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Regulatory, Efficiency, and Management Issues Affecting Rural Financial Markets

Edited by

Eddy LaDue and *Sandra Allen*

Staff Paper 93-23 December 1993

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Department of Agricultural, Resource and Managerial Economics
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Preface

This publication contains the papers presented at the 1993 annual meeting of North Central Regional Project NC-207 "Regulatory, Efficiency and Management Issues Affecting Rural Financial Markets" held at the Federal Reserve Bank of Chicago on October 4 and 5, 1993. The program included an invited speaker session on "Agricultural Finance in the Year 2000." Participants in that session were Mike Frey of The Farm Credit Council, Marilyn K. Duff of Case Credit and Finance, William Whipple of Harris Trust and Savings Bank, and Michael Boehlje of Purdue University. Larry Mote of the Federal Reserve Bank of Chicago was also invited to present a paper on "Regulation and the Changing Role of Banking". Of this group, only Michael Boehlje provided the text of his presentation in a form that could be included in this publication. Mike Frey did provide copies of a publication titled "Positioning the Farm Credit System for the 21st Century, the Executive Summary of the Phase I Research Reports", which contains much of the substance of his remarks, to be distributed as a companion to this publication.

The program for this meeting was developed by Steve Hanson, vice chairman of NC-207, with assistance from Bruce Sherrick, secretary of NC-207, and Eddy LaDue. Local arrangements were made by Gary Benjamin of the Federal Reserve Bank of Chicago.

Cooperating agencies in the NC-207 project are the agricultural experiment stations at the University of Arkansas, North Dakota State University, University of Illinois, Purdue University, Cornell University, Iowa State University, Texas A & M University, Kansas State University, University of Kentucky, Michigan State University, Pennsylvania State University, Southern Illinois University, Ohio State University, South Dakota State University, University of Florida and the University of Minnesota, as well as the University of Guelph, the Farm Credit Administration, the Federal Reserve Banks of Chicago and Kansas City, Federal Reserve Board of Governors and the Economic Research Service of the U.S. Department of Agriculture.

Eddy L. LaDue
Chairman NC-207

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AGRICULTURAL FINANCE IN THE YEAR 2000

Michael Boehlje
Purdue University

The food production and distribution industry is currently and will continue to go through major structural changes during the next decade. Changes in the size, structure, organization and ways of doing business in agriculture suggest a vastly different climate for firms that finance that sector in the 1990's and beyond. This discussion briefly summarizes (in executive summary fashion) the key conclusions from work done at Purdue University as part of the *Agriculture 2000: A Strategic Perspective* project on the challenges of financing agriculture in the year 2000.

A. *The Market*

1. Demand for Capital — The traditional agricultural debt market is a mature, slow growth market (particularly in the input supply and production sector; less so in processing and distribution). The type of loan and credit needs are changing (more specialized and environmentally vulnerable assets). With more emphasis on "control" as opposed to ownership of resources, credit needs for operating loans may grow faster than the demand for long-term loans (except for forestry). The growth area for agricultural credit will be in the value added (beyond the farm gate) part of the food and fiber sector.

2. Segmentation of the Market — The market will be further segmented (i.e., large-small; full service-single product, etc.) with specific products and lenders focused on specific segments. More loan/financial products will be customized for individual borrowers. Borrowers targeted will have a broader array of products and services; those not targeted will have fewer options and choices.

3. Competition and Credit Delivery Capacity — Competition will be keen from historical as well as new players (i.e., captive finance companies), keeping margins under pressure and rates competitive; credit delivery capacity is fully adequate (excessive?). Competition for large borrowers will intensify, creating greater margin rate disparities and access between large and small borrowers.

4. Consolidation — Lenders will continue to consolidate, probably at a more rapid pace. There will be fewer lenders but as much or more opportunity for access on the part of qualified borrowers.

5. Integrated Production Systems — Integration will require the lender to have a better understanding of more stages of the production/distribution system, and to have the ability to assess external linkages (for example, the financial stability of a contract integrator) as well as internal financial strengths of a business in credit decisions.

6. Investors/Agribusiness — With more of the financing needed by agribusiness firms, integrated production units and investors, the clientele for which competition is greatest will grow—requiring a broader focus for traditional agricultural lenders.

7. Global Businesses — Globalization requires global information about the customers and their international competitors as well as an understanding of different institutional, legal and cultural structures and different financial markets; and requires new services in terms of foreign currency exchange, international letters of credit, etc.

B. *Rates, Terms and Products*

1. Interest Rates — Availability of funds and competition will keep rates competitive with those in other sectors. Rates will be less uniform as lenders price individual loans based on risk, size, cost of delivery and other characteristics.

2. Diversified Financing — More sources of funds will be used in the typical farm and agribusiness firm including leasing, investors, contracting and various combinations of debt instruments. Lenders will face soft demand for traditional loan products.

3. New Financial Products — Products such as discount debt or bonds, reverse annuity mortgages, convertible debt and leasing options will be demanded by the market.

4. Financial Services — A broader set of financial services (cash management, property management and trust services, environmental assessment and financial appraisal and counseling, information services, marketing services, etc.) including sourcing equity funds similar to investment banking will be available from competitors and demanded by customers.

C. *Management Challenges/Opportunities*

1. Environmental Regulations — Regulations will increase costs, reduce cash flows and increase the demand for environmental investments. Concerns about liability may make credit for vulnerable assets/uses more difficult to obtain and will result in more use of environmental audits.

2. Risk Control/Credit Quality — Lenders will attempt to reduce their credit quality risk by further increases in documentation standards, use of additional risk rating or assessment procedures, and in some cases requiring private or public guarantees.

3. Asset/Liability Matching — With growth in demand for term loans and fixed rates, lenders will need to become increasingly conscious of the potential for maturity mismatching in sourcing funds and originating loans. They will need to alter funds sources/maturities and asset pricing/maturities accordingly.

4. Cost Effectiveness/Containment — Lenders will need to further reduce cost of credit delivery through use of support personnel, more effective use of loan review time, increased use of rigid rules rather than judgement/documents in decision making for selected credits, etc. Borrowers may work with more specialized personnel, have less time available for general discussion/counseling and be required to provide more detailed and complete information on their business.

5. Multiple Entity Business/Organizational Structures — Multiple entity businesses will require more sophisticated analysis techniques (consolidating financial statements, etc.), proper structuring of loan and security agreements and participation in lending consortiums. A major risk in lending to multiple entities will be analyzing the contingent environmental liability represented by related entities since the courts have largely shredded the corporate veil as a means of limiting environmental liability.

6. Soft Assets and Securitization — Lending on performance and/or investments in people, organizations and information/knowledge (all intangibles) will increase; hard asset securitization will become increasingly difficult. New procedures will be required to lend to firms with less permanency and security.

7. Small Volume Borrowers – Smaller credits are higher cost to serve and such borrowers will have fewer options; this segment (which is very large in some rural areas) will require unique, lower-cost delivery or public subsidies to serve profitably and/or interest rates that reflect costs.

8. Origination – Efficient producer loan origination activity may be by input suppliers, captive finance companies and contract integrators that have regular and frequent contact with producers; conventional lenders may have more of a role as a wholesaler rather than a retailer of credit.

9. Human Resources/Skills – New financial products and services and more complex businesses will require different and/or more specialized personnel (possibly environmental auditors, financial counselors and investment bankers) and additional skills for current loan officers.

10. Information Technology – New information and performance monitoring technology will increase the efficiency of loan processing and decision making and enable "real time" monitoring of physical/financial performance; will also result in fewer personnel for greater volume.

GROWTH IN AGRICULTURAL LOAN MARKET SHARE FOR ARKANSAS COMMERCIAL BANKS

Bruce L. Ahrendsen, Bruce L. Dixon and *Atien Priyanti* [1]

Abstract

Changes in commercial bank market shares of farm debt are decomposed into portfolio decisions, loanable funds availability, and loan market size for 64 counties in Arkansas from 1986 through 1990. A seemingly unrelated regression model is hypothesized to identify county characteristics that are related to changes in commercial bank market shares. Regression results indicate that county differences in economic activity, the relative risk associated with agriculture, farm structure, and regional location contributed to changes in commercial bank market shares. The results imply a market niche for rural commercial banks emphasizing agricultural loans in the presence of unlimited branch banking.

Commercial banks are currently the largest institutional lenders to the farm sector and have dramatically increased their market share of total farm debt since 1981. Factors influencing changes in market share over time and across regions in Arkansas are identified in this study. The extent to which changes in commercial bank lending to agriculture are associated with county economic, demographic and structural characteristics are investigated.

Previous studies concerned with changing market share of nonreal estate farm debt are summarized in Wilson and Barkley (WB). Like WB, the study presented here is interested in explaining changes in commercial bank market share over time (1986-1990) and across regions as opposed to changes that are the result of macroeconomic effects. However, the study presented here differs from WB's in several ways. First, WB analyzed differences in changing market share across states, whereas the study presented here analyzes differences in changing market share across counties, and therefore, at a less aggregated level. Second, since the present study analyzes changes in commercial bank market share for one state, Arkansas, differences in banking regulations among states need not be considered here, although structural differences between rural and urban counties are. Third, WB explained changes in commercial bank market share of nonreal estate farm debt as opposed to total (nonreal estate plus real estate) farm debt as is done here. Fourth, WB explained changes in commercial bank market share during a period of declining market share, whereas the study presented here considers a period of commercial bank market share growth. Finally, the present study uses a more efficient estimator than WB to evaluate changes in commercial bank market share.

The increase in the national, total farm loan market share by commercial banks is primarily the result of an increase in real estate farm debt held by commercial banks. Other lenders' farm real estate loan portfolio decreased. More stringent loan collateral requirements have increased the use of commercial bank revolving lines of credit backed by real estate. Hence, the increased collateral

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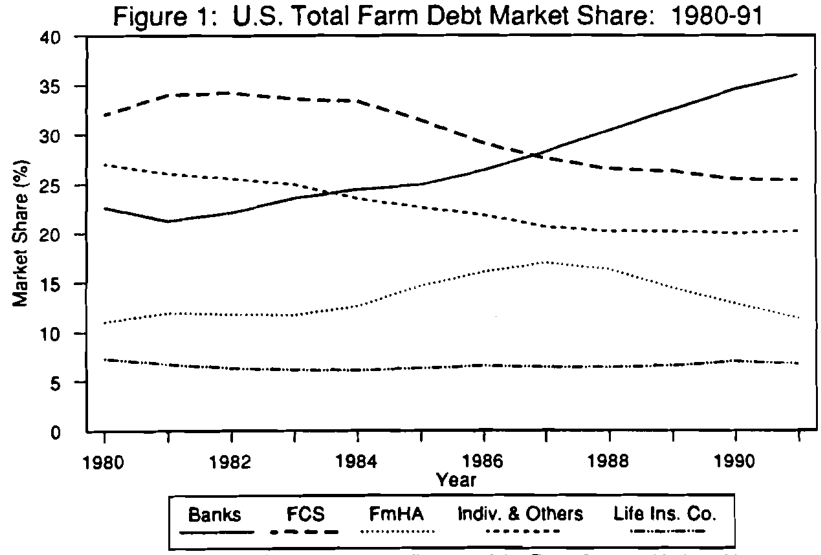
[1] The authors are assistant professor of agricultural economics, professor of agricultural economics and economics, and former graduate student at the University of Arkansas, respectively. Ahrendsen and Dixon are principals of the Center for Farm and Rural Business Finance. Priyanti is with the Research Institute for Animal Production, Bogor, Indonesia. The helpful comments of David L. Neff and data provided by Paul N. Ellinger are gratefully acknowledged. This material is based upon work supported by the Cooperative State Research Service, U.S. Department of Agriculture, under Agreement No. 92-34275-8226.

requirements have shifted loans into the real estate category even though the loans may be for nonreal estate purposes (USDA, 1991).[2] As a result, this study does not differentiate between nonreal estate and real estate farm debt as did WB since categorical differences have diminished.

The farm debt owed to the five major U.S. farm lender categories - commercial banks, Farm Credit System (FCS), Farmers Home Administration (FmHA), life insurance companies and individuals and others - has dramatically declined from a 1983 peak of $205,400 million to $146,982 million in 1991, or a 28 percent decline (USDA, 1992). The bulk of the decline is attributable to the FCS, FmHA and individuals and others while commercial banks experienced a net increase in farm loans. As a result, the market share of individual lender categories varied throughout the 1980s. For example, commercial banks, currently the largest agricultural lender, increased market share from a low of 21 percent in 1981 to a high of 36 percent in 1991 while the FCS lost market share from its peak of 34 percent in 1982 to 25 percent in 1991 as shown in Figure 1. The FmHA market share increased from 11 percent in 1980 to 17 percent in 1987 before retreating to 11 percent in 1991. Individuals and others decreased their market share continuously during the 1980s from 27 percent to 20 percent before experiencing modest gains since 1990, and life insurance companies' market share remained stable at approximately seven percent. Figure 2 demonstrates that Arkansas agricultural lenders experienced a similar pattern of changes in farm debt market share (Priyanti).

Figure 1: U.S. Total Farm Debt Market Share: 1980-91



Source: USDA, ERS, Economic Indicators of the Farm Sector. Various Years.

The study is organized as follows. The first section reviews the regulatory environment for agricultural lending in Arkansas. The second section discusses the methodology, model, estimation approach and data used. The following section presents and interprets the estimated model. Finally, concluding comments are presented.

Agricultural Lending Environment in Arkansas

The regulations governing bank operation can have a sizable impact on banks' market share of a particular type of loan. Wilson and Barkley considered differences in the structure of

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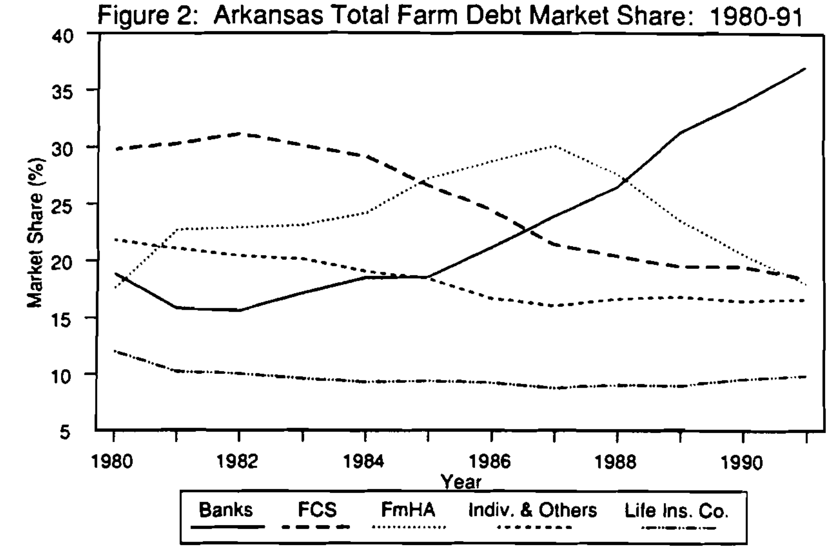
[2] Farm debt is categorized by loan security, not loan purpose. For example, a loan secured by a real estate mortgage will be categorized as real estate farm debt even though the loan funds are used for nonreal estate purposes.

bank systems (unit versus branch banking) among states in their study. Although bank regulations did not vary from county to county in the study presented here, regulatory changes during the 1986 through 1990 study period were considered. In 1988 legislation was passed to allow county-wide branch banking as of January 1, 1989, branch banking to contiguous counties as of January 1, 1994 and state-wide branch banking as of January 1, 1999. The relaxing of branch banking regulations to county-wide branch banking had a minimal, if any, affect on the commercial bank market share of agricultural loans for this study since market share data were aggregated to the county level and much of the county-wide branch banking occurred after the end of the study.

Figure 2: Arkansas Total Farm Debt Market Share: 1980-91



Source: USDA, ERS, Economic Indicators of the Farm Sector. Various Years.

Arkansas usury limits since 1982 have been the Federal discount rate plus 500 basis points. Although one of the most restrictive usury laws in the United States, the law has had a minimal impact on the number of agricultural loans banks grant. From a survey of western Arkansas bankers, Dixon, Ahrendsen and Barry found that few additional agricultural loans would be granted without usury. While usury constrains the amount of loan risk pricing a bank may undertake, FCS, for example, is not subject to usury and may risk price marginal loans. However, FCS has been interested in high-quality loans which have not required risk premiums. Thus, usury has likely had a minimal, if any, impact on market share during the study period.

Methodology and Data

Wilson and Barkley developed a model to explain changes in market share over time. In this paper their methodology is used to analyze the market share of Arkansas commercial banks for the aggregate of nonreal estate and real estate agricultural loans. First, the percentage change in commercial bank market share is decomposed into percentage changes in portfolio decisions, loanable funds availability and loan market size. Next, the changes in the components of market share are explained by exogenous factors in a seemingly unrelated regression framework.

Model Structure

Following WB, commercial banks' market share of agricultural loans can be expressed as:

$$\begin{aligned} MS &= BAL/TAL \\ &= [(BAL/BD)*BD]/TAL, \\ &= ALDR*BD/TAL, \end{aligned} \qquad (1)$$

where MS is commercial banks' market share of agricultural loans, BAL equals total bank agricultural loans, TAL is total agricultural loans outstanding, BD represents total bank deposits and ALDR is the agricultural loan-to-deposit ratio for commercial banks. Totally differentiating (1) yields:

$$dMS = [d(ALDR)^{*}BD/TAL]+[ALDR^{*}d(BD)/TAL]-[ALDR^{*}BD^{*}d(TAL)/TAL^{3}]. \qquad (2)$$

By dividing (2) by (1), rearranging terms and multiplying by 100, a percentage change in commercial banks' market share can be expressed as:

$$\begin{aligned} 100^{*}dMS/MS &= 100^{*}[d(ALDR)/ALDR + d(BD)/BD - d(TAL)/TAL] \\ PCMS &= PCALDR + PCBD - PCTAL, \end{aligned} \qquad (3)$$

where

100*d(ALDR)/ALDR = PCALDR = the percentage change in the agricultural loan-to-deposit ratio (portfolio decisions),

100*d(BD)/BD = PCBD = the percentage change in bank deposits (loanable funds availability), and

100*d(TAL)/TAL = PCTAL = the percentage change in total agricultural loans outstanding (loan market size).

The percentage change in agricultural loan-to-deposit ratio (PCALDR) measures the change in the portfolio decision of a commercial bank. Commercial banks service all sectors of the economy, and a decision must be made as to what proportion of the loan funds will be allocated to agricultural borrowers, other businesses, consumers or industry. In addition, commercial banks must allocate deposits among loans and alternative investments such as government securities, municipal bonds, agency bonds and reserves.

The percentage change in bank deposits (PCBD) measures the change in fund availability. Commercial banks have relied extensively on local deposits as the principal source of funds to finance their assets. In some periods growth in local deposit volume, particularly for rural banks, has not kept pace with the growth in aggregate demand for loans. However, there are sources of funds from outside the local deposit market that banks may access such as loan participation with correspondent banks, the seasonal borrowing privilege from Federal Reserve Banks and loan origination for The Federal Agricultural Mortgage Corporation (Farmer Mac) and other secondary markets. Thus, a rural bank may not have sufficient local funds to meet its goals in agricultural lending, but funds can be made available from other sources.

Loan participations are quite common among banks. In fact, Arkansas Bankers Bank was chartered in 1990 for the sole purpose of providing these and other correspondent banking services. However, the seasonal borrowing privilege and Farmer Mac have been utilized to a much lesser extent. The seasonal borrowing privilege, which has been in existence since 1973, was used by no more than 20 percent of the banks in Arkansas in any given year from 1985 through 1990 (Clark). Activity in the Farmer Mac secondary market by banks in Arkansas was negligible during the sample period. One reason for the past and current limited use of Farmer Mac is that banks have had sufficient funds available to finance their assets.

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[3] BANK may also be a proxy for urbanization (MSA) or change in the number of farms relative to total population (POP). However, multicollinearity diagnostics indicated a nonharmful level of collinearity.

The percentage change in total agricultural loans outstanding (PCTAL) indicates the changes in loan market size, lending activities of all lenders and overall demand for farm loans. Thus, PCTAL indicates the change in relative volume of farm loans.

System of Equations

Equation (3) is an identity because it is derived from (1) which is a definition. The WB approach explains variation in market share by explaining the variation in PCALDR, PCBD and PCTAL. Each of the three components of change can be modelled as a dependent variable to yield a system of three equations such as:

$$PCALDR_i = a_0 + a_1\, PCNFI_i + a_2\, PCFI_i + a_3\, RISK_i + a_4\, POP_i + a_5\, BANK_i + a_6\, MSA_i + e_i \quad (4)$$

$$PCBD_i = b_0 + b_1\, PCNFI_i + b_2\, PCFI_i + b_3\, POP_i + b_4\, BANK_i + b_5\, PCUN_i + b_6\, MSA_i + u_i \quad (5)$$

$$PCTAL_i = c_0 + c_1\, PCFI_i + c_2\, POP_i + c_3\, PCSIZE_i + c_4\, PCVAL_i + c_5\, MSA_i + v_i \quad (6)$$

where $PCALDR_i$, $PCBD_i$ and $PCTAL_i$ are the observations on the percentage changes for the i^{th} county.

The independent variables in (4) - (6) are defined in Table 1. These variables represent the demand for agricultural loans, demand for nonagricultural loans, the relative risk associated with agricultural lending, bank competition, farm structure and bank location.

Table 1. Definitions of Independent Variables used in Model Specification

Variable	Definition
PCNFI	Percentage change in nonfarm income (%)
PCFI	Percentage change in farm income (%)
RISK	Ratio of the coefficient of variation in nonfarm income to the coefficient of variation in farm income
POP	Ratio of the percentage change in the number of farms to the percentage change in population
PCUN	Percentage change in unemployment rates (%)
BANK	Number of banks in the county in 1990
PCSIZE	Percentage change in average farm size (%)
PCVAL	Percentage change in the value of land and buildings (%)
MSA	Dummy variable for metropolitan statistical area (urban area) (1-urban, 0=otherwise)

The variables selected to explain changes in the demand for agricultural loans are the percentage change in farm income (PCFI) and the ratio of the percentage change in the number of farms to the percentage change in total population (POP). The demand for nonagricultural loans is captured by the percentage change in nonfarm income (PCNFI) and the percentage change in the unemployment rate (PCUN). These variables are demand shifters.

It is hypothesized that PCFI is positively related to the PCALDR, PCBD and PCTAL. As farm income increases, farming is more profitable and farmers are more likely to demand farm loans to finance farm investments as well as having more funds to deposit. POP as a local market demand variable is also expected to be positively related to the three dependent variables. The change in the number of farms relative to total population indicates the change in the relative demand for agricultural loans by farmers in the county. The PCNFI is expected to be negatively related to PCALDR and positively related PCBD. As nonfarm income increases, demand for nonfarm loans (commercial and consumer) and bank deposits increase. In addition, PCUN as an indicator of the growth of a county's economic vitality is hypothesized to be negatively related to PCBD.

In equation (4), RISK measures the risk associated with nonfarm loans relative to farm loans. RISK is the ratio of the coefficient of variation of nonfarm income to the coefficient of variation of farm income. Commercial banks are concerned with the risk associated with their loan portfolios and, thus, the underlying variation in nonfarm income and farm income. Commercial banks can diversify their loan portfolios by lending to different sectors of the economy, but certain sectors may be more risky than others. As this risk differential increases, a banker must reevaluate the loan portfolio and make adjustments. Hence, RISK is expected to be positively related to PCALDR since increases in farm income risk, ceteris paribus, make RISK decline.

The degree of bank competition is measured by the number of banks per county (BANK). This measure assumes farmers have uniform access across Arkansas to other agricultural lenders such as the FCS.

Changes in the size and structure of farms are reflected by the percentage change in average farm size (PCSIZE) and the percentage change in the value of land and buildings (PCVAL). These two variables are related to the changes in real estate and fixed asset purchases, which should be positively related to PCTAL.

A measure of the diversification opportunities for a commercial bank is the degree of a county's rurality. A rural county is likely to have a large proportion of agricultural loans to total loans. The U.S. Office of Management and Budget designates ten Arkansas counties as metropolitan statistical areas (MSAs): Washington, Crawford and Sebastian in northwest Arkansas; Faulkner, Saline, Pulaski, Lonoke and Jefferson in central Arkansas; Crittenden in eastern Arkansas; and Miller in southwestern Arkansas. In this study, MSA is a binary variable taking on a value of one if an observation comes from one of these 10 urban counties, and zero otherwise.

The coefficients in (4) - (6) are estimated using Zellner's seemingly unrelated regression (SUR) as opposed to ordinary least squares which was used by WB. SUR is used to gain more efficient estimates since the error terms (e_i, u_i and v_i) in these different equations are likely to reflect some common unmeasurable or omitted factors and, therefore, are contemporaneously correlated (Judge, Hill, Griffiths, Luthkepohl, and Lee). SHAZAM (White, Wong, Whistler, and Haun) is used to obtain all estimates.

Data and Sources

The data used to construct variables are drawn from several sources: U.S. Department of Commerce, Bureau of Economic Analysis (PCNFI, PCFI, POP, RISK); the Federal Deposit Insurance Corporation Call Reports of Income and Condition (PCALDR, PCBD, BANK); the FmHA State Office in Little Rock and the Farm Credit Bank of St. Louis (PCTAL); Arkansas State and

County Economic Data of the University of Arkansas at Little Rock (PCUN); and the Arkansas Agricultural Statistical Service (POP, PCVAL, PCSIZE).

The sample is a cross-section with one observation per county. The percentage change variables compute the percentage change from 1986 to 1990 except for PCVAL, PCSIZE and the numerator of POP which are from 1982 to 1987. Because Arkansas has 75 counties, there are 75 observations (n=75) for the model. All dollar values and percentage changes are based on real dollar figures (Consumer Price Index, 1982 = 100). The bank financial information is based on the fourth quarter call reports as of December 31, 1986 and December 31, 1990 for 256 commercial banks aggregated to their respective county level.

Initially, SUR was used on the full sample with all 75 counties to estimate (4) - (6). Results indicated a general lack of significance of the three equations at the one and five percent levels. The R^2s of the regression equations were also low, approximately seven percent, respectively, for each equation. In addition, only a few of the individual parameters were statistically different from zero. As a result of the unsatisfactory results, outlier identification (discussed below) and other diagnostic procedures (discussed later) were performed to assess the reliability of the model.

Eleven counties were identified as statistical outliers. These counties were Boone, Calhoun, Cleveland, Columbia, Dallas, Grant, Hot Spring, Independence, Marion, Ouachita and Sharp. They were omitted from the sample used to estimate (4) - (6). The PCALDR for Cleveland County is undefined since this county reported no agricultural loans in 1986. Marion County had an extremely large RISK value (31.7). It is unreasonable to expect that the coefficient of variation in nonfarm income is thirty-one times larger than the coefficient of variation in farm income. The other nine outlier counties were detected by identifying counties whose residuals from the estimation of (4) exceeded twice their standard errors. This is a common method for identifying statistical outliers (Belsley, Kuh, and Welsch, p. 43). PCALDR was the most strongly correlated variable with PCMS compared with PCBD and PCTAL. Thus, the outliers were identified using equation (4).

Table 2 presents descriptive statistics of the variables used to estimate the model for the 64 observations remaining in the sample. The sample means for the dependent variables PCALDR, PCBD and PCTAL are 22.02 percent, 2.57 percent and -18.32 percent. Although the county average proportion of agricultural loans in commercial bank investment portfolios increased from 1986 to 1990, PCALDR has very large variation as indicated by a standard deviation of 45.36 percent. The positive mean of the PCBD indicates increased bank deposits, and hence, economic growth. The negative mean for the PCTAL implies that the total county-level agricultural loans have decreased from 1986 to 1990, which is consistent with the decline in Arkansas agricultural loans (Priyanti).

The means of the demand independent variables (PCNFI, PCFI, POP and PCUN) are 5.12 percent, 64.94 percent, 0.56 and -22.47 percent. The variability in nonfarm income is less than the variability in farm income, which is reflected by their standard deviations of 5.33 and 109.88 percent and their coefficients of variation of 1.04 and 1.69, respectively. This relative variability of nonfarm income to farm income is also reflected by RISK's mean of 0.7. A mean less than one indicates that, on average, nonfarm businesses have less income risk than farm businesses.

Summarizing the growth patterns, county economic activity in Arkansas increased from 1986 to 1990. In addition, farm income was more variable than nonfarm income. Since farm income in Arkansas is concentrated in rural counties, income variation is likely to be disproportionately concentrated in rural counties.

Table 2. Descriptive Statistics of the Variables Used[a]

Variables	Mean	Standard Deviation	Minimum	Maximum
PCALDR (%)	22.02	45.36	-46.88	258.92
PCBD (%)	2.57	12.06	-58.38	25.01
PCTAL (%)	-18.32	11.51	-46.27	13.64
PCNFI (%)	5.12	5.33	-6.49	16.63
PCFI (%)	64.94	109.88	-42.92	461.13
POP	0.56	5.55	-24.20	17.90
PCUN (%)	-22.47	17.86	-57.48	31.82
RISK	0.70	1.41	0.005	6.41
BANK	3.51	2.30	1.00	14.00
PCVAL (%)	-28.20	15.58	-52.53	21.34
PCSIZE (%)	3.03	9.07	-21.43	32.40

[a] Variable name definitions are presented in Table 1. Number of observations equals 64.

Results

Regression Diagnostics

In addition to identifying and eliminating outliers as discussed previously, testing procedures were carried out to detect violations of the underlying regression model assumptions. The diagnostic procedures included tests for multicollinearity, heteroskedasticity and a regression specification error test. See Priyanti for additional discussion of the tests and presentation of test results.

Multicollinearity diagnostics indicated the existence of potentially harmful levels of multicollinearity among the explanatory variables in each of the three equations. The variable PCFI was omitted from each equation and collinearity was consequently lessened to a nonharmful level. Omitting a relevant independent variable can bias the remaining coefficient estimates. However, the results of the RESET tests (Ramsey) indicate no significant misspecifications at the 0.05 level.

Homoskedasticity for the three component equations (4) - (6) is not rejected at the 0.01 significance level for each regression equation. Thus no steps are taken in the SUR approach to compensate for heteroskedasticity.

A preliminary specification was estimated with regional binary variables representing the rural coastal, delta and highland counties. However, the impact of these regions was not as significant as simply dividing Arkansas into rural and urban counties.

Final Estimation Results and Discussion

To obtain greater efficiency, equations (4) - (6) with $PCFI_i$ omitted were estimated by SUR using the sample with 64 observations. The implications of the estimated equations are now discussed.

Portfolio Decision (PCALDR)

The SUR estimates of equation (4) are shown in Table 3. The coefficient of determination (R^2) for PCALDR is 0.24. All parameter estimates are significantly different from zero at either the 0.10, 0.05 or 0.01 level.

Table 3. Seemingly Unrelated Regression Results of the Estimated Model (Variable PCFI Deleted, n=64)[a]

	Dependent Variables (equation)		
Variable Name	**PCALDR (4)**	**PCBD (5)**	**PCTAL (6)**
Constant	35.134*** (10.328)	0.422 (3.219)	-10.071*** (2.780)
PCNFI	2.202* (1.162)	0.524* (0.302)	b
RISK	-8.928** (3.998)	b	b
POP	2.584*** (0.964)	-0.289 (0.271)	0.531** (0.234)
PCUN	b	0.059 (0.082)	b
PCSIZE	b	b	0.095 (0.155)
PCVAL	b	b	0.252*** (0.089)
BANK	-4.211* (2.450)	0.501 (0.666)	b
MSA	-46.511*** (15.827)	-5.151 (4.652)	-10.562*** (3.630)
F-test	3.344[c]	1.154	4.182[c]
R^2	0.236	0.090	0.217

[a] Standard errors are in parentheses.
[b] Variable not included in regression equation.
[c] F-test is significant at the 0.01 level.

* Two-tailed t-test is significant at the 0.10 level.
** Two-tailed t-test is significant at the 0.05 level.
*** Two-tailed t-test is significant at the 0.01 level.

The coefficient estimate of percentage change in nonfarm income (PCNFI) is unexpectedly positive and significant at the 0.10 level. A similar unexpected result was found by Pederson. It was expected that increases in nonfarm income would indicate increased demand for nonagricultural loans, implying a decrease in the agricultural loan-to-deposit ratio. In addition, commercial banks may prefer to lend more to nonfarm activities since repayment capacity is likely to increase because of increases in nonfarm income.

However, a positive relationship between PCNFI and PCALDR can be explained. Suppose nonfarm income is not growing as fast as farm income. Then commercial banks may choose to lend to sectors with the highest rate of income growth. This may be true for Arkansas, since average county farm income grew 65 percent, compared with the five percent growth in average county nonfarm income during the study period.

PCNFI also is significantly and positively related to PCBD in equation (5). This implies increases in nonfarm income increase bank deposits. If the best lending opportunities are in agriculture and there are limited lending opportunities in other sectors, then commercial banks would invest the additional bank deposits in farm loans, which results in an increase in the agricultural loan-to-deposit ratio.

The sign of the RISK coefficient in the PCALDR equation is unexpectedly negative and significant at the 0.05 level. Wilson and Barkley's risk variable was not significantly related to PCALDR. The negative parameter estimate on the RISK variable implies that the agricultural loan-to-deposit ratio rises with increases in relative risk of farm business income. This counterintuitive result can be explained by a number of reasons.

Arkansas is primarily characterized by rural areas and these depend more on the agricultural economy than urban areas. Rural banks experience high risks in agricultural lending primarily as a result of variability in farmers' incomes and limited opportunities for asset diversification. Since farm income growth during the study period exceeded nonfarm income growth, commercial banks, especially in rural areas, may have chosen to invest in risky assets like agricultural loans because the fast growth in farm income may be associated with expected high agricultural profits.

Robison and Barry cite a survey conducted by the American Bankers Association that identified bankers' probable changes in the agricultural loan-to-deposit ratio if farm lending became more risky. Only 38 of 119 bankers responding to the survey indicated a likely reduction in farm lending, and 24 bankers indicated an increase in farm lending. Cross-checking of answers for other risk responses, such as increases in interest rates, security requirements and degree of supervision of farm loans, confirms lenders responding to risk in ways other than denying loans. As an example, of the 81 bankers who would not reduce farm lending, 48 reported they would increase interest rates on farm loans as a risk response. Unfortunately, data regarding such commercial bank risk responses are not available for the present analysis.

The proportion of the growth in the number of farms to growth in total population (POP) in each county is used as a proxy for agricultural loan demand relative to consumer loan demand. As expected, the coefficient estimate on POP is positive. Thus, counties having large growth in the number of farms relative to total population growth experienced greater growth in agricultural loan-to-deposit ratios than counties having small growth in the number of farms relative to total population growth. Bank officers and loan committees made decisions to support the greater agricultural loan demand in those counties. This result is consistent with the results found by WB and Betubiza and Leatham.

A proxy for bank competition is measured by the number of banks in each county in 1990 (BANK). The negative parameter estimate on BANK implies that as there are more banks in a county, the agricultural loan-to-deposit ratio decreases. Counties with more banks probably experienced greater opportunities for loan diversification from 1986 to 1990 than did counties with fewer banks. Thus, banks facing greater within-county competition lowered their emphasis on agricultural lending.

The negative parameter estimate for urban areas (MSA) indicates urban commercial banks increased their agricultural loan-to-deposit ratio at a much slower rate, or decreased their agricultural loan-to-deposit ratio (de-emphasized agricultural lending) at a much faster rate, than rural commercial banks. This is not surprising because the more urban an area, the more diverse are the lending opportunities. Thus, commercial banks appear to diversify out of agriculture as long as diversification opportunities are available. Moreover, rural banks are more likely to lend more money to agriculture relative to their deposits than urban banks do because rural banks are more dependent on farm activities. Another reason for the inverse relationship between PCALDR and MSA may be that urban bank management has not maintained the past levels of agricultural lending expertise and commitment to agriculture.

Loanable Funds Availability (PCBD)

SUR coefficient estimates of equation (5) explaining variation in percentage change of bank deposits (PCBD) have only one coefficient significant at 0.10, that of percentage change in nonfarm income (PCNFI). The coefficient of determination for the PCBD equation is 0.09. Additional analysis shows that variation in PCBD explains relatively little variation in PCMS compared with PCALDR. Thus the lack of regressor significance is not particularly troublesome for this study.

Loan Market Size (PCTAL)

All of the SUR coefficient estimates in (6) explaining variation in percentage change of total agricultural loans (PCTAL) are significantly different from zero at either the 0.05 or 0.01 level except the coefficient of PCSIZE. Also, the coefficient estimates have their anticipated signs. The coefficient of determination for the PCTAL equation is 0.22.

Growth in number of farms relative to a county's population is represented by the POP variable. The positive parameter estimate on POP indicates that the greater the percentage change in the number of farms relative to the percentage change in the total population, the higher the percentage change in total agricultural loans outstanding. Thus, a relatively large decrease in the number of farms in a county indicates that the agricultural sector has become a less important part of the county's economy and that there is less demand for agricultural loans.

The overall decrease in loan market size from 1983 through 1990 is consistent with the general perception of weak farm loan demand during the last few years of this period. Farm loan demand was weak because farmers, in general, were concerned with decreasing their debt levels and were perceived to be more risk averse regarding debt. Weak farm loan demand affects all lenders, and thus, the total loan market size is reduced.

The positive parameter estimate on PCVAL indicates that increases in farmland and property values are associated with higher agricultural loans outstanding. Betubiza and Leatham showed that a farm located in an area with higher farmland and property values has greater collateral value, and thus, a farm can support a higher level of loans. An increase in property values, ceteris paribus, decreases the financial risk of the firms so that lenders are likely to grant more loans and farmers are likely to request more loans.

The negative parameter estimate for urban areas (MSA) implies that urban areas experienced larger declines in total agricultural loans outstanding than did rural areas. Urban areas are characterized by large financial institutions that can lend to many businesses in a variety of industries. Therefore, the relatively small concentration of farm loans among large urban financial institutions may reflect an opportunity for these institutions to lend to nonfarm business. This reasoning is supported by the evidence presented by Barkley, Mellon and Potts; and Gilbert and Belongia. Other possible explanations for the inverse relationship between PCTAL and MSA are: significant levels of urban growth displace agriculture in urban counties; and just as with the relationship of PCALDR to MSA, urban bank management may not have maintained their historical level of agricultural lending expertise and commitment.

Concluding Comments

Changes in commercial bank market shares of farm debt were decomposed into portfolio decisions, loanable funds availability and loan market size. In general, commercial banks increased the proportion of agricultural loans in their portfolio. Commercial banks had ample loan funds available to service the demand for farm debt. Decreased loan market size, primarily a result of decreased loan demand by farmers, affected all agricultural lenders, but commercial banks were affected to a lesser extent than other lenders.

Factors affecting the three components (portfolio decision, loan funds availability and loan market size) of percentage change in commercial banks' market share were identified. The percentage change in nonfarm income had a significant impact on the changes in the agricultural loan-to-deposit ratio as well as total bank deposits. Since nonfarm income growth was slower than farm income growth, bank management invested more money in agriculture by granting more agricultural loans. Hence, the agricultural loan-to-deposit ratio increased even though farm income was more variable than nonfarm income. Results demonstrate that the growth in the number of farms relative to total population growth in an Arkansas county had a significant impact on the changes in the agricultural loan-to-deposit ratio as well as loan market size. This implies that structural and demographic effects have an impact on the demand for agricultural loans. In addition, the decrease in agricultural asset values was associated with decreased loan market size because less collateral was available to secure loans and lower credit reserves were available for farmers while at the same time increasing financial risk. Also a county being urban led to lower agricultural loan-to-deposit ratio levels and lower total agricultural loans from 1986 to 1990 than a county being rural.

While the variation in bank deposit changes was not strongly associated with hypothesized regressors, changes in deposit availability explained little of the market share variation. The secondary markets for farm real estate and rural housing mortgages (Farmer Mac I) and FmHA guaranteed portions of operating and farm ownership loans (Farmer Mac II) diminish the dependency of commercial banks on bank deposits as a source of loan funds. However, loan funds availability has not been a limiting factor in the growth of commercial banks market share of farm loans. Commercial banks have other options available, such as loan participations and the seasonal borrowing privilege, that allow them to have adequate funds available to satisfy loan demand. Thus, the success of Farmer Mac appears to depend more on lenders' need to reduce risk than to increase liquidity by selling loans in the secondary market.

The deregulatory trend toward unlimited branch banking in Arkansas and other states may have an impact on commercial banks' market share of farm loans. Gilbert and Belongia; and Lawrence and Klugman have found that rural banks controlled by urban-based banks have proportionately few agricultural loans. Similarly, the study presented here provides significant evidence that a commercial bank located in an urban county has a propensity to grant fewer agricultural loans than a commercial bank located in a rural county. Possible explanations for these results are: rural banks controlled by urban-based banks have more opportunities for loan diversification and urban management may not feel it has sufficient expertise in agricultural lending. Given these results and explanations, to the extent that unlimited branch banking will be dominated by urban-based banks and their lending practices, branch banks associated with the urban banks may grant fewer agricultural loans relative to other loans in rural areas. This might portend a market niche for rural commercial banks emphasizing agricultural loans.

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FINANCING NORTH DAKOTA'S AGRIBUSINESS

Cole R. Gustafson and *Sara J. Anderson*[1]

Abstract

Results from stratified, random, cross-sectional mail survey of 272 agribusinesses in North Dakota found limited evidence of external credit rationing. Only half of the agribusinesses feeling constraint would be willing to pay a premium for additional financing. Significant internal credit rationing existed. The study also provided information on the financial characteristics of agribusiness firms operating in the input, output, and service sectors.

During the 1990-92 recession of the U.S. economy, a "credit crunch," which contributed to the recession and jeopardized the strength of the recovery, was perceived to exist (Bacon and Wessel; Bernanke and Lown; and Greenspan).[2] Reasons ascribed to the decreased availability of credit from commercial banks have included disintermediation, overzealous regulators, banks' unwillingness to lend, and lack of business firms' demand for credit. The extent to which the credit crunch or credit rationing, in general, has impacted agribusiness firms[3] is unknown, partly because few studies about the financial structure, sources of credit, and methods of financial management for agribusiness firms exist.[4]

The objectives of this study were to quantify the capital structures of agribusiness firms in North Dakota, to measure the extent of credit rationing in these firms, and to gauge the relationship between a firm's financial position and whether it had been formally or informally denied credit since 1987. The majority of agribusiness firms in North Dakota are small, privately held firms. Little information exists on the types and terms of their financial arrangements. Necessary information for the study was elicited through a stratified, random, cross-sectional mail survey of 272 agribusinesses in North Dakota. The following sections describe credit rationing as it applies to agribusiness, discuss administration of the survey, and present the results of the study.

Credit Rationing

The primary function of financial markets is to optimally distribute scarce debt capital to savers and borrowers. However, these markets do not always work efficiently because of market

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[2] See Kaufman for a discussion of the origin of this term. For a discussion of previous credit crunches, see Wojnilower.

[3] In this study, agribusinesses are narrowly defined to exclude farm firms directly involved in production agriculture. The definition is intended to include firms that supply inputs to or process and distribute the outputs of farm units. For other definitions see Davis and Goldberg, and Miller and McNamara.

[4] Two studies include Barry, Sonka and Lajili, and Featherstone and Sherrick.

imperfections and transaction costs. Thus, some projects with positive net present values are rejected because of credit rationing.[5]

Forms of Credit Rationing

Credit rationing can be either internal or external. Internal credit rationing occurs when management imposes criteria for either project acceptance or risk exposure to limit debt financing. External credit rationing occurs when lenders quote an interest rate on loans and supply a smaller amount of funds than borrowers want. External capital rationing can involve either loan quantity rationing or loan size rationing (Aguilera). With loan quantity rationing, applicants receive fewer loans than applied for; with loan size rationing, applicants receive all of their loans but with fewer funds. In either case, borrowers have exhausted all sources of loanable funds, but still find the marginal value of credit exceeds its marginal cost. Thus, financial institutions are not willing to loan funds, even though borrowers are willing to pay premiums for debt capital.

Credit rationing can prevail in a market economy because lenders do not think the risk premiums borrowers are willing to pay cover potential costs of default (Stiglitz and Weiss). Also, rationing occurs from information asymmetries since lenders do not have complete information about the investment prospect.

Credit rationing is a chronic problem for North Dakota agribusiness firms (Springer). Torok and Schroeder reported that agribusiness firms in Montana and Wyoming are more concerned with; 1) obtaining long-term loans, and 2) financing new technology than nonagribusiness firms. They inferred that this concern reflects agribusiness firms' drive to expand and creditors' perceived loan risk.

Small businesses, in general, experience credit rationing because of the gap that exists in the number and type of financing institutions that provide long-term debt to small businesses. Credit crunches affect small businesses most severely, particularly if they do not have established lines of credit with a financial institution (Fazzari, Hubbard, and Petersen).

Commercial firms in agriculture do not receive equal credit. While agribusiness firms have credit shortages, farmers continue to benefit from excess supplies of credit (USDA). Farmers can choose from a variety of public and private sources for short-term credit, including various state and federal government lending agencies; local, regional, and national credit programs of merchants; the Farm Credit System; and a more extensive commercial banking system.

Reasons for Credit Rationing to Agribusiness

Rationing debt capital to agribusiness could occur for several reasons. First, most agribusiness firms are located in rural areas. Mikesell noted that rural banks serving this market tend to be conservative with loanable funds because of the high risks associated with lending in rural areas. He reported that rural banks generally do not make loans beyond the amount that deposits alone can support, unlike many urban banks that obtain additional funds from the Federal funds market.

Second, agribusiness firms do not represent a diversification opportunity for banks. Adverse conditions in agriculture directly affect agribusiness firms. Lending to agribusiness would increase the financial risks of rural banks more than would their diversifying a portion of funds into an area that is not directly related to agriculture.

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[5] A more general study of capital rationing that includes equity capital is not considered in this study.

Third, rural lenders have limited experience evaluating agribusiness loans (Gustafson, Beyer, and Saxowsky). When reviewing farm loan proposals, lenders have sufficient applications to compare borrowers and to determine credit risk. However, loan officers frequently do not have an equivalent database for evaluating agribusiness loan applications. Moreover, agribusinesses involve more enterprises than most farm operations. Lenders who do not fully understand businesses hesitate to extend credit to them.

A final problem relates to the value of the collateral pledged to secure agribusiness loans. Unlike farmers, who pledge assets that have minimal economic depreciation and relatively low transaction costs of liquidation, agribusiness collateral is generally highly specialized and illiquid.

Quantifying Credit Rationing

External credit rationing exists if a firm is willing to pay a premium for credit but is unable to obtain necessary funding. One could survey agribusinesses to determine the extent of credit rationing. However, other techniques to determine the extent of credit rationing have been developed.

Morgan identified three indicators of credit rationing: lack of a loan commitment from a bank, a positive correlation between investment spending and cash flow, and low investment when prospects are available. Loan commitments offer protection during periods of low external credit availability and signal the creditworthiness of a firm to secondary creditors. The positive correlation between investment and cash flow implies that outside financing is unavailable. Therefore, any investments must be internally funded.

The final indicator that compares actual investment with available opportunities is difficult to measure empirically. Fazzari, Hubbard, and Petersen have devised a measure of investment opportunity "q," which is defined as the market value of a business as an ongoing entity divided by the current replacement value of the firm. When "q" exceeds zero, firms should invest because the marginal value of investment exceeds its cost. Comparing "q" with actual investment behavior becomes another indicator of financial constraint.

Shaffer and Pulver created an index that defines a capital-stressed firm, based on whether; 1) debt/equity capital to finance expansion could not be obtained within 30 miles of its present location, 2) the firm ranked its banks as fair, poor, or very poor in meeting its credit needs, 3) the firm ranked all sources of capital as fair, poor, or very poor in meeting its credit needs, and 4) the firm had been denied credit on at least one loan application.

Policy Implications

If agribusinesses in North Dakota are experiencing credit rationing, policymakers may want to shift public credit programs from farmers to agribusiness firms. Credit-constrained agribusinesses are unable to attain optimal size, leverage, profitability, and capital structure positions. Reduced levels of economic activity adversely affect rural communities. Less efficient agribusinesses impact farmers through reduced services and increased transaction costs.

Survey Procedures

A stratified, random, cross-sectional mail survey of 272 agribusinesses in North Dakota was conducted to quantify the capital structures of agribusiness firms in North Dakota, to measure the extent of credit rationing in these firms, and to gauge the relationship between credit rationing and the firm's financial position (Anderson). Agribusiness firms included in the survey were divided into three sectors: input, output, and service firms.

Input firms supplied products/services to farmers, such as implement, crop, and feed dealerships. Output firms processed or distributed what farmers produce, such as grain elevators, auction markets, and food processors. Service firms provided technical services to farmers, such as aerial sprayers, crop consultants, and farm management/accounting firms. Individual firms within each group were randomly selected from association and telephone directories in North Dakota.

The mail survey contained seven sections: the first section ascertained the firm's type of business, the proportion of the firm's business that was agriculturally related, the business organization of the firm, and the number of employees. The second section elicited the respondents' opinions regarding credit availability, his firm's ability to raise capital, and the performance of rural financial markets. The third section elicited their perceptions about their firm's financial health. These perceptions were compared with actual financial information obtained later in the questionnaire.

The fourth section determined the firm's willingness to pay for additional capital and the amount of capital needed, in essence, a demand schedule for debt financing. Willingness to pay a premium for debt capital is one indicator of credit rationing. If credit rationing existed, the respondent completed the fifth and sixth sections of the survey to determine whether the rationing was internal or external. The seventh section contained respondent's summarization of his financial statements.

The first of two pretests was conducted under the supervision of a researcher involved in the project. After the general survey was mailed, a follow-up mailing was sent to improve response rates. A telephone survey of nonrespondents was conducted to test for nonresponse bias and to increase the overall rates of response. After these contacts, an overall survey response rate of 27.6 percent was obtained (73 usable questionnaires returned). Sector response rates were comparable: input firms (29 percent), output firms (23 percent), and service firms (29 percent).

Tests of nonresponse bias included a comparison of responses across mailings (Siegel), a geographic comparison of response rates, and a comparison of respondent characteristics with published industry averages. In summary, respondents differed from the population in terms of geographic location, level of liabilities, and net income and were more financially constrained than nonrespondents.

Results

Ninety percent of the agribusinesses surveyed indicated that more than 75 percent of their business was directly related to agriculture. Over half of the respondents considered themselves retailers. The average number of full-time employees ranged from 10 to 13. Unincorporated firms represented 60 percent of the respondents, whereas only 13 percent were incorporated.

Attitudinal Responses

Table 1 summarizes the respondents' attitudes toward financial markets and lenders.[6] The majority of agribusinesses agreed or strongly agreed that lending criteria are not the same for everyone. The input sector may be experiencing more stringent criteria because only four respondents agreed with the statement. The majority of respondents also indicated that agribusinesses have a limited number of lenders to deal with. Based on their divided response, service firms apparently have greater access to credit. In contrast, 80 percent of the input suppliers

[6] Selected disaggregated results pertaining to input, output, and service firms are discussed in this section. Due to space limitations, the disaggregated results are not included in the tables. However, Anderson reported them.

indicated the number of lenders was limited. Over half of the respondents said lenders were knowledgeable about agribusiness finance.

Table 1. North Dakota Agribusiness Attitudes Toward Financial Markets and Lenders

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
			Percent		
1) Lenders apply similar criteria to all agribusinesses	2.8	23.9	36.6	16.9	19.7
2) Agribusinesses have a limited number of lenders to deal with	20.0	44.3	22.9	2.9	2.9
3) Lenders are knowledgeable about agribusiness finance	5.7	47.1	24.3	14.3	8.6
4) Loan applications are too time consuming	7.1	28.6	40.0	10.0	14.3
5) Collateral requirements are excessive	11.8	35.3	26.5	8.8	17.6
6) Credit agreements are too short	7.4	20.6	35.3	10.3	26.5
7) Geographic distances to lenders are too great	1.4	8.6	51.4	14.3	24.3

Lenders have the option of rationing credit through nonprice mechanisms by increasing paperwork burdens, increasing collateral requirements, or shortening credit agreements. Agribusiness firms surveyed did not indicate these impediments. Geographic distances between the firms and their lenders were not considered excessive.

Table 2 shows the firms' attitudes toward credit availability. Thirty seven percent of the respondents indicated agribusiness firms had greater difficulty obtaining credit than did other small businesses. Twice as many input suppliers agreed with this statement, indicating that they are at greater risk of not obtaining credit. Overall, the respondents received necessary funding for profitable investments. The service sector had the least difficulty obtaining funds, whereas the input sector had the most difficulty. Respondents indicated long-term capital was the most difficult type of credit to obtain.

Many of the respondents' credit difficulties may be internal. Over 91 percent of the respondents agreed that managers of agribusiness firms could benefit from improved financial management skills. One-fourth of all firms surveyed (36 percent of input firms) had difficulty meeting debt service obligations. Over half of the firms did not have account receivables up to date. More than a third of the firms did not have a financial plan for the coming year.

Financial Position

The financial characteristics of the agribusiness firms responding to the survey are summarized in Table 3. Although considerable variation existed across firms, most respondents were relatively profitable with an average return on assets of six percent and used only modest levels of financing (debt/asset ratio of 34 percent). Output firms operated with the highest level of assets and input firms with the least. Input firms also had the lowest level of financing (debt/asset ratio of 28 percent).

Table 2. North Dakota Agribusiness Attitudes Toward Credit Availability

Statement	Strongly Agree	Agree	Disagree	Strongly Disagree	Don't Know
			Percent		
1) Agribusinesses have greater difficulty obtaining credit than other small businesses	9.9	26.8	35.2	24.0	28.2
2) Do you have equal access to capital relative to other agribusiness firms	16.9	60.6	15.5	1.9	5.6
3) All of your firms profitable investments have received necessary funds	20.3	47.8	17.4	11.6	2.9
4) Short-term capital is not available	2.9	12.9	52.9	20.0	11.4
5) Long-term capital is not available	5.8	20.3	42.0	17.4	14.5

The current market value of the firms, based on the respondents' assessments of what outside investors would be willing to pay for the firms as ongoing entities, was substantially less than reported equity. The greatest disparity existed for output firms. In a related question, nearly half of the respondents indicated that such an investor could not adequately appraise their firms.

Sources and terms of debt financing the responding agribusiness firms obtained are shown in Table 4. The most popular sources of debt financing were local banks and the Small Business Administration (SBA). Private sources of credit, including stockholders, individuals, family, and other private sources, ranked next. The terms for most credit were fewer than 10 years, with most on an annual basis. Average interest rates ranged from 5.0 percent on public sources of credit to 12 percent on self-financed loans.

Most of the respondents had obtained secured credit from their financial institution (77 percent). Only 12 percent had obtained unsecured credit. Collateral provided as security included the firm's assets and equipment (49 percent), inventory (47 percent), real estate (37 percent), personal assets (31 percent), accounts receivable (27 percent), and other (4 percent). When applying for credit, the following information was required: balance sheet (89 percent), income statement (76 percent), personal financial records (73 percent), business plan (61 percent), and tax returns (60 percent). Input firms were required to submit more information than other sectors.

Over 76 percent of the respondents had easy or moderate access to additional equity funds, including past earnings (37 percent), asset appreciation (19 percent), family (14 percent), friends (9 percent), venture capital (7 percent) and other (5 percent).

Table 3. **Financial Characteristics of North Dakota Agribusiness Firms**

Balance Sheet	All Firms	Input Firms	Output Firms	Service Firms
Current Assets				
Cash	267,930	41,800	815,930	161,680
Accounts Receivable	248,660	76,160	680,870	134,420
Inventory	1,162,480	1,137,040	1,715,770	798,220
Intermediate Assets	512,140	135,750	1,781,330	202,300
Long-term Assets	498,690	167,380	1,221,250	391,620
Accounts Payable	313,140	500,430	218,000	131,120
Total Debt	384,820	344,000	632,370	273,310
Equity	1,991,940	713,700	5,364,860	1,283,810
Market Value of Firm	852,000	726,000	1,246,000	701,000
Current Asset/Current Liabilities	22.72	20.78	35.88	12.78
Debt/Asset Ratio	.34	.28	.33	.43
Income Statement				
Annual Sales	12,600,000	12,630,000	25,970,000	1,880,000
Depreciation	142,120	25,450	366,870	72,930
Interest Expense	28,710	26,090	18,670	41,430
Tax Expense	17,440	8,890	15,440	31,310
Net Income	111,340	43,240	329,600	64,310
Return on Assets	.06	.12	.03	.09

Credit Rationing

One indicator of credit rationing is how close firms are to the minimum amount of debt necessary to operate the business. Those below the minimum assumably would have difficulty obtaining credit. Agribusiness firms in North Dakota report a range of minimum and maximum levels of financing necessary to operate their firms (Table 4). The level of debt most respondents wanted was substantially below current levels. Respondents above their desired debt level indicated that low profitability, unexpected losses, and slow farm economy prevented them from reducing their debt while respondents below their desired debt level indicated that high interest rates and poor cash flows prevented additional borrowing.

Overall, 41 percent of the respondents indicated a financial constraint on the amount of debt capital that they could borrow (Table 5). Thirty one percent of the respondents had been informally denied credit, and 18 percent had had formal applications for credit denied. The average loan amount formally rejected was $432,300. However, this constraint does not indicate capital rationing. Financial markets appear to be operating satisfactorily because only 8 percent of the respondents would be willing to pay a premium for additional debt. If firms willing to pay a premium could obtain additional credit, but had to pay an additional 200 basis points of interest, they would only borrow, on average, an additional $13,800.

Table 4. **Sources and Terms of Debt Financing**

Source	Original Term Mean	Interest Rate Mean	Amount Mean
	Years	*%*	*$*
Stockholders	6.3	9.4	225,600
Local Bank	1.1	11.1	122,300
Individual	5.0	10.0	17,000
Parent Company	Ongoing	9.0	1,142,000
Bank for Co-ops	1.0	6.7	995,000
SBA	12.0	5.0	96,000
Family	7.2	8.5	75,100
Private	10.0	9.0	32,500
Personal Notes	Demand	8.7	115,000
Self	5.0	12.0	6,000
Regional Bank	5.0	7.5	1,000,000
Credit Union	1.0	10.5	23,500
Financing Company	1.0	12.0	10,000

Applying the credit rationing analysis of Fazzari, Hubbard and Petersen resulted in an average q of 67.3, which indicated that market value of the firms is below replacement value and that lack of credit arises from limited internal investment prospects. Based on the index of Shaffer and Pulver, less than three percent of the firms were capital stressed. Therefore, North Dakota agribusiness firms did not seem to experience credit rationing during the last recession.

If all firms in the survey could borrow additional capital at 200 basis points below their existing rate, they would increase debt financing an average of $148,860.

Summary

Results of a stratified, random, cross-sectional mail survey of 76 agribusinesses in North Dakota show limited evidence of external credit rationing among the firms surveyed. Although nearly half of the agribusinesses were constrained in the amount of debt capital that they could borrow, only eight percent of them would be willing to pay a premium for additional financing. Of those willing to pay a premium, the amount of credit that they would borrow at 200 basis points over their present interest rate averaged $13,800. Significant internal credit rationing existed. The survey provided significant information on the financial characteristics of nonfarm agribusiness firms operating in the input, output, and service sectors.

The results of this survey are limited to one time period and geographic area of the country. Similar studies should be replicated in other regions to increase the understanding of the financial characteristics and management practices of agribusiness firms.

Table 5. Indicators of Credit Rationing

	All Firms	Input Firms	Output Firms	Service Firms
Minimum debt level	$95,700	$93,800	$75,400	$111,200
Maximum debt level	$733,700	$353,300	$1,218,300	$767,500
Desired debt level	$60,400	$58,000	$111,400	$25,500
Firms constrained in the amount of debt they can borrow	41%	19%	13%	9%
Willing to pay a premium for additional debt	8%	8%	6%	8%
Informally denied credit	31%	48%	22%	21%
Formally denied loan application in past 5 years	18%	26%	11%	15%
Average amount of rejected loan	$432,300	$701,000	$211,000	$131,667
Amount firm would borrow at -200 basis points of interest	$148,060	$165,200	$233,200	$54,250
Amount firm may borrow at +200 basis points of interest	$13,800	$6,200	$35,300	$5,000

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ECONOMIC MOTIVATIONS FOR VENDOR FINANCING: THEORY AND EVIDENCE

Bruce J. Sherrick and *Robert W. Lubben*[1]

Abstract

Vendor financing is shown to have advantages over competitive bank financing in cases where: there is some "market power" in the product market; there are positive margins in the product market; credit can be used to segment the demand and extract additional economic rents; funding, collateral or security disposition rates favor the vendor; or there is asymmetric information and differing abilities to assess credit risk among the various participants in the credit market. Further, the theory employed predicts that the "optimal" risk exposure for vendor financed operations exceeds that of the traditional lenders, even in cases of purely competitive lending environments. Summary evidence from one vendor finance operation is then presented that is largely consistent with the theory.

Introduction and Background

The purpose of this paper is to investigate the economic incentives for input supply firms to offer credit in conjunction with their products. Although these types of vendor finance programs have been in existence for nearly half a century, several have recently increased in both scale and visibility. These vendor finance programs have become the subject of much additional debate -- by traditional lenders who are uncertain whether to view the "new" entrants in the credit market as competition or opportunity; by other vendors interested in the value of financing their own customers' purchases; and by customer-borrowers interested in the "best deal" they can get. Furthermore, an accurate understanding of the incentives and impacts on the market of these relatively unregulated lenders is needed by policymakers and regulators as they design and implement guidelines for behavior.

At the center of the debate are the economic motivations of the supply firms who chose to create a financing unit. Although there has been relatively little formal treatment of the economics of intermediation by these lenders operating in agricultural markets, there have been several studies and hypotheses put forth related to automotive, industrial supply, and consumer products vendor finance operations. The question remains as to what form of history may repeat with agricultural input supply firms. Will the vendor finance companies largely displace bank supplied financing as has been somewhat the case with automobiles? Or, perhaps only a small number of specific-need borrowers will develop relationships with their suppliers to formalize common trade credit into real debt relationships as has been the case with some industrial supply vendors (Remolona and Wulfekuhler).

There have been many reasons cited for, or explanation of, vendor financing. For example, it may be that the firm is able to stimulate sales of its products through creative financing for customers who, in the absence of the vendor supplied financing, could not purchase the products. For this practice to improve firm profits, it must be the case that the firm earns at least as much on

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the additional product sales as the financing costs. Furthermore, the financing contracts must be designed to effectively attract additional sales, rather than simply substitute for other financing (or cash) by current customers. Next, vendor financing may simply be used in attempts to solidify market share. Or, there may be real cost advantages conveyed to the vendor through reductions in information collection costs because much of this function is accomplished in the course of doing other business with the customer. Furthermore, in addition to shared delivery costs for point-of-sale financing, "scope" economies of providing financing along with the product may also come about because of reduced transactions costs on the part of the borrower.[2] Or, the lending operation may serve as a direct profit center; or a means of accomplishing related diversification for risk management. Further, the bonding costs for the vendor may be lower than for a traditional lender. Hence, what may appear to be an unacceptable credit risk to a bank may be an acceptable credit risk to a vendor, because the borrower needs to maintain relationships with the supplier other than credit alone. Finally, as is argued later, the vendor may use credit terms to effectively offer different price schedules to segments of demand with differing elasticities to more perfectly discriminate according to willingness and ability to pay. Thus, the credit function can be used to move toward a more monopolistic outcome, exploiting market power in the goods market and extracting more rents from the customers than would be the case under uniform pricing without credit.

Other studies have addressed related issues such as the market valuation effect of forming a captive finance unit. Lewellen; Roberts and Viscione(b); and Dipchand, Roberts and Viscione each found that the formation of a captive finance company effectively increased the parent firm's total borrowing capacity. To the extent that this additional capacity is used, the effect may be to expropriate value from existing bondholders toward equity holders (Kim, McConnell, and Greenwood). Roberts and Viscione(a) also consider agency theory implications to the management of the financing function through the formation of a captive. They conclude that the separation of management and credit, but the joint contribution to one firm's performance, potentially reduces monitoring costs and improves overall performance. Staten, Gilley, and Umbeck indicate that indirect lending may reduce a bank's cost of screening potential borrowers. However, issues of the relative merits of the "two-desk" strategy versus formation of a captive are left largely unresolved. Finally Brennan, Maksimovic, and Zechner offer a theory of financial intermediation that indicates some conditions under which vendor financing improves the profitability of firms. Further, they derive "industrial organization" impacts (numbers of firms in equilibrium) and indirectly demonstrate that it may be optimal for only some firms with market power to offer financing to thereby "divide" the customers among differing firms depending on their relative demand elasticities. In other words, it may be optimal for one firm to service the less elastic demand at a high price and another firm to service the more elastic demand customers with credit and somehow share the cartel-like profits.

As noted in the literature, classical economic models with no frictions, no market power, and no information asymmetries leave little room for strategic behavior among financial intermediaries. However, the purely competitive paradigms do not permit many of the interesting or realistic solutions. For example, firms with some market power may chose to cross-subsidize activities away from the activity that is somewhat insulated from the effects of perfect competition. Considering local supply firms, there is likely to be some proximity-conferred market power enabling a situation where price may be greater than marginal product cost and where cross-subsidization of the financing operation may be sustainable. Again, classic theories with perfect competition would prohibit cross-functional subsidies, as the primary activity would simply be "bid away" from the subsidizing firm. Hence, elements of imperfect competition, resulting in some market power (quasi-monopoly supply) are important for much of the theory developed and presented below.

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2 This "one-stop" shopping concept has also been imitated in the form of "two-desk" lending operations where a bank or other traditional lender simply sets up a lending branch at the point of sale (Staten, et. al).

Framework to Evaluate Economic Motivations

In order to better understand the motivations and practices that are observed in the market, an economic framework is needed. Below, a simple structure is presented that is then used to demonstrate expected outcomes in a simple intermediation market when multiple players (such as pure intermediaries and vendor finance operations) are present. It is recognized that there are a myriad of situations involving competition among vendor finance operations and traditional lenders. Rather than attempting to depict various specific markets, several "boundary" cases are examined to impart structure to the entire market. A simple graphic will help illustrate this point.

Figure 1 maps the competitive structure of the market (from pure monopoly, to pure competition) against the level of informational uncertainty about the borrower (from purely asymmetric where the borrower knows credit risks exactly and the lender cannot tell at all, to actuarially fair and exactly observable credit risk). Clearly there are other important features of the credit market that could be contrasted with the present two thereby increasing the dimension of the map. Some of these features are examined (i.e., collateral coverage rates) but are left off this figure for clarity. Two interesting extremes are identified in the graph. First, consider the perfect monopolist's case when exact information about the borrower is available (lower left). The monopolist can design price discriminating supply schedules to completely extract all the producer's surplus in the system. At the top right, the credit market breaks down because the purely competitive nature of the industry means that in equilibrium the lenders will just break even and the asymmetric information situation means that at any interest rate, only borrowers who know themselves to be of higher risk than reflected in the interest rate will present themselves to the offer. Hence, the average risks presented by the borrowers will always be above the level reflected as actuarially fair in the interest rate (this situation is similar to the "Market for Lemons" problem described by Akerlof). However, there are still many other cases of interest. For example, with any level of market power, and hence the potential to cross-subsidize activities from the partially monopolistic activity to another, the amount by which a manufacturer would or should be willing to subsidize a lending operation is potentially positive. Further, the design of the sales offer (price and financing terms) should be such to exploit any self-identification motives present among the borrowers. These and a few related issues are addressed in turn.

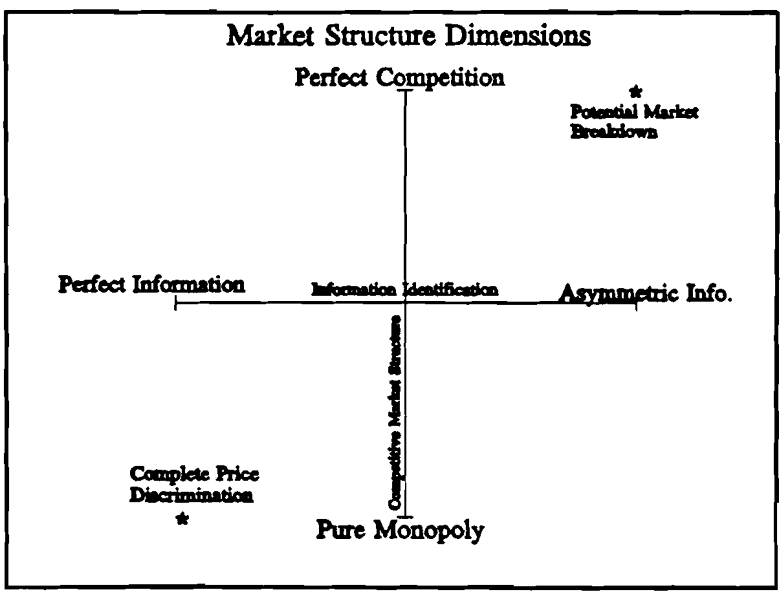

Figure 1

For ease of notation, the paper considers the number of $1 loans to be made in a "banker's discount" framework. That is, the loans are made such that the future value is one dollar, and the interest rate is the amount that needs to be charged to convert the current value to $1 in the future. This convention significantly simplifies the exposition that follows, but does not affect any result that does not depend on loan size. Figure 2 reinforces some of these concepts.

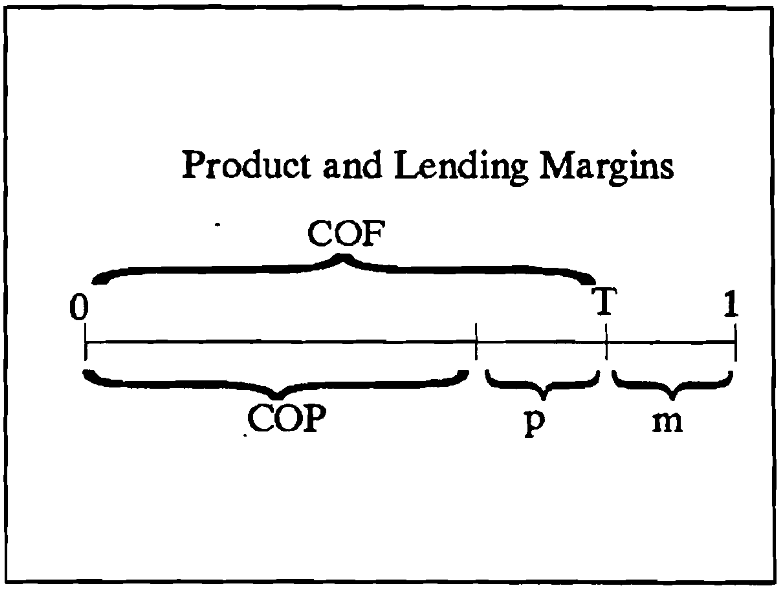

Figure 2

In Figure 2, the following are used:

T	=	price of product
COF	=	total cost of funds to acquire product sold
COP	=	cost of production
m	=	lending margin = (1-T)
p	=	manufacturing margin

The purely competitive interest rate must be m/(1-m), and for simplicity, this rate is assumed to exactly offset additional expenses such that the net economic rents to pure lenders are zero. The lenders are assumed to access a perfectly elastic supply of funds at COF sufficient to finance all borrowers in the market. In this framework COF is the total cost of acquiring the resources that are transferred to the borrower. It is convenient to think of the lender simply buying the input at price T and giving it to the borrower in return for $1 promised future payment. Again, the problem has been placed on this scale for later convenience; and this scaling should not affect any important interpretations.

In what follows, three cases are examined in which banks' and vendor finance units' behavior depend on the competitive structure of their businesses and on varying abilities to discern credit risks. Implications are drawn from the models that can then be compared and contrasted with observations to both validate the structure of the model and improve understanding of the observed behavior. Following these, some summary empirical evidence is provided from one such vendor finance operation. Finally, conclusions and summary remarks are given.

Case 1: Some market power in the product market; purely competitive lending environment; perfectly identifiable credit risks.

In this first case, assume that the borrowers have been correctly and precisely classified and ranked such that the individual (marginal) probability of default can be exactly identified. For exposition sake, the borrowers are sorted with the resulting marginal default function as D(n) shown in Figure 3. A lender faced with such blissful knowledge will lend to the point that the marginal return from lending is equal to the marginal cost. The lender's total profit π, as a function of the number of loans, n, is:

$$\pi(n) = m(n - \int_0^n D(k)dk) - c\int_0^n D(k)dk*(1-m) \quad (1)$$

where c is the "collateral loss rate", $0<c<1$. It can be thought of as 1 less the proportion of principal collateralized. Hence, if c = 1, there is no collateral coverage and defaulted payments are full losses. If c = 0, then there is full collateral on principal value and there is no additional loss from default other than unearned margins. Equation (1) indicates that the profit is equal to the number of nondefaulted loans times the margin earned per loan less the total number of defaulted loans times the principal value as adjusted for collateral recovery. The profit maximizing lender will lend to the point that $d\pi/dn = 0$ or:

$$\frac{d\pi}{dn} = m(1-D(n)) - c(1-m)D(n) = 0 \quad (2)$$

which holds at $D(n^*) = m/[c(1-m)+m]$. Notice that if there is no collateral (c=1), the lender will lend until the marginal default rate is equal to the margin earned on each unit. In the case of partial recoveries, $0<c<1$, $n^* = D^{-1}(m/[c(1-m)+m])$. In these circumstances, the lender will lend to even riskier borrowers, as expected. Because D(n) is monotonically increasing in n, dD(n)/dn is everywhere positive and therefor e dn^*/dc takes on the same sign as $dD(n^*)/dc$. It is easily shown that $dD(n^*)/dc <0$ if $m^2 - m <0$ (as is the case for m<1 in this example) implying that more collateral coverage permits lending to riskier customers. A vendor finance company may very well be better able to deal with specialized collateral than a traditional lender thereby reducing the value of c relative to a traditional lender who recovers the same item as security. For example, a John Deere dealership may be better able to dispose of a repossessed tractor than a local bank; hence the vendor finance unit of John Deere should be able to make loans to some riskier borrowers than the bank because of its lower implied c.

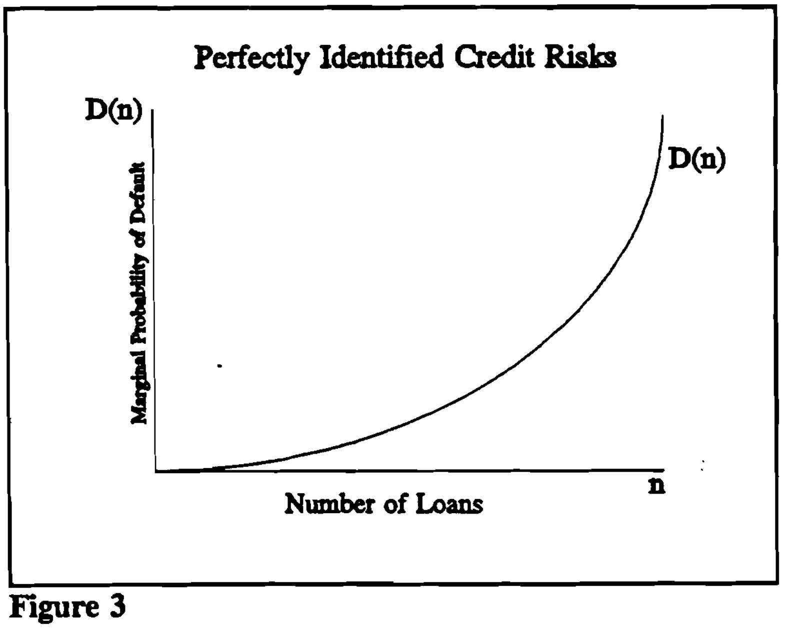

Figure 3

The impact of additional product margin in addition to the lending margin can also be easily established by considering the product margin to simply increase the lending margin to the total margin, (m+p), as in Figure 2. From equation (2) above, it is easily confirmed that $dn^*/dm > 0$, hence, the vendor finance operation *if viewed simply as a financing operation*[3] will always optimally lend to more risky borrowers than the traditional lender if there is any market power which permits T to exceed COP.

It is instructive to work out similar conditions for the vendor finance unit to highlight the interaction between the product margin, lending margin, and collateral coverage rate. For the manufacturer with a vendor finance program, the profit function becomes:

$$\pi(n) = (m+p)(n-\int_0^n D(k)dk) - c\int_0^n D(k)dk*(1-m-p) \qquad (3)$$

Again setting $d\pi/dn = 0$ and solving implies that $D(n^*) = (m+p)/(m+p+c-cm-cp)$ which is everywhere greater than $m/[c(1-m)+m]$ (and also greater than m) in the relevant cases $0<c<1$, and $(m+p)<1$. This result shows that the vendor finance unit will again finance more risky borrowers than the lender in the purely competitive banking-only business. Again notice that if c=0, the firm will lend to everyone (always earning p, whether through payment or sale of collateral) and if c=1, the vendor will lend until the marginal default rate equals the combined product and lending margin. The optimal level of lending can be found at $n^*=D^{-1}((m+p)/(m+p+c-cm-cp))$. The sign of $dn^*/dc < 0$ again as expected, indicates that the lender with the higher valued or less costly to dispose collateral will find lending more profitable to any given borrower and will in equilibrium lend to more borrowers.

Case 2: Perfectly competitive banking system; borrowers risk-classified according to distribution on returns; both lenders competing for market share; vendor sets price T and interest rate, r_v separately from bank.

Consider the next case where there are two classes of borrowers, rich-low risk, and poor-high risk; and those with some potential to default have insufficient cash to buy outright and hence require financing if they are to use the product at all. Further, the only collateral pledged is the return on the product itself. Hence, it is convenient to view both the product and the loan as lasting only one period (i.e., seed, chemicals, etc.) and generating an uncertain return, $\tilde{R}$ over that period.

In contrast to the previous case which considered only the financing decision for the class of purchasers who use credit, the situation now admits the possibility of using credit to discriminate among borrowers according to their risk class while selling some product for cash as well. Again, the risk of default is observable among potential customers, but that default risk is now captured in the form of a distribution of returns that each individual farmer faces. Presume that there are some number N_r of rich farmers each of whose returns distribution, $\tilde{R}$ is sufficient that there is no possibility of default. The competitive banking system will be forced to "break even" on this class or borrowers again implying an interest rate of (m/(1-m)) to this class of borrowers. Next, consider one of the N_p "poor" farmers whose returns distribution $\tilde{R}_p$ includes some outcomes less than 1 or T(1+r), in which case he/she would default on the loan and simply turn over the realized returns to the lender.[4] Before the returns are realized, the farmer knows the distribution, but not the actual, or realized level (this situation may very well corresponds closely to the realities of farming).

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[3] In other words, the internal transfer of the product to the lending operation takes place at a price of COP, hence all returns accrue to the intermediation function alone.

[4] The value of scaling the problem to number of $1 loans should now be more apparent as it simplifies the computation of probability weighted returns as the fraction of $1 is now also equivalent to the "return".

It will also be convenient to utilize two other measures $h^{+}_{i,k}$ and $h^{-}_{i,k}$ which correspond to the conditional expectation for a variable i over the domain that the variable is greater or less than k respectively, scaled for the probability of meeting that condition. For example, suppose R_p takes on values from R_{min} to R_{max}. Then $E[R_p|R_p>k] = [\int_k^{R_{max}} f(R_p)R_p dR_p]/[1-F(k)] = h^{+}_{R_p,k}$, and $E[R_p|R_p<k] = [\int_{R_{min}}^{k} f(R_p)R_p dR_p]/[F(k)] = h^{-}_{R_p,k}$, where f(.) is the probability density function, and F(.) is the cumulative distribution function. Note that $[1-F(k)]*h^{+}_{R_p,k} + [F(k)]*h^{-}_{R_p,k} = E(R_p)$ by definition. Further, $h^{+}_{R_p,R_{min}} = h^{-}_{R_p,R_{max}} = E(R_p)$ as well. These measures are closely related to the incomplete expectation frequently used in the insurance literature, but differ by the weighted value of the variable beyond the boundary k. The incomplete expectation, $IE_{R,k}$ is defined as $[\int_{R_{min}}^{k} f(R_p)R_p dR_p] + k*[1-F(k)]$. These measures are useful in describing expected values of positions that are contingent or dependent upon the outcomes of other variables. For example, the lender may wish to compute expected values of loan positions recognizing that if the borrower eams more than the debt obligation, they will simply pay the face value; but under default, there is some distribution of recovery values. Hence, the expected value of the total loan position contingent on eamings R, is the face value (FV) times the probability of being paid that amount plus $h^{-}_{R,FV}$ * F(FV) which is the expected value of payments on R given that they are less than FV.

In this framework, "k" is the point that determines default corresponding to outcomes less than the future loan payment, $T(1+r_v)$. If the farmer earns more than enough to pay back the loan, then he/she will simply pay the lender and keep the difference. If, on the other hand, the returns do not meet the debt obligation, the farmer simply turns over the realized proceeds and terminates the debt through partial default. A bank lending to this class of farmers will be forced to add a risk premium to the interest rate in an amount to compensate for the average losses on defaulted loans to break even. This rate can be found as the rate r_b, that is the solution to:[5]

$$T(1+r_b) = \frac{(1-[F(T(1+r_b))][h^{-}_{R,T(1+r_b)}])}{(1-F(T(1+r_b)))} \qquad (4)$$

It is apparent that if $T(1+r) < R_{p,min}$ there is no chance of default and even the "riskier" farmers are "risk-free" in terms of lending. On the other hand, if $T(1+r) > R_{p,max}$ then no farmer will be able to purchase the input. However, if $R_{p,max} > T(1+r) > R_{p,min}$, there is some possibility that there will be a price-interest rate combination attractive to both the farmer and the vendor. Suppose the vendor offers financing at rate r_v which is positive, but less than the "default adjusted" rate banks are required to charge to breakeven on the high risk class of borrowers. The vendor's problem is now to maximize profits over the joint choice of T and r_v.

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5 To see this, consider the average "loss" on defaulted loans, or $T(1+r_b)-h^{-}_{R,T(1+r)}$ and since only the fraction $F(T(1+r_b))$ default, the remaining loans must generate enough additional margin that the sum of the returns on defaulted and nondefaulted loans returns to 1. A discrete example will help illustrate. Suppose R is distributed uniformly on the interval (0,3). Then, by definition, f(R) = 1/3, F(k) = k/3, $h^{-}_{R,k}$ = k/2, and [1-F(k)] = (k-3)/3. The choice of the interest rate, r_b can be made such that the incomplete expectation over R is 1. Hence, $h^{-}_{R,T(1+r_b)}*F(T(1+r_b))+T(1+r_b)*[1-F(t(1+r_b))] = 1$; or the average payoff in default times the probability of default plus the face value times the probability of nondefault equals the competitive rate of return, or 1. Solving for $(T(1+r_b))$ in the discrete example given above implies that $T(1+r_b) = (3-3^{1/2})$ or approximately 1.2679. A fairly good first order approximation is to notice that from the competitive interest rate, returns below 1 will default and on average return 1/2 in that state. The remaining 2/3 of the loans must generate the additional margin or the losses (1-(1/2)(1/3)) must be "spread" over 2/3 of the loans. Hence, (1-(1/2)(1/3))/(2/3) = 1.25. The difference is due to the fact that the approximation ignores the fact that the slightly higher interest rate also marginally increases the likelihood of default.

Before turning directly to that issue, it is first important to understand the farmer's decision framework. As depicted in Figure 4, the credit customer receives inputs worth +T and then at the end of the production cycle either receives $R_p > T(1+r_v)$ and pays off the loan worth $T(1+r_v)$ or earns $R_p < T(1+r_v)$ and simply surrenders that return as payment on the debt. Although the relative probabilities (labeled (*p*) and (*1-p*)) of the two types of return outcomes delineated at $T(1+r_v)$ are simply the integrals of $f(R_p)$ split at $(T(1+r_v))$, the relative weights in the "upstate" and "downstate" are immaterial as the sign of the expected value of the sum of the two outcomes depends only on whether the expression on the top line in the figure is positive (and, hence the expected value of the two outcomes will be positive for any $p>0$ because the other component will equal 0)[6]. Under this scenario, the farmer will accept and fully finance inputs T any price less than $R_{p,max}$ so long as there is no equity commitment and no additional costs of default. However, under the more usual arrangement of partial financing (positive equity commitment), and other costs of default (such as reputation damage and the like), additional constraints are imposed on the farmer's behavior. For convenience, it is assumed that the farmers are only willing to finance if the expected returns on their purchase at T increase their expected return on equity. Hence, the inputs are accepted only in cases where the leverage is expected to have a positive boost to return on equity. Finally, the lender is also expected to have some control over the extreme-risk borrower and exclude those for whom there is no possible solution to the risk-premium-equation (4) above. The details of the mechanisms are not important at this point, only there are no "free" options to default, and some level of improvement by the farmer (i.e., an increase in expected returns) is expected from the use of the input.

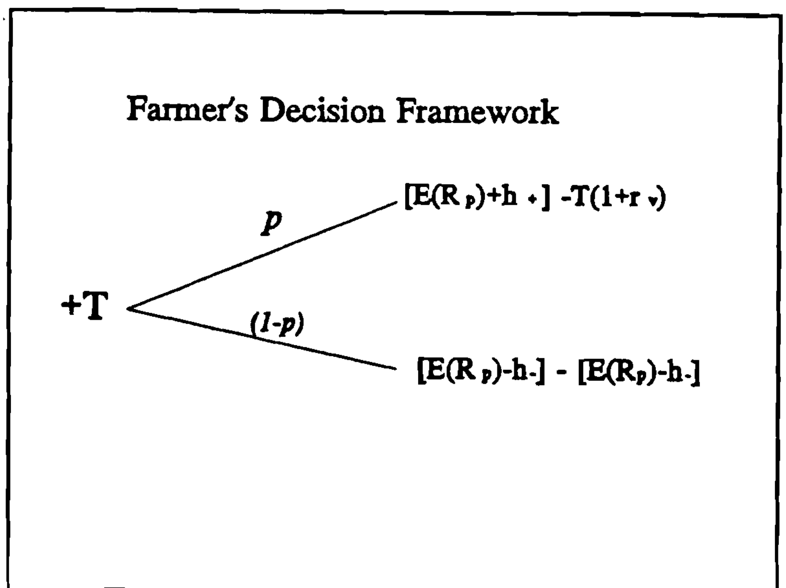

Figure 4

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6 The operational convenience this affords is that, because the decision does not depend on relative probabilities of outcomes, we may proceed as though the farmers are risk-neutral and prices will, in equilibrium return to their expected values (see Ingersoll). Risk neutral pricing is not necessary, but convenient in that we do not need to understand the differing risk attitudes among the farmers, and instead can assume purchase will occur if expected returns are positive. Again, it does not mean we are unconcerned with risk, it simply means that the risk-neutral solution has a unique parallel under risk.

Returning to the issue of jointly determining T and r_v to maximize profits for the vendor, assume that the representative returns distributions for poor and rich farmers are as shown in Figure 5. Then, it is clear that an interest rate adjusted for default will deter the rich farmers from purchasing on credit as they will instead use cash. However, the poor farmers who do not have sufficient cash will still find it to their advantage to purchase on credit if:

$$T(1+r_v)<E(R_p)+h^{+}_{R_p,T(1+r)} \tag{5}$$

implying that they are "better off" with the input. Hence, one strategy for the vendor finance unit to employ would be to set the highest price consistent with purchase by both classes of farmers and charge an interest rate that is as high as possible that permits purchase by poor farmers. The positive level of interest rates and the risk premium will deter the rich farmers from financing; and the interest rate is as high as possible to be consistent with purchase by poor farmers.

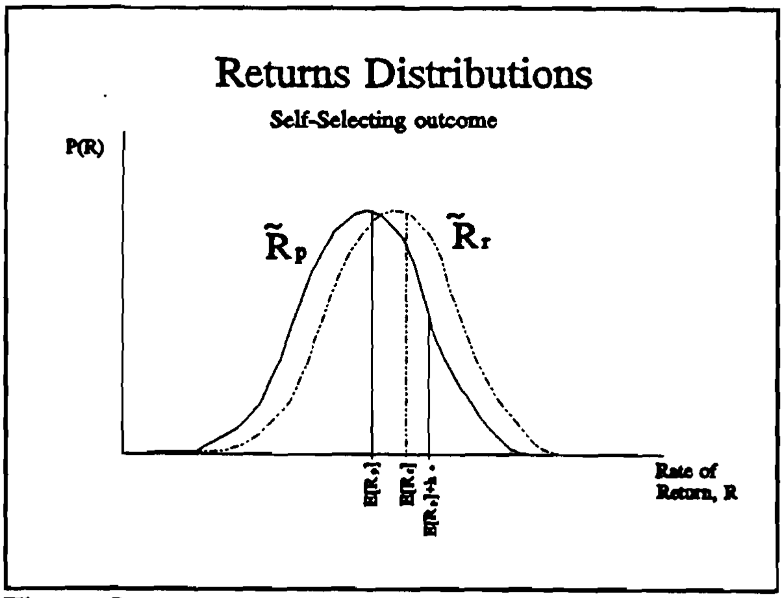

Figure 5

Setting T = $E[R_r]$ extracts all the rents possible from the rich farmers; and solving for the maximum r^{*}_v consistent with the decision framework (equation (5)) of the poor farmer implies $r^{*}_v = [(E(R_p) + h^{+}_{R_p,T(1+r)})/T - 1]$. The vendor's profit in this case is $\pi = N_r(E[R_r]\text{-COP}) + N_p(E[R_p]\text{-COP})$.[7] Comparing this to the maximum profit to the vendor with no financing where $\pi = (N_r+N_p)(E[R_p]\text{-COP}) = N_r(E[R_p]\text{-COP}) + N_p(E[R_p]\text{-COP}$, it is apparent that the vendor earns more from implementing its own vendor finance operation than from relying on external financing of its

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[7] To see this, consider the discrete analog case where one half of the poor borrowers default and one half payoff the loan at the "default" adjusted interest rate. It is then easily shown that the expected value of the payments from the poor group equals the expected value of the returns because the interest rate was chosen to exactly offset losses from the defaulting group with gains from those who do not. Algebraically, total expected profits in this case are equal to: $E(\pi) = N_r(E[R_r]\text{-COP}) + (P(R_p>T(1+r)))^{*}N_p\{[(1+r^{*}_v)T]\text{-COP}\} + (P(R_p<T(1+r)))^{*}N_p\{(E(R_p)-h^{-}_{R_p,T(1+r)})\text{-COP}\}$. Substituting $r^{*}_v = [(E(R_p) + h^{+}_{R_p,T(1+r)})/T - 1]$ and recognizing that $(P(R_p<T(1+r))) + (P(R_p>T(1+r))) = 1$ gives the stated result.

purchasers.[8] Importantly, the banks will be unable to compete for the financing of the poor farmer purchases because the rate of return on the lending operation is actually negative. To see this, notice that the vendor nominally lent to the poor borrowers an amount in total equal to N_p*T and received only $N_p(E[R_p])$. Substituting $E[R_r] = T$ implies a rate of return to lending equal to $\{(E[R_p]/E[R_r])-1\} < 0$. Hence, the traditional lenders will neither want nor be able to compete for this business, and the rich farmers will "self-select" cash due to the positive additional interest rate. The vendor has thus been able to extract all the economic rents from the rich farmers by judiciously setting price, and has been able to extract additional manufacturing margin from the additional sales to the poor farmers. Further implications of the model remain consistent with the earlier section in that the expected average credit quality is less than in cases without vender intermediation, and that the manufacturing margin positively affects the amount of lending undertaken. Even in cases where $E(R_r)>E(R_p)+h^+$, the vendor may find it advantageous to "subsidize" poor borrowers with a negative effective interest rate, if they can effectively exclude the rich farmers from taking advantage of the negative interest rate.[9]

Case 3. Some Self-Selection; incentive alignment motives; and information revelation.

In contrast to the previous cases, suppose that each farmer, i, has a returns distribution that is known to him/her (i.e. they know the likelihood and extent to which their outcomes may deviate from that which is expected), but this information is unobservable to the lenders. Further, before the uncertainty is resolved (i.e., before the production cycle), the farmer will pay cash for a product if $T<E(R_i)$ and will finance it if the contract (price and interest rate) permits an increase in the expected value over T for the equity committed. In other words, the expected rate of return is higher than the cost of debt, so any degree of leverage is preferred.[10]

Although the lenders are unable to determine the individual's riskiness, assume that the "distribution of riskiness" is at least known. The lender may attempt to set an interest rate such that $T(1+r)<E[R]+\gamma^*$ where γ^* is the critical level below which farmers will have no incentive to finance and above which the remaining farmers will generate more product margin than they cost in default expenses. However, if this is all the structure imposed on the problem, the credit market can break down if farmers fully self-select. This breakdown occurs if there is no solution to the following two equations.

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8 The highest price that can be set to sell to both groups of farmers and rely on external financing is to set the price equal to $E[R_p]$. Then, both groups purchase and the banks just break even on the financing of the poor farmer's purchases. Brennan points out that in some cases (i.e., if there are relatively few poor farmers) it would be more profitable to sell only to the rich farmers at a higher price. However, this condition is already precluded in cases where $R_p+h^+>R_r$, as we have assumed, because that case permits charging the rich farmers the highest price they can pay already. However, the possibility that it would be more profitable to restrict sales only to rich farmers should be pointed out for logical completeness.

9 Price discrimination (in its legal forms) exploits the relative elasticities of segments of demand. Much as a phone company may be able to charge the less elastic business users higher rates during typical business hours, the vendor may be able to reduce its rates to poor farmers through a creative interest rate program that somehow screens out rich farmers.

10 Using earlier notation, this is equivalent to accepting an option to default and an expected return equal to $(p)\{E(R_i)+h^+_{R,T(1+r)}-T(1+r)\}$.

$$T(1+r^{*})<E[R]+\gamma^{*} \tag{6}$$

and,

$$[E(T(1+r^{*})|R>(T(1+r^{*}))]+E[R|R<T(1+r^{*})]]-T>0 \tag{7}$$

Equation (6) simply insures that farmers will buy and finance product at price T. The first term in equation (7) reduces to the probability that the return is sufficient to pay the loan times the loan payment; the second term adds the payoffs in cases where there are shortfalls; and then the principal lent is subtracted. The feasibility of the solution depends upon the distribution of returns, but it is easy to construct cases where there is no solution.

Cases where there are no solutions are again similar to the "Market for Lemons" problem popularized by Akerlof. The analogy is that at any rate, r, only customers whose risk adjusted interest rate (that they know from private information) should be higher than r will present themselves to the market. Hence, at a rate r, the pool of potential borrowers will possess higher risks than reflected in rate r, hence, to service that pool, a higher r is needed, but at that rate, only the portion that are still favorably misclassified will remain in the pool; and so on until there are no applicants left because the only rate at which the average borrower's risk will not exceed the offered rate is when the rate is higher than would correspond to the riskiest borrower. But, the vendor sponsored finance, while not guaranteed to be feasible, at least has a higher chance of obtaining so long as there are positive manufacturing margins that are fungible with the lending margins. In other words, if the manufacturing unit "sells" the product to the lending unit at an internal transfer price that results in a profitable financing operation, there remains some possibility of a functioning credit market that effectively discriminates by borrower characteristics.

A further possibility is that the different lenders have differing abilities to assess the risks of the borrowers, hence further polarizing the activities toward lending to higher risk borrowers with a better ability to distinguish risks. The obvious outcome is that the lender is better able to extract the farmer's rents if the risk assessment is more accurate (and hence fewer profitable borrowers are excluded more unprofitable borrowers are excluded).

Also, it remains likely in this case as well that the same borrower is of different risk to the different lenders because of different bonding costs due to other relationships the customer has with the input supplier. Further, the likelihood that the vendor would be better able to dispose of specialized collateral than a traditional lender again favors the vendor.

Empirical Evidence

To date, the evidence collected directly from these types of vendor finance operations is broadly consistent with the theory. Operational differences make direct observation of an isolated lending function difficult. But on balance, the theory suggests that the vendor's portfolio of loans should be riskier than that of a bank, and yet that the performance should reflect losses that are subsidized at least partly by manufacturing margins.

A few summary measures are presented from Growmark's F.S. Credit (FS) program as "case" evidence of one of the (apparently well run) vendor finance programs serving agriculture. These measures are given in terms of performance ratios and the like rather than in absolute numbers both to partially protect information and to make the comparisons to other sized institutions more apparent.

First, consider the composition of the loan portfolio. An examination of the distribution of the debt to equity and debt to asset ratios at application gives a coarse measure of the riskiness of the borrowers. As shown in Figure 6, a significant portion of the portfolio (perhaps as high as 20 percent according to a Farm Credit System employee) is represented by loans that probably would not have been made by banks or the Farm Credit System.

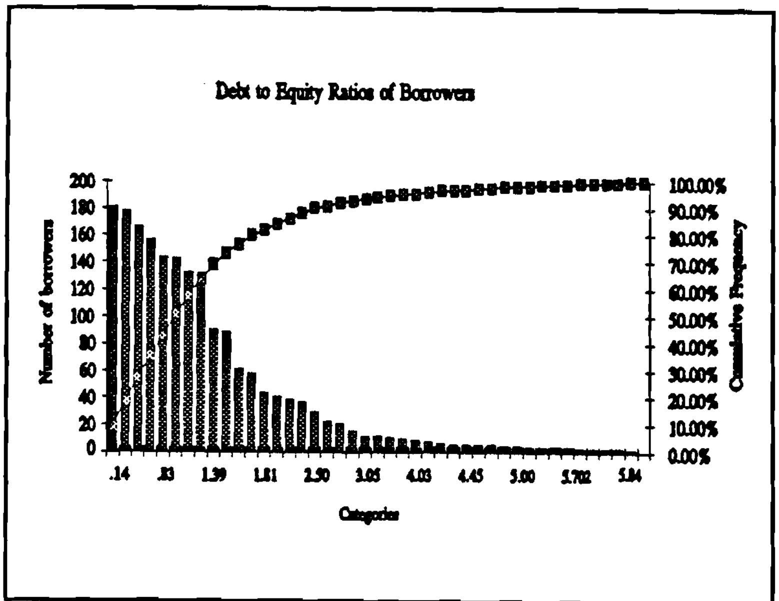

Figure 6

Corresponding to those crude measures of risk at application are measures of performance in the portfolio. Figure 7 shows the loan loss experience of FS compared to banks of various size over various recent calendar quarters. It is important to note that the bank numbers are averages over a large number of institutions that fall into the various size categories and the FS numbers are from one institution. Also, the sample periods available were not identical, yet the overlapping sample periods give some indication of the correspondence. The rates are left in quarterly measures (not annualized) to highlight the seasonal nature of the vender operation. To get annual equivalents, one would simply combine any four adjacent quarters. Given the types of loans in the portfolio, the loss levels may actually be quite low. Further, the accounting convention used at FS is highly conservative and quickly moves defaults to a loss category, even though prospects for recovery may be quite good. In fact, judging by the past seven years, the pattern suggests that the losses could be largely recovered in future periods.

A couple of profitability measures are of interest as well. As shown in Figure 8, the quarterly ROA performance is highly variable and has obvious seasonality. The ROA compares quite well with the bank counterparts, but the operation is leveraged less than a typical bank thereby mitigating some of the benefit to ROE, as can be seen in Figure 9.

Again, it is difficult to get a "clean" read of these issues because the sharing of resources with local delivery points and the allocations of shared costs with the parent company make individual measure of performance difficult to determine. For example, in one major equipment manufacturer's operations, the marketing department pays for many interest rate incentives programs, and even some of the default costs to the lending operation. This practice is probably appropriate for two reasons. First, the interest rate incentives are probably true marketing tools, and the higher quality loans (in essence, partially guaranteed by the marketing department) help maintain the company's low funding costs. Further, it is expected that loans that seem like bad risks to a traditional lender would perform a bit better than expected in the traditional lender's portfolio reflecting the improved bonding that the other relationships provide. This performance may also reflect differing abilities to screen applicants, and perhaps reflect better effective collateral positions as well.

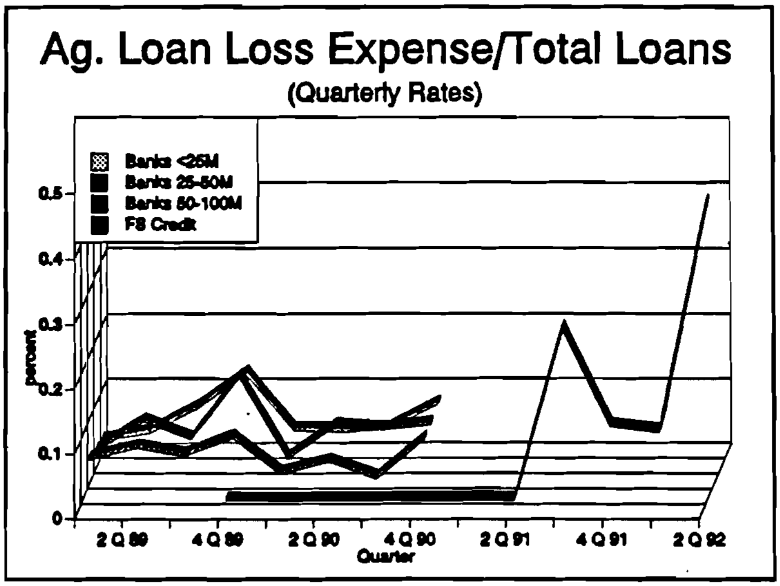

Figure 7

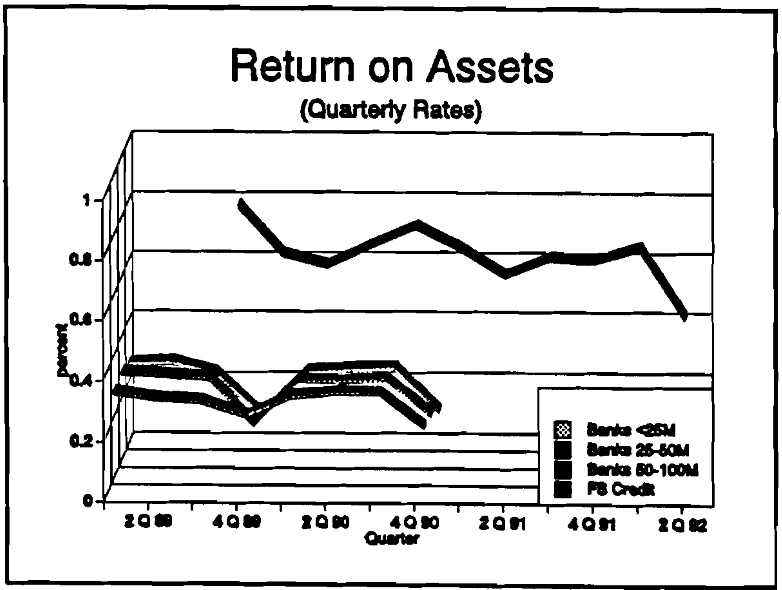

Figure 8

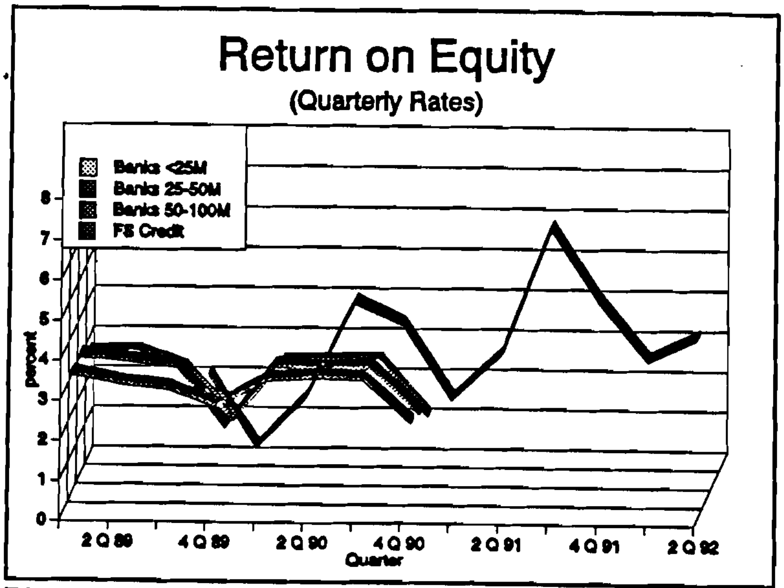

Figure 9

Summary and Concluding Remarks

A simple model of vendor financing was constructed that demonstrated some behavioral differences between a bank and a vendor finance unit. It was shown that the "optimal" risk level up to which to lend was positively related to the total margin and negatively related to "c", a measure of collateral loss rate. In cases where there is some market power, credit can be used to segment the demand and effectively offer different price schedules to segments with differing demands. Further, the banks have no incentive to compete for this business since the rate of return on a lending program that would compete with the vendor would actually be negative. However, total profits for the vendor firm go up because of the positive manufacturing margins earned on incremental sales. In cases where the risks of the individual borrowers were not exactly identifiable, it was argued that the vendor still has advantages if they held superior knowledge, had reduced bonding costs, or improved collateral or security disposition rates. Further, summary evidence from one vendor finance operation is largely consistent with the theory, except that the performance is perhaps a bit better than expected.

Several industrial organization questions remain. For example, why should the vendor become its own parallel lender rather than simply subsidize the banks for making poorer quality loans?[11] Further, given the virtual equivalence between negative lending margins and a reduction in production margin captured, there must be some level of market power for the subsidizing activity to remain. As mentioned, local suppliers may have sufficiently isolated markets that other firms cannot compete in the primary product lines by supplying to the rich farmers alone at lower prices. Hence, the existence of some market power may result in segmented pricing schedules; the existence of which raises other welfare question. These issues, and ancillary investigations such as the impact on total debt supplied deserve fuller attention in the future as well.

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[11] In fact, each of the "Big Three" automakers' captive finance units have at one time in history made that offer to banks (Andrews; Brennan).

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EXPLAINING FARMLAND PRICE DYNAMICS

Madhab R. Khoju and *Bruce L. Ahrendsen*[1]

Abstract

The relationship between farmland price and cash rent is examined in this paper. Cointegration and error correction models are applied to Arkansas farmland prices and cash rents for the period 1922 through 1992. Results show that Arkansas farmland prices and cash rents are cointegrated of order one. Thus a long-run relationship between farmland price and cash rent and the present value model for asset valuation are supported. The error correction model is used to better explain the short-run adjustments in farmland prices. Cash rents are found to cause farmland prices. Although the cointegration results are consistent with some studies, the results are inconsistent with other studies. The particular reasons for the different results among studies should be identified in the future.

The average per acre farmland price in the United States increased at an average annual rate of 13.5 percent from 1971 to 1981. However, by 1987, farmland prices fell by more than a third from their 1981 peak. In inflation adjusted terms, the price of farmland declined by 55.9 percent from 1981 to 1987. Since farmland constitutes the largest share of assets for the majority of farmers, farmers' net worth and, therefore, their financial security are sensitive to farmland price dynamics. Moreover, since farmland is often mortgaged as collateral to secure loans, the safety of these loans and, therefore, the financial condition of the lending agencies are also dependent on farmland price dynamics. Accordingly, the appreciation of farmland prices in the 1970's contributed to the financial prosperity of both farmers and lenders while the depreciation of the 1980's had the opposite effect. As a result, a better understanding of farmland price dynamics has been a topic of widespread research interest. This paper investigates the appropriateness of the cointegration and error correction models in explaining Arkansas farmland price dynamics.

A brief discussion on the time series properties of farmland prices from previous studies is given in the next section. Then cointegration and error correction models for farmland prices and cash rents are presented. The model presentations are followed by a description of the data. Next, the results from the estimated cointegration and error correction models are presented and analyzed. Finally, concluding comments are offered.

Time Series Properties of Farmland Prices

Different explanations for the rise and fall of farmland prices include changes in risk (Barry), changes in nonfarmland returns to land (Robison, Lins, and Venkataraman), changes in net rents (Alston; Burt), capital gains (Melicher; Klinefelter; Castle and Hoch), inflation rates and changes in real returns on alternative uses of capital (Just and Miranowski); credit market constraints and imperfections (Shalit and Schmitz), interaction of inflation and tax laws (Feldstein) and overreaction to changes in net rents (Featherstone and Baker). The basic framework for the majority of these studies is based on the present value model of asset prices.

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Following the present value model, farmland price equals the discounted value of the future stream of net rents from the land (Burt; Featherstone and Baker; Alston). Moreover, for a constant discount rate, there is a long-run relationship between the equilibrium farmland price and net rent (Burt; Tegene and Kuchler). A change in land price, therefore, should arise from a change in expected net rents to land. Net rent expectations, however, are influenced by many factors like input and output prices, mortgage rates, discount rates, supply of land, technological change, etc. Since these factors are difficult to forecast, rent formation expectations of the buyers and sellers of land result in short run dynamic adjustments to land valuation. As information about future rents becomes available, rent expectations are updated which in turn affect the farmland value. Burt used a second-order rational distributed lag on net crop-share rents received by landlords to capture the dynamic movement of prices.

Engle and Granger used the cointegration techniques to study the long-run relationship between consumption expenditures and income, wages and prices, and short and long term interest rates. They also used the error correction representation to represent the short-run dynamics. Accordingly, the cointegration technique also seems appropriate to study long-run relationships between farmland prices and rents while the error correction representation is appropriate to study the short-run dynamics of farmland prices. Cointegration, however, requires that each of the two series must be integrated of the same order and their linear combination yield a stationary series. Furthermore, Campbell and Shiller have shown that if rents are integrated[2] of order one and farmland prices evolve according to the present value model then it is necessary that farmland prices must also be integrated of order one.

Tegene and Kuchler applied the cointegration technique and error correction representation to explain the movement of farmland prices in the U.S. Corn Belt (Illinois, Indiana, Iowa, Missouri and Ohio). They found that both farmland prices and rents were integrated of order one and were also cointegrated implying a long-run relationship between farmland values and rents. They also claim that the error correction model provides more efficient parameter estimates of the dynamics involved than the usual distributed lag models.

Tegene and Kuchler's results are based on the aggregate farmland prices and net rents (weighted by the state acreage) for the U.S. corn belt. Sherrick, Tirupattur, and Monke, however, argue that if the farmland prices themselves are not cointegrated across the states, their aggregation may cause "canceling out" effects and the loss of important state specific information. Accordingly, Sherrick et al., evaluated the time series properties of farmland prices from 1950 to 1990 for each of the eight states - Illinois, Indiana, Iowa, Missouri, Ohio, Minnesota, Nebraska and Wisconsin. They conclude that the farmland prices are stationary in levels for Illinois, Indiana and Iowa while their first differences are stationary for other states. Thus the existence of different time series properties across the states has made the use of aggregated data (Tegene and Kuchler) questionable. Falk, on the other hand, found that annual farmland price and cash rent time series data for Iowa from 1921 to 1986 were each first difference stationary. Similar investigation for three other sets of data - U.S. data from 1910 to 1990, U.S. data from 1950 to 1990, and Illinois data from 1950 to 1990 - however, produced different results (Clark, Fulton, and Scott). For Illinois and U.S. data (1950 - 1990), land values are integrated of order two while land rents are integrated of order one. In contrast, for U.S. data (1910 - 1990), land values are integrated of order one and the land rents are integrated of order zero. These findings are similar to those reported by Baffes and Chambers. As a result, Clark et al., conclude that the present value formulation of farmland values is not appropriate.

The time series properties of farmland prices and rents seem to be sensitive to the particular time series studied, geographic location and level of aggregation. For example, Illinois and Iowa are

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[2] A farmland price time series with no deterministic component that has a stationary, invertible, ARIMA representation after differencing d times is said to be integrated of order d.

adjoining states that are part of the U.S. corn belt and, therefore, have similar land use patterns. However, the time series properties of farmland prices and rents are different. Furthermore, the application of cointegration techniques requires that both farmland price and rent be integrated of the same order. This paper investigates the appropriateness of the cointegration and error correction models in explaining Arkansas farmland price dynamics.

Theoretical Framework

The tests of cointegration have been used to establish the existence of long-run relationships between economic variables (Davidson, Hendry, Srba, and Yeo). The theory of cointegration states that if farmland prices, P_t, and rents, R_t, are integrated of the same order, d, then they are said to be cointegrated if their linear combination produces a stationary series (Engle and Granger). The linear combination of farmland prices and rents is represented by

$$u_t = P_t - \alpha - \beta R_t \tag{1}$$

Accordingly, if u_t is a stationary series then P_t and R_t are cointegrated and the relation $P_t = \alpha + \beta R_t$ is considered the long-run relationship between the two variables (Engle and Granger). u_t is the deviation from the long-run equilibrium and is interpreted as the rational forecast of the present value of all future changes in net rents (Falk).

The test of cointegration involves a stationarity test of each of the series separately. Dickey-Fuller unit root tests are appropriate for the stationarity tests and the standard procedure has been to first test for the unit root in the series levels. If the hypothesis of the presence of a unit root is not rejected, the first difference series is tested for the presence of a second root and so on. Since the Dickey-Fuller tests are based on at most one unit root, at least the first few tests in this sequence would not be theoretically justified if the series had more than one unit root (Sen). As a result, Dickey and Pantula have suggested a different order for performing tests. One should start with the largest order of integration (suppose k) and work down, i.e., decrease k by one each time the null hypothesis is rejected. Once the null hypothesis is not rejected, the testing procedure stops (Dickey and Pantula).

If P_t and R_t are integrated of order one then the cointegration between these two variables is tested by estimating the following OLS regression (cointegrating regression)

$$P_t = \alpha + \beta R_t + u_t \tag{2}$$

If P_t and R_t are not cointegrated, any linear combination of them will be nonstationary, and hence the residuals will be nonstationary. Accordingly, the null hypothesis of no-cointegration is that u_t is nonstationary.

The test of the hypothesis that u_t is nonstationary can be done in two ways. First, the test can be performed using the Durbin-Watson statistic (DW) from the cointegrating regression. If u_t is a random walk, the expected value of $(u_t - u_{t-1})$ is zero, so the DW should be close to zero. Thus one can simply test the hypothesis that DW is equal to zero. If the calculated DW is greater than the critical value (Engle and Granger, Table II) the hypothesis of no cointegration is rejected in favor of cointegration.

The second test, the Augmented Dickey-Fuller (ADF) test, however, is recommended by Engle and Granger based on the stability of critical values and power considerations. The ADF test involves running the following regression:

$$\Delta u_t = \delta\, u_{t-1} + \sum_{i=1}^{n} \theta_i \Delta u_{t-i} + v_t \tag{3}$$

where u_t is the residual series from the OLS regression of P_t on R_t. The order of n for the lagged terms is chosen such that the residual series, v_t, is white noise. The null hypothesis of no cointegration between P_t and R_t is rejected if δ is negative and significantly different from zero. For the ADF test, the ratio of the estimated δ to its estimated standard error from the OLS regression is compared to the critical values of τ in Fuller. Choice of the critical value, however, depends on whether the estimated model has an intercept and/or a linear trend.

If P_t and R_t are both integrated of order one without trends in the mean and are cointegrated then there exists an error correction model that is free from 'spurious regression' (Granger and Newbold). These error correction models (Engle and Granger) are presented in (4) and (5):

$$\Delta P_t = -\rho_1 u_{Pt-1} + \sum_{i=1}^{n} \eta_i \Delta P_{t-i} + \sum_{i=1}^{n} \gamma_i \Delta R_{t-i} + e_{Pt} \quad (4)$$

$$\Delta R_t = -\rho_2 u_{Rt-1} + \sum_{i=1}^{n} \theta_i \Delta P_{t-i} + \sum_{i=1}^{n} \mu_i \Delta R_{t-i} + e_{Rt} \quad (5)$$

where $u_{Pt} = P_t - \alpha_P - \beta_P R_t$, $u_{Rt} = R_t - \alpha_R - \beta_R P_t$ and $|\rho_1| + |\rho_2| \neq 0$. e_{Pt} and e_{Rt} are white noise.

Engle and Granger suggest a two step estimation procedure for estimating the error correction model. In the first step the parameters of the cointegrating regression are estimated, and in the second step the residuals from the cointegrating regression are entered in the error correction model. Both steps require only single equation least squares and they are consistent for all parameters. Moreover, because in a bivariate cointegration, there must be causality in at least one direction, a significant coefficient for the error correcting term implies the direction of Granger causality. Therefore, incorporation of the error correcting term should contribute to improved forecast of at least one of the variables.

The literature indicates that different studies of the same relationship, which use different methods of testing, often report causality results that are not in conformity with one another (Hsiao; Jacobs, Leamer, and Ward). Such conclusions suggest that different methods of causality testing should be applied to the same data set. Accordingly, besides the causality implied by the error correcting term, the methods utilized by Granger (1969) and Sims are also used to examine the causality between farmland prices and rents.

Granger's notion of causality states that R_t causes P_t if the past lagged values of R_t can be used to predict P_t more accurately than merely by using the past lagged values of P_t. For Granger's causality, estimation of the following linear models is needed:

$$P_t = f(\text{Past lags of } R_t, \text{Past lags of } P_t) \quad (6)$$

$$R_t = f(\text{Past lags of } P_t, \text{Past lags of } R_t) \quad (7)$$

A unidirectional causality from R_t to P_t requires that all the coefficients of the past lags of R_t be jointly different from zero in (6) and that all the coefficients of past lags of P_t be jointly equal to zero in (7).

Sims's method, on the other hand, involves regressing farmland prices on past, current and future values of rent and vice versa:

$$P_t = f(\text{current value of } R_t, \text{past lags of } R_t, \text{future lags of } R_t) \quad (8)$$

$$R_t = f(\text{current value of } P_t, \text{past lags of } P_t, \text{future lags of } P_t) \quad (9)$$

Sims has shown that in a regression of P_t on past, current and future values of R_t, the null hypothesis of no causality from P_t to R_t is equivalent to all the coefficients of the future values of R_t being equal to zero. Thus Sims' method tests the null hypothesis that all the coefficients for future lags in (8) and (9) are zero.

Data

Farmland prices and cash rents from 1921 through 1992 for Arkansas are deflated to real terms and used in this study. Because the tenant agrees to pay a prespecified amount and bears all the risk from farming, cash rent is preferred to share lease as a measure of the net benefit of owning land. Moreover, cash rents have been found to predict land price changes more accurately than other measures of returns from land (Burt; Tweeten). The data from 1921 through 1959 are based on unpublished USDA data and the data from 1960 through 1988 from Jones and Hexem. The data from 1989 through 1992 are published in USDA, *Agricultural Resources: Agricultural Land Values Situation and Outlook Summary.*

The surveys on which farmland prices and cash rents are based are obtained at the beginning of the year. As a result, these nominal figures are expected to lag the general price level. The nominal farmland price and cash rent in year t, therefore, were deflated by dividing by the personal consumption expenditure component (PCE) of the GNP deflator in year t-1 to arrive at data in real terms.

Tests and Results

A necessary condition for the cointegration between farmland prices and rents is that each of the series must be integrated of the same order. Accordingly, Dickey-Fuller tests were performed following the sequential procedure recommended by Dickey and Pantula. Dickey and Pantula also suggest to include the intercept term when the alternative hypothesis is that the series is stationary in levels. The test procedure was carried out by considering the possibility of the presence of three unit roots as in Clark et al. The lagged dependent variables in each test are added to make the residuals from the regressions serially independent (Dickey, Bell and Miller):

(1) First the H_0 of three unit roots (integrated of order three) in time series X_t against the H_a of two unit roots (integrated of order two) is tested by estimating the model: $\Delta^3X_t = \alpha_0 + b_2\,\Delta^2X_{t-1} + \Sigma\,\pi_i\,\Delta^3X_{t-i} + z_t$. The τ-value associated with the estimated b_2 is compared against the critical value of τ in Fuller. If the H_0 is rejected the H_0 of two unit roots is tested otherwise the H_0 of three unit roots is not rejected and the testing procedure stops.

(2) The H_0 of two unit roots against the H_a of one unit root is tested by estimating the model: $\Delta^3X_t = \alpha_0 + b_1\,\Delta X_{t-1} + b_2\,\Delta^2X_{t-1} + \Sigma\,\pi_i\,\Delta^3X_{t-i} + z_t$. The τ-value associated with the estimated b_1 is compared to critical value of τ in Fuller. If the H_0 is rejected the H_0 of one unit root is tested otherwise the H_0 of two unit roots is not rejected and the testing procedure stops.

(3) The H_0 of one unit root against the H_a of zero unit root is tested by estimating the model: $\Delta^3X_t = \alpha_0 + b_0\,X_{t-1} + b_1\,\Delta X_{t-1} + b_2\,\Delta^2X_{t-1} + \Sigma\pi_i\,\Delta^3X_{t-i} + z_t$. The τ-value associated with the estimated b_0 is compared to the critical value of τ_μ in Fuller. If the H_0 of one unit root is not rejected the testing procedure stops.

The results of Dickey-Fuller tests are presented in Table 1. The results of test numbers 1 and 2 in Table 1 reject the null hypotheses of three and two unit roots in each of the series. The result of test number 3, however, does not reject the null hypothesis of one unit root, i.e., the series are each stationary in their first differences. The significance levels of the Box-Q statistics indicate that the residuals in all cases are white noise. These results are consistent with those of Falk for Iowa data but at odds with those of Clark et al. for Illinois data.

Table 1. Dickey-Fuller Test Results for Arkansas Farmland Price and Cash Rent Series[a]

Test Number	Test	Farmland Prices	Cash Rents
1	H_0: 3 unit roots vs. 2 unit roots	-11.669* (0.997)	-12.611* (0.433)
2	H_0: 2 unit roots vs. 1 unit root	-4.114* (1.00)	-6.842* (0.701)
3	H_0: 1 unit root vs. zero unit root	-1.416 (1.00)	-1.430 (0.734)

[a] τ-values are presented for the corresponding coefficients. The numbers in parentheses are the significance levels of Box-Q statistics from Dickey-Fuller regressions.

* Indicates significance at the one percent level.

Given that farmland prices and cash rents are both integrated of order one, the test for cointegration proceeded as follows. First, the cointegrating regressions were estimated by OLS. The estimated results are:

$$P_t = \underset{(-9.383)}{-688.09} + \underset{(16.361)}{30.412}\, R_t \qquad R^2 = 0.795 \qquad DW = 0.4979 \tag{10}$$

$$R_t = \underset{(28.581)}{25.873} + \underset{(16.361)}{0.026}\, P_t \qquad R^2 = 0.795 \qquad DW = 0.6386 \tag{11}$$

where the figures in parentheses are t-ratios. The cointegrating regression Durbin-Watson tests (CRDW) of 0.4979 in (10) and 0.6386 in (11) reject the null hypothesis of no cointegration between the variables.

The Augmented Dickey-Fuller (ADF) tests were also performed on the residuals of the estimated cointegrating equations for cointegration. Since the lagged terms of the dependent variables were found to be insignificant, instead of ADF, Dickey-Fuller tests were performed. The estimated Dickey-Fuller regression results for the residuals u_{Pt} of (10) and u_{Rt} of (11) are presented in (12) and (13), respectively:

$$\Delta u_{Pt} = \underset{(-3.046)}{-0.245}\, u_{Pt-1} \tag{12}$$

$$\Delta u_{Rt} = \underset{(-3.520)}{-0.315}\, u_{Rt-1} \tag{13}$$

where the figures in parentheses are τ-ratios. Since the computed τ-ratios are less than the tabulated critical value of -1.95 (Fuller) in both equations, the Dickey-Fuller tests reject the null hypotheses that the residuals are nonstationary (noncointegration) implying that the series are cointegrated.

Since farmland prices and cash rents are cointegrated there is a long-run relationship between them. To represent the short-run adjustments in farmland prices, an error correction model is estimated for P_t and R_t separately. The results are:

$$\Delta P_t = \underset{(0.363)}{2.238} - \underset{(-2.624)}{0.131}\, u_{Pt-1} + \underset{(2.164)}{0.260}\, \Delta P_{t-1} \quad (14)$$

$$\Delta R_t = \underset{(0.109)}{0.048} - \underset{(-1.43)}{0.160}\, u_{Rt-1} \quad (15)$$

where the figures in parentheses represent t-ratios. The lag structure was chosen based on the significance of lagged terms. The error correcting term u_{Pt-1} is significantly different from zero at the one percent level in (14) while u_{Rt-1} is not significant in (15). Since farmland prices and rents are cointegrated, these results indicate that rent is weakly exogenous and, therefore, Granger causality runs from rents to farmland prices.

The causality from rents to farmland prices is also investigated by utilizing the methods outlined in Granger and Sims. For the Granger method, the following regression models were estimated:

$$P_t = f(2 \text{ past lags of } R_t, 2 \text{ past lags of } P_t) \quad (16)$$

$$R_t = f(2 \text{ past lags of } P_t, 2 \text{ past lags of } R_t) \quad (17)$$

$$P_t = f(2 \text{ past lags of } P_t) \quad (18)$$

$$R_t = f(2 \text{ past lags of } R_t) \quad (19)$$

Equations (18) and (19) represent the restricted versions of (16) and (17) respectively. The choice of lag structure was based on the Akaike Information Criterion (AIC). The Granger method results are presented in Table 2. The results indicate Granger causality runs from rents to farmland prices.

Table 2. Granger Causality Test Results

Null Hypothesis	F-Ratios	Results
No Causality from Rents to Farmland Prices	3.905* (2,65)[a]	Reject H_0
No Causality from Farmland Prices to Net Rents	2.256 (2,65)[a]	Fail to reject H_0
Causal Inference	Cash Rents to Farmland Prices	

[a] Figures in the parentheses are the degrees of freedom.

* Significant at the five percent level.

To utilize the Sims' method, the two-sided regression models in (20) and (21) were estimated together with their restricted versions, (22) and (23), respectively. The choice of lagged and lead terms was based on AIC.

$$P_t = f(R_t, 3 \text{ past lags of } R_t, 3 \text{ future lags of } R_t) \quad (20)$$

$$R_t = f(P_t, 3 \text{ past lags of } P_t, 3 \text{ future lags of } P_t) \quad (21)$$

$$P_t = f(R_t, 3 \text{ past lags of } R_t) \quad (22)$$

$$R_t = f(P_t, 3 \text{ past lags of } P_t) \quad (23)$$

The results of the Sims' test are presented in Table 3. In the test for causality from farmland prices to rents (20), the null hypothesis is that farmland prices do not cause rents. Rejection of the null hypothesis implies that farmland prices cause rents. Similarly, in the test for causality from rents to farmland prices (21), the null hypothesis is that rents do not cause farmland prices. Rejection of the null hypothesis implies that rents cause farmland prices. The results in Table 3 indicate that the causality between farmland prices and rents is unidirectional from rents to farmland prices.

Table 3. Sims Causality Test Results

Null Hypothesis	F-Ratios	Results
No Causality from Farmland Prices to Net Rents	0.80 (3,58)[a]	Fail to reject H_0
No Causality from Net Rents to Farmland Prices	3.00* (3,58)[a]	Reject H_0
Causal Inference	Cash Rents to Farmland Prices	

[a] Figures in the parentheses are the degrees of freedom.

* Significant at the five percent level.

The results of each of the three tests imply Granger causality from rents to farmland prices. Accordingly, the data were also used to investigate the movements in farmland prices that were attributed to rents. Following Alston, the percentage change in the growth of real land prices is compared to the percentage change in the growth in real rents with the difference between the two attributed to other factors. The results for the period 1922 through 1992 are:

Mean Percentage Change in Real Farmland Prices = 1.6409 (94.90)

Mean Percentage Change in Real Rents = 0.6467 (115.06)

Difference Between the Two Mean Percentages = 0.9942.

The figures in parentheses are the sample variances. The significance of the difference between the two sample means is tested using the t-test. The computed t-ratio for the difference is 0.574. Since the computed t-ratio is less than the tabulated critical value for any reasonable significance level, the null hypothesis of zero difference between the sample means is not rejected. In other words, the mean growth rate of real farmland price is not significantly different from the mean growth rate of real rent implying that the movements in farmland prices are fully explained by the movements in rents.

Concluding Comments

Results from previous studies display differences in the time series properties of farmland prices and cash rents. These differences may be the result of differences in the particular time series studied, geographic location, aggregation level or methodology. The results from the study presented here show that Arkansas farmland prices and cash rents for the period 1922 through 1992 are cointegrated of order one. Thus a long-run relationship between farmland price and cash rent is supported since these time series are cointegrated. In addition, since both farmland prices and cash rents are cointegrated of order one, the present value model for asset valuation is supported. Although these results are consistent with some studies (Tegene and Kuchler), the results are inconsistent with other studies (Clark et al.; Baffes and Chambers). The particular reasons for the different results among studies should be identified in the future.

The error correction model is used in this study to better explain the short-run adjustments in farmland prices. The results from the error correction model and Granger and Sims causality tests support Granger causality running from cash rents to farmland prices. Also, the mean growth rate of real farmland price is found to be insignificantly different from the mean growth rate of real cash rent which implies that movements in farmland prices are fully explained by movements in cash rents.

While the results from this study support the present value model for asset valuation, additional research is needed. The underlying factors causing changes in cash rents should be identified. These underlying factors such as input and output prices, mortgage rates, discount rates, taxes, inflation and technological change could be used to explain the short-run dynamics between farmland price and cash rent.

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Preliminary Results on

INTEREST RATE DIFFERENCES ON NONREAL ESTATE FARM LOANS FROM COMMERCIAL BANKS

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In a highly efficient financial market, interest rates charged to borrowers on comparable loans (i.e., similar loan purposes, sizes and lending risks) should be the same in all geographic regions. Differences in rates among dissimilar loans should reflect differences in credit risk, loan maturity, servicing costs, loan size, and other known characteristics of the borrower/lender relationship. If differences in rates on comparable loans occur, they should reflect imperfections in the financial market, barriers to the efficient flows of funds among geographically dispersed lending markets, and less than perfectly competitive lending conditions.

For commercial bank lending to agriculture, a study by the Federal Reserve Bank of Kansas City (Swackhamer and Doll) in the late 1960s found significant differences among geographic areas in interest rates charged on farm loans for similar purposes among firms of similar size and for loans of similar risk and secured by similar assets. These differences likely have declined over time in response to financial deregulation and easing of geographic restrictions on banking, growing competition in financial markets, a closer relationship between rural financial markets and the national/international markets, and improvements in electronic technology and communication. Nonetheless, empirical evidence, (e.g., Walraven and Rosine) still indicates that differences in interest rates on farm loans across banks are relatively large. For example, Federal Reserve Data indicate that interest rates on nonreal estate farm loans made by banks during the first week of November 1990 ranged from 10.0 to 12.9 percent of the loan volume. Causes of such differences are not well understood, and substantial variations among regions in commercial banks' market shares of farm debt (Wilson and Barkley) suggest that differences in lending competition and pricing arrangements may still be the case.

In addition, the use of risk adjusted interest rates on farm loans has grown considerably in the past decade (Miller, Ellinger, Barry, and Lajili). This growth suggests improved efficiency in loan pricing at the individual borrower level, but also greater difficulty in measuring and explaining geographic differences in interest rates.

The purposes of this study is to measure and explain differences in average annual interest rates on nonreal estate farm loans from commercial banks. Annual data on average farm loan rates from individual banks are taken from quarterly bank call reports and related to selected bank and market characteristics. The following sections of the paper consider the concepts of loan pricing, review related literature, introduce the data and analytical procedures, report the descriptive characteristics and average annual interest rates on nonreal estate farm loans charged by agriculture banks, and analyze differences among the banks' calculated rates.

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Concepts of Loan Pricing

In principle, interest rates on farm loans result from the interaction between the demand for and supply of farm credit. On the supply side, for a lending institution to remain financially viable, the loan rates must cover the major sources of lending costs (Schramm and Barry; Barry and Calvert; Ellinger and Barry). Included are the costs of funding and administering the loan, as well as compensating for credit, liquidity, interest rate, prepayment and solvency risks. Pricing may also reflect different degrees of competition for the borrower's loan business.

Most of these factors can be measured to some degree, although the process is a difficult one especially when measurement occurs at the individual borrower level. Costs of funds must consider the major sources of a bank's loan funds: purchased funds, deposit balances, and the risk-adjusted required return on the bank's equity capital assigned to the borrower's loan. Equity capital costs reflect assessment of the borrower's credit risk (Ellinger, Barry, and Mazzocco) and the liquidity risk associated with unanticipated variations in the borrower's loan and deposit balances. Adjustments for interest rate risk may also be made when pricing fixed rate versus variable rate loans.

Administrative (or operating) costs include the nonfunding costs (e.g., salaries, data services, occupancy, legal, etc.) of delivering agricultural credit to individual borrowers. These costs are considered to depend on bank size, loan size, bank holding company affiliation, degree of involvement in farm lending, and metropolitan versus nonmetropolitan location (Ellinger and Barry).

Other factors also influencing interest rates on farm loans include special circumstances of the borrower, the range of credit and noncredit services provided, and lending competition. Special circumstances of the borrower may affect interest rate patterns over time. For example, interest rate concessions in the near term might occur in order for young farm borrowers to establish their businesses and grow to become profitable bank borrowers in the future. Similarly, interest rate concessions to financially stressed borrowers may aid in their financial recovery and return to a profitable borrower status in the future. Evaluation of loan pricing is further complicated if interest rates reflect a bundling of credit and noncredit services provided to a borrower, rather than using fees and service charges to compensate for the noncredit services.

Finally, interest rate pricing also may reflect different degrees of competition for a borrower's loan business. That is, a lender may earn a premium or accept a discount on a loan based on its competitiveness in the farm credit market. For example, borrowers who are especially attractive customers to other lenders may be priced at lower profit levels to reflect the greater competition. Less attractive borrowers or lower degrees of competition in the credit market may lead to higher interest rates.

Evaluation of competitive conditions in farm credit markets involves numerous factors. One element is precise identification of the lending market for different types of loans, deposits and other types of financial services. However, this is a challenging process; ideally, identification of a market should evaluate responses of customers' demands to changes in interest rates, but this is difficult to assess. Therefore, evaluation of geographic boundaries is a more feasible approach. Another factor is measurement of the competition, which involves determining the number of competing firms, and the firms' concentration ratios and market shares. More fundamental measures are also involved, including market size, institution size, degrees of specialization, and quality of market information, as well as measures of pricing and loan profitability.

Literature Review

Differences in interest rates charged on loans have been researched for agricultural loans (Swackhamer and Doll), for mortgage loans (Schaaf; Ostras; Zabrenski, Shilling, and Sirmans;

Jameson, Barth, and Marlow; and Jud and Epley), real estate (Longbrake and Peterson) and for commercial loans (Hester). Schaaf analyzed lender and market characteristics and found that regional differences did occur. The empirical results indicated that rates were influenced by distance from capital markets and by local market demand for savings. Ostras re-estimated Schaaf's model, but also included a state usury law variable. He concluded that the usury ceiling and local market conditions influenced mortgage interest rates, but the distance from capital markets did not influence the rates.

Zabrenski, et al. compared regional mortgage rates to regional factors such as loan risk, market structure, market demand, lender's cost of funds, and usury ceilings. The results indicated that regional variation in mortgage interest rates existed, due to loan risk and usury ceilings. Jameson, et al. used a simultaneous-equations system to measure how borrower and lender characteristics affect the regional variation of mortgage yields. They concluded that the rates did vary across regions and that the differences were due to the expected loss from default or because of differences in demand characteristics. Jud and Epley modeled mortgage loan rates as a function of the level of mortgage points, national economic conditions, risk characteristics of the loan, and institutional and regional factors. They found no regional differences, but that the disparities were caused by other factors.

Longbrake and Peterson researched inter- and intra-regional variations in real estate loans. They utilized bank characteristics (such as cost and product mix), market power, market demand, and usury ceiling. Inter-regional differences were found, with significant regional differences in market organization and cost structure, product mix, and local demand factors.

Hester analyzed borrower, lender and market characteristics and how they affect business loans. He concluded that the statistically significant differences in average terms of lending were primarily attributable to differences in the sizes of borrowers and to differences in bank concentration in urban markets.

Procedural Issues

The procedural approach to this study first involves the calculation and evaluation of bank financial characteristics and the average annual interest rates on farm loans charged by agricultural banks, using call report data to calculate the values. The bank characteristics (i.e., average agricultural loan balance, ROE, ROA, farm loan ratio, net interest margin) convey descriptive information about the agricultural banks and can provide insight regarding potential income or cost differences across banks. Measures of rate dispersion (i.e., frequency distributions, means, standard deviations) and average rates at various levels of disaggregation (i.e., bank size) can indicate the relative importance of rate differences across the levels of disaggregation.

Using average interest rate data for the farm loan portfolio will not account for the rate differences that occur among individual borrowers, but it will allow for the comparison of farm loan rates among agricultural banks. In addition, using average annual rates will permit analysis of average rate differences over time, assuming that such differences hold over time.

If significant rate differences are observed, the next step is to identify factors causing these rate differences. This part of the procedures involves identification of the relative importance of the key cost components of interest rates for which call report data are available. Included are:

- Funding costs--funding costs are available at the bank level but not at the individual loan level. Thus, the effect of individual deposit balances cannot be captured. However, it is unlikely that small banks explicitly account for deposit balances in loan pricing (Barry and Calvert); rather, they rely more heavily on the pooled cost of all of the banks' purchased funds. Thus, utilizing costs of funds at the bank level is appropriate.

- Administrative or operating costs--these data also are only available at the bank level from call reports, but not for specific types of loans or borrowers. Thus, any variation in operating costs is only attributable to bank characteristics (e.g., bank size) rather than characteristics of specific types of loans or borrowers. The allocation of operating costs from the bank to the farm loan level can be estimated using cost data from Ellinger and Barry. This procedure will not directly reflect the cost differences by size of individual loan, but it will reflect cost differences at the institutional level.

- Loan losses (provisions and charge-offs)--data on farm loan losses are available from call reports and will directly used in the analysis.

Descriptive Characteristics and Average Annual Interest Rates

Bank call data from U. S. commercial banks are used for this study. The analysis of nonreal estate farm loan interest rates focuses on rates charged by agricultural banks which are defined as having total agricultural loans exceeding or equaling $2.5 million or being more than 25 percent of total loan balance for each quarter. A total of 4,913 banks for 1989 and 4,933 banks for 1990 meet that criteria. Banks without agricultural loan balances in any single quarter are deleted from the study.

Tables 1A and 1B present all agricultural banks by asset size with their average total assets, average balances of agricultural loans, and loans secured by farm real estate and to finance agricultural production, average return on assets (ROA), and average return on equity (ROE). In 1989 (Table 1A), banks with average assets between $100 and $300 million have the highest average ROA (1.03 percent), and banks with between $50 and $100 million in average assets have the highest average ROE (14.79 percent). As reported by Walraven, Ott, and Rosine, agricultural banks and other small banks earned 11 and 10 percent, respectively, on their equity and one and 0.8 percent, respectively, on their assets. The average ROE for the agricultural banks defined for this study is slightly higher (11.13 percent) than the two groups of banks, but the average ROA for the group falls within the range (0.95 percent) of the two bank groups.

Table 1B presents the 1990 agricultural banks. Banks with average assets between $50 and $100M have the highest average ROA (1.04 percent) and banks with between $100 and $300M in average assets have the highest average ROE (12.29 percent) of the five bank size categories. This exceeds the average ROA and ROE values for small banks (.7 and 8.5 percent, respectively) and agricultural banks (1 and 10.8 percent, respectively) in 1990 as reported by Walraven, et al. However, as a group, these agricultural banks lie between small banks and agricultural banks for both average ROA and ROE.

The availability of interest revenue data attributable directly to nonreal estate farm loans varies by bank size and reporting requirements. Banks with more than $25 million in total assets and with nonreal estate farm loans exceeding five percent of total loans and banks with less than $300 million in total assets report interest and fee income from all agricultural loans in a single category. Banks with less than $25 million in total assets are not required to report interest and fee income on agricultural loans, but some banks in this size category do voluntarily report the information. Since the reporting banks may not be representative of that group and the number of observations is low, banks with less than $25M in total assets are dropped from the study. Banks with more than $300M in total assets report interest income on nonreal estate farm loans in a separate category and farm real estate interest income under the real estate category. Therefore, the reporting requirements for banks with less than $300M in total assets do not allow interest and fee income from nonreal estate farm loans to be distinguished from farm real estate loans.

Table 1A

(In Thousands)	<$25 M	$25-<$50M	$50-<$100M	$100-<$300M	>=$300M	Total
	All Agricultural Banks by Average Total Asset Size Year - 1989					
Number of Banks	1616	1321	1002	600	374	4913
Average Total Assets	$14,718.27	$36,490.72	$69,616.86	$156,945.43	$4,257,434.57	$372,115.38
Average Agricultural Loan Balance	$3,482.57	$6,702.28	$8,468.73	$10,619.50	$32,449.88	$8,441.92
Ave Ag Prod Loan Balance	$2,589.46	$4,559.93	$5,288.46	$6,381.29	$22,419.62	$5,642.37
Ave Ag RE Loan Balance	$893.11	$2,142.35	$3,180.27	$4,238.21	$10,030.26	$2,799.55
Return on Assets	0.87	1	1.02	1.03	0.76	0.95
Return on Equity	7.87	11.54	14.79	13.49	10.24	11.13

Table 1B

(In Thousands)	<$25 M	$25-<$50M	$50-<$100M	$100-<$300M	>=$300M	Total
	All Agricultural Banks by Average Total Asset Size Year - 1990					
Number of Banks	1538	1291	1048	661	395	4933
Average Total Assets	$15,073.13	$36,470.20	$69,599.93	$158,218.23	$4,575,184.35	$416,579.40
Average Agricultural Loan Balance	$3,623.41	$6,797.61	$8,867.83	$11,110.59	$33,272.69	$8,945.63
Ave Ag Prod Loan Balance	$2,685.42	$4,618.95	$5,516.67	$6,699.18	$22,975.23	$5,955.42
Ave Ag RE Loan Balance	$937.99	$2,178.66	$3,351.16	$4,411.41	$10,297.46	$2,990.21
Return on Assets	0.85	0.98	1.04	1.03	0.7	0.94
Return on Equity	8.46	9.95	11.43	12.29	8.28	9.98

Due to the aggregation of agricultural loan interest and fee income for banks with less than $300M in total assets, an unambiguous interest rate for nonreal estate farm loans and for farm real estate loans cannot be calculated. Therefore, banks within each total asset size category are further categorized by the percentage of agricultural production and other loans in their agricultural loan portfolio. This categorization is intended to isolate banks whose interest and fee income data would be dominated by loans to finance agricultural production. To evaluate interest rates charged on nonreal estate farm loans, banks with more than 75 percent of their agricultural loan portfolio in loans to finance agricultural production and other to farmers are examined. The threshold of 75 percent is chosen on the basis that a portfolio with less than 75 percent of agricultural production loans would begin to bias the derived interest rates for the agricultural production loans.

Gross interest rates charged for agricultural loans are tabulated by dividing the interest and fee income from agricultural loans by the average quarterly balance of agricultural loans, adjusted for nonaccrual agricultural loans. Not all banks report quarterly balances, and, therefore, those institutions not reporting quarterly balances are deleted from the study. Once the interest rates are calculated, a range of interest rates charged for nonreal estate farm loans is established. The range of seven to fifteen percent is selected for two reasons. First, the calculated cost of funds for the qualifying agricultural banks ranges from 6.94 to 8.01 percent, and it seems unlikely that a bank would charge an interest rate lower than its cost of funds. The second reason is based on the evaluation of the interest rate dispersion for similar loans as reported by Walraven, et al. Their reported interest rates are tabulated from a survey of commercial banks and range from nine to fifteen percent. Since the bank call data are from a broader sample of banks than the survey's sample, the wider range of interest rates is used for this study. Observations with a calculated interest rate of less than seven percent and exceeding fifteen percent are eliminated from the sample.

The number of banks used for this study is 1,089 in 1989 and 1,135 in 1990 after eliminating institutions whose average total assets are below $25M, banks whose agricultural loan portfolios are composed of less than 75 percent agricultural production loans, institutions who don't report quarterly loan balances or banks whose calculated agricultural loan interest rate falls outside the range of seven to 15 percent. Average total assets, average balances for all agricultural loans, agricultural production loans, and agricultural real estate loans, and average ROA and ROE for these banks are presented by bank size category in Tables 2A and 2B. The average total asset balance in 1989 is $1.17B and in 1990 is $1.41B. The banks meeting the criteria have over twice the average agricultural, ag production and farm real estate loan balances in both years and a higher ROE than do all the agricultural banks.

Tables 3A and 3B present descriptive information and financial ratios for the selected sample of banks. The net interest margin (NIM) ranges from 3.82 to 3.99 percent, with 3.94 percent and 3.9 percent being the average NIM for 1989 and 1990, respectively. In both years, the largest banks receive the highest gross interest income and pay the highest interest expense, resulting in the lowest NIM. Total loan balance as a percentage of average assets increases with bank size while loans secured by farm real estate and used to finance agricultural production decrease with bank size. The loan portfolio composition of the banks parallels the balance sheet items with the percentage of both types of agricultural loans decreasing as bank size increases.

In general, the loan to deposit and loan to asset ratios increase with bank size and the equity to asset ratio decreases as banks increase in size. The sample banks' loan to deposit ratios fall between the averages for commercial banks (81.8 percent in 1989 and 81.1 percent in 1990 (*Agricultural Income and Finance Situation and Outlook Report*, February 1990 and February 1991)) and for agricultural banks (54 percent in 1989 and 55 percent in 1990 (Walraven, et al.)). This sample of agricultural banks' average equity to asset ratio is higher than for all commercial banks (6.4 percent for both years (*Situation and Outlook Report*, Feb. 1990 and 1991)) but lower than agricultural banks (10.1 percent in 1989 and 9.9 percent in 1990 (Walraven, et al.)). All commercial banks average a higher loan to asset ratio of 62.2 percent in 1989 and 62.4 percent in

Table 2A

	Agricultural Banks Meeting Criteria by Average Total Asset Size				
			Year - 1989		
(In Thousands)	$25-<$50M	$50-<$100M	$100-<$300M	>=$300M	Total
Number of Banks	415	256	117	301	1089
Average Total Assets	$36,135.67	$68,805.49	$152,555.75	$4,054,265.82	$1,166,936.22
Average Agricultural Loan Balance	$7,542.10	$10,287.85	$15,065.18	$34,443.53	$16,431.40
Ave Ag Prod Loan Balance	$6,469.17	$8,830.86	$13,030.22	$24,361.38	$12,674.67
Ave Ag RE Loan Balance	$1,072.93	$1,456.99	$2,034.96	$10,082.15	$3,756.73
Return on Assets	1.01	1.04	1.02	0.84	0.97
Return on Equity	14.05	11.02	12.6	12.45	12.74

Table 2B

	Agricultural Banks Meeting Criteria by Average Total Asset Size				
			Year - 1990		
(In Thousands)	$25-<$50M	$50-<$100M	$100-<$300M	>=$300M	Total
Number of Banks	411	264	140	320	1135
Average Total Assets	$36,173.48	$68,310.26	$154,174.15	$4,816,591.41	$1,405,986.64
Average Agricultural Loan Balance	$7,584.83	$10,707.02	$15,096.69	$38,102.43	$17,841.71
Ave Ag Prod Loan Balance	$6,434.94	$9,137.58	$12,976.15	$27,139.14	$13,707.73
Ave Ag RE Loan Balance	$1,149.89	$1,569.44	$2,120.54	$10,963.29	$4,133.98
Return on Assets	0.93	0.99	1.03	0.75	0.91
Return on Equity	9.17	10.52	12.48	10.21	10.18

Table 3A

	Agricultural Banks Meeting Criteria By Average Asset Size Year - 1989 $25-<$50 M	$50-<$100 M	$100-<$300	>=$300 M	Total
Number of Banks	415	256	117	301	1089
Income/Expenses as % of Ave Assets					
Gross Interest Income	9.43	9.46	9.41	9.64	9.49
Gross Interest Expense	5.44	5.51	5.46	5.79	5.56
Net Interest Margin	3.99	3.96	3.94	3.85	3.94
Balance Sheet Items as % of Ave Assets					
Total Loans	46.99	46.79	51.9	62.48	51.75
Loans Secured by Farm RE	2.98	2.1	1.37	0.73	1.98
Ag Prod & Other	18.11	12.85	8.75	1.2	11.2
Loan Portfolio Composition (% of Total Loan Balance)					
Loans Secured by Farm RE	6.41	4.68	2.78	1.16	4.16
Ag Prod & Others	39.25	28.85	17.5	2.04	24.18
Farm Loan Ratio	45.66	33.53	20.28	3.2	28.35
Ratios					
Loan/Deposit	53.07	52.72	58.98	77.95	60.5
Equity/Asset	9.83	9.19	8.3	6.77	8.67
Loan/Asset	46.99	46.79	51.9	62.48	51.75
Effective Interest Rates					
Gross Rate Earned	11.74	11.71	11.55	11.5	11.65
Rates Paid					
Interest Bearing Deposits	6.91	6.95	6.97	7.29	7.03
All Interest Bearing Liabilities	6.94	6.99	7.06	7.61	7.15

Table 3B

	Agricultural Banks Meeting Criteria By Average Asset Size Year - 1990 $25-<$50 M	$50-<$100 M	$100-<$300	>=$300 M	Total
Number of Banks	411	264	140	320	1135
Income/Expenses as % of Ave Assets					
Gross Interest Income	9.34	9.39	9.31	9.4	9.37
Gross Interest Expense	5.4	5.48	5.37	5.58	5.47
Net Interest Margin	3.94	3.91	3.94	3.82	3.9
Balance Sheet Items as % of Ave Assets					
Total Loans	46.95	47	51.52	62.48	51.91
Loans Secured by Farm RE	3.21	2.34	1.44	0.68	2.07
Ag Prod & Other	18	13.64	8.78	1.22	11.12
Loan Portfolio Composition (% of Total Loan Balance)					
Loans Secured by Farm RE	6.94	5.16	2.95	1.1	4.39
Ag Prod & Others	39.32	30.22	17.6	2.06	24.2
Farm Loan Ratio	46.26	35.38	20.54	3.16	28.41
Ratios					
Loan/Deposit	53.06	52.95	58.96	77.75	60.72
Equity/Asset	9.81	9.25	8.52	6.79	8.67
Loan/Asset	46.95	47	51.52	62.48	51.91
Effective Interest Rates					
Gross Rate Earned	11.64	11.62	11.42	11.15	11.47
Rates Paid					
Interest Bearing Deposits	7.82	7.96	8.92	7.88	8
All Interest Bearing Liabilities	7.85	7.99	8.01	8	7.94

1990 (*Situation and Outlook Report*, Feb. 1990 and 1991), while the sampled agricultural banks' average loan to asset ratio is 51.75 and 51.91 percent, respectively.

As with NIM, the group of the smallest banks earned the highest gross rate and the largest banks earned the lowest rate for both years. The smallest banks in 1989 and 1990 paid the lowest rate for both interest bearing deposits and all interest bearing liabilities, and the largest banks paid the highest rate for both categories only in 1989.

The dispersion, mean, standard deviation (SD), and coefficient of variation (CV) of the calculated interest rates are presented for the agricultural banks meeting the criteria by bank asset size, by bank group, and by agricultural production loan portfolio percentage in Tables 4 - 6. Table 4A presents the interest rate information for each bank size category and for all the banks in 1989. Banks with average assets between $50 and 100M earn the highest rate on nonreal estate loans (11.92 percent), in addition to having the highest CV (12.1). The smallest banks earned the lowest rate of 11.76 percent with the lowest CV (9.9). The average interest rate earned for all banks in the sample is 11.81 percent, and interest rates for two-thirds of all the banks fall within the range of 10.54 to 13.08 percent. Table 4B shows that in 1990, banks with average assets between $50M and $100M earn the highest rate of 11.74 percent, and banks with more than $300M in assets earn the lowest rate (11.26 percent). The largest banks exhibit the widest variation in interests rates with a CV of 11.03. The average interest rate for all agricultural banks is 11.58 percent, and interest rates for two-thirds of all the banks fall within the range of 10.38 to 12.78 percent.

The overall interest rate eamed for nonreal estate loans decreases by 0.23 percent from 1989 to 1990. The standard deviation and coefficient of variation also decrease by 0.07 and 0.34, respectively. Banks with total assets between $50 and $100M earn the highest rate and the smallest banks have the lowest CV in both years.

Tables 5A and 5B present the banks grouped as small (<$300M in total average assets) and large (>=$300M in assets). In 1989, the small banks earned 11.82 percent on their agricultural production loans, while the larger banks eamed 11.77 percent. The smaller banks have a larger CV (10.97) than do the larger banks (10.07). The small banks in 1990 earn 11.71 percent on their agricultural production loans, while the larger banks earn 11.76 percent.

When comparing the data for the two bank groups between 1989 and 1990, it is noted that the interest rate declines from 1989 to 1990 for both bank size categories, but the variation decreases for the smaller banks and increases for the larger banks from 1989 to 1990. The coefficient of variation decreases in 1990 for the small banks and increases for the large banks from the previous year.

The interest rates categorized by the percentage of agricultural production loans in the ag loan portfolio are presented in Tables 6A and 6B, summarizing the information for each percentage group. For 1989 (Table 6A), banks with ag loan portfolios consisting of 75-80 percent nonreal estate loans exhibit the lowest rate earned (11.71 percent) and have the highest CV (11.73). The highest interest rate of 11.86 percent is earned by two portfolio groups - the 85-90 percent and the 95-100 percent groups. Banks with 95-100 percent of nonreal estate loans possess the lowest CV (10.33).

In Table 6B, portfolios with 90-95 percent of their ag loan portfolio in ag production loans eam the highest rate (11.83 percent). Portfolios with 95-100 percent of their ag loan portfolio in ag production loans earn the lowest rate of 11.39 percent. This low interest rate may be attributed to the fact that 78 percent of the loans in the category are located at the largest banks, which earn the lowest interest rate of all bank size categories. Banks with portfolios of 80-85 percent ag production loans have the highest CV (10.8).

Table 4A

Agricultural Banks Meeting Criteria By Average Asset Size
Year - 1989
Total Asset Size for Agricultural Banks

Interest Rate	$25-50 M	$50-100M	$100-300M	>$300M	Total
7-7.99%	0.24%	1.95%	1.71%	0.33%	0.83%
8-8.99%	2.17%	2.73%	5.98%	2.33%	2.75%
9-9.99%	5.30%	2.34%	5.13%	3.99%	4.22%
10-10.99%	15.18%	14.84%	5.13%	13.62%	13.59%
11-11.99%	33.49%	28.91%	31.62%	36.21%	32.97%
12-12.99%	31.08%	28.13%	35.90%	32.89%	31.40%
13-13.99%	10.36%	15.63%	11.11%	6.64%	10.65%
14-14.99%	2.17%	5.47%	3.42%	3.99%	3.58%
Total	100.00%	100.00%	100.00%	100.00%	100.00%
No. of Banks	415	256	117	301	1089
Mean	11.76	11.92	11.79	11.77	11.81
Stand. Dev.	1.17	1.44	1.4	1.18	1.27
Coef of Var.	9.9	12.1	11.87	10.07	10.73

Table 4B

Agricultural Banks Meeting Criteria By Average Asset Size
Year - 1990
Total Asset Size for Agricultural Banks

Interest Rate	$25-50 M	$50-100M	$100-300M	>$300M	Total
7-7.99%	1.46%	-	0.71%	1.56%	1.06%
8-8.99%	1.22%	3.79%	2.86%	3.44%	2.64%
9-9.99%	4.62%	3.79%	4.29%	5.63%	4.67%
10-10.99%	10.22%	11.74%	16.43%	25.00%	15.51%
11-11.99%	42.58%	42.80%	38.57%	44.06%	42.56%
12-12.99%	29.20%	25.38%	25.00%	12.19%	23.00%
13-13.99%	8.76%	9.09%	9.29%	5.63%	8.02%
14-14.99%	1.95%	3.41%	2.86%	2.50%	2.56%
Total	100.00%	100.00%	100.00%	100.00%	100.00%
No. of Banks	411	264	140	320	1135
Mean	11.7	11.74	11.68	11.26	11.58
Stand. Dev.	1.16	1.17	1.19	1.24	1.2
Coef of Var.	9.89	9.96	10.18	11.03	10.39

Table 5A

Agricultural Banks Meeting Criteria by Bank Size Group
Year - 1989

Interest Rate	Ag Banks <$300M Assets	Ag Banks >=$300M Assets
7-7.99%	1.02%	0.33%
8-8.99%	2.92%	2.33%
9-9.99%	4.31%	3.99%
10-10.99%	13.58%	13.62%
11-11.99%	31.73%	36.21%
12-12.99%	30.84%	32.89%
13-13.99%	12.18%	6.64%
14-14.99%	3.43%	3.99%
Total	100.00%	100.00%
No. of Banks	788	301
Mean	11.82	11.77
Stand. Dev.	1.3	1.18
Coef of Var.	10.97	10.07

Table 5B

Agricultural Banks Meeting Criteria by Bank Size Group
Year - 1990

Interest Rate	Ag Banks <$300M Assets	Ag Banks >=$300M Assets
7-7.99%	0.86%	1.56%
8-8.99%	2.33%	3.44%
9-9.99%	4.29%	5.63%
10-10.99%	11.78%	25.00%
11-11.99%	41.96%	44.06%
12-12.99%	27.24%	12.19%
13-13.99%	8.96%	5.63%
14-14.99%	2.58%	2.50%
Total	100.00%	100.00%
No. of Banks	815	320
Mean	11.71	11.26
Stand. Dev.	1.17	1.24
Coef of Var.	9.95	11.03

Table 6A

Agricultural Banks Meeting Criteria By Portfolio Percentage
Year - 1989
% Nonreal Estate Farm Loans of Total Ag Loans

Interest Rate	>75-80%	>80-85%	>85-90%	>90-95%	>95-100%	Total
7-7.99%	1.45%	0.54%	0.68%	-	0.97%	0.83%
8-8.99%	2.90%	2.15%	2.04%	5.84%	2.18%	2.75%
9-9.99%	4.83%	4.84%	7.48%	2.19%	3.16%	4.22%
10-10.99%	15.94%	16.67%	8.16%	15.33%	12.38%	13.59%
11-11.99%	32.37%	31.18%	34.01%	32.85%	33.74%	32.97%
12-12.99%	26.09%	31.18%	31.97%	29.20%	34.71%	31.40%
13-13.99%	13.04%	9.14%	12.24%	13.14%	8.74%	10.65%
14-14.99%	3.38%	4.30%	3.40%	1.46%	4.13%	3.58%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
No. of Banks	207	186	147	137	412	1089
Mean	11.71	11.79	11.86	11.77	11.86	11.81
Stand. Dev.	1.37	1.26	1.28	1.23	1.22	1.27
Coef of Var.	11.73	10.65	10.79	10.45	10.33	10.73

Table 6B

Agricultural Banks Meeting Criteria By Portfolio Percentage
Year - 1990
% Nonreal Estate Farm Loans of Total Ag Loans

Interest Rate	>75-80%	>80-85%	>85-90%	>90-95%	>95-100%	Total
7-7.99%	0.42%	2.54%	-	0.78%	1.21%	1.06%
8-8.99%	2.53%	1.52%	3.77%	0.78%	3.39%	2.64%
9-9.99%	5.06%	4.57%	3.77%	3.88%	5.08%	4.67%
10-10.99%	11.39%	12.18%	13.21%	10.08%	22.03%	15.51%
11-11.99%	41.35%	43.15%	43.40%	44.19%	42.13%	42.56%
12-12.99%	28.27%	25.38%	21.38%	27.91%	17.92%	23.00%
13-13.99%	8.44%	7.61%	11.95%	10.08%	5.81%	8.02%
14-14.99%	2.53%	3.05%	2.52%	2.33%	2.42%	2.56%
Total	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%
No. of Banks	237	197	159	129	413	1135
Mean	11.7	11.61	11.69	11.83	11.39	11.58
Stand. Dev.	1.18	1.25	1.19	1.05	1.22	1.2
Coef of Var.	10.12	10.8	10.16	8.87	10.7	10.39

There is no similarity in patterns of increases or decreases in the statistics between the years when comparing Tables 6A and 6B. Unlike the unanimous decrease in interest rates from 1989 to 1990 across all bank size groups, interest rates do not consistently decrease from 1989 to 1990 across portfolio categories. The interest rate earned for nonreal estate loans increases and the SD and CV decrease for the 90-95 percent category from 1989 to 1990. The interest rate decreases for the remaining categories, and the variation decreases for all categories except the largest portfolio percentage for which in remains constant. The coefficient of variation increases for the 80-85 percent and 95-100 percent categories and decreases for the 85-90 percent category from 1989 to 1990.

Model Specification

To begin identifying the factors that influence the interest rate differences, the relative importance of the interest rates' key cost components are determined, utilizing the bank call data. This consists of defining an econometric model with the farm loan interest rate being a function of various lender characteristics, evaluating the means of the independent variables across the interest rate categories for similarities or differences, and estimating and assessing the model.

The dependent variable is the derived interest rate earned for nonreal estate farm loans. Nine independent variables are chosen to measure lender characteristics. It is hypothesized that the bank's average asset size might influence interest rate charged - the larger the bank, the lower the lending costs. This is measured by the log of average asset size. The loan to deposit ratio is included, measuring the lender's supply of loanable funds. It is possible that the higher the ratio, the lower the availability of bank's funds for lending. This might positively affect the interest rate. The agricultural loan ratio can be used as a proxy for credit risk as it measures loan portfolio diversification. The lower the ratio, the more diversified the bank's loan portfolio, lowering the idiosyncratic risk. However, the higher the ratio, the more specialized the bank is in agricultural lending; this can potentially lower lending costs and the interest rate. The expected sign of the ag loan ratio is not predicted. Problem agricultural loans are another proxy for credit risk. It is projected that the higher the proportion of 90 day past due and nonaccrual agricultural loans to total agricultural loans, the higher the interest rate. Return on equity is included as a proxy for required rate of return on bank's equity capital assigned to agricultural production loans, with the belief that the higher the ROE, the higher the interest rate earned.

The costs associated with acquiring funds for lending include both interest expense and operating costs. For the interest expense component, it is assumed that a pooling of acquired funds for loans occurs and that the same interest rate is applied to all loans. A bank incurs operating costs while managing its fund-acquisition and fund-using activities (Ellinger and Barry). To appropriately allocate operating costs across the fund -acquisition and -using activities, gross operating costs are adjusted for noninterest income and allocated proportionately across all bank assets and liabilities. It is expected that the higher the interest paid on borrowed funds, and the higher the percent of net operating costs allocated across asset and liability accounts, the higher the interest rate charged.

Dummy variables for whether or not the bank is located in a metropolitan statistical area (MSA) and whether the bank is associated with a multibank holding company (MBHC) are also included. Ellinger and Barry observed that banks in MSAs have higher operating costs, implying that these urban banks may charge a higher interest rate. However, there also may be a higher degree of competition in the MSA, influencing the bank to charge a lower rate. The loan portfolio of a multibank holding company should be more diversified, therefore decreasing credit risk. Nonetheless, the loan policy mandated by the holding company may not allow the local bank to be flexible and responsive to local competition. The expected signs for these two dummy variables are not predicted.

The resulting model is:

$$AGLNIR = \alpha + \beta_1 T1 + \beta_2 MSA + \beta_3 MBHC + \beta_4 IER + +B_5 NOC + \beta_6 ALR + \beta_7 AGPRLN + \beta_8 ATA + \beta_9 LDR + \beta_{10} ROE + \varepsilon$$

where:

AGLNIR	= derived agricultural production loan interest rate
T1	= 0 for 1989; = 1 for 1990
MSA	= metropolitan statistical area; 0 if not in MSA; 1 - otherwise
MBHC	= multibank holding company; 0 if not with MBHC; 1 - otherwise
IER	= interest expense rate
NOC	= net operating costs
ALR	= ag loan ratio
AGPRLN	= problem agricultural loans as a proportion to total ag loans
ATA	= log of average total assets
LDR	= loan/deposit ratio
ROE	= return on equity

Empirical Results

The means for the independent variables by interest rate category are calculated for 1989 and 1990 for two bank size categories: banks with less than $300M in total assets and banks with more than $300M in total assets (Tables 7 and 8). All the variable means for the larger banks exhibit wider variation than for the smaller banks in both years. The mean variation for the interest expense is less than one percent for the small banks and is between 0.71 and 1.59 percent for the larger banks. The mean variation of net operating costs as a proportion of asset and liability accounts is less than one percent for both banks size groups. The proportion of problem loans to total agricultural loans range from 1.86 to 3.96 percent for the small banks and from 0 (one bank within the interest rate category) to 9.51 percent for the large banks; the upper boundary is close for both bank size groups. The ROE mean displays wide variation (1.45 to 22.45 percent), and analysis of the data indicates that outliers are present. As expected, the loan to deposit ratio is lower for the smaller banks, ranging from 49.18 to 57.8 percent , than for the large banks which vary from 70.88 to 82.77 percent. It is hypothesized that an increase in average ag production loan interest rate is a function of an increase of one or more of the following independent variables: interest expense, operating costs, problem loan proportion, ROE and loan/deposit ratio, and of a decrease in bank size. However, the variable means show no statistical pattern of increases or decreases across the interest rate categories.

To further investigate the effect of these lender characteristics on interest rates, OLS regressions are run on the complete sample of banks and on the banks grouped into the small and large categories. The coefficients, t-statistics, and adjusted-R squared are presented in Tables 9-11. The adjusted-R squared for all three regressions are 3.73 percent, 2.73 percent and 7.59 percent for all, small and large banks, respectively, which are low even for cross-sectional data. The coefficients are inconsistent in sign and significance. The MSA coefficient is positive for all three regressions and significant for all institutions. The MBHC coefficient is positive for all banks and the large banks and insignificant for all three models. The coefficients for the interest expense and operating costs are positive, as predicted, for all three regressions; both the IER and NOC coefficients are significant for all banks and the small institutions and insignificant for the large banks. The AGPRLN and ATA coefficients have the predicted signs for all institutions and the large banks, but both are significant for only the large banks. The ROE coefficient is positive but insignificant for all three models, and the ALR and LDR coefficients are not consistent in sign or significance across the regressions.

Table 7A

Agricultural Banks with <$300 M Assets Meeting Criteria Year - 1989									
	Interest Rate								
Variables	7-7.99%	8-8.99%	9-9.99%	10-10.99%	11-11.99%	12-12.99%	13-13.99%	14-14.99%	Total
Ave Interest Rate	7.57	8.7	9.56	10.56	11.59	12.46	13.44	14.43	11.82
Interest Expense Rate	7.13	6.86	6.93	6.96	6.95	6.94	6.96	6.98	6.95
Net Operating Cost	0.91	1.23	1.02	1.08	1.11	1.19	1.27	1.2	1.15
Problem Ag Loans	1.9	1.86	2.27	2.26	2.32	2.33	2.97	3.85	2.47
ROE	11.96	11.03	11.2	10.62	11.04	18.48	7.47	10.8	12.85
Ag Loan Ratio	36.02	36.55	41.89	38.66	39.21	38.49	33.34	31.85	37.95
Loan/Deposit	49.89	53.87	50.12	52.84	53.92	54.06	55.22	55.9	53.84
Ave Total Assets (Thousands)	$82,777.22	$78,659.01	$60,357.12	$54,990.25	$63,051.73	$66,361.98	$66,085.12	$67,370.15	$64,034.94
No. of Banks	8	23	34	107	250	243	96	27	788

Table 7B

Agricultural Banks with <$300 M Assets Meeting Criteria Year - 1990									
	Interest Rate								
Variables	7-7.99%	8-8.99%	9-9.99%	10-10.99%	11-11.99%	12-12.99%	13-13.99%	14-14.99%	Total
Ave Interest Rate	7.41	8.57	9.65	10.59	11.55	12.36	13.38	14.43	11.71
Interest Expense Rate	6.29	6.82	6.74	6.88	6.83	6.79	6.94	6.79	6.83
Net Operating Cost	1.03	1.08	1.14	1.1	1.14	1.24	1.2	1.26	1.17
Problem Ag Loans	3.63	3.37	3.75	3.96	3.54	3.5	3.34	3.43	3.56
ROE	9.18	8.02	8.97	7.91	11.1	10.51	8.75	11.28	10.17
Ag Loan Ratio	40.13	33.52	38.49	37.87	39.79	38.44	34.01	33.61	38.32
Loan/Deposit Ratio	49.18	57.8	51.44	53.45	54.58	54.02	52.84	54.65	54.04
Ave Total Assets (Thousands)	$52,549.20	$73,502.35	$60,436.85	$74,310.52	$66,054.54	$66,256.38	$62,796.99	$75,635.74	$66,853.48
No. of Banks	7	19	35	96	342	222	73	21	815

Table 8A

Agricultural Banks with >=$300 M Assets Meeting Criteria Year - 1989									
	Interest Rate								
Variables	7-7.99%	8-8.99%	9-9.99%	10-10.99%	11-11.99%	12-12.99%	13-13.99%	14-14.99%	Total
Ave Interest Rate	7.04	8.47	9.57	10.54	11.57	12.37	13.52	14.32	11.77
Interest Expense Rate	6.22	7.81	7.6	7.62	7.56	7.71	7.66	7.43	7.63
Net Operating Cost	1.85	1.03	1.18	1.1	1.01	1.08	1.25	1.09	1.08
Problem Ag Loans	0	4.33	2.79	1.17	2.05	2.66	5.63	2.04	2.44
ROE	15.7	12.21	11.49	4.21	13.97	12.63	22.45	9.47	12.45
Ag Loan Ratio	2.69	1.96	2.01	2.71	3.45	3.16	4	3.44	3.2
Loan/Deposit Ratio	70.88	82.77	75.87	77.53	77.9	77.89	79.58	77.35	77.95
Ave Total Assets (Thousands)	$575,278.40	$10,177.84 M	$1,692,452.82	$5,225,770.82	$3,219,737.06	$4,612,419.03	$4,189,181.13	$1,881,945.77	$4,054,265.82
No. of Banks	1	7	12	41	109	99	20	12	301

Table 8B

Agricultural Banks with >=$300 M Assets Meeting Criteria Year - 1990									
	Interest Rate								
Variables	7-7.99%	8-8.99%	9-9.99%	10-10.99%	11-11.99%	12-12.99%	13-13.99%	14-14.99%	Total
Ave Interest Rate	7.65	8.47	9.47	10.56	11.46	12.43	13.48	14.3	11.26
Interest Expense Rate	7.45	7.45	7.44	7.57	7.19	7.24	7.05	7.76	7.32
Net Operating Cost	0.95	0.96	1.07	1	1.08	1.1	1.19	1.17	1.06
Problem Ag Loans	0.08	0.92	2.66	2.75	2.54	1.8	2.53	9.51	2.59
ROE	16.76	7.62	6.7	11.03	10.37	9.4	14.12	1.45	10.21
Ag Loan Ratio	1.71	1.25	1.14	2.98	3.59	2.89	5.4	1.9	3.16
Loan/Deposit Ratio	78.95	74.05	82.78	77.29	78.81	75.6	72.22	79.59	77.75
Ave Total Assets (Thousands)	$2,933,680.92	$4,172,229.96	$5,482,444.99	$8,443,156.37	$3,462,116.11	$2,455,534.93	$5,664,864.86	$2,589,749.52	$4,816,591.41
No. of Banks	5	11	18	80	141	39	18	8	320

Table 9

OLS Estimates for all ag banks, 1989 & 1990

Coefficient for Variable	Coefficient Value	t-statistic
T1	-0.00206	-3.928*
MSA	0.001471	1.887**
MBHC	0.000087	0.146
IER	0.11302	2.486*
NOC	0.511058	5.821*
ALR	-0.00132	-0.79
AGPRLN	0.007432	1.392
ATA	-0.00106	-3.758*
LDR	-0.00264	-1.402
ROE	0.000712	1.007

Adjusted R-squared - 0.0373

* - Significant at the 95% confidence interval

** - Significant at the 90% confidence interval

Table 10

OLS Estimates for ag banks with <$300 M assets 1989 & 1990

Coefficient for Variable	Coefficient Value	t-statistic
T1	-0.00102	-1.649**
MSA	0.00135	1.471
MBHC	-0.00085	-1.142
IER	0.184047	2.447*
NOC	0.667306	6.208*
ALR	-0.00043	-0.239
AGPRLN	-0.00158	-0.247
ATA	0.00051	0.802
LDR	-0.00422	-1.81**
ROE	0.000508	0.694

Adjusted R-squared - 0.0273

* - Significant at the 95% confidence interval

** - Significant at the 90% confidence interval

Table 11

OLS Estimates for ag banks with >=$300 M assets 1989 & 1990

Coefficient for Variable	Coefficient Value	t-statistic
T1	-0.00464	-4.718*
MSA	0.001717	0.984
MBHC	0.00163	1.586
IER	0.064822	1.09
NOC	0.265564	1.643
ALR	0.031684	2.347*
AGPRLN	0.26612	2.722*
ATA	-0.00122	-2.48*
LDR	0.001664	0.497
ROE	0.002156	0.765

Adjusted R-squared - 0.0759

* - Significant at the 95% confidence interval

** - Significant at the 90% confidence interval

Concluding Remarks

The objective of this study is to evaluate the differences in interest rates charged on nonreal estate loans from commercial banks. After reviewing the concepts of loan pricing, related literature, and the procedural issues involved in utilizing bank call data, criteria for institutions to be used in this study is established. The criteria identifies agricultural banks, and eliminates institutions who are smaller than $25M in average total assets, who do not report quarterly averages, whose ag loan portfolio falls below 75 percent in nonreal estate farm loans, and whose derived interest rate does not fall between seven and 15 percent. The derived nonreal estate farm loan interest rates for agricultural banks meeting this criteria are evaluated across bank asset size categories and agricultural loan portfolio composition. A model reflecting lender characteristics and the cost component of pricing a loan is then specified, and the means of the independent variables are analyzed across the interest rate categories. Noting that there is little variation in the cost component variables as the interest rate increases, OLS regressions are run to determine how much variation in the interest rate the variables explain. The adjusted R-squared is less than eight percent for all three models, and the coefficients are inconsistent in sign and significance across the models. These results indicate that the derived ag production interest rates are not determined strictly according to the loan pricing model, and that other factors affecting the supply and demand for loans need to be considered.

The preliminary results provide the foundation and direction for the next step in this research project, which is to analyze the differences in the earnings rate component of interest rates on the ag production loans. The net earnings on the farm loans can be calculated as a residual factor reflecting the difference between the calculated interest rates and the sum of the defined cost components. The objective of this analysis is to determine if the differences can be attributed to competitive or other systematic factors in the farm credit market.

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DYNAMICS OF FARM INTEREST RATES

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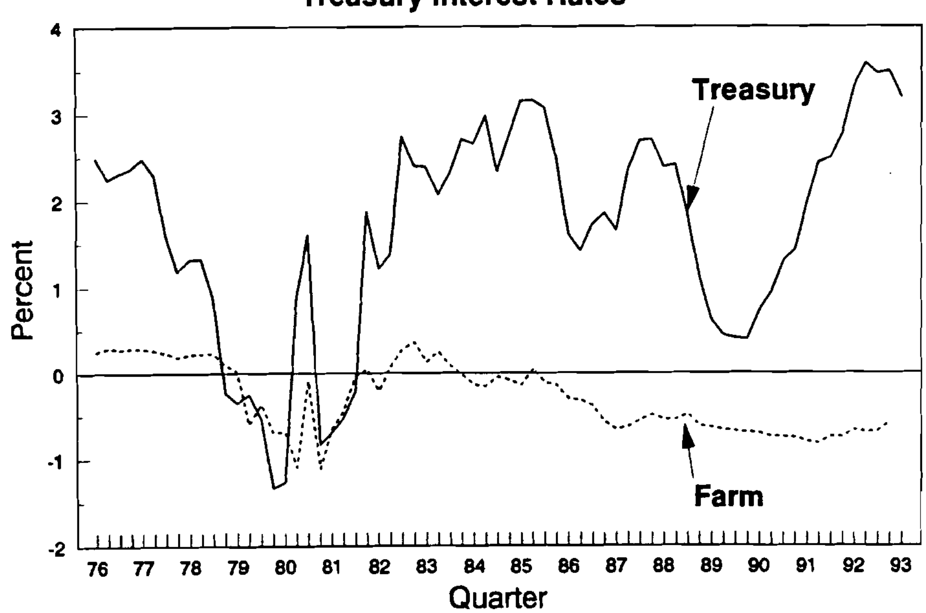
A concern of many U.S. farmers in recent years is that interest rates on farm loans have declined less than short-term interest rates in the national money market. Interest rates on farm loans and in the national money market have generally declined during the early 1990s. During that period, however, short-term rates in the money market have fallen nearly twice as much as farm interest rates.

The four sections of this paper explore the relationship between interest rates in the national money market and interest rates on farm loans. The first section introduces the problem in greater detail. The second section reviews the theoretical concepts which underlie the relationships among various interest rates. The third section describes the empirical methods and data used in the analysis. The fourth section presents the results of the analysis.

Introduction

Interest rates in the U.S. money market have generally declined since early in 1989, but short-term rates fell much more than long-term rates. For example, the yield on six-month Treasury bills fell much more than twice as much (a decline of 621 basis points) as the yield on 10-year Treasury bonds (a decline of only 269 basis points) from March 1989 to December 1992. As a result, the "Treasury spread" (the difference between the yields on the six month T-bill and the 10-year T-bond) widened markedly (Figure 1).

Figure 1. Quarterly Spreads for Farm Lending Treasury Interest Rates



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Interest rates on farm loans in the Tenth (Kansas City) Federal Reserve District also declined sharply during this four-year period, but they did not follow money market rates in lock step. Short-term farm interest rates fell much less than short-term money market rates while long-term farm interest rates fell slightly more than long-term money market rates. For example, the average rate charged on farm operating loans, which usually have a term of less than a year, fell 316 basis points--about half the decline in the six-month T-bill yield, much to the dismay of district farmers. Meanwhile, the average rate on farm real estate loans fell 311 basis points, about 50 basis points more than the decline in the 10-year bond yield, a fact which should lend some comfort to farm borrowers. Thus, the farm interest rates fell almost uniformly, regardless of the term of the loan leaving the "farm spread" (the difference between interest rates on farm real estate loans and on farm operating loans) at about zero, in sharp contrast to the marked widening of the Treasury yield spread (Figure 1).

In contrast to the striking difference in the behavior of farm and money market interest rates in recent years, earlier data point to a closer relationship between the two. For example, the correlation between the farm spread and the Treasury spread from 1976 to 1984 is 74 percent. But after 1984, the correlation drops to only 37 percent. These trends in farm and Treasury interest rates points to the central question of this paper: what relationship exists between farm interest rates and interest rates in the national money market, and how has that relationship changed in recent years?

Theory

The relationship between short- and long-term interest rates is central to the relationship between farm and money market rates. Economists have developed several theories over the decades to explain the term structure of interest rates. These theories include the expectations theory (Fisher; Lutz; and Meiselman), the market segmentation theory (Culbertson, Roll), and the liquidity preference theory (Hicks). The expectations theory of interest suggest that long-term rates are a function of current and expected short-term rates. Thus, when the spread between long-term rates and short-term rates moves, the market's forecast of the future interest rate path has changed. The market segmentation theory of interest is based on the assumption that securities of different maturities are imperfect substitutes for each other. The liquidity preference theory is based upon the risk aversion of the market participants.

Current economic thought suggests an expectations theory which combines elements of the original expectations theory and the liquidity preference theory (Mankiw; Russell). The "normal" shape of the yield curve is upward sloping. The traditional expectations theory would suggest a flat yield curve on average. Factors which have been used to explain the slope of the yield curve include risk of unanticipated changes in interest caused by factors such as unanticipated inflation. The unanticipated inflation can place the security holder at risk of a capital loss. Thus, the security holder will demand a premium to hold longer term securities instead of shorter term securities. This premium is referred to as a term premium.

Economic theory suggests that the term structure of interest rates in national money markets should be closely related to the term structure of farm interest rates. Profit seeking activity of arbitragers who can borrow (or lend) in both the national money market and the farm loan market would maintain a steady relationship between money market and farm interest rates. But that relationship could change through time with changes in the relative riskiness of borrowing or lending in either market (default risk), changes in the relative costs of loan origination (transactions cost), and shifts in demand for credit in the farm sector and in other sectors of the economy.

Other researchers have recently focused attention on the relationship between the national money market rates and farm interest rates. Babula, Duncan, and Vasavada found that farm interest rates tend to be somewhat "sticky" in responding to changes in the 3-month T-bills. Covey and Babula that a one-to-one relationship between changes in nominal farm interest rates and expected inflation (the Fisher relationship) does not exist. Duncan and Singer found that the yield spread between Treasury and Farm Credit System securities widened when the Farm Credit System fell on hard times in the mid-1980s and then narrowed as the System recovered.

The work described herein is unique from these previous efforts in two respects. First, this study uses cointegration analysis to determine the dynamic long-run stability of farm and money market interest rates. Second, the study uses impulse analysis to determine the dynamic response if farm interest rates to changes in money market rates.

Procedures and Methods

The previous discussion of theory would suggested that farm lending rates and macroeconomic rates should have some stable long-run equilibrium. Multivariate cointegration tests have been recently introduced by Johansen; Engle and Granger; and Johansen and Juselius to examine long-run equilibrium relationships. These have been widely applied in the agricultural economics literature (Goodwin and Schroeder; Goodwin).

Bivariate and Multivariate Cointegration Tests

Cointegration tests are a means for evaluating the long-run stability of economic equilibrium conditions. These tests evaluate the long-run stability of linear combinations of two or more variables which are, when taken alone, nonstationary. If a linear combination of two or more nonstationary variables can be used to form a stable equilibrium, the variables are said to be cointegrated. Widespread recognition of the fact that many economic time series are nonstationary has led to increasingly frequent use of cointegration testing techniques.

A number of different approaches to evaluating cointegration relationships have been developed. For bivariate comparisons, Engle and Granger offer a number of different tests. Of their tests, the augmented Dickey Fuller test is the most powerful over a wide range of empirical circumstances and has realized the greatest use. The augmented Dickey Fuller test considers the stationarity of the residuals e_t from the following regression:

$$y_t = \alpha + \beta x_t + e_t \qquad (1)$$

where y_t and x_t are the two nonstationary variables being considered. These residuals are estimated in a first stage and then the following Dickey-Fuller stationarity test is applied:

$$\Delta e_t = -\phi e_{t-1} + \theta_1 \Delta e_{t-1} + \dots + \theta_p \Delta e_{t-p} + \varepsilon_t \qquad (2)$$

The augmented Dickey-Fuller test is given by the ratio of $-\phi$ to its standard error. If the test statistic exceeds the relevant critical value tabulated by Engle and Granger, the null hypothesis of no cointegration is rejected.

More recent work by Johansen and Juselius has developed tests for examining cointegration relationships among several variables.[2] Under Johansen and Juselius' multivariate approach, a fully-specified vector error correction model of the form:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + \dots + \Gamma_{k-1} \Delta Y_{t-k+1} + \Pi Y_{t-k} + \mu + e_t \qquad (3)$$

[2] Johansen and Juselius offer critical values for cointegration tests for up to five variables. Osterwald-Lenum extended Johansen and Juselius' tests to include critical values for testing cointegration in groups of up to 11 variables.

is estimated using maximum likelihood procedures. Note that Y_t is a pxT dimensional matrix of data, ($\Gamma_1, ..., \Gamma_{k-1}, \Pi, \mu$) are parameters to be estimated, and e_t is a random error term. Inferences regarding the number of cointegrating vectors that exist among the p variables are drawn from a consideration of the rank of the Π matrix. If the rank of the Π matrix is greater than zero (but less than p), a cointegration relationship among the variables is implied. Specifically, if the rank of Π is r, then there are r unique cointegrating vectors among the p variables.

Johansen developed two tests for evaluating the number of cointegrating vectors that exist among a set of time series variables. Under Johansen's approach, the following vector autoregressive models are estimated:

$$\Delta Y_t = \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{k-1} \Delta Y_{t-k+1} + v_t \quad (4)$$

$$Y_{t-k} = \Gamma_1 \Delta Y_{t-1} + ... + \Gamma_{k-1} \Delta Y_{t-k+1} + u_t$$

The residual vectors v_t and u_t are then used to construct two likelihood ratio test statistics that can be used to determine the number of cointegrating vectors. The first test statistic, known as the trace test, evaluates the null hypothesis that there are at most r cointegrating vectors and is given by:

$$\tau_{trace} = -T \Sigma_{i=r+1}^{p} \ln(1-\lambda_i) \quad (5)$$

where $\lambda_{r+1}, ..., \lambda_p$ denotes the p-r smallest squared canonical correlations of v_t with respect to u_t. The second test is known as the maximal eigenvalue test. This test evaluates the null hypothesis that there are exactly r cointegrating vectors in Y_t and is given by:

$$\tau_{max} = -T \ln(1-\lambda_i) \quad (6)$$

Each test has, as its alternative, the case of g > r cointegrating vectors.

Impulse Responses for Cointegrated Systems

In applied time series analysis, it is often of interest to consider the time path responses of variables to exogenous shocks to any one of the variables in the system. Such time path responses yield inferences regarding the dynamic adjustments in each of the variables that occur in response to unexpected shocks. These time path responses are referred to as impulse responses. Calculation of impulse responses for a cointegrated system of variables follows much the same approach as what is used to obtain impulse responses in a standard VAR system. However, the fact that cointegration implies an error correction model alters the usual procedures for calculating and interpreting impulse responses. If the variables are cointegrated, shocks to the system should move the time path of the system to a new equilibrium rather than dying out in the long run. This reflects the error correction properties of cointegrated variables. The error shock brings about a correction to a new equilibrium.

Lütkepohl and Reimers discuss the correct approach to calculating impulse responses from cointegrated systems. Under their approach, the error correction model represented by equation (3) is estimated using maximum likelihood procedures. The following matrix is then constructed from the error correction model's parameter estimates:

$$[A_1, A_2, ..., A_k] = [\Gamma_1, ..., \Gamma_{k-1}, \Pi]D + J \quad (7)$$

where:

$$D = \begin{bmatrix} I_k & -I_k & 0 & 0 & \dots & 0 \\ 0 & I_k & -I_k & 0 & \dots & 0 \\ . & & & & . & \\ . & & & & -I_k & \\ 0 \dots & & & & I_k & \end{bmatrix} \quad (8)$$

$$J = [I_k , 0 , \dots, 0] \quad (9)$$

where I_k is a k dimensional identity matrix. Lütkepohl and Reimers show that the impulse responses are then given by:

$$\Phi_n = \Sigma\Phi_{n-m}A_m \quad (10)$$

These adjustments recognize the fact that an error correction term (in levels) must be collected with like first differences for each variable.

Data

Money market interest rates used in the analysis include the yield on six-month T-bills, ten-year T-bonds, and Federal Land Bank bonds. The quarterly yield on the Farm Credit System (FCS) bonds were calculated from the average of the yield on the Federal Land Bank bonds on the date nearest the fifteenth of the month.

Farm rates used in the analysis are the annual rates charged on farm operating loans, feeder cattle loans, intermediate farm loans, and farm real estate loans in the Tenth (Kansas City) Federal Reserve District[3]. The farm interest rate data are collected quarterly in the Federal Reserve Bank of Kansas City's Agricultural Credit Survey, and reported in the Kansas City Fed's *Regional Economic Digest*. For each type of farm loan, the data are unweighted averages of interest rates charged on new loans at the end of each quarter by a panel of commercial agricultural banks[4]. The survey began in 1976 with a panel of 180 banks, which gradually eroded to 140 banks. In 1987, additional banks were added to the survey panel to boost the number of banks participating in the survey each quarter to about 330, a panel which includes roughly a third of the agricultural banks in each of the Tenth District's seven states (Barkema and Stanley).

Results

Unit Root Tests

Augmented Dickey-Fuller tests were used to determine the number of unit roots that exist in each series. Cointegration tests cannot be done unless each series is non-stationary or has at least one unit root. The first step in the Dickey-Fuller tests is to determine the lag length. We determined the lag length using the Schwartz Bayesian Criteria (Judge, Griffiths, Hill, and Lee p. 245-46). The Schwartz Bayesian criteria is a trade off between additional fit from adding additional parameters and the number of parameters. The minimum of the test statistic is chosen to be the appropriate lag length. Table 1 presents the Schwartz Bayesian test for different lag lengths and the augmented Dickey Fuller tests for at least one unit root for each of the seven interest rate

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[3] The Tenth Federal Reserve District includes all or part of seven states: Colorado, Kansas, western Missouri, Nebraska, northern New Mexico, Oklahoma, and Wyoming.

[4] The survey defines an agricultural bank as one with at least 25 percent of its loans to farmers.

series. A lag length of three was optimum for the Feeder Cattle and Operating interest series, while a lag length of one was optimal for the other interest rate series. The Dickey-Fuller test statistic is determined by the t-value on the lagged value in a regression consisting of a constant, a lagged value and lagged values of the differences. The critical values for the unit root test are -2.60, -2.93, and -3.58 for the 10, five, and one percent level of significance, respectively (Fuller, p. 373). The results of the Augmented Dickey Fuller tests suggests that the null hypothesis that at least one unit root exists cannot be rejected at the 10, the five, or the one percent level of confidence.

Table 1. Schwartz Bayesian Criteria for Lag Length and the Dickey Fuller Test for at Least One Unit Root

Lag Length	Feeder Cattle	Operating	Inter-mediate	Real Estate	6-Month T-Bill	10-Year T-Bond	FCS Bonds
0							
1	-.36648	-.39018	-.44360*	-.45975*	.14294*	-.72198	-.71327*
2	-.27311	-.29981	-.34747	-.36285	.18082	-.62616	-.62371
3	-.39460*	-.52897*	-.38970	-.44899	.18786	-.58224	-.56318
4	-.29583	-.43584	-.28929	-.35567	.28792	-.48095	-.46829
5	-.29915	-.44650	-.23377	-.26352	.30789	-.39752	-.38534
6	-.19594	-.34523	-.15219	-.18409	.41068	-.29404	-.28116
T-test[a]	-1.9819	-2.1196	-1.3640	-1.1322	-1.4984	-1.5263	-1.5556

[a] No star indicates that the H_0 is not rejected. This indicates that there is at least one unit root.

* Indicates the lag length at which the augmented Dickey Fuller test is performed.

After testing for at least one unit root, the second step is to test for whether at least two unit roots exist. The results of the Augmented Dickey Fuller test for at least two unit roots (using the same critical values as in the test for at least one unit root on first differenced data) is rejected at the five percent level of significance for feeder cattle, intermediate, and real estate interest rates (Table 2). The test for at least two unit roots is rejected at the one percent level of significance for interest rates for the 6-month T-bill, the 10-year T-bond, and the FCS bonds. The test for at least two unit roots is rejected at the 10 percent level for operating interest rates. The results of the tests suggest that the data series contain one unit root (are nonstationary). The practical significance of the Dickey Fuller tests is that cointegration tests cannot be performed on data series which have different numbers of unit roots.

Multivariate Cointegration Tests

After determining that the series contain 1 unit root, the next step is to determine the appropriate order for the multivariate VAR. The Schwartz Bayesian criteria is again used to determine the appropriate lag length. The minimum test statistic is chosen to be the appropriate lag length of three lags for the system consisting of 6-month T-bill, 10-year T-bond, FCS bond, feeder cattle, operating, intermediate, and real estate rates.

Johansen's Trace test and the Maximum Eigenvalue test are used to determine the number of cointegrating vectors in the seven interest rate system. The results of the cointegration tests and the critical values are presented in Table 3. The critical values are derived by Osterwald-Lenum. The multivariate cointegration tests suggest that three or more cointegrating vectors exist in the set of the seven interest rates. Zero cointegrating vectors would indicate that a stable long-run solution does not exist among the seven series. Thus, the results confirm that a stable long-run solution exists for the seven interest rates.

Table 2. Schwartz Bayesian Criteria for Lag Length and the Dickey Fuller Test for at Least Two Unit Roots

Lag Length	Feeder Cattle	Operating	Inter-mediate	Real Estate	6-Month T-Bill	10-Year T-Bond	FCS Bonds
0							
1	-.32384	-.35180	-.40019	-.42310	.11688*	-.67055*	-.59467*
2	-.41194*	-.53737*	-.41835*	-.48263*	.14813	-.60332	-.51452
3	-.31881	-.45626	-.31755	-.38289	.23490	-.50735	-.41352
4	-.28189	-.42342	-.23976	-.28134	.28842	-.44062	-.34525
5	-.17807	-.33336	-.13842	-.18256	.37862	-.33448	-.23929
6	-.07445	-.22415	-.04907	-.08443	.42609	-.26068	-.13862
T-test	-3.0337	-2.7715	-3.2719	-3.0791	-6.9026	-5.0292	-4.9550

* Indicates the lag length at which the augmented Dickey Fuller test is performed.

Table 3. Co-Integration Tests for the Seven Variable Kansas City Farm Interest Rate Series

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	83.54*	46.45	228.54*	131.71
1	59.51*	40.30	145.00*	102.14
2	44.48*	34.40	85.49*	76.07
3	20.50	28.14	41.01	53.12
4	10.97	22.00	20.51	34.91
5	9.33	15.67	9.54	19.96
6	0.21	9.24	0.21	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Johansen's multivariate cointegration tests were redone eliminating two of the following interest rate series; the 10-year T-bond, the 6-month T-bill, and the FCS bond rates.
The results of these tests are summarized in Tables 4-6. Table 4 contains the results from the multivariate cointegration test of the 6-month T-bill, feeder cattle, operating, intermediate, and real

estate rates. The results indicate that no cointegrating vector exists for this system of interest rates. A stable long-run equilibrium does not exist for these five interest rates. Table 5 contains the results of Johansen's cointegration tests for the 10-year T-bond, feeder cattle, operating, intermediate, and real estate interest rate series. The results indicate that a stable long-run solution exists for this series of interest rates. In fact, the Eigenvalue test indicates that more than two cointegrating vectors exists for this series of interest rates. Table 6 contains the results from the cointegration test of the FCS bond, feeder cattle, operating, intermediate, and real estate rates. The results indicate that a long run stable solution exists for this series of interest rates with more than one cointegrating vectors existing for this series of interest rates. It appears that the most stable equilibrium exists for the Kansas City interest rates and the 10-year T-bond rate then the FCS bond rate. The 6-month T-bill rates and the Kansas City interest rates do not have a long-run stable equilibrium. An implication of the cointegration results is that shorter maturity macroeconomic rates are not an appropriate interest rates to use as proxies for farm lending rates. In addition, when looking to determine future changes in farm interest rate series it is more appropriate to focus on longer term macroeconomic rates than shorter term rates.

Table 4. Co-Integration Tests for the Five Variable Kansas City Farm Interest Rate Series (10-Year T-Bonds and FCS Bonds Eliminated)

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	30.75	34.40	66.93	76.07
1	21.91	28.14	36.18	53.12
2	10.78	22.00	14.27	34.91
3	3.16	15.67	3.49	19.96
4	0.33	9.24	0.33	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

Table 5. Co-Integration Tests for the Five Variable Kansas City Farm Interest Rate Series (6-Month T-Bills and FCS Bonds Eliminated)

Co-Integrating Vectors	Eigenvalue Calculated Value	Eigenvalue Critical Value	Trace Test Calculated Value	Trace Test Critical Level
0	66.12*	34.40	117.78*	76.07
1	28.90*	28.14	51.66	53.12
2	13.27	22.00	22.76	34.91
3	8.62	15.67	9.49	19.96
4	0.87	9.24	0.87	9.24

* Indicates that the null hypothesis of the number of co-integrating vectors is rejected.

The results of the Engle and Granger cointegration tests for the 1976 through 1992 indicate that the farm spread and the treasury spread are not cointegrated at a 10 percent level of significance with a test statistic of -1.82. The results from the cointegration tests for the 1976 to 1984 period also indicated that the vectors were not cointegrated at the 10 percent level of significance with a test statistic of -2.05. The results from the cointegration tests for the 1984 to 1992 period were also not significant with a test statistic of -1.47. Comparing the calculated test statistics of the pre-1984 period with the post-1984 period lends support to the hypothesis that the relationship between the treasury spread and the farm spread was stronger in the pre-1984 period than in the post-1984 period.

Impulse Responses from the Cointegration Results

The impulse response functions measure the effect of a shock to a system of variables on the rest of the variables in the system. When calculating the impulse functions, it is necessary to determine a variable ordering for the system. The more exogenous the interest rate, the higher in the ordering that variable is placed. The interest rates were ordered as follows: 6-month T-bill, 10-year T-bond, FCS bond, feeder cattle, operating, intermediate, and real estate rates. In contrast to a VAR system, a shock to a system may result in a permanent or a transitory effect in a cointegrated system. In a VAR system, the shocks will eventually die out. A one time shock is defined as transitory if it returns to its previous equilibrium after some period of time. A shock is defined as permanent if it settles at an equilibrium different from zero.

Figure 2 examines the time path of the Kansas City interest rates to a shock in the 6-month T-bill rates. A shock in the 6-month T-bill results initially in a movement of about 35 basis points in that interest rate. The shock continues to increase before starting a general downward trend. In response to this shock in the T-bill rate, the four farm rates respond immediately to that shock on an order of about one-half. The farm lending rates continue to increase for another four quarters until they begin to follow the Treasury bill rate. After 20 periods, the real estate and the intermediate lending rate begin to diverge. This likely reflects the fact that the Kansas City rates are not cointegrated with the 6-month T-bill rate.

Figure 2. Response of Kansas City Farm Lending Rates to a Shock in the 6-Month T-Bill Rate

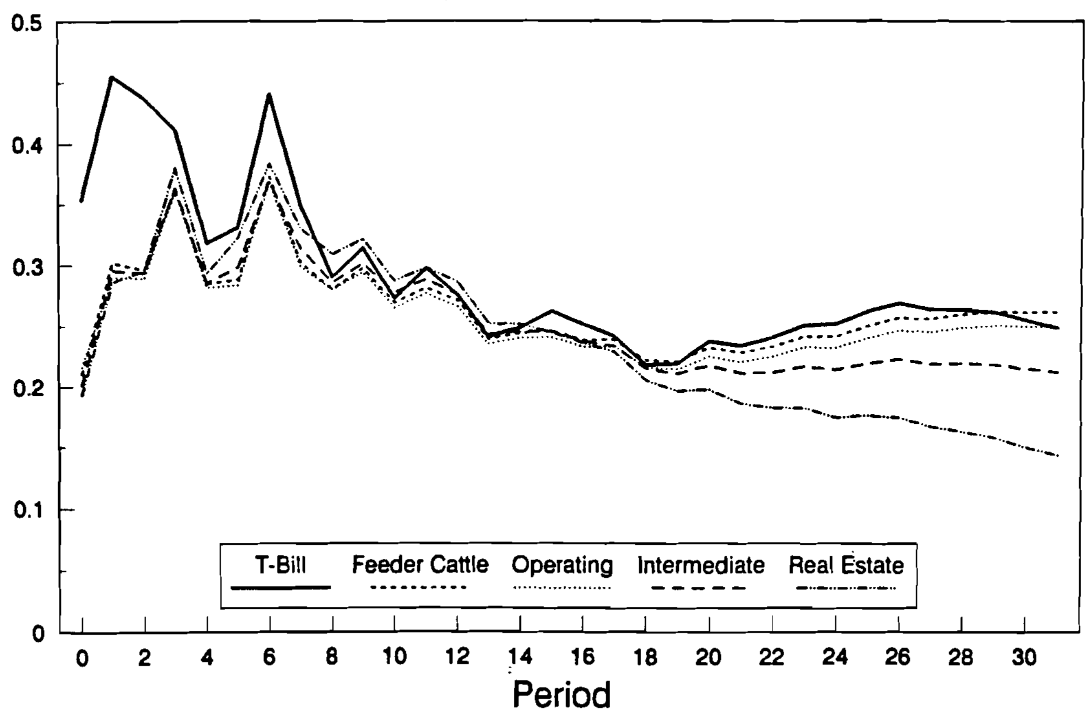


Figure 3 examines the time path of the Kansas City farm lending rates to a shock in the 10-year T-bond rate. The Kansas City rates do not respond much in the short-run to a shock in the long-run interest rate. However, after a year, the Kansas City lending rates move fairly closely with the 10-year T-bond rate. The Kansas City rates do not begin to diverge from the long-term government rate as they did in Figure 2.

Figure 3. Response of Kansas City Farm Lending Rates to a Shock in the 10-Year T-Bond Rate

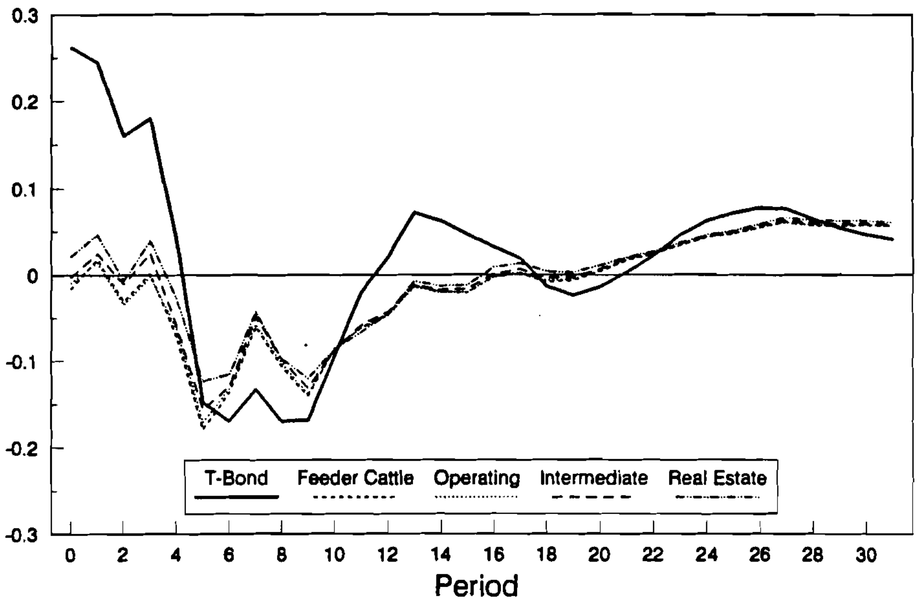
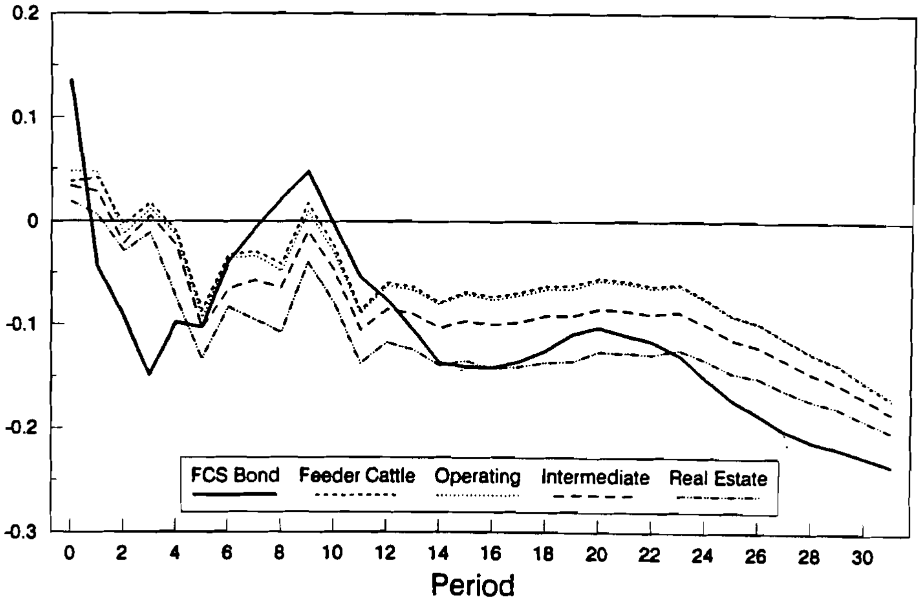


Figure 4 examines the time path of the Kansas City farm lending rates to a shock in the Farm Credit lending rate. The longer-term movement of the farm rates is not as closely aligned with the FCS rate as they are with the 10-year Treasury rate. However, it is more aligned than is the 6-month Treasury bill rate.

Figure 4. Response of Kansas City Farm Lending Rates to a Shock in the Farm Credit Bond Rate



Conclusions

This study has examined the relationship between money market interest rates and farm lending rates. The results from this study suggest that a system of 6-month Treasury bills, 10-year Treasury bonds, FCS bonds, and Kansas City feeder cattle, operating, intermediate, and real estate lending rates does have a stable long-run equilibrium. However, as macroeconomic rates are dropped from the system, we find that a system of 6-month T-bills and the four Kansas City interest rates are do not have a long-run equilibrium relationship. Two alternative five variable systems consisting of the four Kansas City lending rates and alternatively the 10-year T-bond and the FCS bond yield do have long-run stable relationships. One of the implications of these results is that short-term Treasury bill rates are not a good proxy for farm lending rates.

A second implication from this study was found by examining the relationship between the farm yield curve, as defined by subtracting the Kansas City real estate rate from the operating rate, and the treasury yield curve, as defined as the difference between the 10-year T-bond rate and the 6-month T-bill rate. The strength of the relationship between the farm yield curve and the treasury yield curve has weakened in the 1984-1992 period from the 1976-1984 period. This weakening coincides with an inversion of the farm yield curve. During every quarter except one since 1984 operating lending rates have been higher than real estate lending rates in the Kansas City Federal Reserve District. This phenomena has persisted in other regions as well as can be seen by examining lending rates for other Federal Reserve Districts (Walraven, Ott, and Rosine). An explanation of this difference may rest in a shifting in the perceived default characteristics or the cost structure associated with shorter versus longer maturity loans.

Finally, the paper examined the effect of shocks in money market interest rates on Kansas City farm lending rates. In all cases, the response of the farm lending rates to a shock in a macroeconomic rate is not highly aligned for at least four quarters. After that period of time, the rates begin to move together. Developing a plausible explanation for the weakening of the relationship between the farm spread and the treasury spread is an issue the needs further investigation.

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MEASURING ECONOMIES OF SCALE AND SCOPE IN AGRICULTURAL BANKING

Allen M. Featherstone and *Charles B. Moss*[1]

The efficient size of agricultural banks is an issue that will remain important for the rest of the 1990s. The consolidation that is occurring in the rest of the financial services industry has spilled over into agricultural banks. This consolidation has raised concern among the general populous as to whether the consolidated banks will continue to lend to agriculture as has been in the past. In addition, major concerns rest in whether consolidation is moving agricultural banks down their cost curves to achieve greater efficiency, or whether consolidation is resulting in greater market power without achieving cost savings. The study of the production technology of financial institutions can determine whether and to what degree economies of size exist and how agricultural lending will fit into the overall business plans of consolidated banks.

Generally, empirical studies have used either duality theory with the estimation of cost functions or nonparametric estimation methods to assess efficiency in the financial services industry. The purpose of this study is to estimate an indirect multi-product cost function to examine the cost structure of agricultural banks. The uniqueness of this study, when compared to previous studies of efficiency of the financial services industry, is the disaggregation of the outputs so that agricultural lending can be studied.

Clark reviewed 13 studies that measured economies of scope for commercial banks, credit unions, and savings and loan associations. Clark found that these studies offered four broad conclusions: 1) overall economies of scale exist at low levels of input, 2) no consistent evidence of economies of scope, 3) some evidence of cost complementarities, and 4) the results seem to be robust among financial institutions.

Humphery also reviewed studies which examine the issue of bank economies of scale. Humphery found that little cost savings exist for increases in size alone. He found that significant benefits accrue from loan diversification. Humphery also found that the differences in cost structure within the same size category is large compared to measured cost economies.

Featherstone recently examined studies of multiproduct cost bank structure. He found most studies had rejected the hypothesis of homothetic production technologies. Thus, the aggregation of output into a single commodity is inappropriate. Another common finding in the studies is that some evidence of economies of scale does exist for low levels of output, while diseconomies of scale exist for high levels of output. However, the statistical significance of these results is not all that strong. Each of these studies also find that global economies of scale are positive and exist, however, the estimates are not statistically significant.

The paper will be organized in the following manner. First, multiproduct cost concepts will be briefly discussed. A discussion of the empirical model used to estimate the cost structure will follow. The data and procedures used in the estimation of agricultural bank's indirect multi-product cost curves is discussed next. The paper will summarize the empirical findings. Finally, the paper will conclude with an assessment of the strengths and weaknesses of this study and provide comments on future research needs for those interested in agricultural banks.

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Multiproduct Cost Concepts

Multiproduct cost concepts did not arise until the early 1980s (Baumol, Panzar, and Willig). In a multiproduct framework, economies of scale can arise from two sources: product-specific economies and/or economies of scope. Product specific economies are present if the per unit cost of producing an output declines as the output increases. In a multiproduct framework, product specific economies are measured by defining what is known as incremental cost. The incremental cost for the ith output (IC_i) is defined as the cost of producing the entire multiproduct output bundle (C(Y)) minus the cost of producing all of the outputs except the ith output ($C(Y_{N-i})$). Formally:

$$IC_i = C(Y) - C(Y_{N-i}) \text{ where } Y_{N-i} = (Y_1,\ldots,Y_{i-1},0,Y_{i+1},\ldots,Y_N). \tag{1}$$

Product-specific economies of scale (S_i) are then determined by taking the average incremental cost of producing the ith output (IC_i/Y_i) divided by the marginal incremental cost of producing the ith output ($\partial C/\partial Y_i$). Formally:

$$S_i = \frac{(IC_i/Y_i)}{(\partial C/\partial Y_i)}. \tag{2}$$

If S_i is greater than one than product specific economies of scale are said to exist. Product specific economies of scale are most analogous to the single output case of scale economies. This measure can be expanded to include subsets of products if desired.

Economies of scope (diversification) arise from cost savings obtained from the simultaneous production of several outputs together. Economies of scope ($SC_i(Y)$) exist if the cost of producing the optimal level of outputs in "individual firms" is greater than the cost of producing the same optimal output levels in a multiproduct firm. Formally for a two product firm, if

$$C(Y_1) + C(Y_2) > C(Y) \tag{3}$$

then economies of scope exist, where $C(Y_1)$ is the cost of producing output 1 in a single product firm and $C(Y_2)$ is the cost of producing output 2 in a single product firm. For 2 outputs, economies of scope ($SC_N(Y)$) are defined as:

$$SC_N(Y) = [C(Y_1) + C(Y_2) - C(Y)]/C(Y). \tag{4}$$

If $SC_N(Y)$ is greater than zero than economies of scope are said to exist. This indicates the relative increase in cost from a splintering of production into separate groups or the relative cost savings of multiproduct production.

Both economies of scope ($SC_N(Y)$) and product-specific economies (S_i) can be combined to give an overall measure of the returns to scale for an individual firm. These are also referred to as scale economies (S_N). Formally, the measure of economies of scale for a two output firm is:

$$S_N(Y) = \frac{\alpha_1 S_1(Y) + (1-\alpha_1)S_2(Y)}{1 - SC_N(Y)} \tag{5}$$

where α_1 is the first firm's output time the marginal cost as a proportion of the sum of all outputs multiplied individually by their marginal cost.

Economies of scale can then arise under multiple scenarios. If economies of scope are equal to zero, then economies of scale will exist if one of the outputs has constant returns to scale and the other output has increasing returns to scale. Economies of scale can also arise if both outputs have constant returns to scale if economies of scope exist.

Empirical Model

Multiproduct cost concepts were able to develop only after the development and application of duality theory. Rigorous treatment of duality originated in 1953 with a book by Ronald Shephard. This allowed a rapid expansion of the classes of functional forms available for empirical estimation of production relationships. The class of flexible functional forms, which are based on 2nd-order Taylor series approximations, include the translog, generalized Leontief, and the quadratic. The translog is the most commonly applied functional form used in multiproduct cost analysis of the banking industry. A problem encountered with the use of the translog cost function is that outputs are logged in the estimation process. If a financial institution does not produce an output, the log of that output quantity (zero) is undefined. This problem becomes important when calculating incremental costs. A commonly accepted technique is to replace zero outputs with a sufficiently small nonzero value. Cowing and Holtmann; Akridge and Hertel; and Schroeder set zero output values equal to 10 percent of the geometric mean. A drawback of this procedure is that bias may be introduced into the parameter estimates.

A functional form that has been used to avoid this problem encountered with the translog functional form is the normalized quadratic. The normalized quadratic is expressed as:

$$C'=\alpha_0+\sum_{i=1}^{m}\alpha_i w_i'+\sum_{i=m+1}^{n}\alpha_i Y_i+\frac{1}{2}\left(\sum_{i=1}^{m}\sum_{j=1}^{m}\alpha_{ij}w_i'w_j'+\sum_{i=m+1}^{n}\sum_{j=m+1}^{n}\alpha_{ij}Y_iY_j\right)+\sum_{i=1}^{m}\sum_{j=m+1}^{n}\alpha_{ij}w_i'Y_j \tag{6}$$

where C′ is the normalized cost, (cost divided by the 0th input price), w_i' is the ith normalized price, and Y_i is the ith output quantity. The cost function is assumed to be twice-continuously differentiable, and linear homogeneous in input prices. Homogeneity is imposed by the normalization process. To satisfy economic theory, the cost function is also concave in input prices and convex in outputs.

Using Shepherd's lemma, the first derivative of the cost function is the compensated input demand functions.

$$\frac{\partial C'}{\partial w_i'}=x_i=\alpha_i+\sum_{j=1}^{m}\alpha_{ij}w_j'+\sum_{j=m+1}^{n}\alpha_{ij}Y_j \quad for\ i=1,...m-1. \tag{7}$$

Symmetry is imposed by restricting $\alpha_{ij}=\alpha_{ji}$ in the estimation procedure.

Data and Procedures

The normalized quadratic cost function consists of six outputs and four inputs. The value-added approach was used to define the inputs and outputs. The source of the data was the 1990 Federal Reserve Call Report data. A sample of 7,140 rural or agricultural banks were selected if at least 50 percent if the deposits of branches are not located in a metropolitan service area (MSA) or if the bank had an agricultural loan ratio of 25 percent or higher. The outputs consisted of quarterly averages of transaction deposits (Y4), nontransaction deposits (Y5), nonagricultural real estate loans (Y2), nonagricultural nonreal estate loans (Y3), agricultural real estate and nonreal estate loans (Y1), and other bank output (Y6). The inputs consist of the number of employees (X2), fixed assets (X3), total assets (X0), and total deposits (X1).

The sample size was reduced by 32 banks when price variables were calculated due to the division by zero. The definition of outputs was straight forward except for other outputs. Other outputs consisted of federal funds and total securities. The price for labor was determined by dividing employee expense by the number of employees. The occupancy price was determined by dividing the occupancy expense divided by the fixed asset value (Mester). The interest expense was determined by dividing the interest paid divided by total loans. The other input price was determined by dividing other expense by total assets. The price on which the quadratic function was normalized was other operating expenses. Summary statistics for data are found in Table 1.

Results

The parameter estimates of the cost function and three input demand functions: total deposits, labor, and fixed assets are found in Table 2. The inputs carry the subscript 1 to 3 whereas the outputs carry the subscripts 4 to 9. The estimation procedure was iterative seemingly unrelated regression. The adjusted R-square for the cost function was .9947, .9976 for the deposit equation, .9457 for the employee equation, and .8097 for the fixed asset equation. The t-statistics were significant on 89.1 percent of the parameter estimates which is higher than reported in other studies (Akridge and Hertel, Schroeder, Cowing and Holtmann).

Table 3 presents the price elasticity estimates for deposits, labor, and premises. The elasticity estimates are calculated at the mean of the price and output variables. The own-price elasticities for deposits and labor are negative and close to zero. The own-price elasticity on the premises is positive. This indicates that the curvature properties do not hold and thus estimation needs to take place with curvature properties imposed. Caution must be used when interpreting the results.

Table 4 presents the marginal cost estimates and the product specific economies of scale for each of the outputs. If product specific economies of scale are greater than one, that product is said to be produced in a region of increasing returns. All outputs except other bank output have product specific economies nearly equal to one, indicating constant returns to scale at the mean output. Other bank output has an estimate of 1.33 indicating returns of scale exist at the mean level.

Table 5 presents the economies of scope measure for each of the output products. The economies of scope measures presented in Table 5 represent production splintered into two groups: the product being produced alone and the other five products being produced. Each of the measures is slightly negative indicating the that no economies of scope exist or slight diseconomies. This indicates that the production of these outputs will reduce costs on the order of 4.5 to 8.0 percent. Another economies of scope measure was calculated by splintering production into 6 single product firms. The results indicate that the splintering of outputs into single firms would reduce costs by 27.1 percent.

Finally, a measure of the overall economies of scale for the firm at the mean levels of output was calculated. The results indicate that at mean output levels the overall returns to scale measure is .954. The indicates that for this sample of banks, the outputs are being produced in a region of nearly constant returns to scale or a region of slight diseconomies of scale.

Table 1. Summary Statistics of Sample Banks (7,108) Observations

Variable	Minimum	Maximum	Average	Standard Deviation
Y1-Agricultural real estate and nonreal estate loans ($000,000)	0.0	270.2	4.7	7.1
Y2-Nonagricultural real estate loans ($000,000)	0.0	1608.7	14.8	41.1
Y3-Nonagricultural nonreal estate loans ($000,000)	0.0	1317.1	13.0	44.0
Y4-Transactions deposits ($000,000)	0.0	1085.0	12.8	29.4
Y5-Nontransaction deposits ($000,000)	0.0	2690.0	40.0	82.5
Y6-Other bank output ($000,000)	0.0	1215.1	21.5	37.6
X0-Total assets ($000)	1446	4451466	59916	132625
X1-Total deposits ($000)	1866	4591859	59964	136720
X2-Number of employees	1.8	3630.8	32.9	81.2
X3-Fixed assets ($000)	1.0	141910	1187	3119
P0-(X0/total assets)	0.0005	0.1452	0.0113	0.0055
P1-(X1/total deposits)	0.0001	0.1479	0.0487	0.0083
P2-Average salary ($000)	1.5	76.2	27.4	6.4
P3-(X3/fixed assets)	0.002	94.0	0.353	1.505
Cost ($000)	110	389308	4791	11476

Table 2. Parameter Estimates for the 1990 Agricultural Bank Data

Parameter	Estimate	T-Ratio
α_0	-7050.41	-9.27*
α_1	-1695.93	-11.56*
α_2	0.6448	1.70
α_3	-132.49	-18.81*
α_4	2770.18	18.59*
α_5	2339.78	24.77*
α_6	2598.05	28.69*
α_7	-647.91	-6.22*
α_8	-1626.70	-15.96*
α_9	2522.95	26.80*
α_{11}	-440.74	-10.02*
α_{12}	0.2462	4.14*
α_{13}	6.642	15.32*
α_{22}	-.0014	-11.34*
α_{23}	.0169	16.89*
α_{33}	.0232	14.80*
α_{44}	-69.05	-10.08*
α_{45}	-18.96	-4.33*
α_{46}	4.52	1.34
α_{47}	15.67	3.86*
α_{48}	5.41	1.06
α_{49}	-9.67	-1.99*
α_{55}	-3.91	-1.54
α_{56}	-7.89	-3.41*
α_{57}	25.30	7.97*
α_{58}	3.88	1.51

* Significant at the five percent level.

Table 2. (con't) Parameter Estimates for the 1990 Agricultural Bank Data

Parameter	Estimate	T-Ratio
α_{59}	-18.90	-7.06*
α_{66}	-17.27	-7.38*
α_{67}	16.35	5.95*
α_{68}	13.70	5.83*
α_{69}	-21.44	-9.15*
α_{77}	4.63	1.55
α_{78}	-28.16	-8.98*
α_{79}	18.38	6.40*
α_{88}	-6.47	-2.29*
α_{89}	22.57	7.81*
α_{99}	-22.98	-8.29*
α_{14}	666.04	44.53*
α_{15}	-.763	-20.60*
α_{16}	-40.23	-20.84*
α_{17}	629.92	54.03*
α_{18}	-.536	-17.98*
α_{19}	-12.84	-7.39*
α_{24}	712.43	69.34*
α_{25}	-.772	-29.30*
α_{26}	-14.29	-9.40*
α_{27}	1269.91	107.93*
α_{28}	2.76	93.21*
α_{29}	103.03	56.20*
α_{34}	284.01	23.26*
α_{35}	1.06	34.04*
α_{36}	28.12	16.42*
α_{37}	643.94	57.21*
α_{38}	-1.07	-37.75*
α_{39}	-45.22	-28.50*

* Significant at the five percent level.

Table 3. Input Demand Price Elasticities

Quantity	Price: Deposits	Labor	Premises
Deposits	-.0373	.0118	.0044
Labor	.0399	-.1321	.0212
Premises	.0395	.0568	.0011

Table 4. Marginal Costs and Product Specific Economies of Scale for Bank Outputs

Output	Marginal Cost	Product Specific Economies of Scale
Agricultural loans	$ 2039.4	1.0789
Nonag real estate	3317.3	1.0087
Other nonag loans	3411.2	1.0328
Transactions deposits	17797.4	0.9983
Nontransactions deposits	4090.9	1.0316
Other bank output	890.1	1.3254

Table 5. Economies of Scope for Bank Output

Output	Economies of Scope
Agricultural loans	-.0486
Nonag real estate	-.0452
Other nonag loans	-.0541
Transactions deposits	-.0469
Nontransactions deposits	-.0802
Other bank output	-.0722

Conclusions and Implications

The implications from this study will focus along economics implications for agricultural banking and technical issues that still need to be resolved in the banking literature. Any economic implications from this study must be interpreted with care because concavity of input prices and convexity of outputs does not hold globally. The curvature conditions are derived from economic theory and are just as important as conditions which are easily imposed such as symmetry and homogeneity.

Given the results of this study, at the mean size of the banks examined in this study, $60 million, economies of scale are not present. In fact, at the mean bank size, the economies of scale measure is slightly negative. Thus, economies of scale seem to be exhausted at this size of bank output. A second implication is that economies of scope do not exist for any of the individual outputs. Thus, combining agricultural lending into an institution which currently does not have agricultural lending will not lead to economies of diversification. Thus, the results from this study suggest that cost advantages to increasing bank size do not exist at the mean of $60 million in assets.

More technical issues still remain in the agricultural banking literature. The first issue is that studies which examine the relative efficiency of various financial institutions must be cautiously interpreted. If the cost function does not adhere to conditions derived from economic theory, how trustworthy are the estimates reported in this paper or other papers? The results suggest that curvature properties may not hold in the estimation process. A second technical point deals with the determination of input prices in many studies of banking. For example, using total deposits as a measure of quantity to determine more than one price ratio for different commodities is inappropriate. This can be seen by examining equation (7). In actuality, the dependent variable on each of the input demand equations is total deposits. This fact is often masked by the use of the translog cost function. The definition of input quantities in a service institution is an area that continues to need much input. Future research will focus on the imposition of curvature properties and the definition of input quantities.

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MEASURING INEFFICIENCIES OF INDIVIDUAL AGRICULTURAL BANKS

David L. Neff, Bruce L. Dixon, Paul N. Ellinger and *Suzhan Zhu*[1]

Introduction

In a presentation at the 1992 NC-207 regional committee meeting in Minneapolis, Ellinger and Neff examined issues and approaches of efficiency analysis of commercial banks. Ten major issues in estimating bank efficiencies were discussed. These included:

1. Bank data sources
2. Bank cost definition
3. Bank output definition
4. Empirical technique
5. Functional form
6. Bank entity to evaluate
7. Time period used
8. Economies of scale/scope issues
9. Incorporation of risk
10. Incorporation of environmental variables into cost equations

This presentation, and a subsequent *Agricultural Finance Review* article, examined issues 2., 3., and 4. -- bank cost and output definition and empirical technique -- using a sample of 500 agricultural banks and quarterly call report data from March 1987 - December 1990. To examine bank cost and output definition, four cost functions were estimated, each with alternative input and output specifications. The alternative output specifications compared the value-added and intermediation approaches while the alternative input specifications measured the effect of including interest expense as a bank cost. Efficiency analyses of the sample banks were conducted using two empirical techniques and the four alternative models. These techniques were the stochastic parametric and the nonparametric cost frontiers. Summary statistics, histograms and correlation analyses were used to compare efficiency results among the eight models.

The results of this analysis indicated that nonparametric models resulted in larger and more disperse measures of bank inefficiency than the stochastic cost frontier. Inefficiency estimates were 50-87 percent inefficient on average for the nonparametric models and 3-28 percent inefficient on average for the stochastic models. Given that all of the sample banks had been operating for at least a three year period and many of the estimated inefficiency ratios were over 100 percent for the sample banks, it seems unlikely that these banks could have survived at such high cost levels relative to other banks. The nonparametric technique does not allow for random disturbances away from the efficient cost frontier, and hence a portion of the measured inefficiency could have been caused by such occurrences.

In terms of bank cost definition, the inclusion of interest expenses was more desirable. Because noninterest costs can differ substantially based upon the types of funds use, the exclusion of interest costs may rank banks which use funding sources with higher operating costs (e.g., transactions deposits) as less efficient than banks using funding sources with relatively lower operating costs (e.g., federal funds purchased).

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When alternative bank output definitions were compared, the value-added approach (which includes demand, savings and time deposits as outputs) was the preferred approach. Deposits are responsible for a high proportion of value-added by commercial banks and a considerable amount of labor, physical capital and interest expense inputs are employed in producing these services.

Given these earlier results, this analysis employs a translog functional form to estimate a stochastic cost frontier for a much larger sample of U.S. banks (7,140). The value-added approach to output definition is used and bank interest expenses are included as an input. This study focuses on evaluating bank inefficiency results from a given model and method rather than comparing inefficiency results between alternative models and methods. Summary statistics; histograms; graphical examinations of average inefficiency ratios by bank size, Federal Reserve Bank region, agricultural loan-to-deposit ratio and holding company affiliation; and a regression analysis which correlates inefficiency estimates with bank environmental variables are employed to examine inefficiency estimates.

Methods

Bank inefficiency is estimated using the translog cost function system originated by Christensen and Greene and adapted to commercial bank data by Ferrier and Lovell. This specification incorporates both technical and allocative inefficiencies. The translog cost function system is composed of a cost function and input share equations:

Cost function: (1)

$$\ln(w'x)_s = [\alpha_0 + \sum_{i=1}^{m} \alpha_i \ln y_{is} + \sum_{i=1}^{n} \beta_i \ln w_{is} + \frac{1}{2}\sum_{i=1}^{m}\sum_{j=1}^{m} \alpha_{ij} \ln y_{js} \ln y_{js} + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \beta_{ij} \ln w_{is} \ln w_{js} + \sum_{i=1}^{m}\sum_{j=1}^{n} \delta_{ij} \ln y_{is} \ln w_{js} + T_s + A_s + V_s$$

Input share equations: (2)

$$\left(\frac{w_j x_j}{w'x}\right)_s = [\beta_j + \sum_{k=1}^{n} \beta_{jk} \ln w_{ks} + \sum_{i=1}^{m} \delta_{ij} \ln y_{is}] + b_j + u_{js}, \quad j = 1, \ldots, n$$

where, $w'x = \sum_{i=1}^{n} (w_i \times x_i)$, s=1,...,S, indexes banks, j=1,...,n, indexes inputs, x is the vector of inputs, w is a vector of input prices, y is a vector of outputs, T is the technical inefficiency, A is the allocative inefficiency and u and v are statistical noise. It is assumed that T is distributed half-normally and u and v are distributed normally. Furthermore, $B_{js}=b_j+u_{js}$ and $B_{js} \sim N(b_j, \sigma_{Bj}^2)$.

The decomposition of error terms, technical inefficiency and allocative inefficiency can be achieved through methods outlined by Schmidt. He suggests that the decompositions should have two characteristics. These include:

1. $A \geq 0$, with $A = 0$ if and only if all elements of B are zero;

2. A and $|b_s + u_s|$ are positively correlated, and A and the variances of the composed errors $(b_s + u_s)$ are correlated.

In this study, allocative inefficiencies are estimated as:

$$A = FB \otimes B = (F_{11}B_1^2 + F_{22}B_2^2 + .. + F_{nn}B_n^2)$$

where n is the number of inputs, F is 1xn vector with $F_{jj} > 0$. F_{jj} represents the relative effect of allocative inefficiencies from input j on the increasing production cost. The allocative inefficiencies defined in this way reflect the weighted average effect of allocative distortion on each of the share equations. The F_{jj} are estimated with the cost system.

This specification of the linkage of allocative inefficiencies between cost function and share equations not only meets the two requirements recommended by Schmidt, but also provides information on the level of allocative inefficiency for each firm. The estimation of technical inefficiencies in this analysis is similar to the mode of the conditional distribution derived by Jondrow, Lovell, Materov and Schmidt.

Data

The selection of sample banks was based on two criteria:

1. At least 50 percent of the deposits of branches are not located in a metropolitan service area (MSA), or

2. The bank has an agricultural loan ratio of 25 percent or higher.

Criteria #1 selects rural (nonMSA) banks. Criteria #2 allows banks to be selected in MSAs if their agricultural loan ratio is greater than 25 percent. These criteria resulted in a sample of 7,140 banks. Four-quarter averages from 1990 are used for the explanatory input, output, price and cost data.

The translog cost function includes six outputs and four inputs:

Outputs	Inputs
Transaction deposits	Number of employees
Nontransaction deposits	Occupancy expenses
Nonagricultural real estate loans	Other operating expenses
Nonagricultural nonreal estate loans	Interest expense on deposits
Agricultural real estate and nonreal estate loans	
Other bank output	

This model, with imposed homogeneity and symmetry restrictions, consists of four share equations and the translog cost function. To avoid singularity, the last share equation is omitted. Maximum likelihood is used to jointly estimate the cost function and share equations.

Tables 1 and 2 provide summary statistics and the bank size distribution of the sample banks. Approximately seven percent of the sample consists of very small banks (total assets < $10 million) and two percent are large banks (total assets ≥ $250 million) (the average size of the banks is $59,762,600 total assets). The average number of bank employees is 33 and the average annual salary per employee is $27,367. The mean agricultural loan ratio is 26 percent, indicating that 26 percent of the loans made by the sample banks on average is for agricultural purposes or secured by agricultural assets. On average, the banks have about 2.2 branches, a market share of 20 percent and a 9.3 percent rate-of-return on equity capital.

Results

Table 3 presents summary statistics of technical, allocative and overall inefficiency estimates by bank asset size class and for the total sample. On average, the banks exhibited four percent technical inefficiency, two percent allocative inefficiency and six percent total inefficiency. The average total inefficiency of the sample is slightly higher than Ellinger and Neff find using a similar model (approximately 3.3 percent). It is substantially lower, however, than Ferrier and Lovell's estimate of eight percent technical, 17 percent allocative and 26 percent total cost inefficiency for a sample of 575 banks who participated in the Federal Reserve System's Functional Cost Analysis (FCA) program in 1984. One explanation for the difference between the results of Ferrier and Lovell and this study may be due to the data employed (FCA versus Call Report). The outputs used in the Ferrier and Lovell study consist of the number of deposits and loans, rather than their values. In addition, Ferrier and Lovell estimate an average allocative inefficiency level for the total sample, rather than individual estimates for each bank.

Figure 1 provides a histogram of total inefficiency measures for the sample banks. Nearly 6,400 of the 7,140 banks have total inefficiency estimates between zero and ten percent. About 600 banks have total inefficiency between ten and 15 percent and fewer numbers of banks have inefficiency ratios in higher categories. These results are consistent with Ellinger and Neff, who find similarly narrow inefficiency distributions for agricultural banks using the stochastic parametric method.

Technical, allocative and total inefficiency measures decrease somewhat as bank size increases (Table 3). The largest difference is between the smallest size category of banks and the rest of the size classes. Small banks are approximately two percent, one percent and three percent more technically, allocatively and totally inefficient, respectively, on average than larger banks. This results is in contrast to Ferrier and Lovell, who find no apparent relationship between cost inefficiency and bank size using bank deposit size classes.

Figures 2-4 present average technical, allocative and total inefficiency of the agricultural sample banks by Federal Reserve District. The largest average technical inefficiency was 6.6 percent for the San Francisco District banks. The New York District banks also had a relatively large average inefficiency estimate of 5.4 percent. These areas are dominated by branches of large banks located in major metropolitan areas (Los Angeles, San Francisco, New York City, etc.). The competitive forces of these branches may result in higher inefficiencies for other banks. The average allocative inefficiency by Federal Reserve District is fairly uniform at about two percent except for Philadelphia District banks, who have an average allocative inefficiency of 3.0 percent. The average total inefficiency is highest for the San Francisco District banks, at 8.5 percent cost inefficient. The Dallas District exhibited the lowest average cost inefficiency (5.2 percent).

Figure 5 presents average total inefficiency estimates by bank agricultural loan ratio (ALR). Over a wide range of ALRs, the average total inefficiency is fairly constant at approximately six percent. This is nearly the same as the average total inefficiency of the full sample of 7,140 agricultural banks. However, average total inefficiency increases for banks with ALRs of greater than 70 percent with average measures of 7.1, 8.3 and 20.8 percent for banks in the 70-80, 80-90

Table 1. Summary Statistics of Sample Banks (7,140 Observations)

Variable	Minimum	Maximum	Average	Standard Deviation
Y1-Transactions deposits ($000)	0.1000	1,084,966	12,724	29,350
Y2-Nontransaction deposits ($000)	0.1000	2,690,038	39,828	82,359
Y3-Nonagricultural real estate loans ($000)	0.1000	1,608,725	14,691	40,970
Y4-Nonagricultural nonreal estate loans ($000)	0.1000	270,222	4,652	7,117
Y5-Agricultural real estate and nonreal estate loans ($000)	0.1000	1,404,112	13,606	47,255
Y6-Other bank output ($000)	0.1000	74,209	220	1,382
X1-Number of employees	0.5000	3,631	33	81
X2-Expenses of fixed assets & premises ($000)	0.1000	258,616	3,329	7,480
X3-Other noninterest oper. expenses ($000)	0.1000	26,996	233	653
X4-Interest expense on deposits ($000)	0.1000	121,092	686	2,297
P1-Average salary ($000)	0.0000	101.0000	27.3673	6.4575
P2-(X2/total deposits)	0.0000	0.5020	0.0613	0.0093
P3-(X3/total deposits)	0.0000	0.0359	0.0045	0.0024
P4-(X4/total deposits)	0.0000	0.3336	0.0128	0.0076
Agricultural loan ratio	0.0000	0.9514	0.2599	0.2322
Loan to deposit ratio	0.0061	4.7314	0.5703	0.1694
Number of branches	1	302	2.24	5.50
Real estate to total loans ratio	0.0000	1.0015	0.4444	0.1806
Market share	0.0003	1.0000	0.1979	0.1875
ROA	-0.0790	0.0681	0.0086	0.0078
ROE	-8.7941	22.3648	0.0927	0.3613

Table 2. **Bank Size Distribution of Sample**

Asset Size Class	Number of Banks	Percent of Sample
Assets < $10M	491	6.9%
$10M ≤ Assets < $25M	2,029	28.4%
$25M ≤ Assets < $50M	2,093	29.3%
$50M ≤ Assets < $100M	1,577	22.1%
$100M ≤ Assets < $250M	807	11.3%
$250M ≤ Assets	143	2.0%
Total Sample	7,140	100.0%

and ≥90 ALR categories, respectively. These results, however, are being influenced by two things. First, there were only five banks with ALR ≥ 90 percent. Hence, the average inefficiency measure may be being influenced by one or two particularly inefficient banks. Secondly, bank size is inversely related to the ALR. Smaller banks (particularly those with assets of less than $10 million), previously shown (Table 3) to be more inefficient, may be dominating the larger ALR categories.

Table 3. **Technical, Allocative and Overall Efficiency by Bank Size**

Asset Size Class	Obs.	Efficiency	Minimum	Maximum	Mean	Standard Deviation
Assets < $10M	491	Technical	0.000	1.040	0.060	0.081
		Allocative	0.002	1.125	0.033	0.101
		Overall	0.002	1.125	0.093	0.125
$10M ≤ Assets < $25M	2,029	Technical	0.000	0.479	0.044	0.040
		Allocative	0.002	0.189	0.020	0.009
		Overall	0.002	0.493	0.064	0.041
$25M ≤ Assets < $50M	2,093	Technical	0.000	0.647	0.038	0.030
		Allocative	0.004	0.224	0.020	0.008
		Overall	0.005	0.663	0.058	0.031
$50M ≤ Assets < $100M	1,577	Technical	0.000	0.270	0.039	0.027
		Allocative	0.003	0.366	0.020	0.011
		Overall	0.005	0.366	0.059	0.030
$100M ≤ Assets < $250M	807	Technical	0.000	0.237	0.036	0.029
		Allocative	0.005	0.198	0.020	0.008
		Overall	0.006	0.273	0.056	0.031
$250M ≤ Assets	143	Technical	0.000	0.348	0.035	0.052
		Allocative	0.005	0.669	0.024	0.055
		Overall	0.007	0.818	0.059	0.085
Total Sample	7,140	Technical	0.000	1.040	0.041	0.039
		Allocative	0.002	1.125	0.021	0.029
		Overall	0.002	1.125	0.062	0.049

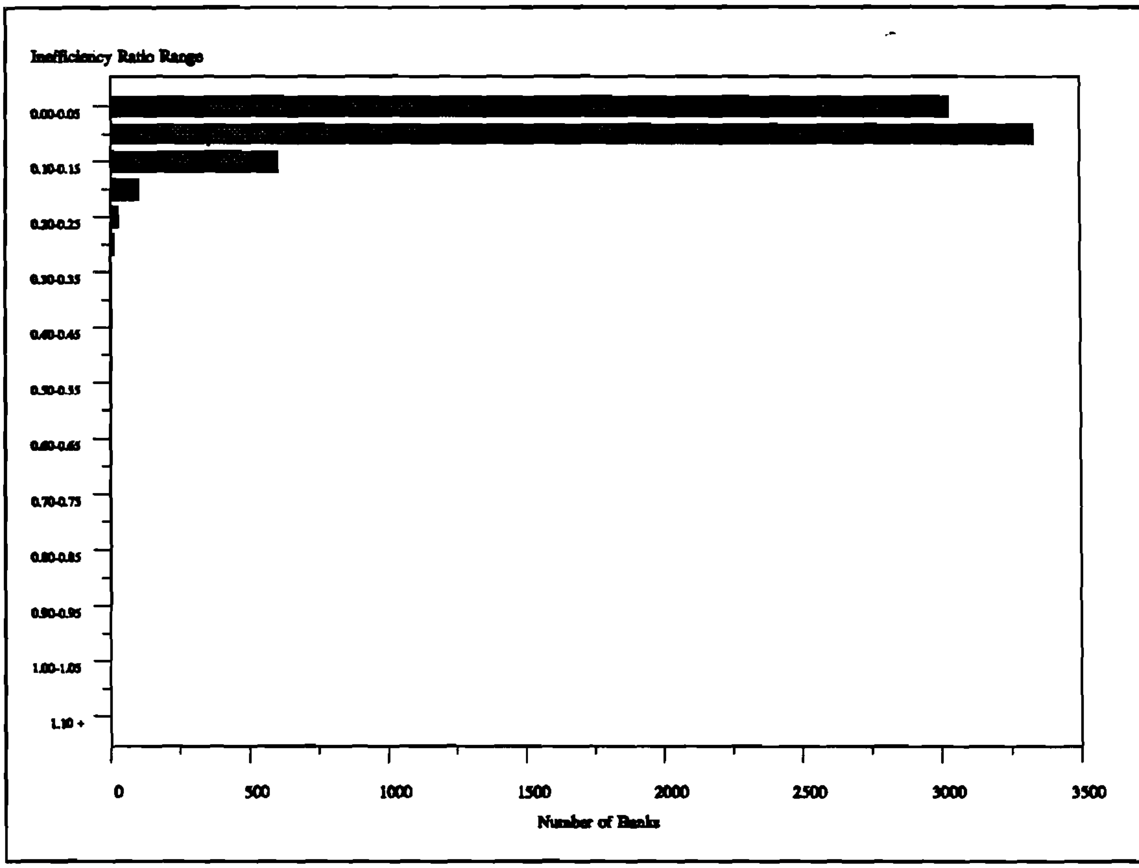

Figure 1. Distribution of Total Inefficiency Estimates for 7,140 Banks

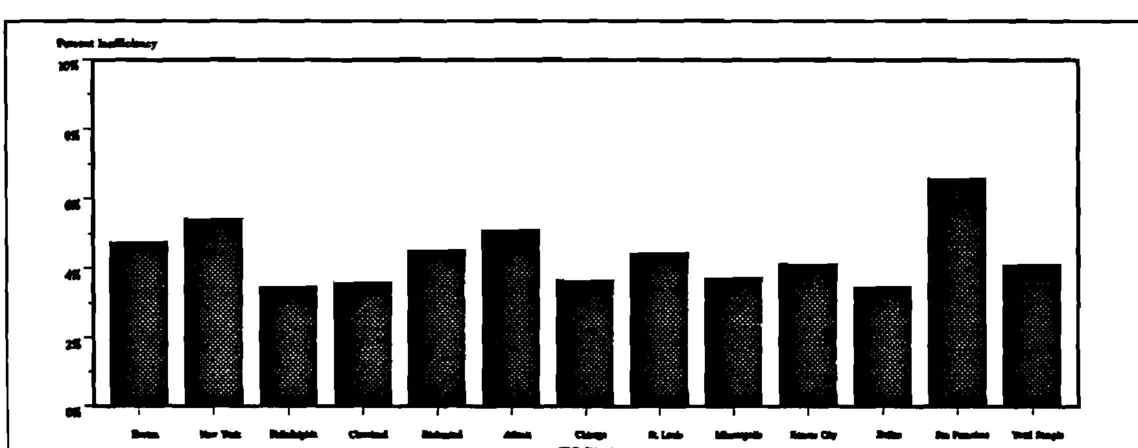

Figure 2. Average Technical Inefficiency by Federal Reserve Bank District

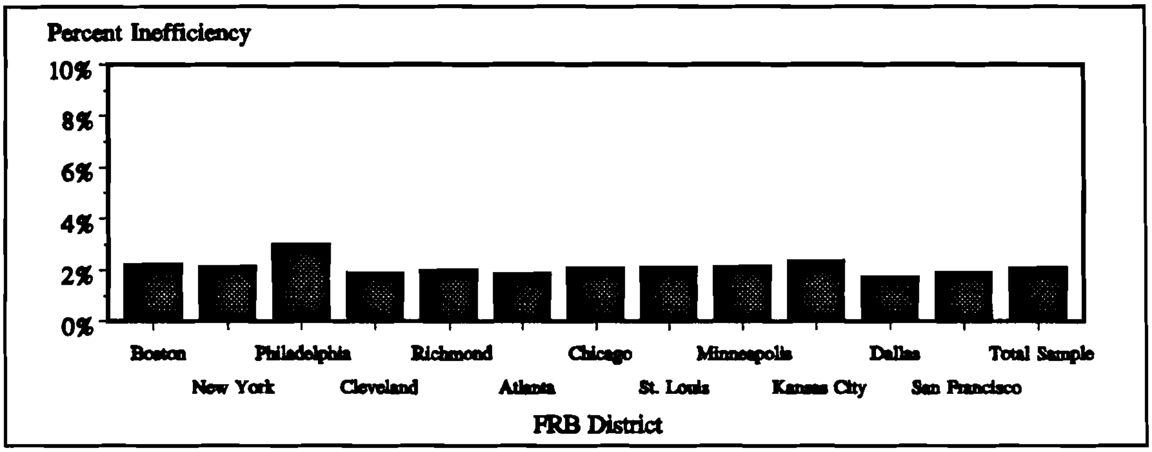

Figure 3. Average Allocative Inefficiency by Federal Reserve Bank District

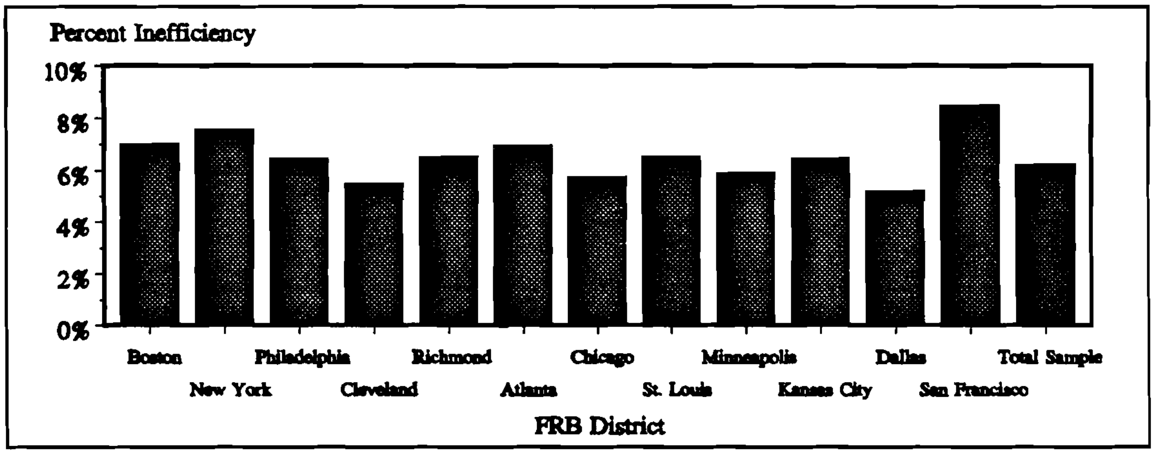

Figure 4. Average Total Inefficiency by Federal Reserve Bank District

To examine this issue in more detail, average total inefficiency by ALR is presented in Figure 6 for only those banks in the $10 million - $25 million total assets size category. Average inefficiency is greater both for banks with very low and very high ALRs. Banks with ALRs of approximately 20 to 70 percent are less cost inefficient than other banks. Hence, the inclusion of agricultural loans in a bank's total loan portfolio may provide some efficiency improvement, provided the ALR does not rise above 70 percent. The limited results of this analysis, however, do not provide strong evidence in support of this argument and further research is clearly necessary to isolate the effect of the agricultural to nonagricultural loan portfolio mix on total bank cost inefficiency.

Figures 7-9 examine bank inefficiency by bank holding company affiliation and size class. In Figure 7, banks that are affiliated with a single- or no-bank holding company (5,499 banks) are more technically and slightly more allocatively inefficient, on average, than those banks that are affiliated with a multi-bank holding company (1,641 banks). Again, the effect of bank size on inefficiency may be influencing the results, since banks which are affiliated with multi-bank holding companies are larger, with average assets of approximately $89 million versus $51 million for single- or no-bank holding company banks.

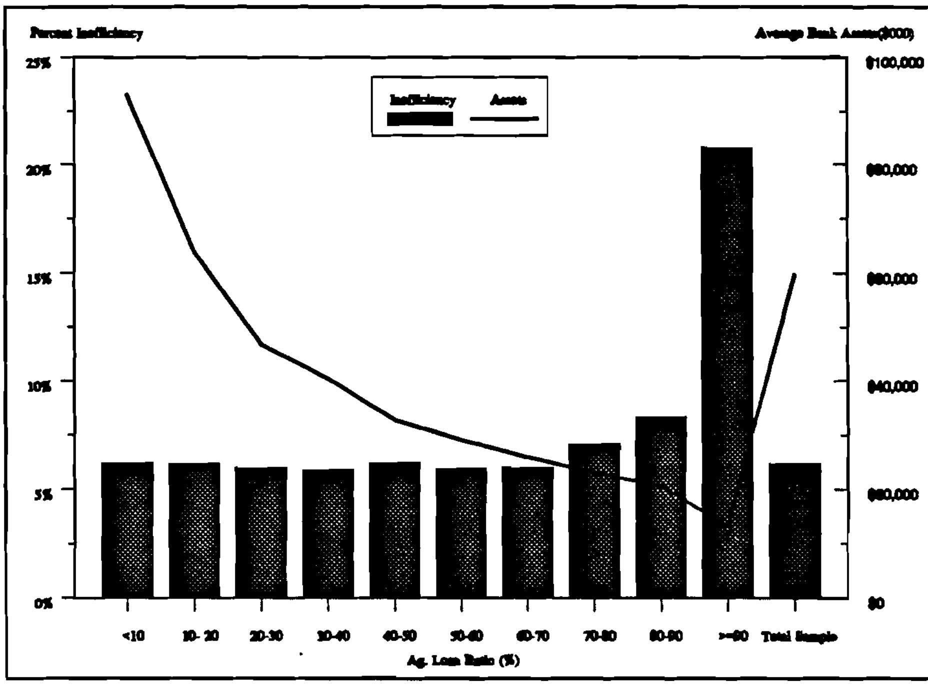

Figure 5. Average Total Inefficiency and Average Bank Assets by Agricultural Loan Ratio

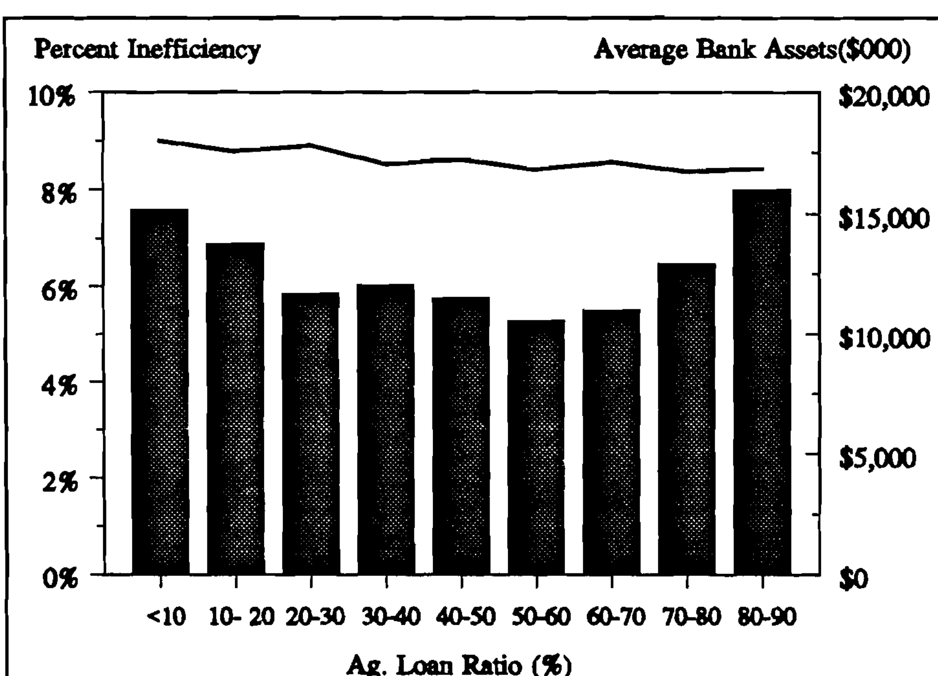

Figure 6. Average Total Inefficiency and Average Total Assets by Agricultural Loan Ratio $10M ≤ Assets < $25M

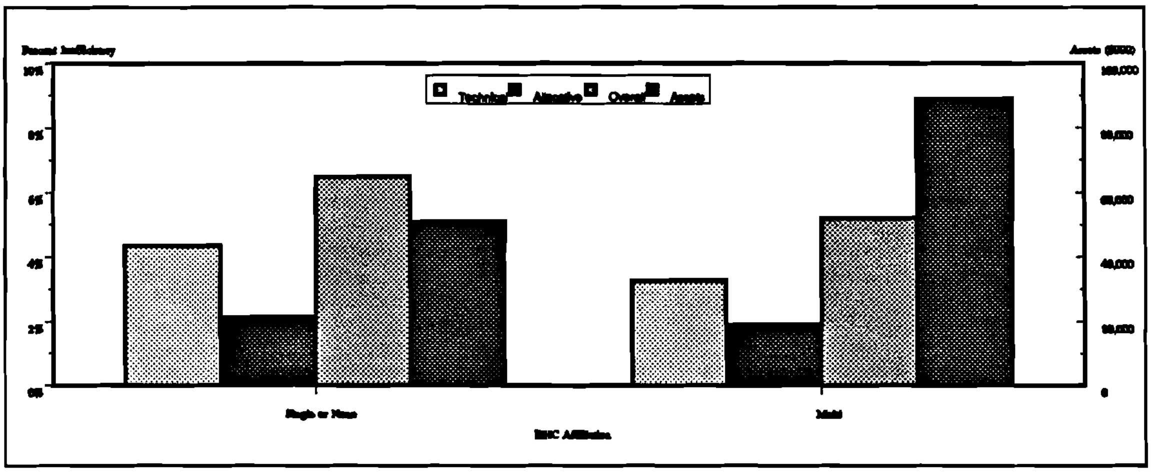

Figure 7. Average Total Inefficiency and Average Assets by BHC Affiliation

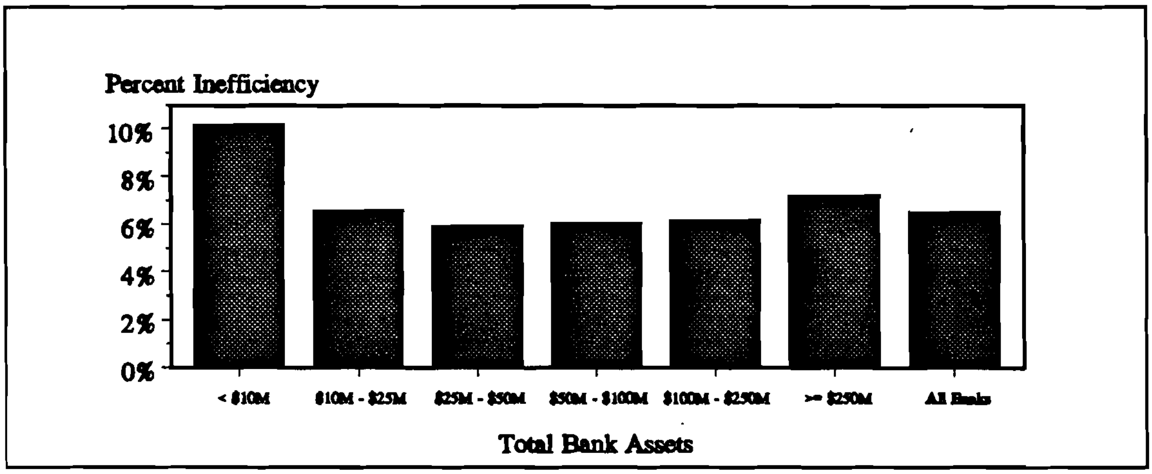

Figure 8. Average Total Inefficiency by Bank Size Class
Single- or No-BHC Banks

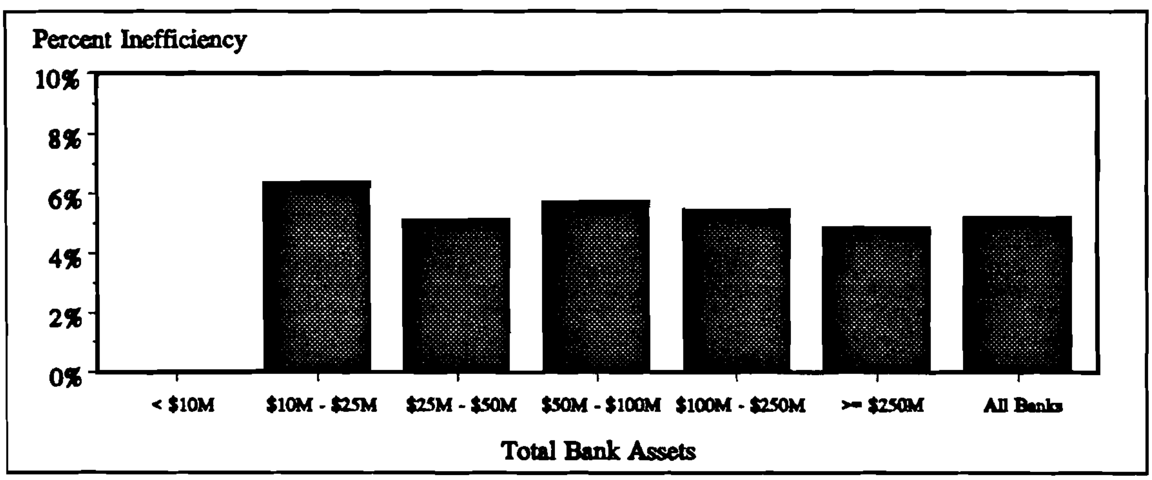

Figure 9. Average Total Inefficiency by Bank Size Class -- Multi-BHC Banks

When average total inefficiency is examined by bank size class for the single- or no-bank holding company banks (Figure 8), small banks have approximately 10 percent total inefficiency. Larger banks are about six percent inefficient, or about the same as the sample average. Banks that are affiliated with a multi-bank holding company (Figure 9) exhibit similar average total inefficiency measures across the $10 million - $250 million size classes. There are no multi-bank holding company banks with assets less than $10 million. However, large banks, those with total assets of greater than $250 million, are somewhat less inefficient, on average, (about five percent) if they are affiliated with a multi-bank holding company than if they are not (Figure 8, about seven percent).

In order to isolate the influences of bank size and holding company affiliation on bank inefficiency, the results of a regression which correlates bank total inefficiency with these variables and several bank environmental variables are presented in Table 4. Bank size (measured as the natural log of assets) is inversely related to inefficiency, which confirms results from the various graphical presentations discussed previously. Affiliation with a multi-bank holding company also decreases inefficiency, supporting the results in Figure 7.

Table 4. Regression Results of Total Inefficiency as a Function of Bank Environmental Characteristics

Variable	Parameter Estimate	P-value
Intercept	0.1324	0.0001
Log Assets	-0.0070	0.0001
Holding Company Affiliation	-0.0104	0.0001
Loans-to-Deposits Ratio	0.0180	0.0001
Real Estate-to-Total Loan Ratio	-0.0074	0.0283
Market Share	-0.0079	0.0131
F Value	51.812	0.0001
Adjusted R-square	0.0344	

Holding a greater proportion of real estate in a bank's loan portfolio also decreases total cost inefficiency. These types of loans typically require less annual servicing than operating and/or shorter-term loans, thus decreasing cost inefficiency (or increasing cost efficiency). Banks which have a relatively greater market share also are less inefficient on average. Lastly, a larger loan-to-deposit ratio increases bank cost inefficiency. Banks with a greater than average loan-to-deposit ratio may be experiencing larger cost inefficiencies because of the greater servicing requirements associated with loans versus deposits.

Summary and Conclusions

This analysis estimates technical, allocative and total cost inefficiency for a sample of 7,140 U.S. agricultural or rural banks using 1990 quarterly Call Report data. A stochastic parametric translog cost frontier with input share equations incorporating six outputs and four inputs is employed to obtain individual estimates of bank inefficiency.

On average, total bank inefficiency is approximately six percent. Approximately two-thirds of the total inefficiency is caused by technical reasons and one-third is associated with allocative inefficiencies. Average inefficiency is the highest for small banks, those with total assets less than $10 million. Inefficiency is relatively constant across other bank size categories, except for extremely large banks (total assets ≥ $250 million). Here, bank inefficiency decreases if the bank is affiliated with a multi-bank holding company but increases if it is not.

Inefficiency is examined by FRB District, but no clear differences are present in the results. Total cost inefficiency is higher for banks with low (less than 20 percent) and high (greater than 70 percent) agricultural loan ratios when banks in the $10 million - $25 million total asset category are examined. This result provides evidence that banks with agricultural loan ratios in the 20 - 70 percent range tend to have lower cost inefficiency, but more research is needed before this hypothesis can be supported with a high degree of certainty.

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AN ANALYSIS OF THE COST EFFICIENCY IN THE FARM CREDIT SYSTEM FOR DIRECT LENDING ASSOCIATIONS

Ming-Che Chien and David J. Leatham[1]

The cooperative Farm Credit System (FCS) in the United States is a network of borrower-owned lending institutions. Its primary economic and political function is to provide reliable, low-cost credit to its owner-borrowers (Collender, Nehring, and Somwaru). For the last few years, the FCS has been undergoing substantial structural changes. Two important factors in these changes are the passage of the Agricultural Credit Act of 1987 (ACA87) and the increasing competition from the commercial banking industry.

The ACA87 contains an extensive set of provisions. Among these, the call for several mergers, with financial incentives involving the repayment of any government federal aid provided, has significant impacts on the organizational structure of the FCS. For example, the Federal Land Bank (FLB) and Federal Intermediate Credit Bank (FICB) in each district, except the FLB of Jackson in receivership, have merged to form the Farm Credit Bank (FCB). Also, 10 of the 12 district Banks for Cooperatives (BCs) voted to merge into the Central Bank for Cooperatives (CoBank). Furthermore, Production Credit Associations (PCAs) and Federal Land Bank Associations (FLBAs) in several districts have merged voluntarily to form Agricultural Credit Associations (ACAs). As direct-lending authority was granted to certain FLBAs, these FLBAs became Federal Land Credit Associations (FLCAs). The organizational changes in the FCS institutions from January 1, 1988 to January 1, 1993 are presented in Table 1.

The increasing competition from the commercial bank industry is shown by the increased outstanding agricultural loans by the commercial banks, both in loan volume and in percentage of market share. As shown in Table 2, total loan volume for the FCS has decreased from about $61.6 million (33.8 percent of total loans) in 1981 to about $35.2 million (25.2 percent of total loans) in 1992. However, total outstanding agricultural loans for the commercial banks have increased from about $38.8 million (21.3 percent of total loans) to about $52.1 million (37.3 percent of total loans) during the same period. The increase in competition puts FCS institutions in a situation where their success depends on their ability to adapt and operate more efficiently in the new environment.

In the past few years, many studies have concentrated on analyzing commercial bank productive efficiency (Evanoff and Israilevich; Ferrier and Lovell; Bauer, Berger, and Humphrey; Berger and Humphrey; Berger, Hancock, and Humphrey). However, comparatively few studies have focused on the efficiency analysis of FCS institutions (Collender; Collender, Nehring, and Somwaru). Furthermore, most studies in bank efficiency used data on a single cross-section of firms, and the separation of technical inefficiency from random noise required strong assumptions about their distributions. Schmidt (1986) advocated the use of panel data to remedy certain serious problems of efficiency analyses, including the one mentioned above.

Productive efficiency literature commonly uses the single equation approach. This method assumes no persistent allocative inefficiency exists. A cost or production function is estimated and the inefficiency is obtained. Alternatively, a system of equations consisting of the cost or production function with the share equations or equations representing the first order conditions for cost minimization can be estimated. This approach is argued to be more appropriate for the internal consistency of the model and to increase the efficiency of the parameter estimates. However, the model will be more complicated and the estimation is intensive, especially for the MLE estimation.

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Table 1. Numbers for Each Farm Credit Institution, 1988Q1 - 1992Q4.

	FLB	FICB	BC	PCA	FLBA	FCB	ACA	FLCA	SC	Total
1988Q1	12	12	13	150	230	12	-	-	4	433
1988Q2	12	12	13	148	229	12	-	-	4	430
1988Q3	1	1	13	143	224	11	-	-	4	397
1988Q4	1	1	13	142	224	11	-	-	6	398
1989Q1	1	1	3	101	148	11	34	4	6	309
1989Q2	1	1	3	96	143	11	39	2	6	302
1989Q3	1	1	3	95	142	11	40	2	6	301
1989Q4	1	1	3	95	148	11	39	2	6	306
1990Q1	1	1	3	94	146	11	40	2	6	304
1990Q2	1	1	3	93	145	11	40	3	6	303
1990Q3	1	1	3	112	144	11	40	4	6	322
1990Q4	1	1	3	112	141	11	40	7	6	322
1991Q1	1	1	3	117	121	11	44	18	5	321
1991Q2	1	1	3	91	96	11	66	19	5	293
1991Q3	1	1	3	87	90	11	70	22	5	290
1991Q4	1	1	3	87	87	11	70	25	5	290
1992Q1	1	1	3	82	84	10	70	24	5	280
1992Q2	1	1	3	75	84	10	70	24	5	273
1992Q3	1	1	3	73	80	10	70	26	5	269
1992Q4	1	1	3	72	78	10	70	27	4	266

Source: FCS Call Reports, 1988Q1-1992Q4, Farm Credit Administration

Note: FLB-Federal Land Bank, FICB-Federal Intermediate Credit Bank, BC-Bank for Cooperatives, PCA-Production Credit Association, FLBA-Federal Land Bank Association, FCB-Farm Credit Banks, ACA-Agricultural Credit Association, FLCA-Federal Land Credit Association, and SC-Service Corporation.

The objective of this study is to estimate and compare the cost efficiency for the Farm Credit System direct lending institutions using a stochastic frontier approach in the context of the panel data analysis. The maximum likelihood estimation technique (MLE) of the single equation approach is used to obtain the efficiency measurements for each institution. Specific objectives are: 1) Use the MLE of the single equation approach to estimate the cost efficiencies for the FCS direct lending institutions, 2) Compare and contrast efficiencies among districts where institutions are highly, moderately, and not yet consolidated and among different types of institutions.

In the next section, the theoretical background of the measurement of cost efficiency will be presented. The estimation procedures for the cost efficiencies of the FCS direct lending associations for the single equation approach in the context of the cost frontier model are detailed

Table 2. **Total Farm Debt, Excluding Households, December 31, 1981-92**

Year	Debt Owed to Reporting Institutions: Farm Credit System	Commercial Banks	Farmers Home Administration	Life Insurance Companies	Total	Individuals and Others	Total Debt
	Million Dollars						
1981	61,566	38,799	20,802	12,150	133,317	49,064	182,381
1982	64,219	41,890	21,275	11,829	139,213	49,592	188,805
1983	63,708	45,422	21,427	11,666	142,223	48,840	191,064
1984	64,686	47,245	23,262	11,889	147,082	46,690	193,782
1985	56,168	44,470	24,534	11,270	136,442	41,150	177,592
1986	45,906	41,620	24,137	10,374	122,037	34,923	156,960
1987	40,026	41,130	23,552	9,352	114,060	30,338	144,399
1988	37,138	42,706	21,852	9,018	110,714	28,654	139,368
1989	36,164	44,794	18,973	9,051	108,982	28,202	137,185
1990	34,954	47,432	16,954	9,641	108,981	27,801	136,782
1991	35,356	50,169	15,212	9,495	110,232	28,522	138,754
1992	35,234	52,132	13,594	9,467	110,427	29,236	139,663
	Percentage Distribution of Total Debt						
1981	33.8	21.3	11.4	6.7	73.1	26.9	100.00
1982	34.0	22.2	11.3	6.3	73.3	26.3	100.00
1983	33.3	23.8	11.2	6.1	74.4	25.6	100.00
1984	33.4	24.4	12.0	6.1	75.9	24.1	100.00
1985	31.6	25.0	13.8	6.3	76.8	23.2	100.00
1986	29.2	26.5	15.4	6.6	77.8	22.2	100.00
1987	27.7	28.5	16.3	6.5	79.0	21.0	100.00
1988	26.6	30.6	15.7	6.5	79.4	20.6	100.00
1989	26.4	32.7	13.8	6.6	79.4	20.6	100.00
1990	25.6	34.7	12.4	7.0	79.7	20.3	100.00
1991	25.5	36.2	11.0	6.8	79.4	20.6	100.00
1992	25.2	37.3	9.7	6.8	79.1	20.9	100.00

Source: Agricultural Income and Finance, Situation and Outlook Report, Economic Research Service, U.S. Department of Agriculture, Feb. 1993.

in the following section. The data needed in this study obtained from the FCA call reports are also discussed, followed by the section of results from empirical estimation of the efficiency measurements for each institution. The concluding section summarizes the major findings and results of this study. Efficiency differences between jointly and nonjointly managed institutions, currently active and dechartered institutions, and acquired and acquiring institutions also will be examined.

The Measurement of Cost Efficiency

The economic theory of the firm assumes production takes place in an environment in which managers attempt to maximize profits by operating in the most efficient manner possible. The possibility that producers might operate inefficiently is typically ignored in modern neoclassical production theory. Early efforts in the investigation of efficiency and its measurement were made by Koopmans (1951, 1957) and Debreu. Koopmans defines a feasible input-output vector to be technically efficient if it is technologically impossible to increase any output and/or to reduce any input without simultaneously reducing at least one other output and/or increasing at least one other input.

While Koopmans offered a definition and characterization of technical efficiency, it was Debreu who first provided a measure or an index of the degree of technical efficiency with his "coefficient of resource utilization." This coefficient is computed as one minus the maximum equiproprotionate reduction in all inputs consistent with continued production of existing outputs, and from it Debreu obtained measures of the magnitude and the cost of technical inefficiency. Farrell (1957) first obtained a partial decomposition of private efficiency into technical and allocative components. Farrell also proposed indexes of technical, allocative, and overall private efficiency, the first being a direct descendent of Debreu's coefficient of resource utilization.

After Farrell's efficiency measures were developed, which were defined over a fairly restrictive technology, subsequent studies have extended or generalized the measures to cover a wide range of technologies (Färe; Färe and Lovell; Färe, Lovell, and Zieschang; Färe and Grosskopf). In this study, we consider the radial, input-induced measures of efficiency like those originally introduced by Farrell. The input-induced measures quantify the efficiency of an input vector in the production of a specified vector of outputs. Because only proportional contractions of the observed input vector are considered in the search for an efficient input vector, they are said to be radial.

The input vector x is called technically efficient for y if and only if $x \in \text{Eff } L(y)$. A technically efficient input vector $x \in \text{Eff } L(y)$ is called allocatively efficient for (y, w) if and only if $w^T x = C(y, w)$. Thus, a firm whose input vector is technically efficient for y and allocatively efficient for (y, w) minimizes the cost of producing its output, and is called cost efficient for (y, w). Note, however, there is no guarantee that the correct output mix is being chosen, given output prices. As a result, efficiency measurement with respect to the input correspondence L(y) is most reasonable in cases in which the output vector y is exogenous to the production unit.

Given these definitions of productive efficiency, the problem is to devise a framework for measuring each type of efficiency. Following Farrell, the technical efficiency (TE) of input vector x $\in L(y)$ is given by

$$TE(x; y) \equiv \min \{\lambda: \lambda x \in L(y), \lambda \geq 0\}. \tag{1}$$

The cost efficiency (CE) of input vector $x \in L(y)$ is given by

$$CE(x; y, w) \equiv C(y, w)/w^T x \tag{2}$$

and the allocative efficiency (AE) of input vector $x \in L(y)$ is given by

$$AE(x; y, w) \equiv CE(x; y, w)/TE(x; y). \tag{3}$$

The notions of cost, technical, and allocative input inefficiencies are illustrated in Figure 1. Assume that a firm uses two inputs, available at fixed prices, x_1 and x_2 to produce a single output, y. Let QQ' be the isoquant depicting various efficient combinations of two inputs which can be used to produce a specific level of output, y_0. The isoquant further to the right (left) corresponds to higher (lower) levels of output. For a given set of input prices, the isocost line, WW', represents the various combinations of inputs which generate the same level of expenditures. Isocost lines further to the right (left) correspond to higher (lower) level of expenditures on inputs.

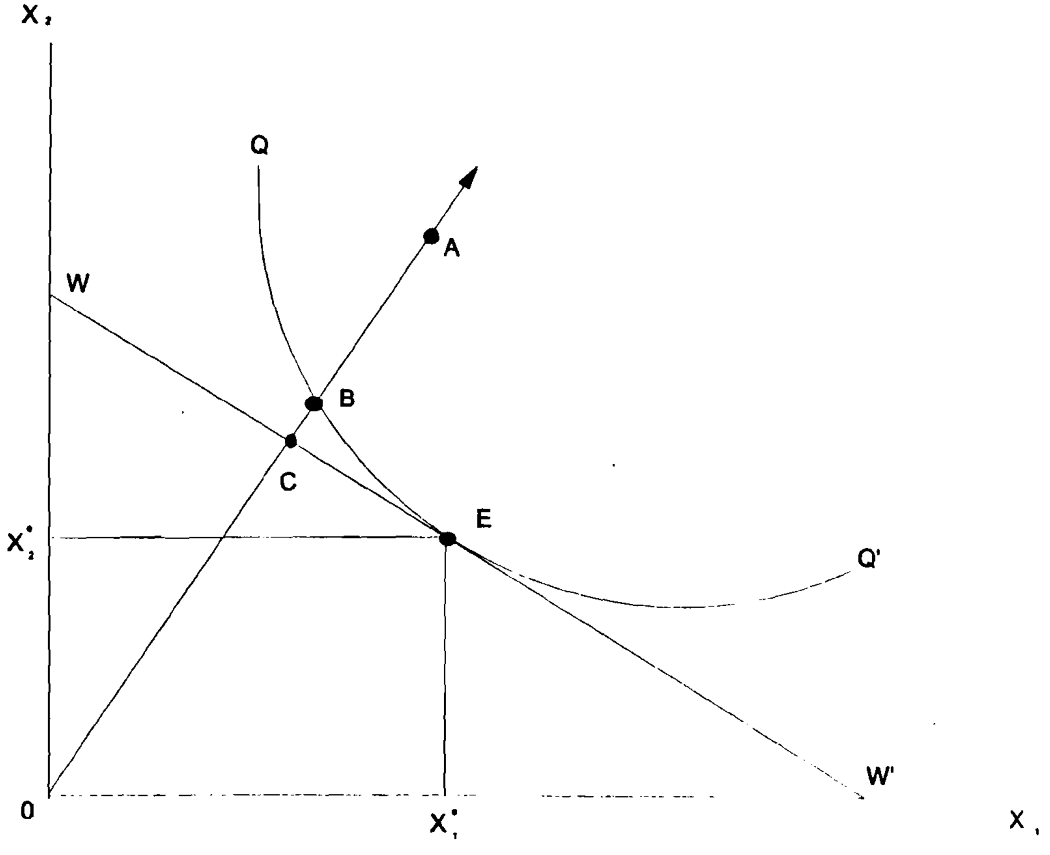

Figure 1. Farrell Efficiency Measurement Using the Input Correspondence

For a firm to produce y_0 at minimum cost, the optimal input combination is at point E. That is, given factor prices, output y_0 can be optimally produced by employing x_1^* units of inputs x_1 and x_2^* units of input x_2. Any other combination of the inputs along the WW' isocost line would generate less output for the same cost. Alternatively, the production of y_0 using any combination of inputs except for that corresponding to point E would cost more. Therefore, at Point E, input efficiency exists. Suppose that the observed input usage of a firm to produce y_0 is at point A. Clearly, the firm is inefficient because it operates above the isoquant for its observed level of output. The firm could contract its input usage along the ray OA to the point B and still produce y_0 units of output. Point B represents the minimum input vector that retains the input mix and output level associated with the firm at point A. Thus, the firm could contract its input vector by a factor OB/OA and suffer no loss of output while realizing a cost savings. The measure OB/OA, which gives the fraction of observed level of output, provides an index of technical efficiency as:

$$TE(x, y) = OB/OA. \tag{1'}$$

Technical efficiency ranges from 0 to 1. A firm observed operating on the isoquant would have a technical efficiency score of 1. Values less than 1 reflect technical inefficiency.

For this sample example, we also can depict allocative inefficiency resulting from producing at point A. Scaling its inputs back to point B would make the observed firm technically efficient, but its costs would still be above the cost minimizing level given by the optimal input mix at point E. Point C represents a level of costs equal to that of the efficient production process at point E because it is on line WW'. Point B corresponds to an output level equal to y_0 because it is on isoquant QQ'. Therefore, the distance CB corresponds to additional production expenses resulting from the suboptimal allocation of inputs. That is, allocative inefficiency exists because we are not on the isocost line, WW'. Formally, OC/OB is a measure of allocative efficiency as:

$$AE(x, y, w) = OC/OB. \tag{3'}$$

OC/OB shows the fraction by which the firm could reduce input usage and, thus, cost to achieve minimum cost. Allocative efficiency also ranges from 0 to 1. A firm observed operating at point of tangency between the isoquant and the isocost curve would have an allocative efficiency score of 1. Values less than 1 reflect allocative inefficiency. Also note that the greater the curvature of the isoquant is (i.e., the less substitutable inputs are), the greater the gap between point B and C would be, and hence the more costly would be any given deviation from the optimal input mix.

Given that the isocost line depicts total expenditures used in production, distance CA is a less than optimal usage of all inputs and corresponds to additional production expenses. Therefore, cost input efficiency is measured as OC/OA. It is the ratio of the minimum possible cost and the observed cost of producing a given level of output and is the product of the two subcomponents, technical and allocative efficiency:

$$CE(x, y, w) = OC/OA = OB/OA \bullet OC/OB. \tag{2'}$$

Estimation Procedures and Data

Based on economic theory, the cost function or the production function uniquely defines the technology. Thus, either the cost function or the production function can be incorporated into the productive efficiency analysis and is normally called the cost frontier and production frontier approach, respectively. However, as pointed out by Kumbhakar (1989), estimation of the production function directly poses two possible problems. First, estimation of the production function directly is appropriate only when inputs can be treated as exogenous. Thus, input demand functions are assumed to be independent to the technical inefficiency of the firm. If outputs are exogenous and inputs are endogenous, direct estimation of the production function using output as the dependent variable is inappropriate. Second, direct estimation of the production function considers only technical inefficiency. Inferences about the overall economic efficiency can not be made unless allocative efficiency is considered.

One of the major advantages of the cost function approach is consistent estimates of the parameters can be obtained if output is exogenous, which is one of the basic behavioral assumptions behind cost minimization. As mentioned before, only the single cost function approach will be considered in this study. Single equation approach has been used by Murray and White; Gilligan and Smirlock; Kim; Goldstein, McNulty, and Verbrugge; Shaffer and David; Goldberg, Hanweck, Keenan, and Young; Ellinger and Neff; and Mester. The cost function used in this study is the translog cost function that can be viewed as a local, second-order approximation to an arbitrary cost function and has been used extensively in the literature.

We will start the specification of the translog cost function as follows by suppressing the firm and time subscripts:

$$\ln TC^Z = \alpha_0^Z + \sum_{i=1}^{n} \alpha_i^Z \ln w_i^Z + \sum_{k=1}^{m} \beta_k^Z \ln y_k^Z + \frac{1}{2}\sum_{i=1}^{n}\sum_{j=1}^{n} \gamma_{ij}^Z \ln w_i^Z \ln w_j^Z$$

$$+ \frac{1}{2}\sum_{k=1}^{m}\sum_{l=1}^{m} \delta_{kl}^Z \ln y_k^Z \ln y_l^Z + \sum_{i=1}^{n}\sum_{k=1}^{m} \theta_{ik}^Z \ln w_i^Z \ln y_k^Z + \varepsilon^Z, \tag{4}$$

where, α's, β's, γ's, δ's, and θ's are parameters to be estimated with $\gamma_{ij} = \gamma_{ji}$ and $\delta_{kl} = \delta_{lk}$, the TC is the total production costs, the w_i's are the n input prices, and y_k's are the m outputs, and Z is the type of association representing PCA, ACA, and FLCA. The restrictions of the linear homogeneity in factor prices for the cost function are imposed as:

$$\Sigma\, \alpha_i = 1,\ \ \Sigma\, \gamma_{ij} = 0, \text{ and } \Sigma\, \theta_{ik} = 0. \tag{5}$$

Following Aigner, Lovell, and Schmidt; and Meeusen and van den Broeck, the error term, ε_{ft}, is composed of two different types of disturbances:

$$\varepsilon_{ft} = u_f + v_{ft} \tag{6}$$

where u_f is one-sided distributed, $u_f \geq 0$, which represents inefficiency and v_{ft} is a stochastic variable that represents uncontrolled random shocks in the production process.

The MLE will be used to estimate equation (4) to obtain the cost frontier and the associated inefficiency measurement for each institution. To estimate equation (4) by the MLE technique, we need to derive the probability density function (pdf) of the composed error term, $\varepsilon_{ft} = u_f + v_{ft}$, first. The distributional assumptions on the composed error are: u_f is i.i.d. one-sided distributed with half-normal density function

$$h(u) = \frac{2}{\sqrt{2\pi}\,\sigma_u} \exp\left(-\frac{u^2}{2\sigma_u^2}\right),\ u \geq 0; \tag{7}$$

v_{ft} is i.i.d. with mean zero and variance σ_v^2, u_f and v_{ft} are independent.

Let g(v) be the density function of v_{ft}. Following Pitt and Lee; and Maddala (p.195), the joint pdf $f(\varepsilon_{ft})$ of ε_{ft} can be defined as follows:

$$f(\varepsilon_{ft}) = \frac{2}{\sigma}\, \phi\left(\frac{\varepsilon_{ft}}{\sigma}\right) \left[1 - \Phi\left(\frac{\varepsilon_{ft}\lambda}{\sigma}\right) \right], \tag{8}$$

where, $\sigma^2 = \sigma_u^2 + \sigma_v^2$, $\lambda = \sigma_u / \sigma_v$, and $\phi(\bullet)$ and $\Phi(\bullet)$ are the density function and distribution function of the standard normal, respectively. Then the log-likelihood function for the pooled data is

$$\ln L = \frac{FT}{2} \ln \frac{2}{\pi} - FT \ln \sigma - \frac{1}{2\sigma^2} \sum_{f=1}^{F}\sum_{t=1}^{T} \varepsilon_{ft}^2 + \sum_{f=1}^{F}\sum_{t=1}^{T} \ln \left[\Phi\left(\frac{\varepsilon_{ft}\lambda}{\sigma}\right) \right]. \tag{9}$$

The above model can be estimated by the maximum likelihood techniques. After the model is estimated, the efficiency measurement for each institution can be obtained from the conditional mean or mode of u_f given ε_{ft}. Jondrow, Lovell, Materov, and Schmidt have shown that the distribution of u_f conditional on ε_{ft} is a normal distribution truncated at zero. The mean or mode of u_f given ε_{ft} is then expressed as follows, respectively:

$$E(u_f|\varepsilon_{ft}) = \left(\frac{\sigma_u\sigma_v}{\sigma}\right)\left[\frac{\phi(\frac{\varepsilon\lambda}{\sigma})}{\Phi(\frac{\varepsilon\lambda}{\sigma})} + \frac{\varepsilon\lambda}{\sigma}\right], \tag{10}$$

$$M(u_f|\varepsilon_{ft}) = \frac{\sigma_u^2}{\sigma_v^2}\varepsilon_{ft}, \text{ if } \varepsilon_{ft} \geq 0; \text{ otherwise zero.} \tag{11}$$

Given the availability of panel data, Kumbhakar has shown that the mean or mode of $u_f|\varepsilon_{ft}$, a point estimator of u_f, is unbiased and consistent as $t \rightarrow \infty$. In this study, we choose the conditional mean of u_f given ε_{ft} as the inefficiency estimate for each FCS institution by evaluating equation (10) at the estimates of σ_u^2 and σ_v^2.

The Data

Data needed in estimating the cost function and, thus, the cost efficiency include total costs, outputs, and input prices for each institution at each time period. In bank efficiency analysis, two approaches exist for defining inputs, outputs, and costs. The production approach views banks as production units. Loans and deposits are treated as outputs using labor, capital, and other inputs to produce them. Operating cost is the only cost considered. Intermediation approach, on the other hand, views banks as the institutions that intermediate funds into loans. It views the dollar volume of loan and deposits as the outputs, while the costs included are operating costs and interest costs. For cooperative FCS institution, the intermediation approach seems to be more appropriate than the production approach because one of the major functions of the FCS institutions is to channel lower cost of credit to members of the association.

Following Collender, outputs considered in this study are accrual and nonaccrual loans. Inputs include labor, physical capital, other operating expenses, and interest costs of borrowed funds. The price of labor is approximated by dividing total labor expenses (salary and benefit expense, director expense) by total liabilities for each institution. The price of physical capital is approximated by dividing occupancy and equipment expenses by the average book value of fixed assets. The price of other operating expenses is approximated by dividing total other operating expenses by the total liabilities. The price of interest expenses is approximated by dividing interest expenses by total liabilities. These data are obtained from the FCA call reports by each institution. To account for the seasonality characteristic of agricultural loans, especially those short-term operating loans, quarterly data with time series running from 1988Q1 through 1992Q4 are used in this study. The end-user computer package, TSP, is used to perform the MLE.

Empirical Results

Parameter and Efficiency Estimates

The MLE parameter estimates for PCA, ACA, and FLCA are presented in Table 3. As shown, more than half of the parameter estimates for the PCA are significant at one percent level, while slightly less than half of the MLE estimates for the ACA are significant at one percent level. Most parameter estimates for the FLCA are surprisingly not significant at five percent level. Because of its lengthy report, the efficiency estimate for each association and its associated ranking will not be presented here but are available from the authors. However, some general findings are summarized as follows. First, the efficiency measurement for individual PCA ranges widely from 0.5807 of one PCA to 0.9714 of another PCA both in the Texas District. The PCA with the 0.5807 efficiency measurement is the least efficient because it is now in liquidation. Second, the efficiency measurement for each ACA also ranges widely, from 0.6432 of one ACA in the St. Paul District to 0.9934 of an ACA in the Baltimore District. The ACA with the efficiency measurement of 0.6432 is not currently active. The efficiency measurement for each FLCA ranges from 0.8065 for a FLCA in

Table 3. MLE Parameter Estimates of the Translog Cost Function

Variable	PCA Parameter Estimater	PCA Standard Error	ACA Parameter Estimate	ACA Standard Error	FLCA Parameter Estimate	FLCA Standard Error
LY1	0.4011	0.0685*	0.6527	0.1282*	-0.2967	0.5755
LY2	0.2187	0.0350*	0.2790	0.0681*	0.2639	0.1868
LW1	-0.5106	0.1642*	-1.7201	0.1658*	1.5854	1.2591
LW2	0.5576	0.0625	-0.5417	0.1316*	0.3029	0.3943
LW3	0.2396	0.1632	0.2259	0.1847	-0.9023	1.3118
LW4	0.3947	0.2647	-0.5245	0.4127	1.0745	0.9413
LY1W1	0.0744	0.0101*	0.0179	0.0156	-0.0692	0.0937
LY1W2	-0.0134	0.0036*	-0.0207	0.0122***	-0.0146	0.0334
LY1W3	0.0173	0.0074*	-0.0100	0.0135	-0.0260	0.1224
LY1W4	0.0129	0.0144	-0.0349	0.0235	0.0538	0.0622
LY2W1	-0.0442	0.0055*	0.0094	0.0093	0.0005	0.0247
LY2W2	-0.0004	0.0016	0.0049	0.0055	0.0041	0.0079
LY2W3	-0.0033	0.0041	0.0061	0.0054	-0.0107	0.0309
LY2W4	0.0128	0.0067***	0.0348	0.0114*	0.0067	0.0246
LY1Y1	0.1329	0.0030*	0.0184	0.0149	0.0906	0.0903
LY1Y2	-0.0522	0.0017*	-0.0064	0.0055	-0.0263	0.0129**
LY2Y2	0.0267	0.0012*	0.0085	0.0014*	0.0038	0.0102
LW1W1	-0.0562	0.0273**	-0.0576	0.0294***	0.1212	0.2206
LW1W2	0.0016	0.0106	-0.0987	0.0168*	0.0230	0.0549
LW1W3	0.0599	0.0171*	0.0038	0.0271	-0.0294	0.2274
LW1W4	-0.0385	0.0292	-0.2340	0.0367*	0.0080	0.1764
LW2W2	-0.0056	0.0035	-0.0017	0.0157	0.0041	0.0232
LW2W3	-0.0044	0.0080	0.0064	0.0153	-0.0036	0.0743
LW2W4	-0.0079	0.0133	-0.0518	0.0253**	0.0087	0.0532
LW3W3	0.0626	0.0123*	0.0321	0.0269	-0.1291	0.2618
LW3W4	-0.1028	0.0352*	-0.0448	0.0368	-0.0705	0.1850
LW4W4	0.1974	0.0541*	0.0889	0.0827	0.3034	0.1347**
$1/\sigma$	7.1273	0.2082*	11.3642	0.2488*	8.7960	1.0716*
λ	1.9588	0.2064*	5.0205	0.7292*	1.8347	0.7476*
Constant	0.8696	0.6771	-6.8608	1.1405*	9.5693	3.8077*
σ_v^2		0.0041		0.0003		0.0030
σ_u^2		0.0156		0.0074		0.0100
Log of Likelihood Function	1621.95		1273.92		220.76	

* Statistically significant at one percent level, ** Statistically significant at five percent level,
*** Statistically significant at 10 percent level.

the St. Paul District to 0.9741 for a FLCA in the St. Louis District. Both of them are currently located in the Agribank District, a result of the mergers of St. Paul and St. Louis Districts in 1992.

Efficiency Comparisons

While the efficiency estimate of each association above helps us understand the efficiency performance of each firm relative to those of the others, it also provides us a basis to conduct several efficiency comparisons of interest. In this section, the efficiency differences among types of associations, among districts, and between associations with different characteristics are compared and contrasted using the efficiency estimates of the MLE.

Efficiency Differences Among Types of Associations

The PCAs are authorized to make short term loans directly to association members, while those FLBAs authorized to make the long term loans directly to members of the associations will become the FLCAs. The ACAs are the combined services of the PCAs and the FLCAs in which both long and short term loans are made directly to members of the associations. It may be of interest to see if efficiency differences exist between or among PCA, ACA, and FLCA.

Table 4 presents the average cost efficiency estimates of the MLE by each farm credit district and type of association. As shown, the total average efficiency estimates of the ACA are higher than those of the PCA and FLCA using either all sample associations or currently active associations. The all sample associations include all chartered or dechartered associations during 1988Q1 to 1992Q4, while the currently active associations are those currently chartered associations only. By examining average cost efficiency estimates for each district, we found that only ACA efficiency estimates for St. Paul and Spokane and Western districts are lower than those of PCA or FLCA using all sample associations and currently active associations, respectively. Both total and district average efficiency estimates of the MLE suggest that FLCA is more efficient than PCA using all samples or currently active associations.

Efficiency Differences Among Districts

While the restructuring of the farm credit associations is still under way, each farm credit district has been experiencing different impact and structural change. As of January 1, 1993, PCAs are active in the Omaha, Wichita, and Texas districts only, while ACAs are active in the Springfield, Baltimore, Columbia, Louisville, and Spokane districts only. Loans made by the above districts are highly specialized through single type of association. Two districts, Western and Agribank districts, are diversified in loan services in which the PCAs, ACAs, and FLCAs are all active in both districts. Thus, in terms of channelling loans to members of the associations, three groups are categorized: districts with PCAs only, districts with ACAs only, and districts with PCAs, ACAs, and FLCAs. In this section, the district efficiency differences within and between groups will be compared and contrasted first.

As shown in the lower panel of Table 4, for districts that channel loans to members directly through PCAs only, MLE efficiency estimates show little difference in the cost efficiency for all four districts, with Texas being the least efficient. For districts that channel loans through ACAs only, Springfield and Baltimore are most efficient, followed by Columbia, Louisville, and Spokane districts. For districts with all types of associations being active, PCAs in the Western district are found to be more efficient than Agribank district. ACAs in the Agribank district are found to be more efficient than those of Western, while results of the FLCA show little difference between these two districts.

Table 4. Average Cost Efficiency Estimates for Each Farm Credit District

District	PCA	ACA	FLCA
All Sample Associations:			
Springfield	0.9110	0.9601	-
Baltimore	0.9124	0.9567	-
Columbia	0.8272	0.9449	-
Louisville	0.9122	0.9396	0.9340
Jackson	0.9202	-	-
St. Louis	0.8732	-	0.9158
St. Paul	0.8803	0.8762	0.8823
Omaha	0.9231	-	-
Wichita	0.9177	-	-
Texas	0.9133	-	-
Western	0.9144	0.8923	0.9383
Spokane	0.8103	0.7659	-
Agribank	0.8922	0.9433	0.9398
Total Average	0.8950	0.9345	0.9267
Currently Active Associations Only:			
Springfield	-	0.9604 (N=11)	-
Baltimore	-	0.9522 (N=16)	-
Columbia	-	0.9450 (N=19)	-
Louisville	-	0.9390 (N=5)	-
Jackson	0.9202 (N=2)	-	-
St. Louis	-	-	-
St. Paul	-	-	-
Omaha	0.9231 (N=1)	-	-
Wichita	0.9200 (N=11)	-	-
Texas	0.9112 (N=16)	-	-
Western	0.9122 (N=13)	0.8904 (N=4)	0.9382 (N=9)
Spokane	-	0.7659 (N=1)	-
Agribank	0.8902 (N=20)	0.9433 (N=10)	0.9399 (N=18)
Total Average	0.9082 (N=63)	0.9431 (N=66)	0.9393 (N=27)

Comparing efficiency estimates between groups of districts, in general, we find that PCAs in those districts with multi-loan-channels such as Western and Agribank districts are less efficient than those districts with single-loan-channel such as Wichita, Texas, Omaha, and Jackson districts. ACAs in those districts with single loan channel are also found to be more efficient than those with several loan channels, with a few exceptions. Results above suggest that districts specializing in loan services are more efficient than districts with diversified loan services.

Second, the degree of the consolidation between associations is different in each district. For example, PCAs in the Omaha and Jackson districts have been highly consolidated into one and two associations, respectively. PCAs in the Wichita, Westem, Texas, and Agribank districts are moderately or less consolidated in which numbers of PCAs are 11, 13, 16, and 20, respectively. Districts with highly consolidated ACAs include Spokane, Western, and Louisville with one, four, and five ACAs, respectively. Districts with moderately or less consolidated ACAs are Agribank, Springfield, Baltimore, and Columbia districts with 10, 11, 16, and 19 ACAs, respectively. Western district FLCAs are moderately consolidated in which nine are active currently, while Agribank district has 18 FLCAs and is considered less consolidated. The efficiency difference between districts with different degrees of consolidation is examined next.

As shown in the lower panel of Table 4, in general, districts with highly consolidated PCAs such as Omaha and Jackson are more efficient than districts with moderately or less consolidated PCAs. Districts with highly consolidated ACAs are less efficient than moderately or less consolidated districts. With FLCAs being moderately consolidated, cost efficiency of the Western district is found to be little different from the Agribank district with less consolidated FLCAs.

Efficiency Differences Between Associations with Different Characteristics

Other than the efficiency differences among types of associations and among districts, comparisons of efficiencies for associations with different management characteristics also may be of interest. For example, it may be interesting to see if associations currently active are more efficient than associations already dechartered. We should expect that associations currently active are more efficient than those already dechartered. Several associations are authorized by the FCA to be jointly managed such that they are at the same office and building and share the incurred operating costs. It may be of interest to see if the associations with joint management status are more efficient then those without nonjoint management. Last, the mergers between or among farm credit associations have been ongoing for years, it is of major concern to association managers and policy makers to see if mergers between or among associations have resulted in efficiency gains. Thus, the efficiency differences between acquired and acquiring associations also will be examined in this section.

As shown in Table 5, as expected, currently active PCAs, ACAs, and FLCAs are found to be more efficient than those already dechartered. However, jointly managed PCAs and FLCAs are not found to be more efficient than nonjointly managed PCAs and FLCAs. The efficiency gains or losses of mergers are not obvious. As shown, the cost efficiencies of the acquired and acquiring PCAs are not much different with the acquired PCAs slightly higher than that of the acquiring PCAs. The cost efficiency of the acquired and acquiring ACAs also show little difference with acquiring ACAs slightly higher than acquired PCAs.

Conclusions

The cooperative FCS has been undergoing substantial structural changes for years. The Agricultural Credit Act of 1987 and the increasing competition from the commercial banks are the major contributions to these changes. As a result, the FCS institutions are in a situation where their success depends on their ability to adapt and operate more efficiently in the new environment. In this study, the cost efficiency of each FCS direct lending institution is estimated using the single equation stochastic cost frontier approach. Efficiency differences among types of associations, among districts, and between associations with different characteristics are compared and contrasted.

Table 5. Efficiency Comparisons Between Associations with Different Characteristics

	Number of Observations	Average Efficiency
PCA:		
All Sample Associations	210	0.8950
Currently Active Associations	63	0.9082
Dechartered Associations	147	0.8884
Jointly Managed Associations	37	0.9009
NonJointly Managed Associations	33	0.9164
Acquired Associations	23	0.9171
Acquiring Associations	14	0.9162
ACA:		
All Sample Associations	90	0.9345
Currently Active Associations	66	0.9431
Dechartered Associations	24	0.9044
Jointly Managed Associations	-	-
Nonjointly Managed Associations	-	-
Acquired Associations	5	0.9711
Acquiring Associations	2	0.9781
FLCA:		
All Sample Associations	47	0.9267
Currently Active Associations	27	0.9393
Dechartered Associations	20	0.9096
Jointly Managed Associations	22	0.9399
Nonjointly Managed Associations	5	0.9635
Acquired Associations	-	-
Acquiring Associations	-	-

Results show that, first, the efficiency estimates for PCAs and ACAs range widely. The least efficient PCA is only 58.07 percent efficiency of the efficiency of the best practice firm, while the least efficient ACA is only 64.32 percent efficiency of the efficiency of the best practice firm. Second, comparisons among different types of associations show that ACA providing both long- and short-term loan services are, in general, more efficient than PCA and FLCA providing only short- and long-term loan service, respectively. The result above suggests that associations providing a complete and coordinated set of short- and long-term credit services to members may be the direction for the future restructuring. On average, FLCA is found to be more efficient than PCA. Third, cost efficiencies are not much different for districts channelling loans to members directly through PCAs only. Springfield and Baltimore districts are the most efficient for districts channelling loans through ACAs only. For districts with all types of associations active, PCAs in the Western district are found to be more efficient than those in the Agribank district, while ACAs in the Agribank district are found to be more efficient than those of Western district.

Fourth, districts specializing in loan services are found to be more efficient than districts with diversified loan services. Districts with highly consolidated PCAs are more efficient than districts with moderately or less consolidated PCAs. This result supports the recent movement of most or all of PCAs in several districts being restructured into a single district-wide PCA. However, districts with highly consolidated ACAs are not found to be more efficient than moderately or less consolidated districts. The unexpected result above suggests that the operations of the newly created ACAs may not have adjusted to be as effective as those of PCAs whose operations have been in existence since the establishment of the FCS. Last, efficiency comparisons between different characteristics show that, as expected, currently active associations are more efficient than those already dechartered associations. Jointly managed PCAs and FLCAs are not found to be more efficient than those of nonjointly managed. The impact of association mergers on efficiency show undetermined results in which acquired PCAs are slightly more efficient than acquiring PCAs, while acquiring ACAs are slightly more efficient than acquired ACAs.

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FDICIA: ITS POTENTIAL TO IMPACT REGIONAL FINANCIAL STABILITY

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On December 19, 1991, after almost a year of debate on banking reform, Congress passed the Federal Deposit Insurance Corporation Improvement Act (FDICIA). Its primary purpose was to provide additional resources to help the industry refinance its own insurance fund. FDICIA also instituted supervisory practices intended to reduce the drain on the Bank Insurance Fund (BIF) so that, with the additional financial support provided by Congress, problems in the industry could be resolved.

Ironically, current economic conditions - specifically, low interest rates, improved asset quality, and high bank liquidity - have reduced the number of bank failures and their overall cost to the insurance fund. The FDIC reported that, as of first quarter 1993, the insurance fund balance was a positive $1.2 billion. In spite of this improved outlook, the industry must still deal with the legislated changes in bank supervision and resolution intended to reduce the cost of bank failures.

One fundamental change brought about by FDICIA is a movement toward depositor discipline, while at the same time changing part of the safety net that promotes stability. FDICIA cuts back or eliminates several tools that provided much of the financial stability in banking during the problems of the 1980s. This article explores the FDICIA provisions that have the most potential for affecting financial stability. Three of these are highlighted: prompt corrective action, liquidity support, and least-cost resolution. The following sections address the origins of the provisions, what they contain, and how they could accentuate liquidity pressures.

Where Did It Come From?

Why did Congress feel that it was necessary to impose strict regulation on banking? The short answer is, to reduce the cost of bank failures to the insurance fund and ultimately taxpayers. According to FDIC statistics, the balance in the insurance fund was a negative $7 billion (net of reserves) as of year-end 1991.

The ongoing savings and loan bailout heightened Congress' sensitivity to the issue of providing taxpayer assistance to failed financial institutions. Practices identified as factors contributing to the high cost of the savings and loan clean-up were targeted for tight regulation by FDICIA. Regulatory forbearance, regulatory accounting, lax capital standards, rapid loan growth, and high interest rates on brokered deposits were some of the factors identified by the General Accounting Office (GAO) as contributing to thrift industry losses.

Banking regulators were criticized for allowing institutions to remain open long after unsafe and unsound conditions had been identified. Barth, Brumbaugh, and Litan reported that the average length of time a failed bank had been on the regulators' problem list increased from 15 months in 1980 to 28 months in 1989. Meanwhile, FDIC resolution costs increased from 12 percent of failed bank assets in mid-decade to 22 percent in 1989. Forbearance was costly.

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Bank resolution policies, particularly "Too Big to Fail" which provided 100 percent coverage for uninsured depositors at large banks, came under fire. In 1991, the Treasury estimated that the cost of the "Too Big To Fail" policy for six large bank resolutions that occurred prior to 1991[2] was approximately $3 billion.[3] When the FDIC began raising insurance premiums to replenish the insurance fund, banks objected to the policy of paying off uninsured depositors at these large institutions.

In 1991, Congress was faced with yet another appropriations request for the savings and loan bailout as well as a request for funding for the bank insurance fund. In an effort to contain industry losses borne by the taxpayers, Congress passed FDICIA with the intention of minimizing the taxpayers' future liability for failed banks. FDICIA contains significant changes in Federal Reserve discount window lending, the bank supervision process, and bank resolution practices. The following section describes these changes and analyzes the potential implications for the banking system.

Overview of FDICIA

FDICIA contains many sections, but this article will concentrate on changes in the bank supervision process, liquidity support for troubled banks, and requirements for ensuring the least-cost resolution of failing institutions. These sections contain the essence of the "new order" for bank depositors. The following sections briefly review each of these provisions.

Bank Supervision

FDICIA initiates a capital-based supervisory system known as prompt corrective action. This framework consists of mandatory and discretionary supervisory actions that become increasingly severe as institutions reach specified capital "tripwires", eventually resulting in closure if a bank's tangible equity becomes two percent or less of total assets. The prompt corrective action framework makes three major changes to regulators' traditional approach to bank supervision. First, capital is singled out as the primary indicator of a bank's condition; second, supervisory actions are mandated as a bank's capital declines; and third, early closure is instituted. Capital ratios that define each "tripwire" are presented in Table 1.

The combination of capital requirements and activity restrictions is not a new approach to bank supervision. The Financial Institutions Reform, Recovery, and Enforcement Act of 1989 tied these two approaches by limiting certain activities such as asset growth and holdings of brokered deposits based on bank capital levels. FDICIA expands this approach by combining mandatory activity restrictions and capital requirements in the prompt corrective action framework. The mandatory and discretionary supervisory actions associated with each capital level are detailed in Table 2.

The activity restrictions contained in FDICIA center around curtailing risk-taking and preventing management from depleting an undercapitalized institution's equity capital. FDICIA limits potentially risky activities of undercapitalized banks by restricting asset growth; requiring divestiture of any subsidiary that poses a significant risk to the insured institution, or is likely to cause a dissipation of its assets or earnings; and limiting access to high cost deposits by limiting

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[2] The resolution of BancTexas, First City (the first time), First Republic, MCorp, Texas American Bancshares, and National Bancshares Corporation were six of the largest bank resolutions that occurred from 1987 through 1990.

[3] The figures on the cost of "Too Big to Fail" are gross figures and do not include such things as offsets against loan balances that would have reduced depositor losses. Thus, the cost should be viewed as a maximum estimate.

interest rates to prevailing rates and prohibiting brokered deposits. Restrictions on the payment of management fees, dividends, inter-affiliate transactions, capital distributions, and bonuses and raises to senior executive officers, are some of the restrictions that curtail management's ability to deplete the equity of undercapitalized institutions.

Table 1. Capital Zones for Prompt Corrective Action

Capital Zone	Total Risk-Based Ratio[a]		Tier 1 Risk-Based Ratio[b]		Leverage Ratio[c]
Well Capitalized	10 or above	and	6 or above	and	5 or above
Adequately Capitalized	8 or above	and	4 or above	and	4 or above[d]
Undercapitalized	Under 8	or	Under 4	or	Under 4[e]
Significantly Undercapitalized	Under 6	or	Under 3	or	Under 3
Critically Undercapitalized[f]					

[a] Ratio of qualifying total capital to weighted risk assets.
[b] Ratio of Tier 1 capital to weighted risk assets.
[c] Ratio of Tier 1 capital to average total consolidated assets.
[d] The standard is three percent or above for a bank with a composite CAMEL rating of one in its most recent report of examination.
[e] The standard is under three percent for a bank with a composite CAMEL rating of one in its most recent report of examination
[f] The only criteria is a tangible equity to assets ratio that is equal to or less than two percent. Tangible equity includes core capital, plus cumulative perpetual preferred stock, minus all intangible assets except purchased mortgage servicing rights (up to a specified limitation). The denominator is quarterly average total assets minus the deductions made in the numerator.

Table 2. Supervisory Actions Applicable to Institutions in Various Capital Categories

Well Capitalized

Mandatory Actions

May not make any capital distribution or pay a management fee to a controlling person that would leave the institution undercapitalized.

Discretionary Actions

None

Adequately Capitalized

Mandatory Actions

May not make any capital distribution or pay a management fee to a controlling person that would leave the institution undercapitalized.

Must obtain a waiver from the FDIC to accept brokered deposits. The rates paid for such deposits cannot significantly exceed the rate paid on deposits of similar maturity in the institution's normal market area or the national rate for deposits accepted outside the institution's normal market area.[a]

May not provide insurance on pass through deposits unless the bank has permission to offer brokered deposits.[b]

Discretionary Actions

None

Undercapitalized

Mandatory Actions

May not make any capital distribution or pay a management fee to a controlling person that would leave the institution undercapitalized.

Must cease paying dividends.

Subject to increased monitoring.

May not accept brokered deposits or offer pass through insurance.[c]

May not solicit deposits by offering rates of interest that are significantly higher than the prevailing rates of interest on insured deposits (1) in the institution's normal market areas; or (2) in the market area in which such deposits would otherwise be accepted.[d]

Must submit an acceptable capital restoration plan within 45 days and implement the plan.

Growth of total assets must be restricted.

Approval from the appropriate agency is required prior to acquisitions, branching, and new lines of business.

Discretionary Actions

The agency may, if it determines that such action is necessary to carry out the purposes of prompt corrective action, take any of the following additional actions:

> Order the institution to recapitalize by issuing equity or debt (including voting stock) or acceding to acquisition or merger.
>
> Restrict inter-affiliate transactions.
>
> Restrict the interest rates the institution pays on deposits.
>
> Order a new election of the board of directors, dismissal of certain senior executive officers, or hiring of new officers.
>
> Prohibit acceptance of deposits from correspondent depository institutions.
>
> Require a company that controls the institution to obtain its regulator's approval before making any capital distribution.
>
> Require the institution to divest or liquidate any subsidiary that poses a significant risk to the institution, or is likely to cause dissipation of its assets or earnings.

Require any controlling company to divest any affiliate that is in danger of insolvency and poses significant risk to the institution, or is likely to cause dissipation of its assets or earnings.

Require any controlling company to divest the institution.

Require the institution to take any other action that would carry out the purposes of prompt corrective action more effectively than the above actions.

Significantly Undercapitalized

Mandatory Actions

Subject to all provisions applicable to undercapitalized institutions.

Bonuses and raises to senior executive officers prohibited without prior written approval.

The agency will take the following actions unless it determines that doing so will not further the purposes of prompt corrective action:

Must raise additional capital or arrange to be merged with another institution.

Transactions with affiliates must be restricted by requiring compliance with section 23A of the Federal Reserve Act as if exemptions of that section did not apply.

Interest rates paid on deposits must be restricted to prevailing rates in the region.

Subject to at least one of the discretionary actions for undercapitalized institutions.

Discretionary Actions

Subject to additional discretionary actions for undercapitalized institutions if they will better carry out the purpose of prompt corrective action.

Subject to any of the supervisory restrictions for critically undercapitalized banks if such action is necessary to carry out the purposes of prompt corrective action.

Subject to conservatorship or receivership if the institution fails to submit or implement a capital restoration plan or to raise capital pursuant to agency order, if such action is necessary to carry out the purposes of prompt corrective action.

Critically Undercapitalized

Mandatory Actions

Must be placed in receivership within 90 days unless the appropriate agency and the FDIC concur that other action would better achieve the purposes of prompt corrective action.

Must be placed in receivership if it continues to be critically undercapitalized on average during the fourth calendar quarter after it initially became critically undercapitalized, unless the primary regulator and the FDIC certify that the institution is still viable and determine that it has a positive net worth, is in substantial compliance with its capital restoration plan, and is profitable or has a sustainable upward trend in earnings.

Within 60 days, must stop making any principal or interest payments on subordinated debt.

If not closed, the institution's activities must be restricted. At a minimum, it may not do the following without the prior written approval of the FDIC:

Enter into any material transaction other than in the usual course of business.

Extend credit for any highly leveraged transactions.

Amend the institution's charter or bylaws.

Make any material change in accounting methods.

Engage in any "covered transactions" as defined in section 23A of the Federal Reserve Act, which concerns affiliate transactions.

Pay excessive compensation or bonuses.

Pay interest on new or renewed liabilities at a rate that would cause the weighted average cost of funds to significantly exceed the prevailing rate in the institution's market area.

Discretionary Actions

Additional restrictions (other than those mandated) may be placed on activities.

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[a] This provision of FDICIA is in section 301, Limitations on Brokered Deposits and Deposit Solicitations, rather than section 131, Prompt Corrective Action.
[b] This provision of FDICIA is in section 301, Limitations on Brokered Deposits and Deposit Solicitations, rather than section 131, Prompt Corrective Action.
[c] This provision of FDICIA is in section 301, Limitations on Brokered Deposits and Deposit Solicitations, rather than section 131, Prompt Corrective Action.
[d] Included in the FDIC's final rule on brokered deposits which implements section 301, Limitations on Brokered Deposits and Deposit Solicitations, of FDICIA effective June 16, 1992.

The ultimate activity restriction is closure. For the first time, FDICIA allows regulators to close banks before equity capital reaches zero. Closing banks when they hit the two percent capital tripwire concentrates more of the risk of failure on equity holders.

The important difference between previous supervisory efforts and the provisions contained in FDICIA is that supervisory discretion is reduced. FDICIA grants few new powers for federal banking supervisors; however, Congress has now mandated when supervisory powers are to be exercised. This contrasts with the pre-FDICIA concept of reliance on internal supervisory guidelines that could be adapted to meet particular situations.

Prompt corrective action is intended to limit losses to the bank insurance fund by (1) increasing the "cushion" available to absorb losses at problem institutions, (2) reducing the time problem institutions remain open, thereby limiting the flight of uninsured depositors, and (3) restricting risk-taking by undercapitalized banks.

Liquidity Support

Traditionally, the Federal Reserve discount window has served as a source of emergency liquidity for banks because of its role as a lender of last resort. However, a report prepared by the House Committee on Banking, Finance, and Urban Affairs argued that during the 1980s, discount window credit funded the flight of uninsured depositors and allowed problem banks to remain open longer, increasing losses to the Bank Insurance Fund. Because discount window loans are collateralized, their position in the event of closure is equal to that of insured depositors. When discount window loans are used to replace uninsured deposits, the effect on resolution is to leave fewer creditors to share in the losses and less collateral available for recovery. FDICIA provisions affecting the discount window are detailed in Table 3.

Table 3. Discount Window Provisions

Undercapitalized Institutions[a]

To avoid liability, lending is limited to 60 days in any 120-day period.

If the Federal Reserve Board or the appropriate federal regulator determines, with due regard to economic conditions and market circumstances, that the institution is viable, the 60-day limitation may be extended for additional 60-day periods upon receipt of a written certification.

Critically Undercapitalized

If any discount window borrowings remain outstanding 5 days after the institution becomes critically undercapitalized, the Federal Reserve Board will be liable for any "increased loss" to the FDIC.

The Federal Reserve Board's liability for increased losses is limited to the lesser of (1) the amount that the Board or a Federal Reserve Bank would have lost on any increases in the amount of advances after the expiration of the applicable lending period if those advances had been unsecured, or (2) the amount of interest received on the increased amount of the advances.

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[a] In this section only, FDICIA defines undercapitalized institutions to include any institution so classified on the basis of the capital ratios presented in Table 1 or any institution having a composite CAMEL rating of five under the Uniform Financial Institutions Rating System as of the most recent examination.

In addition to limiting discount window funds, FDICIA also prevents troubled banks from shifting to volatile funds to meet liquidity needs. **Adequately Capitalized** banks may only accept brokered deposits[4] or offer pass-through insurance[5] if they obtain a waiver from the FDIC. **Undercapitalized** banks may not accept brokered or pass-through deposits and cannot offer interest rates on any deposit that exceed prevailing market rates.

FDICIA has reigned in the "lender of last resort" function served by the discount window and bank participation in the brokered deposit market with the intention of reducing insurance fund losses. It is argued that losses will be reduced for two reasons: (1) the flight of uninsured depositors increases the likelihood that these depositors will not be around to share in BIF losses, and (2) problem banks will no longer be able to avoid the consequences of depositor discipline by offering high interest rates on, or even accepting, brokered deposits.

Least-Cost Resolution

Traditionally, the FDIC covered all uninsured depositors. The Treasury described pre-FDICIA resolution policies as follows:

> "One would expect a policy that protects only insured depositors, with an occasional extension of coverage in rare circumstances to uninsured depositors.

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[4] Brokered deposits are funds received by depository institutions through third party intermediaries.

[5] Pass-through insurance occurs when a fiduciary such as a pension fund deposits funds for a large number of beneficiaries, with $100,000 of deposit insurance "passing through" to each of the beneficiaries.

Instead, the policy has been to protect uninsured depositors whenever possible, with exceptions occurring only in those few instances when the FDIC cannot find an acquirer for the failed institution." (pg. 18)[6]

In contrast, FDICIA now requires that the resolution alternative chosen must result in the least cost to the Bank Insurance Fund. The cost of transferring insured deposits must now be compared with the cost of transferring all deposits and any other resolution alternatives available. Costs must be compared on a present-value basis using a realistic discount rate to account for the time it takes to dispose of the assets and pay off the liabilities. Already this has led to a drop in the number of bank resolutions where all deposits are "assumed" or covered from 83 percent in 1991 to approximately 13 percent during the first eight months of 1993.

FDICIA also specifies that the least-cost evaluation be calculated as of the date the bank first enters receivership or conservatorship, regardless of when the resolution takes place. The cost of liquidation may not exceed the difference between insured deposits and the present value of the net recovery the FDIC reasonably expects as its share on the disposition of the bank's assets. As a result, the FDIC is limited in the steps it can take to protect uninsured depositors. To further reinforce the fact that resolution methods must consider the cost to the insurance fund, FDICIA states that after December 31, 1994, the FDIC may not take any action that would increase losses to the insurance fund by protecting uninsured depositors or creditors other than depositors.

An exception to the least-cost alternative is permitted only if it is determined that (1) liquidation of a troubled bank could cause serious adverse effects on economic conditions or financial stability, and (2) FDIC actions could mitigate these adverse effects. Invoking this exception requires written recommendations from two-thirds of the Board of Directors of the FDIC, two-thirds of the Board of Governors of the Federal Reserve System, and the Secretary of the Treasury in consultation with the President of the United States. The cost of these actions must be repaid by a special assessment on all members of the insurance fund. So, although FDICIA does provide a legal basis for "Too Big to Fail", it appears unlikely that these requirements would be met except in the most dire circumstances.

This section of FDICIA spells out to the FDIC that its first priority is to resolve problem banks at the least cost to the insurance fund. Peripheral considerations such as the impact on other financial institutions are secondary and can only be factored into the resolution decision under specified circumstances.[7] These provisions put uninsured depositors on notice that they can no longer expect full restitution from the insurance fund.

Where Will It Take Us?

Will this piece of legislation accomplish the intended objective of reducing the cost of bank resolutions? Experts are certainly divided on this issue. Limitations on the "Too Big to Fail" doctrine, promptly closing critically undercapitalized banks, and requiring failed banks to be resolved in the manner that results in the least cost to the fund should accomplish this purpose. However, FDICIA has altered the supervisory system, the liquidity support available for troubled banks, and the traditional system of bank resolution. Changes of this magnitude will alter the way depositors,

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[6] During this time period, the FDIC's preferred resolution method was a purchase and assumption where the purchasing bank acquired all deposit liabilities of the failed institution. This method of resolution was less costly than liquidation, as required by law. However, existing regulations did not require the FDIC to request bids on only the insured deposits and compare them to the bids for all deposits.

[7] FDICIA requires the FDIC to evaluate the impact of the means of resolution on the viability of other insured depository institutions in the same community. They must then "take such evaluation into account" when deciding which resolution method to use.

investors, and bank management operate. The remainder of the paper will explore the potential impact of these changes.

Bank Supervision

Lawmakers adopted capital-based regulation as an answer to the increased cost of bank resolutions because of both the number of bank failures and the cost of resolving these failures. Without a doubt, capital reduces the likelihood of failure. This is true for any business, but has special implications for banks. In a world where there is deposit insurance, the more capital a bank has, the greater the bank's potential to absorb losses and the lower insurance fund losses in the event of failure. The concept of capital-based supervision presumes that:

- banks will engage in more risky behavior as capital declines, contributing to bank failures, and

- reported capital ratios are leading indicators that accurately reflect a bank's condition. Early supervisory intervention based on these leading indicators can reduce the number of bank failures.

The following sections discuss these assumptions and examine the potential effectiveness of these new regulations.

Capital as an incentive to reduce risky behavior. Business owners with little equity have an incentive to engage in risky investments that offer high returns. As equity declines, owners have less to lose and more to gain on high-risk, high-yield investments. For banks, the existence of deposit insurance limits the downside risk of failure. If investments turn sour, the insurance fund pays off the insured depositors and bank owners lose their equity. If the investment succeeds, bank owners will have generated a high return on their investment. As their "at risk" equity in the bank declines, management's incentive to take risks increases.

But the "real world" is not this simple. If bank supervision is effective, undercapitalized banks will be prevented from engaging in risky activities, even if deposit insurance provides incentives for such behavior. FDICIA addresses the risk-taking incentives inherent in deposit insurance by imposing mandatory supervisory restrictions on bank activities as bank capital declines. But the question is, will mandatory restrictions be superior to the historical discretionary approach in curtailing risky behavior of undercapitalized banks?

The GAO contended that if capital-based regulation with mandatory restrictions and higher capital standards had been in effect in the 1980s, the banks comprising the Bank of New England Corporation would have had restrictions on asset growth in the mid-1980s and formal enforcement actions by 1986 or 1987. They concluded that "such interventions could have compelled the banks to correct problems before they adversely affected earnings and capital." (pg. 20)

While supervisory intervention based on capital levels may have been warranted in the case of the Bank of New England Corporation, studies that looked at a large number of bank failures over several years did not find evidence that supervisory intervention based on capital levels would have altered the outcome for these institutions. Gilbert (1992) focused on two risky behaviors, rapid asset growth and excessive dividend payments, and did not find that these activities occurred to any great extent. None of the banks in his 854-bank sample that had equity capital below five percent for five or more consecutive quarters before failure had asset growth or dividend payments in their last year. Additionally, banks in the sample that were responsible for disproportionately high losses to the insurance fund did not have above average asset growth or dividend payouts.

In another study, Gilbert (1993) found that supervisors were effective in slowing the asset growth and reducing the dividends of problem banks. Also, banks that were examined in the 12 months prior to failure had significantly lower insurance fund losses as a percent of total bank assets when compared to banks that were not examined. These results demonstrate that, at least during the second half of the 1980s, bank supervisors were effective in constraining the activities of undercapitalized banks and mandatory supervisory restraints would most probably not have changed the outcome for these institutions.

Capital as a leading indicator. For capital-based regulation to be effective in reducing insurance fund losses, declining capital must serve as an accurate and early indicator of bank problems. Clearly, declining capital is indicative of problems. But, studies of capital levels at failed banks have found that deteriorating conditions were often times not signaled by a decline in capital ratios. In a sample of 206 banks that failed in 1989, the Treasury found that only 41 percent had capital ratios below regulatory minimums as of June 30, 1988, and only 48 percent had capital ratios below regulatory minimums by year-end 1988. These numbers indicate that, at least for a majority of the banks that failed in 1989, reported capital levels gave no warning of impending failure less than four quarters prior to failure. Similar results were reported by Gilbert (1991). In his study, only 44 percent of his sample of 854 banks that failed between 1985 and 1990 had capital consistently below regulatory minimums for five or more quarters prior to failure. These results illustrate the problem with relying on capital ratios to identify troubled banks.

Traditional regulatory supervision, which focuses on asset quality, management, earnings, and liquidity, in addition to capital, has historically had a better record for identifying problem banks than the results reported above. For example, in Gilbert's 1993 study 66 percent of the 854 failed banks would have been identified as troubled banks using the composite CAMEL rating, the traditional supervisory tool which reflects all five aspects of a bank's condition, at the examination prior to failure. This compares favorably with the 44 percent that would have been identified by capital ratios alone.

Similar conclusions can be drawn from comparing the number of banks on the FDIC problem bank list with the number of banks subject to prompt corrective action based on capital ratios alone. According to December 31, 1992, Reports of Condition, less than 1.4 percent of all U.S. banks were undercapitalized. The FDIC classified more than seven percent of U.S. banks as problem banks in need of close supervision as of year-end 1992. If it is argued that mandatory supervisory actions are the major changes contained in prompt corrective action, then only a small percent of U.S. banks will be affected by this provision. Traditional supervisory methods - focusing on capital, asset quality, management, earnings and liquidity - identified more than five times the number of institutions needing close supervision. Therefore, it is not obvious that focusing on capital as an indicator of bank soundness will provide additional insights over what is already covered in the supervisory process.[8]

Part of the drawback to relying on capital measures alone is the difficulty in accurately measuring capital. A bank's reported capital can be significantly overstated if the loan loss reserve has not been adequately funded. For example, Lemieux described what would have happened to the capital ratios of banks that failed during the 1980s if they had funded reserves to cover average loan losses. Based on unadjusted reported capital, only 24 percent of sample banks would have had capital below the early closure "tripwire" in FDICIA, at the examination prior to failure. However, when capital measures were adjusted for losses inherent in the loan portfolio, 83 percent would have hit the early closure tripwire at the examination prior to failure. This study demonstrates that accurate measurement of capital is critical to the identification of troubled banks under capital-based supervision.

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[8] FDICIA does not ignore the traditional supervisory process. Procedures were included in the law that allow a regulator to downgrade a bank's capital zone for a less than satisfactory supervisory rating on asset quality, management, earnings, or liquidity.

An added complication of accurately measuring capital is the magnifying effect of regional economic downturns on loan losses. Economic downturns can cause capital shortfalls when declining loan performance and/or declining collateral values force banks to write down the value of their loan portfolio. In a review of loans classified substandard at a sample of Kansas and Oklahoma agricultural banks, Lemieux and Spong found that loss rates on these loans reached 52 percent of substandard loans in 1983 when real per farm income in Kansas and Oklahoma bottomed out.[9] By 1989, agricultural income had improved, and losses on substandard classifications dropped to 22 percent of substandard loans. Over a ten-year period, charge-offs on substandard loans averaged 36 percent for these sample banks. This actual loss rate was significantly higher than the 20-percent rate traditionally used as a "rule of thumb".

Given the impact of the economy on loan values, reserve allocations should be increased when economic conditions deteriorate. Results of the previous study suggest that this is not done as aggressively as it should be. The banks in the study were healthy and not in danger of failing. However, if their reserves had been adjusted in line with the sample's average historical loss rate, their reported capital ratios would have fallen at least two percentage points during the height of the farm crisis. By the end of the decade when the agricultural economy improved, there was little difference between reported capital and capital measures that were adjusted for the sample's average historical losses.

The accuracy of the loan loss reserve, and consequently capital, could improve with more frequent examinations and more consistent policies on valuation reserves for impaired loans. However, the impact of loan loss provisions on earnings, and in turn capital, will still provide an incentive to minimize the recognition of loan losses.

The write-down of a loan portfolio sufficient to affect bank capital will likely occur only after asset quality problems become severe. For this reason, bank capital is more likely to serve as a lagging indicator of bank performance rather than a leading indicator.

Liquidity Support

FDICIA increases the economic incentive depositors have to monitor the soundness of their banks. If more uninsured depositors consistently suffer losses, they will place their funds in banks that are better capitalized. In this way, liquidity could constrain a weakened bank before capital levels cause regulators to consider closure.

This has already been proven. *The Wall Street Journal*, in reporting on the January 29, 1993 failure of First National Bank of Vermont, Springfield, Vermont said, ". . . because of publicity about the tough new rules taking effect Dec. 19 [the prompt corrective action provisions of FDICIA], the bank was hit by waves of withdrawals." The Merchants Bank, Kansas City, Missouri, experienced deposit outflows after negative publicity about the bank's owners and the closing of its sister bank.[10] Both of these banks ended up being closed because of liquidity problems - not capital insolvency.[11] If uninsured depositors are to share in the losses of troubled institutions, banks must be closed when these depositors are still around.

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9 These states are particularly relevant because more than 55 percent of the banks that failed during the 1980s were located in Texas, Oklahoma, Kansas, or Louisiana, states affected by regional economic downturns in the agriculture and energy sectors.

10 For more information see the Appendix.

11 The First National Bank of Vermont was closed January 29, 1993, and The Merchants Bank was closed November 20, 1992.

In addition, liquidity problems could affect BIF losses. For example, limitations on discount window assistance could force troubled banks to sell assets to meet liquidity needs. If the proceeds from asset sales are used to fund uninsured depositor flight, FDIC resolution costs will increase because fewer uninsured depositors will be left to share losses with the FDIC and the volume of quality assets passing to the FDIC will be less.

Moreover, what will be the impact on the financial system when many institutions in the same geographic area are experiencing troubles? During periods of regional economic problems, improvement in bank performance may not be possible until the economy improves. Enforcing certain FDICIA provisions during adverse economic conditions could increase BIF losses rather than reduce them. Mandatory early closure rules could increase the number of bank failures during an economic downturn if economic conditions erode bank capital to the point that viable banks hit early closure tripwires. In addition, closing banks during a recession is more costly. If banks are closed that could have survived, BIF losses will increase.

It should be noted that FDICIA does contain some provisions that serve to limit or alleviate system-wide liquidity pressures. For example, provisions that restrict interbank liabilities reduce the interdependence among banks. This limits the likelihood that isolated bank problems could roll through the financial system. However, restriction of correspondent deposits may further weaken an undercapitalized bank and contribute to a liquidity crisis.

"Too Big To Fail" is another example of a FDICIA provision intended to alleviate system-wide liquidity pressures. If a widespread loss of depositor confidence leads to contagious depositor runs, if a deterioration of correspondent banking relationships causes widespread bank failures, or if there is a breakdown in the payments mechanism, "Too Big to Fail" would allow the FDIC to cover all uninsured depositors. However, the approval process required to invoke "Too Big to Fail", reduces the likelihood that this provision will ever be used. It appears that these built-in safeguards to preserve financial stability might be found lacking under certain circumstances.

<u>Least-Cost Resolution</u>

While requiring the FDIC to resolve problem banks in the least costly manner will reduce losses to the BIF, least-cost resolution in conjunction with early closure could have some unintended effects during an economic downturn. The pool of potential buyers with the necessary capital to acquire troubled banks ebbs with the economy. A reduced pool of potential buyers can reduce the bid price offered to the FDIC or force the FDIC to liquidate rather than transfer the assets of a troubled bank. Either of these alternatives increases the cost of bank resolution for the FDIC. In fact, FDIC statistics show that losses on bank resolutions were 13 percent of assets in 1988 when the economy was relatively strong but jumped to 22 percent of assets in 1989 and 1990 when the economic downturn began.

Conclusion

So far the FDIC has been able to handle bank failures and impose losses on uninsured depositors without serious repercussions for other banks. Falling interest rates have boosted bank profitability and liquidity, and failures have declined. However, FDICIA regulations have yet to be tested in an environment similar to that of the Midwest during the mid-1980s or the East Coast during the late 1980s, when many banks in the same geographic region experienced problems. The question then becomes, can the banking system under FDICIA withstand similar economic stress without a taxpayer bailout? Or has it produced a system that will be vulnerable to economic downturns?

The costs of adjusting to this new order may be significant. FDICIA has altered the liquidity support for troubled banks and the traditional system of bank resolution. Changes of this magnitude will alter the way depositors, investors, and bank management operate. There will be more liquidity insolvent banks. Viability and liquidity support decisions will have to be made at an earlier stage in a bank's deterioration. This increases the difficulty in gauging when individual bank problems could spread to other parts of the banking system, especially during economic downturns.

In addition, historical data does not clearly support that supervisory intervention based solely on capital levels will be more effective than traditional supervisory methods in curtailing risky activities at undercapitalized banks. There is also the question that capital ratios alone may not be the best indicator of a bank's condition. Historical studies show that capital tends to be a lagging - not a leading - indicator of bank problems. Further, the complexities of adequately assessing loan losses can significantly impact the accuracy of reported capital, particularly for troubled banks or banks impacted by regional economic downturns. In light of the difficulty in accurately measuring bank capital and reserving for expected losses and the accompanying reporting burden for the banking industry, capital-based regulation may not provide enough benefits to outweigh its costs. However, overall, FDICIA may offer some benefits in encouraging banks to maintain adequate capital and promptly correct problems.

A repeat of the economic conditions of the last decade could raise questions about the ability of FDICIA to promote financial stability. There are no easy answers to bank reform, but recognition of potential problems will help policymakers in their efforts to create a financial system that contains the economic incentives necessary to promote safety and soundness in the banking system.

Appendix 1

Chronicle of the Merchants Bank

During the 1980s, The Merchants Bank developed its niche as a real estate lender in the Kansas City metropolitan area and subsequently expanded into the national market. Merchants' strategy was one of growth driven by aggressive lending practices, including the purchase of loans originated at affiliated banks.[12] To fund these loans, the bank competed aggressively for deposits, both locally and through deposit brokers. The bank operated with limited liquidity in its balance sheet: its loan-to-deposit ratio remained above 85 percent from 1986 through 1990 and often exceeded 100 percent for short periods of time.

In the three years from 1983 through 1986, Merchants increased its asset base by a factor of eight primarily through loan growth.[13] This growth was due in part to the boom in real estate development resulting from the favorable tax treatment available for real estate investment under the 1981 tax act. Merchants' rapid growth and concentration in real estate lending contributed to its operating risk. However, this high risk strategy also initially generated high returns: the bank's return-on-assets averaged 1.7 percent from 1984 through 1986, placing it among the top performers in the industry. Capital growth was also favorable during this period and actually exceeded asset growth.

However, the strategies that were so effective for Merchants in the mid-1980s, were disastrous in the changed environment of the late 1980s. Chart 1 presents selected financial ratios that illustrate Merchants' financial condition from 1987 through the third quarter of 1992. Real estate overbuilding and the tax law changes in 1986, followed by a recession in the early 1990s, radically altered the profitability of real estate lending. Merchants' net loan losses mounted, increasing from $12 million in 1986 to over $42 million in 1990. The continued decline in the health of the real estate industry increased Merchants' need for capital. In an effort to maintain capital ratios, Merchants' asset base steadily shrank after 1989.

The passage of the Federal Deposit Insurance Corporation Improvement Act (FDICIA) in December 1991 made several changes that were to significantly affect Merchant's ability to survive. First, changes in the brokered deposit regulations impacted Merchants' ability to continue to aggressively acquire the deposits that were essential to its funding structure. In anticipation of becoming subject to the brokered deposit restrictions, Merchants began to reduce its reliance on these deposits. In 1989, brokered deposits accounted for eight percent of total deposits, yet by year-end 1992 brokered deposits were down to four percent of deposits. To replace these funds, Merchants offered higher rates on its insured deposits. This strategy worked until June 16, 1992, when the brokered deposit regulations became effective. In addition to limiting the banks that could accept brokered deposits, the new FDIC regulations clarified the fact that undercapitalized banks were subject to interest rate caps on all deposits not just brokered deposits. With Merchants' weakened capital position, its ability to compete for deposits by offering high interest rates was curtailed.

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12 Merchants' affiliated depository institutions included Metro North State Bank in Kansas City, MO.; Bank of St. Joseph in St. Joseph, MO.; Citizens Bank & Trust in Smithville, MO.; First Bank of Gladstone, MO.; Home Savings Association in Kansas City, MO.; Valley View State Bank in Overland Park, KS.; Industrial State Bank in Kansas City, KS.; The Mission Bank in Mission, KS.; and Security Bank of Kansas City, KS. The entire banking chain controlled approximately $8 billion in assets as of year-end 1989.

13 Total assets were $157 million at year-end 1983. By year-end 1986 total assets had reached $1367 million. Acquisitions of other banks accounted for 30 percent of the growth in assets.

Chart 1. The Merchants Bank

	1987	1988	1989	1990	1991	1992[a]
Real Estate Loans to Total Loans (%)	.43	.43	.48	.46	.50	.50
Loan Losses to Total Loans (%)	.01	.01	.02	.03	.02	.04
Brokered Deposits to Total Deposits (%)	.10	.08	.08	.06	.02	.04
Loans to Deposits (%)	.99	.96	.89	.87	.82	.80
Return on Average Assets (%)	1.25	1.74	1.40	.10	-1.10	-4.62
Total Capital to Average Assets (%)	7.24	8.35	8.74	9.11	8.46	5.97
Asset Growth (%)	.07	.13	.11	-.10	-.01	-.12
Equity Growth (%)	.27	.29	.17	-.04	-.17	-.56

[a] As of September 30, 1992.

Source: Reports of Income and Condition.

Second, FDICIA put uninsured depositors on notice that the Bank Insurance Fund could not be expected to cover losses on uninsured deposits anymore. The change in Merchants' deposit structure, in addition to its continued high loan-to-deposit ratio, increased its vulnerability to a loss of depositor confidence. From mid-1992 on, negative publicity concerning fraud charges against some of the principal stockholders; publication of Merchants' losses during 1991; and the closing of Home Savings, an affiliated thrift, heightened depositors' concerns about Merchants' soundness. When the affiliated Metro North State Bank failed on November 13, 1992 and uninsured depositors were offered 50 cents on the dollar, depositors' concerns about Merchants escalated into a silent run. Although long lines never developed in the bank lobby, wire transfers drained the bank of most of its large deposits. In total, over $200 million left the bank during its last month, with over 50 percent of that leaving in the last week after the failure of Metro North. When the bank closed on November 20, 1992, few uninsured depositors remained.

Merchants' whole strategy had been based on the ready access to liquidity from the deposit market and a continuation of high returns on real estate. FDICIA's changes to coverage of uninsured deposits and limitations on brokered deposits eliminated the deposit market as a source of liquidity for Merchants.

In a last ditch effort to meet its liquidity needs, Merchants began to market its assets. Loan sales to competitors allowed the bank to meet deposit outflows for the three days prior to closing. But on November 20, 1992, the bank was unable to meet the continued deposit outflow. As reported in the *Kansas City Business Journal*, the bank was ineligible for discount window assistance because regulators, "didn't see Merchants continuing as a viable bank because of its non-performing loans, its low capital levels and the run." As a result, the bank was closed. In a news release, Earl Manning, Commissioner of Finance for the State of Missouri, identified liquidity problems as the critical factor in the failure of the bank:

> "It was the result of a higher than normal level of deposit withdrawals where too many customers demanded their money. The Merchants Bank simply ran out of cash."

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FINANCIAL INSTITUTIONS AND INVESTMENT COORDINATION: EVIDENCE FROM THE BANKS FOR COOPERATIVES

Laura M. Geis[1]

During the last several years, farmer cooperatives in the United States have struggled to adapt to changing market conditions through restructurings and joint ventures. Cooperatives in the 1980s faced their most serious financial stress in fifty years. Many cooperatives have been saddled with excess productive capacity, particularly in grain storage, feed manufacturing, fertilizer mixing and application, farm input retailing, and many other lines of business. Despite consolidations and closings, excess capacity persists in many areas, particularly among local grain and farm supply cooperatives.

It has been estimated that excess capacity in retail fertilizer operations in a 24 county area of Missouri results in farmers paying as much as 25 percent more than if cooperatives' capacity were matched with demand (Van Dyne and Rhodes). A survey of cooperative unit train grain loading facilities found them to be operating at 17 percent of total capacity in Iowa, two percent in Nebraska, and 43 percent in North Dakota (Cobia, Wilson, Gunn, and Coon).

As further evidence of financial difficulties from excess capacity, between 1970 and 1985, the total number of cooperatives in the United States declined by more than 2,000. Half of these went out of business, and the rest merged or were acquired (National Society of Accountants for Cooperatives). Although more recently cooperative financial performance has improved, reflecting the healthier agricultural economy and the streamlining of operations, excess capacity remains a problem in many areas. This research explores whether the Banks for Cooperatives (BCs), as dominant lenders to the cooperative sector, can prevent overinvestment by their borrowers or assist them in rationalizing excess capacity.

In general, excess capacity occurs when there is overinvestment relative to future demand for a product, or when demand conditions change so that existing capacity is underutilized. The current problems with excess capacity may be explained in part by the following demand-related factors: a less-than-anticipated demand for farm inputs due to the farm debt crisis, government commodity programs (for example, the PIK program, conservation reserve, ARP, etc.), or changes in transportation systems. On the other hand, the excess capacity problem may also be explained in part by supply-related factors. Overinvestment in productive capacity may have at its root government policies promoting cooperatives, or a lack of effective mechanisms available to cooperatives for signalling investment plans to other firms in the industry.

The response of agricultural economists to conditions of excess capacity in agribusiness industries has been focused on ways to mitigate the problem. Chambonnet and Schrader; and Van Dyne and Rhodes addressed how to optimize local grain and fertilizer capacity relative to a given demand density in a specific geographic area. Van Dyne constructed a model to determine what size, location, and product mix would provide service to farmers at a minimum cost, given the existing facilities. Taylor and Vogler addressed how regional cooperatives could minimize costs to members by consolidating retail facilities and product lines. Gunn and Cobia surveyed cooperative managers about their responses to excess capacity problems.

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The research thus far has focused on measuring or dealing with the consequences of excess capacity, but little emphasis has been placed on the decision making structures which allowed the problem to occur in the first place. Although excess capacity has many causes, one thing seems to be apparent: both as the dominant lenders to farmer cooperatives and as cooperatives themselves, the three Banks for Cooperatives (BCs) have a key role to play in coordinating investments in productive capacity with anticipated future demand for that capacity.

The three Banks for Cooperatives are located in St. Paul, MN, Springfield, MA, and Denver, CO. Part of the cooperatively owned Farm Credit System, the BCs provide loans and financial services to agricultural cooperatives, as well as to rural electric, water and telecommunications systems. The BCs also make loans to foreign buyers of U.S. cooperative-sourced agricultural commodities. Combined, the BCs currently serve about 2,700 borrowers and hold over $12 billion in outstanding loans. They provide a very large share of the debt financing used by farmer cooperatives, many of which have had more limited access to alternative sources of credit than their investor-owned competitors. Moreover, because the benefits of cooperative membership can be gained only by patronizing the cooperative, there is no secondary market for the equities of cooperatively owned firms. Because of these limits on the ability of cooperatives to access many sources of both debt and equity financing, the BCs are well-positioned to coordinate investments in some agribusiness industries by extending or denying credit or influencing the expansion decisions of their borrowers.

This research asked whether the BCs would be able to "turn off the tap" of credit flowing into a market or industry when the sum of planned and existing capacity is fairly well-matched with projected demand. Three conditions are necessary for the BCs to successfully coordinate investments through their credit decisions: 1) they must provide a large share of the credit used by cooperatives, 2) their cooperative borrowers must have a large market share, and 3) the BCs must effectively use the information they receive from monitoring borrower accounts to guide the investment decisions of other borrowers wishing to expand. This study explored the extent to which each of these conditions is met for particular agribusiness industries.

Data was obtained from two surveys: a census of the 290 largest agricultural cooperatives and a series of face-to-face interviews with senior members of the BC credit staff. Survey results indicate that the BCs have had a significant impact on the match of industry capacity and long-run demand among local farm supply and grain cooperatives, where they have the largest market share among lenders and the greatest influence over borrowers. In some parts of the country, the banks have played a very active role in rationalizing excess capacity by initiating mergers and joint ventures among their borrowers based on their analysis of borrower financial data. However, as discussed below, several factors limit the BCs' influence over their borrowers.

Conceptual Framework

The activities of thousands of people may contribute to the production of a single good. Economic agents scattered over thousands of miles make decisions and act based on imperfect information and rules of thumb. A central economic problem is how to coordinate their contributions across space and time in an efficient manner, given that information and control mechanisms are imperfect (Shaffer).

"Coordination" refers to the matching of the supply of a good with the demand for it at every step of the vertical production sequence, at prices consistent with costs of production (Shaffer and Staatz, 1988). Neoclassical economic theory tells us that when supply of a good is precisely matched with demand at prices equal to the marginal cost of production, resources are efficiently allocated. Much of the study of economics is concerned with how prices perform this coordinating function. However, markets are only one of several ways of coordinating supply and demand.

Investment coordination, or the matching of the capacity to produce a good with the long-run demand for it, is accomplished by a mix of institutions including markets for goods and services, as well as bond and equity markets and financial institutions. Although some periods of excess capacity may signal the transition of an industry to a new technology or new demand conditions, the presence of persistent excess capacity may also be an indication that some part of this system of coordinating institutions has failed for a particular industry.

In general, coordinating mechanisms can be classified into three categories (markets, cooperatives, and integration), which refer to the type of transaction whereby the task of coordinating the actions of economic agents is accomplished. The value of this categorization is that it can assist the economist in diagnosing the sources of coordination failures, as well as the factors contributing to effective coordination of investments. The investment of farm supply cooperatives in capacity to produce and distribute far more fertilizer than is demanded by farmers (resulting in either higher prices than necessary or lower or even negative patronage dividends to cover the investment error) is an example of a coordination failure.

Investment coordination has both a vertical and a horizontal dimension. Vertical coordination takes place with respect to complementary investments, i.e., it determines whether the investments of an input industry are sufficient to allow firms in the next stage of the vertical production sequence to expand output as needed. Horizontal coordination takes place with respect to competitive investments in the same industry. The main focus of this research is on the horizontal coordination of investments, although the BCs are important in both.

The process of investment by firms in productive capacity is a particularly difficult coordination problem. It takes place in an environment of pervasive uncertainty. This uncertainty derives not only from the inability of the firm to predict events which will affect future demand (primary uncertainty), but also from its inability to predict the investments that will be undertaken by rival firms in the industry (secondary uncertainty). The degree of secondary or "game-theoretic uncertainty" is a function of the way in which the economic system is organized. The degree of game-theoretic uncertainty that a firm faces when undertaking an investment may be greater or lesser, depending on the effectiveness of the mix of coordinating institutions guiding the investment decision. The problem of investment coordination requires that the game-theoretic uncertainty imposed on one firm by another firm's actions be minimized. Since game-theoretic uncertainty is a function of how the economy is organized, it can only be reduced by appropriate mechanisms for influencing or at least signalling the investment plans of competing firms.

According to neoclassical economic theory, the prices that result from perfectly competitive markets are the ideal mechanism for allocating resources. However, critiques of neoclassical theory have centered on the inability of markets to allocate investment opportunities (Richardson). If demand for a good increases, prices rise, and many firms rush to expand capacity, some institution is needed to determine at what point the expansion of capacity should stop in order to avoid the waste of resources involved in unnecessary investments and subsequent bankruptcies. Because of game-theoretic uncertainty, a competitive system does not convey the appropriate information to effectively deal with the investment coordination problem.

Game theory has been used to model the coordination of investments by firms competing in an industry. (See, for example, Porter and Spence; and Farrell). The capacity expansion process of an industry can be modelled as a noncooperative coordination game, in which the players (firms) cannot communicate with one another or make binding commitments to behave in a certain way. The payoff structure of this type of game is such that they can only achieve the highest payoffs if they act in concert. The intellectual process of a player in a coordination game involves more than just predicting what other players will do. Tacit coordination involves predicting what they will predict about what you will predict they will do, etc. Complicating this process of coordination for common gain is the fact that there is rivalry among alternative common courses of action. In the capacity expansion process of an industry, competing firms do not communicate investment plans to one another, each seeking to preempt its rivals' investments. If many firms respond to a general profit opportunity by rushing to expand capacity, overinvestment (and an unstable dynamic equilibrium) may result.

In game theory, the only solution concept for a noncooperative game is the Nash equilibrium, at which each player's strategy is the best response he could make to the strategies chosen by each of his opponents. However, a game may have more than one equilibrium. When multiple Nash equilibria are possible, it is difficult to predict which equilibrium will result based only on a formal description of the game. Schelling argues that it is possible to predict the outcome of games of tacit coordination only if you have some understanding of the context of the game and the likely expectations of participants. He believes that players will settle on a Nash equilibrium that has some kind of salience or conspicuousness for the persons playing the game. Such solutions are called "focal points." An example of a focal point solution to an investment coordination problem would be for all the firms in an industry to expand enough to maintain historical market shares in an expanded market.

Economic information plays a vital role in the creation of expectations of how other firms in a market will act. If all the firms in an industry obtain information about future demand prospects and rivals' investment plans from common sources, their expectations may converge on a common equilibrium. Common information sources often include the pool of prospective customers, the capital markets, public statements by industry participants, and actual decisions to commit resources.

Capital markets play an extremely important role in the creation of expectations. Security analysts develop predictions of future demand that are published and widely read by the firms in an industry, contributing to a common set of expectations. However, because there is no secondary market for cooperative stock, the cooperative segment of agribusiness industries is lacking an important source of information for tacitly coordinating investment decisions. This study hypothesizes that the BCs substitute for the missing stock market signals by using "inside" information gained from some borrowers to guide the investment decisions of others.

According to Schelling, in recurrent coordination games, players have an incentive to create institutions or rules to render the behavior of their cohorts more predictable. A particular type of institution for resolving coordination problems is a mediator. A mediator has the capacity to absorb and analyze huge amounts of complex information in a way that could not be handled by pre-specified rules. As a source of credit for new investments, banks have a central role as mediators in the capacity expansion process. By interacting with investors who are prohibited by legal or competitive considerations from interacting with each other, bankers may filter information and use it to make lending decisions that lead to a stable expansion of industry capacity. A mediator may be converted into an arbitrator if the players irrevocably surrender authority to him to make binding decisions. A bank may become a *de facto* arbitrator with the power to coordinate investments when a large number of the firms in an expanding industry have few alternative sources of financing.

A primary role of financial institutions in all economies is to serve as screening agents for the allocation of credit. Banking systems and financial (bond and equity) markets interact to determine which firms gain access to financing in order to undertake investments. The organization of a banking system may facilitate information flows which aid banks in their investment coordination role. In Japan and Germany, for example, banks have large shareholdings in the major commercial and industrial firms, as well as interlocking directorates, which enable the banks to exert considerable influence over the investment decisions of their borrowers. Banks provide the majority of financing to industry, and stock markets are relatively weak. In the United States, in contrast, legal barriers exist which prevent banks from owning the stock of their borrowers, strengthening the role of the stock market as a source of discipline on the investment decisions of firms. In general, countries which allow banks liberal powers tend to have weaker stock and bond markets, and those which restrict bank powers tend to have stronger stock and bond markets.

Interesting parallels can be drawn between the banking systems of Japan and Germany and the cooperative sector of the U.S. The signals of the stock market, a common source of discipline and convergent expectations for investor-owned firms, are missing for cooperatives as no secondary market exists for the stock of patron-owned firms. Therefore, this study hypothesizes that the role of the Banks for Cooperatives in monitoring and influencing their borrowers' decisions is enhanced.

Research Methods

Information on issues relevant to investment coordination was gathered from surveys of both borrowers and lenders. The survey of potential borrowers was a mail survey, and the survey of lenders was a series of face-to-face interviews with senior credit officers at each of the BCs.

A census of cooperatives eligible to borrow from the BCs was undertaken, targeting the largest cooperatives in the country, which had sales ranging from $30 million in 1990 to almost $4 billion. The total response rate for the survey was 61.4 percent, or 178 firms responding out of 290 in the survey population.

The 290 firms in the survey population are very representative of the U.S. cooperative sector as a whole and account for the majority of cooperative sales. Respondents reported levels of borrowing from the BCs that ranged from nothing to $400 million. The mean level of borrowing was $21.6 million. Table 1 shows the breakdown of respondents by commodity group. The largest category is farm supply cooperatives, comprising 20.8 percent of all respondents.

Table 1. Breakdown of Respondents by Commodity Group

How would you classify your cooperative by commodity group? (Choose one)

Response	Frequency	Percent[a]
Fruits/Vegetables	27	15.2
Farm Supply	37	20.8
Dairy	34	19.1
Grain	27	15.2
Sugar	6	3.4
Rice	2	1.1
Cotton	8	4.5
Poultry/Livestock	10	5.6
Farm Supply and Grain[b]	20	11.2
Other[c]	7	3.9

[a] Percentages based on 178 valid cases (i.e., no missing values).
[b] A separate category was added for the cooperatives that reported their business was evenly divided between farm supply and grain.
[c] The category "other" includes: seed marketing, honey, petroleum, catfish and dry beans.

In addition to the survey of potential borrowers, senior representatives of the credit staff were interviewed at CoBank, the St. Paul BC and the Springfield BC. These people were generally at the senior vice president level in their respective banks and were in charge of credit decision making. They were identified by other BC officials as those playing a key role in loan decision making or the setting of loan policies.

A total of nine BC credit officers were interviewed, including the senior credit officers in each of the three banks. They were initially approached for the interviews with a letter describing the research project and requesting an interview. This was followed up with telephone calls to make arrangements for meeting. Each person was interviewed individually, with the exception of two people at the St. Paul Bank, who requested a joint interview. The meetings with officials at CoBank and the St. Paul BC lasted approximately one hour, and were taped. The interview with a representative of the Springfield BC was conducted over the telephone, and was not taped.

Research Findings

Research findings in each of three areas are discussed below. The survey of cooperatives elicited information in two key areas: the investment decision making practices of cooperative firms, and the decision of cooperatives to obtain financing from a BC as opposed to an alternative credit source. The survey of lenders sought information to evaluate the effectiveness of the BCs in coordinating investments.

Investment Decision Making by Cooperative Firms

The survey of cooperatives disclosed that considerable excess capacity exists in many parts of the cooperative system, particularly in grain storage, feed manufacturing, fertilizer mixing and application, farm input retailing, and many other lines of business. Over a fourth of the respondents which are engaged in the assembly and handling of member products, a traditional economic role for cooperatives, were operating at less than half of their capacity. (See Table 2).

Table 2. Number and Percent of Firms Utilizing 50 Percent of Capacity or Less, by Enterprise

Line of Business	Number of Firms	Percent of Firms in that Line of Business
Retailing of Farm Inputs	5	6.3
Manufacturing of Farm Inputs	8	20.0
Assembly and Handling of Member Products	19	25.3
Processing of Member Products	9	12.7
Other[a]	7	63.6

[a] "Other" includes: bulk petroleum distribution, petroleum retailing, regional wholesale farm supply, and warehousing.

Excess capacity appears to be widespread across many industries. To circumvent the thorny problem of defining when capacity is "excess" for different industries, the assumption was made that those involved would know it when they see it. Cooperative managers were simply asked to report whether they were suffering from problems of excess capacity in any of their lines of business. Excess capacity was most often reported by grain, farm supply, rice, and fruit and vegetable cooperatives. (See Table 3).

Table 3. Cooperatives with Excess Capacity, by Commodity Group

Are you suffering from serious problems of excess capacity in any of your lines of business?

Commodity Group	**Percent Reporting Excess Capacity**
Fruits/Vegetables	40.7
Farm Supply	38.9
Grain	63.0
Farm Supply and Grain	50.0
Dairy	27.3
Sugar	33.3
Rice	50.0
Cotton	0
Poultry/Livestock	30.0
Other	14.3

Although the excess capacity in the cooperative system appears to be extensive, this study made no attempt to diagnose its causes, which undoubtedly vary from one industry to the next, or the role the BCs may have played in contributing to excess capacity in particular industries. This can only be done effectively in detailed case studies of individual industries. However, the research did explore a number of barriers to investment coordination which are unique to agribusiness industries, the cooperative form of business organization, and the attitudes of typical cooperative members and directors.

First, the structural characteristics of agribusiness industries often make investment planning difficult. Farmer-owned cooperatives have traditionally participated in low value-added commodity industries adjacent to farming, which means that they often face highly volatile markets for their inputs and outputs. As one seasoned agribusiness lender commented,

> Agribusiness is so dynamic that you can't attempt to see what is coming next. When you are making major capital expenditure decisions, it is simply not possible to foresee accurately what government policies will be, what export markets will be like, and so forth. Instead, you just prepare for anything.

The firms in these industries are primarily commodity businesses in low value-added and low differentiation markets, facing unstable demand and prices. They have little brand differentiation to insulate them from the effects of competitors' investment decisions. Many of these firms face significant barriers to exit. For example, it is not easy to sell a grain elevator when the local market will no longer support it. Because cooperatives are closely tied to farm production, their markets often have a strong spatial dimension. Therefore, coordination of investments takes on added importance as an efficient distribution system is needed to transport bulky commodities in a cost-effective manner.

Second, several characteristics of cooperatively owned firms complicate the investment planning process. The stockholders of cooperatives are the major patrons, the return on investment is gained through patronage of the firm, and the firm is under democratic control.

These characteristics of cooperatives have many implications for investment coordination, particularly in the areas of investment strategy, access to different types of financing, and governance of investment decisions (Staatz, 1984, 1987).

Farmer-owned cooperatives pursue investment strategies that are often quite different from investor-owned firms in the same industries. There is a strong complementarity between investments at the farm level and those undertaken by cooperatives. Often the cooperative and members' farms are run as fairly integrated operations, rather than as completely separate profit centers. In addition, it is a common belief among cooperative managers that an important role for marketing cooperatives is to provide a marketing outlet for members' production, which may lead to a bias towards overinvestment by cooperatives if excess capacity exists at the farm level. The stockholder/patron identity results in a horizon problem for some cooperatives, in which older members may not want the cooperative to expand since they will not be around to reap the benefits of the investment. This can create difficulties for these firms in raising new equity capital for financing an investment. In addition, the democratic governance structure sometimes complicates the investment decision-making process, although most cooperatives do not feel the ownership structure of their firm greatly inhibits their ability to respond to investment opportunities. For the majority of cooperatives, management and the board take the lead in analyzing investments, with very little direct member involvement. Thus, management attitudes are of primary importance in matching industry capacity and demand.

A third factor impacting on investment coordination is the attitudes and selective perceptions of cooperative members, directors and managers. Many cooperative members believe that competition among cooperatives is desirable and maintain membership in more than one cooperative, leading to redundant capacity from the point of view of the cooperative system as a whole. The majority of cooperative managers believe that large-scale preemptive capacity expansion is an appropriate strategy. Even though the majority of survey respondents had experienced competitors using such a strategy, few had reconsidered or abandoned expansion plans in response to a rival firm's preemptive strategy. When analyzing investments, most cooperative managers consider their competitors' expansion plans to some extent, relying mainly on customers for information about the capacity of their rivals as well as market growth. This common information source may contribute to convergent expectations among competing firms and contribute to a stable expansion of capacity.

Cooperative managers in general seem to be fairly unsophisticated in their use of financial analysis techniques in feasibility studies for major expansion projects, although the larger cooperatives exhibit a greater degree of financial sophistication. Often cooperatives ignore the cost of equity capital (which is difficult to estimate for a patron-owned firm) and simply use the cost of debt as the discount rate when analyzing the feasibility of a proposed expansion, which has the effect of making projects appear more profitable than they may in fact be. This bias may contribute to overexpansion in cooperative-dominated industries.

Cooperative managers' own analysis of their failed investments, as well as their failure to invest when opportunities were available, reveals that their selective perceptions may have a large impact on industry-wide investment coordination. They acknowledged that game-theoretic uncertainty contributed to the failure of some investments. Most firms that had experienced unprofitable investments blamed the failure on lower-than-anticipated demand, although more than a third of them said that expansion by rivals was a factor in the failure of their investments to turn a profit. The most commonly cited reason that cooperatives fail to invest when an opportunity is available was that management was unaware of the opportunity. This indicates that the differential responsiveness of management is an important factor in investment coordination. Denial of credit by lenders appears to be a much less important coordinating factor in the opinion of cooperative managers.

BC Market Share

In order for the BCs to play a large role in coordinating investments, they must first have a large share of the credit market for farmer cooperatives, and second, cooperatives must in turn have a large market share relative to investor-owned firms in the industries they participate in. If these two conditions are met, the BCs will have access to the investment plans of many firms in an industry. This creates the information base necessary for the banks to have an impact on investment coordination.

The survey of cooperatives eligible to borrow from the BCs, as well as interviews with the senior credit officers, revealed that the BCs' greatest potential for coordinating investments is with local (i.e., retail) grain and farm supply cooperatives. The BCs provide over 70 percent of the long-term debt financing used by grain and farm supply cooperatives, and these firms in turn account for a large share of their local markets. Table 4 presents a breakdown of the BC percentage of cooperatives' long-term debt by commodity group among the survey respondents. Other sources of long-term debt for cooperatives are presented in Table 5.

Table 4. Percent of Long-Term Debt Financing Obtained from the Banks for Cooperatives by Commodity Group

Commodity Group	Mean	Standard Deviation	Number of Firms
Fruits/Vegetables	52.9	43.9	24
Farm Supply	70.5	37.6	36
Dairy	40.1	42.2	32
Grain	70.0	38.9	21
Sugar	56.3	45.3	6
Rice	42.5	46.0	2
Cotton	64.3	47.6	7
Poultry/Livestock	46.1	41.9	8
Other	65.0	44.8	7
Farm Supply and Grain	73.4	31.5	19

When the BCs' share of long-term financing for the industry groups noted above is matched up with the cooperatives' share of product markets, a more complete picture of the BCs' coordinating potential emerges. (See Table 6). The BCs provided 70 percent of the long-term debt used by grain cooperatives, and they in turn accounted for 57 percent of wheat, 40 percent of feed grains, and 46 percent of soybeans marketed in the U.S. at the first-handler level. The banks provided about 70 percent of long-term debt to farm supply cooperatives, and they accounted for about a third of the market for farm inputs. Dairy cooperatives, which have a 68 percent market share, get 40.1 percent of their debt financing from the BCs, on average. However, these figures on cooperative market shares by industry may mask much higher or lower shares in particular local markets, which may be more important than industry shares for purposes of investment coordination.

Table 5. Sources of Long-Term Debt Financing to Cooperatives

Over the past five years, approximately what percent of your firm's long-term debt financing was obtained from each of the following sources?

Source	Mean Percent[a]	Standard Deviation	Minimum	Maximum
Banks for Cooperatives	59.6	41.2	0	100
Bonds, notes or debt certificates issued to members	4.1	13.9	0	100
Commercial Banks	14.9	31.6	0	100
Insurance Companies	4.2	15.4	0	95
Capital Lease Obligations	4.6	13.0	0	100
Industrial Development Revenue Bonds	2.6	8.7	0	53
Other[b]	4.6	19.1	0	100

[a] Percentages based on 162 valid cases.
[b] "Other" includes: contract purchases with the seller of the assets, government programs, and the National Cooperative Bank.

The BCs are clearly the dominant lenders to the cooperative sector in the United States. Not only do they provide more long-term debt financing to cooperatives than any other lender, they are looked to by cooperatives as an important source of financial and management advice. They are well-positioned to influence the investments of their borrowers in an effort to avoid excess capacity. Whether they actually do so is addressed in the next section.

Effectiveness of BCs in Coordinating Investments

In the terminology of systems science, a stable dynamic equilibrium is only possible in a closed system, that is, one that is free of influences from the environment outside the system. By analogy, if the Banks for Cooperatives provided all of the credit to the cooperatives in an industry, and those cooperatives faced no competition from investor-owned firms, the BCs would be able to control the flow of credit into the industry, simply turning off the tap when investments in capacity are fairly well-matched with demand. In the real world, however, such control by a single institution is not possible (and, many would argue, not desirable). Cooperatives do not have a 100 percent market share in any industry, and the Banks for Cooperatives do not supply 100 percent of the credit used by cooperatives. Therefore, "control" becomes "influence." In the absence of a stock market-based coordinating mechanism, the BCs do have considerable influence on the capacity expansion decisions of their borrowers. This section explores the factors which contribute to and detract from the banks' ability to influence the match of industry capacity and long-run demand. The information presented is based on interviews with senior members of the credit staff at each of the BCs.

The BCs seem to be effectively organized to make good use of available information in their credit decisions. All three banks have electronic databases of borrower financial information which they are able to access in order to assess the financial performance of a borrower relative to its peers. These databases are unique to the BCs among agribusiness lenders and are made economically feasible only by the concentration of the banks' loan portfolios in these industries.

Reliable information on the cooperative portion of many agribusiness industries exists only by virtue of it being gathered by the BCs from their borrowers for use in credit decisions.

Table 6. Market Share of Cooperatives

Commodity	Cooperative Market Share
Marketing Cooperatives	
Milk	68
Broilers	12
Eggs	2
Turkeys	18
Hogs	17
Fed Beef	10
Wheat	57
Rice	59
Feed Grains	40
Soybeans	46
Cotton	30
Fresh Vegetables	7
Processing Vegetables	20
Citrus Fruits	67
Other Processing Fruit	65
Other Fresh Fruit	40
Farm Supply	
Feed	16
Fertilizer	44
Petroleum	44
Chemicals	29
Seed	15
Machinery	2

Sources: Knutson, Penn and Boehm.

In many cases, the BCs have used information from their borrower databases to facilitate a more effective match between capacity and demand in particular markets. For example, the St. Paul BC was able to influence the consolidation of grain cooperatives into more economically viable units which optimized storage capacity and access to rail lines on a system-wide basis. In addition, by facilitating mergers to rationalize duplicative capacity in mature industries, the BCs have enabled many cooperatives to adjust to changing economic conditions in a less costly manner than through bankruptcy.

There are two broad factors which facilitate the coordination of investments by the BCs: their market share and the closeness of their relationships with their borrowers.

The most important factor facilitating investment coordination is the BCs' share of the cooperative credit market. BC officials reported that their greatest market share, and thus their greatest potential for coordinating investments, is with local grain and farm supply cooperatives. They subjectively estimated their market share among these firms to be about 80 percent, only slightly higher than the figure obtained in the survey of the 290 largest cooperatives (see Table 4).

Maintaining lending relationships with a large number of the firms in an industry enables the BCs to construct a database useful for analyzing various ways to optimize investments in productive capacity. During the period in which the former St. Louis BC actively encouraged its borrowers to consolidate (1984-86), it was lending to about 175 local farm supply and grain cooperatives across three states. All of the locals were being audited by the same firm (the Illinois Agricultural Auditing Association). A former loan officer with the St. Louis BC reported that it was exceedingly easy to set up a database of borrower financial information because, for the most part, these firms were in the same type of business and were audited by the same firm using the same reporting format to provide comparable information for each cooperative. He commented that once the database was established, the BC functioned in many ways like the finance department of a large firm with many locations. This financial coordination role was not adopted by the regional grain and farm supply cooperatives because they were dominated by people with marketing backgrounds who were more concerned with pushing the regional's products through the local outlets than with optimizing investments in the system as a whole.

The closeness of relationships between the BC credit staff and their borrowers also gives the BCs greater influence over borrowers' decisions. Loyalty contributes to the BCs' coordinating ability. When loyalty to the BC is strong, loan officers have greater latitude to influence borrowers without worrying that they will alienate them and lose their business. Many borrowers reported that they only borrow from a BC and do not even "shop around" when seeking credit.

The BCs are somewhat unique in their relationship orientation to banking, which has both positive and negative aspects. While other lenders to agribusiness may gain or lose customers fairly often based on the deals they are able to offer prospective borrowers, most of the BCs' borrowers are long-term customers with close personal relationships with the BC credit staff. A former BC loan officer who later worked for a major international agribusiness lender commented, "A lot of banks talk about 'relationship banking' and think they do business that way, but the BCs really do it." Another loan officer noted that BC lending differs from commercial bank lending in that BC loan officers are "more maternal" and do a lot more "hand-holding" with their borrowers. With regard to investment coordination, a potential negative aspect of the close relationship is that the borrowers as owners may also pressure the banks to make loans they might not otherwise have made.

Although the BCs have been successful in coordinating investments in some areas, they have been less successful in others. A variety of forces, including competition from other lenders, conflicting pressure from other sources of discipline on cooperatives, the banks' concern with lender liability issues, and the cooperative nature of BC ownership, have limited the banks' influence over their borrowers' investment decisions.

Competition from other lenders is keenest for the business of large, financially successful cooperatives. These firms are courted by a wide variety of lending organizations, both international and domestic, and are more price-sensitive and likely to shop around than smaller customers. The BCs face much less competition for the business of smaller cooperatives, many of whom have outgrown the capacity of local banks to serve their needs. They have much greater influence over the decisions of these firms than the larger ones with greater access to alternative sources of financing.

The BCs are but one of many sources of discipline on cooperatives. Regional cooperatives, other lenders, members, and competing firms influence investment decisions and may be motivated toward different ends than the BCs, reducing their ability to coordinate investments.

In some cases, particularly those involving stressed borrowers, BC management may be reluctant to exert a strong influence on borrowers' decisions for fear of being held liable if the borrower experiences losses and the bank is perceived as participating too closely in the management of the firm.

The cooperative structure of BC ownership also places some limits on the extent to which BC management tries to influence borrowers' decisions. Because the borrowers own the banks, there may be a reluctance on the part of BC management to actively influence certain borrowers, particularly the larger ones. Because a few very large cooperatives make up a disproportionately large share of the BCs' loan portfolios, BC officials are less likely to influence their decisions, although many of these borrowers mentioned that they view the BCs as an important source of advice and information.

The financial status of the borrower also affects whether or not a BC will make a loan to expand capacity when they have doubts about the success of the venture. As long as a borrower has the financial depth to repay a loan even if the venture proves to be unprofitable, the BC will probably make the loan. A senior credit official at CoBank commented,

> I think we have some influence, but does that mean this plant gets built even though it shouldn't be? Yes, it does. Because if the borrower has the ability to finance it, and we are comfortable that we'll get repaid, the plant gets built. We'll certainly encourage dialogue and communication to the extent that we don't violate confidentiality and those types of things, but in the end, the borrower gets to make the investment decision. That's not a decision we make. The issue really becomes one of "Does it impact our ability to get repaid?" If we have doubts about that, we're going to have a major say in it because we don't think it's feasible.

In this regard, the behavior of the BCs is much like that of any other bank: getting their money back is the bottom line.

Conclusions and Policy Implications

This study addressed three separate but related questions: 1) Can the BCs coordinate investments? 2) Do the BCs coordinate investments? and 3) Should the BCs coordinate investments?

The banks can coordinate investments in some industries, mostly where they have a large share of the cooperative credit market, and where that market consists mostly of a large number of smaller firms which, when combined, account for a large portion of the industry. These conditions characterize first handling of grain and farm supply retailing at the local level. The banks have much less influence on larger borrowers, such as Sunkist or Ocean Spray.

Although the BCs can coordinate investments in some industries, whether they do so when possible is another story. BC officials revealed in interviews that they do attempt to coordinate investments, but they do it mostly through "moral suasion" rather than denial of credit. However, they also stressed that there are many factors which limit their ability to influence their borrowers' investment decisions. They are often unwilling to take a very proactive role in encouraging mergers or joint ventures or in discouraging certain investments, in part because they do not feel it is the appropriate role of bankers, and in part because they fear alienating the borrowers/owners.

There is a fear among bankers of being held liable for borrower losses if they intervene too closely in the management of a borrower, as well as losing the priority of their claims in any bankruptcy proceedings. This leads them to be cautious about trying to influence borrower investment decisions. Also, they sometimes face confidentiality problems in using inside information. Although the courts have ruled that banks are free to use internally, for example in credit decisions (Brick), any information obtained from borrower accounts, they are careful not to disclose information about one borrower to another.

When asked what they would do if two competing, long-term borrowers requested financing for similar projects when the market would only support one of them, BC credit officials responded that, first of all, they would never disclose proprietary information of one borrower to another. If both cooperatives were committed to the project and had the necessary financial strength, they would both get loans. However, if each knew of the other's plans, BC officials might discuss the possibility of a joint venture with them:

> If we knew in fact that both knew that they were going after the same market with basically the same expansion program, then we would not in that instance be
>
> reserved about saying, "Maybe you all ought to be talking about how you'll work that out, otherwise you're going to beat each other's brains out in the marketplace."

Even in instances when the banks are in a position to influence borrowers' decisions to prevent overinvestment, whether they should or not is debatable. The existence of excess capacity in many parts of the cooperative sector suggests that the BCs do have a role to play in encouraging mergers to rationalize excess capacity and trying to prevent investments that would lead to excess capacity from being undertaken. The lack of a secondary market for cooperative stock also points to the appropriateness of a more interventionist role for the BCs.

Although cooperatives as a group could benefit from more active investment coordination by the BCs, the majority of those responding to the survey (57.9 percent) do not feel that the BCs should be more active than any other lender in trying to coordinate investments. Many cooperatives, failing to recognize their interdependence with others in the same line of business, view any attempts by the BCs to influence their decisions as undue interference. Those who do not want the BCs to actively coordinate investments cited the banks' lack of industry expertise as a primary reason for their opinions. While they generally welcome advice from the BCs, cooperative managers also feared losing autonomy in decision making if the banks were to more actively intervene. Cooperative managers who favored investment coordination by the BCs tended to focus on the interdependence of cooperatives, both as industry participants and as shareholders of a commonly owned bank.

Many in the cooperative system have recognized a need for some kind of system-wide coordinating institution. In 1987, the Senate Agricultural Appropriations Subcommittee directed the Agricultural Cooperative Service to conduct a study on what cooperatives need to do to remain viable businesses. ACS enlisted the expertise of a wide range of cooperative leaders in identifying and analyzing strategies for helping cooperatives face future challenges (ACS).

One need identified in this report was for an institution to coordinate the resources of the existing cooperative system to allow it to compete more effectively with the extremely large and complex firms that dominate much of the food and fiber sector. The broad cooperative system designs they considered included: 1) a "National Cooperative System" involving complete horizontal integration of cooperative involvement in a given commodity, coupled with vertical integration to move the product from farm to end-user in cooperative hands; 2) a "Cooperative Trading Bloc" approach, which would organize cooperatives into geographically defined blocs dealing with all commodities and inputs common to a specific region; and 3) a "Holding Company or Cooperative Umbrella" approach, allowing cooperatives to centralize under a holding company certain functions, such as accounting and financial management, that have significant economies of scale.

In considering schemes for improving coordination among cooperatives and promoting the position of the cooperative system as a whole vis-a-vis investor-owned competitors, cooperative leaders completely ignored the existing role and potential contributions of the Banks for Cooperatives. This study provides some analysis of how an existing set of institutions might and does coordinate the activities of hundreds of cooperatively owned firms.

Given the lack of a secondary market for cooperative stock, the BCs assume a role of critical importance in coordinating the investments of the cooperative sector. Although they do perform a coordinating function, there are actions that could be taken to augment their coordination role. These include demanding of their borrowers more rigorous analysis of proposed investment projects, devoting more resources to gathering information to be used in credit analysis, and taking a more proactive stance in identifying and encouraging mergers or joint ventures among borrowers where they make economic sense.

What will happen to the BCs if no actions are taken to augment their coordinating role? There is clearly excess capacity in many parts of the U.S. banking industry, a situation that is likely to continue over the next several years. Until the industry consolidates, competition among lenders will continue to be fierce, with different lenders seeking specialized market niches (Duncan, 1992). The credit staff of the Banks for Cooperatives, however, expects that the BCs will stay viable into the future. They cite several reasons for the banks' expected continued success.

They anticipate being able to fill the market niche comprised of cooperatives partly because of their relationship orientation to banking. Most of their borrowers are long-term customers with strong personal relationships with the BC credit staff. Moreover, BC officials anticipate being able to continue their industry specialization, which allows them to offer meaningful advice to their borrowers. They perceive this advice to be of primary importance to their ability to maintain sound long-term relationships with their customers. Moreover, they feel that the vast majority of their customers have a sense of ownership toward the BCs, which adds to their loyalty.

However, the long-term survival of the BCs is directly dependent on the long-term survival of their borrowers. BC officials reported that, for the most part, cooperatives have weathered the financial difficulties they faced in the 1980s. Many have rid themselves of excess capacity through mergers and joint ventures (although more remains to be done in some areas), and have improved decision making, becoming more sophisticated and market-oriented. Because cooperatives and the BCs are dependent on each other for their survival, the BCs have played a key role in their borrowers' adjustments to changing economic conditions. One lender, however, remarked that it is hard to kill a cooperative, given their advantages in sourcing inputs, taxation, and financing. As long as the BCs continue to advise cooperatives in such a way to keep them competitive and maintain their market share relative to their investor-owned competitors, and especially if government policy remains favorable toward cooperatives, the banks will continue to exist and be profitable into the future.

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BUSINESS PERFORMANCE BASED CREDIT SCORING MODELS: A NEW APPROACH TO CREDIT EVALUATION

Madhab R. Khoju and *Peter J. Barry*[1]

Credit evaluation basically involves making judgements about the future loan performance of a borrower. Such judgements should be contingent on future performance of the financed business, because other sources of the borrower's income (e.g., outside employment) may not be reliable. Credit scoring models, therefore, should focus on evaluating a borrower's future business performance. Similarly, the validity of these models should be based on the accuracy in predicting future business performance.

As an example, one might test to see if the credit score corresponds closely with the borrower's eventual change in net worth, repayment ability or loan performance. Such an approach requires time series data for a sample of borrowers so that the data for the preceding years are used as the estimating sample while the data for the following year constitute the hold-out sample. The estimating and hold-out samples in past credit scoring studies in both commercial and agricultural lending (Dietrich and Kaplan; Lufburrow, Barry, and Dixon; Mortensen, Watt, and Leistritz; Ohlson; Scott; Barry and Ellinger; Srinivasan and Kim; Miller and LaDue; Turvey and Brown; Turvey) consist only of cross sectional observations on different borrowers.

This study proposes and develops a performance based credit scoring model (PBCSM) for credit evaluation based on a borrowers' potential business performance. Business performance is acceptable (problem) if the repayment ability of the financed business is higher (lower) than the repayment obligation. Accordingly, the borrower attributes related to the repayment ability are the potential predictors of business performance in estimating a PBCSM.

The credit scores of borrowers computed from an estimated PBCSM serve as proxies for the repayment probabilities and are compared with an objectively predetermined standard (cut-off level) to distinguish acceptable (who would repay) from problem (who would default) borrowers. If the lender misclassifies an acceptable borrower as problem (type II error), the lender foregoes current interest earnings and potential earnings from a future relationship. On the other hand, if the lender misclassifies a problem as acceptable (type I error), the lender may lose both the principal and accrued interest. The lenders likely are more concerned about type I errors because of their immediate higher costs relative to type II errors.

Depending on the weights used for the predictor variables, even a borrower with relatively undesirable levels of one or more predictor variables (e.g., very high level of leverage) may be evaluated as acceptable from the estimated PBCSM. A lender, may not want such a borrower in the loan portfolio because of the high cost of a potential type I error. To identify such borrowers, this study also develops a financial outlook index.

The importance of the predictor variables in a credit scoring model estimated from cross sectional observations is conditional on the favorable or unfavorable economic environments that generated the estimating sample. Accordingly, the lenders must reestimate the credit scoring model each time the economic environment changes and it involves significant resources. Changes in economic environments, however, may not be a problem for the PBCSM because it is

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estimated from a time-series of cross-section data. Moreover, the PBCSM may be updated using a simulated data base. For this, the business performance of a representative case farm business may be subjected to a stochastic set of output and output price levels for alternative tenure and solvency positions. Replicating this approach over time results in a data base that is analogous to cross section and time series. The predictive accuracy of a PBCSM estimated from simulated data may then be compared to that of the PBCSM estimated from actual data.

The specific objectives of this paper are threefold - (1) assess the usefulness of a PBCSM in assessing the credit worthiness of agricultural borrowers, (2) use the financial outlook index to further screen borrowers evaluated as acceptable by the PBCSM, and (3) assess the usefulness of updating PBCSM using the simulated data.

Theoretical Framework

A. Performance Based Credit Scoring Model:

Consider a loan of $L for one period at rate of interest, i. The contractual revenue on this loan is $R_r = (1+i)L$. Actual revenue, however, depends on Y, the repayment ability from the financed business. Accordingly, the realized revenue as a function of Y is given as:

$$\text{Realized Revenue} = \begin{cases} R_r & \text{if } Y > R_r \\ -(R_r - Y) & \text{if } 0 < Y < R_r \\ -R_r & \text{if } Y < 0 \end{cases} \quad (1)$$

In general, the contractual revenue R_r is much smaller than M, the expected value of Y. However, because of the probability that the repayment ability may be less than R_r, the lender may not receive the contractual revenue. For simplicity, the probability distribution of the realized revenue from the loan is represented by a Bernoulli trial:

$$\text{Realized Revenue} = \begin{cases} R_r & \text{with repayment probability } P \\ R_d & \text{with default probability } (1-P) \end{cases} \quad (2)$$

where, R_d is the product of q, the write-off rate of delinquent loans, and L_d, the unpaid balance in the written-off loans.

Assuming the riskless rate of earnings, i_f, from investments like government securities as the opportunity cost of loanable funds, a risk neutral lender will approve loans to only those borrowers for whom the expected returns (represented by the left hand side of equation 3) exceed the opportunity cost of loanable funds (represented by the right hand side of equation 3) i.e.,

$$P^*L^*i - (1-P)^*L_D{}^*q > P^*L^*i_f + (1-P)^*L_D{}^*i_f \quad (3)$$

Moving the right hand side of equation 3 to the left hand side and with some algebra, the expected profit on the loan can be expressed as:

$$P^*L^*(i-i_f) - (1-P)^*L_D{}^*(q+i_f) > 0 \quad (4)$$

It is evident from (4) that the expected profit on the loan depends on both the probability of repayment and the pay-offs in the event of default or repayment. Following Boyes, Hoffman and Low, (4) can be written as:

$$P > [L_D(q+i_f)]/[(L(i-i_f)+L_D(q+i_f)] \quad (5)$$

The credit evaluation of a borrower depends on whether P is higher or lower than the cut-off level given by the right hand side term in (5). Such a cut-off level can be approximated by the lender and, therefore, the credit evaluation hinges on the lender's judgement about P. For this, the lenders utilize the estimated credit score for the ith borrower as a proxy for $\hat{P}_i$, the estimated conditional mean of the repayment probability, P_i, i.e.,:

$$P_i = \hat{P}_i + e_i \tag{6}$$

where, e_i denotes the residual associated with this process.

The repayment probability of a borrower in this study, is approximated by the credit score based on an estimated PBCSM. Formulation of a PBCSM, however, entails identification of borrower attributes affecting repayment ability of the business. Since the firm's solvency and liquidity positions at the beginning of the year and returns from the assets and operating expenses over the year determine repayment ability, these four variables serve as the potential predictors of business performance.

In this study, a logit model is used because of its merit relative to other statistical methods for credit scoring (Collins and Green). Because the business performance is binary i.e., takes a value of 1 if repayment ability is higher than the repayment obligation, and zero otherwise, a dichotomous logit model is specified as:

$$\log [P_i/(1-P_i)] = \alpha + \Sigma\beta_{ij} X_{ij} \tag{7}$$

Where, P_i is the probability of acceptable business performance for the ith borrower, the dependent variable is the logarithm of the odds ratio, α is the intercept, β_{ij} is the logistic regression coefficient, and X_{ij} is the jth attribute of ith borrower related to business performance. By taking antilogs of both sides in (7), P_i is expressed as:

$$P_i = [\exp(\alpha + \Sigma\beta_{ij} X_{ij})]/[1 + \exp(\alpha + \Sigma\beta_{ij} X_{ij})] \tag{8}$$

The estimated P_i from (8) is compared with the cut-off level to distinguish acceptable from problem borrowers. Depending on the parameter estimates such an evaluation can classify a borrower as acceptable even if the lender may not like the levels of one or more borrower attributes. To identify such borrowers, the financial outlook index is discussed next.

B. Financial Outlook Index:

Assume the utility function of a lending officer from evaluating the ith borrower is represented as:

$$U_i(.) = U_i(X_{i1},...X_{ij},...X_{ik}) \tag{9}$$

where, X_{ij} is the level of the jth predictor of business performance for the ith borrower. Each predictor, j = 1,2,...,k, is measured such that the higher the level of the jth predictor, the higher the level of utility. By invoking additive utility theory (Fishburn), (9) can be expressed as:

$$U_i(.) = a_1 U_i(X_{i1}) + ... + a_j U_i(X_{ij}) + ... + a_k U_i(X_{ik}) \tag{10}$$

Where a_j, j = 1,...,k are the weights. Equation (10) allows numerical evaluation of the utility function (9) as a weighted average of utilities from each of the predictors. The utility from jth predictor variable, $U_i(X_{ij})$, is evaluated as:

$$U_i(X_{ij}) = U_i(X_{mj})^*F_j(X_{ij}) \tag{11}$$

where, $U_i(X_{mj})$ represents the level of utility from X_{mj} (the maximum value of X_j in the estimating sample), and $F_j(X_{ij})$ is the distribution function of X_{ij} relative to all X_j's in the estimating sample. A similar assumption was made by Shashua and Goldschmidt.

Since X_{mj} is the maximum value of X_j, $U_i(X_{mj})$ is assumed constant and is represented by b_j. The utility function in (10) then can be expressed:

$$U_i(.) = W_1 F_1(X_{i1}) + ... + W_j F_j(X_{ij}) + ... + W_k F_k(X_{ik}) \quad (12)$$

where, $W_j = a_j{}^*b_j$

Equation (12) allows numerical computation of the utility function (9) as a linear combination of the distribution function of each predictor variable. However, because it is based on the assumption of additive utility theory, it is valid only if the arguments of the utility function (9) are independent.

The distribution function for a particular predictor may be approximated from the cumulative percent of the predictor in the estimating sample. The weights, on the other hand, may be chosen based on the relative importance of the predictors. By choosing the weights such that $\Sigma W_j = 1$, equation (12) results in a financial outlook index, I_i, whose maximum possible value is 100.

The financial outlook index of a borrower is sensitive to the cumulative percent of each of the predictor variables in the estimating sample. Accordingly, the financial outlook index will be lowered if the cumulative percents of one or more predictor variables are low relative to others in the estimating sample. Accordingly, the financial outlook index resulting from (12) has the potential of identifying the borrowers who have relatively low levels of one or more predictors and thus further screen borrowers evaluated as acceptable from the estimated PBCSM.

Data and Model Specifications

Data for the study came from the Illinois Farm Business Farm Management (FBFM) Association records. Although FBFM started maintaining records of cooperating farmers in Illinois in the 1940's, certification of balance sheets was initiated only in 1985. The majority of certified farm businesses are located in central Illinois and are predominantly grain farms followed by hog and dairy farms. Because the coefficients in (8) and weights in (12) are likely to differ between grain farms and other types of farming enterprises e.g., livestock or dairy, the PBCSM in this study is estimated for grain farms only.

The following two criteria are used in selecting the sample for this study - (1) the grain farms must have certified financial statements for each of the six years (1985 to 1990), and (2) at least three grain farms must be in a given county to reduce heterogeneity in the sample data. In checking the FBFM records, only 74 grain farms satisfied the criteria.

A grain farm is classified as having acceptable (problem) business performance if the repayment ability (sum of depreciation and net farm income net of income tax, social security tax and family living withdrawal) of the business in year t is higher (lower) than the repayment obligations in year t. Because the repayment ability of a business at the end of year t depends on the solvency and liquidity position at the beginning of year t, as well as the realized profitability and operating efficiency during the year t, these criteria are identified as potential predictors of business performance.

In this study, solvency is represented by the equity to asset ratio (EAR). Higher EAR indicates lower debt financing which in turn implies less repayment obligation. The liquidity position is represented by the current ratio (CR) which is measured as the ratio of current assets to current liabilities. Higher liquidity is associated with higher repayment ability. Profitability is represented by the rate of return on equity (ROE) because it is sensitive to the financial structure of the business. ROE is measured as the ratio of net farm income from operations less unpaid labor charge for operator and family to the farm equity. Higher profitability implies a stronger repayment ability of the business. Efficiency is measured by the operating efficiency ratio (OER) which is computed as the ratio of gross returns plus depreciation net of operating expenses to the gross returns. This ratio reflects the efficiency of operating expense management. Hence, higher the OER the higher is the profitability and repayment ability.

The dichotomous logit model is specified as :

$$\log[P_i/(1-P_i)] = \alpha + \beta_{1i}X_{1i} + \beta_{2i}X_{2i} + \beta_{3i}X_{3i} + \beta_{4i}X_{4i} \quad (13)$$

where, X_{1i} is the observed ROE of the business in year t, X_{2i} is the EAR of the business at the beginning of year t, X_{3i} is the CR of the business at the beginning of year t, and X_{4i} is the observed OER of the business in year t. Other variables have been defined above.

Model Estimation and Validation Results

The end of the year balance sheet for the preceding year is the same as the beginning of the year balance sheet for the following year. Accordingly, the beginning of the year balance sheet and the income statement for year t were used to compute business performance for year t and the levels of the predictor variables for year t. For example, the end of the year balance sheet for 1985 and the income statement for 1986 were used to compute the business performance for 1986. This resulted in a pooled time series of 370 observations on business performance and predictor variables (74 for each of the years 1986 to 1990). Of this, a pooled time series of 296 observations (74 observations from 1986 to 1989) were used as an estimating sample and the observations for 1990 as a hold-out sample. In the estimating sample 142 observations (i.e., 47.97 percent) had acceptable business performance and the remaining 154 (i.e., 52.03 percent) had problem business performance. Since the businesses are chosen and then their performances are observed later, the sampling design used is considered exogenous (Manski and Lerman).

SAS LOGIST procedure was used for model estimation. Because the coefficient of current ratio had a p-value of 0.69 it was omitted from the final model. The estimates of the final model are presented in Table 1. All coefficients are significant at the 0.02 level. The R statistic for the model is 0.575 which is relatively high. R statistic is similar to the multiple correlation coefficient in the normal setting after a correction is made to penalize for the number of parameters to estimated (Harrell). To highlight the relative importance of predictor variables in indicating acceptable business performance, their estimated elasticities (evaluated at the means) are also presented in Table 1. These elasticities represent the percent increase in the probability of acceptable business performance for one percent increase in the corresponding predictor variable. Based on estimated elasticities the OER has the greatest impact on the probability of acceptable business performance followed by EAR and ROE, respectively.

Validation of the Estimated PBCSM

The validity of the estimated PBCSM was examined by its accuracy in predicting known 1990 business performances of 74 grain farms in the hold-out sample. Of the 74 businesses in the hold out sample, 32 had acceptable and the remaining 42 had problem business performances. The predicted business performance for each observation is based on whether the estimated probability of acceptable business performance is higher or lower than the predetermined cut-off probability level. The estimated model is validated using cut-off levels of 50 and 60 percent in order to examine the sensitivity of the model validation to changes in the cut-off probability. The predicted business performance for each observation is then compared with its actual performance.

The results are presented in Table 2 for the cut-off probability levels of 50 and 60 percent, respectively.

Table 1. Estimated Performance Based Credit Scoring Model

Variable	Coefficient	Std. Error	Chi-square	P Value	Elasticities
Intercept	-6.04	0.88	46.67	0.00	
ROE	14.95	2.57	33.79	0.00	0.536
EAR	2.91	0.93	9.65	0.02	1.060
OER	5.82	1.34	18.71	0.00	1.690

Model Chi-square with 3 degrees of freedom = 141.71.
P Value = 0.00.
R Statistic = 0.575.

Using the information in Table 2, different prediction measures of the estimated PBCSM for the hold-out sample are calculated and presented in Table 3. Table 3 also presents the prediction accuracy of the estimated model in the estimating sample. The estimated PBCSM correctly predicted 74.32 and 78.38 percent of the business performances in the hold-out sample for the cut-off levels of 50 and 60 percent, respectively. These predictive accuracies are associated with type I errors of 30.96 and 19.05 percent, respectively. The estimated model also correctly predicted the business performances of 80.40 and 77.03 percent of the estimating sample for the cut-off levels of 50 and 60 percent, respectively. The corresponding type I errors are 20.13 and 12.99 percent, respectively. These results do not differ significantly from the prediction accuracies of reported credit scoring models in the literature e.g., 79.7 percent for Lufburrow, Barry and Dixon; 85.7 percent for Miller and LaDue, and 69.7 percent for the Logit model in Turvey. However, because the economic environment generating the observations in the hold-out sample may be different from the economic environment that generated the estimating sample, the validity of the PBCSM is subjected to a more stringent test than these credit scoring models.

Table 2. Classification Table for Alternative Cut-off Levels, Actual Data

	Predicted Classification		
	Acceptable	Problem	Total
50 Percent Level			
Actual Acceptable	26	6	32
Classification Problem	13	29	42
Total	39	35	74
60 Percent Level			
Actual Acceptable	24	8	32
Classification Problem	8	34	42
Total	32	42	74

As expected, the prediction results in Table 3 indicate a modest degree of sensitivity to changes in the cut-off level. Raising the cut-off level from 50 to 60 percent reduces the likelihood of type I error; however, the likelihood of type II error also rises.

Table 3. **Prediction Measures**

	Cut-off Level of	
Measures	**50 Percent**	**60 Percent**
Hold-out Sample		
Total Predictive Accuracy	74.32	78.38
Type I Error	30.96	19.05
Type II Error	18.75	25.00
Estimating Sample		
Total Predictive Accuracy	80.40	77.03
Type I Error	20.13	12.99
Type II Error	19.01	33.80

Construction of Financial Outlook Index

Two requirements must be satisfied for the construction of financial outlook index - (1) each predictor should be measured such that the higher the level of the predictor, the higher is the lender's utility level, (2) the predictor variables must be independent. The measures of ROE, EAR and OER (significant predictors of business performance) satisfy the first requirement. However, the estimated sample correlation coefficients among these variables are significantly different from zero and, hence the second requirement is not satisfied. The predictor variables are, therefore, needed to be represented by their transformations such that the transformed variables are independent of one another. For this, the three predictor variables are substituted by three principal components, PC_p; p = 1,2,3. Accordingly, equation (12) is expressed as

$$U_i(.) = W_1 F_1(PC_{i1}) + W_2 F_2(PC_{i2}) + W_3 F_3(PC_{i3}) \quad (14)$$

The computation of financial outlook index, therefore, requires - (a) the construction of three principal components for each observation in the hold-out sample, (b) the cumulative percent of each of these principal components in the estimating sample, and (c) the weights. The principal components for each observation in the hold-out sample are constructed in two steps - (i) the predictor variables are first standardized using their means and standard deviations in the estimating sample, and (ii) the standardized predictors are then multiplied by the eigne vector corresponding to each principal component in the estimating sample. Moreover, since the eigne values represent the amount of variance in the data accounted for by the principal components, the proportion of the variance explained by each principal component is used as the weights in computing the financial outlook index.

The resulting financial outlook index is used to further evaluate the borrowers in the hold-out sample that are acceptable by PBCSM. For the cut-off levels of 50 and 60 percents, the estimated PBCSM respectively predicted 39 and 32 observations in the hold-out sample to have acceptable business performances (Table 2). However, of these only 26 and 24 actually had acceptable business performance. Hence if the credit evaluation was based on PBCSM alone, there was a potential of committing type I error in 13 and 8 cases respectively. This is where the financial outlook index may be helpful.

Of the 39 observations in the hold-out sample that are acceptable by the PBCSM at 50 percent cut-off level, only 32 have a financial outlook index greater than 50. The remaining 7 with the financial outlook index less than 50 have in fact problem business performances. Similarly, of the 32 observations in the hold-out sample that are acceptable by the PBCSM at 60 percent cut-off level, only 28 had a financial outlook index greater than 50. The remaining 4 with less than 50 have in fact problem business performance. Hence, if the financial outlook index is used to further screen acceptable borrowers from PBCSM, the potential type I error may be reduced by 53.84 (=(7/13)*100) and 50 (=(4/8)*100) percent, respectively.

Simulated Data for Updating PBCSM

Two approaches to generate a data base for updating PBCSM were explored. First, a stochastic multi-period model of a case grain farm business was formulated. The attempts to establish the validity of such a multi-period model were not successful because of the lack of detailed information about the case farm in FBFM records. As a result, the data base is generated using separate simulation models for each year (with no linkages over the years) of the case grain farm. This approach utilizes the available certified balance sheet and income statements for the case farm. These statements in a given year reflect actual business performance for the chosen asset structure, operating expenses, financing terms, tenure status, solvency position, production, price levels, etc.

A data base on business performance and its predictors is generated by subjecting the case farm to a set of stochastic outputs and their prices under alternative solvency and tenure scenarios. The solvency position reflects the repayment obligation due and interest expenses. The tenure status reflects the operator's share in the revenue and operating expenses as well as the liability structure (because of differences in the level of real estate loan to finance real estate across tenure status). Hence for the same volumes and prices of outputs, the income statement for the same asset structure will differ across solvency and tenure scenarios. The data base generated this way may be interpreted as the potential consequences if the farm operator were to choose the same asset structure across alternative solvency and tenure positions.

A farm business in Champaign county was randomly selected as a case farm from a list of grain farms in FBFM records that represented majority of grain farms in central Illinois. The case farm's balance sheet information for 1985 to 1990, and actual crop acreages, crop yields, prices, tenure status, operating expenses, operator's share in revenue and expenses, other farm income including government payments, interest expenses, depreciation and unpaid family and operator for 1986 to 1990 are reported in Khoju.

The crop revenue is computed as the sum of the returns from corn and soybeans. The operator's revenue includes 100 percent of the revenue on the land the operator owns plus one-half of the revenue on the leased land. The operator's crop revenue is then subtracted from operator's reported revenue (in FBFM records) to calculate the amount of other farm income including government payment.

Alternative solvency positions affect the repayment obligations and interest expenses, and, hence, the repayment ability. For data generation purpose, four debt-to- asset ratios - 0.2, 0.4, 0.6 and 0.8 - were used to represent solvency scenarios. The liabilities under alternative debt-to-asset ratios are adjusted using the debt adjustment factor (the ratio of assumed debt-to-asset ratio to the actual debt-to-asset ratio). This factor is used to proportionately adjust the short, intermediate and long term liabilities. The interest expenses on the liabilities are calculated using the actual interest rates prevailing in each year (Agricultural Statistics, 1990).

Alternative tenure status is associated with different operator's share in the revenue and operating expenses as well as the liability structure. Since these variables have direct effects on the repayment ability, for data generation purpose, five tenure levels (proportion of tillable acres owned by the operator) are considered - 0.05, 0.20, 0.40, 0.60 and 0.80. The farm size across tenure status, however, is assumed fixed to maintain similar machinery and other required inputs. The operator's share of land ownership under alternative tenure scenarios is adjusted by the land adjustment factor (the ratio of assumed tenure status to actual tenure status).

The operator's ownership of land is assumed to be financed by the same ratio of debt financing as the actual ratio of real estate loan to the farm real estate, henceforth called the land-debt factor. For the changes in the real estate loans, the principal amount due each year is also adjusted using the ratio of actual annualized principal amount due to the actual real estate loan. These adjustments alter the liability structure and, therefore, the solvency positions. Since four alternative solvency positions have already been considered, the reported median debt to asset ratios for the group of farms within tenure status of 0-10, 11-25, 26-50, 51-75 and above 75 (Financial Characteristics of Illinois Farms) are used as the solvency position for assumed tenure scenario of 0.05, 0.20, 0.40, 0.60 and 0.80, respectively. The liability structure is then adjusted using the ratio of median debt to asset ratio to the debt-to-asset ratio for the given tenure status resulting from the adjustments in land ownership and its financing. Detailed discussions about the adjustment factors can be found in Khoju.

For the given solvency and tenure scenarios, the business performance for the asset structure depends on the realized outputs and their prices. Prediction of these stochastic variables for each of the years (1986 to 1990) is discussed next.

Prediction of Crop Yields and Prices

The farm level yields and prices for each crop (corn and soybeans) are assumed to be uncorrelated for two reasons. First, the production level at a particular farm is not large enough to affect its price (assuming a perfectly competitive market). Secondly, crop prices are not expected to affect current production levels because acreage decisions are based on future expected prices. Corn and soybean yields, however, are assumed to be correlated because they are grown under the same conditions (weather, pest damage etc). Similarly, since corn and soybeans are substitutes to each other to some degree their prices are also assumed to be correlated. Accordingly, the crop yields and prices can be predicted separately.

Farm level crop yield reflects two sources of risk: 1) aggregate factors such as weather and pest infestations in a county, and 2) idiosyncratic factors such as localized weather, soil fertility and management. The variability attributable to these factors represents, respectively, the systematic and nonsystematic risks of an individual farm yields. Because county average yield (acreage weighted average of individual farm yields) diversifies away the nonsystematic risk, it may be used to represent aggregate risk factors. As a result, just as the return of an individual security is related to the level of an index (Sharpe's single index model), the crop yields of an individual farm are linearly related to the county average yields and random elements. Estimation of such a relationship is used to predict farm level crop yields given the predicted levels of county average yields (systematic risk) and random elements (idiosyncratic risk). The county average yields are predicted from their estimated density function using their available long series, and the random elements are predicted from the distribution of the residuals of the estimated single index models. This approach of predicting farm level crop yields is discussed in detail in Khoju, Nelson and Barry. Following this approach a total of 225 corn and soybean yields (25 for each of 9 scenarios i.e., 4 solvency and 5 tenure positions) were predicted for each of the years 1986 to 1990.

Time-series on corn and soybean nominal prices are available only at the county level (Illinois Agricultural Statistics). Because crop prices received by farmers in a county are essentially equal, the historical data are used to estimate the parameters of the density function, the random draws from which are used to represent farm level prices. Because negative crop prices are not possible, corn and soybean prices are assumed to have log-normal distributions. Since the most recent prices contain the most information about future prices, the parameters of the density function were estimated using the price series from 1970 onward only. The predicted corn and soybean prices are represented by the random draws from their estimated bivariate log normal distribution. To predict prices for 1986, the bivariate log normal distribution was estimated using the price series from 1970 to 1985. Similarly, the prices for 1987 to 1990 were predicted. As with the crop yields, 225 prices were drawn randomly for each year.

Model Estimation Based on Generated Data Base:

Using the beginning of the year balance sheet and the predicted price and production levels, the income statement for each year is computed for assumed solvency and tenure scenàrios. The business performance and the predictor variables for the logit model are computed as in the case of pooled time series. This approach resulted in a sample of 900 observations (225 for each of the years 1986 to 1989) on business performance and predictors.

The generated sample of 900 observations was used to examine the usefulness of PBCSM estimated from the simulated data base. Of these, 638 (i.e., 70.88 percent) had acceptable business performance and the remaining 262 (i.e., 29.12 percent) had problem business performance. These were used to estimate the PBCSM. Since the liquidity measure was not a significant predictor of business performance in the pooled time series, it was dropped as a potential predictor of business performance in the generated data base. The estimates of the model are presented in Table 4. All regressors are highly significant and have the expected signs. The R statistic for the model is 0.88 which is higher than 0.575 for the model estimated from the observed pooled time series data base. The estimated elasticities of the predictor variables (computed at the means) are also presented in Table 4. These elasticities indicate that the EAR has the greatest impact on the probability of acceptable business performance followed by OER and ROE respectively.

Table 4. Performance Based Credit Scoring Model Estimated from Generated Data Base

Variable	Coefficient	Std. Error	Chi-square	P Value	Elasticities
Intercept	-27.00	3.03	79.04	0.00	
ROE	60.06	6.66	81.34	0.00	0.159
EAR	25.42	2.47	105.17	0.00	0.395
OER	12.88	3.18	16.40	0.00	0.211

Model Chi-square with 3 degrees of freedom = 847.08.
P Value = 0.00.
R Statistic = 0.88.

Validity of PBCSM Based on Generated Data

To examine the usefulness of the PBCSM estimated from the generated data, the estimated model was also used to predict business performance in the hold-out sample of the pooled time series (i.e., actual business performances of 74 grain farms in 1990). For this, the coefficients estimated from the simulated data were used to compute the estimated probability of acceptable business performance for each observation in the hold-out sample. Parallel to the PBCSM estimated from the observed pooled time-series, this model was also validated using cut-off levels of 50 and 60 percent. The predicted business performances are compared with their actual performances and the classification results are presented in Table 5.

Using the information in Table 5, different prediction measures of the estimated models are computed. For comparison, these prediction measures for the PBCSMs estimated from actual and generated time series are presented in Table 6. While both models have respectable degrees of accuracy, the prediction accuracy of the PBCSM estimated from pooled time series was higher and it has lower type I error. The pooled time-series represents the experiences of a group of farms over time, rather than the single farm in the case of the generated data. The pooled time series for a sample of grain farms represent the actual relationship of predictor variables to business performance in each of the years 1986 to 1989. The generated data base was created by subjecting the case grain farm to a set of stochastic production and prices under alternative solvency and tenure positions. Moreover, the hold-out sample consisting of 74 grain farms are heterogenous in terms of farm size. The predictive accuracy of the PBCSM estimated from generated data, therefore, may be increased if the model is estimated from generated data for three case grain farms each representing small, medium and large farms, respectively.

Table 5. Classification Table for Alternative Cut-off Levels, Generated Data

	Predicted Classification		
	Acceptable	**Problem**	**Total**
50 Percent Level			
Actual Acceptable	28	4	32
Classification Problem	23	19	42
Total	51	23	74
60 Percent Level			
Actual Acceptable	28	4	32
Classification Problem	21	21	42
Total	39	25	74

Of all the credit scoring studies related to agricultural lending, Turvey and Brown (1990) examined the prediction accuracy of the estimated credit scoring model using the observations for the following years as the hold-out samples. They estimated the credit scoring model using the observations for 1981 and examined the prediction accuracy using the observations for 1982. The estimated model had a total predictive accuracy of 61.29 percent with 71.70 and 8.64 percent type I and type II errors. Based on the type I error for one year ahead projection, the PBCSM estimated from the simulated data for a single case grain farm yielded a lower type I error than Turvey and Brown credit scoring model. Such results are expected because the PBCSM is estimated from the observations over four years while Turvey and Brown model was estimated from the observations of only one year.

Table 6. Prediction Measures of Estimated PBCSM Based on Simulated Data

	PBCSM from Pooled Data		PBCSM from Simulated Data	
Measures	**50 Percent**	**60 Percent**	**50 Percent**	**60 Percent**
Total Predictive Accuracy	74.32	78.38	63.51	66.22
Type I Error	30.96	19.05	54.76	50.00
Type II Error	18.75	25.00	12.50	12.50

Concluding Comments

This study is designed to assess the usefulness of PBCSM as a new approach to credit evaluation of agricultural firms. The results of the study indicate that the PBCSM has respectable degree of prediction accuracy and is close to the prediction accuracies of existing credit scoring models even though the PBCSM is subject to a more stringent test. The credit evaluation based on PBCSM should be appealing to lenders because it is based on the potential performance of the financed business, rather than on subjective classification of lenders. Moreover, the financial health of the lender also depends on the business performance of the borrowers in terms of both timely loan repayment and increased loan demands in the future.

The financial outlook index developed in this study allows the lender to further investigate the levels of the predictor variables of the borrowers that are evaluated as acceptable from estimated PBCSM. This index helps in identifying and excluding the borrowers with relatively undesirable levels of one or more predictor variables from the loan portfolio. The results of this study indicate that adoption of this approach may reduce the type I error by as much as 50 percent. Hence, the financial outlook index should be of interest to the lending institutions.

This study also evaluated the usefulness of one cost effective technique of updating the PBCSM -- a farm level simulation approach of data generation. The validation results of the PBCSM estimated from the simulated data indicate respectable degrees of prediction accuracy. Accordingly, this approach of updating PBCSM has potential usefulness and warrants further research.

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CHARACTERISTICS OF FMHA GUARANTEED FARM LOANS IN DEFAULT

Steven R. Koenig and *Patrick J. Sullivan*[1]

Abstract

Much of the Farmers Home Administration's (FmHA) credit assistance to farmers now comes in the form of loans made by commercial or cooperative lenders, but guaranteed against default losses by FmHA. As a result, FmHA's loan guarantee programs represent a growing source of potential Federal liabilities. To better understand the factors contributing to guaranteed farm loan default, this study profiles and compares fiscal 1988 guaranteed farm loans that subsequently went into default by June 1992 with nondefaulting loans made in that year. Results indicate that defaulting borrowers are more highly leveraged and operate under slimmer profit margins than nondefaulting borrowers. Defaulting loans show regional and commodity specific concentration and tend to be larger and carry less collateral than nondefaulting loans.

The Farmers Home Administration (FmHA) provides both direct and guaranteed farm loans. In the 1980's, policy changes affecting FmHA's farmer programs placed greater reliance on the use of loan guarantees. As a result, annual obligations for farm loan guarantees have risen sharply over the past 10 years and now comprise nearly 70 percent of FmHA's total farmer program obligations. Under its guaranteed farm loan programs, FmHA guarantees repayment of up to 90 percent of the losses on a loan made by a qualifying lender if the borrower defaults on the loan.

To date, FmHA's loan guarantee programs have experienced low rates of delinquency and default, especially given the programs' objective of assisting lenders serve high risk farm borrowers. At the end of fiscal 1992, loan volume delinquency rates were just two percent and net charge-offs were just 1.3 percent of yearend outstanding guarantee volume. However, these modest rates might be misleading because many guaranteed farmer loans are relatively new and hence have yet to experience repayment shortfalls more common among maturer loans. Delinquency rates (90-days past due and/or in nonaccural status) on the outstanding farm loan volume of commercial banks, the Farm Credit System (FCS), and life insurance companies ranged from 3.3 to 5.5 percent at mid-1992 (USDA).

With the greater emphasis on delivering Federal farm credit assistance through loan guarantees, we need to better understand the factors that determine the success or failure of guaranteed loan program participants. An improved understanding of the factors contributing to default could help improve program design and assist in developing methods to predict and screen loans with a higher than average potential for default. Therefore, the initial step of this research and our primary objective in this paper is to provide a profile of the characteristics of a sample of defaulted and nondefaulted guaranteed loans and borrowers. Specifically, we compare projected income statements, balance sheets, loan terms, and collateral statements for these two classes.

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Data Development

We use data obtained from sections of FmHA's national database (the Guaranteed System) and from a special survey of loan records maintained at FmHA's county offices. The Guaranteed System database (referred to as the master file) concentrates on accounting and administrative information and, therefore, does not contain information about an applicant's financial health or income. This information is obtained at the time a loan application is made, but is retained at the county office issuing the guarantee. A special survey of county office files was completed to obtain this and other information.

The special survey, conducted in two stages, collected information from the applicant's balance sheet, annual projected cash income statement, and collateral statement at the time of loan application. Questions on loan terms were included in the questionnaire to supplement loan term data available from the master file. Some general borrower characteristics were also collected.

Only loans guaranteed under the farm ownership (FO) and operating loan (OL) programs that were obligated (received FmHA approval and commitment to fund) and disbursed in fiscal 1988 were included in the study. (Fiscal 1988 ran from October 1, 1987 through September 30, 1988.) Applying these criteria, the universe consists of 12,042 guaranteed loans and 9,149 borrowers (Table 1). These loans totaled $1.2 billion.

Table 1. Guaranteed Loan Program Borrowers, Loans, and Dollar Volume By Survey Status, Fiscal 1988

Program	Numbers: Survey	Numbers: Universe	Proportion Surveyed
	Number		*Percent*
Borrowers[a]	1,922	9,149	21.0
Nondefaults	1,580	8,758	18.0
Defaults	342	391	87.5
Loans	1,994	12,042	16.6
Nondefaults	1,592	11,582	13.7
Defaults	402	460	87.4
	Million Dollars		
Volume	212.4	1,226.6	17.3
Nondefaults	167.6	1,176.5	14.2
Defaults	44.8	50.1	89.4

[a] Because a single borrower can have more than one loan, the total number of borrowers is less than the number of loans.

Sources: 1988 and 1992 survey of FmHa's guaranteed loan applicant folders and the Guaranteed System's master file.

Default Definition

We considered a fiscal 1988 guaranteed loan to have defaulted if a loss settlement was paid to the participating lender or if the loan was delinquent with principal past due greater than or equal to a selected minimum percentage of loan volume (10 percent for FO and 50 percent for OL loans). Only loans meeting this definition on or before June 30, 1992 are included. Therefore, loans that defaulted but had sufficient collateral to repay the lender without guarantee are not included in our analysis. However, for program management purposes these are less important and maybe few in number. Using these criteria, 460 loans made to 391 borrowers were in default.

When a borrower fails to make scheduled payments, the participating lender is required to notify FmHA of any repayment shortfall that exceeds 30 days. To prevent default, lenders are allowed to adjust loan repayment schedules or terms, provided certain conditions hold, and FmHA approves. When such servicing actions cannot cure a loan delinquency, the lender may proceed with collection of the loan. While FmHA must agree to a liquidation plan and has the right to take over the liquidation process, the lender normally handles the liquidation, including any legal foreclosure actions. FmHA reimburses the lender for up to 90 percent of its realized losses (principal, accrued interest, and liquidation costs). Beginning in 1991, lenders can receive reimbursements from FmHA for losses incurred under a partial farm liquidation.

County Survey

The special survey of county files was conducted jointly with FmHA in two stages. The first stage was completed shortly after the close of fiscal 1988 as part of a study to establish a baseline of information about the operation of the guaranteed loan programs before the advent of the Federally sponsored secondary market for such loan guarantees (Koenig and Sullivan). This stage called for a 15-percent sample of guaranteed loans that were obligated and disbursed during fiscal 1988. Of the survey responses completed by county staff, 1,643 loan guarantees were deemed usable for analysis.

The second stage was completed in late-1992 and covered only guaranteed loans in default on or before June 30, 1992. Of the 460 defaulted loans identified, 51 had already been surveyed during the first stage. Therefore, in the second stage, 409 questionnaires were sent to county offices. Of these, 351 were returned suitable for analysis, giving a total of 402 loans or 342 borrowers. Roughly half of the 58 unsuitable questionnaires were excluded because the file was unavailable to county staff. The remaining had gross discrepancies or certain key data was missing from the file. The unsuitable records did not appear to be concentrated in any one subset. All questionnaires were subjected to extensive logic and consistency checks. However, checks made on collateral data from the first stage were not as extensive as the second stage, so comparisons made may not be as reliable as other aspects of the survey.

Combining stages one and two yielded a total survey sample of 1,994 loans and 1,922 borrowers representing 16.6 and 21.0 percent of the universe totals, respectively. The 402 defaulted loans for which usable survey data was collected represent 87.4 percent of all defaulted loans and 87.5 percent of defaulting borrowers. Nondefaulting loans and borrowers surveyed comprise 13.7 percent and 18.0 percent of their respective universe totals.

Survey data was then merged with data from the master file. The analysis reported here is based on the merged data from these two sources. Whenever a data item, such as the loan amount or percent of loan guaranteed, is available from the master file, we report statistics based on all fiscal 1988 guaranteed loans (the universe), and not just those in the survey.

Programs Analyzed

Statistics are reported for the guaranteed farm ownership (FO) and operating loan (OL) programs. Guaranteed OL loans can be made for a range of purposes, including annual crop and feed expenses, the purchase of livestock and machinery, and the refinancing of nonreal estate debt. FmHA guarantees these loans for up to seven years, but under certain circumstances the guarantee could be extended for up to 15 years. Both lines of credit and term notes are eligible, but in 1988 the lines of credit were guaranteed for only three years and limited to payment of annual expenses. The total amount of guaranteed loans to any borrower is capped at $400,000.

In fiscal 1988, loans guaranteed under the farm ownership program could be for the purchase, repair, or improvement of farm real estate and the refinancing of existing farm real estate debt. Loans are typically secured with a first lien on real estate and attached structures. FO loan guarantees are made for up to 40 years and are capped at $300,000 per borrower.

An interest rate assistance program for guaranteed loans was in operation during fiscal 1988 (known as the Interest Rate Buydown Program). Under the program, lenders received payments from FmHA if they agreed to reduce interest rates on fixed-rate guaranteed FO and OL loans to borrowers that could not demonstrate a positive cash flow without such a reduction. Lenders were reimbursed for 50 percent of the cost of the reduction, up to a maximum write-down of four percentage points for a maximum of three years. The program was changed in 1990; FmHA now provides 100 percent reimbursement of the writedown cost.

Loan Characteristics

Default Rates are Modest

The guaranteed FO and OL programs provided 9,149 applicants with 12,042 loans in fiscal 1988 using our selection criteria. By June 30, 1992, 391 borrowers (460 loans) had defaulted on $50.1 million in guaranteed loans. Defaults represented 4.3 percent of total borrowers and 4.1 percent of guaranteed loan volume (Table 2). Considering that the mission of these programs is to assist high risk farm borrowers, the rate of default is modest.

Table 2. Guaranteed Loan Program Defaults By Program, Fiscal 1988

	Borrowers			Loan Amount		
Program	Defaults	Total	Proportion	Defaults	Total	Proportion
	Number		*Percent*	*Million Dollars*		*Percent*
Farm Ownership	37	2,293	1.6	6.1	345.2	1.8
Operation Loans	364	7,645	4.8	44.1	881.4	5.0
Credit Lines	247	4,618	5.3	27.9	407.1	6.8
Notes	166	4,727	3.5	16.2	474.3	3.4
Total[a]	391	9,149	4.3	50.1	1,226.6	4.1

[a] Because a single borrower can have a loan from more than one program and can have more than one loan within a program, the total number of borrowers is different from the sum of borrowers participating in each loan program.

Source: Guaranteed System's master file.

There are sizable differences in default rates in the FO and OL programs. The FO program has a much lower incidence of default than the OL program, 1.8 percent versus 5.0 percent. This occurrence was anticipated since FO loan guarantees have longer maturities, are better collateralized with real estate, and farmers tend to keep real estate loans current when repayment difficulties occur. The data supports this contention in that farmers having both an FO and OL loan were more likely to default on their OL loan than their FO loan. Furthermore, 25.6

percent of nondefaulted borrowers had an FO loan, but only 13.6 percent of defaulted borrowers had one.

With higher default rates the OL program accounted for the majority of total defaulting borrowers, loans, and loan volume. OL loans accounted for 81 percent of total loan numbers and 72 percent of total dollar origination volume in fiscal 1988. By mid-1992, that program accounted for 92 percent of defaulted loans and 88 percent of defaulted loan volume. Within the OL program, credit line loans had a higher default rate than loans made with notes. One explanation for this finding is that lines of credit are used to finance annual production expenses whereas notes often finance chattel purchases that offer greater collateral coverage and control of loan proceeds.

Borrowers in Default Often Have More Than One Loan

There is a tendency for defaulted borrowers to have more than one OL loan. Of the 391 defaulted borrowers 32 percent had two or three OL loans. This compares with 21 percent for the nondefaulted borrowers. Only 19 defaulting borrowers did not have at least one OL loan (exclusively FO program borrowers).

Experience with the guarantee program did not appear to be influencing default rates for fiscal 1988 loans. Most defaulting and nondefaulting borrowers were new to the guarantee programs in fiscal 1988. Over 69 percent of nondefaulting borrowers did not have a previous OL loan and only slightly more defaulting borrowers (72 percent) were first time users of the program. Likewise, for the FO program, 97.3 percent of borrowers not in default and 98.2 percent of borrowers in default did not have an FO loan prior to fiscal 1988. No defaulting borrower had more than four previous loans from either program, whereas 0.4 percent of nondefaulting borrowers had between five and eight loans prior to fiscal 1988, all from the OL program.

Loans and Borrowers Show Geographic Concentration

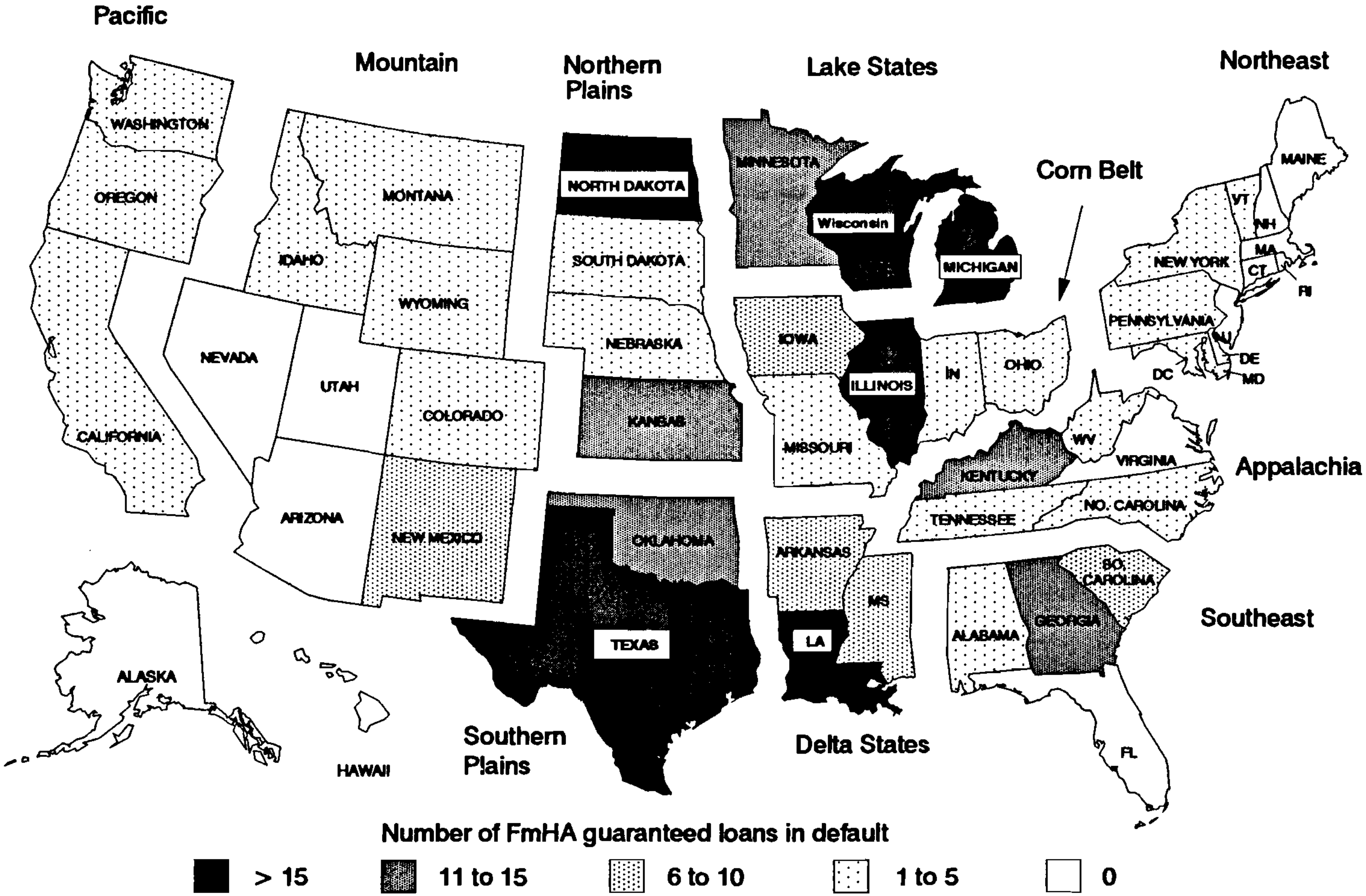
Geographic dispersion of defaulted loans is closely aligned with geographic location of all guaranteed loans. Defaults are concentrated in the central U.S., with the Lake States, Southern Plains, and Delta States showing the highest concentration (Figure 1). One State, Louisiana, clearly dominates as a source of defaulted loans issued in fiscal 1988 and hence significantly influences the values of the statistics presented. Louisiana accounts for 11 percent of all 1988 borrowers and 10 percent of all loans, but 39 percent of defaulting borrowers and 38 percent of defaulting loans. The default rate of Louisiana's guaranteed loans was 14.5 percent as of mid-1992. The next closest state is Texas which accounts for four percent of total guarantees and 7.6 percent of defaulted loans. In terms of numbers or dollar volume, defaults in the Northeast and West were few and sporadic.

When examined by region, the story is very similar. Borrower default rates for eight of the 10 USDA production regions ranged from 1.4 to 3.5 percent, while the Southern Plains and Delta States reported default rates of 6.0 and 10.8 percent, respectively (Figure 2). Again, Louisiana and Texas dominate these two regions. Because of their dominance, the type of agriculture (cotton and rice farms) in these two regions greatly influences the overall comparison of defaulted and nondefaulted loans and borrowers. The lowest default rates are in the Corn Belt, Northern Plains and Pacific regions.

Banks are Leading Source of Defaults

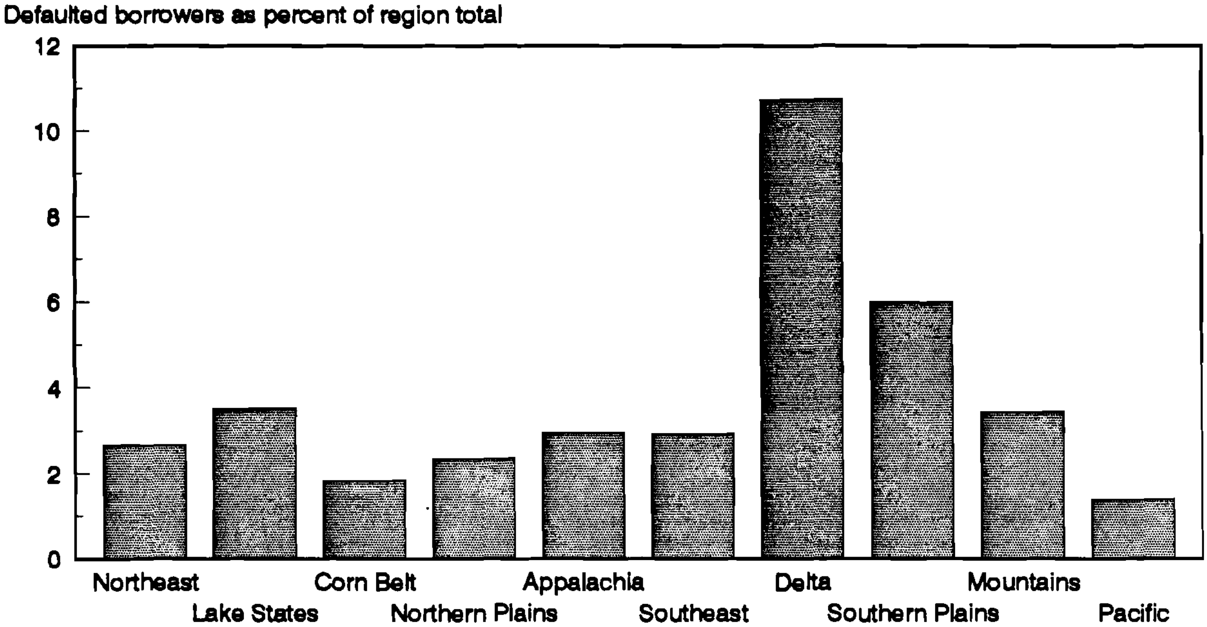
Commercial banks were the primary source of defaulted guaranteed farm loans obligated in fiscal 1988. Banks' share of total 1988 nondefaulted loans was 75.8 percent, but the share of defaulted loans was 87.6 percent (Figure 3). The share difference can primarily be attributed to the relatively low default rate of FCS loans. The FCS accounts for nearly 23 percent of nondefaulted loans, but only 8.5 percent of defaulted loans. Default rates were 4.4 percent for banks, 1.5

Figure 1
Location of defaulted guaranteed loans made in fiscal 1988



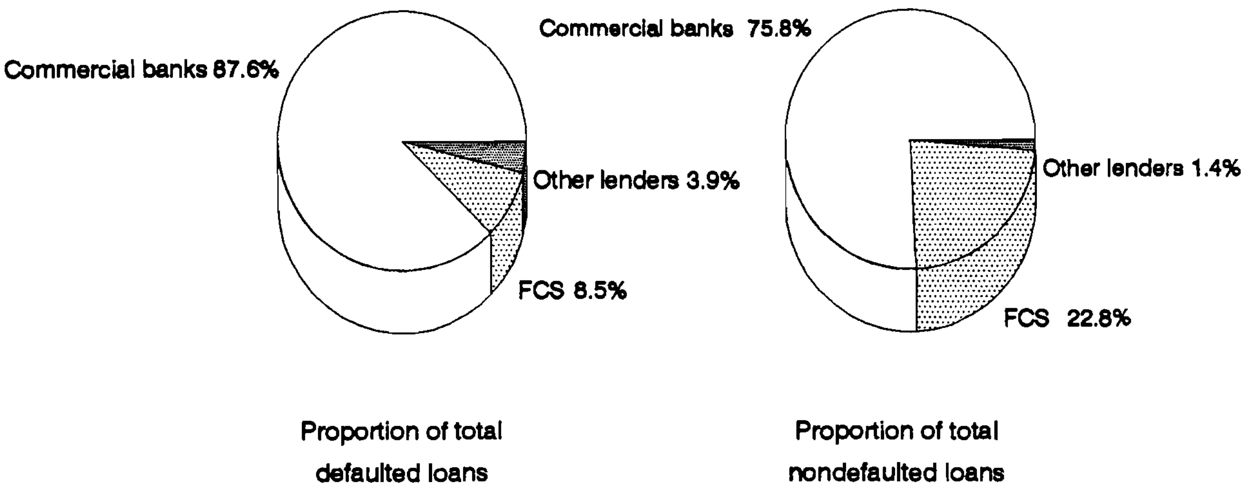
Source: Guarantee System's master file.

Figure 2
Default Rates by Region, Fiscal 1988 Loans



Source: Guarantee System's master file.

Figure 3
Proportion of defaulting and nondefaulting loans held by lender groups



Source: Guaranteed System's master file.

percent for the FCS, and 10.3 percent for other institutions. Other lenders with defaulted loans included savings and loans, credit unions, mortgage loan companies, and unspecified lenders. Mortgage companies accounted for 60 percent of the 175 loans originated by other classified lenders and 72 percent of the 18 loans that defaulted.

In terms of loan volume, the results are similar. Banks' account for 74.3 percent of the $1,176 million loan volume not in default, but 86.2 percent of the $50 million of defaulted loan volume.

Defaults Not Prevalent in Refinancing Loans

A smaller proportion of loans in default (29 percent) where primarily used to refinance existing farm debt than in the nondefaulting group (37.5 percent) (Table 3). There is a perception that many lenders are using the guarantee program to minimize losses on existing high risk loans that have little or no chance of success. If correct, this should be particularly true for fiscal 1988 loans because of the farm financial stress still present during the period. However, this data does not appear to support that perception.

Table 3. Selected Loan Attributes of Defaulted and Nondefaulted Guaranteed Loans, Fiscal 1988

Loan Attribute	Loans In Default	Loans not In Default
	Percent	
Proportion of Loans Borrowed for the Purpose of:		
Refinancing Existing Debt	28.9	37.5
Operating Expenses	57.2	48.2
Purchasing:		
Real Estate	1.2	6.9
Machinery	4.0	2.6
Breeder Livestock	2.5	1.8
Feeder Livestock	5.5	1.5
Repairing or Constructing		
Farm	0.8	0.0
Structures	0.0	0.3
New Farm Start-up	0.0	1.2
Other	100.0	100.0
Total		
Proportion with Maturity of:		
	9.1	13.9
Less than 1 Year	56.3	41.3
1 to 4.9 Years	27.4	26.8
5 to 9.9 Years	2.2	7.1
10 to 19.9 Years	5.0	10.9
20 Years or More[a]	100.0	100.0
Total		
	Years	
Average Loan Maturity	5.1	6.9

[a] The maximum maturity on guaranteed operating and farm ownership loans is 15 and 40 years, respectively.

Source: 1988 and 1992 surveys of FmHA's guaranteed loan applicant folders and the Guaranteed System's master file.

The largest share of defaulted loans went to finance annual operating expenses--57 percent of the total. These are the most risky loans that lenders provide to farmers. Remaining loans in default--13.9 percent--were concentrated in loans for livestock and machinery purchases. Only a few loans made to purchase farm real estate went into default by June 30, 1992. Just over one percent of defaulted loans were for that purpose, far less than the nearly seven percent share of nondefaulting loans.

The average maturity of loans in default was nearly two years less than those not in default. Only 7.2 percent of defaulted loans had maturities greater than 10 years, while 18 percent of nondefaulting loans had such maturities. The low default rate of long-term FO loans and high default rates on three year credit lines likely explains much of the maturity differences.

Larger Loans and Greater Guarantees

Mean and median values indicate that loans in default tend to be larger ($109,000) in size than loans not in default ($101,579) (Table 4). Most of the difference is evident in two size groups: less than $50,000 and $50,000 to $150,000. Defaulted loans are less prevalent in the under $50,000 class, but are more prevalent in the $50,000 to $150,000 class.

Table 4. Selected Loan Characteristics of Defaulted and Nondefaulted Guaranteed Loans, Fiscal 1988

Loan Attribute	Loans in Default	Loans not in Default
	Dollars	
Size of Loan[a]:		
Mean	$109,000	$101,579
Median	83,225	77,000
	Percent	
Proportion of Loans:		
Less than $50,000	22.0	32.0
$50,000 to $149,999	53.9	44.5
$150,000 to $4249,999	16.1	15.8
More than $250,000	8.0	7.7
Total	100.0	100.0
Percentage of Loan Guaranteed by FmHA:		
Mean	88.9	88.2
Median	90.0	90.0
Proportion:		
Below 80 Percent	4.1	5.9
80 to 90 Percent	3.5	7.8
90 Percent	92.4	86.3
Total	100.0	100.0

[a] Guaranteed farm operating and farm ownership loans are capped at $400,000 and $300,000, respectively.

Source: Guaranteed System's master file.

Loans in default had a slightly higher probability of carrying the maximum guarantee rate (90 percent) than nondefaulting loans--92.4 percent versus 86.3 percent. A lower guarantee percentage means the lender must adsorb greater losses in the case of default. The greater the risk of default, the greater the incentive for a lender to seek the highest guarantee percentage available from FmHA.

Interest Rates

Loans with a higher than average probability of default typically get charged higher interest rates with shorter term commitments to compensate the lender for greater default risk. Under the FmHA guarantee programs, as operated in fiscal 1988, lenders could charge their guaranteed customers no more than one percentage point higher than their average farm customer received. Therefore, little difference in rates charged among guarantee borrowers should be expected. Yet, loans in default show a higher probability of carrying variable-rate terms and somewhat higher variable interest-rates. The mean rate on variable rate loans posted at mid-1990 was a half a percentage point higher for loans in default (Table 5).[2] Fixed-rate loans showed no difference between defaulted and nondefaulted loans.

Table 5. Selected Loan Terms for Defaulted and Nondefaulted Guaranteed Loans, Fiscal 1988

Loan Attribute	Loans In Default	Loans not In Default
	Percent	
Average Interest Rate on 5/90:		
Fixed Rate	10.1	10.1
Variable Rate[a]	11.9	11.4
Proportion of Guaranteed Loans on 5/90 with:		
Fixed Rates	21.2	27.2
Variable Rates	78.8	72.8
Total	100.0	100.0
Proportion of Variable Rate Loans Using a Base Rate of:		
Lender's Prime	32.6	46.9
Major Bank Prime	24.3	32.3
Regional Bank Prime	26.3	4.3
FCS Rate	4.7	6.7
U.S. Treasury Rate	3.3	6.7
Other[b]	9.0	3.1
Total	100.0	100.0
	Percentage Points	
Spread Between Base Rate and Rate Charged on Variable Interest Rate Loans:		
Mean	2.4	2.0
Median	2.0	2.0

[a] Variable rates vary depending upon frequency of adjustment and frequency of reporting to FmHA. Therefore, comparisons made from one loan to the next may be inappropriate.

[b] Includes Federal Home Loan Mortgage Corporation, Federal Reserve Discount, Federal Funds, and other rates.

Source: 1988 and 1992 survey of FmHA's guaranteed loan applicant folders.

[2] Comparisons of variable rate loans is difficult to properly assess because the rate quoted depends upon when the lender last updated the loan record.

Variable rate defaulted loans tended to use a wider range of base rates than nondefaulted loans. Where 79 percent of nondefaults were tied to the lender's own prime or a major bank prime rate, defaults were more equally tied to either the lender's own prime rate, a regional bank prime, or major bank prime rate. The use of an FCS base rate is lower in the defaulted population because the default rate on FCS loans was low.

Less Collateral

Loans in default were not as well collateralized as their nondefaulting counterparts. Average loan-to-collateral value ratios were 0.62 for defaulting loans, but only 0.53 Borrowers for nondefaulting loans (Table 6). The absolute value of collateral and the quality was also better for nondefaulting loans. Where collateral was equally spread between chattel, crops, and real estate for nondefaults, nearly half of the collateral value backing a defaulting loan was concentrated in crops, either growing or in inventory. Typically, most of the crop collateral value results from expected values of growing crops. This collateral often does not materialize when production does not meet projected output and is more frequently sold without the proceeds being applied against the loan. It was not uncommon for the listed crop collateral value to be equal to the entire value of projected crop income for the coming year.

Table 6. Collateral Backing Defaulted and Nondefaulted Guaranteed Loans, Fiscal 1988

Attribute	Loans in Default	Loans not in Default
	Dollars	
Average Net Value of Collateral:		
Machinery and Chattel	53,565	64,503
Crops	84,650	65,739*
Real Estate	39,174	67,906*
Total	177,938	198,701
Average Loan Amount		
	Ratio	
Loan-to-Collateral Ratio[a]	0.62	0.53

[a] Average loan amount divided by total net collateral value, weighted.

* Mean values significantly different at the five percent level.

Source: 1988 and 1992 survey of FmHA's guaranteed loan applicant folders.

Borrower Characteristics

Data suggest that borrowers with defaulting loans typically owned less farmland, had fewer assets, and projected greater gross incomes than borrowers with nondefaulted loans. Noteworthy among the farm enterprise distribution is that the percentage of defaulting borrowers listing cotton or tobacco as their major enterprise was nearly double that of the nondefaulting borrowers (Table 7). The majority of this category are believed to be cotton farms. Poultry operations on the other hand, although small in number, had very low default rates. This might be attributable to the high percentage of poultry operations borrowing only through the FO program and from more stable incomes resulting from production contracting.

Table 7. Selected Guaranteed Loan Program Borrower Characteristics Defaulted and Nondefaulted, Fiscal 1988

Borrower Attribute	Borrowers in Default	Borrowers not in Default
	Percent	
Proportion whose Major Farm Enterprise is:		
Cash Grain	37.1	44.3
Dairy	11.7	16.0
Beef, Hog, and Sheep	15.5	15.1
Cotton and Tobacco	21.6	11.0
Specialty Crops	6.7	7.5
General Farming	3.8	3.0
Poultry	0.6	3.0
Other Livestock	2.1	0.3
Other Enterprises	0.9	0.0
Proportion with Total Assets of:		
Less than $100,000	24.9	12.7
$100,000 to $499,999	56.4	59.4
$500,000 to $999,999	12.6	21.3
$1,000,000 or More	6.1	6.7
Proportion with Gross Cash Farm Income of:		
Less than $40,000	4.1	9.0
$40,000 to $99,999	19.6	25.4
$100,000 to $249,999	50.9	44.8
$250,000 to $499,999	20.2	15.4
$500,000 or More	5.3	5.4
Proportion with Planned Farmland of:		
Less than 100 Acres	15.2	8.4
100 to 499 Acres	34.5	34.1
500 to 999 Acres	28.1	30.0
1,000 to 1,499 Acres	10.2	13.1
1,500 Acres or More	12.0	14.5
	Acres	
Average Planned Farm Size[a]		
Farmland Owned	172.3	322.0*
Farmland Rented	624.3	592.6
Cropland Owned	113.2	196.0*
Cropland Rented	491.9	445.2

[a] Borrower's projection of acres to be farmed in the coming year.

* Mean values significantly different at the five percent level.

Source: 1988 survey of FmHA's guaranteed loan applicant folders.

The lack of financial resources among defaulting farmers in evident in that the amount of farmland owned is roughly half that of nondefaulting borrowers, or just 172 acres. But, defaulting borrowers rented slightly more total farmland than nondefaulting borrowers. Therefore, in terms of total farmland acres, defaulting borrowers planned only slightly smaller operations.

Defaulted Borrowers Project Greater Expenses

Defaulting borrowers were projecting greater cash incomes, but were also projecting much greater cash expenses than nondefaulting borrowers. The result is projected net cash incomes of borrowers in default was only 58 percent of nondefaulted borrowers (Table 8). The fact that defaulting borrowers were anticipating tighter cash flows is consistent with expectations about these borrowers. On average, projected cash income-to-expense ratios were 1.41 for defaulting borrowers and 1.56 for nondefaulting borrowers. Also, the proportion of borrowers with high ratios (greater than 1.4) was less for borrowers in default.

Table 8. Average Projected Cash Income Statement for Guaranteed Loan Program Borrowers Defaulted and Nondefaulted, Fiscal 1988

Borrower Attribute	Borrowers in Default	Borrowers not in Default
	Dollars	
Cash Farm Income From:		
Livestock Sales	69,060	52,468*
Crop Sales	113,751	107,785
Other Sales	23,936	33,712*
Total	206,897	190,420
Net Nonfarm Income	8,012	9,380
Total Cash Income	215,516	201,255
Cash Expenses for:		
Hired Labor	10,756	10,262
Interest	20,285	22,255
Property Taxes	1,806	3,026*
Family Living	13,815	14,906*
Total[a]	187,401	152,965*
Net Cash Income	28,115	48,400*
	Ratio	
Cash Income/Expense Ratio[b]	1.41	1.56*
	Percent	
Proportion with Cash Income/Expense Ratios:		
Less than 1.0	2.1	2.3
1.0 to 1.09	12.9	10.6
1.1 to 1.39	55.3	49.4
1.4 to 1.69	15.8	22.1
1.7 or More	14.0	15.6
Total	100.0	100.0

[a] Totals include expenses not listed.

[b] Defined as the ratio of total gross cash income to total cash expenses.

* Mean values significantly different at the five percent level.

Source: 1988 and 1992 survey of FmHA's guaranteed loan applicant folders.

These projections were made for just one year, typically calendar year 1988, and therefore may not be indicative of the borrower's longer term prospects. Defaults were registered through mid-1992 and so many of these borrowers would have made income and expense projections for subsequent years that might present a different picture. Furthermore, cash income projections do not provide an indication of long-term profitability because noncash expenses, such as capital depreciation, are not considered.

Defaulting Borrower are More Leveraged

The total value of assets held by defaulting borrowers is significantly less than nondefaulting borrowers. Defaulting borrowers had an average $352,017 in assets as opposed to $420,999 for nondefaulting borrowers (Table 9). Although real estate accounts for much of the difference, machinery and livestock asset values are also less for defaulting borrowers. The percentage of defaulting borrowers with less than $100,000 in assets is nearly double (24.9 percent) that of nondefaulting borrowers (12.7 percent).

Table 9. Average Balance Sheet for Guaranteed Loan Program Borrowers Defaulted and Nondefaulted, Fiscal 1988

Borrower Attribute	Borrowers in Default	Borrowers not in Default
	Dollars	
Value of Assets:		
Livestock	32,663	42,915*
Machinery	82,875	93,794*
Real Estate	163,755	220,235*
Total[a]	352,017	420,999*
Value of Liabilities:		
Chattel and Crop	128,178	109,599*
Real Estate	109,061	148,008*
Other	24,616	18,519
Total	261,866	279,359
Value of Equity	90,151	141,884*
	Ratio	
Debt/Asset Ratio:		
For All Borrowers	0.92	0.70*
For Solvent Borrowers	0.67	0.62*
	Percent	
Proportion with Debt/Asset Ratio:		
Less than 0.4	10.2	13.7
0.4 to 0.7	25.2	44.2
0.7 to 1.0	38.3	33.7
1.0 or More	26.3	8.4
Total	100.0	100.0

[a] Totals include assets not listed.

* Mean values significantly different at the five percent level.

Source: 1988 and 1992 survey of FmHA's guaranteed loan applicant folders.

On the liability side of the balance sheet, defaulting borrowers reported less real estate debt but greater chattel and crop debt. The net affect is that average total liabilities of defaulted borrowers are only slightly less than nondefaulting borrowers. Lower debts did not offset the difference in total assets, leaving borrowers in default with nearly $52,000 less equity than nondefaulting borrowers.

With a much smaller asset base and only slightly less debt burden, defaulting borrowers are more leveraged than nondefaulting borrowers. Defaulting borrowers had an average debt/asset ratio of 0.92 while nondefaulting borrowers averaged 0.70. Both these ratios are very high compared to all farm operators, which report an average ratio of less than 0.20. These ratios decline significantly if insolvent borrowers are excluded. The debt/asset ratios falls to 0.67 for defaulting and 0.62 for nondefaulting borrowers.

Over one in four borrowers in default was insolvent in fiscal 1988 and hence had no equity in their farm operation. This compares to only 8.4 percent for nondefaulting borrowers. Clearly, guarantees made on loans to insolvent borrowers represent a much greater default risk to the agency. Moreover, two-thirds of defaulting borrowers had ratios in excess of 0.70 as opposed to 42 percent for nondefaulting borrowers.

Much of the little equity that borrowers do possess tends to be in real estate. Debt/asset ratios for the nonreal estate portion of the balance sheet were different at 1.14 for defaulting and 0.74 for nondefaulting borrowers. The low equity position of borrowers produced high guaranteed loan amount-to-equity ratios. For defaulting borrowers with equity, the ratio was double that of nondefaulting borrowers with equity--8.47 to 4.00.

Conclusions

The default rate on fiscal 1988 guaranteed farmer program loans through mid-1992 has been relatively modest, especially when the period in which these loans were made is taken into consideration. These loans were guaranteed on the heels of a period of significant financial turmoil in U.S. agriculture and just a few years after loan guarantees were elevated in importance. Loans in default exhibit some common characteristic, many of which were anticipated given the objective of the programs. We found that annual operating loans are the greatest source of defaults and that defaults were regionally concentrated in the Delta and Southern Plains. Banks were more likely to originate a defaulting loan than were FCS lenders, but less likely than other classes of lenders. Defaulting loans had a greater tendency to be larger in size, have less collateral, and carry a greater guarantee rate than nondefaulting loans. Analysis of borrowers indicates that defaulting farmers had fewer financial assets and were more leveraged than their nondefaulting counterparts. Not only were defaulting borrowers more leveraged, they also were more likely to project slimmer cash flow margins (less projected net cash income), mostly due to higher projected operating expenses. Guaranteed loans made to farmers with insolvent balance sheets had a high probability of default.

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AN ANALYSIS OF MULTI-PERIOD AGRICULTURAL CREDIT CLASSIFICATION MODELS FOR NEW YORK DAIRY FARMS

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One of the most important factors influencing the quality of a lender's loan portfolio is the character of the loans selected for inclusion. As lenders search for ways to improve the selection process, the use of credit scoring or credit screening models has been given increased consideration. The initial models (Johnson and Hagan; Dunn and Frey; Hardy and Weed; Hardy and Adrian; Hardy, Spurlock, Parrish and Benoist; Mortensen, Watt and Leistritz) reported in the agricultural literature validated their models with within sample statistics only. That is, the effectiveness was measured by the proportion of the fitted sample that were correctly classified by the model. This procedure was improved upon by later researchers who used hold out samples or cross validation methods to validate the models (Lufburrow, Barry and Dixon; Miller and LaDue). Of course, these methods also use the same basic data set, or part of it, as the test data for validation. Therefore, the test data were from the same basic group of farms, for the same year.

More recently, Turvey and Brown found that models developed under the economic conditions of any one year may be unreliable predictors in years with different economic conditions. Model parameter estimates and significance levels may be unstable over time for models fit to data for different time periods. The ability of fitted models to predict whether a borrower will default or be creditworthy next year or in some future year is poor. Since the most frequent application of such models by lenders is to use a model fit using data from one period to classify loans for a future period, this shortcoming of previously developed models severely limits their usefulness.

The objectives of this study are to test the conclusions reached by Turvey and Brown using a different data set and evaluate the use of a multi-period model, employing Farm Financial Standards Task Force (FFSTF) ratios and economic environment indicators, as a method of reducing parameter estimate instability and increasing model usefulness. To meet these objectives we (1) develop a set of single period best-fit models for a series of years, (2) fit a prespecified model to several years of data, and (3) developed multi-period models with economic environment indicators for two and three year periods.

In the remainder of this article we describe the creditworthiness model used, explain the data set used for the analysis and present the results obtained with the best-fit, prespecified and multi-period models. Finally, we present some conclusions.

The Creditworthiness Model

Previous research on agricultural credit evaluation models has largely been concentrated on loan review or credit screening, where the credit classifications are related to a pre-existing, mutually exclusive, loan classification schemes. Most commonly, these schemes establish two groups, one denoting a "good" loan and the other a "bad" loan. "Good" loans are paid current and "bad" loans are in some form of default, including slow paying, delinquency, bank examiner classification, and official default (Betubiza and Leatham).

A problem with the default oriented classification methods is that they can be influenced by the borrower's or lender's subjective behavior (Miller and LaDue; Lufburrow, et al.). The lender can influence the classification by decisions to forbear, restructure or grant additional credit to repay a

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delinquent loan. A borrower with split credit may have one loan paid current and classified as "good" with one lender, and another loan that is delinquent and classified as "bad" with another lender. Borrowers may also have avoided a current default status because they have made payments by selling assets or through other unrepeatable means. An infusion of funds from inheritance when aunt Sara dies or sale of the combine cannot be repeated next year, or in any future year. Such behavior on the part of the borrower or the lender can result in intrinsic errors in credit evaluation models.

One alternative to default measures is a lender classification where the lender identifies good and bad borrowers or uses the examiner evaluations. However, this introduces a high level of subjectivity.

This study avoids these borrower and lender influences without introducing added subjectivity by measuring creditworthiness rather than default. A creditworthy borrower is defined as one with a positive capital replacement and term debt repayment margin. Two debt repayment margin definitions are used. The first, called the **farm and nonfarm** debt repayment margin, uses the FFSTF definition where the debt repayment margin equals

Net farm income
\+ Nonfarm income
\+ Interest expense
\+ Depreciation expense
\- Personal withdrawals
\- Personal income taxes
\- Planned principal and interest payments

The second definition, called the **farm** debt repayment margin, is calculated in the same manner, except that nonfarm income is excluded. The rationale for this measure is that in many cases the lender and/or farmer is most interested in whether the farm business generates sufficient income to make the necessary payments. Businesses with loans that can be repaid from farm sources without an infusion of funds from nonfarm sources may be lower risk than when loan repayment is dependent on nonfarm income. This approach views the farm operation as a business unit separate from the operation's nonfarm and family activities.

The creditworthiness measure has the advantage that it can be applied to any set of financial statements. It does not depend upon lender default classifications. It can be applied to businesses that provide financial statements but for which the evaluator does not have data on past debt payment history. Thus, it can be used in either credit scoring or credit screening situations.

The model used in this study is a qualitative, lagged-dummy model. The model is expressed as:

$$Y_{i,t+1} = \beta_1 Y_{i,t} + \beta_2 P_t + \sum_{k=3}^{N} \beta_k X_{k,i,t} + u_t$$

where $i = 1,2,...$ M refers to the individual farm, and
$t = 1,2,...$ T refers to a single year. Thus,
$y_{i,t+1}$ is the dependent variable representing creditworthiness for farm i in time period t+1. Similarly, $Y_{i,t}$ is a lagged dependent variable representing creditworthiness for farm i in time period t. The creditworthiness measure is a binary dependent variable. That is, a positive repayment margin is converted to one, and a negative repayment margin is converted to zero.
P_t is the economic environment indicator,
$X_{k,i,t}$ refers to the (N-2) explanatory variables for farm i in time period t, and β is the corresponding coefficient for the explanatory variables.

The logit statistical method was employed. It was chosen over the linear probability model and discriminate analysis based on the logit's favorable statistical properties and the ability to translate credit classifications into creditworthiness scores. The choice of the logit over the probit method was based on the fact that the logit coefficients are not affected by the unequal sampling rates of creditworthy and less creditworthy farms. Only the constant term is affected, therefore, there is no need to weight the observations before estimation (Maddala).

The logit model is specified as:

$$P_i = \frac{1}{1+e^{-(x_i B)}}$$

where e is the base of natural logarithms and P_i is the probability of the ith farm being creditworthy, given knowledge of X_i, the set of financial and production ratios and measures.

For estimation purposes this equation is restated as:

$$\ln \frac{P_i}{1-P_i} = x_i B$$

The dependent variable is the logarithm of the odds that a particular farm will be creditworthy. β is a 1 by (N-2) vector of regressor coefficients corresponding to the (N-2) by 1 independent variables in X for the ith farm. The model was estimated using the maximum likelihood method.

The economic environment indicator is designed to reflect the differences in the year to year economic environment in which the farms operate. A major factor contributing to inaccurate model predictions of borrower creditworthiness is variation in the basic profitability of the type of business being evaluated. On dairy farms, most costs tend to move upward with inflation. These cost shifts tend to influence profitability, and thus, creditworthiness, in a somewhat predictable way. The primary exception would be feed costs which show somewhat more variability. On the other side of the profit equation, however, the milk price swings widely. Thus, year to year variability is caused largely by fluctuation in milk prices. To reflect this variability, the percent change in the New York blend milk price was used as the economic environment indicator. For validation and general use of the model, where the future price change is not known, blend price projections as published by the Department of Agricultural Economics at Cornell University (New York Economic Handbook: Agricultural Situation and Outlook) were used.

Two basic principles were used in selecting the remaining individual farm variables. First, model is to include only one explanatory measure from each of the factor categories. Multivariate analysis requires that each ratio or measure in the model convey as much information as possible (Beaver). In other words, ratios or measures with similar components should not be used in the same credit evaluation model (Chen and Shimerda). Financial ratios and measures from the same factor category usually have a higher occurrence of multicollinearity which can confound the interpretation of the individual ratio coefficient and overall production ability of the models. Therefore, it is important that one measure in most cases be selected to represent each factor category in a multivariate statistical analysis. In this study, no two measures from the same factor category will be used in the creditworthiness evaluation model, except for production measures. The production measures may exceed the one measure limit because these measures are not usually derived from the same components, unlike many of the financial measures.

The second procedure is to use the FFSTF recommended ratio and measure definitions to represent the factor categories whenever possible. In previous research, the financial ratios' and measures' definitions have varied considerably (Betubiza and Leatham). This variation has largely been due to researchers selecting ratios and measures they deem as important or were accessible from the data available. As a consequence, these predispositions and limitations have precluded comparison between credit evaluation models and data sets. Hopefully, by employing the FFSTF recommended ratios and measures, it will initiate a foundation for future comparison of credit evaluation models. By using the same ratio and measure definitions, credit evaluation models can be tested on alternative data sets.

Selection of individual variables largely draws from previous empirical agricultural credit evaluation studies and the results of a regional survey on credit evaluating procedures in agricultural banks (LaDue, Lee, Hanson, Hanson, and Kohl).

The measure that was used most consistently, that is in 89 percent of the previous studies (Table 1) was a measure of solvency. This usage can be attributed to the concept that credit evaluation models are loosely analogous to capital structure theory, where an increase in leverage is directly related to an increase in financial risk (Miller). However, the analogy stops there, for farms with a higher debt/asset ratio usually have a higher degree of financial risk, but a higher degree of financial risk does not always necessarily mean a greater degree of financial stress (Lins, Ellinger, and Lattz). This is especially true for highly profitable farms which can sustain high debt levels. Furthermore, the results of a regional survey on credit evaluation procedures were consistent with previous studies where 100 percent of the banks responding used a solvency measure in their credit evaluation. This study will use the debt/asset ratio as a measure of solvency.

Table 1. Summary Factor Categories and Related Measure for Credit Scoring Models

Factor Category	Usage In: Prior Research[a]	Usage In: Bank Evaluation[b]	Measures Used
	percent		
Solvency	89	100	Debt/Asset Ratio[c]
Liquidity	33	57	Current Ratio[c]
Profitability	22	14	Rate of Return on Assets[c]
Repayment Capacity	67	100	Repayment Trend
Financial Efficiency	33	36	Asset Turnover
Collateral	22	71	None
Production			Milk Per Cow (1,000 lbs)
			Hay Per Acre
Economic Risk			% Change in Milk Price

[a] The percentage of prior research that included the factor.
[b] The percentage of agricultural banks that include the factor in their credit evaluation procedures.
[c] FFSTF recommended calculations.

Two other factor categories included in 33 and 22 percent of the previous studies were liquidity and profitability, respectively. In addition, these categories were used by 57 and 14 percent, respectively, of the banks surveyed. While these two categories have been used extensively in nonagricultural credit evaluation, the adaptation to agriculture has been limited. This study will include the current ratio as a liquidity measure and the rate of return on assets as a profitability measure. The relatively low use of profitability in previous credit evaluation studies is perhaps a reflection of the historical emphasis on loan default, not creditworthiness.

Only 33 percent of the previous studies included some type of repayment capacity measure, while the survey found that 100 percent of the banks used a repayment capacity measure. This study will incorporate a lagged dependent variable. The lagged dependent variable will represent whether a farm was able to make its debt payments the previous year using the same debt repayment margin calculation.

The factor category efficiency encompasses various titles in previous research such as financial, capital, and economic efficiency. An aggregate of the three was found significant in 33 percent of the previous studies. However, limiting this category to just financial efficiency, the survey results showed that 36 percent of the banks used some type of financial efficiency measure. This study will use an asset turnover ratio as a measure of financial efficiency. Collateral was used in 33 percent of the previous studies and by 71 percent of the banks surveyed. A collateral measure may be a viable explanatory variable in a single loan default model, however, in a creditworthiness model a solvency measure may be more appropriate because it can be viewed as a claim on the entire farm's assets, not collateral on a single loan.

The primary nonfinancial measures found significant in previous studies were production measures. Given that this study is limited to the dairy industry, the production management measures selected are pounds of milk produced per cow, and tons of hay crop harvested per acre.

Turvey and Brown also showed that commodity types and geographical regions can be used as indicators of credit risk. However, neither commodity type nor geographic region will be included in the model because the data are all dairy farms located in New York State where creditworthiness is not expected to differ much by region. Based on previous studies, a creditworthiness model can appropriately be expressed as a function of solvency, liquidity, profitability, repayment capacity, financial efficiency, and production management measures.

The Data Set

The data for this study were collected from New York State dairy farms in a program jointly sponsored by Cornell Cooperative Extension, and the Department of Agricultural Economics at the New York State College of Agricultural and Life Sciences, Cornell University. The information collected includes a complete set of financial statements with the essential components for deriving a complete set of financial ratios and measures as recommended by the FFSTF. One key component available was each farm's planned debt payment for the subsequent year.

The number of participants in this program averaged 410 per year for the 1986-91 sample period. Since participation is on a volunteer basis, not all farms submit data each consecutive year. There were 155 farms that did submit data for each year of this particular time period, and of these farms, only 138 used debt in their capital structure. Data for these 138 farms are analyzed in this study.

Due to the procedure used to select participating farms, this is not a random sample. However, the sample does provide consistent information for 138 farms over the sample period. Such a data set is critical in studying the dynamic effects on farm creditworthiness.

The nonrandomness of the data does not pose a problem for the credit evaluation model estimation. Loan portfolios of financial institutions are by nature nonrandom.

Table 2 exhibits the annual mean value of the financial and production measures for the 138 farms. All financial ratios and measures have been calculated according to the FFSTF Guidelines (1991). The production measures, in general, are fairly specific to the dairy industry and were selected because of their historical use as proxies for the production management capabilities of the farm operators.

Table 2. **Average Financial and Selected Production Measures, 138 New York Dairy Farms, 1987-91**

	Year				
Measures	**1987**	**1988**	**1989**	**1990**	**1991**
Liquidity					
Current Ratio	3.23	3.49	3.83	3.12	2.84
Solvency					
Debt/Asset Ratio	.38	.36	.34	.35	.35
Repayment Capacity					
Term Debt and Capital Lease Coverage Ratio	1.86	1.57	1.90	1.69	1.08
Profitability					
Return on Assets	4.56	4.07	5.72	3.69	1.07
Other					
Milk Sold/Cow (lbs)	16,576	17,091	17,516	17,815	18,222
Hay Crop (T/A)	2.8	2.7	2.7	2.9	2.7

This group of farms could be viewed as a combination commercial lender and FmHA portfolio. It contains more marginal borrowers than a typical commercial lender portfolio where they have eliminated many of the marginal borrowers by not making loans to them.

Single Period Best-Fit Models

To test the basic conclusions of Turvey and Brown that model parameters and levels of significance of single period models are unstable, a series of single period best-fit models were estimated (Table 3). These models used the farm definition of creditworthiness; nonfarm income was excluded. The models were estimated using a 95 percent confidence level decision rule, stepwise variable selection procedure. The initial set of variables incorporated were those identified for the basic creditworthiness model (above) except that the economic environment indicator was excluded. The resulting models are similar to the types of single period models reported in most earlier studies. Researchers with data covering only one year could be expected to report such model results with some confidence in their value.

For both models, statistics are not excellent but are quite acceptable for individual farm data. The within sample prediction rate is similar to that found in previous studies. However, the out of sample prediction rate is much lower. Part of this low out of sample prediction rate results from the fact that 1991 was used for out of sample evaluation. 1991 was one of the worst years for the dairy industry for some time. The observed very high rate of false positives likely results from these unusually poor economic conditions.

The basic instability of such models is clearly indicated by these two models. Even though the same farms are used in both years, the variables included change completely from one year to the next. This confirms, in a rather significant way, that the magnitude, sign and/or significance of single period model coefficients can be much different from year to year. It is not surprising that ex ante prediction rates using such models are poor.

Table 3. Two Best-Fit Single Period Farm Creditworthiness Evaluation Models 138 New York Dairy Farms

Variable	1989 Model (P-Value)	1990 Model (P-Value)
Intercept	-5.56	0.65
	(0.00)	(0.49)
Lagged Dependent	1.49	
	(0.00)	
Milk/Cow	0.25	
	(0.01)	
Working Capital	0.10	
	(0.04)	
Debt/Asset		-5.21
		(0.00)
Debt Repayment Margin		0.20
		(0.01)
Milk/Worker		0.04
		(0.02)
Operating Expense Ratio		4.51
		(0.05)
R	0.42	0.45
Model X^2	39.19	38.76
Within Sample Prediction (%)		
False Positive	24.1	15.7
False Negative	32.7	43.3
Positive	77.8	87.5
Negative	64.9	50.0
Total Correct	72.5	78.3
Out of Sample Prediction (1991) (%)		
False Positive	53.7	56.3
False Negative	25.4	11.4
Positive	63.3	91.8
Negative	59.6	34.8
Total Correct	60.9	55.1

Single Period Prespecified Models

Credit scoring or screening models are usually factor-based because there is no well developed theoretical foundation for their design (Marais, Patell, and Wolfson). To compensate for this lack of theory, a starting point for developing a model and selecting a useful set of factor categories, is prior empirical research (Chen and Shimerda). However, if the prior research is complete and correctly interpreted, once a basic model has been developed it should be appropriate for all years. The type of results that researchers could expect to obtain, depending upon the particular year for which they had data, are illustrated in Table 4. In this case the prespecified model is used in all years. The variables included are those indicated in the model description above.

Table 4. Two Prespecified Single Period Farm Creditworthiness Evaluation Models 138 New York Dairy Farms

Variable	1989 Model (P-Value)	1990 Model (P-Value)
Intercept	-6.93	-2.20
	(0.00)	(0.30)
Debt/Asset Ratio	0.11	-5.11
	(0.94)	(0.00)
ROA	0.01	0.15
	(0.91)	(0.03)
Current Ratio	0.08	0.16
	(0.21)	(0.30)
Lagged Dependent	1.39	-0.30
	(0.03)	(0.62)
Capital Turnover	-0.22	3.85
	(0.92)	(0.19)
Milk/Cow	2.87	0.11
	(0.01)	(0.31)
Hay/Acre	0.41	0.38
	(0.11)	(0.24)
R	0.37	0.39
Model X^2	39.12	37.24
Within Sample Prediction (%)		
False Positive	25.9	15.0
False Negative	36.8	32.0
Positive	74.1	92.3
Negative	63.2	50.0
Total Correct	69.3	81.9
Out of Sample Prediction (1991) (%)		
False Positive	52.2	59.3
False Negative	23.2	5.0
Positive	67.4	98.0
Negative	59.6	21.3
Total Correct	62.3	48.6

The statistical properties are slightly poorer than those obtained with the best-fit models, but are still in the reasonable range for individual farm data. The out of sample prediction rate is still much lower that the within sample rate with a large number of false positive. The 1990 model was much superior in within sample prediction but much poorer in out of sample prediction.

The sign, magnitude and significance of the variables changes significantly from year to year. For example, the parameter value for the debt/asset ratio goes from being small, positive and insignificant with 1989 data to being much larger, negative and significant with 1990 data. The lagged dependent variable is positive and significant in 1989 and negative and insignificant in 1990.

Clearly, the characteristics of these confirm the Turvey and Brown results that single period models have unstable parameters that could be expected to make them unreliable in predicting borrower performance. There is good reason for nonadaption of such models by lenders.

Multi-Period Models

In an attempt to develop models with improved stability and predictive ability, the complete model including the economic indicator variable was fit to two and three years of data (Table 5). Model statistics were similar to, or better than, those obtained for single period models. Parameter values and levels of significance were much more stable. Comparing the two year model with the three year model showed no sign changes and all had the expected sign.

Within sample prediction rates were within the range of those found with the single period models, however, there is less variation between years. The multi-period model had rates of 77.5 to 73.7 percent compared to 69.3 to 81.9 percent for the single period models. Since a model is less likely to be able to fit to the specific characteristics of one year's economic conditions, it is expected that the within sample prediction rates would be similar to those found with single year models. The predictive results are also similar to those obtained by previous research. It, thus, appears that use of the FFSTF categories did not significantly improve model performance. It is likely that this results from the fact that the FFSTF ideas are not new and many of the suggested variables have been used in prior research.

The out of sample prediction rates were better, 63.0 to 64.5 compared to 48.6 to 62.3, than those found with any of the single period models. This indicates the superiority of the multi-period model. However, the absolute improvement achieved was not great. There were still a large number of false positives. The unusual economic conditions of 1991 are not well predicted with any of the models fit.

The economic environment indicator appears to be of value in bridging the interyear gap. Although its coefficient is quite small, the level of significance is quite high in both multi-period models. One shortcoming that this variable has, of course, is the fact that it must be estimated to use the model for predicting. Economists performance in predicting future prices has been reasonable, but is not perfect.

Based on this experience, it appears that multiple period models may be an improvement over single period models. The peculiarities of any individual year have less influence on the model.

Including Farm and Nonfarm Income

The models presented in Tables 3 through 5 use the farm definition of creditworthiness; nonfarm income is excluded. Including both farm and nonfarm income is consistent with the FFSTF definition of repayment capacity (term debt and capital lease coverage ratio), represents the ability of the family to make debt payments, and is closer to a default equivalent. For many farm situations, including nonfarm income provides a more accurate measure of creditworthiness.

Using the basic model with the farm and nonfarm definition of creditworthiness (Table 6) resulted in considerably poorer results. Model statistics were not as good; both the R and X^2 were lower. Also, both within and out of sample predictions were lower. However, the biggest problem is that the sign on the ROA is negative. The coefficient is not large and the level of significance waivers, but the sign is negative.

Re-examination of the model indicates that all of the explanatory variables are farm based in nature and that possibly a nonfarm income indicator should be included. Do to its character, the number of variables available to predict nonfarm income are few. In an effort to correct the situation, the previous years level of nonfarm income was added to represent predicted nonfarm income (Table 7).

Table 5. Two Multi-Period Farm Creditworthiness Evaluation Models 138 New York Dairy Farms

Variable	1988-89 Model (P-Value)	1988-90 Model (P-Value)
Intercept	-4.47	-4.59
	(0.00)	(0.00)
Debt/Asset Ratio	-3.79	-2.25
	(0.00)	(0.01)
ROA	0.13	0.06
	(0.01)	(0.09)
Current Ratio	0.11	0.09
	(0.17)	(0.08)
Lagged Dependent	0.30	0.62
	(0.46)	(0.05)
Capital Turnover	3.28	1.46
	(0.06)	(0.22)
Milk/Cow	0.19	0.19
	(0.02)	(0.00)
Hay/Acre	0.33	0.38
	(0.11)	(0.01)
Milk Price Change	0.07	0.07
	(0.00)	(0.00)
R	0.47	0.42
Model X^2	92.24	112.3
Within Sample Prediction (%)		
False Positive	17.3	19.8
False Negative	34.1	37.7
Positive	84.5	78.7
Negative	62.9	64.4
Total Correct	77.5	73.7
Out of Sample Prediction (1991) (%)		
False Positive	52.0	50.0
False Negative	28.4	31.5
Positive	49.0	30.6
Negative	70.8	83.1
Total Correct	63.0	64.5

The nonfarm income parameter value was negative. This is consistent the net effect many believe nonfarm income may have on dairy farms. There are two possible explanations (1) as nonfarm income increases, the amount of time and attention that is focused on the farm, and thus, farm income, declines, or (2) the farmers that are not very good managers, and have low farm incomes as a result, have to get nonfarm jobs to make debt payments. However, adding the nonfarm variable did not help with our sign problem on ROA. It continues to be negative with variable levels of significance.

At this point we do not have a solution to the problem. If this group of geniuses has suggestions on the cause of, or solutions to the problem, we would be glad to hear them!

Table 6. Two Multi-Period Farm and Nonfarm Creditworthiness Evaluation Models 138 New York Dairy Farms

Variable	1988-89 Model (P-Value)	1988-90 Model (P-Value)
Intercept	-2.71	-4.23
	(0.06)	(0.00)
Debt/Asset Ratio	-1.72	-1.33
	(0.07)	(0.07)
ROA	-0.03	-0.06
	(0.45)	(0.09)
Current Ratio	0.17	0.05
	(0.09)	(0.25)
Lagged Dependent	1.13	1.10
	(0.00)	(0.00)
Capital Turnover	3.50	1.99
	(0.05)	(0.10)
Milk/Cow	0.05	0.16
	(0.56)	(0.01)
Hay/Acre	0.33	0.41
	(0.11)	(0.01)
Milk Price Change	0.07	0.06
	(0.01)	(0.01)
R	0.37	0.34
Model X^2	59.62	76.3
Within Sample Prediction (%)		
False Positive	15.7	19.4
False Negative	49.9	50.9
Positive	81.0	71.3
Negative	56.3	61.7
Total Correct	74.9	68.4
Out of Sample Prediction (1991) (%)		
False Positive	44.1	50.0
False Negative	36.5	40.0
Positive	33.3	15.8
Negative	81.5	88.9
Total Correct	61.6	58.7

Table 7. **Two Multi-Period Farm and Nonfarm Creditworthiness Evaluation Models 138 New York Dairy Farms**

Variable	1988-89 Model (P-Value)	1988-90 Model (P-Value)
Intercept	-2.46	-3.81
	(0.08)	(0.00)
Debt/Asset Ratio	-1.64	-1.04
	(0.09)	(0.18)
ROA	-0.03	-0.08
	(0.57)	(0.04)
Current Ratio	0.25	0.07
	(0.02)	(0.15)
Lagged Dependent[a]	0.36	0.87
	(0.41)	(0.01)
Capital Turnover	3.55	2.12
	(0.04)	(0.08)
Milk/Cow	0.29	1.37
	(0.72)	(0.02)
Hay/Acre	0.51	0.49
	(0.01)	(0.00)
Nonfarm Income	-0.28	-0.25
	(0.14)	(0.01)
Milk Price Change	0.06	0.06
	(0.02)	(0.06)
R	0.34	0.33
Model X^2	53.64	72.71
Within Sample Prediction (%)		
False Positive	16.8	19.4
False Negative	51.9	52.9
Positive	80.0	69.6
Negative	53.5	69.6
Total Correct	73.2	67.4
Out of Sample Prediction (1991) (%)		
False Positive	43.6	48.0
False Negative	35.4	38.9
Positive	38.6	52.0
Negative	79.0	61.1
Total Correct	62.3	59.4

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THE DEMAND FOR AGRICULTURAL LOANS AND THE LENDER-BORROWER RELATIONSHIP

Calum G. Turvey and *Alfons Weersink*[1]

Much of the economic literature on loan demand views it in terms of the lender-borrower relationship. Early work in this field, namely Freimer and Gordon; and Jaffee and Modigliani, viewed loan demand and credit risk as being passive to the borrower but active to the lender; that is the loan offer curve made explicit use of credit risk, whereas the borrower's decision did not. The Jaffee-Modigliani model of credit rationing has received wide attention and encouraged substantive debate as to exactly what the borrower-lender relationship should be.

The question of whether or not borrowers actively incorporate credit risk in their demand for loans is an important one. In terms of pure conjecture it seems unreasonable to characterize borrowers as making risky investment decisions using financial leverage independently of the incremental increase in financial risk associated with debt financing. Azzi and Cox argue that if borrowers offer collateral or equity to secure debt, lenders would be able to recover at least some portion of financial obligation below the default rate of return, and as they argue borrowers must satisfy the collateral/equity needs in order to convert a desire for loan into a demand.

In related work Smith argues that borrower's equity acts as an 'external economy' to the lender which implies an intrinsic stochastic dependency between the borrower and lender which allows for an increasing supply of debt as borrower equity increases. Baltsenberger commenting on Smith, and Hansen and Thatcher, note a certain independence between the contractual rate of interest charged the borrower and loan demand. Baltsenberger; and Hansen and Thatcher argue that loan demand must be viewed by both borrower and lender in terms of loan quality, where quality refers to the riskiness of the loan measured in terms of debt relative to equity. Thus the borrower's interest payment must be related to the amount of equity provided and the probability of default. In Baltsenberger's formulation parieto efficient loan contracts consistent with a competitive equilibrium in the loan markets exists, whereas in Smith's model parieto efficient contracts cannot exist if equity is an external economy to the lender and firms have limited liability. Rather, Smith argues that parieto efficient contracts emerge only through negotiated contracts wherein lenders constrain borrower's equity capital to a minimum while borrowers constrain debt capital to a maxima.

A related class of problems occurs when there is more than one class of borrower distinguished in a perfect information economy by investments with differing expected returns and/or risk. In such an economy parieto efficient outcomes can be established through lenders' offerings of multiple contracts with each being unique to the risk class of individuals. To avoid credit rationing of any sort borrowers must be willing to accept interest rates above the prevailing market price while lenders must be allowed to offer differential interest rates to different classes of borrowers. In equilibrium, credit rationing would not occur.

However, in reality information is not perfect, and obtaining perfect information comes at a cost to the lender. Asymmetric information may be sufficient to drive equilibrium solutions which are characterized by credit rationing (Stiglitz and Weiss; Jaffee and Russel). For example, it is plausible that a lender may assess multiple loan applicants investing in projects of equal expected returns, but different risks. Since probability information is far more difficult to garnish than

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expected returns there would be sufficient ambiguity in establishing which borrowers are high risk and which borrowers are low risk. Lenders can then employ screening devices such as credit scoring models to objectively sort risk classes and thus eliminate demand rationing (Bester). However credit scoring models are in themselves imperfect because they may reject or ration loans which would otherwise be acceptable or accept loans which would otherwise be rejected. Alternatively, lenders may charge all borrowers the same rate of interest based upon the pooled risk, but this is again inefficient since loans would be a bargain, and therefore attract, high risk types, while being to dear, and therefore rationing low risk types.

Pooled interest rates can also act as a signalling device, which can lead to adverse incentive effects which actually increase the riskiness of loan portfolios. Recall again that pooled interest rates are sufficient to attract high risk types to the loan market, but they may also encourage low risk types to increase their desired loan amount and encourage adoption of higher risk projects (Stiglitz and Weiss; Jaffee and Stiglitz).

While arguments such as those presented above focus on the borrower-lender relationship they have not been used to establish characteristics which can be used to empirically estimate loan demand curves. Perhaps this is because a unified, generally agreed upon notion of what constitutes demand or the lender-borrower relationship has yet to surface. Yet there is much in these theories which dictate what a candidate loan contract curve could look like, while explaining some potentially observable characteristics of the lender-borrower relationship.

While in theory opinions on loan demand and supply are diverse, in practice loan demand is probably related to all of the factors considered above. First, because of the borrower-lender relationship the desired demand is unlikely to be observed. In terms of data, what is observed are contracts whereby borrowers and lenders have negotiated a loan amount at a specified price. From the theory we can suppose that factors such as probability of default, debt-equity structure, limited liability, and security/collateral, are all factors to be considered. But it is not observed, nor could it possibly be observed, how individual market participants negotiate, say equity structure and collateral, in order to satisfy the lender-borrower relationship.

What can be observed are ex post characteristics of this relationship and the probability of default given various performance measures. These are the same characteristics which are used to obtain objective *ex ante* probabilities from credit scoring models which are used to screen loan applicants. Thus if we can use quantitative and qualitative variables to compute loan default probabilities from credit scoring models then we should be able to determine the 'demand for loans' from credit scoring models as well. However, 'demand for loans' in this context must be viewed as a hybrid 'loan contract' function of the borrower/lender relationship along a locus of feasible loan outcomes.

The purpose of this paper is to empirically estimate the demand for credit on loans made to Canadian farmers through the Farm Credit Corporation. In the next section we develop a general model of the borrower-lender relationship assuming both are profit maximizers and note that the implicit demand for debt is a function of the probability of default and the implicit supply of debt is a function of this same probability. The result implies that when information is perfect and costless all loans lie on a concave (backward-bending) contract curve. The importance of the result is that it refutes the notion that loan demand and loan supply can generally be viewed in isolation, which thus implies that empirical estimation using observed loan contracts may be justified. In addition we show that downward sloping loan demand curves are guaranteed to exist if loan default probabilities are constant along their slope and lenders are profit maximizers. The converse possibility that distinct loan supply curves are downward sloping holds too if lenders apply credit scoring or other screening devices which restrict risk in a safety-first context, while borrowers are profit maximizers. These concepts are then expanded to show how ambiguous probability information about multiple classes of borrowers, can lead to credit rationing. From analyzing the basic structure of the lender-borrower relationship we use empirical credit scoring models to derive loan 'demand' functions for different risk classes of agricultural loans. The advantage of this theoretical model guiding the empirical model is that consideration of hedonic pricing such as that proposed by Baltsenberger, as well as collateral/equity consideration as proposed by Smith, Azzi and Cox; and Stiglitz and Weiss, can be evaluated within the basic structure of the Jaffee-Modigliani model.

The Borrower-Lender Relationship

<u>The Borrower's Problem</u>

This section develops, along the lines of Smith, a general model of the borrower-lender relationship assuming a profit maximization objective. The firm has a fixed amount of wealth, W_o, which can be invested in a riskless asset or as equity in a leveraged risky investment. The investment horizon and loan payback period is for one year. If θ is the proportion of wealth invested in the risky asset, and $(1-\theta)$ in the riskless asset then end-of-period wealth, defined by initial wealth plus profits, is:

$$\bar{\pi} = (1-\theta)W_oR_f + (\theta W_o+D)\bar{R} - ID \tag{1}$$

where R_f equals 1 plus the riskless rate of return, $\bar{R}$ equals 1 plus the expected rate of return on risky investment, and I is 1 plus the interest rate on debt, D. We assume limited liability which protects personal holdings of the riskless investment. Hence the loan is in default if $r < r^*$, where

$$r^* = ID \,/\, (\theta W_o+D) \tag{2}$$

is the critical or breakeven (1 plus the) rate of return. Since $\partial r^*/\partial I$, and $\partial r^*/\partial D$ are positive, increases in interest rates or debt increase the chance of default, while $\partial r^*/\partial \theta$ and $\partial r^*/\partial W$ indicate that increased equity or initial wealth decreases the chance of default. Let f(r) be the probability density function about the random return on the risky investment. Then with limited liability and loan default risk expected terminal wealth is given by

$$\begin{aligned} Max_{\theta,D}\, \bar{\pi} = {} & (1-\theta)W_oR_f + (\theta W_o+D)\bar{R} - ID \\ & - \int^{r^*}[(\theta W_o+D)R-ID]\, f(r)dr\,. \end{aligned} \tag{3}$$

Integrating the last term by parts and substituting in r^* yields

$$Max_{\theta,D}\, \bar{\pi} = (1-\theta)W_oR_f + (\theta W_o+D)\bar{R}-ID+(\theta W_o+D)\int^{r^*}F(r)dr \tag{4}$$

The firm's choice is to maximize terminal wealth by choosing the optimal equity investment in risky to riskless assets, θ, and how much of the risky investment is to be financed with debt. Assuming that all second order conditions are satisfied, the first order conditions for an interior maximum are

$$\frac{\partial\pi}{\partial\theta} = W_o(\bar{R}-R_f) + (\theta W_o+D)\ F(r^*)r^*_\theta + W_o\int^{r^*} F(r)dr = 0 \tag{5}$$

and

$$\frac{\partial\pi}{\partial D} = \bar{R}-I + (\theta W_o+D)\ F(r^*)r^*_D + \int^{r^*} F(r)dr = 0 \tag{6}$$

where $r^*_\theta = \partial r^*/\partial\theta = -W_o ID/(\theta W_o+D)^2$ and $r_D^* = \partial r^*/\partial D = \theta W_o I/(\theta W_o+D)^2$. Substituting (5) into (6) yields the optimal condition

$$\partial\bar{\pi}/\partial D = R_f - (1-F(r^*))\ I = 0 \quad , \tag{7'}$$

or

$$F(r^*) = \frac{I - R_f}{I} \quad , \tag{7}$$

the implicit solution of which provides the loan demand curve $D(\theta,W_o,R_f,I,F'(r^*))$. The condition implies that debt will be used in place of equity until the probability of default $F(r^*)$ equals the loan risk premium as a percent of the interest cost. As the riskless rate increases the investor places relatively more resources into risk investment and borrows less for risky investment so loan default risk decreases. As interest rates increase the probability of default increases as fixed financial obligations increase.

<u>The Lender's Problem</u>

The lender's problem is to maximize expected end-of-period wealth $\bar{Z}$. Here the lender must choose the optimal amount of debt, B, given the borrower's equity position, and facing the possibility of bankruptcy. If $r < r^*$ then the borrower under limited liability foregoes $(\theta W_o+B)R < IB$. The lender takes a loss on the loan but the loss may not be total. It is also assumed that the lender can acquire all of B at the opportunity cost rate δ. The lender's objective function is

$$MAX_{\theta B}\ \bar{Z} = \int^{r^*} [\theta W_o+B]R\ f(r)dr + IB \int_{r^*} f(r)dr - \delta B \tag{8'}$$

or

$$MAX_{\theta B}\ \bar{Z} = (I-\delta)B-(\theta W_o+B) \int^{r^*} F(r)dr \tag{8}$$

First order conditions are given by $\partial\bar{Z}/\partial B$ and $\partial\bar{Z}/\partial\theta$. Here the derivative $\partial\bar{Z}/\partial\theta$ refers to Smiths view that the proportion of equity a borrower puts into risky investment is an external economy to the lender. Differentiation yields the following first order conditions.

$$\partial\bar{Z}/\partial\theta = -W_o\int^{r^*} F(r)dr - (\theta W_o+B)\ F(r^*)r^*_\theta = 0 \tag{9}$$

and

$$(10)\quad \partial\bar{Z}/\partial B = (I-\delta) - \int^{r^*} F(r)dr - (\theta W_o+B)\ F(r^*)\ r^*_B = 0\ . \tag{10}$$

Here r^*_θ and r^*_B are the same as for the borrower except B is substituted for D. Substituting (9) into (10) gives

$$\partial\bar{Z}/\partial B = I(1-F(r^*))-\delta = 0 \tag{11'}$$

or,

$$F(r^*) = \frac{I-\delta}{I}\ . \tag{11}$$

In (11), I-δ is the risk premium required by the lender in order to supply the amount of debt implied by $F(r^*)$. This is the same solution obtained by Jaffee and Modigliani and thus takes on the general backward-bending shape of the Jaffee-Modigliani loan supply curve.

Equilibrium in the Borrower/Lender Relationship

Equations (7) and (11) provide the optimal conditions for loan demand and supply. If a parieto efficient contract is to be made then clearly there must be agreement between the borrower and lender on not only the probability of default, $F(r^*)$, but also the amount of equity contributed to investment, and the interest rate charged. Importantly a necessary condition for optimality is that $\delta = R_f$; that is unless the lender's opportunity cost of capital (passbook account charges, GIC's, and operating/monitoring costs) equals the risk free rate, competitive equilibrium parieto efficient loan contracts cannot occur[2]. However, under the assumption that $R_f = \delta$ there is a further point of importance. If equity is treated as an external economy to the lender then there does not exist, in the usual sense of the terms, distinct loan demand curves or loan supply curves. All parieto efficient demand and supply combinations are satisfied along this curve.

The implicit solution to the loan contract problem is given by equations (7) and (11) which are equivalent for contracts D=B and $R_f=\delta$. Implicit differentiation yields

$$\frac{dD}{dI} = \frac{1-F(r^*) - IF'(r^*)r_I^*}{IF'(r^*)r_D^*} \tag{12}$$

Since the denominator is always positive the slope of the loan contract curve is determined by the numerator. Using $r_I^* = D/(\theta W_o+D)$, the slope of the contract curve is determined by

$$1 \gtrless r^* \frac{F'(r^*)}{1-F(r^*)} \tag{13}$$

The term $F'(r^*)/(1-F(\theta^*))$ in (13) is the conditional probability of default (Smith). Since $\partial r^*/\partial I > 0$, $\partial r^*/\partial D > 0$ and $\partial^2 r^*/\partial I\partial D > 0$, r^* increases along the demand curve until $dD/dI = 0$, and then decreases as D decreases. The conditional probability of default increases at all points along the contract curve. Loan contract curve with these features is illustrated in Figure 1, where the vertical axis is measured in terms of the optimal debt-equity ratio, and the horizontal axis, the marginal interest rate. The main results of the lender-borrower relationship are summarized in the following paragraphs.

Proposition I: Under perfectly competitive conditions, loan demand and loan supply curves are identical for both the borrower and lender.

The result implies that along a single locus of loan contracts expressed in terms of debt, equity and interest rates marginal expected profits of the borrower equal marginal expected profits of the lender. The proof is obtained by noting that $\partial\bar{Z}/\partial B = \partial\bar{\pi}/\partial D = 0$ for D = B at an optimum. That both demand and supply lie along a single contract curve, as discussed above, is proven by setting $\delta = R_f$ and noting that equation (7) and equation (9) are identical for all I.

Proposition II: For both borrower and lender marginal profits are constant along the contract curve as I increases.

Proof: Assume that D=B and $R_f=\delta$, so that (7') and (11') are equivalent. Integrating both sides of (7') over outcomes below r^* so that $\int^{r^*}F(r)dr=\int^{r^*}(I-r_f)/I\, dr = (I-R_f)r^*/I$. Substituting this into (4) and (8)

2 To see this note that $\partial F(r^*)/\partial\delta < 0$ in (11. If $\delta > Rf$, $(I-\delta)/I > (I-Rf)/I$ the acceptable risk to the borrower for a given interest rate will always be greater than that acceptable to the lender, and the borrower will be forever rationed.

gives conditional profit functions π^* and Z^*. Differentiating with respect to I, yields $\partial\bar{\pi}^*/\partial I=0$ and $\partial\bar{Z}^*/\partial I=0$. The result implies that optimal contracts along the contract curve for increasing I represent parieto optimal contracts, because profits are neither increasing or decreasing for borrower or lender. The result contrasts with Jaffee and Modigliani and Kalay and Rabinovitch, who find that marginal profits are increasing for lenders along the contract curve.

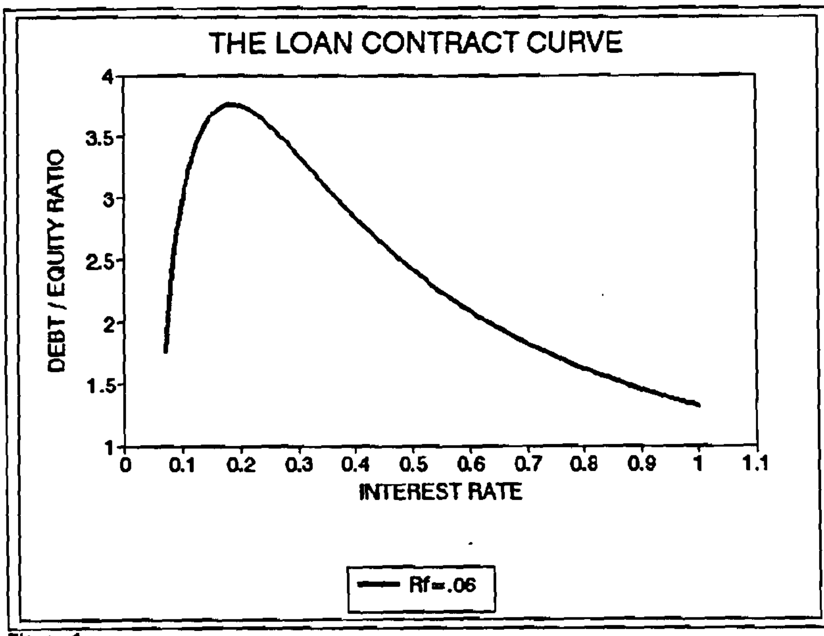

Figure 1

Corollary I: Given perfect information about F(•), and R_f=δ, parieto optimal loan contracts are not characterized by any credit rationing equilibria: that is given propositions I and II both borrowers and lenders can have their respective loan demands and supplies satisfied at the prevailing market rate of interest. Furthermore since these parieto optimal outcomes are also competitive equilibria,lenders would never have to act as discriminating monopolists, as described in Jaffee and Modigliani.

Proposition III: For any given I, borrower profits increase as debt is varied any direction from the optimum while lender profits decrease.

Proof: From (7) it is found that $\partial^2\bar{\pi}/\partial D^2=IF'(r^2)r^*_D > 0$ for the borrower, and from (11'), $\partial^2\bar{Z}/\partial D^2=-IF'(r^*)r^*_D<0$. The results imply that borrower's profits are convex in (θ,D) while lenders' profits are concave in (θ,B).

Proposition IV: Debt and equity are gross substitutes for borrowers and gross compliments for lenders.

Proof: First from (7'), $\partial^2\pi/\partial D\partial\theta=IF'(r^*)r^*_\theta < 0$, for $r^*_\theta < 0$. Second from (11'), $\partial^2\bar{Z}/\partial B\partial\theta=-IF'(r^*)r^*_\theta > 0$. The proposition is an interesting one for it provides the key motivation for borrower behavior. When the contract curve is upward sloping borrowers increase debt for each dollar of equity, thereby transferring equity into risk-free personal holdings which are bankruptcy protected. The preference to the borrower is to leverage increased financial risk, and risk of default, through increased personal holdings in riskless assets. As interest rates increase there is a point where financial risk is so high, that in order to maintain profits, equity is transferred from personal holdings to the risky investment so that the proportion of debt relative to equity in risky investments decrease.

In contrast, lenders would prefer to see an increase in borrower provided equity, since this would reduce expected losses due to default. Lenders would be willing to increase the amount of debt available if the lender were to provide more equity. Azzi and Cox; Smith; Baltsenberger; Stiglitz and Weiss; and Jaffee all provide collateral-based arguments supporting this proposition.

However, the result is indicative of conflicting objectives in the borrower-lender relationship. This conflict arises from the concavity-convexity conditions outlined in Proposition III. Should the lender demand more equity for a given amount of debt the borrower would, all other things being equal, anticipate a marginal decrease in profits and would thus respond by decreasing debt until marginal profits are zero. Likewise, lenders facing a demand for debt which is disproportionate to equity contributed, would anticipate a marginal decrease in expected profits, and respond by increasing the equity requirement until marginal profits are zero. Through this mechanism a single, zero marginal profit contract curve emerges. Indeed, competitive equilibria, must be described by this process if loan contract outcomes are to be parieto optimal. This notion of equilibrium is consistent with Smith.

Proposition V: All other things held constant, as R_f increases relative to δ, lenders would be rationed for all I, and as δ increases relative to R_f borrowers would face credit rationing for all I.

Proof: As defined by Jaffee and Modigliani, credit rationing occurs to borrowers if they cannot obtain all that is demanded at the prevailing market price, and in Jaffee, lenders are rationed if they cannot supply the optimum amount of debt at the prevailing market price.

Given (7) and (11) and Corollary I, parieto optimal, competitive equilibrium solutions occur along a single contract curve for both borrower and lender, if $R_f=\delta$. However, there are many frictions in the market which may cause δ to differ from R_f. For example, variations in deposit rates, excessive costs of servicing and monitoring may all rise, at least in the shortrun, to affect equilibrium. When a parieto optimal equilibrium does not exist then supply and demand can be identified along uniquely identifiable curves. That is for $R_f \neq \delta$ the risk premiums $(I-R_f) \neq (I-\delta)$.

The effect on optimal leverage can be seen by noting that $\partial F(\bullet)/\partial R_f = \partial F(\bullet)/\partial\delta = -1/I < 0$ sos that the optimal probability of default must decrease. Thus, as illustrated in Figure 2, the demand curve will lie everywhere above the supply curve is $R_f > \delta$, and everywhere below for $R_f < \delta$. The characteristics of this problem prohibit parieto efficient-competitive equilibrium solutions from occurring, and depending on Sign$(R_f-\delta)$ either borrowers or lenders would be rationed for all I.

Proposition VI: Parieto optimal loan contracts require complete agreement between borrower and lender as to the exact probability distribution which characterizes $\bar{R}$.

Proof: The proof is by example. Suppose that borrowers and lenders are in fundamental agreement about $\bar{R}$ and its variance σ^2_R, but do not subjectively agree on the nature of the underlying probability distribution. Assume that the borrower perceives risk to follow a two-parameter logistic distribution of the form $F(r^*)=1/(1+e^{(r^*-\bar{R})/\sigma})$, while the lender assumes a more even dispersement of probabilities as suggested by the uniform distribution $F(r^*)=(r^*-a)/(b-a)$ where $a=\bar{R}-3\sigma$ and $b=\bar{R}+3\sigma$.

For $R_f=\delta=.06$, $\sigma=.15$, and $\bar{R}=1.15$, the two contract curves are depicted in Figure 3. For the borrower, the lender's perception of risk would be sufficient to ration credit t all points to the left of the intersecting curves, while the lender would be rationed at all points to the right. Likewise, if it were the lender perceiving the logistic distribution and the borrower, the uniform, rationing criteria would be reversed.

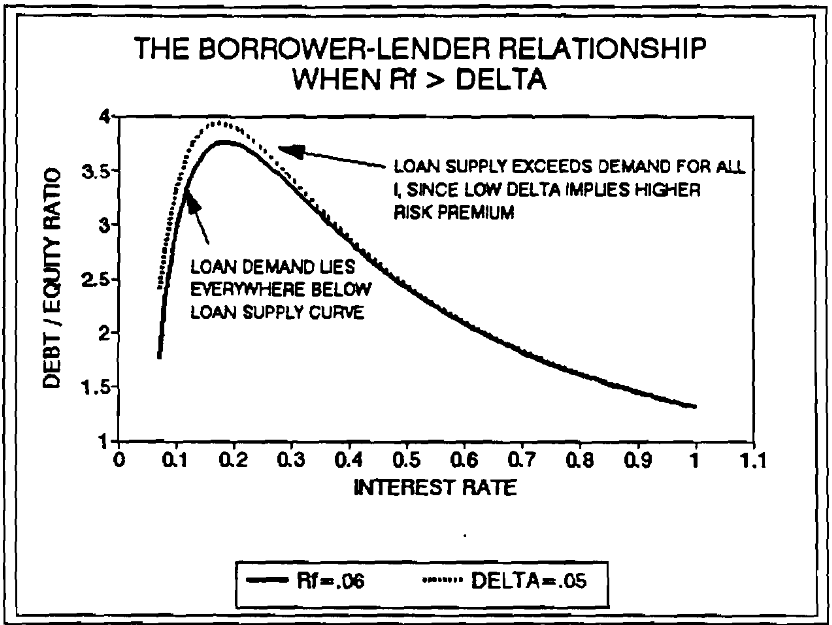

Figure 2

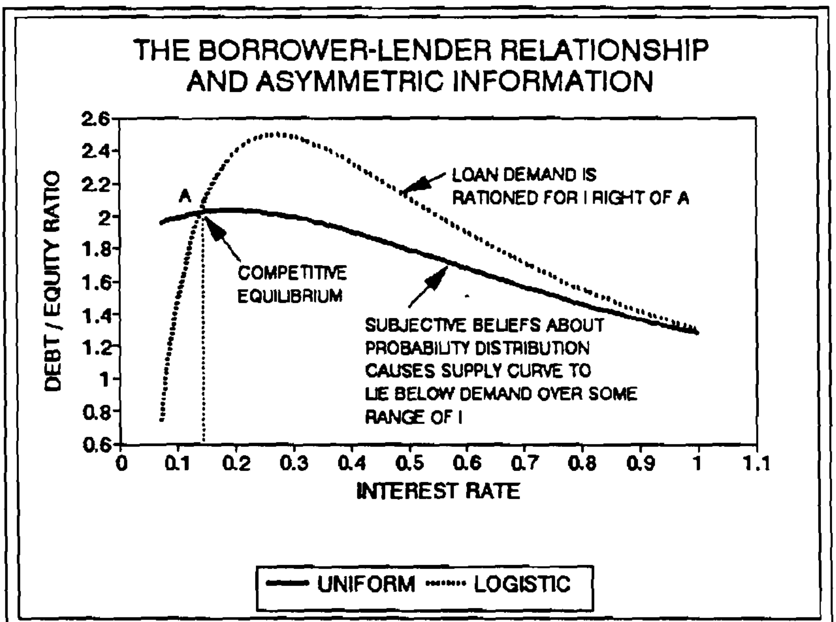

Figure 3

That differences in risk perception, or asymmetric information about outcome probabilities, can lead to different contract curves provides the following corollaries.

Corollary II: When lenders and borrowers differ in their perception of risk distinct loan demand and supply curves can be defined, and

Corollary III: Differences in risk perception between the borrower and lender can lead to outcomes for which either the borrower or lender are rationed over some range of interest rates.

Proposition VII: An exogenous increase (decrease) in downside-risk holding I constant, leads to a corresponding decrease (increase) in the contracted loan amount.

Proof: Assume a mean preserving transformation which either increases downside risk through increased variance, or increases downside risk through allocating probabilities from the upper to lower end of the probability distribution as in Rothschild and Stiglitz or Menezes et al. Then the transformed density function $G(r^*)$ must be greater than the original distribution. Let $dF(r^*)=G(r^*)-F(r^*)>0$. Then from (7') or (11'), $dD/dF(\bullet)=-1/F'(r^*)r^*_D<0$. The result implies that loan contract curves shift down (up) as downside risk increases (decreases).

Proposition VIII: An exogenous increase (decrease) in downside-risk, holding debt constant, leads to an increase (decrease) in the contracted loan rate.

Proof: Using the same assumptions as Proposition VII, then from (7') or (11') $dI/dF(\bullet)=I^2/R_I=I^2/\delta>0$. Propositions VII and VIII are depicted in Figure 4, for a logistic distribution with $\bar{R}=1.10$, and $\sigma=.10$, .15 and .20. By changing the variance, contract curves shift down and to the right, thus confirming the propositions. We have also the following corollaries:

Corollary IV: As downside-risk increases (decreases) the slope along the loan contract curve becomes flatter (steeper).

Proof: Define the conditional probability of default by $\lambda(r^*)=F'(r^*)/(1-F(r^*))$, then divide the numerator and denominator of equation (12) by $(1-F(r^*))$ to get $dD/dI=(1-r^*\lambda(r^*))/I\lambda(r^*)r^*_D$. Then $d^2D/dId\lambda(\bullet)=-\lambda(r^*)^{-2}<0$. Thus, high-risk contracts are likely to be less responsive to increasing interest rates than low-risk contracts. Evidence of this is provided in Figure 4, as risk increases the slope of the contract curves become flatter.

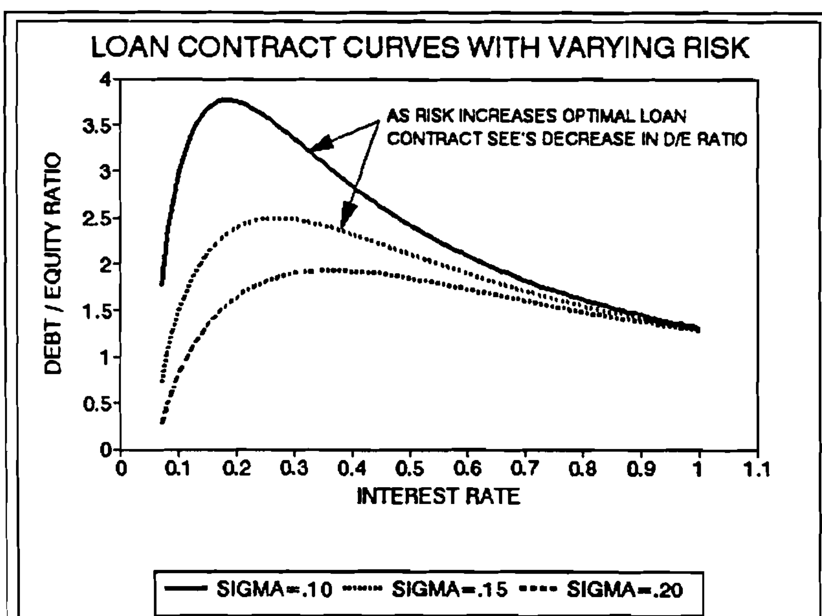

Figure 4

Corollary V: Mutually identifiable groups of borrowers with distinct, measurable, and heterogenous investment risk profiles can be separated into different loan classifications by lenders.

The corollary follows proportions VI and VII and Corollary IV. If we assume, as do Stiglitz and Weiss and Bester, that single lenders with multiple borrowers cannot due to asymmetric information possibly identify all default risks *a priori* then they face a problem of adverse selection. Then lenders will use screening or signalling devices in order to identify borrower' risks and create risk pools. Formal credit evaluation techniques such as credit scoring can be used to create such pools, and can be used to reduce the number of adversely selected borrowers.

Credit scoring is one such screening device. Since credit scoring models are used to estimate $F(r^*)$, the probability default, they can be used, according to (7) to identify diverse groups for which $F_1(I)>F_2(I)>F_3(I)$, where the subscripts represent customer types and the probabilities are measured relative to a given interest rate. This too is illustrated in Figure 4 where the three curves can be viewed as contract curves for three different risk groups. Through screening devices, such as credit scoring, lenders can offer different loan contracts. If properly identified, these contracts will be parieto optimal (Bester). However, if either type I error (i.e., a good loan is rejected), or Type II error (i.e., a bad loan is accepted), then credit rationing outcomes, consistent with adversely selected groupings can occur.

Proposition IX: For profit maximizing lenders and borrowers with self-imposed (or safety-first) credit risk constraints, unique demand and supply curves, can be defined with the loan demand curves being everywhere downward sloping.

Proof: Set the right-hand side of equation (7) equal to probability $\bar{F}$, such that $F(r^*)\le\bar{F}$. Total differentiation yields $dD/dI=-r^*_I/r^*_R=-D(\theta W_o+D)/I\theta W_o<0$ and $d^2D/dI^2>0$.

This situation is presented in Figure 5 which shows the lender supply curve for the logistic distribution with $\bar{R}$=1.15, σ=.15, and probability limits equal to .05, .10, and .15, respectively. All points on the demand curves reflect equal probabilities for all (D,I) combinations. At points to the left of the demand-supply intersection borrowers would appear to be rationed by the lender. However, since the nature of the constraint is an ≤ inequality there is no reason to suspect that the iso-risk demand curves would be binding. Thus, loan contracts would follow along the lender's supply curve until the constraint becomes binding at the loan demand-supply intersection. Points to the right of this intersection indicate that borrowers ration lenders. A reverse proposition holds for profit maximizing borrowers and risk constrained lenders. If both borrowers and lenders impose internal risk constraints one of the two will be rationed unless risk constraints are equal.

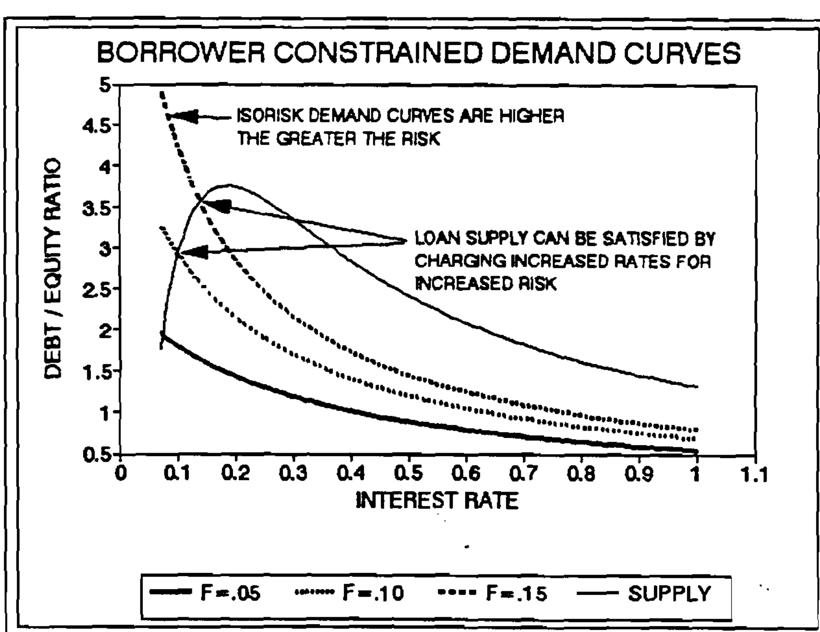

Figure 5

The notion of safety-first constraints implies the existence of a shadow-price for risk, which represents profits foregone by borrowing below the parieto optimal contract curve. This would appear irrational in a frictionless economy, but in reality there are many reasons why borrowers would impose such constraints including prohibition on future debt use which would come at a much higher opportunity cost, the loss of reputation due to public embarrassment of perceived failure, or risk. Aversion regulatory controls on maximum loan-loss provisions.

Loan Demand and the Empirical Significance of Credit Scoring

From the theoretical model of Section I, and the above results, it is clear that loan demand is indistinguishable from loan supply, even for disequilibrium loan contracts. From an empirical perspective, data on loans is generally censored because neither the actual loan request, the maximum loan possible, or loans applications denied are not generally observable. What is observed are the contract amounts at stated interest rates. Thus it is virtually impossible to directly test for the significance of internal or external credit rationing on the borrower/lender relationship.

However, it is possible to use loans contract data to estimate the two types of loan contract curves discussed if loan demand is estimated in conjunction with a credit scoring model, and loan amount and interest rates are included as arguments in both models. This is the intention of this section. In particular this section estimate for farm credit corporation loans data, a logistic credit scoring function and a quadratic loan contract equation, and thus derives estimates of the loan contract curve and iso-risk contract curves.

A total of 8,451 mortgage and refinancing loan records are used in the analyses covering about 25 percent of all FCC loans made between 1981 and 1988. Data used represent only those loans which were still outstanding as of January 1, 1992, were clean of possible errors, and had maintained the original loan.[3] The status of loans were categorized as being current, or noncurrent as at January 1, 1992, with noncurrent loans being defined as those being over $500 in arrears. No data on actual loan default was available[4], hence credit risk is proxied by the probability of being in arrears.

Agriculture, unlike most other industries, has the unique characteristic that seemingly homogenous products are produced with varying degrees of risk depending on the region of production, soil fertility and quality, heat, sunlight, moisture and other environmental/ecological factors. Hence it is questionable as to whether or not a single aggregate demand for loans is reasonable: As posited in the theoretical section investment classes defined by differential means and variance would be characterized by different levels of demand, all other things being equal.

Similarly, since the FCC is a federal lending agency its loan portfolio includes loans made to different types of farming. For example, cash crops - mostly grains and oilseeds, dairy and poultry, beef and hogs, and other horticultural, specialized farming operations must be served. Each one of these farming types faces unique risks which are not entirely systematically related to the others. Furthermore, similar commodities grown in different regions, have different associated risk, (Turvey; Turvey and Brown). This heterogeneity of risks across commodities and regions provides a unique opportunity to empirically investigate the borrower/lender relationship.

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[3] Loans outstanding and free of error were 12,229. However, some loans had been adjusted, added to, or restructured over time. Because the nature of the loan adjustement was unknown, these loans were eliminated.

[4] Approximately 20,000 of the loans made between 1981 and 1988 were retired, but there was no indication which of these were paid out or loan losses.

Accordingly the loans were categorized into four different regions, Pacific (British Columbia and Alberta), Prairies (Saskatchewan and Manitoba), Central (Ontario and Quebec) and Atlantic (Newfoundland, Price Edward Island, New Brunswick and Nova Scotia). Farm types were categorized into cashcrops (grains and oilseeds), supply managed[5] (dairy and poultry), livestock (hogs and beef) and other. Each region is defined by these commodities so there are a total of 16 commodity-region combinations. Some sample statistics are presented in Table 1.

The econometric formulation of the estimated loan contract curves is defined by two equations. The first equation is a logistic credit scoring model which includes variables reflecting liquidity, solvency, profitability, repayment capacity, security, and farm-type and regional risk differentials. It is of the for

$$F(Z) = 1/(1+e^{-Z}) + \varepsilon \tag{14}$$

where

$$\begin{aligned} Z = {} & \propto_o + \propto_1 LR + \propto_2 DA + \propto_3 DCM + \propto_4 ROA \\ & + \propto_5 RR + \propto_6 LS + \propto_7 LOAN + \propto_8 RATE \\ & + \sum_{i=1}^{4} \sum_{j=1}^{4} \propto_{8+k} DR_i F_j + \sum_{y=1}^{7} \propto_{24+y} DY_y \end{aligned} \tag{15}$$

and LR is the liquidity ratio; DA is debt-asset ratio; DCM is the change in contribution margin; ROA is the return on assets; RR is the repayment ratio; LS is the loan to security ratio; LOAN is the loan contract amount; and RATE is the interest rate charged on the loan. The 16 dummy variables DR_iF_j represent covariance between regions (R_i) and farm type (F_j) while the dummy variables DY_y represent the year in which the loans were made. To avoid singularity a dummy variable for loans made in 1981 was not included.

The loan demand (contract) curve was estimated using a simple quadratic form:

$$\begin{aligned} LOAN = {} & B_o + B_1 RATE + B_2\, RATE^2 + B_3\, F(Z) \\ & + \sum_{i=1}^{4} \sum_{j=1}^{4} B_{5+r}\, DR_i\, F_j + \sum_{y=1}^{7} B_{17+y}\, DY_y + e\,. \end{aligned} \tag{16}$$

In (16), F(Z) is the estimated probability of default as proxied by the probability of a loan being noncurrent. The predicted value of (15), $\hat{F}(Z)$, is used as an instrumental variable in this equation. Both equations were estimated in SHAZAM (White, et.al.) with equation (16) being corrected for heteroscedasticity.

Results

Econometric results are presented in Table 2. As would be expected, loan default probabilities decrease with increased liquidity (LR), profitability (ROA), repayment ability (RR), and security (LS), and increase with financial leverage (DA), change in contribution margin (DCM), absolute loan amount (LOAN), nominal interest rate (RATE), and with refinancing (REFIN). Relative to loans made in 1981, loan default probabilities were higher for loans made in 1982 and 1985, but none of the year dummy variables were significantly different from zero at the five

[5] Supply managed commodities such as dairy, broilers, eggs and turkeys, face institutional quotas on individual farm and aggregate production. Farmers must purchase quotas at a fair market price, and are penalized for over producing. However, farmers holding quota receive monopoly-like prices, and hence tend to earn super-normal profits at low risk.

Table 1. **Sample Statistics for Empirical Model**

Risk Class	OBS	F(Z)	LR	DA	DCM	ROA	RR	LS	Loan Amount	Interest Rate
					Pacific					
Crops	777	.496	5.46	.512	.084	.053	1.27	.685	183400	10.82
	-	-	(3.94)	(.205)	(.184)	(.038)	(.399)	(.157)	(130150)	(2.94)
Dairy/Poultry	162	.198	5.15	.565	.015	.076	1.345	.724	237860	9.285
	-	-	(.399)	(.189)	(.101)	(.031)	(.369)	(.150)	(162240)	(3.002)
Livestock	366	.415	5.66	.483	.088	.053	1.343	.703	164970	10.784
	-	-	(3.784)	(.212)	(.194)	(.039)	(.511)	(.143)	(118080)	(2.868)
Other	53	.453	5.46	.477	.082	.055	1.261	.691	150450	11.398
	-	-	(3.89)	(.299)	(.184)	(.034)	(.356)	(.154)	(94338)	(2.951)
					Prairie					
Crops	4,139	.527	6.039	.414	.049	.056	1.289	.651	129300	11.458
	-	-	(3.73)	(.221)	(.144)	(.039)	(.336)	(.129	(91064)	(2.55)
Dairy/Poultry	124	.250	4.896	.518	.041	.08	1.325	.708	158130	11.006
	-	-	(3.82)	(.225)	(.120)	(.032)	(.326)	(.138)	(114360)	(2.883)
Livestock	486	.496	5.467	.444	.082	.061	1.367	.664	122750	11.210
	-	-	(3.701)	(.225)	(.172)	(.04)	(.35)	(.163)	(95236)	(2.53)
Other	68	.544	5.491	.462	.110	.065	1.335	.713	108120	12.076
	-	-	(4.078)	(.187)	(.148)	(.049)	(.336)	(.134)	(87762)	(2.035)
					Central					
Crops	606	.256	3.799	.544	.085	.085	1.310	.690	162840	11.897
	-	-	(3.815)	(.240)	(.165)	(.047)	(.441)	(.170)	(118910)	(2.059)
Dairy/Poultry	821	.107	4.284	.478	.019	.061	1.305	.677	149810	10.399
	-	-	(3.958)	(.197)	(.102)	(.026)	(.386)	(.179)	(106940)	(2.732)
Livestock	485	.177	4.094	.593	.054	.072	1.420	.737	123140	10.971
	-	-	(3.562)	(.231)	(.163)	(.045)	(.490)	(.156)	(85201)	(2.727)
Other	68	.324	4.068	.529	.115	.056	1.447	.755	106960	12.615
	-	-	(3.847)	(.268)	(.228)	(.058)	(.496)	(.139)	(72445)	(1.441)
					Atlantic					
Crops	119	.319	3.369	.513	.052	.0060	1.411	.700	115030	11.186
	-	-	(3.294)	(.189)	(.171)	(.046)	(.616)	(.160)	(97128)	(2.727)
Dairy/Poultry	99	.131	4.806	.422	.005	.054	1.297	.676	76037	11.419
	-	-	(4.116)	(.198)	(.092)	(.029)	(.316)	(.181)	(56970)	(2.342)
Livestock	46	.239	4.736	.474	.015	.040	1.381	.686	77204	11.57
	-	-	(3.753)	(.233)	(.110)	(.048)	(.392)	(.162)	(74101)	(2.234)
Other	4	.50	3.564	.459	-0.79	.056	1.356	.709	63000	12.350
	-	-	(4.303)	(.076)	(.137)	(.038)	(.229)	(.068)	(59099)	(.900)

percent level of confidence. The regional-farm type dummy variables indicate that the most risky loans are those made to Saskatchewan cash-crop farmers. In fact with the exception of the supply managed commodities in that province, Saskatchewan loans tend to be more risky than any other region in Canada. The supply managed commodities, dairy and poultry are in each region prone to the least amount of credit risk, while livestock and other crops pose modest credit risks.

Table 2. **Results of Econometric Models**

Variable	Probability Model		Loan Demand Equation	
	Coefficient	Standard Error	Coefficient	Standard Error
Constant	-2.542	.679	85735	22409
LR	-.033	.069	-	-
DA	.961	.152	-	-
DCM	.727	.164	-	-
ROA	-.304	.697*	-	-
RR	-.436	.084	-	-
LS	.457	.194	-	-
LOAN	.225E-5	.271E-6	-	-
RATE	.127	.018	-10570	4149
$RATE^2$	-	-	-411.13	232.77
REFIN	.507	.078	-	-
F(Z)	-	-	519480	10501
DPC	.876	.452	-53057	12473
DPS	-.415	.492*	118470	15605
DPL	.622	.460*	-29338	12719
DPO	.701	.531*	-50142	15837
DPRC	1.266	.447	-112400	12181
DPRS	-.299	.498*	54386	14019
DPRL	1.139	.456	-108110	12564
DPRO	1.056	.516	-116880	14795
DCC	-.605	.456*	75766	12601
DCS	-1.136	.460	96791	12433
DCL	-.786	.462	54550	12442
DCO	-.216	.525	10023	14820*
DAC	.108	.491*	-17738	14293*
DAS	-.813	.541*	35192	12977
DAL	-.197	.574*	-14907	15593
DAO	.778	1.136*	-125040	13301
D82	.051	.410*	-17466	41492
D83	-.244	.403*	57995	232.77*
D84	-.227	.411*	48483	8631.90
D85	.027	.416*	17019	8247.1
D86	-.635	.409*	86725	8981.6
D87	-.679	.409*	79096	9001.8*
D88	-.812	.436*	88812	8851.3
R^2	.20		.41	
Prediction Success				
Overall	61.3%			
Type = 0	56.9%			
Type = 1	53.3%			

The overall prediction accuracy of the credit scoring model is 61.3 percent, with 66.9 percent of current loans being correctly predicted, and 53.3 percent of noncurrent loans being correctly predicted. Typically, it is more difficult to predict bad loans because extraneous factors (such as death, divorce, drought, trade wars), etc., are much more difficult to assess *a priori* than objective measures of liquidity, profitability and solvency, etc.

The predicted values estimated by the credit scoring model were used, in the second stage, as an instrumental variable in the loan demand (contract) function. However, there is a major flaw in the procedure which cannot easily be overcome, and this may cause bias. The flaw is that the estimated logistic probabilities are defined in terms of posterior probabilities, whereas realistic credit scoring and credit rationing are theoretically dependent on prior probabilities. Thus it is assumed that the posterior, conditional probability estimates are perfectly correlated with subjectively or objectively determined prior probabilities.

The demand equation, corrected for heteroscedasticity, had an adjusted R^2 of 41.1 percent which is fairly high for cross-sectional data. Holding risk constant the demand elasticity (flexibility) is given by E_I = -(10570 RATE + 411.13 RATE^2)/LOAN. When risk is variable (i.e., $\partial \hat{F}(Z)/\partial RATE \neq 0$ and $\partial \hat{F}(Z)/\partial LOAN \neq 0$) the elasticity is determined by the total derivative (dD/dI) rather than the partial derivative, $\partial D/\partial I$.

The total derivative is given by

$$\frac{dLOAN}{dRATE} = \frac{(B_1 + 2B_2\ RATE + B_3\ \partial\hat{F}(Z)/\partial RATE)}{(1 - B_3\ \partial\hat{F}(Z)/\partial LOAN)} \tag{17}$$

where $\partial\hat{F}(Z)/\partial RATE = \alpha_8(1-\hat{F}(Z))\hat{F}(Z)$ and $\partial\hat{F}(Z)/\partial LOAN = \alpha_7\ (1-\hat{F}(Z))\hat{F}(Z)$.
From Table 2 the estimated equation (16) B_1 = -10520, B_2 = -411.13, and B_3 = 519,480, and from equation (15), α_8 = .127, and α_7 = .226E-5. Hence

$$\frac{dLOAN}{dRATE} = -\frac{(10570 + 822.26\ RATE - (519{,}480)(.127)\ 1-\hat{F}(Z)))\ F(Z)))}{(1 - (519{,}480)\ (.00000226)\ (1-\hat{F}(Z))\ \hat{F}(Z))} \tag{18}$$

Since the denominator in (18) is, by these estimates, always positive, the shape of the demand curve is determined by the numerator. As proposed in the theoretical section, the demand curve is downward sloping when risk is held constant so it is the impact of credit risk on demand which causes a backward-bending curve. This possibility is allowed by equation (18) which will be positive (negative) when (10570 + 822.26 RATE) < (>) (519,480)(-127)(1-$\hat{F}$(Z))F(Z).

In Figure 6 we plot the derived demand for credit for cash-crop farms in the Pacific, Prairie, and Central regions of Canada, as well as the average loan demand function. The first point of interest is that Prairie cash crops shows a backward-bending contract curve: up to approximately nine percent interest loan demand is increasing. Cashcrop loans in Ontario and Quebec seem to be more responsive to changes in interest rates than Prairie and Pacific which are equally responsive, except that Pacific region loans tend to be higher on average.

What is important about these contract curves is the different shapes they take. For relatively homogenous products (grains and oilseeds) regional characteristics, including risk, are significantly unique, to affect loan demand. Corresponding to this is the argument that regional supply of debt must also respond to regional and farm-type differences.

The elasticities, as derived in (17) and (18) are presented in Table 3 along with the average nominal interest rates, loan contract amounts and probabilities of default and success, used in the calculations. The fifth numerical column in Table 3 indicates the relative elasticities when default risk is excluded from the elasticity measure (i.e., equation (17)). These elasticities range from -.56

for Pacific region dairy producers to -3.067 for Atlantic producers of 'other' commodities. Evaluated at the means, all elasticities are negative. In general the 'other' category showed the more elastic response in all regions; that is a one percent increase in the nominal interest rate would decrease the loan amount by 1.16, 1.74, 1.85, and 3.067 percent for the Pacific, Prairie, Central, and Atlantic regions, respectively. With the exception of the Atlantic region, the smallest elasticity is attributed to dairy and poultry farms, which are the least risky of all commodity groups.

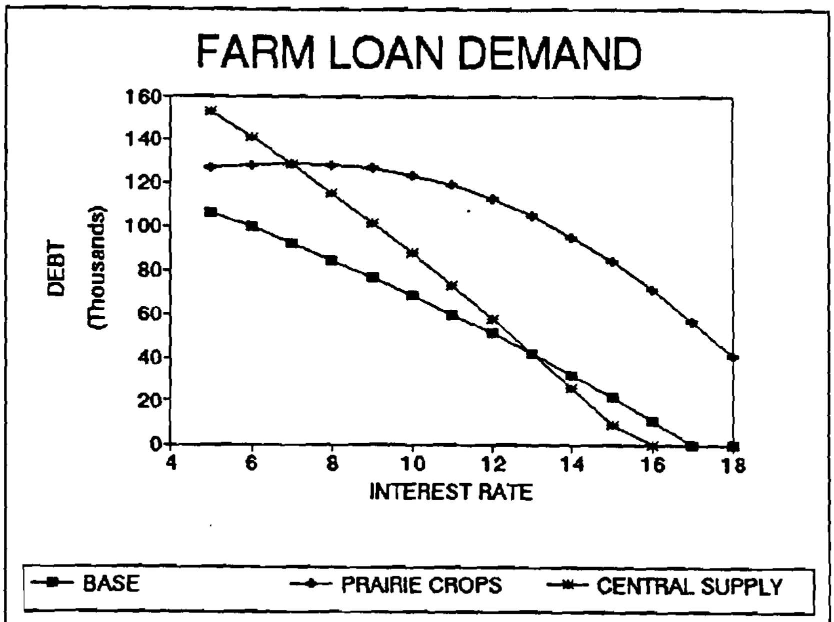

Figure 6

In the sixth numerical column in Table 3 we present the elasticities for loans which exclude the marginal change in default probabilities (i.e., equation (18)). The effect is to either increase or decrease the elasticity relative to those in column 5. Nine of the 16 classes showed a decrease in the elasticity amount. For example, the Central region crop elasticity falls from -1.35 to -1.18 when risk is included, whereas Central dairy farms showed an increase from -1.03 to -1.27.

That elasticities can either increase or decrease ought not to be surprising given the theoretical model. In essence, if default or bankruptcy risk is incorporated into the profit maximizing level of investment, then increasing the amount of debt -and the probability of default - may be optimal for some farmers. Recall that from the borrower's perspective, debt and equity are substitutes; for some farmers debt may be increasing as equity is decreasing, while for others, debt may be decreasing while equity is increasing.

Figure 7 shows the aggregate contract curve and two contract curves which have constant (hypothetical) risk of 20 and 30 percent, respectively. These iso-risk contract curves are more responsive to increased interest rates than the aggregate function. If we view the aggregate function as a demand curve and the 2 iso-risk curves as supply response functions consistent with credit scoring criteria, borrowers would be rationed for loans below and to the right of intersecting points. Alternatively, if the aggregate curve represents aggregate supply, and the two iso-risk curves borrower demand, then lenders would be rationed for all loans below and to the right of the intersecting points.

Table 3. Average Loan Demand (Contract) Elasticities

Variable	Probability of Default	Probability of Success	Loan Amount	Interest Rate	Default Risk Held Constant	Default Risk Allowed to Change
			Pacific			
Crops	.496	.503	183400	10.822	-.89	-.87
Dairy/Poultry	.197	.802	237860	9.285	-.56	-.55
Livestock	.415	.585	164970	10.784	-.98	-.59
Other	.453	.547	150450	11.398	-1.16	-.44
			Prairie			
Crops	.527	.472	129300	11.458	-1.35	-1.18
Dairy/Poultry	.250	.750	158130	11.006	-1.05	-.93
Livestock	.496	.504	122750	11.21	-1.39	-.26
Other	.544	.456	108120	12.076	-1.74	-1.51
			Central			
Crops	.256	.744	162840	11.897	-1.13	-1.40
Dairy/Poultry	.107	.893	149810	10.399	-1.03	-1.27
Livestock	.177	.823	123140	10.971	-1.34	-1.51
Other	.324	.676	106960	12.615	-1.85	-1.89
			Atlantic			
Crops	.314	.681	115030	11.186	-1.475	-1.74
Dairy/Poultry	.131	.869	76037	11.419	-2.29	-2.79
Livestock	.239	.761	77204	11.574	-2.29	-2.13
Other	.500	.500	63000	12.35	-3.067	-4.06

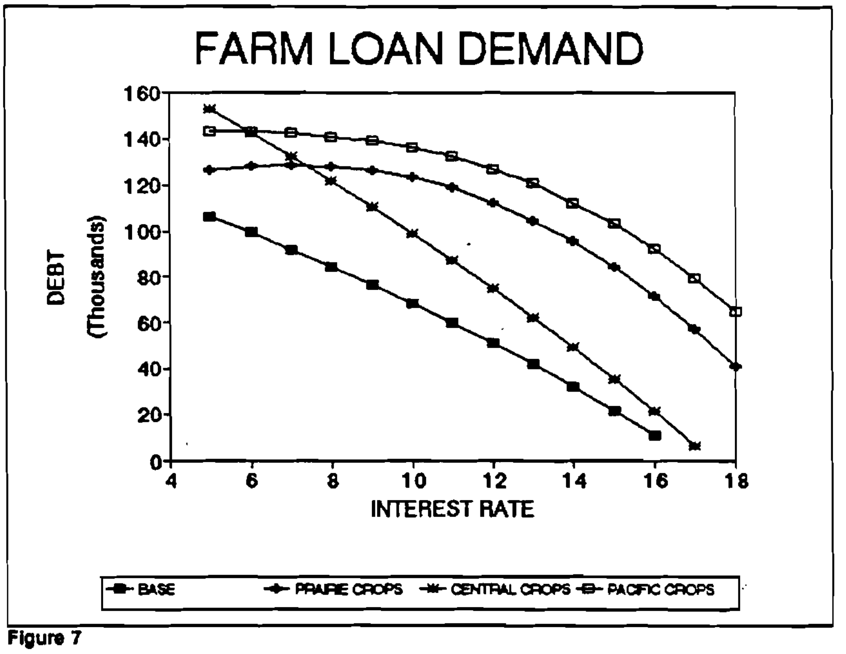

Figure 7

The iso-risk curves in Figure 7 are derived from the theoretically consistent loan contract curves and as such do not truly reflect demand or supply, nor is it possible to determine whether, for any given rate of interest, the borrower is being rationed, or the lender is being rationed or if any rationing is taking place at all. However, the derived iso-risk curves do span all points along the loan contract curve and thus they span the distribution of loan-rate observations about the average loan. It is thus feasible that the aggregate loan contract curve reflects loan-interest rate combinations for loans which are rationed by either the borrower or the lender. We are not, given unavailable data on lender-borrower intent, able to prove this and it is thus treated here as conjecture only.

Conclusions

This research developed first a series of propositions about the lender-borrower relationship and used these to develop and interpret empirical loan demand (contract) equations for Canadian Farm Credit Corporation Loans. From the theoretical model it was shown that loan demand and/or contract curves can have backward bending properties which are the result of bankruptcy probabilities. For the borrower, debt and equity are substitutes so that over some range of contracts debt relative to equity actually increases for risky investment, while personal holdings of risk-free investments, protected from bankruptcy by limited liability increases. Asymmetric information was posited as one reason why distinguishable loan demand and loan supply curves could emerge. It was also noted that loan demands differ substantially across different loan-type classifications, and asymmetric information can be resolved by identifying separate groups of borrowers.

From an empirical perspective, the irrefutable conclusion that loan demands cannot be estimated in isolation of default probabilities is an important one. In fact, screening devices such as credit scoring are employed by lenders to lessen informational asymmetries. For a contract to occur there must then be subjective agreement between the borrower and lender on the probability of success. This property is then used to estimate a loan contract function which includes a measure of loan default probability as an endogenous variable, where the loan default probability is estimated from an empirical credit scoring (logistic) regression.

The results confirm, for 16 pooled risk classes representing different regions and commodity groupings across Canada, that indeed different demand functions emerge according to risk. From a lender's perspective it is important to identify how loan demand might change given an increase in the nominal rate. For the data used in this study, elasticities ranged from a low of -.55 to a high of -4.06. It was also shown that for some classes, recognition of the marginal changes in default probabilities caused an increase in elasticity measures, while for others a decrease. This result is consistent with the theoretical model.

There are several points on which to conclude. First, the notion of farm level loan demand, as defined by the lender-borrower relationship should account for loan default probabilities, which differ across farm regions and types. Second, it is unlikely that any single loan demand curve exists which can describe the entire industry without taking into account farm type and regional differences. Finally, lenders should recognize that heterogenous risks imply heterogenous demands, and thus should be prepared to offer multiple loan contracts to each distinctive risk classes.

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