IMPLICATIONS OF ENERGY AND ENVIRONMENT UPON GROWTH IN THE FOOD AND FIBER SECTOR

by

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This paper synthesizes information on the effects of environmental restraints and increased energy costs on prices and quantities in the food and fiber sector. It looks at how direct impacts on one commodity lead to subsequent impacts on other commodities, resulting in a synergistic effect. The data measuring these effects are analyzed with the assistance of POLYSIM which utilizes elasticities to estimate deviations from a baseline scenario of crop and livestock variables at the farm production level (Ray and Moriak).

Processing, transportation and distribution components of the food and fiber sector also have important and perhaps critical environmental and energy related pressures on retail prices. However, this paper does not treat those components of the food and fiber system.

Neither does the paper indicate the long-term possibilities of overcoming environmental restraints and increasing energy costs.

Environmental Impacts

Environmental impact studies have been done for a large number of potentially contaminant agents affecting food and fiber. These studies usually were applied to a specific commodity in a given location. Generally the studies showed little National impacts.

The herbicides and pesticides affecting major crops used in this study are 2,4-D; aldrin; 2,4,5-T and chlordane. Restricting 2,4-D, used in weed control, would have noticeable repercussions on

Presented at AAEA annual meeting, Columbus, Aug. 10-13, 1975.

U.S. yields for feed grains and wheat (Fox). The result of restricting aldrin on corn yields would be minimal (Delvo). Efforts to offset the negative effects of these chemical restrictions would increase variable costs. Alternatives to 2,4-D on feed grains would noticeably affect variable costs per acre (Fox). The cost impacts of aldrin, 2,4,5-T, and chlordane would be small for feed grains and wheat (Delvo; Fox; Jenkins). The upper left side of Table 1 shows the Nationally accumulated impacts on yield and variable production costs from restricting these items.

The environmental impacts on livestock feed efficiency and costs are due to DES and other antibiotics at subtherapeutic levels, waste water runoff and lindane. DES and other antibiotics are routinely used in minute amounts for increased growth and reduced mortality in beef cattle and hogs. Their limitation could decrease feed efficiency. The change in variable costs, other than feed, due to their limitation would be small (Gilliam et al.). Reducing waste water runoff from concentrated feeding operations would have tremendous cost impacts on small producers; however, current regulations apply only to large producers--1,000 beef animals, 2,500 hogs, and 700 dairy cows. Estimates on nonfeed variable costs, in the lower left of Table 1, would be more nearly representative of 50-60 cow dairy herds and 200-300 hogs (House of Rep).

Energy Impacts

Estimating energy consequences on costs in agriculture is complex and there is a great deal of confusion regarding appropriate comparisons. Some use kilocalorie output/kilocalorie of fossil fuel

Table 1--Working estimates of the impacts on output per unit of input and costs due to environmental restraints and energy related cost increases

	Environmental restraints[1/]	Energy related costs[2/]
	---Percent---	
Output/acre:		
Feed grain	-2.74	
Wheat	-4.05	
Variable costs:		
Feed grain	4.15	10.8
Wheat	.72	8.24
Soybean	---	7.48
Cotton	---	10.7
Output/feed:		
Beef	-1.6	
Hogs	-1.8	
Nonfeed variable costs:		
Beef	3.03	.54 - 2.88
Hogs	5.5	1.46 - 2.66
Sheep	.18	1.10 - 1.62
Broilers	---	.96 - 3.10
Turkeys	1.5	1.02 - 3.90
Eggs	---	.52 - 1.56
Milk	4.23	1.54 - 2.98

Continued

Table 1--Working estimates of the impacts on output per unit of input and costs due to environmental restraints and energy related cost increases--Continued

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1/ Estimates were developed by weighting data from impact studies to a U.S. average and calculating changes in yields and costs for the year of study.

2/ Estimates show the impact of a 20% cost increase on variable cost items for crops in 1975. The 20% cost increase was applied to a range in quantities of energy used in livestock production as a percentage of nonfeed variable cost.

input to show the declining efficiency of transformation. Aggregating alternative energy sources is hazardous. They are measured in different units. Some energy is portable, some requires expensive fixed cost equipment, and other kinds are difficult to handle. Without considering joint costs and other restrictions, diesel's cost effectiveness at today's prices in relation to gasoline per horsepower hour is about 2:1, that for BTU is less impressive. The cost effectiveness of natural gas in relation to gasoline is about 4:1 per H.P. hour and 5:1 for BTU's (ERS and Strathmann). The decision problem as to which source and how much to purchase is more difficult than that of a feed manufacturer determining the purchases of corn, sorghum, or soybean meal because of the fixed capital inflexibilities.

The consequences on variable production costs for crops due to an overall 20 percent cost increase for the highly energy related items are shown in the upper right of Table 1.[1/] These costs items include fertilizer, chemicals, fuel and lubrication[2/] (Krenz) and assume a constant purchased input mix. In the shortrun, farmers can't shift among energy sources. In the longer run, the feasibility of shifting to minimum tillage as an energy conservation measure is limited because reduced fuel costs frequently are offset by increased use of herbicides, which depend on fossil fuels, and amplified environmental problems (USDA-OPE). Consequently, it was assumed that over the next five years, farmers will have little opportunity to substitute other inputs for those dependent on fossil fuels. The data show corn and cotton variable costs would rise substantially as energy related input prices increase by 20 percent. Wheat costs also would rise perceptibly but soybeans would be somewhat less affected.

The changes on nonfeed variable costs for livestock commodities are shown in the lower right of Table 1. The low end of the ranges are ERS estimates which include gasoline, diesel, and LPG used in livestock production. The high values at the upper end of the range also include natural gas and electricity. These are California State estimates (Cervinka) except for turkeys which are from a large private firm in Minnesota. The upper ends of the range are 1.5-5 times those of the lower end.[3/] However, the sensitivity on farm income or food costs may be minimal because only 21 percent of the fuel used in farm production in 1973 was used for livestock (ERS, p. 23).

POLYSIM Results

POLYSIM was used to estimate the intercommodity impacts of the environmental constraints and energy related cost increases at the rates shown in Table 1. This simulation model estimates deviations from a base scenario of supply, utilization, prices, income, and costs of major crop and livestock commodities. In preparing POLYSIM, the base scenario variable costs per acre and nonfeed costs per pound were altered to represent the impacts of immediate environmental restraints, and two scenarios about periodic energy related input cost increases of 10 and 20 percent per year. Since farmer's decisions on acreage and purchased inputs are affected by general cost changes, the results of energy price rises were added to the index for production items, interest, taxes, and wage rates excluding feed and feeder livestock.[4/] The output per unit of input variables for feed grains, wheat, beef, and hogs were also subjected to reduced technology. An operating rule, included for each crop, specified that variable production expenses must be less

than a specified percentage of lagged cash receipts.[5] This operating rule was necessary because if farmers did not curtail purchased inputs, production expenses would surpass cash receipts. It was postulated that curtailment of purchased inputs would reduce yields as well as per acre costs.

The model showed that 20 percent per year energy cost increases could have a sharply depressing economic stress on yield of most crops as shown in Table 2. Crop prices could push sharply higher but this would not be completely carried through to cash receipts as quantity demanded would be down.[6] Livestock production could be off and prices would rise substantially, especially for the grain dependent varieties such as pork, broilers, turkeys, and eggs. Consumer expenditures would be up a couple of percent but net farm income would fall off by a third.

Energy cost increases of only one-half those above would have significantly less of a depressing economic stress on yield. Crop prices would be 1/2 to 2/3 as strong, and livestock production would be somewhat better. There would be a slightly smaller impact on consumer expenditures but net farm income could still be off by over 15 percent.

Conclusion

The impact of 10-20 percent per year cost increases for energy related inputs on prices and quantities of major crops greatly surpasses those associated with environmental restraints. In response to the economic stress of increasing energy related costs farmers may curtail fertilizer, irrigation, cultivation, pesticides and herbicides due to the squeeze on farm income and lead to sharply declining yields.

Item	Acreage	Yield	Production	Domestic Use	Export	Price
			---Percent---			
Crop Impacts:						
Feed grains	-1.2 to -2.4	-9.7 to -14.8	-10.8 to -16.8	-9.1 to -14.4	-13.2 to -21.0	27 to 42
Wheat	.6 to -.7	-12.2 to -16.6	-11.5 to -16.8	-6.8 to -10.9	-5.8 to -10.4	40 to 65
Soybeans	-4.6 to -7.8	-.5 to -1.3	-5.1 to -9.0	-5.2 to -9.2	-4.8 to -8.6	10 to 18
Cotton	-1.5 to -1.8	-2.7 to -13.9	-4.3 to -15.8	-1.2 to -2.7	-1.3 to -2.8	8 to 17
Livestock Impacts						
Beef			-.6 to -1.0			6 to 9
Hogs			-3.7 to -6.1			9 to 14
Sheep			-.1 to -.2			3 to 5
Broilers			-3.4 to -5.6			7 to 11
Turkeys			-3.0 to -4.9			6 to 10
Eggs			-1.3 to -2.1			7 to 12
Milk			-.1 to -.3			1 to 2

1/ The impacts of 10% energy cost increases on crops and low requirements for livestock are on the left of each column set. The impacts of 20% energy cost increases on crops and high requirements for livestock are on the right.

The stress on net farm income indicates that something will have to bend. The pressures for adjustment may reduce the demand for purchased farm inputs, and cause a softening in the price rise of energy related items. The economic pressures may also provide incentives for farmers to improve management practices such that these inputs are used more efficiently. This study shows the importance of research on the decision framework for purchased farm inputs and its efficiency of use. Such information can be summarized in alternative crop and livestock budgets. These data for both quantities and prices are an important underpinning for an integrated analysis.

Interrelationships among commodities, represented in this study by elasticities, are also important. Since elasticities represent decision makers' behavioral response, research is needed on how elasticities vary in relation to the economic stress. For environmental and energy policy decision making, the results need to include the effects on retail prices due to their impacts in the processing, transportation and distribution components. With over half of the consumers' food dollar going to the farm-retail spread, these components cannot be ignored.

FOOTNOTES

* Theo F. Moriak is an agricultural economist with the Commodity Program and Policy Analysis area, CED, ERS. Comments by George Rogers (CED-ERS), and John Schaub (NRED-ERS) and Daryll Ray (Oklahoma State Univ.) were very helpful.

1/ In a recent delphi exercise done at USDA, the modal probability for tripling energy prices within a single year by 1985 was 40 percent, the range was 0-50 percent.

2/ In cotton, 50 percent of the ginning cost was also assumed to be energy related.

3/ There are substantial opportunities for energy conservation through tightening management practices.

4/ Since 37.5 percent of the index is energy related, it was increased by 3.75 for each 10 percent change in energy costs.

5/ Cost and cash receipt data for 1967-72 indicated the maximum of this percent for corn as 82, wheat-46, soybeans-33 and cotton-107. This study used the proportions .8-corn, .5-wheat, .6-soybeans and 1.0-cotton.

6/ No allowance was made for shifting demand because of changes in consumer income which could result in the economy from higher cost energy.

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