MAXIMIZING EFFICIENCY IN AGRICULTURE

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> *"Let me first bury one convenient rationalization; namely that larger farms result from economy of scale. With the possible exception of some mechanized feedlots and egg cities, there is no research evidence that larger units in agriculture are more efficient in physical operation than moderate size ones." (Breimyer).*

This statement by Harold F. Breimyer is part of the conventional wisdom that permeates the structure of agriculture issue.

It is undoubtedly true that the forces that mold the structure of agriculture are highly complex. Technology, tax laws, farm programs, agribusiness strategies, changes in relative resource prices, and producer objectives all play a part. It is equally clear that the role of researchers and extension educators is to sort out the relative importance of the various causes and effects of structural change. This might in turn improve the factual basis upon which policy decisions are made.

Our assignment is to interpret the impact of structural change occurring in agriculture upon efficiency. Efficiency is defined in a technical sense as the relationship between the quantity of inputs utilized in production and the quantity of output generated.

It is also defined in an economic sense as the average cost of production per unit. The discussion will be limited to two types of structural change: (1) the trend toward fewer but larger farms and (2) the trend toward vertical integration of input supply, production, and marketing functions.

Efficiency as a Criteria for Structural Decisions

Since the late 1960s there has been a tendency among economists to play down the importance of efficiency as a basis for policy decisions in food and agricultural industries. This strategy was apparently based upon the premise that we were either (1) clearly

the most efficient country in the world agriculturally, or (2) our efficiency and wealth had increased to the point where we could afford both guns and butter or the good life (Marion and Handy).

During this period studies of the efficiency of agriculture virtually vanished. Significant quantities of our agricultural research resources were diverted from methods of reducing cost to social concerns including the environment, rural development, food safety, and nutrition. At the same time, the rate of increase in federal and state appropriations for agricultural research declined precipitously.

The production shortfalls of the mid-1970's may have temporarily shaken our confidence in our capacity to produce. But it did not change our overall strategy or apparent lack of concern for efficiency. We maintained a steady course of primary concern for social goals despite increasing evidence of a declining rate of productivity and increasing evidence that our comparative advantage as a world economic power was shifting away.

The only bright sign was that we allowed U.S. agriculture to compete in world markets by reducing price supports and eliminating production controls on major agricultural commodities. At the same time the basic direction of government policy was to make agriculture less competitive in international markets. Policies were governed by the questionable premises that (1) the family farm was and always would be the most efficient and (2) U.S. agriculture was sufficiently efficient that it could bear the costs imposed by social concerns.

In 1974 Brandow cited three reasons to be concerned about the productivity and capacity of U.S. agriculture: (1) the impact upon inflation, (2) the impact upon world economic and political stability and (3) the impact upon the competitive position of the United States in international markets. Increases in energy prices and increasing questions about the availability of water for irrigation makes these concerns even greater today.

Much debate exists concerning what is happening to the productivity of U.S. agriculture (Castle). A Brookings Institution publication notes that the annual rate of increase in labor productivity in agriculture has declined from over 6 percent during the period 1948-73 to less than 4 percent in the period 1973-78 (Norsworthy, Harper and Kunze). The National Academy of Science has emphasized that a number of warning signals exists indicating the potential for reduced total productivity in U.S. agriculture.

How does this relate to the structure of agriculture? In at least three ways:

1. Technological change has been identified as one of the primary factors in influencing the trend toward fewer but larger farms as well as increasing the productivity of agriculture (Ball and Heady, Lu, Schertz, Swanson, and Sonka). Public research has been a

primary source of technology in agriculture. Research thus becomes one of the tools government could use to influence the structure of agriculture. Side effects of such action would, however, affect the productivity of agriculture.

2. The agricultural research establishment is unique in that it is an integral part of the Land-Grant University system of teaching and extension. Extension has traditionally viewed one of its prime clientele as being commercial farmers. A government policy toward structure could rearrange this priority.

3. Increasingly policies that potentially raise the cost of production for larger production units are being suggested as a means of changing the structure of agriculture (Miller). These units generally produce the bulk of our agricultural production. The price and quality of food could, in turn be affected. Examples of such policy initiatives include a progressive property tax, taxing large scale farm equipment, making employers responsible for training displaced workers, restricting public research and extension to helping smaller farmers, and directing low interest government credit to smaller farmers.

These effects make our role as public policy researchers and educators critical to the resolution of the structure issue. Our job is to make sure that we assemble for policymakers an accurate set of facts on which they can base their decisions.

Relation between Farm Size, Vertical Integration and Efficiency

One of the important relationships needed by policymakers to assess the impact of structural policies upon agriculture is the relationship between farm size, vertical integration, and efficiency. Available evidence indicates that there is no easy way to specify this relationship. Also, available evidence suggests that it is inaccurate to suggest that one or two man family farms are always the most efficient. The biggest efficiency advantages of scale appear to exist in animal agriculture.

Animal Agriculture Cost Relationships

In April 1980 the Senate Committee on Agriculture published a series of papers that it commissioned on structural change in agriculture. The papers on animal agriculture are particularly important because of the general recognition that animal agriculture has not only become industrialized, but that this industrialization process has an overall subsector efficiency basis. A brief review of each of the major animal agriculture subsectors is, therefore, in order.

The poultry industry has become the model for industrialization and integration in agriculture. Brooks and Schrader recognize the economies that have been achieved from technological change resulting in increased scale and integration of operations. Brooks'

analysis suggests a 50 percent reduction in costs resulting from vertical integration and technological developments in broilers. While Schrader suggests that production units no larger than 50,000 to 70,000 layers would be cost efficient, he is careful to insert such units would have to be "appropriately coordinated" (p. 225).

For hogs, the 1970 hog subsector conference reflected the conflict between the reality of developing technology supporting industrialization and those committed to the nostalgia of family farm hog production. In 1980 Rhodes and Grimes are apparently convinced "Hog production is becoming a factory operation" (p. 185). Technological change, economies of size and capital availability are suggested as important contributing factors to this change. Interestingly Rhodes and Grimes suggest that the family farmer may be even less willing to "sit up with the sow" than the integrated producer (p. 189). They also indicate that there is no evidence of diseconomies of size (p. 189).

Beef efficiency studies indicate that substantial efficiency advantages are associated with the large-scale feedlot operations that characterize the West and Southwest in comparison with the farmer feeders of the Cornbelt (Dietrich, 1980). A 1979 USDA study by Gee, Van Arsdall, and Gustafson found that total direct feeding costs were about 10 percent lower ($4.91 per cwt) for western commercial feedlots than for midwest farmer feeders. The results updated and confirmed earlier work by Dietrich indicating substantial economies of scale in the cattle feeding industry.

More recent developments that tie together meat packing, feedlot, and grain supply functions suggest that additional economies might be gained from vertical integration. There are some indications that the trend toward a dispersed structure of cattle raising may now be reversing itself. It is our belief that by the year 1990 a substantial proportion of the calf crop will be contracted by feedlots — possibly even before birth of the calves.

Milk production likewise appears to be going through a structural revolution. Despite the prevailing thinking that a family based dairy industry will continue to prevail (Jacobson), there is general recognition of rapid expansion in the proportion of milk produced by large-scale dairy farms in the South and West.

A California study found economies of herd size up to 750 cows (Matulich). While the dairy industry still tends to be characterized as a predominantly family enterprise, farms with more than 250 cows are increasingly being recognized as the most efficient even in the Northeast (McGuire). These farms are hardly family farms in the traditional sense of the term.

Without doubt, the conclusion that one must draw from this analysis is that animal agriculture is so far down the road toward industrialization, that it cannot be reversed. More important, while

suggestions have from time to time been made that industrialization of animal agriculture is more a tax gimmick than it is efficiency based, this is not confirmed by these studies. Surely the tax laws are a factor, but efficiency and income maximization are most likely the overriding considerations.

Crop Agriculture Cost Relationships[1]

Is it likely that the same industrialization trends that characterize animal agriculture, will eventually spread through crop agriculture? A consensus appears to exist that it will not (Penn, Miller, Swanson and Sonka, Breimyer). However, recent studies on crop agriculture are limited in both number and space.

Among the recent studies, Bailey concluded that the one-man farm captures most economies associated with size. Miller, after evaluating USDA cost-of-production data concluded that there was no evidence that economies of size are a significant force in explaining the trend toward large farms. Chan, Heady and Sonka found that for corn farms beyond 480 acres, increased volume of output contributes substantially more to net farm income than economies of size.

On the other hand, a study of Krause and Kyle found that economic advantages do exist to large midwestern corn farms that are not available to family-sized corn farms. In addition, to efficiency economics, Krause and Kyle found input prices to be as much as 25 percent lower on 5,000-acre farms than on 500-acre farms.

Except for the study of Krause and Kyle, the other economies of scale studies cover only a limited range of farm sizes and fail to evaluate the potential for lower input costs. None of the studies evaluated the incidence of vertical integration by large-scale producers.

A Texas Agricultural Experiment Station study, partially supported by ESS, USDA is attempting to overcome these shortcomings. The study encompasses six counties on the High Plains. A random sample of 35 farms stratified on the basis of size, was selected for each of the six counties. Data collected for each farm included production practices, machinery complement, financial position, participation in farm programs, input procurement, and marketing practices.

At this point, we are in a position to report only on farms located in three South Plains cotton producing counties. These farms range from 11 to 6,500 cropland acres — a considerably wider size range than has existed in previous studies. The following preliminary conclusions are pertinent to this discussion:

[1]Crop agriculture as used here refers to the major food grain, feed grain, oilseed, and cotton crops.

1. Economies of size in terms of energy intensive inputs, i.e., fuel, fertilizer, and chemicals, tend to be fully captured by a farm having about two sections (1280 acres) of cropland. These energy intensive costs account for about 27 percent of total receipts from these farms.

2. Economies in terms of machinery ownership exist throughout the size range. Per acre farm machinery ownership costs decline 40 percent from farms having 960 to 1280 acres to farms having over 4400 acres. Machinery ownership costs average approximately 20 percent of total farm receipts.

3. Volume discounts on inputs were available only to those farmers who were large enough to be classified as a distributor. To be a distributor a farmer generally had to have over 3500 acres of cropland. Discounts for distributors ranged from 10 to 25 percent on inputs purchased such as fuel, machinery, fertilizers, and chemicals.

4. Six of 13 farms (46 percent) having over 2800 acres of cropland were vertically integrated into either a cotton gin or chemical supply dealerships. Such farmers have obvious advantages in both marketing and farm supply purchases. We are not yet in a position to report on the advantages large farmers have in marketing.

5. All of the farms surveyed were basically family-owned enterprises. But farms with more than 960 acres generally employed more labor than was supplied by family members.

6. The average ratio of debt to equity (leverage ratio) rose at a declining rate from .34 for farms having less than 320 acres to .79 for farms having 640 to 960 acres. All farm size groups with more than 960 acres had an average leverage ratio that was not significantly different from .79 (at the 95 percent level). Large farms thus tend to be highly leveraged and in a growth posture.

The preliminary results suggest that the advantages of large-scale crop production extend beyond those associated with pure production economies. It emphasizes the need to consider a wider range of farm sizes than has been typical of economies of scale studies.

It is also important to recognize that structural change is a dynamic process. The relative position of the long-run average cost curve is continuously shifting as technology changes. A 1965 study of cotton farms on the High Plains of Texas by Madden and Davis found that a farm having 440 acres using six-row equipment was the most efficient. Only farms with less than 320 acres today use six-row equipment. Larger size farms typically use 1 or more complements of eight-row equipment.

Our preliminary results suggest that the optimum size of farms on the Texas High Plains cotton growing region has expanded at least three fold since 1965 to over 1200 acres. At this point, we are not in a position to specify how much over 1200 acres the optimum

size farm is on the High Plains. We can say that a significant percentage of the largest farms have found it advantageous to vertically integrate into farm supply and marketing functions outside the cooperative system.

Implications

The results of this survey suggest that animal agriculture is continuing to move in the direction of an industrialized market structure. Within this structure hired labor and management play a more important role in decision making. Family farms are sometimes utilized as one aspect of a vertically integrated contract farming system. Such systems have demonstrated their long-run efficiency and competitive advantages. The greatest threat to such advantages could be unionization of labor employed by such integrated systems.

The future structure of crop agriculture is more debatable. We anticipate that efficiency driven technological change will continue to play an important role. The existence of diseconomies of size is far from certain. The potential for integration by large-scale crop producers to obtain either cost or revenue advantages is an important unknown. At a minimum, no readily apparent end exists to the dynamic process of technological change that continuously shifts farms toward larger-size categories.

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