EFFECTS OF DEBT LEVELS AND LOAN ARRANGEMENTS ON FARM FIRM SURVIVAL AND GROWTH

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Variability of both agricultural prices and yields causes aggregate and individual farm incomes to vary. Strategies such as enterprise diversification may reduce year-to-year income variation, but commonly this reduction involves some cost in terms of a decrease in expected income.[1] Marketing strategies such as hedging, forward contracting and spreading sales seek to reduce price risk. Not all of these marketing strategies will necessarily decrease income variability, but these strategies commonly involve some costs for a farmer such as commissions, margin requirements or service changes.[2] Financial risk management strategies such as maintaining a credit reserve or adequate liquidity are other means of accommodating price and production risk.[3] The costs of financial risk management strategies, as reflected by investments foregone and slower growth, may be considerable, but are less apparent than for other risk management strategies.

This paper attempts to analyze the effects of different levels of debt and loan repayment arrangements on the survival and growth of farm firms. Different debt/asset ratios and loan repayment arrangements are simulated in an environment of price and yield variability to determine their effects on the probability of survival and growth, defined as capital investment and net worth accumulation, of typical, but hypothetical farm firms. Comparison of the various situations simulated will provide a first approximation of the costs and returns of some financial management strategies.

The first section of this paper provides an overview of the basic interrelationships in the model. Emphasis is given to the differences in loan repayment arrangements analyzed. Second, the hypothetical resource situations and simulation procedures are described. Results obtained are presented and discussed in the third section. The paper concludes with some of the implications of these preliminary results and suggestions for additional research.

Description of the Model

The simulation model used in this study is an extension of the behavioral model described by Patrick and Eisgruber. For each of the hypothetical situations analyzed, the resources available, goals of the operator and past experience define the set of alternatives considered. Anticipated results of each alternative are calculated using prices and yields expected by the operator and are evaluated in relation to the multi-goal objective function. The alternative giving the highest level of satisfaction is selected and implemented. Results obtained from implementation of the selected alternatives are used to update information for the succeeding year's decision-making.

Alternatives considered are influenced by the firm's resource position, goals of the farm operator, and externally controlled factors. In the planning process, the first alternative considered is that of repeating last year's plan, if it provided at least a minimum level of overall satisfaction. Next, alternatives involving purchase or share renting of additional land are considered. Externally imposed restrictions of land availability, internal

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financial constraints, or labor availability can limit consideration of land purchase and/or expansion of the acreage operated on a crop share lease. Given the existing livestock operation, alternative crop rotations are considered. After the cropping program is analyzed, livestock alternatives are considered. First, expansion within existing facilities is considered, followed by expansion in new facilities. Custom harvesting and off-farm work are additional alternatives which can be considered. Additional labor, machinery, equipment, and building resources can be acquired if necessary to implement an alternative. The added costs of these resources are considered in the budgeting process.

It is assumed that the farmer has multiple goals, the weighting of which will vary with changes in the resources of the farm operator and his personal circumstances. The goals and the initial weights assumed are: Family consumption .40; Net worth accumulation .25; Risk aversion .25; and Work-leisure preference .10. Standards are established for each goal and alternatives are evaluated in a satisfying framework. Anticipated results of a particular plan are compared with the standard for each specific goal. The level of satisfaction with respect to a goal is multiplied by the weighting of the goal, and the overall level of satisfaction is obtained by summing these values for the four goals. The alternative with the highest level of overall satisfaction -- the plan which best attains the multiple goals of the operator -- is selected for implementation. Patrick provides a more complete discussion of expectations, goals, and evaluation of plans in the model.

Inflation is introduced explicitly into the model. Land prices, farm input prices, and non-agricultural prices are assumed to increase 6 percent annually. Prices of farm products are assumed to increase 5 percent annually, but the lag in agricultural price increases is offset by an increase in productivity which is assumed in the model. Consumption and net worth accumulation standards, the self-employment tax base, personal exemptions, zero bracket amount, and income tax brackets are also adjusted to reflect inflation.[4] Inflation could be made stochastic in the model, but it is beyond the scope of this study.

Several forms of financing are available to the farmer in the model. If sufficient cash is not available for current operating expenses, the amount required, up to 100 percent of operating expenses, can be borrowed on a six-month note. These funds cannot be used for investment purposes. Should a farmer encounter cash flow difficulties and be unable to meet loan repayments or family living expenses in a given year, funds can be borrowed for a one year period. Use of this type of financing is considered a danger signal in the model and if used for three successive years would lead to the farm operation being liquidated and the simulation being terminated.[5] Termination could also occur if the firm had constantly failed to attain the goals set or did not expect to attain the desired goals.

Two types of intermediate term credit are available, one for machinery and breeding livestock and the other for buildings and grain handling equipment. Initially the terms for loans on farm machinery and breeding livestock are 5 years and 15 years for building loans. In later simulations the terms are increased to 7 and 20 years. If a farmer had an existing machinery loan and wished to finance the acquisition of additional machinery, the outstanding balance is assumed to be refinanced when the additional funds are utilized. This refinancing would also occur with building loans if additional or replacement buildings were financed. Land purchases could be financed over a 25 year period. The later simulations increased the period to 35 years. As is the case with the intermediate term credit, long-term debt is refinanced if additional land is purchased.[6]

Three types of loan repayment arrangements are considered. In the first case, it is assumed that all loans are of the equal principal payment-declining total payment type. The total payment in a given year is calculated as the outstanding loan balance divided by the years of remaining life of the loan plus interest on the outstanding balance. In the second case, it is assumed that all loans are of the fully amortized-equal total payment type. Loan repayments are calculated using standard amortization formulas. The third type of loan repayment arrangement assumes a fully amortized-equal total payment loan with a reserve fund-insurance program similar to the variable amortization loan proposed by Baker.

In all three loan repayment arrangements, family consumption is calculated as a function of a weighted average of farm income available for consumption. Farm income available for consumption is defined as sales of crops and livestock plus off-farm income, minus current operating expenses, interest paid, taxes paid, and debt principal payments. Because of the relative importance of crops in the farm operations simulated, income in year t is weighted as 0.2, year t-1 as 0.5, and year t-2 as 0.3.[7] Income which is not consumed is added to cash and is available for other uses. If consumption is greater than the income available for consumption, then cash available or a one-year loan is used to cover the shortfall.

In the reserve fund-insurance payment loan repayment arrangement cases, if income available for consumption exceeds consumption, one-half of the difference is put into a reserve fund. If the reserve fund exceeds three times the annual debt payment, additional contributions are not required. If the income available for consumption is less than consumption, the shortfall is covered by withdrawals from cash or the reserve fund.[8] If the reserve fund was not sufficient to cover the deficit, the insurance program would be used and the farmer would not be forced into short-term borrowing to meet the deficit. If he was forced to utilize the insurance program for three successive years, the farm would be liquidated. A farmer could borrow against the balance in his reserve fund if he wished, but the fund could not be utilized directly as cash.[9]

The base model assumes prices, costs, and yields similar to those of Central Indiana during the late 1970's. Average corn and soybeans prices are $2.40 and $6.00 per bushel and direct costs, excluding fertilizer, are $63.50 and $51.75 per acre. Yields for the farmers considered would average about 120 bushels of corn and 38 bushels of soybeans per acre. Yields increase about 1 percent annually because of the effects of new production technology. Land prices initially are about $2,000 per acre for an 80 acre tract with 5 acres of land which cannot be used for crops.

Three levels of debt, 50, 70, and 90 percent, are considered in this study. In each case the maximum permitted intermediate and long-term debt is limited to the specified percentage of the value of the intermediate and long-term assets. Loans can be used to acquire additional resources desired or replace existing machinery and equipment. Credit for current operating expenses is essentially unlimited, but farm operators consider the overall debt to asset ratio when evaluating an alternative.[10] An annual interest rate of 9 percent on borrowed funds is assumed.

Prices of agricultural products and yields of crops and livestocks vary in the model. Yields of livestock activities are assumed to vary independently. Because of the influence of weather, crop yields are correlated and are based on a variance-covariance matrix derived from Purdue Agronomy Farm data for the 1951 to 1977 period. In this micro-level, variations in prices are assumed

independent of yields as a group. Correlations among prices are based on annual average prices received by Indiana farmers during the 1951 to 1977 period, expressed in terms of 1977 purchasing power. Prices received are also not permitted to fall below a level equal to approximately 70 percent of the average and these minimum prices increase with inflation.

Initial Situations and Procedures

Three hypothetical farm firms were developed to represent different asset positions of farmers. Each of the farm operators had sufficient power, tillage, planting, and harvesting equipment for about 400 acres of crops. All of the operators were assumed to be in their late 20's, married, and to have three children. The hypothetical farmers were assumed to have experienced the same prices and yields in the past and to have the same technical coefficients and goals. The initial weightings of these goals and standards of goal achievement did differ because of differences in the resouce positions of the farmers.

Farm A was developed to represent the low resource-full tenant farmer who owned no land or livestock. During the preceding year, he had operated 400 acres on a 50-50 crop share lease. He had an investment of $71,600 in machinery and $5,000 in cash. The outstanding balance on the loan on his machinery was $35,000, his net worth was $41,600, and the debt/asset ratio was .49. It was assumed that if the low resource farmer purchased land in the future, it would have some buildings which could be used for livestock.

Farm B, the intermediate resource situation, had a total operator investment of $269,970 and a debt/asset ratio of .47. The farm operator owned 80 acres, share leased an additional 320 acres and had 25 sows. His net worth was $141,970, and he had a short-term debt of $3,000, intermediate-term machinery debt of $15,000, intermediate-term building debt of $20,000 and long-term real estate of $90,000.

Farm C, the high resource situation, was assumed to own 240 acres, share lease an additional 160 acres and have 25 sows. The total operator investment was $594,370 and the net worth was $406,370 with a debt/asset ratio of .32. The short and intermediate run debt structure was the same as Farm B and there was $150,000 of long-term real estate debt. The machinery, buildings, and livestock on Farms B and C were identical.

Land could be purchased in 80 acre tracts if the farm operator wished and had sufficient financial resources. A farmer was required to wait at least one year between land purchases. Five acres of additional land purchased could be used only for forage production, but the rest of the land was assumed to be as productive as land currently owned. Land was also assumed to be available in 40, 80, or 120 acre tracts on 50-50 share leases. Possibilities of livestock share leases were not considered.

The farm firms with the initial resource situations were simulated for 20 year periods under a variety of assumed conditions. Each of the farms was simulated using the three types of loan repayment arrangements and the three levels of maximum permitted debt. In each case, the conditions were replicated 25 times to determine the effects of variability in prices and yields. Farm B, the intermediate resource farm, was also simulated assuming the longer debt repayment periods discussed previously.

Results and Discussion

Table 1 shows the average net worth accumulation and operator's capital investment of Farm A after 20 years of simulation under the three types of loan repayment arrangements and levels of maximum permitted debt. In all cases, the average net worth accumulation is greater than the amount which would result if the initial net worth had increased at the 6 percent annual rate of inflation. In the situations in which debt is limited to the 50 and 70 percent levels, the low initial resource farmers are unable to purchase land and the type of loan repayment arrangement has very limited effects on results obtained. The lack of heavy long-term debt commitments generally enables the firms to survive without difficulty. Observed differences in net worth accumulations and capital investments among loan repayment arrangements and between the 50 and 70 percent debt limits are well within the range of sampling variability. The loan insurance program is used by 24 percent of the farmers at both the 50 and 70 percent debt levels, but none of the farmers uses the program more than once in the 20 year period simulated.

The average net worth accumulations at the 90 percent debt level are more than double those occurring with the 50 and 70 percent debt limits and the increases in operator's capital investment are of even greater magnitude. The coefficients of variation for both net worth and capital investment are also much greater than those with lower debt limits. Under the equal principal payment loan arrangement with the 90 percent debt limit, 88 percent of the farmers acquire land and their capital investment ranges from $294,000 to $1,842,000 in the final year of simulation. With the fully amortized loan arrangements, 92 percent of the farmers acquire land, and capital investment varies from $240,000 to $2,505,000. For the amortized loan with insurance program, only 64 percent of the farmers acquire land, apparently because the need to hold a loan repayment reserve fund restricts their flexibility.[11] The coefficient of variation of the operator's capital investment, 66.0 percent, is the largest of the three groups. Even with the higher level of permitted debt and extensive purchase of land, only 27 percent of the farmers are forced to use the insurance program.

The level of permitted debt is clearly more important than the loan repayment arrangements in determining the expansion possibilities of the low initial resource farmer. It should be noted that the low resource farmer is really only a low resource farmer in terms of land owned. Share lease arrangements permit this farmer to have a very substantial farm business and generate a high income. The high probability of survival of the low initial resource farm firm is due to the relatively low absolute debt service requirements. Even when land is purchased, the debt service requirements are low relative to the income generated by the overall farm business.[12]

Simulation results for Farm B, the intermediate initial resource farmer, are presented in Table 2. At the 50 percent maximum debt level, there is no difference in the probability of firm survival under the three types of loan repayment arrangements considered.[13] However, the average net worth accumulation and capital investment of farmers making equal principal payments are higher than for the other loan repayment arrangements. Because equal principal loans require larger cash payments during the early years than fully amortized loans, family consumption on farms under this arrangement is reduced. The frugal living which is forced on the farm families leads to a faster accumulation of net worth and serves as a basis for greater expansion. The loan insurance program is used by only 17 percent of the farmers remaining in business.

Table 1. Effects of Various Loan Repayment Arrangements and Maximum Permitted Levels of Debt on Average Twenty Year Net Worth Accumulations and Operator Capital Investments, Coefficients of Variation and Survival Probabilities of Low Initial Resource Farms. [a/]

Type of Loan Repayment		Maximum Debt Permitted (Percent) 50	70	90
Equal Principal Payments	Net Worth ($1,000)	190	191	411
	Coefficient of Variation (%)	13.2	14.6	54.1
	Capital Investment($1,000)	263	267	1109
	Coefficient of Variation (%)	6.5	10.7	39.3
	Survival Probability (%)	100	100	100
Fully Amortized Loans	Net Worth ($1,000)	184	184	464
	Coefficient of Variation (%)	13.5	14.7	57.5
	Capital Investment ($1,000)	273	267	1450
	Coefficient of Variation (%)	13.8	10.0	42.2
	Survival Probability (%)	100	100	100
Fully Amortized Loans With Insurance	Net Worth ($1,000)	199	194	421
	Coefficient of Variation (%)	15.8	20.9	80.4
	Capital Investment($1,000)	261	262	1141
	Coefficient of Variation (%)	7.2	14.2	66.0
	Survival Probability (%)	100	96	96

[a/] Inflation rates of 6 percent annually for land, farm costs and nonfarm prices and 5 percent annually for agricultural product prices are assumed. The initial net worth of the low resource farmer, $41,600, would be equal to $133,417 after 20 years at the 6 percent rate of inflation.

Table 2. Effects of Alternative Loan Repayment Arrangements and Levels of Maximum Permitted Debt on Average Twenty Year Net Worth Accumulations, Operator Capital Investment, Coefficients of Variation and Survival Probabilities of Intermediate Initial Resource Farms. [a/]

Type of Loan Repayment		Maximum Debt Permitted (Percent) 50	70	90
Equal Principal Payments	Net Worth ($1,000)	927	1434	1412
	Coefficient of Variation (%)	6.4	8.8	12.0
	Capital Investment ($1,000)	1378	1915	1881
	Coefficient of Variation (%)	14.8	8.1	14.3
	Survival Probability (%)	92	64	72
Fully Amortized Loans	Net Worth ($1,000)	770	1470	1555
	Coefficient of Variation (%)	12.6	16.0	14.3
	Capital Investment ($1,000)	1267	2446	2742
	Coefficient of Variation (%)	21.8	15.7	16.2
	Survival Probability (%)	92	56	68
Fully Amortized Loans With Insurance	Net Worth ($1,000)	747	1493	1483
	Coefficient of Variation (%)	15.0	15.1	21.5
	Capital Investment ($1,000)	1093	2524	2529
	Coefficient of Variation (%)	22.4	12.7	24.6
	Survival Probability (%)	92	88	76

[a/] Inflation rates of 6 percent annually for land, farm costs and nonfarm prices a and 5 percent annually for agricultural product prices are assumed. The initial net worth of the intermediate resource farm, $141,970, would be equal to $455,317 after 20 years at a 6 percent rate of inflation.

When the level of maximum permitted debt is increased from 50 to 70 percent, the probability of firm survival decreased under all of the loan repayment arrangements.[14] At the same time, the average net worth accumulation and operator capital investments of the surviving firms increase sharply. The net worth accumulations under the three repayment arrangements are very similar, but capital investment under the equal principal payment program is lower. The heavy cash flow requirements of the equal principal payment loans lead to acquisition of less land than the other repayment arrangements. This slower expansion also results in a higher rate of survival than under the fully amortized loan. With the loan insurance program, 88 percent of the firms survive as compared with 56 percent without the program. Of the 22 surviving firms, 12, or 59 percent, used the insurance program at least once and 4 of them used the program three times.

Increasing the maximum permitted debt from 70 to 90 percent has unexpected results for the intermediate resource farm. Under the equal principal payment and fully amortized loan programs, the probability of survival increases from the 70 to 90 percent debt level. Typically the farms which do not survive at the 70 percent debt level purchase land and then encounter cash flow difficulties which force them to be liquidated. With the increase from 70 to 90 percent maximum permitted debt, some farmers encountering cash flow difficulties utilize the extra borrowing capacity to expand their livestock operations. Under the fully amortized loan program, this leads to higher average net worth accumulation and capital investment. Of the 19 surviving firms, 12, or 63 percent, utilized the insurance program at least once. Two of these farmers utilized the program 5 times or more in the 20 year period simulated.[15]

Simulation results from Farm C, the high initial resource farm, are presented in Table 3. Unlike the previous resource situations, the level of debt permitted has essentially no influence on the results obtained. The small differences occurring between the 50 and 70 percent debt levels under the fully amortized loans are due to the differences in the number of firms surviving. Because of the relatively low initial debt/asset ratio, .32, the loan limits are generally not a factor limiting acquisition of additional land with a given debt repayment arrangement. Differences in the debt repayment arrangements do have some influence on the amount of land acquired and survival of the firms. With the equal principal payment loans the surviving firms generally acquire 80 acres less land than with the fully amortized loans. This results from higher cash flow requirements of the equal principal payment loans which slow firm growth. These higher cash flow requirements also cause a higher percentage of the firms to liquidate.[16] At the 50 percent debt level, 8 of the 19 surviving firms (42 percent) and 11 of the 21 surviving firms (52 percent) at the 70 and 90 percent debt levels utilize the loan insurance program at least once during the twenty year period simulated.

Table 4 compares the effects of "normal" and extended loan repayment terms on the simulation results obtained for Farm B, the intermediate initial resource situation. Under the "normal" repayment periods, machinery loans are for 5 years, building loans for 15 years and real estate loans for 25 years. With the extended repayment period, these terms become 7, 20 and 35 years respectively.

At the 50 percent maximum debt level, extension of loan repayment periods has the effect of reducing the net worth accumulation and operator's capital investment under all three types of loan arrangements. With the long loan repayment periods, the debt service requirements are reduced and a larger amount of income is available for consumption and investment. As income

Table 3. Effects of Alternative Loan Repayment Arrangements and Levels of Maximum Permitted Debt on Average Twenty Year Net Worth Accumulations, Operator Capital Investment, Coefficients of Variation and Survival Probabilities of High Initial Resource Farms.[a/]

Type of Loan Repayment		Maximum Debt Permitted (Percent) 50	70	90
Equal Principal Payments	Net Worth ($1,000)	2269	2269	2269
	Coeficient of Variation (%)	5.8	5.8	5.8
	Capital Investment ($1,000)	2769	2769	2769
	Coefficient of Variation (%)	9.1	9.1	9.1
	Survival Probability (%)	64	64	64
Fully Amortized Loans	Net Worth ($1,000)	2378	2371	2371
	Coefficient of Variation (%)	8.6	8.5	8.5
	Capital Investment ($1,000)	3386	3393	3393
	Coefficient of Variation (%)	11.2	11.2	11.2
	Survival Probability (%)	76	72	72
Fully Amortized Loans With Insurance	Net Worth ($1,000)	2356	2453	2453
	Coefficient of Variation (%)	11.2	8.6	8.6
	Capital Investment ($1,000)	3543	3499	3499
	Coefficient of Variation (%)	10.7	10.4	10.4
	Survival Probability (%)	76	84	84

[a/] Inflation rates of 6 percent annually for land, farm costs and nonfarm prices, and 5 percent annually for agricultural product prices are assumed. The initial net worth of the high resource farm, $406,370, would be equal to $1,303,283 after 20 years at the 6 percent rate of inflation.

Table 4. Effects of Alternative Loan Repayment Periods on Average Twenty Year Net Worth Accumulation, Operator Capital Investment, Coefficients of Variations and Survival Probabilities of Intermediate Resource Farms Under Various Loan Repayment Arrangements and Maximum Permitted Levels of Debt. a/

Type of Loan Repayment		Maximum Debt (Percent) 50% Debt		70% Debt		90% Debt	
		Loan Repay. Per. Normal	Extended	Normal	Extended	Normal	Extended
Equal Principal Payments	Net Worth ($1000)	927	728	1434	1415	1412	1388
	Coeff. of Var. (%)	6.4	13.4	8.8	11.5	12.0	12.1
	Cap. Invest. ($1000)	1378	1184	1915	2169	1881	2080
	Coeff. of Var. (%)	14.8	23.2	8.1	11.3	14.3	13.1
	Survival Probability(%)	92	92	64	84	72	88
Fully Amortized Loans	Net Worth ($1000)	770	685	1470	1483	1555	1590
	Coeff. of Var. (%)	12.6	12.6	16.0	12.3	14.3	9.8
	Cap. Invest. ($1000)	1267	988	2446	2917	2742	3013
	Coef. of Var. (%)	21.8	25.4	15.7	15.7	16.2	13.0
	Survival Prob. (%)	92	100	56	80	68	80
Fully Amortized Loans With Insurance	Net Worth ($1000)	747	644	1493	1346	1483	1462
	Coeff. of Var. (%)	15.0	7.8	15.1	12.2	21.5	11.0
	Cap. Invest. ($1000)	1093	803	2524	2834	2529	2900
	Coeff. of Var. (%)	22.4	11.8	12.7	12.6	24.6	14.1
	Survival Prob. (%)	92	100	88	92	72	92

a/ Inflation rates of 6 percent annually for land, farm costs, and nonfarm items and 5 percent for agricultural product prices are assumed.

available for consumption increases, the consumption goal standard also increases and the farmer will be less likely to undertake investment which reduces the income available for consumption. Increasing the loan repayment period also results in a higher probability of firm survival under the fully amortized loans. With the normal loan repayment period, 4 of the surviving farms use the loan insurance program, but only 1 farmer uses it with the extended repayment period.

At the 70 and 90 percent maximum debt levels, the effects of extending the loan repayment periods are somewhat different than those at the 50 percent debt level. Increasing the payment period has essentially no impact on the average net worth accumulated, but the probability of firm survival and operator capital investment are sharply higher in most instances. With the regular repayment terms, a number of firms make substantial investments, then encounter cash flow difficulties and are forced to liquidate. Extension of the loan repayment periods eases the cash flow difficulties and enables these firms with large capital investments to achieve their objectives and continue farming.

Conclusions

The results obtained in this study suggest that financial management does have considerable implications for risk management. Variations in debt levels and loan arrangements do have substantial impacts on the probability of farm firm survival and growth. However, the relationships among the level of debt, type and period of loan repayment, and the resource position of the firm are more complex than might be expected. Based on the results obtained in this study, it is not possible to make statements of the type that increasing the maximum percent debt permitted will decrease the probability of firm survival. For some situations, changing the maximum level of permitted debt has no effect and in other cases increasing the level of debt increases the probability of survival. With only a few exceptions, higher levels of debt does allow surviving firms to achieve greater growth in terms of higher levels of net worth and capital investment. Extending the period of loan repayment generally does increase the probability of survival, but the effects on net worth accumulation and capital investment are mixed.

In this study, the changes in debt levels and loan arrangements are superimposed on a model which includes a number of decision rules. In some situations debt level and loan repayment arrangements act as constraints and do influence the alternative selected. However, in other situations the basic decision rules built into the model determine the alternatives selected and the debt level and loan arrangements have no effect on growth and capital investments. Although the initial resource situations analyzed do have a wide range of resources, introduction of intermediate points would help obtain better estimates of the effects of financial management strategies on growth and survival of the firm.

It is expected that within a certain range, financial management considerations may have a major impact on decisions. However, for other types of decisions or range of considerations, financial management strategies may have no impact. Financial management is one part of the overall risk management strategy of a farmer. Further research will be necessary to determine the guidelines for a financial management strategy which fits with other risk management strategies and the overall objectives of the farm firm.

Footnotes

1. Brink found that varying degrees of risk aversion of Indiana farmers lead to changes in the crop combinations, but he did not estimate the reduction in expected income due to diversification. Other studies, such as Boehlje and Trede, have shown that the returns on diversified farms tend to have lower coefficients of variation than specialized farms. Differences in resource bases and other factors do not permit the costs of diversification to be determined from these sources.

2. In the case of cattle feeding, McCoy and Price found that routine hedging clearly reduced the returns when prices are rising. Holland, Purcell, and Hague and later Shafer, Griffin, and Johnston have demonstrated that selected hedging strategies can actually increase returns and reduce variance. Wisner found that a strategy of hedging corn in mid-September and lifting the hedge in mid-June lead to a lower return and higher variance of returns than not hedging in the 1971-1975 period. Boehlje and Trede found that spreading corn sales generally reduced the variance of the net price,--price minus storage and interest costs,--but a once a year sale in July provided a higher return and lower variance than the spread sales.

3. Patrick and Eisgruber, as well as other studies, have analyzed the effects of alternative debt levels on firm growth. McManus attempted to develop credit reserve guidelines for firm survival. Baker and Barry and Baker have shown an inverse relationship between the credit reserve and financial risk and between the credit reservation price of credit and the amount of risk.

4. For a more complete discussion of the adjustments in the model made for inflation and an analysis of inflation on growth, see Patrick.

5. It is recognized that other options, including partial liquidations, are available in the real world, to reduce the financial stress on a firm, but they are not conisdered in the model.

6. Increases in equity due to inflation could be utilized in borrowing for expansion, but the model did not permit refinancing of existing debt to resolve repayment difficulties.

7. Weights are used to have consumption respond to changes in income with a lag. The weights assigned are arbitrary but do not appear inconsistent with the casually observed consumption behavior of farmers.

8. Alternatively, this could be expressed as money not being available to make debt payments, given family consumption. Although lenders would be more likely to prefer this type of justification, the mechanics of how the fund is handled in the model are easier to explain from the consumption side.

9. It is assumed in the model that the reserve fund balance and cash held by the farm firm will draw interest at a rate 2 points below the borrowing rate of interest.

10. The maximum debt level is an externally imposed limit and a farmer may decide to utilize less than the maximum allowed.

11. Under the loan repayment arrangements which made the insurance program available, one farmer sold out at both the 70 and 90 percent debt levels. In both instances the insurance program helped the farmer during a period of financial stress in the early years of simulation, but caused him to over-expand. With no insurance program, the expansion program was slower and more conservative.

12. The availability of land, particularly on share lease, is overestimated in the model. Many low resource farmers in the real world find themselves unable to acquire control of sufficient land to provide an adequate level of income.

13. In all of the cases in which the simulations were terminated, the alternatives evaluated did not provide satisfactory levels of goal attainment. This would correspond to the real world farmer who decided to try non-farm alternatives even though he was not bankrupt.

14. With the higher debt limit a number of farmers found that their actual achievements were less than the goals they set and terminated the simulation rather than continuing to farm.

15. Only one simulation was terminated because the farmer was forced to use the insurance program for three successive years.

16. In all cases, liquidation occurs because the farmers are unable to meet their goals or because they do not expect to be able to reach their goals. A more typical response among real world farmers would be to refinance their loans or to liquidate part of their holdings. These alternatives are not considered in the model.

References

Baker, C. B. "A Variable Amortization Plan to Manage Farm Mortgage Risks," Agricultural Finance Review, Vol. 36, April 1976, pp. 1-6.

Baker, C. B. "Credit in the Production Organization of the Firm," American Journal of Agricultural Economics, Vol. 50, No. 3, August 1968, pp. 507-520.

Barry, P. J. and C. B. Baker. "Reservation Prices on Credit Use: A Measure of Response to Uncertainty," American Journal of Agricultural Economics, Vol. 53, No. 2, May 1971, pp. 222-234.

Boehlje, M. D. and L. D. Trede. "Risk Management in Agriculture," Journal of the American Association of Farm Managers and Rural Appraisers, Vol. 41, No. 1, April 1977, pp. 20-29.

Brink, L. "Plans, Decisions and Results: An Evaluation of a Procedure for Farm Planning Under Risk." Unpublished Ph.D. dissertation, Purdue University, December 1976.

Holland, D., W. D. Purcell and T. M. Hague. "Mean-Variance of Alternative Hedging Strategies," Southern Journal of Agricultural Economics, Vol. 54, August 1972, pp. 123-128.

McCoy, J. H. and R. V. Price. "Cattle Hedging Strategies," Bulletin 591, Kansas Agricultural Experiment Station, August 1976.

McManus, B. R. "Credit Reserves for Midwestern Farmers." Unpublished Ph.D. dissertation, Purdue University, January 1971.

Patrick, G. F. "Some Impacts of Inflation on Farm Firm Growth," Southern Journal of Agricultural Economics, Vol. 10, No. 2, December 1978, pp. 9-14.

Patrick, G. F. and L. M. Eisgruber. "The Impact of Managerial Ability and Capital Structure on Farm Firm Growth," American Journal of Agricultural Economics, Vol. 50, No. 3, August 1968, pp. 491-507.

Shafer, C. E., W. L. Griffin and L. D. Johnston. "Integrated Cattle Feeding Hedging Strategies, 1972-1976," Southern Journal of Agricultural Economics, Vol. 10, No. 2, December 1978, pp. 35-42.

Wesner, R. N. "Comparison of Storage Hedges Placed in Mid-September and Lifted in Mid-June vs. Unhedged Storage of Corn and Soybeans in Mid-June, 1971-1974," Cooperative Extension Service, Iowa State University, 1976.