AFFECT THE QUALITY OF FEDERAL LAND BANK LOANS

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Abstract

Financial conditions existing in agriculture are placing severe pressure on lenders as well as borrowers. Data from both good and foreclosed Federal Land Bank loans were analyzed to determine the most important characteristics leading to the failure of loans. The analysis was completed by comparing means through t-tests and the development of a discriminant model. The ratio of total debt service to total income, the debt to asset ratio, the ratio of total loan amount to appraised value, and the ratio of acres in security to acres owned were determined to be the most important discriminating variables.

Key words: financial analysis, credit scoring, discriminant analysis, loan evaluation.

The financial health of the U.S. agricultural industry has deteriorated greatly over the past few years. Rising production costs, high interest rates, adverse environmental factors, and relatively low product prices have created an environment in which some farmers are not able to manage effectively so that financial difficulties can be avoided. High debt levels held by many of these individuals increase financial risk, the need for reallocation of agricultural resources, and the possibility of loan default and foreclosure.

Foreclosure rates have reached unusually high levels for lenders who serve agriculture. As of June 30, 1985, the combined acquired properties held by institutions of the Farm Credit System totaled $851 million. This was 60 percent higher than at the same time in 1984 (Raufner and Pelzer). By June 30, 1986, the total had increased another 20 percent to $1,018 million according to an unpublished report prepared by the Director of Research at the Farm Credit Banks of Jackson, Mississippi.

The poor financial health of the agricultural industry not only puts pressure on borrowers, but erodes the financial base of lenders as well. Increased levels of foreclosure create direct costs to lenders when a portion of uncollectable loans must be written off. Additional costs are realized through increased administrative activity required for foreclosures and for the management and disposal of acquired properties. Loss from a given loan may become even greater if the value of the acquired property declines. Lenders also experience increased collection costs for many other loans in their portfolio during periods of financial stress for borrowers.

The purpose of the research presented in this paper was to examine the agricultural real estate credit market and determine which loan, borrower, and farm business characteristics are most important in discriminating between loans that are good (borrowers are able to meet repayment obligations) and those that have deteriorated to the level of foreclosure. Previous studies have examined the general credit quality issue (Bauer and Jordan; Dunn and Frey; Hardy and Patterson; Hardy and Weed; and Johnson and Hagan). They emphasized characteristics that differentiate between borrowers who are making payments as scheduled and those who have moved to the problem, vulnerable, or loss categories. No attention was given in these studies to the treatment of foreclosed accounts since the problem was nearly nonexistent.

Recent increases in the levels of foreclosure have brought the need for additional analysis

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to determine the most important characteristics that might make foreclosure necessary. For this analysis, it was hypothesized that certain borrower, loan, and farm business characteristics would be significantly different between borrowers who are making their payments and those who had suffered foreclosure. An additional justification for the analysis was the need to determine if the most important discriminating characteristics in the current financial market are similar to those found by other earlier studies. Certainly, the current financial market for agriculture is different from that which existed in the past.

METHODS AND PROCEDURES

Data for this analysis were taken from the loan files of the Federal Land Bank (FLB) in the Fifth Farm Credit District, Jackson, Mississippi, in spring 1985. The data represented a sample of loans closed between January 1, 1979, and December 31, 1981, in Alabama, Louisiana, and Mississippi. Data from those years were selected because they represent relatively recent history. Also, the loans are of sufficient age to provide some indication of whether the borrower would be able to meet loan payment obligations.

Data recorded in the loan files by the FLB represented an estimate of the financial and cash-flow situation that would exist for the borrower after loan closing. These are the data used by the FLB in determining whether to accept or reject a specific loan application. Obviously, the initial indication from these data to FLB loan officers was that the loan was a good risk since the decision was made to make the loan. No data were available for loans that were not made.

A stratified random sample of loan accounts was taken so that observations would lie at both extremes of the performance scale. Good loans were those that were having no problems in repayment (not classified as problem, vulnerable, or loss), and bad loans were those that had already suffered foreclosure. Even though a large portion of the FLB loan portfolio lies between these two extremes, it was felt that these data would give a better estimation of discriminating variables. A total of 68 observations were classified as good and 76 were from foreclosed accounts.

PAST RESEARCH

Several methods are available for the analysis of credit quality and individual loan applications. Procedures range from simplistic interviews with a loan officer and his subjective evaluation to the use of statistical procedures for data analysis. These statistical analyses could begin with the simple comparison of means for certain variables and end with the use of complex multivariate techniques such as logit, probit, and discriminant analysis. A review of the literature revealed that discriminant analysis is by far the most prominent and widely accepted technique, thus that procedure was selected for use in this research.

Since 1936, when R. A. Fisher introduced discriminant analysis, it has been used successfully to evaluate numerous practical problems. One of the earliest applications of discriminant analysis for solving credit scoring and evaluation problems was completed by Durand in 1941. He analyzed data from loans on used car purchases and was able to construct an effective credit scoring model to classify borrowers as either acceptable or unacceptable.

Discriminant analysis has been used in several studies similar to the one presented in this paper in which the agricultural credit market was evaluated. None of these studies used data from foreclosed accounts because agricultural financial conditions during the periods covered by their analysis were such that very few farmers had suffered foreclosure. Emphasis was placed on differences between good loans and those that were classed as either problem, vulnerable, or loss. Bauer and Jordan, Johnson and Hagan, Dunn and Frey, and Hardy and Weed examined Production Credit Association loans. In the Bauer and Jordan analysis, data from Tennessee were used to construct a discriminant model which classified 85 percent of the loans correctly. Variables which they found to be significant were current ratio, debt-to-asset ratio, reasonable farm value, total liabilities, marital status, and family living expenses as a portion of total farm expense.

Missouri data were used by Johnson and Hagan to develop a model which correctly classified 62 percent of the loans that were analyzed. Variables found to be important in their analysis were loan repayment made plus marketable inventory divided by loan repayment anticipated, current ratio, and debt-to-asset ratio.

The Dunn and Frey model, based on data from the cash grain area of Central Illinois, also found that the debt-to-asset ratio was an important discriminating variable. Additional discriminating variables were amount of

credit life insurance, number of acres owned, and amount of the note divided by net cash farm income. Their model correctly classified 90 percent of the acceptable loans and 60 percent of the problem loans.

Hardy and Weed used Alabama Production Credit Association data to construct a model which classified 81 percent of the loans correctly. The model contained only two variables: the debt-to-asset ratio and annual loan repayment anticipated divided by total assets.

An additional study by Hardy and Patterson was even more similar to the one presented in this paper since it was based on Federal Land Bank data. Data were obtained from the Fifth Farm Credit District on loans that were closed during 1974 to 1978. A 10 percent random sample of these loans was taken, giving a total sample size of 1,980. Of this sample, 1,765 were good loans, while 215 were classified as either problem, vulnerable, or loss. The discriminant model, which classified 71 percent of the loans correctly, found the debt-to-asset ratio and the ratio of loan commitment to net worth to be the most important discriminating variables.

RESULTS

Comparative Descriptive Analysis

Data presented in Table 1 give the general characteristics of the farmers and farm businesses represented in the sample.[1] Means for each variable are presented along with an indication of whether there is a statistically significant difference between the loans that are in good standing versus those that have suffered foreclosure. Statistical differences were determined through the use of the t-test with significance measured at the 0.01 and 0.05 levels. Evidence of statistical differences was important in determining which variables to include in the discriminant analysis.

The characteristic data in Table 1 may be grouped into several categories. First, age of borrower, acres operated, and acres owned serve to describe the type of operator and the overall size of the operation. These characteristics were designated as operation variables. There were no statistically significant differences between the good and foreclosed groups for these variables.

Next, the group of variables beginning with gross farm income and ending with the total debt service to total income ratio represent earnings, debt carrying capacity, and overall repayment ability. These annual projections of income, expenses, and debt service were designated as repayment ability variables. Several variables in this category displayed statistically significant differences between the two groups. Net farm income was higher for foreclosed observations, but salary was lower. The amount of FLB loan was significantly higher for the foreclosed operations. This larger loan amount likely could be a major cause of the repayment problems experienced by those who had defaulted. Federal Land Bank annual debt service values also reflect the repayment pressure that was felt by the foreclosed group.

When repayment ratio variables were constructed, large differences were seen between the means of good and foreclosed groups. The ratio of total income to total liabilities was higher for the good loans as expected. Net farm income per acre operated and net farm income per dollar of total income were higher for the foreclosed loans. Ratios relating FLB annual debt service and total annual debt service to total income were also higher for foreclosed loans. These higher values for foreclosed loans are an indication of the repayment pressure faced by those individuals who had defaulted.

The general financial condition of the farm operation is represented by the set of balance sheet variables beginning with current assets and ending with the ratio of total liabilities to acres owned. Those with foreclosed loans had generally higher liability levels, with the difference statistically significant for intermediate liabilities. The total liabilities to total assets ratio (debt-to-asset ratio) and total liabilities to net worth (leverage) ratio showed significant differences between the good and foreclosed groups. As would be expected, debt loads of the foreclosed loans were higher relative to asset and net worth values.

The final set of variables permitted an examination of the level of security and the relative amount of collateral associated with the loan. Variables related to security revealed that the foreclosed group had a significantly larger number of acres in security. Also, the ratios of loan amount to appraised value and loan amount to acres in security were signifi-

[1]Most variables are self explanatory. Some, however, may need additional clarification: Salary refers to any income that the farm family receives from off-farm employment; Other Income also relates to off-farm income from sources such as interest, investments, etc.; FLB Annual Debt Service is the total principal and interest due to the Federal Land Bank during the year; and Balance Remaining for New Investment is total income minus debt service requirements and other expenses.

TABLE 1. MEAN VALUES FOR SELECTED CHARACTERISTICS OF SAMPLE LOANS FROM FIFTH FARM CREDIT DISTRICT LAND BANK CLASSIFIED BY STATUS OF LOAN[a]

Characteristic	Good Loans	Foreclosed Loans
Number of observations	68	76
Operation Variables		
Age of borrower (yr)	47	42
Acres operated (ac)	932	1,396
Acres owned (ac)	775	839
Repayment Ability Variables		
Gross farm income ($)	148,494	275,666
Net farm income ($)	65,212	109,047[c]
Salary ($)	36,765	15,453[c]
Other income ($)	28,069	21,719
Total income ($)	130,945	146,219
Loan amount ($)	204,760	395,400[c]
FLB annual debt service ($)	25,350	49,921[c]
Total annual debt service ($)	57,451	85,935
Balance remaining for new investments ($)	91,067	114,777
Total income/total liabilities (%)	52	27[b]
Net farm income/acres operated ($/ac)	52	85[b]
Net farm income/total income (%)	38	68[b]
FLB annual debt service/total income (%)	21	31[b]
Total debt service/total income (%)	34	53[b]
Financial Condition Variables		
Current assets ($)	295,539	198,036
Intermediate assets ($)	247,818	300,073
Fixed assets ($)	1,085,788	1,055,999
Total assets ($)	1,629,145	1,554,108
Current liabilities ($)	37,480	60,925
Intermediate liabilities ($)	28,142	77,198[b]
Long-term liabilities ($)	414,717	590,006
Total liabilities ($)	480,339	728,129
Net worth ($)	1,148,806	825,979
Total liabilities/total assets (%)	33	49[b]
Total liabilities/net worth (%)	58	117[b]
Total liabilities/acres operated ($/ac)	619	732
Total liabilities/acres owned ($/ac)	684	1,286[b]
Security Variables		
Acres in security (ac)	282	481[c]
Loan amount/appraised value (%)	63	74[b]
Loan amount/acres in security ($/ac)	698	871[b]
Appraised value/acres in security ($/ac)	1,174	1,181
Acres in security/acres operated (%)	62	50[c]
Acres in security/acres owned (%)	64	78[c]

[a]Ratios of average values presented in the table may not be the same as the average of the ratios.

[b]Significantly different at .01 level.

[c]Significantly different at .05 level.

cantly greater for foreclosed loans. Significant differences were present in the ratios of acres in security to acres operated and acres in security to acres owned.

Discriminant Analysis

As was indicated earlier, the discriminant procedure was selected as the primary analytical tool to be used in the analysis. The technique permitted a further examination of particular variables that might help in predicting whether a given loan would be good or result in default and eventual foreclosure.[2] Four variables proved to be important in discriminating between good loans and those which had been foreclosed. These variables, in the order of their selection for the discriminant function, were the ratio of total debt service to total income, the ratio of acres in security to acres owned, the ratio of loan amount to appraised value, and the debt-to-asset ratio.

The unstandardized discriminant function derived from the analysis is as follows:

$$Y = -5.532 + 4.102X_1 + 1.463X_2 + 3.180X_3 + 1.197X_4,$$

where:

Y = the calculated discriminant score which distinguishes between good loans and foreclosed loans;

X_1 = the ratio of total debt service to total income;

[2]The SPSS discriminant analysis procedure was used in this research. Numerous runs were made, first with all variables included and then with various combinations of the variables, until the best discriminating set was found. For each run, the procedure selected variables to enter the function in a stepwise manner so that the Mahalonobis distance between the two groups was maximized. With this criterion, the variable that maximized the smallest F-ratio between pairs of groups was selected at each step.

X_2 = the ratio of acres in security to acres owned;
X_3 = the ratio of total loan amount to appraised value; and
X_4 = the debt-to-asset ratio.

All variables included in the function indicate a measure of financial pressure on either the earnings or asset base of the farm business. As would be expected, the mean values for each of these variables are less for the good loans than for those that had been foreclosed as shown in Table 2. The mean values for each of these variables were significantly different as was indicated earlier in Table 1. When values of the discriminant function were calculated using these two sets of means, a lower value, −0.798, was observed for those loans that were considered to be good. The value obtained when using the means for the foreclosure loans was 0.709. Thus, in using the function to classify individual loans, lower values would tend to indicate the likelihood of the loan being good.

Data presented in Table 3 and illustrated in Figure 1 show for good, foreclosed, and all loans the proportion that were classified correctly by the discriminant function for several specified cut-off scores.[3] The range of scores was permitted to be wide enough so that the function could go from the extremes of correctly classifying all good loans but incorrectly classifying all foreclosed loans to correctly classifying all foreclosed loans but incorrectly classifying all good loans. For example, if the cut-off score was set at 3.00, the decision criterion would be that if a loan "scores" above that level, it would be classified in the foreclosed category. All loans that "score" below 3.00 would be in the good category. For

TABLE 2. MEAN VALUES FOR VARIABLES INCLUDED IN DISCRIMINANT FUNCTION AND VALUES OF FUNCTION CALCULATED WITH MEANS FOR GOOD AND FORECLOSED LOANS

Variable	Good Loan Means	Foreclosed Loan Means
Total debt service/total income	.342	.528[a]
Total debt/total assets	.329	.494[a]
Loan amount/appraised value	.628	.738[a]
Acres in security/acres owned	.643	.777[b]
Discriminant score	−.798	.709

[a]Significantly different at .01 level.
[b]Significantly different at .05 level.

TABLE 3. PERCENTAGE OF SAMPLE OF LOANS FROM FIFTH FARM CREDIT DISTRICT WHICH WERE CLASSIFIED CORRECTLY USING DISCRIMINANT EVALUATION MODEL AND SPECIFIED CUT-OFF SCORES

Discriminant Function Cut-Off Score	Percent Correctly Classified		
	Foreclosed Loans	Good Loans	All Loans
−3.50	100.0	0.0	52.8
−3.25	100.0	1.5	53.5
−3.00	100.0	2.9	54.2
−2.75	100.0	4.4	54.9
−2.50	98.7	5.9	54.9
−2.25	98.7	7.4	55.6
−2.00	98.7	11.8	57.6
−1.75	98.7	14.7	59.0
−1.50	97.4	20.6	61.1
−1.25	97.4	29.4	65.3
−1.00	94.7	36.8	67.4
−0.75	93.4	47.1	71.5
−0.50	92.1	63.2	78.5
−0.25	86.8	75.0	81.3
−0.19	85.5	79.4	82.6
0.00	77.6	85.3	81.3
0.25	65.8	88.2	76.4
0.50	61.8	89.7	75.0
0.75	48.7	91.2	68.8
1.00	43.4	94.1	67.4
1.25	32.9	98.5	63.9
1.50	23.7	100.0	59.7
1.75	11.8	100.0	53.5
2.00	6.6	100.0	50.7
2.25	2.6	100.0	48.6
2.50	2.6	100.0	48.6
2.75	2.6	100.0	48.6
3.00	0.0	100.0	47.2

[3]When using the discriminant function to analyze a loan request, the analyst would calculate the loan applicant's discriminant score from data in the loan application. For the function derived in this research, if the applicant "scores" above a specified cut-off amount, the loan would be classified as bad and a potential for foreclosure. If the score is below the cut-off, the loan would be categorized as good.

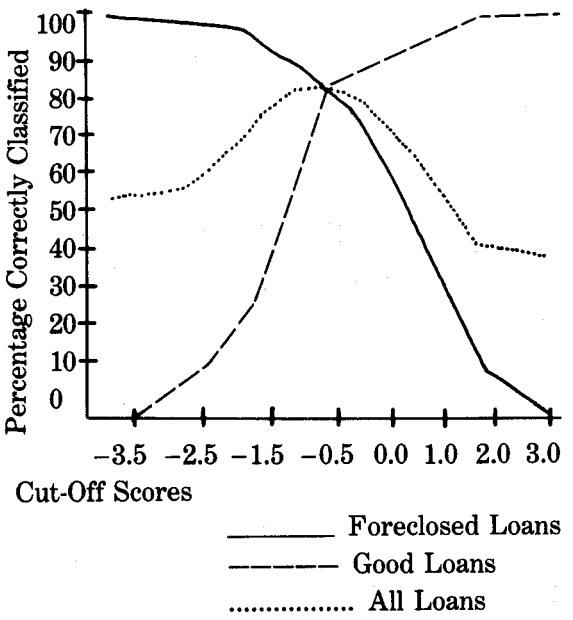

Figure 1. Percentage of Loans (Good, Foreclosed, and Total) That Were Classified Correctly Using Specified Cut-Off Scores.

the sample data, no loans had a discriminant function value above 3.00, so all were classified as good. This would obviously classify correctly all loans that were actually good, but all those that were actually in the foreclosed group were classified incorrectly. With a cut-off score of 3.00, only 47.2 percent of the total sample was classified correctly.

The optimal cut-off score was determined to be −0.19. With a decision rule based on this value, 82.6 percent of the total sample was classified correctly. Individually, the model correctly classified 85.5 percent of the foreclosed group and 79.4 percent of the good group.

Even though a cut-off score of −0.19 maximized the percentage of loans classified correctly, this cut-off score may not provide maximum profits to the FLB. As the cut-off score is increased from −3.5 to 3.0, a trade-off exists between the cost of misclassifying a good loan (foregone returns) and the cost of misclassifying a bad loan (net loss from additional collection expenses or, possibly, loan foreclosure). The profit-maximizing cut-off score would need to be determined by estimating the revenue and cost functions over the relevant cut-off score range. Additional research would be required to estimate these cost values.

Several procedures are available to statistically verify the validity of a given discriminant function. The U-Method is a particularly appropriate technique when sample sizes are relatively small, as was the case in this analysis (Nath and Pavur, and Hora and Wilcox). With this method, one observation at a time is deleted from the sample and the discriminant classification function is derived using the remaining observations. The deleted observation is then classified with the new function. This process is continued until n classification functions each using n-1 observations have been derived, where n is the number of observations. The "test of goodness" is the measure of the portion of the individual observations that are classified correctly. For the data used in this research, the U-method correctly classified 79.9 percent of observations. Since this level of correct classification is relatively close to that achieved by the initial function, 82.6 percent, it can be assumed that the estimation error rate of about 17.4 percent in the original model is valid. This error rate would be associated with the classification of extreme cases (good and foreclosed accounts).

SUMMARY AND CONCLUSIONS

The stressful financial conditions that exist in our nation's agricultural industry point to the need for increased care and concern in the use of debt financing. From the viewpoint of the farmer, the desire for debt funding must be evaluated on the basis of the productivity of the additional funds and the ability to handle the repayment stress of additional debt. Loans made to farmers who cannot productively use the funds are a disservice for that individual.

From the viewpoint of the financial institution, careful evaluation is necessary so that the volume of good loans is maximized and the number of foreclosures is minimized. Lenders are in business to make loans, provide necessary service, and collect principal and interest. Most do not look forward to the prospects of foreclosure and the attendant costs.

The goal of the analysis presented in this paper was to determine which measurable variables would do the best job in describing differences between Federal Land Bank loans which were good and those which had defaulted to the level of foreclosure. The first step of the analysis was to examine the differences between means of selected variables for the good and foreclosed groups. The analysis was continued through the use of

discriminant analysis. A discriminant function which correctly classified 82.6 percent of the sample data was derived. This function included four variables: the ratio of total debt service to total income; the debt-to-asset ratio; the ratio of loan amount to appraised value; and the ratio of acres in security to acres owned.

Variables found to be important in this analysis were similar to those found by other researchers as shown in Table 4. The debt-to-asset ratio was identified by Hardy and Patterson in their analysis of Federal Land Bank data, while Bauer and Jordan, Johnson and Hagan, Dunn and Frey, and Hardy and Weed also found the ratio to be a significant discriminating variable in their examinations of Production Credit Association data. These other studies also found the relationships between loan amount and loan payment to income and asset values to be important as did the research presented in this paper.

The discriminant function derived through this research can provide an objective method for evaluating Federal Land Bank loan applications for the Fifth Farm Credit District. Since farmer characteristics differ from one area of the country to another, additional analysis would be necessary to evaluate loan applications for other geographic locations. Also, changing conditions over time may create the need for reevaluation. The function can in no way replace the subjective evaluation of a trained and experienced loan officer. It can, however, serve to increase the analytical evaluative tools that are available and assist the loan officer in doing a better job.

TABLE 4. SIGNIFICANT CHARACTERISTICS FOR EVALUATING AGRICULTURAL CREDIT QUALITY AS REPORTED BY SELECTED STUDIES

Characteristic	Bauer and Jordan PCA 1971	Dunn and Frey PCA 1976	Hardy and Patterson FLB 1983	Hardy and Weed PCA 1980	Johnson and Hagan PCA 1973	Present Study
Total debt/total assets	X	X	X	X	X	X
Total debt service/total income						X
Total liabilities	X					
Loan amount/net cash income		X				
Loan repayment anticipated/ total assets				X		
(Loan repayment + marketable inventory)/loan repayment anticipated					X	
Loan amount/net worth			X			
Loan amount/appraised value						X
Aces in security/acres owned						X
Acres owned		X				
Reasonable farm value	X					
Current assets/current liabilities	X					
Marital status	X					
Family living expenses/total farm expenses	X					
Credit life insurance		X				

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