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Effect of Variable Interest Rate Loans
on the Agricultural Sector

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ABSTRACT

Variable interest rates shift the risk of interest rate changes from the
lender to the borrower. Various agribusiness firms and the agricultural
sector were analysed to determine whether variable rates contribute
significantly to fluctuations in net cash income. Results indicate that
variable rates increase the instability of net cash flows for major mid-west
farm types and but not for farmer owner cooperatives.

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Until the late nineteen-sixties, farm loans traditionally were made with a stated interest rate that remained the same during the life of the loan. In this situation any risk associated with the changing cost of funds used to support outstanding loans was born by the lender. However, when rates fluctuated, lenders frequently found themselves holding a volume of fixed rate loans which had to be financed with funds procured at a higher average cost than when the loans were made. As a result lenders increasingly made loans under contracts which allowed them to adjust interest rates as the cost of money changed. A result of the widespread use of variable rate loans has been to shift the risk of interest rate change from the lender to the borrower.

The current widespread use of variable interest rates may inject another important source of risk into the firm's operation and planning process. If, as Markowitz argues, individuals prefer choices having smaller income variances to those having larger variances, firms adversely affected by variable rate loans can be expected to reduce their use of debt capital or adopt strategies which reduce interest rate variability. In either case the firm's efficiency and cost are affected.

The objective of this paper is to examine whether variable interest rate loans have introduced a new source of instability to segments of the agricultural sector and if so, is this instability significant? Morris contends that variable interest rates in the nonfarm sector may reduce income variance because high and low rates tend to be correlated with periods of strong and weak business activity. Net returns of most business firms are in turn positively related to overall business activity. While this may be the

pattern for many nonfarm firms it need not be true for various industries within the agricultural sector. Net income of agribusiness firms may chart a different pattern than nonfarm business activity due to random changes, for example, in farm output or foreign demand. In 1974, Frances argued that farm income responds to monetary actions in a manner similar to GNP and industrial production which would seem to support the Morris view. However, Frances goes on to say that interest rates charged farmers were less sensitive to monetary actions than rates charged other major sectors of the economy and indeed may lag other rates. Thus, from his perspective in 1974, we were not able to deduce the correlation between interest rates and net cash income of farm firms in the agricultural sector.

Methodology

A variety of approaches might be used to determine whether variable interest rates contribute to the instability of net income. However, the line of reasoning used by Morris encouraged us to focus on the correlation between interest expense and net cash income of the firm. This in turn led us to a model basic to portfolio selection (Barry, Penson and Lins).

$$\sigma_T^2 \; = \; \sigma_I^2 \; + \; \sigma_{iE}^2 \; - \; 2r(\sigma_I)(\sigma_{iE})$$

Where:

σ_T^2 =   variance of net cash income after interest expenses are deducted

σ_I^2 =   variance of net cash income

σ_{iE}^2 =   variance of interest expense

r =   correlation between net cash income and interest expense

The model states that the variance of net cash income after deducting interest expense is equal to the variance of net cash income plus the variance of interest expense minus the covariance of net cash income and interest expense.

If there was no variance of interest expense, such as would occur under a constant debt and a fixed interest rate loan, the last two terms drop-out of the model and $\sigma_T^2 = \sigma_I^2$. Thus we conclude that with a constant debt size, fixed rate loans do not affect the variability of net income.

With a constant debt and a variable rate, σ_T^2 depends upon $\sigma_I^2, \sigma_{iE}^2$ and the covariance term. In the situation in which r is zero, the covariance term drops out and it is concluded that variable interest rates increase the variance of net cash income by the amount of the variance in interest expenses, therefore the equation becomes $\sigma_T^2 = \sigma_I^2 + \sigma_{iE}^2$. If r is negative σ_T^2 increases by an additional amount which is indicated by the covariance term.

The situation is slightly more complex if r is positive. In this situation σ_T^2 could increase or decrease depending upon the size of σ_{iE}^2 relative to the covariance term. In effect, each firm has an unique positive "break-even" r value at which variation in interest expense will have no impact upon variation in net cash income. Values of r greater than the break-even value imply that variation in interest expense will have a stabilizing impact upon net income, while values of r below the break-even r will contribute to increased net income variability.

The initial task was to obtain data enabling us to observe variances and correlations between net cash income and interest expense under a variable interest rate regime. By selecting "representative firms" we believed we would adequately measure the variance of net cash income. However, if we used the firm's annual interest expense, the variance of net cash income after

interest expenses would be affected not only by the interest rate but by changes in the use of credit through time. In order to determine the separate effect of variable interest rates, we arbitrarily chose two debt levels. One was constant throughout the study period and the other increased through time.

Use of the interest expense based on the constant debt level in the model enables us to determine the separate effect of variable interest rates on the firm. A constant debt level in an inflationary period could occur if at the beginning of the period the firm undertook an investment which was financed by debt requiring annual principal payments. As the outstanding amount of this long term debt declined annually, operating credit lines could have increased reflecting the higher cost of annual inputs. Use of the interest expense based on the increasing debt load in the model enables us to determine the effect of variable rates in an inflationary situation where total credit needs increase. We recognize these are but two debt patterns which could be chosen from among a virtually infinite number.

Since businesses must pay interest in current dollars, we envisioned a methodology that reflects this and yet was not substantially influenced by the underlying positive trend in net income and interest expense. The net income and interest expense series did not increase uniformly during the study period, thus we were wary of using any one deflator for both series (Shepherd p. 121). The method chosen was to obtain the residuals of net cash income and interest expense from the respective trend line of each series and to correlate these residuals.

The Data

We examined this model using data representing four mid-west farms, two farmer owned cooperatives and the entire farm sector. Except for the farm sector, the data represented annual averages of firms of similar types and

size. Farm data are from Illinois Farm Business Farm Management Service while the cooperative data are from members of a regional system. We used actual income and expenses for each set of firms and calculated an annual average net cash income (table 1).

The "constant debt" level was $100,000 in each year for the four farms. The increasing debt level rose annually approximately in line with the firms' assets. This resulted in about the same debt-to-asset ratio through time. For the cooperative, the concept was the same except the constant debt was $500,000 for the marketing cooperative and $930,000 for the supply cooperative. Because the outstanding debt increased through time for the farm sector, we could not estimate the model under the constant debt load.

The variable interest rate used for the farms was the average annual rate charged by the St. Louis Federal Land Bank. For the cooperatives it was the average annual rate charged by the St. Louis Bank for Cooperatives. For the farm sector we used actual sector debt but recalculated interest expense assuming the variable rate charged by the Federal Land Bank.

Empirical Results

As indicated by our model fixed rate loans do not alter the variability of net cash income. Thus, our task was to observe the correlation between interest expense using variable interest rates and net cash income. Our results indicated that there is a tendency for the residuals of annual net farm cash income and interest expense from their respective time trends to move in opposite directions (table 2). Seven of eight possible farm correlations have negative signs. Thus, we conclude, variable rates increase the instability of the net cash flows of these farms.

The separate effect of variable rates is most clearly shown by the farms having constant debt level because all variation in interest expense is caused

by the variable rate. When debt levels were allowed to increase during the study period, farm correlations move closer toward zero. This probably occurs because debt levels increase more in high income years than in low income years. For the cash grain farm the correlation between residuals becomes slightly positive, but not significantly different from zero. For the cash grain farm, r's above +.03 result in less variance of net cash income after interest expenses. Thus, for these four types of farms under two different debt loads, we conclude variable interest rate loans increase the instability of net cash income in all cases except possibly the cash grain farm when debt levels were increasing.

For the entire farm sector, r is +.04 but is not significantly different from zero. The "break-even" r is +.01. Literally interpreted for the farm sector, variable rates have reduced the variance of net cash income after interest payments. The practical interpretation is that the model fails to conclusively show whether variable interest rates reduce or increase the variability of the sector's net cash income after interest payments. However, results from the sector analysis can be misleading because changes in the net cash income of individual farms tend to offset one another when aggregated into the sector account. Hence, measures of income variance can be quite different for the sector than for individual farms.

For both cooperative types we found relatively large correlations between net cash income and interest expense under both debt loads. Furthermore, the correlation coefficients were larger than the breakeven r values. Hence, we conclude for these cooperatives in these situations variable interest rates tend to stabilize net cash income after interest expense.

Rather than discuss possible explanations for the differences between farm firms and the cooperatives, we simply note that inspection of our

interest rate and net income series shows that different results could occur.
Interest rates charged by the Bank for Cooperatives and the Federal Land Bank
are not perfectly correlated. While net income of the four farm types show
some correlation with each other, net income of the cooperatives show a
different pattern. The result is that variable interest rates affect
agribusiness firms differently.

Should the variance of net cash income in the future increase relative to
the variance of interest rate expense, the positive break-even r would
decline. This could occur for the cash grain farm, the marketing cooperative,
and the farm sector, if, for example foreign demand fluctuates causing farm
prices and income to have more instability in the future than in the study
period. This source of instability would not likely have as much effect on
the livestock farms or the supply cooperative because they are influenced less
by changes in foreign demand.

On the other hand, if the variance of interest expense in the future
increases relative to the variance of net cash income, the positive break-even
r's could increase above the positive r's shown in table 2. We believe this
situation is more likely to occur in the future for three reasons. First, the
early portion of our study period included some years when interest rates did
not change much. Second, many believe that the new emphasis of the Federal
Reserve to set policy goals in terms of growth in monetary aggregates instead
of interest rates will result in greater fluctuation in interest rates than
previously. And, finally, other studies (Herr, Melichar) show that movements
in farm interest rates in recent years are more similar to changes in nonfarm
rates than in earlier years.

Our results indicate that for important mid-west farm types, variable
interest rates increase the variance of net cash income after interest

expenses are paid. For two types of cooperatives, and the entire U.S. farm sector, variable rates apparently decreased net cash income variability. If our view of future interest rate variability is correct even low positive r's could, however, result in increasing the variance of net income for these segments of the agribusiness sector in the future.

We conclude that not only has income variability of important segments of the agricultural sector increased but this source of variability is significant. Among farm sector expense items, we found total interest expense to be a major annual expense item and its coefficient of variation is as high or higher than other expense items including fertilizer, petroleum products, feed, etc.

Summary and Implications

For some years, lenders and borrowing firms have contended with interest rate cost as a source of variation in their cash flow accounts. As indicated by our findings this source of variation may be more important for some segments of the agricultural sector than for others. Recognizing that economic efficiency can be improved when risk and uncertainty are reduced, we believe efforts should be undertaken to alleviate this source of instability. We see several possible types of studies which may help alleviate this problem.

1. Can some of the risk of interest rate change be shifted outside the farm sector via the financial futures market to speculators and other risk bearers? If this is possible, is the optimum strategy for lenders , borrowers or both to engage in the hedging transaction?

2. Recognizing that individual borrowers may have widely different preferences for income and associated variability, lenders should explore the possibility of offering fixed as well as variable rate loans to accomodate these differing borrower preferences. This requires knowledge of the mix of loans which a firm should offer and the method for determining the fixed rate in a volatile environment.

3. The shift to variable rates have presumably lowered the lenders'
    cost but as the risk is shifted to borrowers it has increased their
    cost. Overall, has the change been beneficial to the agricultural
    sector or has it reduced efficiency?

We believe capital use and the efficiency of the agricultural sector can

be improved if these and related aspects of variable rate loans are examined

and alternative strategies developed.

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Table 1. Selected Characteristic of Selected Segments of the Agribusiness
Sector Analyzed in Study

Segment of Agribusiness Sector	Period Studied	Size of Firm in Last Year of Study	Average for Period	
			Net Cash Balance[1]	Total Investment
Farms				
Cash Grain	1963–78	530 acres	$41,880	$667,000
Hog	1963–78	105 litters	32,216	504,000
Dairy	1963–78	50 cows	16,145	303,000
Beef	1963–78	249 head	18,141	499,000
Marketing Coop.	1973–80	$7.5 million sales	377,394	2,925,000
Supply Coop.	1970–79	$14.3 million sales	$779,279	5,400,000
U.S. Farm Sec.	1964–79	NA		

[1]Before taxes and interest payments.

Table 2. Actual and Break-even Correlations of Residuals from Trend in
Net Cash Income and Interest Expense for Selected Segments of
the Agribusiness Sector for Two Debt Situations.

Segment of Agribusiness Sector	Debt Situation			
	Constant		Increasing	
	Observed r	Break-even r	Observed r	Break-even r
Farms				
Cash Grain	-.15	+.01	+.04	+.03
Dairy	-.52	+.06	-.43	+.14
Hog	-.43	+.03	-.30	+.04
Beef	-.25	+.02	-.21	+.05
Supply Coop.	+.33	+.04	+.19	+.17
Marketing Coop.	+.48	+.09	+.70	+.57
U.S. Farm Sector	NA	NA	+.04	.01