EFFECTS OF MANAGEMENT DECISIONS ON AGRICULTURAL BANK FAILURES

Michael T. Belongia & R. Alton Gilbert

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Department of Agricultural Economics
Texas A&M University
College Station, Texas 77843-2124
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INTRODUCTION

Of the 721 commercial bank failures between 1984-88, 244 were agricultural banks, identified as banks with a ratio of agricultural loans to total loans greater than the national average value.[1/] One common explanation for the high concentration of bank failures among agricultural banks has been that the severe post-1980 downturn in farm sector income significantly impaired the ability of farm borrowers to repay their debts. Perhaps more important for lenders, however, was the 30 percent decline in the average value of farm land from 1981 through 1988, with much larger percentage declines in some areas. These sharp reductions in land values indicate that, even if a bank had been able to foreclose and sell land pledged as collateral for farm loans, the receipts from the sales might not have covered the outstanding principal balance on the loans.

The adverse effects of a sectoral downturn on agricultural banks, however, do not explain the observed pattern of agricultural bank failures. Because most of the failed agricultural banks were located in rural counties where other agricultural banks continue to operate profitably, a simple linkage between declines in aggregate farm income and bank failures seems to be rejected. In fact, this observation raises a different research question: Did portfolio decisions by managers of individual banks expose their institutions to significantly greater risk of failure? This article attempts to identify the factors that explain why many agricultural bank failures in 1984-1988 occurred in areas where other agricultural banks still operate profitably.

Section I presents data on the geographic concentration of the failed agricultural banks and on the financial condition of banks that continue to operate in areas where agricultural banks have failed. Section II reviews the literature on causes of bank failures, distinguishing between models designed to predict bank failures and those designed to test hypotheses about the determinants of bank failures. Section III develops a theoretical model of the determinants of bank failures. Section IV reports the results of estimating the coefficients of the empirical bank failure model, and Section V presents our conclusions.

I. DETERMINANTS OF AGRICULTURAL BANK FAILURES: SECTORAL DOWNTURN VERSUS BANK MANAGEMENT DECISIONS

Prior Research

The adverse developments in the agricultural sector in the 1980s made the failure of agricultural banks more likely in the sense that there would have been fewer agricultural bank failures if general economic conditions had been more favorable. There are problems, however, with the argument that economic conditions were the primary cause of agricultural bank failures. One problem is that failed agricultural banks have been scattered widely throughout rural, agricultural areas. Some prior research, for example, indicates there are few counties in rural agricultural areas with more than one failed agricultural bank in the years 1984 through 1986; the 105 failed agricultural banks in that study were located in 96 rural counties (Belongia and Gilbert (1987)). If the failures of agricultural banks reflected primarily conditions in the local agricultural

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economy, one would expect to see a more pronounced geographic clustering of failed agricultural banks.

Prior research also indicates that in 1981, at the peak of farm land prices in most states, the agricultural banks that subsequently failed had significantly higher ratios of loans to assets than agricultural banks located in the same counties which did not fail. Indeed, most of the agricultural banks located in counties where agricultural banks failed remain in sound financial condition. Again, the casual inference is that agricultural bank failures appear to reflect the risk that was assumed in portfolio decisions made prior to the

Gunther (1989) finds a similar result for medium-sized banks located in large metropolitan areas in Texas. Those banks that recorded large losses in the economic downturn in Texas had balance sheet ratios that reflected relatively high risk prior to the downturn.

An Overview of the Financial Condition of Agricultural Banks

Although more detail on sample selection is provided in section IV, our criteria for including banks in this study yield data on 160 failed agricultural banks in 138 rural counties in ten states.[2/] Thus, in most of the 138 counties, only one agricultural banks failed. Moreover, because we only include counties that had more than one agricultural bank, the limited geographic clustering of failures is consistent with the notion that the causes for bank failures include factors beyond local economic conditions.

The financial condition of the agricultural banks that remain in operation in those counties where other agricultural banks have failed also has implications for the hypothesis that local conditions are responsible for the failures. Suppose, for example, that most of the surviving agricultural banks are in relatively poor condition, near failure themselves. Such an observation would tend to support the view that adverse conditions in the agricultural sector explain the bank failures, since the difference between the condition of the surviving banks and that of the failed banks, when they were closed, is small. If, however, most of the surviving banks are profitable and adequately capitalized, general economic conditions would seem to be a less likely explanation for failures than the portfolio decisions of the failed banks themselves.

Table 1 presents some information about the agricultural banks that continued to operate in 1988.[3/] These data, for June of 1981 and 1988, highlight key measures of bank performance before and after the farm sector downturn. The first two measures, the returns on equity (ROE) and on assets (ROA), show sharp declines between the two points in time and both of these differences are statistically significant. Although lower in 1988, however, these performance measures still are in broad alignment with the banking industry as a whole. In other words, agricultural banks, which had earnings ratios substantially higher than the general banking industry in the late 1970s and early 1980s, have seen their earnings ratios fall back in line with the industry average.

The ratio of primary capital to total assets of the surviving banks is another key measure of financial strength. The average capital ratio of these surviving banks declined only slightly over this seven year period. In fact, the average capital ratio of these surviving banks remains about three percentage points above the minimum ratio of six percent required by the federal bank supervisors. Moreover, these banks were able to remain solvent and generate reasonable earnings performance without making large changes in their farm lending; the average percentage of their loans in agricultural loans was only about three percentage points lower in 1988 than in 1981. Overall, the data in table 1 do not support the idea that agricultural banks which survived the farm sector downturn of the 1980s are on the brink of failure. Instead, this overview indicates that most of these agricultural banks remain in sound financial condition despite sectoral problems.

II. MODELS AND EVIDENCE ON CAUSES OF BANK FAILURES

Models

Empirical models of bank failures fall into two categories. Most bank failure models are designed to predict failures. These studies include independent variables largely on the basis of their contribution to

predict failures. These studies include independent variables largely on the basis of their contribution to predictive power. The bank supervisory agencies use the results of these studies to identify banks with relatively high probabilities of failing in the future and, thus, focus their efforts on reversing unfavorable trends at those banks.[4/]

With accurate prediction as the basic objective, however, it is difficult to interpret the empirical results as tests of hypotheses about the determinants of failure. To illustrate, predictive models use various measures of earnings and loss ratios as explanatory variables. Because these variables reflect both local economic conditions and decisions of bank management to hold portfolios of assets subject to varying probabilities of losses, it is not clear what is implied by a significant coefficient on an ex post measure of performance. Explanatory variables in predictive models also tend to be highly correlated. For instance, some models include as explanatory variables total loans divided by total assets and measures of loans of poor quality divided by total assets. If the proportion of loans that turn out to be of poor quality is distributed randomly among banks, these two variables would tend to be positively correlated and the significance of the total loans to assets measure could not be interpreted reliably as a test of its influence on the probability of failure.

In the second group of studies, the goal is to explain differences in the probability of failure within a set of banks, rather than to predict failures. Because our interest is in isolating the effects of management decisions on the probability of failure, we adopt this latter type of explanatory model in our study. For this reason, we deliberately exclude variables that reflect local economic conditions or are correlated with the variables under the control of bank management, even though they might contribute significantly to the accuracy of bank failure predictions.

Explanations for Bank Failures

Studies designed to explain the reasons for bank failures also can be divided into two groups: those that list characteristics of banks that fail and those that test hypotheses about the determinants of failure using statistical tests. A few studies base their conclusions entirely on lists of the characteristics of failed banks. For example, a study commissioned by Dun and Bradstreet found failures to be most common among small unit banks (less than $25 million in assets) with low rates of return on assets (ROA) relative to other banks in their size class in the year or last two years prior to failure. The study also found evidence of higher loan-to-asset ratios and lower equity-to-asset ratios at failed banks (see Scott, et al. (1984) and Peterson and Scott (1985)). The House Subcommittee on Commerce, Consumer and Monetary Affairs, looking at 75 failures between 1982 and the first quarter of 1984, found that in 46 cases bank officials were engaged in "actual or probable criminal misconduct"; rapid growth also was cited as a contributing factor (see Pate (1984) and Peterson and Scott (1985). A recent study by the Office of the Comptroller of the Currency examined the characteristics of failed and healthy banks (Graham and Horner (1988) and Office of the Comptroller of the Currency (1988)). That study concluded that the most important characteristics distinguishing the two groups of banks were the quality of bank management and the degree of involvement of the boards of directors in bank operations.

Other studies test hypotheses concerning the determinants of bank failure. Short, et al. (1985), in a study of bank failures in 1982-83, found that allocating more of total assets to loans and relying more on purchased liabilities were the most significant factors increasing the probability of failure. Smith (1987) found that the probability of failure was higher for banks with lower ratios of capital to assets, higher ratios of loans to assets and higher concentrations of loans in agricultural loans and in commercial and industrial loans. Banks that operate in states that restrict branch banking also tended to have higher probabilities of failure, holding other factors constant.

These two studies indicate that bank failures are related to risk-increasing portfolio decisions made prior to the failures. The results of these studies imply that a sectoral downturn is a "cause" of a bank failure only in the sense it implies, ex post, that a bank's portfolio was not sufficiently diversified or its capital-to-asset ratio was too low to survive the downturn.

III. DETERMINANTS OF BANK FAILURE: THE THEORY

This section develops a theoretical framework that links decisions of bank management to the probability of bank failure. Variables included in the empirical failure model, which is estimated in section IV, are derived from this theoretical analysis.

As a point of departure, it is important to recall that the failure of a bank reflects the actions both of bank supervisors and bank shareholders. After the supervisors discover that, based on their estimates, the net worth of the bank is zero or negative, it is not necessary that the bank fail. As an alternative, shareholders may choose to inject the funds necessary to recapitalize the bank. Without a capital injection, however, supervisors respond by closing the bank.

The factors that influence the probability of failure, therefore, are those that reflect the risk assumed by banks and the incentives of shareholders, facing failure and loss of their original capital, to inject additional capital into their banks. This description of the conditions under which banks are declared to have failed suggests a method of dividing the determinants of failure into three categories: management decisions that influence the probability distributions of returns on assets, the ratio of capital to total assets and the factors that influence the response of shareholders to losses by their banks.

Determinants of Revenue

The return on each asset (loan or security) is assumed to be a random variable with a probability distribution. The probability distribution of revenue, therefore, will depend on the probability distributions of the individual assets and the covariances of their returns. The probability distribution of total revenue can be viewed as a function of the following arguments: (1) total assets, (2) composition of assets, (3) correlation of returns across types of assets, (4) effects unique to the area in which the bank is located and (5) effects unique to the individual bank. Each of these arguments is discussed in turn below.

In regard to total assets, suppose a bank grows larger but keeps the same composition of assets. In proportion, it purchases the same types of securities and lends to borrowers in the same industries. The probability distribution of the returns on loans to each borrower has its unique characteristics. The law of large numbers indicates that, for a given composition of assets, the coefficient of variation of the return on assets will be negatively related to total assets. Thus, growing larger is a form of diversification; one determinant of the probability of bank failure, therefore, is TOTAL ASSETS.

The variance of the return on total assets will tend to be higher if the bank invests in types of assets that have higher variance in their returns. The probability distribution of the returns on total assets also reflects the correlations of returns across types of assets. Thus, the variance of revenue will tend to be relatively high if returns on a relatively high percentage of a bank's loans or securities are positively correlated, indicating a limited degree of diversification. These points about the variances and covariances suggest the following variables to reflect the composition of assets and the correlation of returns.

Loans tend to have higher variances of returns than securities, and the securities with the lowest default risk are the debt obligations of the U.S. Treasury. A bank tends to have a higher variance of return on total assets, therefore, if it has a higher ratio of total loans to total assets (TOTAL LOANS/ASSETS) and a lower ratio of U.S. Treasury securities to total assets (TREASURIES/ASSETS). The ratio of agricultural loans to total loans (AG LOANS/TOTAL LOANS) is chosen to reflect the composition of assets and degree of diversification. Many of the banks in this study have little diversification across industries in their loan portfolios, as indicated by relatively high ratios of agricultural loans to total loans (see tables 1 and 2). Also, agricultural loans represented a high risk category of loans in the 1980s.

The lending policies of banks affect their probabilities of failure. Some banks follow conservative lending policies, while others are willing to make riskier loans if borrowers agree to pay higher interest rates. We do not have information on the lending policies of banks. The variable TOTAL LOANS/ASSETS, however, may reflect loan policies indirectly. Melichar (1986) found a positive association between the ratio of loans

to assets and the percentage of loans that were nonperforming, as of December 1985. This evidence may be interpreted as indicating that the agricultural banks which maintained relatively high ratios of loans to assets also tended to make riskier loans. The nonperforming loans provide an ex post measure of the risk assumed by the banks.

Some studies find that banks with relatively high percentages of their loans to insiders (bank officers and directors) tend to have higher loss rates (Lawrence, Kummer and Arshadi (1987), Graham and Horner (1988) and Office of the Comptroller of the Currency (1988)). This result seems to reflect a problem of maintaining consistent, rigorous standards for quality of loans when banks lend to insiders. Thus, another determinant of the probability of bank failure is insider loans as a percentage of total loans (INSIDER).

Although influences unique to the areas in which the banks are located are beyond the control of bank management and are difficult to measure in any case, it is nonetheless important to control for them in testing the effects of portfolio decisions on the probability of bank failure. This objective is accomplished in this study by limiting the sample to rural counties that had at least one agricultural bank fail in recent years and at least one agricultural bank survive the sectoral downturn.

Finally, bank failures often are at least partly the result of fraud and poor management, factors that are unique to individual banks (Benston, et al (1986), pp. 1-35, Graham and Horner (1988) and Office of the Comptroller of the Currency (1988)). Data on the quality of bank management, however, are not available. Although bank supervisors make qualitative judgments of the quality of management at banks, they do not generally make those evaluations available for purposes of research. The error term of the equation, therefore, reflects factors that cannot be measured directly, such as fraud and quality of bank management. For purposes of statistical inference, it is necessary to assume that these factors, which are reflected in the error term, are not correlated with the independent variables.

Additional Determinants of Net Income

Each of the variables listed so far affects the probability distribution of returns through default risk. An additional dimension of risk assumed by banks, however, is interest rate risk. If the assets and liabilities of banks have different duration, a change in interest rates will have different effects on the market values of the assets and liabilities and, hence, will affect the market value of the bank. Such a change also may affect reported income.

One widely-used measure of interest rate risk is based on the difference between the duration of assets and the duration of liabilities (Kaufman (1984)). Data on the assets and liabilities of commercial banks are not adequate, however, for calculating durations accurately. This study uses a more simple maturity gap measure of interest rate risk, specified as as follows: GAP -- assets with maturities under one year minus liabilities with maturities under one year, divided by total assets.

The implications of this GAP measure for the probability of failure depends on the direction of change in interest rates during the year. To illustrate, suppose that at the beginning of the year a bank raised most of its funds in the form of liabilities with maturities under one year and invested a high percentage of its assets in categories with long maturities. In this case, GAP would be negative, and the market value of the bank would depend on the pattern of change in long-term and short-term interest rates during the year. For instance, the market value of the bank would rise if long-term and short-term interest rates fell. On the other hand, this bank would be vulnerable to large losses in market value if both long-term and short-term interest rates rose or if long-term rates remained unchanged while short-term rates rose.

The composition of liabilities also has implications for the probability of bank failure. We assume that each bank competes for funds in two markets: (1) a local market, in which it has some monopoly power, and (2) the national market, in which it is a price taker. A bank with a higher percentage of its liabilities from the national market will tend to have a higher average interest rate on its liabilities. Holding other factors constant, a bank with a higher average interest rate on its liabilities has a higher probability of a loss that exceeds the capital of the bank. The variable included to reflect the share of liabilities purchased from the

national market is specified as follows: PURCHASED/LIABILITIES -- purchased liabilities as a percentage of total liabilities.[5/]

Capital Ratio

A second category of determinants of bank failure is bank capital. Since capital serves as a cushion to absorb losses, the probability of the failure will be lower if it has a higher ratio of capital to assets (CAPITAL/ASSETS), holding constant other factors.

Determinants of Recapitalization by Shareholders

The final category of determinants of failure involves the incentives of shareholders to inject new capital into a failing bank. If a bank has a loss that exceeds its capital, the only other alternatives are closure by its chartering agency or an injection of capital by its shareholders. In one case, suppose the bank is owned by an individual. Failure of the bank eliminates wealth invested in the bank but has no additional implications for the wealth of the owner. To minimize his loss, the owner is likely to refuse additional investment in the bank, even if he has sufficient wealth in liquid form to raise its capital ratio to the level required by the bank supervisors.

Consider, in contrast, the incentive of a large bank holding company (BHC) to invest in a relatively small bank subsidiary which has negative net worth after incurring losses. The BHC has two reasons to inject capital into its subsidiary that are not relevant for an individual owner. First, failure of the bank subsidiary would tend to undermine the confidence of investors in the ability or willingness of the BHC to meets its obligations, raising the interest rate at which the BHC borrows. The increased interest expense of the BHC resulting from the failure of a subsidiary could exceed the opportunity cost of recapitalizing the failing bank subsidiary.

BHCs are concerned also about their reputations among members of the Federal Reserve Board (Board). A BHC must get permission from the Board to acquire each subsidiary. One of the issues the Board considers in ruling on an application by the BHC to acquire a subsidiary is whether the BHC has served as a source of strength for its bank subsidiaries. Assume that part of the wealth of the BHC before it discovers the loss at a bank subsidiary is the discounted present value of earnings from subsidiaries to be acquired in the future. A BHC could jeopardize its privilege to acquire those subsidiaries if the Board considered the failure of a bank subsidiary as evidence that the BHC failed in its role as a source of strength for its subsidiaries.[6/] The strength of the incentive of the BHC to recapitalize a failing bank subsidiary would depend on the size of the bank subsidiary relative to the present value of anticipated future earnings from subsidiaries to be acquired in the future. A BHC is more likely to recapitalize a bank subsidiary to retain the favor of the Board if the failing bank subsidiary is small relative to the total assets of the BHC.

To reflect the incentives of shareholders to inject capital into a failing bank, the model includes the variable RHCS. For subsidiaries of multi-bank holding companies, RHCS takes a value equal to the natural log of the total assets of the bank subsidiary divided by the total banking assets of the BHC; RHCS is zero for other banks. The values of this variable will be negative for subsidiaries of multi-bank holding companies. The coefficient on RHCS is hypothesized to be positive, indicating that the probability of a bank's failure rises as its assets rise relative to the assets of banks in its BHC, holding constant the influences of other variables.[7/]

IV. RESULTS

Although 244 agricultural banks failed in the years 1984-88, not all observations are usable. All failures in states that permit statewide branching were eliminated because the data used in this study are not available for their individual branches, but activities at a particular branch could be responsible for the bank's failure. To hold constant the effects of local economic conditions, it was necessary to restrict the sample to failed and surviving banks that had all of their offices in the same geographic areas. The sample was restricted further by including only counties that experienced the failure of an agricultural bank and had, in

1981, more than one agricultural bank. The sample was constructed in this manner so that the failed and surviving banks in the study faced the same local economic conditions. Stated differently, any empirical analysis based on bank failures in some areas and surviving banks in others could be affected by local variations in the quality of farm debt, local demand for farm credit and even the riskiness of the farm production in those regions. Finally, to limit our analysis to banks lending to traditional agricultural enterprises, rather than operations that may receive substantial off-farm income or face significantly different economic conditions, only agricultural banks from rural areas are considered.

Table 2 provides some descriptive statistics for the independent variables, and the appendix gives detailed descriptions of the independent variables. The model is estimated using probit analysis, setting the dependent variable equal to one if a bank fails in a given year and zero otherwise. Coefficients on the independent variables can be interpreted as the effects of changes in the values of the independent variables on the probability of bank failure.

Data for Independent Variables Lagged One Year

Table 3 presents the empirical results. The first regression pools the observations for bank failures for the years 1985 through 1988. Values for the independent variables are measured as of June of the prior year. So, for example, values of the independent variables for each agricultural bank located in a county where an agricultural bank failed in 1985 are based on data as of June 1984.[8/] End-of-June data are used throughout for explanatory variables because of seasonality in farm bank data: most new farm loans are not on the books until the second quarter, and third and fourth quarter data are affected by payoffs of spring operating loans and end-of-year "window dressing."

The first regression excludes observations for the failures in 1984 in order to include the independent variable INSIDER. Data used for calculating INSIDER are available as of June 1984 but not June 1983. The first regression also includes dummy variables for individual years, to test the hypothesis that the probability of failure is different for individual years, holding constant the influence of the other independent variables.

Economic Significance of the Coefficients

In the first equation in table 3, the coefficients on the independent variables listed below are statistically significant and have the hypothesized signs. The economic significance of these coefficients can be gauged in terms of the impact of small changes in the independent variables on the probability of failure. The following ratios are measured in percentage points. A one percentage point increase in the following ratios would have the following effects on the probability of failure, holding constant the values of the other variables:

Ratio	Change in probability of failure
AG LOANS/TOTAL LOANS	+ 1.26%
TOTAL LOANS/ASSETS	+ 3.04
TREASURIES/ASSETS	- 2.54
CAPITAL/ASSETS	- 27.00
PURCHASED/LIABILITIES	+ 2.90

For instance, a rise of one percentage point in agricultural loans as a percentage of total loans would increase the probability that a bank would fail by 1.26 percentage points, holding constant the other determinants of failure. Since the variable RHCS is the natural log of the ratio of banking assets, interpretation of the economic significance its coefficient is more complex than for the other independent variables. The economic significance of this variable is illustrated for a specific example. Suppose a bank with total assets of $10 million is a subsidiary of a BHC with total banking assets of $100 million. If the total assets of the BHC rise to $200 million, the probability of failure by the $10 million bank declines by 13.4 percentage points.

Data for Independent Variables Lagged Two Years

An argument could be made that the effects of some of the independent variables in the first equation of table 3 reflect the responses of bank balance sheets to the problems that cause them to fail, rather than the effects of management decisions on the probability of failure. For example, the failed banks may have had relatively large losses for a few years prior to their failure. The pattern of losses prior to failure may explain the negative coefficient on the capital ratio one year prior to failure. Under this interpretation, the coefficient on the capital ratio would reflect the timing of losses of failed banks, rather than a management decision to operate with a relatively low capital ratio. The banks recording relatively large losses may have increased their purchased liabilities after the losses reduced the confidence of the depositors in their local areas. The banks with the largest losses may have been forced to sell their Treasury securities to pay for depositor withdrawals, thus raising TOTAL LOANS/ASSETS and reducing TREASURIES/ASSETS by the June of the year prior to their failure. Banks also may sell some of their loans to fund depositor withdrawals. If agricultural loans are less marketable than other categories of loans, loan sales to fund depositor withdrawals could account for the positive, significant coefficient on the AG LOANS/TOTAL LOANS variable.

If the significance of the coefficients on these variables, measured one year prior to failure, reflects these responses of balance sheet ratios to relatively large losses, their coefficients would tend to be insignificant with the variables measured at longer lags. The second and third columns of table 3 present observations that are relevant for investigating the alternative interpretations. The second equation is the same as the first, except the last four variables are eliminated. Results for the second equation are presented for comparison to those of the third, which includes the same variables but the data lagged an extra year.

All of the variables with significant coefficients in the second equation (one year lag on the data) also have significant coefficients in the third equation (two year lag on the data). These results support the interpretation that the statistical significance of the variables reflects the effects of management decisions on the probability of failure in later periods. The significant coefficient on RHCS in the third equation rules out one interpretation of the coefficient of that variable in the first two equations: BHCs sell their troubled bank subsidiaries, so that they are not recorded as subsidiaries of BHCs one year prior to failure.

Independent Variables Measured with 1981 Observations

The fourth equation presents another approach to distinguishing between the effects of management decisions on the probability of failure and the effects of relatively large losses on the balance sheet ratios of banks. Values for the independent variables are measured as of June 1981, prior to the downturn in the agricultural sector.

We would expect the explanatory power of the fourth equation to be lower than for the other three, since estimation of the fourth equation ignores the effects of management decisions made after June 1981 on the probability of failure. Results in table 3 indicate that, in fact, the likelihood ratio test statistic is lower for the fourth equation than the others, although it is still significant at the one percent level. Several of the independent variables in the fourth equation also still have significant coefficients. These significant independent variables reflect the composition of assets and liabilities and the affiliation of banks with multi-bank holding companies. Thus, the significant coefficients in the other equations of table 3 cannot be explained entirely as reflections of the responses of banks to differential effects of the sectoral downturn.

Efficiency of the Equations in Classifying Failed and Surviving Banks

A check on the explanatory power of a bank failure model is its accuracy in classifying failed and surviving banks correctly. Percentages of observations classified correctly tend to be high for models of bank failure because high percentages of the banks in the samples do not fail and are correctly classified as surviving. The failure prediction models are much less successful, however, in classifying the failed banks as failures. This feature of the classification of banks can be especially troublesome in predictive applications in which the objective is to identify the banks most vulnerable to failure.

Korobow and Stuhr (1985) developed a measure of model efficiency designed to examine the ability of models to classify failed banks correctly as failures. Their weighted efficiency (WE) measure is defined as follows:

$$WE = \frac{(FB)\ (FB)}{(VB)\ (TF)}\ (CC)$$

where FB = number of actual failures identified correctly by the model;
VB = number of failures predicted by the model;
TF = total failures in the sample;
CC = percentage of banks (in all categories) classified correctly.

This measure, which can range between zero and 100, will have each of its three components equal to 100 percent if the model classifies banks perfectly. WE is designed to give a higher value to models that do a better job of classifying failed banks correctly.

The values of WE and its components are presented at the bottom of table 3. Some criterion for comparison is necessary in evaluating these values of WE. In the studies of failure prediction models examined by Korobow and Stuhr, each had WE values less than 5. Against this benchmark, the WE values for the first three equations in table 3 appear to be relatively good, especially since the independent variables included in this study are limited to those derived from a theoretical model of the bank decisions that affect failure.

The fourth equation has less power in classifying the failed banks than the first three equations. The fourth equation, which correctly classifies only 13 of the 152 failed banks, has a weighted efficiency value of 3.85, similar to that of bank failure prediction models reported in the literature.

V. CONCLUSIONS

Failures of agricultural banks in the 1980s often have been attributed to the post-1980 aggregate downturn in the agricultural sector. This explanation, however, is not consistent with the observation that many healthy agricultural banks continue to operate in counties where other banks have failed. Instead, data on the balance sheets of failed and surviving agricultural banks with offices in the same rural counties generally indicate that the failed banks assumed more risk than the surviving banks. Thus, vulnerability to failure appears to reflect portfolio decisions of bank management.

The influence of management decisions on the probability of bank failure was estimated using a probit model. Independent variables included balance sheet items that reflect risk and are under management control. Results indicated that banks with higher ratios of loans to assets and higher percentages of their loans to farmer had higher probabilities of failure. Conversely, banks that maintained higher capital ratios had lower probabilities of failure. Banks also tended to have lower probabilities of failure if they were subsidiaries of multi-bank holding companies.

The evidence indicates that the agricultural banks that failed in the 1980s took relatively high risks and suffered the consequences in an agricultural sector downturn. Moreover, even though the number of agricultural bank failures is large, the evidence does not indicate that agricultural banks as a group are in serious danger of failing.

FOOTNOTES

1/ This definition of an agricultural bank is generally attributed to Emanuel Melichar. See Melichar (1986).

2/ The number of observations depends on the restrictions on the sample. These numbers are based on agricultural bank failures in the years 1984-88, using observations as of June 31, 1981.

3/ The 554 banks included in table 1 were located in rural counties in ten states where at least one agricultural bank had failed in the years 1984-88. The ten states are Alabama, Colorado, Illinois, Iowa, Kansas, Minnesota, Missouri, Texas, Wisconsin and Wyoming. These banks were in operation in June 1981 and June 1988. Some banks that met these conditions were excluded because of incomplete data.

4/ For references to studies with models designed to predict bank failures, see Bovenzi, Marino and McFadden (1983), Bovenzi and Nejezchleb (1985), Lane, Looney and Wansley (1986) and Pantalone and Platt (1987).

5/ Some studies include a core deposits item -- demand plus savings deposits -- relative to liabilities as a factor that reduces risk. This study includes only one measure of the composition of bank liabilities because a core deposits variable would provide redundant information. Core deposits plus purchased liabilities is approximately equal to total liabilities under various specifications of these variables.

6/ See Board of Governors (1987), pp. 71-72, and Duncan (1987) for a discussion of the principle followed by the Federal Reserve Board that bank holding companies should act as sources of strength for their bank subsidiaries.

7/ There is empirical evidence which indicates that this variable is likely to be a significant determinant of bank failure. Gajewski (1989) finds an inverse relation between the number of bank subsidiaries in a BHC and the probability that a bank will fail. Gilbert (1989) finds that the variable described above, RHCS, is a significant determinant of the investment by shareholders in banks that have reported losses that drive their capital ratios below minimum ratios required by bank supervisors.

8/ The first regression in table 3 was estimated with data for 145 failed banks and 608 classified as surviving banks. These 608 surviving banks did not necessarily survive the entire 1984-88 period; some surviving banks for one year are failed banks for later years. Some of these observations for surviving banks are for the same banks at different points in time. This would occur in cases in which different agricultural banks in the same county failed in different years.

The fourth regression in table 3 includes 152 failed and 577 surviving banks. Observations for the fourth regression exclude banks that did not exist in June 1981, excludes as surviving banks those that failed at any time in the years 1984-88 and includes observations for each surviving bank only once.

APPENDIX

SPECIFICATION OF THE INDEPENDENT VARIABLES

TOTAL ASSETS	--	total assets of a bank
AG LOANS/TOTAL LOANS	--	agricultural production loans plus loans secured by farm real estate as a percentage of total loans, net leases
TOTAL LOANS/ASSETS	--	total loans, net of leases, as a percentage of total assets
TREASURIES/ASSETS	--	U.S. Treasury securities as a percentage of total assets
CAPITAL/ASSETS	--	equity capital as a percentage of total assets
PURCHASED/LIABILITIES	--	purchased liabilities (time and savings deposits in denominations of $100,000 or more, federal funds purchased and securities sold under agreements to repurchase) as a percentage of total assets minus liabilities with maturities under one year (total transactions deposits, savings deposits and time deposits with maturities under one year) as a percentage of total assets
INSIDER	--	loans to officers and directors of the bank as a percentage of total loans
RHCS	--	for a bank in a multi-bank holding company, the natural log of a subsidiary bank's total assets divided by the total assets of banks in the multi-bank holding company; RHCS is zero for a bank not in a multi-bank holding company

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