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Robert W. Dubman

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Department of Agricultural Economics and Rural Sociology
The Pennsylvania State University
University Park, Pennsylvania 16802
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THE NEUTRALITY OF INFLATION IN AGRICULTURE

Robert W. Dubman*

Inadequate recognition of the role of inflation in the agricultural sector may lead to faulty income forecasting and improper conclusions about the gainers and losers from inflation. The farm sector is increasingly connected to and affected by the general economy. All purchased inputs (fuel, labor, feed, fertilizer, interest, equipment, etc.) have inflation imbedded in their prices determination structure. Prices paid indices for farm inputs show large gains since 1960. Reliance on purchased inputs has escalated; feed and chemical purchases compose a larger share of budgets. Simultaneously, prices received indexes of farm commodities have also shown correlations with inflation measures. A general presumption in the agriculture community is that inflation is harmful to farmers. The unconfirmed belief is that input price increases have exceeded output price increases causing a decline in net income. The effect of macroeconomic disturbances on the level of real farm prices and incomes remains an open question (Gardner). This paper addresses the effects of inflation on aggregate net farm income.

Historical linkages between economy-wide inflation and commodity prices will be examined. Two approaches are applied: first from the commodity price side and then an aggregate analysis through a large econometric macro model of the farm sector. Conclusions on the burden of inflation will be given for costs vs receipts and crops vs livestock.

Historical viewpoint

Inflation was low from 1950 to 1970 and then increased from 1970 on (see graph on next page). The early 1980's were a period of unusually high inflation. This section looks at simple long term relations between inflation and commodity prices.

Correlations between commodity prices and inflation were formulated with historical prices. An average annual percentage rate of change of each commodity prices was determined by averaging prices for 1960-64 and again for 1984-88. Then [average annual percentage rate]= $(([ave_{1984-88}/ave_{1960-64}]^{(1/24)})$ $-1)*100$. A similar rate of change was found for the GNP deflator. The two rates were compared to determine the proportion of commodity price changes explained by inflation. An inflation based forecast of the prices to the year 2000 is also presented (see 7 graphs beginning on next page) based on an expected change in the GNP deflator of 3 percent annually. The inflation based trends are based only on past price correlations with the GNP deflator, and are not extensions of past commodity price trends. These extensions to 2000 help illustrate the consequences of inflation on commodity prices. With zero inflation the trends would be flat.

Seven commodity price series were compared to inflation: The GNP deflator increased at an average annual rate of over 5 percent from 1960 to 1988, while the seven commodity prices increased from 2.4 to 4.6 percent annually.

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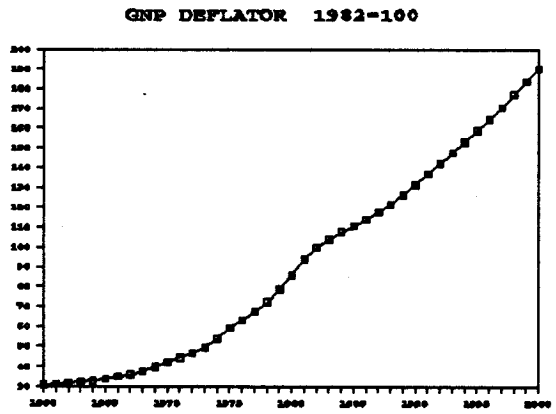
*Robert Dubman is with the Economic Research Service of USDA

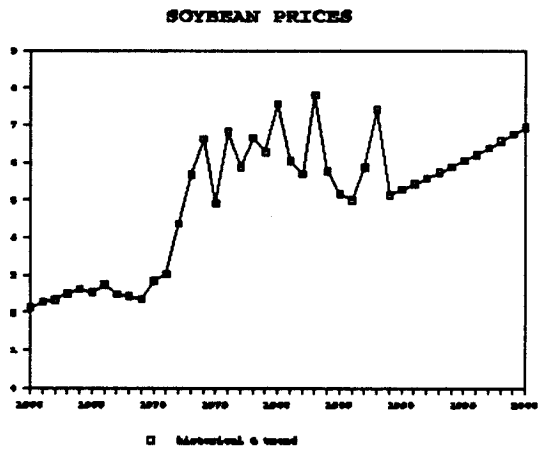
As demonstrated in the following graphs, during 1960-88:

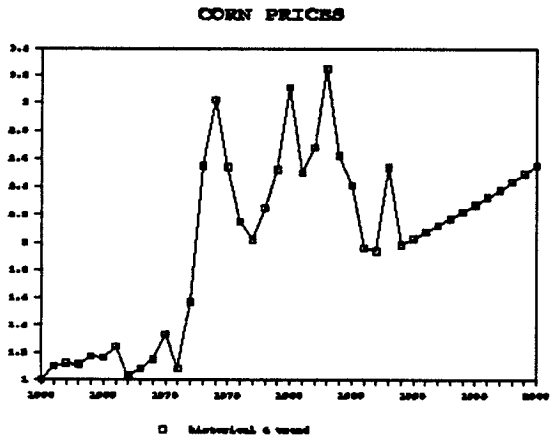
- Corn prices increased 57 percent as fast as inflation.
- Soybean prices increased 70 percent as fast as inflation.
- Wheat prices increased 44 percent as fast as inflation.
- Cotton prices increased 47 percent as fast as inflation.

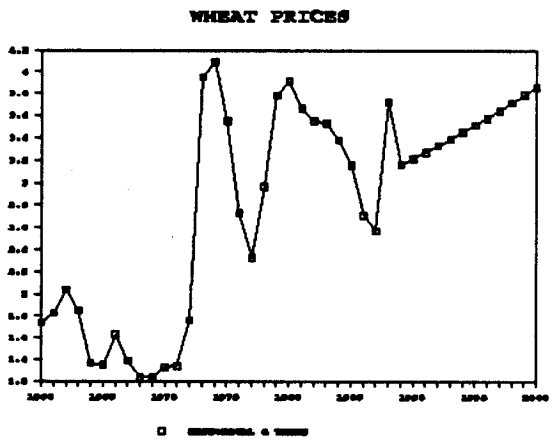
- Hog prices increased 86 percent as fast as inflation.
- Cattle prices increased 84 percent as fast as inflation.
- Milk prices increased 87 percent as fast as inflation.

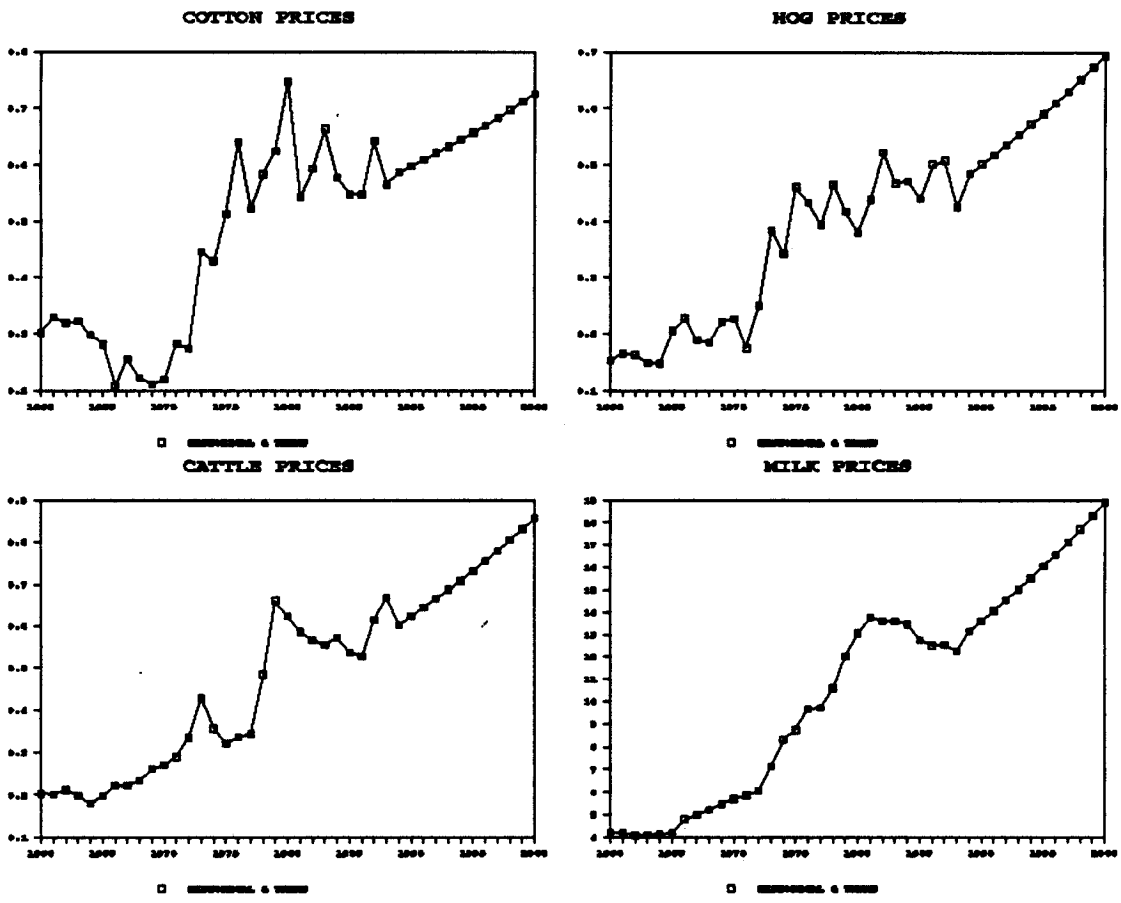
Thus, the above major commodities appear to have inflation as a component of their price determination mechanism. The GNP deflator alone can explain 44 to 87 percent of the price changes. Crop prices have not followed inflation as closely as livestock prices. Productivity gains in crops, especially corn,











lowered real prices. Cattle and hog productivity gains were not as dramatic. Target prices set the true price level for commodities and participants in Government programs. Target prices above market equilibrium may insulate market prices of commodities in Government programs from inflationary influence. For example, prices for soybeans, a commodity with no target price, have followed inflation more closely than have prices of commodities with target prices such as corn, wheat, and cotton.

Hypotheses

Two hypotheses are examined. First, since prices paid and prices received are not perfectly correlated to inflation, what have been the consequences of inflation on net farm income. Second, since livestock prices have followed inflation more closely than crop prices, we might conclude that livestock producers will not be hurt by inflation as much as crop producers. To test both hypotheses, the full multiplier effects must be considered. For example, corn is both an input and an output; a change in corn prices has both direct and indirect effects on income.

Method

To consider multiplier effects, a simultaneous equation macro model of the farm sector is required. An inflation free simulation was done by using the Farm Income Research and Forecasting Model (FIRFOM) from the Economic research Service. The model was run twice. One run was with realized prices for 1982-1989 to show what occurred with inflation during this period. Second, all the prices or corresponding monetary values and price indices were deflated to 1982 dollars using the GNP deflator. A comparison of these two runs reveals the predominant effects of inflation.

The Farm Income Research and Forecasting Model predicts farm income statistics over the period 1980 to 1990 and is primarily used to forecast ten years in advance. A core of 116 exogenous variables allows the calculation of 203 endogenous variables. Eighty-five of the equations are econometrically estimated and have error terms. Sixty-six equations are inexact proportions and involve splitting stocks between years, seasons, or commodities; these relationships may be historical or expert estimates. The remaining equations are strict accounting procedures following the USDA farm accounting process and involve adding up the components of farm income. Values of the exogenous variables are provided by the Economic Indicators of the Farm Sector.

The model is divisible into ten sections: cash receipts, other income, off-farm income, production expenses, farm capital expenditures, net income, balance sheet of the farm sector, farm output indices, prices received by farmers indices, and inventory changes. The sections of the model are interdependent and cannot be solved separately.

A solution to the system of equations is found by the Gauss-Seidel iterative method using GASSP (General-Analytical-Simulation-Solution-Program) on a mainframe computer. The Gauss-Seidel method is straight-forward but does not guarantee solution convergence or locate multiple solutions. In practice, convergence almost always occurs. This is especially true if historical values (and thus reasonable values) are used as initial values.

To demonstrate the solution procedure, consider the following two variable, two equation simultaneous model.

$$y = x/3 + 0.3 \quad \text{and} \quad x = y + 0.4$$

Applying the Gauss-Seidel method, let x have an initial value of zero. Then y= 0/3 +0.3= 0.3 and x=0.3 +0.4= 0.7. If x=0.7 then y=0.53 and x=0.93. Iterations continue until x and y change by only some small amount. Values of x and y converge to two decimal places quickly (table 1). Letting y (rather than x, as above) have an initial value of zero results in another set of iterative values that converge on the same solution values of x= 1.05 and y=.65 (table 1). Equation ordering and model complexity affect the speed of convergence. Using GASSP, the Farm Income Research and Forecasting Model converges in 35 to 40 iterations for each year.

Table 1 - Iteration values of x and y

		x	y	x	y
Initial Value		0.0			0.0
Iteration	#1	.70	.30	.40	.43
	#2	.93	.53	.83	.58
	#3	1.01	.61	.98	.63
	#4	1.04	.64	1.03	.64
	#5	1.05	.65	1.04	.65
	#6			1.05	.65

Results

Without any surprises the results suggest that input expenses and farm income are equally affected by inflation. Further, the modeling suggested that crop and livestock farmers are equally affected by inflation. Multiplier effects appear to balance crops and livestock price disparities.

Running FIRFOM with realized prices and then deflating to 1982 dollars yielded net farm income results very close to deflating the components of net farm income to 1982 dollars and then running the model (table 2). While the model does a reasonable task of predicting net farm income, a modest degree of error occurs. For the 1982-90 period in which the model was run, predicted and realized net farm income had an R^2 of .985. Recall that over one-third of the equations are econometric and have error terms. Thus, comparisons were made of the predicted net far incomes of the two runs; realized net farm income was not used in the analysis. The closeness of the two sets of predictions (table 2) suggests that inflation is neutral within agriculture. Over the 1983-90 period, farmers, on net, did not lose or gain from inflation.

Table 2 - Predicted net farm incomes with and without inflation were close

Year	Predicted Net Farm Incomes		
	Current Dollars	1982 Dollars	Percent Difference
1983	17.0	17.5	-2.86
1984	30.0	30.6	-1.96
1985	29.9	29.4	1.70
1986	28.8	29.7	-3.03
1987	36.0	36.2	-0.55
1988	36.3	36.1	0.55
1989	40.0	39.0	2.56
1990	41.4	40.2	2.99

Differences between the runs appear small and are attributable to sources other than inflation. Perhaps the major source is that no money illusion was allowed; crop production, inventories, and input quantities were not changed. A more rigorous analysis might include changes in quantities as well as prices.

The second hypothesis is that crop producers are hurt more by inflation than livestock producers. Livestock producers rely more on farm-origin inputs such as feed and feeder livestock. Farm-origin inputs are also farm outputs and as shown in the first part of paper have not fully followed inflation. Non-farm origin inputs such as fuel, chemicals, labor, and interest have prices that more fully capture inflation. On balance, if farm origin input expenses have lagged behind increases in non-farm origin expenses, livestock producers will gain relative to crop producers. Clearly, a multiplier effect occurs which can be approximated by a simultaneous equation system such as FIRFOM.

The results between the two runs indicate no distortion between the ratio of farm-origin input expenses to non-farm origin expenses. Multiplier effects appear to balance the increases. For example, if fuel prices increase then farm output prices and farm-origin expenses increase. However, the increase in farm-origin expenses is likely to have minimal effect on non-farm origin expenses. Thus, while farm origin input prices do not follow inflation as closely as non-farm origin input prices, the multiplier effect allows inflation to increase both expenses about equally.

Again, this result could be from the model design and not allowing quantities to adjust. An alternative approach to measuring the effects of inflation woud be to compare the USDA indices of prices paid and prices received with vector autoregression and cointegration tests (Robertson and Orden). However, this test may overlook some of the multiplier effects of outputs and inputs.

Since about half of farm household income comes from off-farm sources, inflation may, in total, have a negative impact on farm household income. Lowering real off-farm income may increase farm financial stress and the chances of bankruptcy. This is another issue for further study.

Conclusions

Inflation appears neutral in agriculture. One may legitimately deflate either net income measures or deflate the components of net income (receipts and costs). While livestock prices appear more responsive to inflation than crop prices, inflation appears to affect crop producers equivalently to livestock producers. Another significant implication is that forecasters must apply inflation to both inputs and outputs. Input price inflation is generally accepted; however historically output prices do not always appear to follow an increasing trend. The 1986 repeal or curtailment of four key tax incentives to invest (investment credit, capital gains, rapid depreciation, and passive losses) may decelerate supply growth and preserve the tighter historic link between livestock prices and inflation.

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