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Commercial banks have traditionally played an important role in financing agriculture. Their commitment to agriculture, however, fluctuates. For example, between 1968 and 1987 their market share in non-real estate farm lending in the U.S. ranged from a high of 66.8% (9.7 billion dollars) in 1968, to a low of 47.3% (32.8 billion dollars) in 1981, closing at 53.1% in 1987 (Walraven and Rosine). The fluctuation in market share is a combination of the adjustment in the volume of funds lent by banks to the agriculture sector and the adjustment in the number of banks lending to the agriculture sector. In Texas, the proportion of banks with zero agricultural loans outstanding increased from 16.6% in 1968 to 35.5% in 1987. Between 1980 and 1987, 91 commercial banks, which had been active agricultural lenders in this time period, had zero non-real estate agricultural loans outstanding in 1987. A number of factors have lead to these fluctuations in agricultural lending.

It is expected that recent deregulation of the commercial banks has effected agricultural lending. Since the passage of the Depository Institutions Deregulation and Monetary Control Act of 1980 (particularly with the elimination of interest rate ceilings -- commonly known as regulation Q) banks have increased their competitiveness in acquiring loanable funds, mainly in form of time deposits (Bundt and Schweitzer; Waldrop; Keely and Zimmermann). However, these time deposits are associated with higher and more variable costs which increase the overall risk of the bank operation. Moreover, changes in the type and characteristics of a bank's loanable funds can elicit a re-alignment of the bank's asset portfolio to reflect the new composition of its liabilities.

The competition for loanable funds is likely to have an effect on the cost and availability of loan funds to agricultural borrowers. Borrowing costs may go up as lenders attempt to transfer some of these higher costs incurred in acquiring funds to borrowers. Loan funds to agricultural borrowers may be curtailed, for example, as banks seek to match their liabilities with non-loan assets, e.g. matching certificates of deposit with treasury securities. Banks might increase security requirements, or decrease the term of the loan. Banks might also opt to increase the supervision of the loans to increase performance. However, because increased supervision is costly to the bank, loans may only be extended to those borrowers with a more than "usual" likelihood of repayment, thus excluding many potential farm borrowers.

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A tobit econometric procedure was used in this study to examine the effects of selected demand and supply factors on agricultural lending. These factors include bank location, lender competition, bank capitalization, bank organization, interest rate sensitivity of deposits, farm profitability, farm risk, collateral value of farm assets, ownership of farm land, size of farming community, the level of farm mechanization, oil production, and population. In particular, the impact that increased commercial bank reliance on interest sensitive deposits after deregulation has on funds available to agricultural borrowers was examined. Also, independent banks were compared to multi-bank holding company affiliates to determine the impact of bank organization on the supply of agricultural loans. The data used in this study is unique to Texas but inferences can be extended to commercial banks in the U.S.

MODEL DEVELOPMENT

Previous research has not included banks with zero agricultural loans outstanding when investigating factors affecting agricultural lending. Data samples have been limited to the agricultural banks (e.g. Barry and Pepper). This omission, however, creates sample selection bias (Heckman). Rather than delete banks with zero agricultural loans outstanding from the sample, tobit analysis is used to account for this information and to adequately portray the full range of commercial bank behavior (Tobin).

Changes in commercial bank lending to the agricultural sector involve two types of adjustments: A) changes in the number of banks lending to the agricultural sector , and B) changes in the number and size of agricultural loans made by commercial banks already lending to agriculture. Time-series observations on changes in total agricultural lending reflect both types of adjustment. However, it is impossible to estimate the separate types of adjustment from aggregate time-series data based on average bank lending to the agricultural sector (Thraen, et al.). Cross-sectional data, on the other hand, include observations on individual banks -- some of which are agricultural lenders, and others are not. One could estimate the quantity adjustment coefficients by exclusion of those banks that were not lenders to agriculture at the time of the survey. However, it is also possible to estimate both the lending volume adjustments of commercial banks already lending to agriculture, and the lending volume adjustments due to the entry or exit of banks by using the tobit estimation procedure.

The Model

Lending is not done until the "desire" to lend exceeds a certain level. Desires, however, cannot be observed. "Negative loans," corresponding to various levels of desire *below* the threshold level are recorded *as zero* agricultural loans. No distinction is made between commercial banks which are close to lending to agriculture and those that had very little desire to do so. However, the tobit procedure provides a way to recognize this distinction.

Let

(1) $$Y = X\beta + \epsilon,$$

be a regression equation for which all basic assumptions are satisfied. For commercial banks that make agricultural loans, Y is equal to the actual agricultural loans made. For those banks that did not, Y represents an index of the "desire" to make agricultural loans. The X matrix is a set of factors that are thought to affect Y. β is a conformably defined parameter vector, and ϵ represents the stochastic disturbance term of the regression.

The value of Y cannot be observed when loans are not made. Thus, instead of using Y, Y^a is used and is defined as

(2)
$$Y^a = Y \quad \text{if } Y > 0$$
$$Y^a = 0 \quad \text{if } Y \leq 0.$$

The new equation is

(3)
$$Y^a = X\beta + \epsilon^a$$

where Y^a is truncated at zero and ϵ^a is truncated at $-X\beta$. This further implies that the lower tail of the distribution of Y^a (and thus of ϵ^a) is cut off and the probabilities are piled up at the cut-off point. Consequently, the mean of Y^a is different from that of Y, and the mean of ϵ^a is different from that of ϵ which is zero. This is true whether the points for which Y^a equal 0 are included or not included in the sample. Therefore, limiting the range of the values of the dependent variable leads to a non-zero mean of the disturbance and the biasness and inconsistency of the least squares estimators.

Equation (3) will be estimated using the tobit procedure. The β parameters will be estimated using the maximum likelihood method (assuming normality of the disturbance term). This procedure assures the large-sample properties of consistency and asymptotic normality of the estimated coefficients so that conventional tests of significance are applicable.

Following McDonald and Moffit, different elasticities, evaluated at the means, can be computed as follows:

(4)
$$\eta E[Y^a] = \frac{\partial E[Y^a]}{\partial X}\frac{\overline{X}}{E[Y^a]},$$

(5)
$$\eta E[Y^*] = \frac{\partial E[Y^*]}{\partial X}\frac{\overline{X}}{E[Y^*]}, \text{ and}$$

(6)
$$\eta F(z) = \frac{\partial F(z)}{\partial X}\frac{\overline{X}}{F(z)}.$$

where $\eta E[Y^a]$ is the elasticity of the unconditional expected value of agricultural lending,

$\eta E[Y^*]$ is the elasticity of the conditional expected value of agricultural lending,

$\eta F(z)$ is the elasticity of the probability of making agricultural loans,

$F(z)$ denotes the cumulative standard normal distribution function, and

$E[Y^*]$ is the conditional expected value of Y.

It can be shown that the sum of equations (5) and (6) is equal to equation (4) (McDonald and Moffit). In other words, the unconditional elasticity of making agricultural loans can be broken down into its component parts: A) the elasticity of making agricultural loans, for current lenders to agriculture, and B) the elasticity of the probability of making agricultural loans. By looking at the two components, one can find out which component reacts the most to changes in the explanatory variables. Thus, in addition to the usual parameter estimates, the tobit procedure provides these elasticities which serve as a measure of the impact of changes in an independent variable on agricultural lending, not just for current agricultural lenders, but for those that quit or enter into agricultural lending as well.

Variable Description

The model regressand, Y^a, was defined as the ratio of non-real estate agricultural loans outstanding to total bank assets for each commercial bank at the end of 1987. The year 1987 was chosen because it is the first year following complete deregulation. The model regressors (Table 1) were chosen to represent the supply and demand factors that may affect Y^a.

Four bank variables were included in the model. The composition of bank deposits were measured as the ratio of a bank's time and savings deposits to total deposits (DEPOSIT). Banks that are associated with multi-bank holding companies (MBHC) and banks located in urban areas (URBAN) were defined as binary variables. The ability of each bank to absorb loan losses and remain solvent was measured by the ratio of a bank's equity to total bank assets (EQUITY).

The competition faced by an individual bank affects the volume of its agricultural loans. Barkley et al., measured competition by the number of alternative credit sources in the community. However, this does not take into consideration the size of the competitors. A proxy for bank competition was specified that was based on the volume of the assets of its competitors in its market. In this study a bank's market area was delineated by county boundaries. Although this might not be true in all cases, it has been found to be a reasonable assumption under conditions where the study does not focus on local market characteristics and flow of funds (Barry and Pepper, Gilbert).

The major competitor of commercial banks in the non-real estate farm loan market is Production Credit Associations (PCAs). A competition index was computed that consisted of PCA assets and total assets of the commercial banks operating in the same county. The proxy for competition faced by bank was computed as

$$\text{(7)} \qquad competition\ index_j = 1 - \frac{bank\ assets_j}{total\ assets},$$

where competition index (COMPETITION) is an index measure of the amount of competition faced by the jth bank in its market area, with 0 denoting lack of competition and 1 denoting maximum competition; bank assets refer to the total assets of the jth bank; and total assets refer to all the combined assets of PCAs and commercial banks operating in the county.

Six agricultural variables were included in the model. The profitability of farming was measured as the ratio of net cash income from farm sales to total farm assets in a county (PROFIT). The riskiness of farm operations relative to nonfarm businesses was measured as the ratio of the coefficient of variation of farm income to the coefficient of variation of total income in each county (RISK). The collateral value of farm operations was measured by dividing the total value of farm land and farm buildings in a county by the total acres of farm land (LAND). The dependence of banks on the agricultural sector was measured by the ratio of per capita farm income to total per capita income in a county (INCOME). The stability of farm businesses was measured by the ratio of the number of farmers operating their own land to the total number of farmers in each county (OWNER). The need for farm equipment financing was measured as the estimated market value of all farm machinery and equipment in a county (MACHINE).

Two general variables were included in the model. Population was used as a proxy for the potential supply of deposits and demand for nonfarm loans in a county (POPULATION). The impact of oil production on agricultural lending (particularly important in oil producing states) was measured by including oil production in each county.

Data Sources

Data on bank variables were obtained from the FDIC call reports on condition and income, and agriculture data came from the *Census of Agriculture* (USDA, 1978 and 1987). Population and per capita income figures came from the *Local Area Personal Income* publications of the U.S. Department of Commerce, and oil production figures come from the *Railroad Commission of Texas*. Loan information for each PCA was obtained directly from personnel at the Farm Credit Bank of Texas. It was estimated that loans were 80-90% of total PCA assets. Total PCA assets were apportioned among counties by assigning weights to assets based on the value of farm output per county relative to the total value of farm output in the PCA area.

Summary Statistics

There were 1053 Texas banks included in this study. Each of these banks were in business before deregulation (1978) and after deregulation (1987). Table 2 provides descriptive statistics for the banks included in this study. In 1978, 7.3% and 25.8% of the rural and urban banks were MBHC affiliates, respectively. By 1987, 24.3% and 56.9% of the rural and urban banks were MBHC affiliates, respectively. Thus, it is important to study the impact this move toward MBHC organization has on agricultural lending.

Rural banks invested an average of 11% of their assets in non-real estate agricultural loans (agricultural loan portfolio) in 1978 (Table 2). However, this percentage dropped to 7.6% for rural independent banks and 6.6% for MBHC affiliates in 1987. Urban banks have experienced similar, but less dramatic, decreases as well. Part of this drop may be traced to deregulation, particularly to the high levels of interest rate sensitive deposits that have characterized the post deregulation era. However, there has also been some important changes in the agricultural and banking sector over this period of time.

Rural independent banks held fewer time and savings deposits to total deposits (55%) in 1978, than rural MBHC affiliates (58%) (Table 2). These ratios rose to 83% and 84% respectively, in 1987. Urban banks held 57% percent of their deposits in time and savings deposits in 1978, and 82% in 1987. This important increase in interest sensitive deposits will likely increase the banks' cost of funds and its volatility, which in turn will influence the asset allocation decisions made by each bank.

Average bank equity ratios in 1978 ranged from a low of 7.3% (Urban MBHC affiliates) to a high of 8.9% (Rural Independent) (Table 2). After deregulation, equity ratios decreased by 1.9, 1.2, and 0.4 percentage points for urban and rural MBHC affiliates, and urban independents, respectively. Capital increased by .4 percentage points for rural independent banks.

A summary of bank competition as defined in equation (7) is presented in Table 3 with well over one half of the banks in the sample facing a high level of competition in their market, i.e. had a competition index of 75% or more. Although, the level of competition faced by Texas banks did not change much since deregulation, individual banks may have experienced an increase or decrease in competition.

The county average of PROFIT was 2.3% in 1987 (Table 4)[1]. Data for net cash return from farm sales were not available for computing PROFIT for 1978. The county average of RISK increased from 66.4% before deregulation to 67.5% after deregulation. LAND increased from $464 per acre to $706 per acre. INCOME increased from 9.3% to 9.9%. OWNER increased from 51.9% to 56.6%. MACHINE increased from $17.7 million to $22.5 million. POPULATION increased from 53,141 people to 66,054 people. OIL decreased from 4.1 million barrels to 2.9 million barrels. As expected, there was a lot of differences between counties as measured by the standard deviation.

ESTIMATED STRUCTURAL COEFFICIENTS

The estimated tobit coefficients are presented in Table 5. Columns two and three show the coefficients and their asymptotic t-ratios. Column four shows the change in probability of making agricultural loans due to a unit change in each independent variable. Columns five and six show the two components of a total change in E[Y], given a change in each independent variable. Column five represents the change in E[Y] for those banks that are already making agricultural loans, weighted by the probability of making agricultural loans. Column six represents the change in probability of making agricultural loans, weighted by the conditional expected value of making agricultural loans $E[Y^*]$. F(z) denotes the cumulative standard normal distribution function. The estimated equation was statistically significant[2]. Table 6 contains tobit elasticities computed with equations (4), (5), and (6).

Deposit Structure

It can be argued that there should be a positive relationship between DEPOSIT and loans because time and savings deposits enhance the stability of loanable funds. Thus, banks need less liquidity and can invest more money in loans. It can also be argued that there should be a negative relationship because these deposits are more interest sensitive and banks may chose to invest in more assets that adjust in tandem with prevailing market rates and less in loans that do not. Banks may choose to invest in more investment securities like U.S. treasury securities because their interest rate movement more closely matches the interest rate movements on deposits, thus, reducing interest rate risk. This may especially be true in the post-deregulation era that is characterized by volatile interest rates. Banks could use adjustable interest rates on loans to make them more sensitive to interest rate movements. However, repricing a loan can result in additional transaction costs to the bank and transferring risk to a borrower may increase the likelihood of a loan default.

The latter argument overshadows the first. The estimated coefficients for DEPOSIT was negative and statistically significant (Table 5). Thus, some of the decrease in agricultural loans portfolios since deregulation can be explained by the increase in interest sensitive deposits held by banks (Table 2). A 1% increase in DEPOSIT results in a 0.85% decline in agricultural loan portfolios (Table 6). Approximately 0.43 percentage points of the 0.85% decline in agricultural loan portfolios would be attributable to banks that are already lending to agriculture. However, 0.42 percentage points of the 0.85% decline in agricultural loan portfolios would be attributable to banks that stop lending to agriculture.

Competition

The estimated coefficient for COMPETITION was negative as expected, and statistically significant (Table 5). A 1% increase in COMPETITION results in a 0.37% decrease in agricultural loans-to-total bank assets. Almost half of this decrease would come from banks that decrease their agricultural loan portfolio and the other decrease would come from banks that stop lending to agriculture. Bank competition has not changed much since deregulation (Table 3), thus, COMPETITION does not explain the decrease in agricultural loans portfolios.

In rural areas, much of the competition faced by commercial banks comes from PCAs. Thus, the future of PCAs, and the Farm Credit System as a whole, will have an impact on the extent to which rural banks participate in agricultural lending. Reduced PCA activity would lead to increased commercial bank participation in agricultural lending, *ceteris paribus*. Conversely, increased PCA activity would lead to less commercial bank participation in agricultural lending.

Multi-Bank Holding Company (MBHC) Affiliation

Barry and Pepper contend that bank holding company affiliation in general provides banks with greater lending capacity, more competitive behavior, stronger risk bearing, more flexible funds acquisition, and deeper service capacity. Thus, MBHC affiliation may contribute positively to the availability of credit services offered by smaller banks to agriculture. Following this reasoning, a positive relationship would be expected between MBHC affiliation and agricultural loans, reflecting the affilate's greater capacity to generate loanable funds, to meet large loan requests, to have more specialized personnel, and to provide credit-related services. However, MBHC affiliates might also have more diverse clients and investment opportunities that might compete for their loanable funds resulting in reduced agricultural lending.

Results showed that the coefficient for MBHC was negative and statistically significant (Table 5). Holding everything else constant, agricultural loan ratios for MBHCs would be 1.1% lower than independent banks. This corresponds to $1.1 million of agricultural loans for a bank with $100 million in assets. MBHC affiliates increased from 16.5% of the total number of commercial banks in Texas before deregulation to 40% after deregulation. Thus, part of the decrease in agricultural loan ratios over this period of time can be attributed to the increase in MBHC affiliates after deregulation. Moreover, the recent proposals by the Treasury Department to revise banking laws may decrease agricultural loan portfolios further if they encourage an increase of MBHCs.

Urban

The estimated coefficient for URBAN was negative and significant at the 5% level (Table 5). It was estimated that a rural bank with $100 million dollars in assets was lending an average of $2.3 million more to agriculture than a similar urban bank. This is not surprising because urban banks have more diverse clients, thus are more inclined to diversify out of agriculture. Moreover, rural banks are more likely to lend more money to agriculture relative to their assets than urban banks because rural banks are more dependent on the agricultural economy. A comparison of the estimated coefficients for MBHC affiliation and location reveals that location plays a bigger role than MBHC affiliation in determining the level of the agricultural loan portfolio.

Equity

An important function of bank capital is to reduce risk. Koch discusses three ways in which this is achieved. First, it provides a cushion for firms to absorb losses and remain solvent. Second, it provides ready access to financial markets and thus guards against liquidity problems caused by deposit outflows. Third, it constrains growth and limits risk taking. A well capitalized institution is in a better position to take on risk by investing more in loans and less in safe assets like government securities. Its large equity base would cushion the institution against large loan losses. However, the decision makers of less capitalized institution may choose this equity position to increase expected profits, albeit at a greater risk. Thus, it is consistent with this risk/return preference for them to invest in more risky assets like loans because of their higher expected returns.

The estimated coefficient for EQUITY was negative and statistically significant (Table 5). This suggests that less capitalized banks had relatively more agricultural loans relative to their assets than more capitalized banks. As explained above, less capitalized banks may have assumed more risk by investing proportionately more of their assets in loans which have higher expected return and a higher risk. If successful, this strategy would result in greater profits relative to the capital committed. However, the negative relationship could be a reflection of the poor performance of the agricultural sector in the early 1980's. Banks making agricultural loans could have incurred heavy loan losses that eroded the loan loss reserves of these institutions.

Farm Profitability

A firm that is achieving a high rate of return on its assets can increase the returns to equity by increasing its leverage, as long as the rate of return on assets exceeds the rate of interest paid on farm debt (Collins). Thus, farmers in a county with profitable farming operations would demand more agricultural loans. Similarly, banks in such a county would be willing to supply more agricultural loans to farm borrowers because of the reduced likelihood of loan defaults.

The estimated coefficient for RETURN was positive and statistically significant. As expected, results show that communities with more profitable farming operations attract more agricultural loans than communities with less profitable farming operations. Thus, part of the observed decline in agricultural loan portfolios at Texas commercial banks since deregulation was a reflection of the declining performance of the agricultural sector in Texas in the 1980's relative to the 1970s. A 1% decrease in PROFIT results in a 0.14% decrease in agricultural loan portfolios (Table 6). More than half of this decrease would come from banks that decrease their agricultural loan portfolio and the other decrease from banks that stop lending to agriculture.

Farm Risk

The estimated coefficient for RISK was negative and statistically significant (Table 5). As expected, counties where farm income is relatively more volatile than nonfarm income, less money is lent to agriculture compared to other sectors. Thus, part of the observed decline in the agricultural loan portfolios at commercial banks since deregulation was a result of the increased risk in production agriculture (Table 4). A 1% increase in RISK results in a 0.30% decrease in agricultural loan portfolios (Table 6). More than half of this decrease would come from banks that decrease their loan portfolio and the other decrease would come from banks that stop lending to agriculture.

Value of Farm Land and Buildings

A farm located in an area with high farmland and property values has greater collateral value. More collateral reduces a lenders likelihood of loan losses thus, supports higher levels of debt. Of course, the lender would consider the repayment capacity of the business as well. An increase in property values, *ceteris paribus*, would decrease the financial risk of a firm through a reduction of the debt-to-asset position of the firm. A farmer might respond to this change by increasing leverage to reflect his/her risk-return preferences.

However, an area with high farm property values may also be in an area that offers greater nonagricultural business opportunities. In fact, such areas with high property values will likely be located near commercial and industrial centers. These commercial and industrial concerns (and consumers in those communities as well) may compete for bank loans. Thus, agricultural loan portfolios of commercial banks in these areas may actually be smaller.

The estimated coefficient for LAND was negative and statistically significant (Table 5). Part of the observed decline in the commercial bank agricultural loan portfolios since deregulation was a result of the increase in farm land and building values Table 4). A partial explanation may be that much of the increase in value was a result of its close proximity to urban centers. Banks in this area may have shifted more of their assets to support nonagricultural growth. Results show that a 1% increase in LAND decreases agricultural loan portfolios by 0.28% (Table 6). A little more than half of this decrease would come from banks that decrease their agricultural loan portfolio and the other decrease would come from banks that stop lending to agriculture.

Size of Farming Community

Banks located in predominantly agricultural communities will likely obtain a large percentage of their deposits from farm firms. In order to cultivate a strong bank-borrower relationship, these banks will likely lend to the local farming community. Moreover, there is a feedback effect, whereby a thriving local community will increase the amount of deposits, providing more loanable funds for the bank. However, specializing in agriculture can lead to financial difficulties for the bank in the event of an economic downturn in the local economy.

The estimated coefficient for INCOME, a proxy for the importance of agriculture in a county, is positive and statistically significant (Table 5). This is expected because a bank located in a predominantly farming community depends on agriculture for borrowers and on farm related income for its deposits. However, INCOME did not increase much after deregulation, thus, it does not help explain why bank agricultural loan portfolios have decreased (Table 4).

Ownership of Farm Land

Farm operators that own there own land likely have greater stability in a community than tenant farmers. It is also likely that the owner-operators will be interested in developing and maintaining a more long term relationship with his/her lender than tenant farmers. Thus, in general, lending to an owner-operator will be less risky than lending to a tenant farmer because owner-operators will likely have a longer farming history and loan collateral on land. In fact, several credit scoring studies have found land ownership (tenure) to be an important factor in discriminating between potentially good agricultural loans and bad loans (Dunn and Frey; Lufburrow, Barry and Dixon; Reinsel). However, there are other important credit factors such as management ability, repayment ability, and the borrower integrity, factors that are not unique to owner operators. Moreover, tenant farmers may not have as much equity capital as owner-operators and may require more non-real estate financing.

The estimated coefficient for OWNER was negative and statistically significant (Table 5). This result suggests that owner-operators borrow less non-real estate debt than tenant farmers, contrary to the previously stated hypothesis that land ownership would correspond to high agricultural loan ratios. This may occur because tenant farmers on the average have less equity capital, thus, require greater financing of operating expenses and machinery. It is also possible that the owner-operators that obtain their land loans from the Federal Land Bank may also obtain non-real estate loans from PCAs. This result may also be data specific. Non-real estate debt is reported as a real estate debt in the FDIC call reports when land is used as collateral. Thus, non-real estate debt may be under reported for owner-operators.

Level of Farm Mechanization

The estimated coefficient for MACHINE was positive but statistically insignificant at the 5% level (Table 5). As expected, counties with more mechanized operations attracted more debt capital to finance this equipment and probably more operating cash as well. Thus, part of the observed decline in agricultural loan portfolios at commercial banks since deregulation was offset by an increase in the value of machinery and equipment used in agricultural production (Table 4). A 1% increase in MACHINE results in a 0.13% increase in agricultural loan portfolios (Table 6). A little more than half of this increase would come from banks that increase their agricultural loan portfolio and the other increase would come from banks that stop lending to agriculture.

Population

POPULATION was used as a proxy for consumer loan demand in each county. Nonfarm population is expected to provide deposits to commercial banks, thus, providing banks with additional loanable funds. However, the nonfarm population will also compete with farmers for these loanable funds. As expected, the estimated coefficient for POPULATION was negative and statistically significant (Table 5). The more populated counties attracted money away from agriculture. Thus, part of the observed decline in agricultural loan portfolios at commercial banks since deregulation was a result of the increased nonfarm population in Texas (Table 4). A 1% increase in POPULATION results in a 0.10% decrease in agricultural loan portfolios (Table 6). A little more than half of this decrease would come from banks that decrease their agricultural loan portfolio and the other decrease would come from banks that stop lending to agriculture.

Oil Production

An economy strengthened by increased oil revenue benefits agriculture as a whole, much as an economy weakened by a loss of oil revenue hurts agriculture. In addition to providing loanable funds, oil revenues also affect the purchasing power of those who depend on agriculture for food and fiber. However, this model was not designed to capture those inter-relationships.

It is easy to predict the effect of an oil boom or burst on the general economy of a given state, but it is more difficult to assess its impact on a local farming community. Oil production will stimulate the local economy directly from employment and oil producing business activities, and indirectly from oil profits retained in the community. The increase in economic activity may lead to an increase in local deposits, thus increasing banks' loanable funds. However, the increase in economic activity will likely increase loan demand for working capital, expansion of nonagricultural businesses, and consumer loans that compete with agricultural loans.

The estimated coefficient for OIL was negative and statistically significant (Table 5). The results suggest that agriculture was not a major beneficiary from "petro-dollars" in oil producing counties. Thus, part of the observed decline in agricultural portfolios at commercial banks since deregulation was a result of a large decrease in oil production (Table 4). A 1% decrease in OIL results in a 0.06% decrease in agricultural loan portfolios (Table 6). Half of this decrease would come from banks that decrease their agricultural loan portfolio and the other decrease would come from banks that stop lending to agriculture.

SUMMARY AND CONCLUSIONS

A tobit econometric procedure was used to examine the effect of selected demand and supply factors on agricultural lending by commercial banks. In particular, the impact of increased commercial bank reliance on interest sensitive deposits after deregulation on funds available to agricultural borrowers was examined. Also, independent banks were compared to multi-bank holding company affiliates to determine the impact of bank organization on the supply of agricultural loans.

Results indicate that as commercial bank deposits continue to be more sensitive to market rates, the supply of agricultural loans is likely to decline. Results showed that a 1% increase in the ratio of time and savings deposits to total deposits was associated with 0.85% decline in the ratio of agricultural loans to total assets. Moreover, almost half of this decline came from banks that stopped making agricultural loans. Also, banks affiliated with multi-bank holding companies lend less money to agriculture relative to their assets than do non-multi-bank holding company affiliates. Thus, as multi-bank holding company affiliates continue to increase (e.g., through acquisitions of failed institutions by existing banking organizations or through voluntary mergers), there will be a reduction in agricultural loans provided relative to the volume of assets held by commercial banks.

FOOTNOTES

[1]The Agricultural Census Bureau derives the cash return from agricultural sales for the farm unit by subtracting operating expenditures from the gross market value of agricultural products sold. Depreciation and the change in inventory values are excluded from expenditures. Gross sales include sales by the operator as well as the share of sales received by partners, landlords, and contractors. This ratio does not included capital gains. Farm assets were defined as the sum of the market value of land and buildings, and the market value of machinery and equipment.

[2]A test using the chi-square distribution replaces the usual F test to test the significance of all the coefficients in the tobit model when maximum likelihood is used. First, the likelihood function is evaluated when all parameters other than the constant are set to zero (L_0). Next, the likelihood function at its maximum (L_{max}) is evaluated. The likelihood ratio test is constructed as $-2(\log L_0 - \log L_{max}) \sim X^2,p$ where p is the number of regressors in the statistical model.

REFERENCES

Barkley, David L., Cindy Mellon, and Glenn T. Potts "Effects of Banking Structure on the Allocation of Credit to Non-metropolitan Communities." *West. J. Agr. Econ.*, 9(1984):283-292.

Barry, Peter J., and W.H. Pepper "Effects of Holding Company Affiliation on Loan-Deposit Relationships in Agricultural Banking." *NC J. Agr. Econ.*, 7(1985):65-73.

Bundt, Thomas P., and Robert Scheitzer "Deregulation, Deposit Markets, and Banks' Costs of Funds." *The Fin. Rev.*, 24(1989):417-430.

Capps, Oral Jr., and John M. Love "Determinants of Household Expenditure on Fresh Vegetables" *So. J. Agr. Econ.*, 15(December, 1983): 127-32.

Gilbert, R. Alton "Requiem for Regulation Q: What It Did and Why It Passed Away." *Review*, Federal Reserve of St. Louis, 68(February 1986):22-37.

Hagemann, Robert P "The Determinants of Household Vacation Travel: Some Empirical Evidence." *Applied Econ.*, 13(1981): 225-34

Heckmann, J.J. "Sample Selection Bias as a Specification Error." *Econometrica*, 47(1979):153-61.

Keeley, Michael C., and Gary C. Zimmermann "Competition of Money Market Deposit Accounts." *Proceedings: A Conference on Bank Structure and Competition.* Federal Reserve Bank of Chicago, (May 1985):612-635.

Kmenta, Jan *Elements of Econometrics* Second Edition New York: MacMillan Publishing Company, Inc., 1986.

Koch, Timothy W. *Bank Management* Orlando, Florida: The Dryden Press, 1988.

McDonald, J.F., and R.A. Moffitt "The Uses of Tobit Analysis." *Rev. Econ. and Stat.*, 62(1980):318-21.

Railroad Commission of Texas *Oil and Gas Annual Report* Oil and Gas Division, Austin, Texas, several issues.

Thraen, C.S., I.W. Hammond, and B.M. Buxton "Estimating Components of Demand Elasticities from Cross-Sectional Data." *Am. J. Agr. Econ.*, 60(1978):674-677.

Tobin, James "Estimation of Relationships for Limited Dependent Variables." *Econometrica*, 26(1958):24-36.

U.S. Department of Agriculture *Census of Agriculture* Government Printing Office, Washington D.C., several issues.

U.S. Department of Commerce *Local Area Personal Income, 1983-88. Volume 5: Southwest, Rocky Mountain, and Far West Regions and Alaska and Hawaii* Bureau of Economic Analysis. Government Printing Office, Washington D.C., July 1990.

Waldrop, R "Interest Rate Deregulation and Its Impact on the Cost of Funds at Commercial Banks." *Banking and Economic Review*, Federal Deposit Insurance Corporation 4(March 1986):19-22.

Walraven, N.A., and John Rosine *Agricultural Finance Databook* Board of Governors of the Federal Reserve System. Washington D.C., April 1989.

Table 1. Explanatory Variables in the Tobit Model

DEPOSIT	=	ratio of a bank's time and savings deposits to total deposits.
COMPETITION	=	an index that measures the amount of competition a bank faces in its market area for agricultural loans .
MBHC	=	binary variable: 1 if a bank belongs to a bank holding company.
URBAN	=	binary variable: 1 if a bank is located in a metropolitan statistical area (urban).
EQUITY	=	ratio of a bank's total equity to its total assets.
PROFIT	=	ratio of net cash income from farm sales to total farm assets in each county.
RISK	=	ratio of the coefficient of variation of farm income to the coefficient of variation of total income in each county.
LAND	=	value of land and buildings ($1,000/acre, average) in each county.
INCOME	=	ratio of per capita farm income to total per capita income in each county.
OWNER	=	ratio of the number of farmers operating their own land to the total number of farmers in each county.
MACHINE	=	estimated market value of all machinery and equipment in the county ($million).
POPULATION	=	population in each county (1,000's).
OIL	=	amount of oil produced in each county in 1987 (barrels).

Table 2. Descriptive Statistics for Banks Included in Study

Variable	Location	Before Deregulation (1978)				After Deregulation (1987)			
		Independent		MBHC - Affiliates[a]		Independent		MBHC - Affiliates[a]	
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Sample									
Banks (No.)[b]	Rural	496	N/A[c]	39	N/A	414	N/A	133	N/A
	Urban	384	N/A	134	N/A	218	N/A	288	N/A
$[Y^a]$[d]	Rural	0.112	0.108	0.112	0.102	0.076	0.089	0.066	0.089
	Urban	0.036	0.060	0.011	0.030	0.020	0.031	0.009	0.022
DEPOSIT[e]	Rural	0.549	0.132	0.582	0.091	0.832	0.099	0.848	0.083
	Urban	0.573	0.101	0.569	0.065	0.816	0.061	0.820	0.062
EQUITY[e]	Rural	0.089	0.024	0.088	0.022	0.093	0.041	0.076	0.025
	Urban	0.080	0.019	0.073	0.015	0.076	0.030	0.054	0.030

[a] Banks that are affiliated with multi-bank holding companies (MBHC).
[b] There are 1,053 banks included in this study.
[c] Not applicable.
[d] Ratio of non-real estate agricultural loans outstanding to total bank assets.
[e] Complete definitions are presented in Table 1.

Table 3. Frequency distribution of Competition Faced by Sample Banks, 1978 and 1987

Competition Category[a]	Frequency (Number of Banks) 1978	1987
0.00 - 0.25	29	31
0.26 - 0.50	68	70
0.51 - 0.75	226	217
0.76 - 1.00	730	735

[a] A 0 denotes no competition and 1 denotes maximum competition. See equation (7) for details on the computation of the competition index.

Table 4. County Summary Statistics for the Non-Bank Variables Used in the Tobit Model, 1978 and 1987, (Number of Counties = 254)[a]

	1978		1987	
Variable	Mean	Standard Deviation	Mean	Standard Deviation
PROFIT	---	---	0.023	0.030
RISK	0.664	0.284	0.675	0.194
LAND	0.464	0.262	0.706	0.478
INCOME	0.093	0.105	0.099	0.133
OWNER	0.519	0.137	0.566	0.126
MACHINE	17.678	15.237	22.452	15.665
POPULATION	53.141	191.280	66.054	239.050
OIL	4.099	10.513	2.854	6.641

[a] Variable name definitions are presented in Table 1. Dollar values are in nominal terms.

Table 5. Summary Statistics for Tobit Analysis of the Demand and Supply of Agricultural Lending in Texas, 1987

Variable	β	Asymptotic t-ratio	$\left[\frac{\partial F(z)}{\partial X}\right]^a$	$\left[\frac{\partial E[Y^*]}{\partial X}F(z)\right]^b$	$\left[\frac{\partial F(z)}{\partial X}E[Y^*]\right]^c$
DEPOSIT	-0.0648*	-2.61	-0.3646	-0.0229	-0.0222
COMPETITION	-0.0286*	-2.43	-0.1641	-0.0103	-0.0100
MBHC	-0.0112*	-2.64	-0.0401	-0.0025	-0.0024
URBAN	-0.0229*	-4.26	-0.1426	-0.0090	-0.0087
EQUITY	-0.1496*	-2.56	-0.8261	-0.0519	-0.0503
PROFIT	0.5163*	4.81	2.9687	0.1865	0.1808
RISK	-0.0287*	-2.21	-0.1670	-0.0105	-0.0102
LAND	-0.0198*	-2.85	-0.0898	-0.0056	-0.0055
INCOME	0.2391*	7.77	1.3974	0.0878	0.0851
OWNER	-0.1038*	-4.14	-0.6138	-0.0386	-0.0374
MACHINE	0.2765	1.74	1.6536	0.1039	0.1007
POPULATION	-0.0146*	-3.67	-0.0850	-0.0053	-0.0052
OIL	-0.0013*	-3.86	-0.0076	-0.0005	-0.0005
CONSTANT	0.2163*	7.08	1.2577	0.0790	0.0766

* Significant at the 5% level.

[a] Change in the probability of making agricultural loans due to a change in the corresponding independent variable.

[b] Change in E[Y] for those banks already making agricultural loans, weighted by the probability of making agricultural loans.

[c] Change in the probability of making agricultural loans, weighted by the conditional expected value of making agricultural loans $E[Y^8]$.

Note: The standard error around the Tobit index is 0.0580. The predicted probability that Y > 0, at the mean of X, is 0.7191, and Theil's goodness-of-fit statistic is 0.3762.

Table 6. Calculated Elasticities from Tobit Coefficients for Agricultural Lending in Texas, 1987

Variable	$\eta E[Y]^a$	$\eta E[Y^*]^b$	$\eta F[z]^c$
DEPOSIT	-0.8528	-0.4330	-0.4198
COMPETITION	-0.3748	-0.1903	-0.1845
MBHC	-0.0816	-0.0414	-0.0402
URBAN	-0.1938	-0.0984	-0.0954
EQUITY	-0.1794	-0.0911	-0.0883
PROFIT	0.1410	0.0716	0.0694
RISK	-0.3007	-0.1527	-0.1480
LAND	-0.2816	-0.1430	-0.1386
INCOME	0.1897	0.0963	0.0934
OWNER	-1.0494	-0.5328	-0.5166
MACHINE	0.1364	0.0693	0.0672
POPULATION	-0.0986	-0.0501	-0.0485
OIL	-0.0581	-0.0295	-0.0286

[a] The elasticity of unconditional agricultural lending (equation (4)). Note that $\eta E[Y] = \eta E[Y^*] + \eta F(z)^*$.

[b] The elasticity of agricultural lending from banks making agricultural loans (equation (5)).

[c] The elasticity of agricultural lending from banks that begin or quit making agricultural loans (equation (6)).