THE EFFECTS OF PCA CAPITALIZATION POLICIES ON FARMERS' BORROWING COSTS

Bruce L. Jones & Peter J. Barry

Proceedings of a Seminar
Sponsored by North Central Regional Project NC-161
"Evaluating Financial Markets for Agriculture"

FINANCIAL MARKETS FOR AGRICULTURE: MACRO, INSTITUTIONAL, AND POLICY ISSUES

St. Louis, Missouri
October 31-November 1, 1984

THE EFFECTS OF PCA CAPITALIZATION POLICIES ON FARMERS' BORROWING COSTS

Bruce L. Jones and Peter J. Barry

Interest in the Farm Credit System (FCS) and Production Credit Associations (PCAs) is well documented in the review of agricultural finance and capital market research by Brake and Melichar [3]. Many studies provide both a descriptive and an analytical framework for evaluating the activities and performance of PCAs and FCS. For example, Frey and Lins [5] trace the flow of loan funds from national money markets to farmers and ranchers and Smith [12], Bildersee [2], Tauer and Boehlje [14], and Morris [7] address some of the FCS banks' financing problems. Osburn and Hurst [8] examined economies of size in PCAs and Sundell and Tiegen [13] identified factors that affect the contract interest rate charged by PCAs. Relationships between borrower characteristics and PCA loan quality were identified by Dunn and Frey [4], and Lee, Marsh and Meyer [6].

While numerous studies of PCAs have been performed, none have determined the extent to which a PCA is able to improve the income and well-being of farmers and ranchers. This is the mandate that Congress has given PCAs and the FCS and this objection is met in part by keeping the level and the variability of borrowers' costs as low as possible. The acquisition and management of equity capital is a component of a PCA's operations that likely has significant effects on the level and the variability of borrowing costs.

PCAs acquire and manage two general forms of equity capital: stock and retained surpluses. An association accumulates equity in the form of stock by requiring patrons to purchase stock at a rate specified in terms of the dollar value of total loans outstanding. Retained surpluses are analogous to the retained earnings of a non-cooperative business and they are the accumulated after-tax operating surpluses that exist after payments of dividends and/or patronage refunds. The level of operating surpluses is affected by the margin of the spread between the contract interest rate charged on loans and the cost of the PCA's borrowed funds. Thus an association's retained surpluses are affected by its spread, dividend, and patronage refund policies.

Observation of the 1982 stock rates, spreads, dividends, and patronage refunds for the 43 PCAs supervised by the St. Louis Federal Intermediate Credit Bank (FICB) indicated these associations use a wide variety of capitalization methods [1]. The mean and standard deviation of the spread for these associations were 1.27 percent and .65, respectively, and the mean and standard deviation for the December 31 B-stock rates were 12.20 percent and 3.16, respectively. Dividends were paid by only 17 of these associations in 1982 and only 9 of the 43 PCA paid patronage refunds.

Bruce L. Jones is an assistant professor of Agricultural Economics, University of Wisconsin-Madison; Peter J. Barry is a professor of Agricultural Finance University of Illinois-Urbana-Champaign.

This diversity of the PCA's capitalization methods causes concern because these associations are presumably trying to achieve the objective cited earlier and no prior analyses have evaluated the effects of capitalization methods on borrower's costs. Thus it is possible that some PCAs are employing capitalization methods that are not compatible with the mandate objective. Therefore, further information is needed about the effects of capitalization methods on the level of the stability of borrowing costs.

The objectives of this study are: 1) to conceptualize and model the intermediation process performed by PCAs using stochastic simulation techinques; 2) to analyze historic PCA operating characteristics, particularly capitalization methods; 3) to utilize the model to evaluate the effects of alternative capitalization methods on the level and the stability of borrowing costs; and 4) to evaluate the model and capitalization methods under various economic conditions. In the following sections we show the model specifications, discuss the historic capitalization characteristics of PCAs, report results, and consider their implications.

The PCA Model

The PCA is modeled as an economic unit that maximizes expected utility on behalf of its member-patrons where the expected level and the variance of borrowing costs are determinants of expected utility. Hence the conceptual model is developed as follows.

(1) $E(U) = \alpha(E(AIR), V(AIR))$

(2) $E(AIR) = \beta(c, N, X, E(f))$

(3) $V(AIR) = \gamma(c, N, X, V(f))$

where

$E(U)$ = the collective expected utility of the PCAs' borrowers;

$E(AIR)$ = the expected value of the net after-tax borrowing costs AIR) for the PCAs' borrowers;

$V(AIR)$ = the variance of the AIR;

c = the vector of the capitalization variables controlled by the PCA;

N = the vector of endogenous variables that comprise the PCA's uncontrollable environment;

X = the vector of exogenous variables that comprise the PCA's uncontrollable environment;

$E(f)$ = the expected value of the interest rate the PCA pays on the capital it borrows;

$V(f)$ = the variance of the interest rate the PCA pays on borrowed capital;

α = the function that transforms E(AIR) and V(AIR) into expected utility;

β = the function that transforms c, N, X, and E(f) into E(AIR); and

γ = the function that transforms c, N, X, and V(f) into V(AIR).

The PCAs objective function (Equation 1) states that the collective expected utility of borrowers is a function of the expected level (E(AIR)) and the variance (V(AIR)) of borrowers' net after-tax borrowing costs. Both of these variables are inversely related to borrowers' expected utility (E(U)); therefore increases (decreases) in E(AIR) or V(AIR) cause E(U) to decline (increase).

The PCA contributes to borrowers' expected utility maximization by causing the expect level and/or the variance of borrowing costs to fall. Hence one PCA action is preferred to another when either of the following conditions hold.

a) When $E(AIR_1) < E(AIR_2)$ and $V(AIR_1) \leqq V(AIR_2)$, the action resulting in $E(AIR_1)$ is preferred to the one resulting in $E(AIR_2)$.

b) When $E(AIR_1) \leqq E(AIR_2)$ and $V(AIR_1) < V(AIR_2)$, the action resulting in $E(AIR_1)$ is preferred to the one resulting in $E(AIR_2)$.

Equations 2 and 3 indicate that the E(AIR) and the V(AIR) are both functions of the PCA's capitalization method, the endogenous environment, and the exogenous environment. Furthermore these equations indicate that the expected value and the variance of the interest rate the PCA pays on its borrowed capital affect the E(AIR) and the V(AIR), respectively. The association must manage these variables, under various economic conditions, as it attempts to contribute to its borrowers' objectives.

For this analysis the net after-tax cost of borrowing (AIR) is the discount rate that equates to zero the net present value of all the cash flows associated with a PCA loan. The total net present value (Equation 4) has four components: 1) the present value of the average amount of loans received in cash by borrowers (Equation 5); 2) the present value of the interest payments made by borrowers (Equation 6); 3) the present value of the dividends and patronage refunds received by borrowers (Equation 7); and 4) the present value of the net change in the surpluses held by the PCA (Equation 8). The interrelationships between the variables in Equations 5-8 and their effects on the level and the stability of borrowers' costs are explained in the following sections.

$$(4) \quad NPV = PF + IP - DPR - RPE = 0$$

$$(5) \quad PF = \Sigma \left(\overline{CB}_q \left[1 + (AIR/4)\right]^{-q} - \overline{CB}_q \left[1 + (AIR/4)\right]^{-q-1}\right)$$

$$(6)\quad IP = \Sigma\left([1 - t] \cdot [(\tfrac{1}{4})(f_q + s_q)(1-b_q)^{-1}\overline{CB}_q] \cdot [1 + (AIR/4)]^{-q}\right)$$

$$(7)\quad DPR = \Sigma([([1 - t]\ DIV_q) + [p_q - t]\ PR_q) + SAR_q] \cdot [1+(AIR/4)]^{-q})$$

$$(8)\quad RPE = \Sigma([([1 - t]\ SR_q + SA_q)(1+[AIR/4])^{-q}]-[([1-t]\ SR_{q-1} + SA_{q-1}) \cdot (1 + [AIR/4])^{-q-1}])$$

where:

NPV = Net present value of PCA loans

PF = The present value of the average amount of loans received in cash by borrowers

IP = The present value of interest payments made by borrowers

DPR = The present value of dividends and patronage refunds received by borrowers

RPE = The present value of the net change in the surpluses held by the PCA

$\overline{CB}_q$ = Average amount of loans received in cash by borrowers in quarter q

t = Borrowers' marginal tax rate

f_q = FICB interest rate in quarter q

s_q = PCA's spread in quarter q

b_q = PCA's stock rate in quarter q

DIV_q = Dividends received by borrowers in quarter q

p_q = Percentage of patronage refunds paid as cash in quarter q

PR_q = Patronage refunds declared by the PCA in quarter q

SAR_q = Surplus allocated revolved to borrowers in quarter q

SR_q = Surplus reserve held by the PCA in quarter q -- not to be revolved

SA_q = Surplus allocated held by the PCA in quarter q -- to be revolved

Capitalization Variables

Identified in Equations 5 through 8 are the six capitalization variables that determine the value of the AIR: 1) stock requirements

for loans, 2) the interest rate spread, 3) the timing of the collection of accrued interest from borrowers, 4) the dividend rate paid by the PCA, 5) the percentage of patronage refunds paid in cash, and 6) the length of the revolving period for deferred patronage refunds. The first three variables affect the level and the timing of borrowers' interest payments; the other variables determine the level and the timing of cash flows to borrowers.

Both spread and stock requirements are positively related to borrowers' interest expense; increases (decreases) in either of these variables cause the AIR to rise (fall). The stock requirement directly affects the PCA's equity position because much of the association's equity is stock. The spread indirectly affects the PCA's equity position through its effects on the level of operating surpluses.

How frequently the PCA collects accrued interest from borrowers also affects the AIR. Quarterly versus annual collection of accrued interest increases borrowing costs because borrowers forego the use of cash earlier and thus lose earnings on alternative interim investments.

Dividends, patronage refunds, and revolvements of deferred patronage refunds also affect the level of the AIR. Increases in dividend rates and payments of greater percentages of patronage refunds in cash decrease the AIR. Conversely lengthening the revolving period for deferred patronage refunds increases the AIR because this action reduces borrowers' annual cash receipts.

The PCA's capitalization decisions also affect the variance of the AIR. In general, the V(AIR) will decline as the PCA generates cash and thus reduces its use of variable cost debt capital. Therefore capitalization methods like high spreads and stock rates, low dividends and patronage refunds, and more frequent collection of accrued interest will tend to stabilize borrowers costs because these methods allow the PCA to generate cash and reduce its use of debt capital. In contrast the PCA's utilization of capitalization methods that involve greater use of debt capital will cause the V(AIR) to rise.

Environmental Variables

The level and the stability of the AIR are also affected by exogenous and endogenous variables. Some of the exogenous variables are products of competitive markets as in the case of the level of loan demand, the FICB interest rate, salary levels, and rental rates on buildings and equipment. Others are attributed to institutional regulations such as tax requirements, limits on leverage and patronage refunds, stock requirements, and provisions for loan losses.

The interest rate charged by the FICB strongly affects both the level and the stability of the AIR. This stochastic variable is affected by conditions in the national financial markets where the FICB obtains most of its loan funds through periodic sales of Farm Credit

securities. Other market-determined variables comprising the PCA's exogenous economic environment are wages and salaries, rents on capital assets, and the loan demands of farmers.

FICB and governments regulations are also components of the PCA's exogenous environment [10]. For example, the PCA's leverage ratio (Debt/Equity) cannot exceed 7.50. In addition the FICB's patronage refund decisions determine how much of the PCA's interest expense is refunded each year. Some of the governmental regulations affecting the PCA include: 1) income tax obligations, 2) maximum dividend rates (8 percent per annum), 3) the minimum percentage of patronage refunds that must be paid in cash to avoid tax obligations (20 percent), and 4) the minimum and maximum allowable PCA stock rates (5 percent and 10 percent, respectively). Government regulations also stipulate that the PCA's provisions for losses are accumulated until they equal 3.5 percent of the association's year-end outstanding loans to borrowers. In addition government regulations state that annual additions to provisions for losses cannot exceed .5 percent of the PCA's year-end outstanding loans to borrowers.

Endogenous factors in the PCA's environment include the association's financial position and the financially-related services provided to farmers and ranchers. Assets, liabilities, and equity comprise the PCA's financial position at a point in time. The levels of these factors depend on past events and actions and they represent the departure point for future PCA operations. Financially-related services like machinery leasing, insurance, and farm records also affect the level of a PCA's operating surpluses and its financial structure.

The functional relationship between the PCA's variables operating expenses and its volume of loans outstanding to borrowers is another endogenous environmental variable for a PCA. Equation 9 is a PCA variable operating expense function that was estimated using ordinary least squares regression techniques and 1982 cross-sectional data for the 43 Sixth District PCAs.

$$(9)\quad \underset{(t)}{VOE} = \underset{}{562.0} + \underset{(14.02)}{17.29(NL)} - \underset{(-11.05)}{289.28(NLPE)} \qquad \underset{(22.05)}{}$$

where: VOE = variables operating expenses in $1000s;

NL = average of loans less B-stock outstanding to borrowers in $1,000,000s;

NLPE = NL per full-time employee equivalent; and

(t) = student's "t" statistic for each coefficient.

Equation 9 explains approximately 93 percent of the observed variation in the variable operating expenses of the Sixth District PCAs ($\bar{R}^2$ = .9257). The signs of the estimated coefficients conform with expectations that variable operating expenses are positively related to

loan volume and negatively related to efficiency of labor use. In addition, the estimated coefficients are highly significant, given their respective t statistics; and no heteroskedasticity or multicollinearity problems appear to exist.

Equation 9 indicates the PCA's variable operating expenses will rise (fall) nearly $.017 for every $1 increase (decrease) in the amount of usable cash credit that is supplied to borrowers when NLPE remains constant. However, if NLPE falls (rises) when $1 of additional cash credit is supplied to borrowers, the resulting increase in the PCA's variable operating expenses will be greater (less) than $.017. Thus, the marginal cost of supplying usable cash credit decreases when labor is used more efficiently (increases in NLPE) and the reverse occurs when labor is used less efficiently (decreases in NLPE).

Historic PCA Operating Characteristics

Historic data were obtained from the St. Louis FICB which reflected the operating characteristics of the 17, 12, and 14 PCAs located in Illinois, Missouri, and Arkansas, respectively. These associations year-end leverage positions ranged from 1.8 to 6.8 in 1982 and their average loans ranged from $14.7 million to 74.7 million. The data obtained from the FICB were analyzed to learn about economic conditions experienced by these associations and the capitalization methods used by PCAs with various geographic and size characteristics. The findings of these analyses were used in specifying the operating characteristics of the model PCA for the simulation analysis.

Economic Conditions

Data relating to four environmental variables were analyzed to determine the economic conditions a PCA could experience in the future. The variables were: 1) growth in December 31 outstanding loans net of B-stock (net loans); 2) growth in financially related services income; 3) FICB patronage refund rates; and 4) FICB interest rates. Table 1 presents the data related to the first three variables for the years of 1977 through 1982 and the annual averages of monthly FICB interest rates from 1957 through 1982 are presented in Figure 1.

The average annual rate of growth in net loans was 6.34 percent between 1977 and 1982. The greatest rate of growth occurred in 1979 when net loans increased 21.38 percent. After 1979, however, annual growth in loans steadily decreased and in 1982 net loans decreased 11.42 percent. The annual growth in financially-related services income averaged 3.73 percent between 1977 and 1982. The greatest growth occurred in 1981 when financially-related services income increased 8.4 percent. FICB patronage refund rates decreased from a high of 13.6 percent in 1977 to a low of 5.9 percent in 1982. The average FICB patronage refund rate between 1977 and 1982 was 9.62 percent and the average refund rate was 8.10 percent from 1980 through 1982.

Figure 1 shows average annual FICB interest rates increased at varying rates over the period observed. Between 1957 and 1977 FICB interest rates rose from 4.0 percent to nearly 7.3 percent. In contrast, average annual FICB interest rates rose from approximately 7.3 percent to nearly 13.4 percent in 1982. Thus, the growth in FICB interest rates between 1977 and 1982 was nearly three times greater than from 1957 through 1977.

The coefficients of variation reported in Figure 1 indicate that the relative variability of FICB interest rates decreased from 1958 through 1977. However, from 1978 through 1982 the relative variability of FICB interest rates increased dramatically. Notice that the coefficient of variation was .20 for the 1978-1982 period while the coefficient of variation for FICB interest rates was .10 for the 1973-1982 period. Also notice that the coefficient of variations for the 1958-1982 period was considerably greater than those for the sub-periods. Thus, the relative variability of FICB interest rates was greater over the long term than it was in the short term.

PCA Capitalization Methods

From 1978 through 1982 the 43 Sixth District PCAs generally increased spreads and B-stock rates and paid little or no dividends and patronage refunds. The average spread charged by these associations in 1978 and 1982 were: 95 percent and 1.27 percent, respectively. In 1982 the PCAs which used the higher spreads had lower amounts of loans outstanding and they generally were located in Illinois and Missouri.

The mean B-stock rates for the PCAs were 11.13 percent and 12.20 percent for 1978 and 1982, respectively. The associations with the greater B-stock rates were normally located in Arkansas. Furthermore the PCAs with the higher B-stock rates generally had lower leverage positions and smaller amounts of loans outstanding.

None of the PCAs paid dividends on B-stock from 1978 through 1982 but some paid A-stock dividends during the same period. The number of PCAs paying A-stock dividends in a year ranged from 17 to 24 and the average dividend rate ranged from 5.34 percent to 6.58 percent. PCAs with lower amounts of loans outstanding and those with higher leverage positions were generally the ones that paid A-stock dividends.

Patronage refunds were not commonly paid by the 43 Sixth District PCAs between 1978 and 1982. The number of associations that declared patronage refunds from 1978 through 1982 were 10, 4, 15, 14, and 9, respectively. The percentage of the borrowers' interest expense that was refunded ranged from 3.60 percent to 6.00 percent. The PCAs most frequently declaring patronage refunds were generally located in Missouri and Arkansas and their leverage positions were relatively low. Also PCAs with greater amounts of loans outstanding more frequently declared patronage refunds.

The number of PCAs that deferred a portion of patronage refunds from 1978 through 1982 were 7, 3, 6, 7, and 7, respectively. The percentage of patronage refunds that were deferred ranged from 33.33 percent to 44.29 percent. PCAs with higher leverage positions generally deferred the greatest percentages of patronage refunds. Also greater portions of patronage refunds were deferred by PCAs with lower stock rates or spreads.

The Analysis

The conceptual model was operationalized and used to simulate stochastic PCA operations over 20 years to determine the effects of capitalization methods on the level and the stability of borrowers' costs and the PCA's financial condition. The FICB interest rate was the stochastic variable for all simulations; it was specified in terms of means and variances for each simulation. The model randomly drew FICB interest rate observations from the specified normal distributions.

This study's model drew heavily from the previous modeling efforts of the St. Louis FICB [11]. Like the St. Louis model, this study's model generates balance sheets that reflect the changes in the PCA's financial condition over time. However, this study's model also generates measures of the PCAs earnings and reports the mean and the variances of the borrowers' costs over time.

Specifications

The model PCA's general operating characteristics, capitalization methods, and economic environment were specified for each simulation. These specification were based on historic PCA operations data and the recommendations of FICB personnel.

General Operating Characteristics of the Model PCA: Table 2 presents the beginning financial position that was specified for the model PCA. The beginning leverage ratio of 4.5 to 1 and outstanding loan volume of $36 million reflect average values for the PCAs in the Sixth Farm Credit District in 1982. The base level of financially-related services income was set at $89,375 because this was average amount of this income that was received by the Sixth District PCAs in 1982. The seasonality of the model PCAs lending was reflected by the 1982 seasonal lending indexes for the sample PCAs: 1) Quarter 1 -- .98, 2) Quarter 2 -- 1.02, 3) Quarter 3 -- 1.06, and 4) Quarter 4 -- .94. The value of model PCAs average outstanding loans less B-stock per full-time employee equivalent was set at 1.61 since this was the mean for the Sixth District PCAs in 1982. The collective marginal tax rates of the model PCA's borrowers was set at 30 percent.

To increase the realism of the simulations two assumptions were made about the model association. First, purchases of fixed assets were assumed to occur in years 3 and 12 resulting in cash outflows of $100,000 and $250,000, respectively. Second, loan losses of $500,000 and $1,250,000 were specified for years 8 and 17, respectively. The years of these events were selected arbitrarily.

Capitalization Methods: Five of the six capitalization variables discussed earlier were used to define nine unique capitalization methods for the model PCA: 1) spread, 2) B-stock rate, 3) timing of accrued interest collection, 4) patronage refund payment method, and 5) revolvement period for deferred patronage refunds. Dividends were not included because historic data indicated PCAs typically did not pay dividends. Furthermore, FICB personnel recommended that dividends be excluded from the analysis. Table 3 presents the specifications for each of the nine capitalization methods.

Capitalization Method 0 (CM-0) is the base from which other methods were created. For CM-0 the B-stock rate is 10 percent, accrued interest is collected annually, and patronage refunds are declared whenever operating surpluses exist with 20 percent of the refund paid in cash immediately and the balance paid over five years in equal installments. The PCA's spread is annually adjusted for inflation so inflationary increases in variable operating expenses are offset by greater interest receipts. This inflation adjustment causes the spread to change in the following manner. If the spread is 1.50 percent in year 1 and inflation is 6 percent then the spreads are 1.59 percent (1.50 x 1.06) and 1.69 percent (1.59 x 1.06) in years 2 and 3, respectively. This adjustment causes the nominal spread to increase but the real spread remains constant.

CM-1 is identical to CM-0 except the B-stock is 5 percent versus 10 percent. The difference between CM-2 and CM-0 is the revolvement period for deferred patronage refunds. For CM-2, patronage refunds are revolved over ten years with 1/20th of the deferred refunds paid annually in years 1 through 9 and the balance is paid in year 10. CM-3 is the same as CM-0 except no patronage refunds are deferred. CM-4 is identical to CM-0 except accrued interest is collected from borrowers quarterly versus annually.

The difference between CM-5 and CM-0 is the spread. For CM-5 the nominal spread remains constant for the entire simulation period rather than increasing with inflation. Thus, the real value of the spread decreases in CM-5. The constant spread and the inflation-adjusted spread are specified to yield about the same total loan revenues over the simulation period, but the timing of the receipts differs. In years 1 through 10 the constant spread results in the greater loan revenues. However, in years 11 through 20 the loan revenues for the constant spread are less than those for the inflation-adjusted spread.

CM-6 is identical to CM-5 except the B-stock rate is 5 percent versus 10 percent. For CM-7 the PCA never declares or pays patronage refunds. All other specifications for this method are the CM-0 specifications. CM-8 is the same as CM-7 except the spread is constant versus annually adjusted for inflation.

Economic Environment: Six variables comprised the model PCA's economic environment: 1) inflation rate for operating expenses, 2) FICB patronage refund rates, 3) the expected value(s) of the FICB interest

rate, 4) the variance(s) of the FICB interest rates, 5) annual growth rate for loans outstanding, and 6) annual growth rate for financially-related services incomes. The model PCA was specified to operate under three economic scenarios that represent different expectations on one or more of the first four variables. Historic data were the basis of the specifications for annual growth rates for financially-related services income, FICB patronage refund rates, and the variance(s) of the FICB interest rate. Projections made by the Farm Credit Administration for the year 1985 were used in formulating the annual rates for loan growth, inflation, and cost of FICB funds. The numeric specifications for each scenario are presented in Table 4.

For the base scenario, ES-0, annual growth in loans and financially-related services income are 5 percent and 3.75 percent, respectively, inflation is 6 percent, and the FICB patronage refund equals 8 percent of the PCA's interest expense. The FICB's expect cost of funds is 9.75 percent and its spread is .75 percent; thus the PCA's expected cost of funds from the FICB is 10.50 percent (9.75 + .75). The variance of the FICB interest rate is specified as 20.00 so the coefficient of variation (standard deviation ÷ mean) for the FICB interest rate is the same as the one for the 1958-1982 period (mean -- 6.72 percent, standard deviation 2.88).

ES-1 differs from the base scenario in two ways. First the FICB interest rate is 11.25 percent versus 10.50 percent reflecting an increase of .75 percent in the FICB's spread. Second the FICB's patronage refund rate is 4 percent versus 8 percent. These changes reflect the FICB's attempts to generate and retain greater amounts of equity capital. Elimination of the FICB's tax-exempt status or substantial increases in the potential for loan losses by PCAs are two conditions that might trigger the FICB actions reflected by ES-1.

For ES-0 the expected value and the variance of the FICB interest rate are constant over the entire simulation horizon. However, for ES-2 these variables change every five years. These changes reflect what would occur if financial conditions stabilized in precisely the same manner as they destabilize from 1963 through 1982. Inflation rates in ES-2 were also adjusted to match the changes in interest rates because interest rates and inflation were considered closely correlated.

Procedures

The model was used to perform a set of 50 simulation runs for each operating condition that was specified in terms of: 1) general operating characteristics, 2) a capitalization method, and 3) an economic scenario. A Monte-Carlo approach was followed in randomly drawing quarterly FICB interest rate observations from a normal probability distribution(s). The distribution(s) remained constant for all simulation runs comprising the set. Thus, the FICB interest rate observations for each simulation run were different, but they were all drawn from the same probability distribution(s).

The model computed the value of the AIR for each year of a simulation run and then used the annual AIRs to compute the mean and the variance of the AIR for the simulation period (E(AIR) and V(AIR), respectively). Next, the model used the E(AIR) and the V(AIR) for each simulation run comprising the set to compute: 1) the mean of the E(AIR)s ($\overline{E(AIR)}$) and 2) the mean of the V(AIR)s ($\overline{V(AIR)}$. The $\overline{E(AIR)}$s and the $\overline{V(AIR)}$s associated with each capitalization method were then evaluated using the risk efficiency criteria previously discussed. This evaluation was performed to determine the preferability of each capitalization method relative to other analyzed methods.

For each set of simulation runs, the model also computed the mean of the model PCA's 20th year leverage positions ($\overline{LEV}$). The $\overline{LEV}$ value was compared with discretionary and legal limits on leverage in evaluating the financial feasibility of the various capitalization methods. FICB regulations require that a PCA's leverage never exceeds 7.5 to 1 or the association's loan discounting privileges are revoked. Keeping leverage below 7.5 in normal years was considered a logical response to this restriction. Thus, a discretionary leverage limit of 6.0 was stipulated for the analysis. A capitalization method resulting in a value for $\overline{LEV}$ greater (less) than 6.0 was deemed infeasible (feasible).

The nine capitalization methods and three economic scenarios made it possible to simulate 27 different PCA operating conditions. However, the high costs of running the simulation model made at infeasible to evaluate all the capitalization methods under all economic scenarios. All nine capitalization methods were simulated under ES-0; then, the resulting values for the $\overline{E(AIR)}$s, $\overline{V(AIR)}$s and $\overline{LEV}$s were used to identify four financially-feasible capitalization methods that were risk efficient and/or representative of historic PCA capitalization methods. These methods were in turn simulated under ES-1 and ES-2 to yield eight additional sets of $\overline{E(AIR)}$, $\overline{V(AIR)}$, and $\overline{LEV}$ for evaluation.

Results

Table 5 indicates the values for $\overline{E(AIR)}$, $\overline{V(AIR)}$, and $\overline{LEV}$ that were obtained for the 17 sets of simulations. Columns 3, 4, and 5 of the table present the results for the ES-0, ES-1, and ES-2 conditions, respectively.

Results for ES-0

Three capitalization methods resulted in values of $\overline{LEV}$ greater than 6.0 and were deemed financially infeasible: CM-1 (5% stock rate), CM-5 (constant spread), and CM-6 (5% stock rate and constant spread). These findings suggest PCAs cannot simultaneously pay patronage refunds and use low stock rates and spreads under ES-0 conditions; doing so jeopardizes the PCAs financial positions because sufficient amounts of equity capital are not accumulated and retained under the stochastic interest rate conditions specified here.

The $\overline{E(AIR)}$s and the $\overline{V(AIR)}$s for the six financially feasible capitalization methods indicated three of the methods were dominated by

two methods. As Table 5 indicates, CM-0 and CM-3 (100% payment of patronage refunds in cash) both dominate CM-2 (10 year revolvement of deferred patronage refunds), CM-4 (quarterly collection of accrued interest), and CM-7 (no payments of patronage refunds). These latter three methods cause the $\overline{E(AIR)}$ and the $\overline{V(AIR)}$ to exceed those for either CM-0 or CM-3. Thus, borrowers' expected utility is higher under ES-0 conditions when CM-0 or CM-3 are used in favor of CM-2, CM-4, or CM-7.

CM-8 (no patronage refund payments and constant spread) was also a risk- efficient capitalization method for the base economic scenario. For CM-8 borrowers' costs were highest but most stable because the PCA retained surpluses and became insulated from FICB interest rate variations. Furthermore, the PCA held spread constant and this action also reduced the variability of borrower costs. This latter PCA action is the reason that the value of $\overline{V(AIR)}$ is less for CM-8 than it is for CM-7 (no patronage refund payments and an inflation-adjusted spread).

CM-3 (no deferment of patronage refunds) resulted in the lowest, least stable costs for borrowers because the PCA retained no operating surpluses and therefore made greater relative use of variable cost FICB funds. CM-0 caused borrower costs to be higher but more stable than for CM-3 because deferred patronage refunds were revolved over five years. This action allowed the PCA to use less FICB funds than occurred under CM-3. From these results it appears that borrower costs increase and stabilize when patronage refunds are deferred and revolved versus paid immediately in cash.

The $\overline{E(AIR)}$s and $\overline{V(AIR)}$s for CM-0 and CM-4, respectively, indicate that quarterly collection of accrued interest causes financing costs of borrowers to be higher and more volatile than under annual collections (CM-0). The CM-4 $\overline{E(AIR)}$ was higher because borrowers had to forego the use of cash more quickly and for a longer period when interest is collected more frequently. Borrowers' costs were less stable for CM-4 because interest payments were affected by FICB interest rates four times a year versus once a year. This finding suggests financing costs become less stable as a PCA collects accrued interest more frequently.

The capitalization method preferred by the PCA depends on the preferred trade-off between the level and the variability of borrowers' costs. The more risk averse PCA might select CM-8 (or a similar method) because it has the lowest value for $\overline{V(AIR)}$. CM-0 might be chosen by a PCA with an intermediate risk aversion while CM-3 might be selected by a less risk averse PCA that desires relatively low costs for its borrowers.

Results for ES-1 and ES-2

The three financially feasible and risk-efficient capitalization methods for ES-0 were also evaluated for ES-1 and ES-2, respectively. In addition, CM-7 was evaluated under these scenarios because it resembled the capitalization method typically used by the Sixth District PCAs from 1977 through 1982.

One should conclude that CM-0, CM-3, CM-7, or CM-8 are the "best" capitalization methods for ES-1 or ES-2. Some of the other specified methods could be financially feasible and risk-efficient for these other scenarios; but these other methods were not analyzed.

Scenario ES-1 was characterized by a higher cost of funds from the FICB and lower FICB patronage refund payments. The higher cost of funds caused the ES-1 $\overline{E(AIR)}$s to exceed those for ES-0, and the lower rate of patronage refunds from the FICB resulted in values of $\overline{LEV}$ that exceeded those of the base scenario. Despite the higher leverage, all four capitalization methods were financially feasible for ES-1. However, only CM-0 and CM-8 were risk-efficient. CM-7 had a greater $\overline{E(AIR)}$ and $\overline{V(AIR)}$ than did CM-8. Similarly CM-0 was preferred to CM-3 because borrower costs were lower and more stable when the former method was used.

For this second, scenario the $\overline{E(AIR)}$ for CM-0 is less than the one for CM-3 (no deferment of patronage refunds). This is exactly opposite of what occurred for the base scenario. Based on these results it appears that when FICB interest rates are rising and FICB patronage refund rates are falling a PCA should initiate a policy of deferring and revolving patronage refunds (CM-0). This action allows the association to reduce its use of relatively expensive FICB funds and thus borrowers' costs are lower than they would be if patronage refunds were not deferred and greater amounts of FICB funds were used.

For the ES-2 scenario the level and the variability of the FICB interest rate were specified to decrease in exactly the same manner that they increased from 1963 through 1982. The spread specification for CM-8 (constant spread and no patronage refunds) was increased from 2.69 percent to 3.40 percent so that it would nearly equal the average inflation-adjusted spread for CM-0, CM-3, and CM-7.

The leverage measures again indicated that each of the capitalization methods was financially feasible for ES-2 because all values $\overline{LEV}$ were less than 6.0. As occurred for the other scenarios, the base capitalization method was included in the risk-efficient set. The other risk-efficient method was CM-3 in which no portion of the patronage refunds was deferred. These two methods dominated CM-7 and CM-8 in which no patronage refunds were paid. These findings indicate that when interest rates are declining and stabilizing, borrowers' costs will increase and destabilize if no patronage refunds are paid. This suggests that when ES-2 interest rate conditions exist, a PCA should take full advantage of FICB interest rate reductions and stabilization by assuming higher leverage positions and causing borrowers' costs to decrease and stabilize.

Conclusions

This study has developed a conceptual framework of PCA operations that can be used in analyzing the multitude of variables associated with any PCA's operations. Furthermore, this study's conceptual framework is applicable Federal Land Bank Associations and any other credit

cooperatives. Therefore, this study has yielded an educational tool that can be utilized in explaining the objectives and operations of any credit cooperatives that are similar to PCAs. This information should be useful as we attempt to educate both the members and managers of credit cooperatives in all region of this country.

The findings of this study confirm that PCAs can manage the level and the stability of borrowers' costs by employing different capitalization methods. In addition the study's findings indicate that risk-efficient capitalization methods for one set of economic conditions are not necessarily risk-efficient when different economic conditions exist. Therefore PCAs may have to adjust their capitalization methods in response to changes in economic conditions.

In general this study's findings indicate that borrower's costs would be relatively high, but stable when a PCA holds spread constant over time and does not pay patronage refunds. However this capitalization method does not appear to stabilize borrowers' costs when interest rates are becoming more stable. These findings suggest PCA's concerned with stabilizing borrowers' costs should pay patronage refunds in periods when interest rates are stabilizing and they should eliminate patronage refunds when interest rates are becoming more volatile.

This study's findings also suggest that PCAs might prefer a capitalization method similar to the base method which possessed the following characteristics: 1) a 10 percent B-stock rate, 2) an inflation-adjusted spread, 3) annual collection of accrued interest, 4) payment of 20 percent of patronage refunds in cash, and 5) revolvement of the deferred portion of patronage refunds over five years in equal installments. Although this capitalization method generally did not result in the lowest or most stable borrower costs, it was the only method that was preferred (risk-efficient) for all three economic scenarios. Thus in a changing economic environment PCAs might consider capitalization methods similar to the based method of this study.

At this time PCAs are facing a relatively uncertain economic environment. For example, interest rates could remain high and volatile. In addition, the Farm Credit System could lose agency status and/or tax-exempt status. Furthermore, PCAs may begin merging with other PCAs or Federal Land Bank Associations. All of these events could have dramatic impacts on borrower costs and PCA financial positions. Thus, PCA management should have a high need for the information this study's model can yield. Therefore, this study's model of PCA operations may prove to be a valuable resource for the management and directors of PCAs and other Farm Credit System institutions as they attempt to cope with an increasingly uncertain environment.

TABLE 1: GROWTH IN NET LOANS, GROWTH IN FINANCIALLY-RELATED SERVICES INCOME, AND FICB PATRONAGE REFUND RATES

YEAR	GROWTH IN NET LOANS	GROWTH IN FINANCIALLY-RELATED SERVICES INCOME	FICB PATRONAGE REFUND RATES
77	6.21%	3.5%	13.6%
78	10.27%	3.3%	11.5%
79	21.38%	6.2%	8.3%
80	8.12%	-2.5%	9.7%
81	3.46%	8.4%	8.7%
82	-11.42%	3.5%	5.9%

TABLE 2: BEGINNING BALANCE SHEET FOR THE MODEL PCA

CASH	39596.
INV IN FICB	1586213.
ACC & NOTES REC	31947.
LOANS LESS PCO's	35688670.
SALES CONTRACTS	0.
LOANS IN LIQ/ACQ PROP	95493.
PROVISION FOR LOSSES	1249103.
ACC. INT. REC.	2007131.
FIXED ASSETS	459648.
OTHER ASSETS	5269.
TAX DEPOSIT--STATE	0.
TAX DEPOSIT--FEDERAL	0.
TOTAL ASSETS	38664864.
NOTES PAYABLE RICB	30746052.
ACCRUED INT PAYABLE	835065.
OTHER LIAB	53767.
TOTAL LIABILITIES	31634884.
A-STOCK	107000.
B-STOCK	3568870.
OTHER SYSTEM CAPITAL	0.
SURPLUS ALLOCATED	0.
SURPLUS RESERVE	3354110.
ACCUMULATED EARNINGS	0.
TOTAL EQUITY	7029980.
TOTAL LIAB & EQUITY	38664864.
LEVERAGE	4.500000.

TABLE 3: CAPITALIZATION METHODS USED FOR SIMULATIONS

Capitalization Methods	Equity Acquisition Variables			Patronage Refund Variables	
	Stock Rate	Spread (a)	Interest Collection (b)	% Paid Revolving In Cash Period (c)	
0	10	IAS	A	20	5
1	5	IAS	A	20	5
2	10	IAS	A	20	10
3	10	IAS	A	100	-
4	10	IAS	Q	20	5
5	10	CS	A	20	5
6	5	CS	A	20	5
7	10	IAS	A	-	-
8	10	CS	A	-	-

(a) IAS = Inflation-Adjusted Spread

CS = Constant Spread

(b) A = Annually

Q = Quarterly

(c) 5 = 5 year revolving period

10 = 10 year revolving period with payments based on 20 year repayment plan

TABLE 4: ECONOMIC SCENARIOS USED IN SIMULATIONS

Economic Variables		Economic Scenario 0	Economic Scenario 1	Economic Scenario 2
1) Growth in Loans (%)				
Years (yrs.)	1-5	5.00	5.00	5.00
Yrs.	6-10	5.00	5.00	5.00
Yrs.	11-15	5.00	5.00	5.00
Yrs.	16-20	5.00	5.00	5.00
2) Growth in Service Income (%)				
Yrs.	1-5	3.75	3.75	3.75
Yrs.	6-10	3.75	3.75	3.75
Yrs.	11-15	3.75	3.75	3.75
Yrs.	16-20	3.75	3.75	3.75
3) Inflation in Operating Expense (%)				
Yrs.	1-5	6.00	6.00	9.80
Yrs.	6-10	6.00	6.00	7.70
Yrs.	11-15	6.00	6.00	4.60
Yrs.	16-20	6.00	6.00	1.60
4) FICB Patronage Refund Rate (%)				
Yrs.	1-5	8.00	4.00	8.00
Yrs.	6-10	8.00	4.00	8.00
Yrs.	11-15	8.00	4.00	8.00
Yrs.	16-20	8.00	4.00	8.00
5) FICB Interest Rate (%)				
Yrs.	1-5	10.50	11.25	11.46
Yrs.	6-10	10.50	11.25	7.78
Yrs.	11-15	10.50	11.25	6.82
Yrs.	16-20	10.50	11.25	4.90
6) Variance of FICB Interest Rate				
Yrs.	1-5	20.00	20.00	5.00
Yrs.	6-10	20.00	20.00	5.00
Yrs.	11-15	20.00	20.00	5.00
Yrs.	16-20	20.00	20.00	5.00

TABLE 5: RESULTS OF THE SIMULATIONS

Capitalization Method	Variable	Values of E(AIR)s, V(AIR)s, and LEVs for: Economic Scenario 0	Economic Scenario 1	Economic Scenario 2
0	$\overline{E(AIR)}$	9.96	10.54	8.37
0	$\overline{V(AIR)}$	3.05	3.12	.69
0	$\overline{LEV}$	3.64	4.54	4.51
1	$\overline{E(AIR)}$	9.92	-	-
1	$\overline{V(AIR)}$	2.95	-	-
1	$\overline{LEV}$	6.54	-	-
2	$\overline{E(AIR)}$	10.08	-	-
2	$\overline{V(AIR)}$	5.33	-	-
2	$\overline{LEV}$	3.00	-	-
3	$\overline{E(AIR)}$	9.90	10.62	8.33
3	$\overline{V(AIR)}$	3.14	3.26	.75
3	$\overline{LEV}$	3.70	4.62	4.52
4	$\overline{E(AIR)}$	10.06	-	-
4	$\overline{V(AIR)}$	3.55	-	-
4	$\overline{LEV}$	3.44	-	-
5	$\overline{E(AIR)}$	9.97	-	-
5	$\overline{V(AIR)}$	3.04	-	-
5	$\overline{LEV}$	6.21	-	-
6	$\overline{E(AIR)}$	9.94	-	-
6	$\overline{V(AIR)}$	3.19	-	-
6	$\overline{LEV}$	37.34	-	-
7	$\overline{E(AIR)}$	10.35	10.98	8.56
7	$\overline{V(AIR)}$	3.65	3.31	.85

TABLE 5 (continued)

Capitalization Method	Variable	Values of E(AIR)s, V(AIR)s, and LEVs for:		
		Economic Scenario 0	Economic Scenario 1	Economic Scenario 2
7	$\overline{LEV}$	2.75	3.16	3.64
8	$\overline{E(AIR)}$	10.40	10.95	8.81
8	$\overline{V(AIR)}$	2.62	2.75	1.31
8	$\overline{LEV}$	3.32	3.79	4.35

REFERENCES

1) Annual Report to the Board of Directors of the Federal Intermediate Credit Bank of St. Louis -- 1977 to 1983.

2) Bildersee, J.S. "The Selection of Issues Size and Term to Maturity of a New Fixed Return Security." Financing the Needs of the Farm Credit System, Part II: Technical Papers. Rodney L. White Center Financial Research, University of Pennsylvania, Philadelphia, November 1973:54-81.

3) Brake, J.R., and E. Melichar. Agricultural Finance and Capital Markets." A Survey of Agricultural Economics Literature: Volume 1, University of Minnesota Press, Minneapolis, 197/, pp. 416-481.

4) Dunn, D.J., and T.L. Frey. "Discriminant Analysis of Loans for Cash-Grain Farms." Agr. Fin. Rev. 36(1976):60-66.

5) Frey, T.L. and Lins, D.A. "Covering Agriculture's Lending Needs: Part 2: The Farm Credit System." Agri Fin, August, 1979:21-26.

6) Lee, W.F., G.A. Marsh, and R.L. Meyer. Factors Affecting the Incidence of 'Vulnerable' and 'Loss' Loans in PCAs." Risk Management in Agriculture: Behavioral, Managerial, and Policy Issues. AE-4478, Department of Agricultural Economics, University of Illinois, July 1979.

7) Morris, J. "A Simulation of Alternative Maturity Policies." Financing the Needs of the Farm Credit System: Part II. (see Bildersee):82-141.

8) Osburn, D.D., and J.R. Hurst. "Economies of Size Among Production Credit Associations." Farm Credit Administration Research Journal 4(1981):31-34.

9) Project 85: The Economic ENvironment in 1985 and Implications for Planning in the Farm Credit System. Economic Analysis Division, Farm Credit Administration, Washington, D.C., 1980.

10) Regulations for Banks and Associations of the Farm Credit System. Farm Credit Administration, Washington, D.C., 1980.

11) Sixth District PCA Financial Planning Model Manual (Draft). St. Louis FICB.

12) Smith, P.F. Financing the Needs of the Farm Credit System Part I: Summary and Recommendations. Rodney L. White Center for Financial Research, University of Pennsylvania, Philadelphia, September 1973.

13) Sundell, P., and L. Teigen. "A Reduced Farm Model for PCA Interest Rates." Agr. Fin. Rev. 42(1982):24-30.

14) Tauer, L., and M. Boehlje. "A Debt Selection Model for Banks of the Cooperative Farm Credit System." West. J. Agr. Econ. December 1981: 181-194.