SOME IMPACTS OF INFLATION ON FARM FIRM GROWTH

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During the 1970s, many changes have influenced U.S. agriculture. Researchers have devoted considerable attention to analyzing the effects of greater variability of agricultural product prices and means of coping with imperfect knowledge. Questions related to energy and the environment are receiving increased research emphasis. Hathaway [2] has written on inflation and food prices and Tweeten [10] has analyzed the real price effects of inflation on agriculture and total net farm income. Agricultural lenders, farmers, and others have expressed concern about higher land prices and capital requirements, but little research has been directed toward analyzing the effects of inflation at the firm level.

The objective of this study is to analyze some of the impacts of inflation on growth, defined as real net worth and capital investment of the farm firm. First, the simulation model developed to analyze the effects of inflation and other factors on the growth of a farm firm is described. Then three hypothetical initial "farm" or resource situations are described and analyzed. Finally, the simulation results obtained and some of their implications are reported.

MODEL

The simulation model used in this study is an evolution of the behavioral model described by Patrick and Eisgruber [7]. 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 by using prices and yields expected by the operator. The anticipated outcome is evaluated in relation to the multigoal objective function and the plan providing the highest level of satisfaction is selected for implementation. Results obtained from implementation of the selected alternative are used to update information for the following year's decision-making.[1]

The firm's resource position and goals of the operator influence the set of alternatives considered. 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 leasing of additional land are considered. Financial and labor constraints can limit consideration of land purchase and/or expansion of the acreage operated on a crop share lease. Given existing livestock, alternative crop programs representing different crop rotations are considered. After analysis of the crop program attention is directed to expansion and changes in the livestock enterprises. Additional labor, machinery, equipment, and building resources can be acquired if needed to implement an alternative and the additional costs of these resources are considered in the budgeting process. The alternatives considered, such as land purchase, can be influenced by the relative importance of the operator's goals.

Price and yield expectations of the hypothetical farm operator are used to budget the anticipated results of each alternative. Research [6, 9] indicates that farmers tend to project the recent past into the future. It is assumed in formulating expectations for year t that year t-1 is weighted as 70 percent, year t-2 as 20 percent and year t-3 as 10 percent.[2] Long-term expectations with respect to prices and yields are the mean of the past three years' levels.

The model assumes the farm operator has

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[1]For a further description of the various feedback loops and model's structure, see [7] and the general discussion in [4].

[2]These weights are arbitrary, but do not appear inconsistent with the studies cited and they are similar to the weights used by Chien and Bradford [1]. Varying the weights of the years was found to have little effect in the model.

multiple goals, the weighting of which can change with the farmer's resources and 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.[3] Standards are established for each goal. The family consumption standard is a function of current and past income, family size, age of the operator, and the relative importance given the family consumption goal. The norm for net worth accumulation is specified as a percentage increase in net worth. The magnitude of possible losses, in view of various prices, relative to net worth is the standard for risk aversion. The standard for the work-leisure preference goal is in terms of the days of operator labor required and is a function of the operator's age and importance of the goal.

Alternatives are evaluated in a satisfying framework. Four levels of satisfaction are specified for each goal and the anticipated outcome is compared with the standard.[4] 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 one which best attains the operator's multiple goals — is selected for implementation.[5]

With inflation, prices in the real world do not all increase proportionately. From 1964 to 1973, the average annual price increase for all purchased farm inputs was 5.17 percent, but ranged from 1.54 percent for fertilizer and lime to 6.91 percent for real estate taxes [10]. The model allows specification of three rates of inflation in a particular simulation run: one for land prices, another for prices of agricultural products, and the third for farm input prices, living expenses, and other costs. Inflation rates vary over time in the real world, but the rates specified are constant for the 20-year period considered.

In addition to causing changes in output prices, value of assets, and input costs, inflation affects the model in several other ways. First, the family consumption goal and actual consumption are adjusted by a factor reflecting the rate of inflation of nonfarm prices so that the real level of consumption is maintained. Second, the 1976 income tax rate is adjusted to make the marginal tax rate constant over time for a given level of real taxable income. Actual tax payments increase slightly in real terms, reflecting a lag in adjustment of the personal exemptions and standard deduction.[6] Self-employment tax is calculated as a constant percentage of the income subject to tax, and the maximum income subject to tax increases with inflation of nonfarm prices. Third, the standard for net worth accumulation is a function of the absolute level of the farmer's net worth and the rate of inflation. For example, if a farmer considers an annual increase in net worth of 3 percent as acceptable with no inflation, with 5 percent inflation the standard would be an 8 percent increase.

Inflation also affects the model indirectly through expectations with respect to future prices of agricultural products. The distributed lag model used for formulating price expectations for year t incorporates much of the past inflation into expectations about the future. However, inflation during the current year is not anticipated in price expectations. Although it would be possible to allow the farmer to anticipate future inflation, to do so is beyond the scope of the study.

The base model assumes prices, costs, and yields similar to those of Central Indiana during the mid-1970s. Corn and soybean prices are $2.25 and $5.50 per bushel and direct costs, excluding fertilizer, are $54.00 and $36.00 per acre. Yields for an average level manager are 110 bushels of corn per acre and 34 bushels of soybeans. Yields of crops are assumed to increase about 1 percent annually during the period simulated because of the effects of new production technology. Land price is $1500 per acre, about the Spring 1977 average for Indiana. Intermediate and long-term credit is limited to 70 percent of the value of the assets and can be used to acquire additional resources required or to replace existing machinery and equipment.[7] An interest rate of 9 percent is assumed. Annual operating credit is essentially unlimited, but the farmers consider the overall debt to asset ratio in their evaluation of an alternative.

The model can be operated in a deterministic

[3]Several studies [3, 5, 8] have analyzed farmers' goals. In general, the ranking of goals found in these studies is interpreted as not being opposed to the weights assigned in the model.

[4]For example, an alternative providing an income of 140 percent or more of the family consumption goal would be considered very satisfactory and given a satisfaction level of 4. In contrast, a plan providing an income of less than 90 percent of the consumption norm would be unsatisfactory and given a 1. Plans providing 90 to 110 percent of the consumption goal would receive a satisfaction level of 2 and plans providing 110 to 140 percent would receive a 3.

[5]If an alternative involves the purchase of land, the satisfaction level with respect to net worth accumulation is increased enough to offset a one unit decrease in satisfaction with respect to the family consumption risk and aversion goals.

[6]This is partially offset by use of the inflated values of machinery and buildings in calculating depreciation and net worth.

[7]A farmer in the model is permitted to borrow against equity which has been generated by inflation if he wishes.

or stochastic mode and with various assumptions about inflation. In the deterministic mode with no inflation, the prices and yields indicated above would be received by the farmer. If inflation is incorporated, prices received and costs increase by the specified rates of inflation each year. In the stochastic mode, yields of various types of livestock a farmer obtains vary independently. Because of the influence of weather, crop yields are correlated and the prices of many products are correlated because of substitution effects. In this micro-level model, variations in the prices received as a group are assumed independent of yields as a group. For crops, the correlations among yields are based on a variance-covariance matrix derived from Purdue Agronomy Farm data for the 1951 to 1976 period. Correlations among prices are based on the annual average prices received by Indiana farmers during the 1951 to 1976 period, expressed in terms of 1976 purchasing power. Prices received also are not permitted to fall below a level approximately 70 percent of the average and these minimum prices increase with inflation.

INITIAL SITUATIONS

Three hypothetical farm firms represent different asset positions of farmers. For all three situations the farm operator is assumed to be 28 years old, married, and to have three children. Each farmer also has the power, tillage, planting, and harvesting equipment sufficient for about 320 acres of crops. The hypothetical farmers are assumed to have experienced the same prices and yields and to have the same goals. The initial weightings of these goals and standards of goal achievement differ among farmers because of the differences in their resource positions.

For Farm A, the low resource farmer has no land or livestock and operated 240 acres the preceding year on a 50-50 crop share lease. He has an investment of $29,160 in machinery, outstanding loans of $12,000 on the machinery and $3,000 for operating capital, and a net worth of $14,160. Debt payments of $7,000 are due the first year of the simulation. It is assumed that if he purchases land in the future, the initial purchase would include some buildings which could be used for livestock.

For Farm B, the intermediate resource farmer owns 80 acres, has 25 sows, and operated an additional 240 acres the preceding year on a crop share basis. His total investment is $162,247 and he has long-term debt of $75,000, intermediate debt of $20,000, and operating credit of $5,000 for a net worth of $62,247. Debt payments of $14,000 are due the first year.

For Farm C, the high resource farmer owns 240 acres, has 25 sows, and operated an additional 80 acres the preceding year on a crop share lease. His total investment is $379,247 and he has a net worth of $246,247. Outstanding debt includes $105,000 in long-term debt, $25,000 in intermediate debt, and $3,000 for operating credit. Debt payments totaling $16,250 are due the first year of simulation. The buildings and livestock operations on Farms B and C are identical.

Land can be purchased in 80-acre tracts if the farmers wish to buy and have the necessary financial resources. Five acres of additional land purchased can be used only for permanent pasture. Land also is assumed to be available in 40, 80, or 120 acre tracts on 50-50 crop share leases. Possibilities of livestock share leases are not considered. A simulation run is terminated if alternatives providing a minimal level of satisfaction cannot be attained in three successive years.

Farm operators with three levels of managerial ability, differing only in their technical transformation rates, are assumed.[8] The average manager obtains yields essentially equal to the averages indicated previously. Yields obtained by the high or above average level manager are 10 percent above the average level and yields of the below average manager are 10 percent below the average.

RESULTS AND IMPLICATIONS

The farm firms with the initial resource situations described were simulated under a variety of assumed conditions. First, the farms were simulated for a 20-year period with average and above average management in the deterministic mode assuming no inflation. Preliminary analysis indicated that farmers with below average managerial ability generally could not attain acceptable levels of satisfaction and the simulations were terminated. They are not included in the analysis. Second, these simulations were repeated assuming that all prices, asset values, and costs increase 3 percent annually. Third, the same initial resource situations were replicated 25 times in the stochastic mode assuming no inflation and then with 3 percent inflation annually. Fourth, deterministic simulations were performed using rates of inflation of 5 percent for land values, 1 percent for product prices, and 3 per-

[8]Managerial ability has many aspects. Although only the technical transformation aspect is included in this study, differences in other aspects of managerial ability are expected to have similar results.

cent for input prices. Finally, Farm B, the intermediate resource situation, was simulated in the stochastic mode assuming the differential rates of inflation.

Table 1 shows the net worth accumulation and operator's capital investment of the farms after 20 years in the deterministic set of simulations. The above average managers typically accumulated net worths which were 25 percent or more greater than those of average managers and the relative differences among farmers of different managerial abilities were almost unchanged by inflation. The effect of inflation on both net worth accumulation and capital investment depended largely on the initial resource position assumed.

With no inflation, both average and above average managers of Farm A, the low resource farm, purchased 240 acres of land and operated a total of 480 acres. However, when 3 percent annual inflation was included in the model, neither the average nor above average manager purchased land starting with the resources of Farm A. The farmers' assets, beyond their machinery, were accumulated as cash or bank deposits which were unaffected by inflation and therefore the farmers were unable to acquire sufficient assets for the downpayment on land which would appreciate with inflation. With inflation the farmers with low initial resources had debt-free operations, but their net worth and capital investment were less in real terms than when no inflation occurred.

The real net worth accumulation of Farm B, the initial situation of an intermediate quantity of resources, was not greatly affected by inflation. The average manager accumulated 4 percent greater real net worth with inflation because of a larger livestock operation. Real net worth accumulation of the above average manager was about 3 percent less with inflation because of slower expansion of the farm business. Inflation did have a major impact on the operators' real capital investment. Both the average and above average managers owned 400 acres, 80 acres less land than with no inflation, and their real capital investments were only about 75 and 80 percent, respectively, as great as with no inflation. In both cases, although current income and equity increased, the price of assets also increased and retarded expansion. For example, with no inflation the above average manager decided to purchase 80-acre blocks of land in years 3, 12, 16, and 20, but with inflation purchases were made in years 4, 16, and 17 only.

The high resource situation, Farm C, benefited from inflation. The average and above average managers accumulated 4 and 7 percent, respectively, greater real net worth with inflation than with no inflation. Inflation tended to slow the acquisition of additional resources during the first years of the simula-

TABLE 1. DETERMINISTICALLY SIMULATED TWENTY YEAR NET WORTH AND CAPITAL INVESTMENT BY FARMS WITH VARYING MANAGERIAL ABILITY, INITIAL RESOURCE SITUATION AND RATE OF INFLATION.[a]

		Net Worth Accumulation and Total Capital Investment (Thousands of Dollars)					
		Average Managerial Ability			Above Average Managerial Ability		
			3% Inflation			3% Inflation	
Initial Situation		No Inflation	Current Dollars	Deflated Dollars	No Inflation	Current Dollars	Deflated Dollars
Farm A	NW[b]	176	175	97	219	227	125
	CI	383	175	97	387	227	125
Farm B	NW	212	399	221	346	605	335
	CI	500	676	374	612	876	485
Farm C	NW	493	929	515	622	1203	666
	CI	723	1424	788	813	1408	780

[a]The 0 and 3 percent rates of inflation are assumed to be constant and affect all prices and costs equally.

[b]NW indicates net worth and CI indicates the operator's capital investment.

TABLE 2. MEAN TWENTY YEAR NET WORTH ACCUMULATIONS, CAPITAL INVESTMENT, COEFFICIENTS OF VARIATION AND NUMBER OF EARLY TERMINATIONS FOR FARMERS OF VARYING MANAGERIAL ABILITY, INITIAL RESOURCE SITUATIONS AND RATE OF INFLATION[a]

		Means and Coefficients of Variation of Twenty Year Net Worth Accumulations and Capital Investments and Number of Terminations					
		Average Managerial Ability			Above Average Managerial Ability		
			3% Inflation			3% Inflation	
Initial Situation		No Inflation	Current Dollars	Deflated Dollars	No Inflation	Current Dollars	Deflated Dollars
Farm A	NW[b]	108	153	85	157	206	112
	CV	32.1	26.9	--	24.2	22.3	--
	CI	199	169	93	325	212	117
	CV	49.5	61.4	--	40.2	28.2	--
	Term	0	1	--	0	0	--
Farm B	NW	219	441	244	339	684	378
	CV	8.4	14.9	--	6.8	8.8	--
	CI	409	655	362	530	973	538
	CV	14.1	30.1	--	11.3	27.6	--
	Term	8	7	--	8	0	--
Farm C	NW	483	939	520	527	1107	613
	CV	8.8	7.8	--	6.9	6.2	--
	CI	666	1180	653	747	1355	750
	CV	10.8	10.7	--	8.0	6.2	--
	Term	9	7	--	2	3	--

[a]The 0 and 3 percent rates of inflation are assumed to be constant and affect all prices and costs equally.

[b]NW indicates mean net worth in thousands of dollars, CI indicates capital investment in thousands of dollars, CV is the coefficient of variation in percent and term refers to the number of 25 replications of each situation which terminated before 20 years of simulation were completed.

tion, but as inflation continued to increase the farmers' equity, the resource acquisition process was accelerated. With no inflation, the above average manager purchased land in years 2, 7, 11, and 19 and with inflation purchases were made in years 3, 8, 11, and 13. The average manager's acquisition of 80 acres more land with inflation resulted in a real capital investment about 9 percent higher than with no inflation.

Table 2 shows the results of the stochastic simulation in terms of the mean net worth accumulation, mean capital investment, coefficients of variation, and number of runs which terminated before 20 years of simulation were completed.[9] In general the mean values of net worth and capital investment of the stochastic simulations were lower than values obtained from the deterministic simulations. Variability tended to reduce capital investment to a greater extent than net worth. The initial situation was an important factor affecting the impact of inflation, but managerial ability had an important role in determining whether a farmer remained in business. In 8 of 25 replications for Farm B and 9 of 25 cases with Farm C, the average manager was unable to attain a minimally satisfactory plan for three successive years. Usually the farmer had gone into debt to purchase land and then experienced cash flow difficulties. Inflation did not help the farmer of average managerial ability very much because 7 of 25 cases, for both Farms B and C, were terminated before 20 years of simulation were completed. In contrast, although 8 of the 25 replications of Farm B with above average management were terminated with no inflation, none were terminated with the 3 percent inflation. [10] This outcome suggests that inflation does not substantially increase the probability of survival of a firm with average management.

The largest coefficients of variation with respect to net worth accumulation and capital investment occurred with Farm A, the low resource farm. However, in only one of the total of 100 replications did termination occur before 20 years were completed. The larger coefficients of variation resulted from the effect a good year could have on net worth accumulation and capital investment. If a good year, or a series of good years, occurred a farmer could commonly acquire land. Moreover, by not having as large an absolute amount of debt as the farmer starting with B or C, the farmer starting from situation A was able to make debt payments and maintain family consumption in spite of adverse results. It was assumed a farmer could share lease additional land if he desired. Many farmers with limited resources, especially those of only average managerial ability, may be unable to obtain sufficient land on a share lease in the real world to generate a satisfactory income.

In the real world, all prices and costs do not increase proportionately. Land prices have tended, at least for much of the post World War II period, to increase faster than the general price level and agricultural produce prices have lagged. To represent this type of situation, it was assumed that land prices increase 5 percent annually, agricultural prices increase 1 percent and all other prices and costs inflate 3 percent annually. Table 3 shows the deterministically simulated net worth and the operator's capital investment for the three initial situations under the different levels of managerial ability.

TABLE 3. DETERMISTICALLY SIMULATED TWENTY YEAR NET WORTH ACCUMULATIONS AND CAPITAL INVESTMENT BY FARMERS WITH VARYING MANAGERIAL ABILITY AND INITIAL SITUATIONS[a]

		Net Worth Accumulation and Capital Investment (Thousands of Dollars)			
		Average Managerial Ability		Above Average Managerial Ability	
Initial Situation		Current Dollars	Deflated Dollars	Current Dollars	Deflated Dollars
Farm A	NW[b]	51	28	101	56
	CI	58	32	101	56
Farm B	NW	307	170	604	334
	CI	384	212	658	364
Farm C	NW	886	490	1167	646
	CI	914	506	1209	669

[a]Inflation rates of 5 percent annually for land, 1 percent for the prices of agricultural products and 3 percent for all other prices and costs were assumed. The 3 percent "general" rate of inflation is used to deflate.

[b]NW indicates net worth and CI indicates the operator's capital investment.

As would be expected because of the low rate of inflation of product prices, net worth accumulations of farmers were generally lower than indicated in Tables 1 and 2. Farm A was particularly hard hit by the differential inflation. Both the average and above average managers accumulated less than one half the real net worth that they had attained in the previous simulations. Although the net worth

[9]As indicated previously these were cases in which a minimally satisfactory plan could not be attained for three successive years. These cases were not included in calculation of the mean or coefficient of variation.

[10]Because of the way in which the stochastic simulation was performed, it was possible to apply the same sequence of variations in prices and yields to each initial situation.

accumulation of Farm B was somewhat reduced, the reduction in the operator's capital investment was substantial. In real terms, the net worth accumulation of the average manager was only 77 percent as great as when inflation rates were equal (Table 1) and capital investment was only 57 percent as great. For above average management, the respective figures were 99 and 75 percent. Effects on the average managers with Farm C were similar. Farm C with above average management had about a 3 percent lower real net worth with the differential inflation, but real capital investment was only about 86 percent as large as when inflation rates were equal. In all of these cases the differential rates of inflation led to the purchase of less land and lower capital investment, but this was partially offset by the higher per acre values of land owned. Again, the impact of inflation depends in large part on the initial asset position of a farmer, but his managerial ability is also important.

Because of the rather substantial impact of differential inflation on both net worth and capital investment, Farm B was also simulated with average and above average management in the stochastic mode. With the average level manager, 20 of the 25 replications were terminated before the simulation runs were completed because of dissatisfaction. In contrast, only 9 of the 25 replications with above average management terminated early. The average net worth was only 87 percent as great as in the deterministic simulation and the coefficient of variation, 17.4 percent, was about twice as large as when the rates of inflation were equal.

In summary, the results indicate that the effects of inflation vary with the initial asset position of the farmer. The individual with more real assets tends to benefit in relation to the individual with fewer real assets. However, individuals generally accumulate less land and have lower real capital investments and net worth with inflation, particularly if differential inflation occurs, than with no inflation. Inflation increases equity, but it also increases the price of assets and tends to slow expansion of the firm. If an individual could anticipate inflation and were willing to assume considerable risk, growth could be increased, but such a situation would be unusual.

The coefficients of variation of real net worth accumulation and capital investment are generally higher with inflation than with no inflation. The levels of real net worth and capital investment generally are reduced further by the introduction of variability in yields and prices. Managerial ability of operators is an important factor enabling an individual to obtain acceptable levels of satisfaction in situations of variability and to survive in situations of uncertainty. Although the simulation results cannot be tested by comparisons with farms in the real world, the general conclusions appear consistent with the behavior of Central Indiana farmers over time.

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