ADAPTING TO TURBULENT CREDIT MARKETS: LOAN PRICING OPTIONS FOR THE FARM CREDIT SYSTEM

Merritt R. Hughes

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North Dakota State University
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ADAPTING TO TURBULENT CREDIT MARKETS: LOAN PRICING OPTIONS FOR THE FARM CREDIT SYSTEM

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The Farm Credit System may now be in recovery from what has been one of the most tumultuous decades in its history. Recovery has been propelled to a significant degree by legislative and financial aid from the Federal government. This paper examines the extent to which the System is able to dampen future shocks to net income through use of discretionary tools already at its disposal. In particular, the effect of different loan pricing rules on net income instability are analyzed from an economic perspective.

A simple model is developed describing the System as a set of accounting identities and discretionary loan pricing rules mediating between farmer/borrowers and bond investors.[1] These discretionary policies are then shown to influence the responsiveness of loan volume and the effective interest rate spread, hence System net income, to shifts in general credit market conditions. The degree of net income instability is then compared for several alternative loan pricing policy regimes.

The loan pricing strategies discussed include fixed versus flexible interest rates, with the loan interest rate on new or repriced loans being based either on the new bond interest rate or the weighted average interest rate of all outstanding bonds. The degree of net income instability is shown to vary with the loan pricing rule, with the exact nature of the dependency being determined by the elasticity of loan demand and the extent to which swings in net income influence the risk premium attached to Farm Credit System (FCS) bonds.

This paper is organized as follows. Section I motivates the analysis by outlining the sources and extent of recent volatility in the System's net income. Some legislated changes that address this problem by modifying portfolio and portfolio-related characteristics of the FCS are also summarized. It is noted that, although these changes make the System less likely to need Federal financial assistance in the future, they do little to reduce potential volatility of the System's income stream. Section II provides an overview of the causal links

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[1] The Farm Credit System is a system of cooperatives that by charter lend virtually exclusively to farm and farm-related businesses by bond issuance.

determining the effect of loan pricing policies on the variability of System net income resulting from a given change in market interest rates. Section III presents the formal model and Section IV derives and discusses the mathematical expressions for these effects. Section IV summarizes the main results and discusses their implications for loan pricing policy.

I. Recent Instability

From 1975 to 1983 the System increased its volume of farm loans from roughly \$23.0 billion to \$67.4 billion, and total market share from roughly 28.5 to 33.5 percent. Since that time both have dropped considerably. Among the most widely cited explanations for the System's financial success in the late 1970's and early 1980's was its practice of basing the interest rate of new loans on the average cost of outstanding bonds. Since this was a period of secularly rising interest rates, the System lagged, hence under-bid its competitors' largely marginally priced loans. By the early 1980's, however, the System experienced a series of adverse developments. Interest rates began to drop from the historic highs of 1981 just after the System issued long-term, noncallable bonds. Almost simultaneously, the farm sector experienced a financial crisis which resulted in heavy loan defaults and a large drop in the sectoral debt to asset ratio. As a result, the System was faced with dropping loan volume and a high default rate at the same time it was locked into funding costs that were rising above those of its competitors. Surplus, (the Farm Credit System equivalent of accrued retained earnings), during the crisis years of 1985 to 1987 shrank from more than \$6 billion to less than \$1.3 billion.

In response to the System's financial problems, Congress authorized individual System institutions to price loans by whatever method they chose, rather than being tied to a System-wide policy, beginning in 1986. The effect of that legislation was to encourage institutions to set loan interest rates closer to their competitors' rates by using a reference closer to the cost of new System bond issuances. The pricing flexibility has not been revoked by subsequent legislation and allows institutions to return to average cost pricing if it is perceived as more advantageous.

By 1987 direct aid seemed imperative to retain System solvency, and Congress passed an assistance package with numerous provisions including a \$4 billion line of credit and mandated organizational changes such as the establishment of a bond insurance fund and increased capital requirements. These organizational changes decrease the likelihood that the System will be forced to ask for direct aid in the future, but do not necessarily imply that the System will operate so as to stabilize net income in the face of future shifts in credit market conditions.

The newly established bond insurance fund, like the implicit Federal guarantee the FCS has historically enjoyed, assures bondholders of eventual receipt of principal and interest due, but does not (again like the historic Federal guarantee) assure them of timely repayment.

Just as risk premiums occurred despite Federal guarantee in the past, high risk premiums on funding capital are likely to re-occur in the future if the System experiences significant difficulties.

While these changes may strengthen the System's capacity to absorb fluctuations in net income, doubts must remain that these organizational changes address the type or magnitude of effects generated by external shocks or the ability of the System's routine operational strategies to avoid or dampen the adverse effects as they occur.[2] But it is exactly the success with which the FCS can cope with unforeseen shocks that will determine its continued viability. For example, sharp interest rate fluctuations that caught the System off-guard in 1981 may continue to be relatively common. It is important, therefore, to ask how System operational strategies currently within its discretion, such as loan pricing rules, can be used to influence the effect of unforeseen autonomous changes in credit market conditions on its net income.

II. Conceptual Issues

To what extent can the Farm Credit System reduce its vulnerability to adverse capital market shocks through the operating policies at its disposal? I examine this question by analyzing which loan pricing policies are best suited to reduce the instability in System income resulting from movements in the general level of interest rates. Four loan pricing options are analyzed below. Reflecting the most widely discussed pair of rating options used by the FCS, the interest rate on new FCS loans may be set with reference to either the interest rate associated with new bond issues or to the weighted average interest rate on bonds outstanding. I shall refer to these two policies as marginal and average cost pricing, respectively. The FCS has recently made wide use of loans with flexible interest rates in attempt to avoid losses from unanticipated changes in the cost of funds. This second set of policy options is addressed by examining a pair of limiting cases: interest rates on loans may be either fixed at the time of contract, or be continually repriced as the general level of interest rates fluctuates. These two policies will be referred to as the fixed and flexible pricing policies. Since operation involves the choice of one option from each policy pair, the choices may be combined in four distinct ways, each implying different effects on net income from shocks originating in the external credit market.

A simple model based on income and balance sheet accounts of the consolidated System is presented in the next section and used to

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[2]Since the FCS member banks lend almost exclusively to farms and farm-related businesses by charter, the System's performance will continue to be highly dependent on the health of the overall farm sector. The recent legislation has provided significant relief for risk associated with this dependence by requiring mergers between Federal Land Banks and Federal Intermediate Credit Banks. Additionally, the newly legislated secondary market for farm mortgages may decrease some risk associated with the long-term nature of farm mortgages.

analyze the choice of loan pricing policies. Unlike previous accounts-based models, a loan demand function and a risk premium function on funding cost are explicitly recognized. This allows for a fuller accounting of direct and indirect effects of loan pricing rules in mediating the impact of a change in market interest rates on net income.

Most directly, the loan pricing rule affects net income by determining how a change in market interest rates affects the spread between the average earnings on loans and the average cost of capital. The pricing rule, however, may also affect net income through a change in loan volume as the interest rate charged on loans by the FCS diverges from the interest rate offered by its competitors. These "first round" or <u>direct</u> effects on net income may then induce secondary feedback or <u>indirect</u> effects as shifts in net income cause System investors to reassess the level of risk premium appropriate for FCS bonds, thus further changing funding costs.

Under a marginal cost pricing rule, net income is affected primarily through the change in the spread between the weighted average interest rate on loans and that of bonds. No direct volume effect exists in this case since FCS competitors' loans are also assumed to exhibit marginal cost pricing. Net income reacts pro-cyclically to change in the general level of interest rates (e.g., rises as market interest rates rise) if interest revenue changes more than interest expense. Pro-cyclical change thus occurs when more loans than bonds are quickly adjusted to the new interest rate level. Accordingly a loan portfolio composed solely of contracts with flexible interest rates almost certainly leads to pro-cyclical change in net income. A loan portfolio of fixed rates, however, may yield either a pro-cyclical or counter-cyclical reaction. Secondary changes in spread and volume will then occur as bond investors react to the direct impact on net income by adjusting the risk premium demanded. It will also be important to determine whether these secondary affects amplify or dampen the initial change in net income.

Under an average cost pricing regime, net income is less affected by directs changes in the spread than under the marginal cost pricing regime, since the loan interest rate is tied to the average bond interest rate. The fact that the System loan interest rate no longer moves one-for-one with the rate charged by its competitors, however, generates a direct volume effect and the elasticity of loan demand plays a key role in determining the size of net income shift. This suggests the average cost pricing regime results in greater net income volatility than the marginal cost pricing regime when demand elasticity is sufficiently high. As in the marginal case, the direct effects can be either amplified or dampened by additional indirect effects through the risk premium on FCS bonds.

III. Formal Model

The following model is designed to illustrate the effect of an autonomous change in the general level of interest rates on net income under a variety of loan pricing rules. Exogenous interest rate shocks are translated into changes in net income through direct and indirect effects on, (a), the spread between the effective interest rates of assets and liabilities, and, (b), the total volume of assets. In this model assets are defined as "loans" and liabilities include "bonds" and "surplus." Surplus, in turn, is defined as the accumulation of net income. To simplify the analysis, operating overhead and all other earnings and expenses not directly associated with the interest of loans and bonds are assumed to be proportional to total loan volume, hence easily modelled as a constant mark-up term. Since the same cost mark-up applies to FCS competitors, these costs have no influence on the end results presented here, and will for the most part be ignored.

Current net income (NI_t)[3] may be described as the product of current total volume of loans, times the spread (pi_t) between the weighted average interest rate on outstanding loans (i^l_t) and the sum of the annualized cost of funding capital to the System (i^k_t), and per unit operating costs (mu):

EQ 1 $$NI_t = L_t * pi_t$$

where

EQ 2 $$pi_t = i^l_t - i^k_t$$

A basic accounting identity from the balance sheet is that total loans (L_t) equal total bonds (B_t) plus surplus (S_t):

EQ 3 $$L_t = B_t + S_t$$

The cost of funding capital in this model incorporates the implicit subsidy which surplus provides to the weighted average cost of outstanding bonds. As surplus increases, System interest expenditure stretches over a larger volume of loanable funds. The internal cost of capital (i^k_t) therefore equals the weighted average bond interest rate (i^b_t) multiplied by total outstanding bonds (B_t) divided by total outstanding loans:

EQ 4 $$i^k_t = \frac{(B_t)i^b_t}{L_t}$$

Substituting equations (2), (3) and (4) into equation (1) produces an alternative expression for net income that emphasizes the subsidy from (S_t):

EQ 1' $$NI_t = L_t(i^l_t - mu) - (L_t - S_t)i^b_t$$

where ($B_t = L_t - S_t$).

But what is the weighted average interest rate of bonds? Total interest payments are equal to new interest payments plus payments on bonds remaining from the past:

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[3] Throughout this paper subscript (t) indicates the current time period and subscript (t-1) refers to the previous time period.

EQ 5 $\qquad i^b{}_t B_t = i^b{}_t B^1{}_t + i^b{}_{t-1} B^2{}_t$

where $i^b{}_t$ and $i^b{}_{t-1}$ are the new, and weighted average old interest rates respectively, and $B^1{}_t$ and $B^2{}_t$ are the new, and old (remaining) bonds, respectively[4]. Thus:

EQ 5 $\qquad B_t = B^1{}_t + B^2{}_t$

Using equation (6) we can rewrite equation (5) to express the current weighted average interest rate on bonds as a partial adjustment of last period's average rate to this period's marginal rate:

EQ 4' $\qquad i^b{}_t = i^b{}_{t-1} + \frac{(B^1{}_t)}{B_t}*(i^b{}_t - i^b{}_{t-1})$

The determination of the interest rate on new FCS bonds follows traditional capital market analysis. First, the notion of a "general level of interest rates" is captured in this model by a basic riskless interest rate ($i^t{}_t$). This rate is then translated into the interest rates charged by investors in FCS bonds through addition of a variable risk premium. This risk premium (rho) is assumed to adjust instantaneously to net income (NI_t), which in this simple model is identical to the change in surplus from one period to the next, hence is a good barometer of the solvency of the System:

EQ 7 $\qquad i^b{}_t = i^t{}_t + rho(NI_t) \qquad$, where rho'<0

and

EQ 8 $\qquad NI_t = S_t - S_{t-1}$

Farmer/borrowers of this model are comparison shoppers. New loan demand by borrowers is based on the difference between the rate currently offered by the System and that of its competitors ($i^c{}_t$):

EQ 9 $\qquad L^1{}_t = V(i^1{}_t - i^c{}_t) \quad$, where $V' < 0$

The interest rate charged by competitors is assumed to fluctuate in tandem with the treasury rate (i.e., $i^c{}_t = i^t{}_t + mu$, where mu is a mark-up reflecting operating costs).

Total loans equal new loans plus loans remaining from the past period:

EQ 10 $\qquad L_t = L^1{}_t + L^2{}_t$

Similar to the derivation for the weighted average interest rate on bonds, the weighted average interest rate on outstanding loans ($i^1{}_t$) can be expressed as the partial adjustment of the average interest rate on remaining loans ($i^1{}_{t-1}$) to the new loan rate where the degree of

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[4] I assume that interest rates on retiring bonds were representative of those on remaining bonds, so that the current average interest rate on old bonds is last period's average bond rate.

adjustment equals the ratio of new to old loans:

EQ 11 $i^l_t = i^l_{t-1} + (L^l_t/L_t)*(i^l_t - i^l_{t-1})$

If all loans have flexible rates, (i.e., are repriced with each shift of (i^t_t)), (L^l_t/L_t) will equal unity: all loans are effectively new. As average time to maturity of outstanding loans increases, the ratio becomes smaller. Thus, the fixed versus flexible pricing rules are captured by the ratio (L^l_t/L_t) in equation 11.

Determination of the new loan interest rate is the other pricing policy variable which is discussed in this paper. The marginal pricing rule allows the new loan interest rate to follow the new bond interest rate paid:

EQ 12.a $i^l_t = i^b_t + mu$

where (mu) is the markup rate covering operating costs and is assumed to be equal to that of competitors.

Alternatively, the average cost pricing rule bases the interest rate of new loans on the weighted average interest rate of outstanding bonds:

EQ 12.b $i^l_t = i^b_t + mu$

IV: Evaluation

Equations 1 through 11, plus either 12.a or 12.b define model containing 12 endogenous variables: NI_t, pi_t, L_t, L^l_t, B_t, B^l_t, i^l_t, i^l_t, i^b_t, i^b_t, rho_t, V_t. By the implicit function theorem, the model's equations define net income as an implicit function of the exogenous variables, including (i^t_t), and the derivative of (NI_t) with respect to (i^t_t) can be calculated. Solving the model for each of the four pairs of policy options allows examination of which of the pairs of policy options produce the smallest derivative (i.e., the least volatility of net income in response to an autonomous interest rate change) under a variety of conditions.

Taking the total derivative of equation (1') with respect to a change in the treasury rate, and using equations (2) through (11) to substitute out endogenous variables, yields policy results for the marginal cost pricing regime. For the fixed loan rate case:

EQ 13 $$\frac{dNI_t}{di^t_t} = \frac{L^l_t - B^l_t}{1 - i^b_t - rho'(L^l_t - B^l_t) - rho'V'(i^l_t - i^b_t)}$$

The expression for the change in net income induced by an autonomous change in the Treasury rate is most easily understood if it is first decomposed into the direct and indirect effects. The direct effects can be identified by setting (rho' = 0) in equation (13):

EQ 13' $\frac{dNI_t}{di^t_t} = (L^1_t - B^1_t)/(1-i^b_t)$

Thus, the direct effect on net interest inflow is proportional to the relative values of loans and bonds carrying a new interest rate.

If the value of new loans, (L^1_t), is greater than the value of new bonds, (B^1_t), some new loans will, in effect, be backed by bonds carrying the old weighted average bond interest rate, and net income will react pro-cyclically to change in the treasury rate (i.e., the total derivative is positive.) High system surplus or maturity levels on bonds that are high relative to those for loans, thus, contribute to pro-cyclicality of net income. The direct spread effect, captured by the numerator of equation (13') is enlarged by the effective subsidy to operation that the additional net income provides (the denominator equals unity minus the weighted average bond interest rate, hence is positive but less than unity.)

The direct spread effect causes a set of indirect effects as changing conditions in FCS finance induces bond investors and farmer/borrowers to modify their behavior. Bond investors will react to the change in net income by changing the risk premium in the opposite direction, and the resulting feedback term is captured by the last two terms in the denominator of equation (13). In the case of a pro-cyclical direct effect $(L^1_t>B^1_t)$, the resulting reduction in (rho) dampens the initial rise in the new bond interest rate, (third term in the denominator) thereby dampening the direct spread effect and reducing the pro-cyclicality of net income. The fall in (rho), however, also creates an indirect volume effect (fourth term in the denominator of equation (13)), by reducing the FCS new loan interest rate below the rate charged by competitors, and thereby tending to re-enforce the pro-cyclicality of net income. In sum, the indirect effect may either exacerbate or dampen the instability of net income in the pro-cyclical case.

Alternatively, if the value of new loans is less than the value of new bonds, some loans carrying the old loan interest rate will be, in effect, backed by bonds with new interest rates. The direct spread effect will thus operate counter-cyclically, and an increase in the treasury rate will reduce the spread between the old weighted average loan interest rate and the new bond interest rate causing net income to fall. A secondary round of effects will occur as bond investors react by increasing the risk premium, further squeezing the spread. Borrowers will also react to the higher rate by further curtailing loan demand, with the result both indirect effects magnify the counter-cyclical instability of net income.

While direct effects are equal with respect to pro-cyclical and counter-cyclical shifts in net income, the feedback effects are not. Asymmetry in feedback effects under the marginal cost pricing regime imply that maturity mixes of loans and bonds which induce direct counter-cyclical movements in net income encourage greater income volatility than maturity mixes which induce pro-cyclical direct movements of the same magnitude.

Net income shifts under the marginal cost pricing regime with flexible loan interest rates are the same as that of a regime with fixed rates, except now the direct spread effects are based on the difference between all outstanding loans (since they are all instantaneously repriced) and new bonds:

EQ 14
$$\frac{dNI_t}{di^t_t} = \frac{L_t - B^1_t}{1 - i^b_t - rho'(L_t - B_t) - rho'V'(i^1_t - i^b_t)}$$

The flexible rate marginal pricing case is clearly more likely to induce pro-cyclical net income change given an autonomous interest rate shock than the fixed rate case, the numerator of equation 14 ($L_t - B^1_t$) exceeds the numerator of equation 13 ($L^1_t - B^1_t$). Unless there is negative surplus, some new-priced loans will be backed by old-priced bonds, and, an increase in the treasury rate causes interest inflow to rise faster than interest outflow, increasing net income. To the extent that the flexible interest rate policy leads almost certainly to pro-cyclical shifts in net income the total indirect effect is composed of two off-setting effects and is likely to be small.

The derivative in equation 13 is zero when ($L^1_t = B^1_t$). The key to net income stability in the marginal cost pricing regime is thus to match the maturity structure of loans and bonds. This is most easily accomplished with fixed pricing where (L^1_t) is maintained approximately equal to (B^1_t).

The results for the average cost pricing regime are similar to marginal cost pricing in a number of respects. The expressions for net income instability are, however, somewhat more complicated since there are direct effects both on volume and spread. Temporarily setting volume change equal to zero ($V' = 0$) allows easier comparison with the marginal cost pricing regime. The induced change in net income resulting from an autonomous change in the treasury rate for fixed and flexible loan rates under the average cost pricing regime, without volume effects, are presented in equations 15 and 16, respectively:

EQ 15
$$\frac{dNI_t}{di^t_t} = \frac{(L^1_t - B_t)*(B^1_t/B_t)}{1 - i_{bt} - rho'(L^1_t - B_t)*(B^1_t/B_t) - (i^b_t - i^b_{t-1})*(L^1_t - B_t)*((B^2_t/(B_t)^2)}$$

EQ 16
$$\frac{dNI_t}{di^t_t} = \frac{(L_t - B_t)*(B^1_t/B_t)}{1 - i^b_t - rho'(L_t - B_t)*(B^1_t/B_t) - (i^b_t - i^b_{t-1})*(L_t - B_t)*((B^2_t/(B_t)^2)}$$

The effective subsidy to operation that additional net income provides (second term in the denominator of both equations) shows up as an amplifying effect, similar to the marginal regime results. Moreover, the difference between fixed and flexible interest rates under the average cost pricing regime is conceptually the same as under marginal pricing. Whereas the fixed rate case has only a fraction of total loans with the new interest rate, in the flexible rate case all outstanding loans have the new loan interest rate.

There are also some differences. The spread in the numerator differs from that for marginal pricing in that the difference expression is now between repriced loans and all (not just new) bonds, and the difference is reduced in absolute magnitude by the ratio $(B^1{}_t/B_t)$. The weighted average bond rate on which the new loan interest rate is now based does not increase one-for-one with the Treasury rate, and the new loan interest rate in the average pricing regime is based on all outstanding bonds. Furthermore, an additional term appears in the denominator. For very small changes in $(i^t{}_t)$, hence $(i^b{}_t)$, this term is near zero and it clearly becomes the case that the flexible rate rule would imply a smaller spread effect in the average than marginal pricing regime[5]. As the size of the interest rate change increases, the spread effect in the average pricing flexible rate case is dampened relative to the marginal case.

Since $(L^1{}_t - B_t)$ is less than $(L^1{}_t - B^1{}_t)$, and typically negative, a fixed rate loan policy is more likely to induce a counter-cyclical spread effect under average cost pricing than marginal pricing. For a very small positive change in the interest rate (i.e., very small fourth term in the denominator of equation 15) the spread effect of the average pricing fixed rate case is more counter-cyclical than the marginal pricing case. As the change in interest rates increase, the spread effect is further magnified (i.e., increases more than linearly.)

The average cost pricing regime is subject to an additional direct force on net income that does not occur under marginal pricing. Because competitors are assumed to base their loan rate on a marginal cost pricing policy, the discrepancy between marginal and average bond rates created by a change in $(i^t{}_t)$ leads to a divergence between the FCS loan rate and its competitors' loan rate, inducing a shift in FCS loan volume. The total derivatives of net income with respect to a change in the treasury rate may be written in their entirety for the fixed and flexible cases, respectively:

EQ 17

$$dNI_t/di^t{}_t = ((L^1{}_t-B_t)*(B^1{}_t/B_t) - V'(L^1{}_t-B_t)*(i^b{}_t-i^b{}_{t-1})*((B^2{}_t/(B_t)^2))/$$

$$(1 - i_{bt} - rho'(L^1{}_t-B_t)*(B^1{}_t/B_t) - (i^b{}_t-i^b{}_{t1})*(L^1{}_tB_t)*((B^2{}_t/(B_t)^2) -(i^b{}_t-i^b{}_{t-1})*V'(1-i^b{}_t)*((B^2{}_t/(B_t)^2))$$

EQ 18

$$dNI_t/di^t{}_t = ((L_t-B_t)*(B^1{}_t/B_t) - V'(L_t-B_t)*(i^b{}_t-i^b{}_{t-1})*((B^2{}_t/(B_t)^2)) /$$

$$(1 - i^b{}_t - rho'(L_t-B_t)*(B^1{}_t/B_t) - (i^b{}_t-i^b{}_{t-1})*(L_t-B_t)*((B^2{}_t/(B_t)^2) - (i^b{}_t-i^b{}_{t-1})*V'(1-i^b{}_t)*((B^2{}_t/(B_t)^2))$$

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5 It is assumed that the new bond interest rate is above last period's weighted average bond interest rate, since $(di^b{}_t/di^t{}_t)$ equals the change in the treasury rate $(di^t{}_t)$ plus a (small) feedback effect on rho.

Comparison between equations 15 and 16 reveals that the direct volume effect is captured by the second terms in the numerators and the fourth terms in the denominators. The value of the direct volume effect depends on the age mix of bonds and loans, (e.g., relatively fewer new bonds implies a greater interest lag), the interest responsiveness of loan demand (V'), and the value of bond interest rate change from one period to the next.[6] The results for the fixed rate, average cost pricing derivative (equation 17) suggest that for small changes in the bond interest rate, the volume effect will be relatively small. As the interest rate change increases, however, the volume effect works both to re-enforce counter-cyclical movement in the numerator, and dampen it in the denominator. Following a flexible rate rule (equation 18), the volume effect augments pro-cyclical force of the spread in the numerator, but dampens it in the denominator. Whether the marginal or average cases are more likely to be stable depends on which of the numerator or denominator effects dominate.

While relative magnitudes of net income change in flexible and fixed rate cases depend on a substantial number of other relative values, it is possible to pinpoint the optimal degree, with respect to minimizing net income volatility, of loan rate flexibility for the average pricing regime. Thus, when $(L^1{}_t = B_t)$, both terms in the numerator of equation 17 equal zero. The average cost pricing regime has a stable solution when the value of loans with a new loan interest rate equals the total value of bonds. In other words, $(B^t = L_t - S_t)$ should be repriced each year, as compared to just $(B^1{}_t = L_t - S_t - B^2{}_t)$ under marginal cost pricing. If (S_t) is near zero, net income stability under average cost pricing requires flexible interest rates for almost all loans.

V: Conclusion

During the last decade the Farm Credit System has been exposed to considerable volatility in its net income. Legislation recently passed diminishes apprehension of immediate System insolvency and works toward removal of certain sources of risk leading toward instability. Volatile capital markets remain a potential source of instability in System net income, however. This paper has examined two pairs of loan pricing options the FCS has at its disposal that can influence the volatility of net income with respect to autonomous shocks in the general level of interest rates. The two pairs of options were flexible versus fixed loan interest rate rules, and marginal versus average cost pricing regimes. Conditions under which each of the four possible combinations of these options may be expected to ameliorate instability in net income resulting from a shock in the underlying "treasury rate", accounting for reactive behavior by farmer/borrowers and FCS bond investors, were investigated.

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[6] The exposition assumes an infinitesimal increase in the treasury rate is the only factor that induces $(i^b{}_t)$ to be different from $(i^b{}_{t-1})$.

This model suggests that in both the marginal and average cost pricing regimes it is possible to insulate net income from changes in the general level of interest rates. It is noted that the marginal cost pricing case implies zero shift in net income when the values of loans and bonds with new interest rates are equal. In the average cost pricing case zero net income shift occurs with a loan portfolio primarily of new rate loans. When zero shift conditions do not hold, which of the four cases exhibit the least net income volatility overall depends to a significant degree on the magnitude of the interest rate change and loan demand elasticity. The model suggests as loan demand elasticity and/or interest rate changes become very small, net income shift is larger in the marginal than average pricing regimes for pro-cyclical change, but larger under the average pricing regime for counter-cyclical change.

The model shows why as deregulation of the financial markets took place the FCS could be expected to find income stability a difficult objective to achieve if they had maintained an average cost pricing rule. As deregulation took place, volume effects grew dramatically. Both loan demand elasticity and interest rate change blossomed into significant de-stabilizing forces. The model suggests moving to marginal cost pricing as the financial markets became more unstable did work to decrease net income volatility. The decrease in volatility came from decreasing the potential volume effect caused by divergence of FCS and competitors' loan interest rates as market interest rates fluctuated. Furthermore, as interest rates fell, lengthening the average maturity on loan relative to bonds is shown to act as a counter-cyclical force, stemming net income loss.

Conditions for net income stability in this model suggest that the average loan maturity under average cost pricing should be shorter than under marginal. Alternatively, if a decision were made to lengthen the effective maturity of farm loans, e.g., to decrease the interest rate risk that farmer/borrowers must face, maintaining a marginal cost pricing regime is relatively conducive to stable Farm Credit System net income.

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