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Cost and Pecuniary Economies in Cotton Production and Marketing:

A Study of Texas Southern High Plains Cotton Producers

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SUMMARY

In recent years, the "family farm" and its chances for survival has emerged as one of the major agricultural policy issues. The decline in farm numbers and increase in farm size have led to renewed interest in the efficiency of different-size farms. This study isolates the degree of pecuniary economies existing for input purchases and marketings on cotton farms by size in the Texas Southern High Plains. The results indicate that substantial cost and marketing economies are being realized by the largest farms in the region.

KEYWORDS: Pecuniary economies/vertical integration/economies of size/large-scale farms/cotton farms.

Cost and Pecuniary Economies in Cotton Production and Marketing: A Study of Texas Southern High Plains Cotton Producers

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INTRODUCTION

In recent years, the "family farm" and its chances for survival has emerged as one of the major agricultural policy issues. The decline in farm numbers and increases in farm size have led to renewed interest in the efficiency of different-size farms. Efficiency is important to resolving the debate on this farm policy issue. If, in fact, family farms are just as efficient as their larger competitors, policies that enhance the movement toward larger farms could have negative impacts on the performance of U. S. agriculture.

If, on the other hand, larger-size farms are more efficient, then policy which would limit growth would mean that agricultural products would be produced at higher costs than necessary. Therefore, comprehensive economies of size studies need to be updated for major agricultural crops in different geographical regions so appropriate policy actions can be taken.

Objectives

The principal objective of this study was to develop cost of production and pecuniary economy data by farm size on cotton farms in the Texas Southern High Plains. Emphasis was placed on determining the magnitude of pecuniary economies related to:

- Input economies;
- Marketing economies;
- Economies of vertical integration.

Pecuniary economies are defined as lower costs of purchased inputs and higher returns to marketings as farm size increases. Previous studies generally have treated pecuniary economies either as being insignificant or nonexistent.

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Cost of Production or Economies of Size Studies

The most frequently cited economies of size study is Madden's review of selected literature in the area (1967). His review discussed the findings from 14 farm-size crop studies. He concluded that crop farms requiring one or two man-years of labor can capture most of the available economies due to size.

Madden and Davis conducted an economies of size study in 1965 on the Texas High Plains. Although limited to irrigated cotton farms, the study concluded that large farms were no more efficient than smaller one-man farms of approximately 440 acres.

Miller, Rodewald, and McElroy (1981) completed an economies of size study that covered seven basic regions of the United States, one of which was the High Plains of Texas. Their study concluded that long-run average cost curves suggest cost economies of 18.9 cents per dollar of gross income as High Plains farms grow from 115 to 974 acres. However, they viewed such economies as not being large.

Most of the previous studies on economies of size, including those of Miller et al. and Madden and Davis, used the synthetic firm approach, an approach that Madden (1967) recommended as providing reliable results. Like most economies of size studies, these failed to analyze either pecuniary economies or the advantages gained from vertical integration.[1]

Krenz, Heid, and Sitler (1974) found evidence of pecuniary economies in both input and output markets when studying large wheat farms in the North Central Great Plains. In comparing farms up to 12,000 acres with those in the 1,500-acre range, they found that as many as 40% of the larger farms were vertically integrated to some extent.

Krause and Kyle (1971) found that the return on investment was greater for larger farms due to techni-

[1]Vertical integration means the control by a firm of two or more stages of production or marketing, i.e., cotton producer owning a cotton gin.

cal economies as well as pecuniary economies in purchasing and selling. They found evidence that farms in the 5,000-acre range could receive as much as a 20% advantage over farms of approximately 500 acres when purchasing inputs. In addition, marketing advantages could result in as much as $5 per acre for the larger farms. Midwestern corn farms were analyzed in their study.

In summary, most economies of size research, on crop farming units where pecuniary and marketing economies have been assumed zero, concur with Miller et al. (1981) that medium-size commercial farms (gross incomes from $41,000 to $76,000) achieve most technical cost efficiencies and any further increase in size results in little benefit to society. Unfortunately, little of the research on technical economies has studied large-scale farms that produce a majority of the agricultural production in the United States.

ECONOMIES OF SIZE

The theories of cost production and economies of size are important to this study because of the implication they have for farm survival and thus the structure of agriculture. If the relationship between farm size and cost of production can be adequately developed, the impacts of government policy on structure can be more accurately analyzed. Economies of size occur when the cost of producing a unit of output declines as farm size (measured in acres of land in this study) increases. Conversely, if the cost of producing a unit of output increases as farms become larger then diseconomies of size have occurred, and if they remain the same the farm is experiencing constant returns to size. These relationships are depicted in Figure 1 by use of the familiar short- and long-run average cost curves. From the point on the long-run average cost curve (LAC) labeled q1 to quantity q2, the farm is experiencing economies of size. Infinitesimally about quantity q2 the firm has constant returns to size, and as output increases to the right of q2 diseconomies of size occur.

Although many factors contribute to economies of size, Ferguson and Gould (1975) conclude that two broad forces are responsible. First, specialization and division of labor can occur as farm size increases. This specialization can contribute considerably to lowering cost per unit of output. Second, some inputs, such as heavy equipment, can be used in a more effective manner on larger operations. In addition to specialization of labor and technological forces, there are financial contributions to economies of size referred to as pecuniary economies. These pecuniary economies occur when, due to volume or sheer market power, a firm is able to obtain a lower price on purchased inputs. Diseconomies usually occur due to management and coordination problems. The point at which such diseconomies begin is debated extensively in agriculture (Knutson 1979).

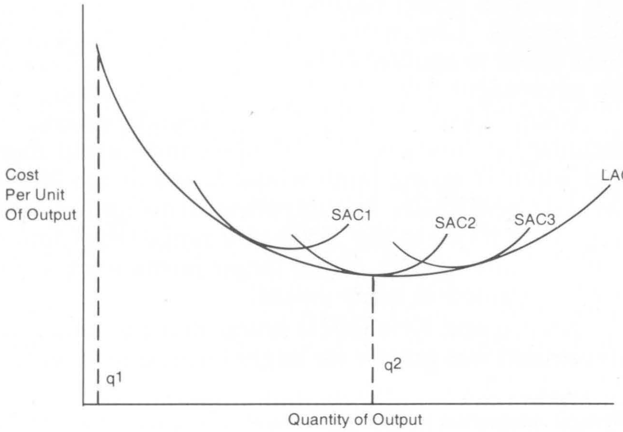

Figure 1. Short- and long-run average cost of production.

It is important to distinguish between the short- and long-run average cost curves. Ferguson and Gould (1975) conclude that perhaps the best distinction is that firms plan in the long run and operate in the short run. The long run is defined as the length of time necessary for all inputs to be regarded as variable. Therefore the LAC curve can be referred to as a planning curve. Since the LAC curve reflects the minimum cost of producing any level of output when all inputs are variable it will always be below the short-run average cost (SAC) curve except at the point of tangency when the costs are identical. Therefore, in theory, all farms would gravitate toward quantity q2 in Figure 1 for it is at this point where economies of size can be achieved and the SAC and LAC curves are tangent.

Realistically, not all farms in agriculture will operate at the optimum size. This is due to various levels of producer knowledge, variation in management skill, fixed resources, and lags in the adjustment process. Therefore, when analyzing actual farm data one observes a broad range of costs—many of which are above the LAC curve. In reality there may be a substantial range of sizes where the LAC curve is flat or nearly so as illustrated in Figure 2.

Pecuniary economies[2] exist when some farms are able to achieve discounts or premiums on their inputs and output because of volume and/or market power. Such economies may arise from three sources:

- Input economies;
- Marketing economies;
- Economies of vertical integration.

Regardless of how pecuniary discounts are achieved, their effect is to lower the technical long-run average cost curves for the farms able to achieve such economies. As pecuniary economies are gained, the LAC curve is shifted downward and returns to management increase, thus giving the incentive for expansion (illustrated by dashed LAC′ in Figure 2). This effect is reinforced if producers are able to gain an additional advantage due to economies in marketing

[2]Pecuniary economies are defined as lower costs of purchased inputs and higher returns for marketed production as a function of farm size.

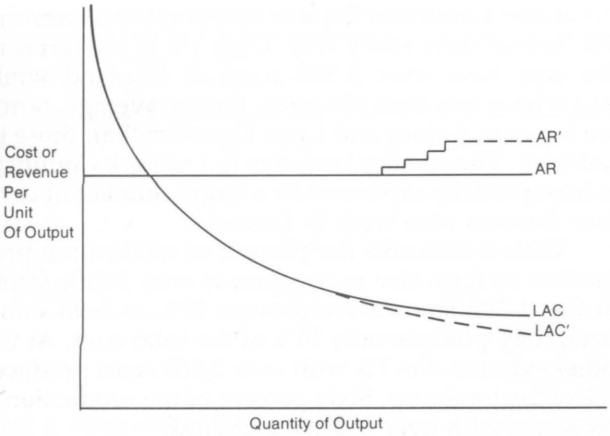

Figure 2. Traditional long-run average cost and revenue curves adjusted for pecuniary economies.

resulting in higher prices for their output (illustrated by dashed addition to horizontal average revenue line in Figure 2). Such increases in profit would allow larger firms distinct advantages in building equity and servicing debt, thus leading to even further growth in farm size.

Methodology

Madden (pp. 24-34) reviews several analytical techniques that have been used in trying to measure economies of size in various agricultural industries and concludes that no single method is best for all economies of size studies. However, Madden concludes that the synthetic firm approach provides the most reliable results in studying economies of size in farming. Madden states that the:

> synthetic-firm analysis is appropriate when either of two research questions is asked: (1) What is the average cost per unit of output or profit that firms of various sizes could potentially achieve using modern or advanced technologies, or (2) What are the differences in average cost per unit of output attributable strictly to differences in size of firm, and not to differences in degree of plant utilization, use of obsolete technologies, or substandard management practices.

The synthetic firm approach is useful in analyzing the normative concept of what potential economies exist.

The synthetic firm approach was rejected for use in the present study because of its normative nature. If policy makers want to analyze the impacts of farm programs on the structure of agriculture, they need to know what conditions actually exist in the industry, not just what could exist under ideal circumstances. The composite firm approach, on the other hand, uses actual firm data to develop averages of the various input costs that exist for different-size operations. This approach is used in the study to determine existing average cost of production per unit of output, since it is not the intent of this research to develop a long-run average cost curve. Instead, it is to determine points along the actual short-run average cost curves as they exist for various-size farms in the Texas Southern High Plains in 1980. These costs thus represent the actual costs that farms are experiencing.

Madden (p. 28) lists several disadvantages of the composite firm approach including the following:

1. Inaccurate cost data are utilized.
2. Composite farms do not accurately reflect the actual average cost of firms within the size category.
3. Several characteristics of individual farms are averaged; thus, the resulting composite is an inaccurate replica of the group it represents.
4. Composite farms do not accurately reflect potential economies of size.

To respond to point one, inaccurate cost data is a problem to all analytical procedures and cannot be held specifically against the composite firm approach. The utmost caution was utilized in gathering data for this study; thus, this disadvantage is no greater in the composite approach than in the synthetic firm approach. In fact, since a synthetic firm by definition never operates in reality, the costs and economies presented in this study could be argued as more accurate.

As for the composite firm not accurately reflecting average cost within the size category, procedures were employed in this study to develop data as accurately as resources allowed. Although the size groups are determined subjectively, they are small enough at the lower end of the size scale to allow true cost differentials to be observed.

Differences in firm characteristics are particularly troublesome in diversified agriculture where multiple crop and livestock enterprises exist. However, the region under analysis is largely one of specialized cotton production. This disadvantage, therefore, is minimized.[3] Further, since the intent of the research is to study actual cost differences, this disadvantage does not weigh as heavily as it would in measuring potential economies.

The last point is not relevant, since this study is trying to determine not the potential long-run average cost curve, but the results as determined by actual agricultural forces. It is important to this study that all factors of cost are reflected by farm size. For example, it is not a problem if small farms are behind technologically or operate at less than full capacity, since this represents reality in the region.

In summary, the composite firm approach was selected because, in the study region, it is believed to give a more accurate representation of the actual average cost of production by farm size. Madden's disadvantages were developed in a context where the

[3]A trend toward specialization in the production of one or two crops exists across much of agriculture. This trend makes the firm characteristics more uniform than those that existed at the time of Madden's research.

intent of research was to develop the potential economies of size. That is not the intent of the present study.

Pecuniary economies are measured directly from information provided by producers, agribusiness firms, and financial institutions. In addition, pecuniary economies achieved through vertical integration were developed indirectly based on input purchase discounts reported by integrated firms and major input supply wholesalers. Marketing economies were developed from producer and first handler supplied data.

Study Area

Three South Plains counties were randomly selected for study because of the homogeneity of crop production in the area. Gaines, Lynn, and Lubbock counties were selected at random from 11 counties illustrated in Figure 3. These counties produced over 220,000 bales of cotton each as reported by the Texas Department of Agriculture. Cotton constituted 85% of total crop acreage in Lubbock and more than 90% of the total crop acreage in Lynn and Gaines counties. Therefore, cotton was the only crop included in the analysis.

Irrigated acreage varied from 20.3% of total cropland in Lynn County to 42.7% in Gaines, and 63.8% in Lubbock (Texas Crop and Livestock Reporting Service [b]). Although there would be significant differences in cultural practices between dryland and irrigated crops, this should not affect the analysis of pecuniary economies of size. It could, however, impact the cost of production per pound of lint. This would be a problem if lower unit cost were observed on farm sizes having a greater proportion of their cultivated land under irrigation. This, however, was not the case for the producers surveyed.

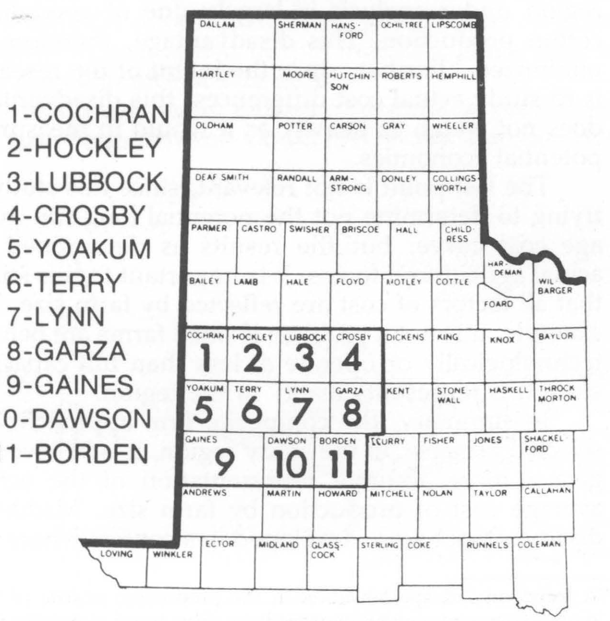

Figure 3. Study area, Texas Southern High Plains. Random sample included Lubbock, Lynn, and Gaines counties.

Table 1 indicates the size and number of farms in the three-county study area. Only 1% of the farms in the area have over 2,500 acres of cropland while 40.1% have less than 320 acres. On the average, farms are larger in Gaines and Lynn Counties than those in Lubbock. The smaller farm size in Lubbock County is at least partially explained by a larger number of part-time farmers who work in Lubbock.

Table 2 indicates the percent of total cotton production by farm size in the sample area. While farms in the 0-320 acre class represent 40% of farm numbers, they produce only 14% of the total crop. At the other extreme, the 1% with over 2,500 acres produces 6% of the total crop. Sixty percent of the production is on farms with over 640 acres of land.

Procedure

A stratified random sample of 35 farms was selected from each of the three counties to obtain data on production practices, machinery complements, financial position, participation in commodity programs, input purchases, and marketing. The sample was stratified into seven categories based on farm size (acres). Five farms from each size category were selected, where available, for interview in each county, resulting in 105 possible survey farms.

A questionnaire was administered to the farmers in the survey by personal interview. Of the 105 survey schedules, 98 were usable. Selected input and market-related agribusiness firms were also surveyed to supplement the producer data on the cost of inputs purchased and potential sources of marketing economies. Financial institutions were interviewed to obtain data on the credit and leverage positions of each farm size, as well as the machinery complements held as security in obtaining credit.

Data obtained from the surveys were analyzed and used two ways in developing the per unit cost by farm size:

- Actual prices and quantities of input purchases were used in conjunction with average machinery, interest, and associated opportunity costs on intermediate and long-term assets to determine the average cost per unit of output, including any pecuniary economies associated with input costs.
- For comparative purposes, average input prices were assumed in developing production cost, assuming an absence of pecuniary economies.

The difference between these two cost relationships indicate the magnitude of pecuniary economies for input purchases. To minimize the impact of input inventories, the respondents were asked to list purchase price of inputs as of June 15, 1980. Yield data revealed no apparent difference in crop yield per size category; thus, constant yields were assumed across all farm sizes. Marketing economies were analyzed from sales data as reported by farm operators with supplementary information obtained from agribusiness questionnaires.

TABLE 1. FARM NUMBERS IN SELECTED SIZE CATEGORIES FOR GAINES, LYNN, AND LUBBOCK COUNTIES, 1980

	# Farms With Cropland	# Farms 0-120 Acres	% of Total	# Farms 121-320 Acres	% of Total	# Farms 321-640 Acres	% of Total	# Farms 641-1380 Acres	% of Total	# Farms 1281-2500 Acres	% of Total	# Farms 2501-4400 Acres	% of Total	# Farms 4400+ Acres	% of Total
Gaines	592	62	10.5	132	22.3	142	24.0	177	29.9	66	11.1	9	1.5	4	.6
Lynn	553	42	7.6	163	29.5	177	32.0	126	22.8	40	7.2	5	.9	0	0
Lubbock	842	113	13.4	286	34.0	237	28.1	153	18.1	51	6.1	2	.2	0	0
Total for Area	1,987	217	10.9	581	29.2	556	28.0	456	22.9	257	7.9	16	.8	4	.2
Cum % # Farms			10.9		40.1		68.1		91.0		98.9		99.7		99.9

TABLE 2. PERCENTAGE PRODUCTION AND FARM NUMBER BY SELECTED FARM SIZE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Size Interval (acres)	Percent of Total Cotton Production	Percent of Number of Farms
0-320	14	40.0
321-640	24	28.0
641-1,280	35	23.0
1,281-2,500	21	8.0
2,501-4,400	4	0.8
4,400+	2	0.2

INPUT ECONOMIES

Pecuniary economies in input purchases exist when per unit input costs decline as farm size increases. Three main sources of such economies include:

- Volume discounts resulting in a lower price for larger volume purchases;
- Vertical integration into an input supply function;
- Timing of input purchases.

Babb (1979, p. 53) indicates volume discounts could be as important as technical efficiency in reducing production cost on larger firms, thus providing incentives for growth. He further contends that volume discounts could affect not only the number and size distribution of farms, but also the degree of specialization in production. Other economists such as Stigler (1968) and Williamson (1975) have identified the absence of volume discounts in the open market as one of the factors giving rise to integration.

Volume discounts may result either from cost savings associated with large volume purchases or from the market power of the buyer. Market power exists when a farmer purchases (or sells) a sufficiently large proportion of a business's volume that the farmer can bargain for discounts (or premiums) regardless of those justified by cost considerations. Market or bargaining power can be gained by a farmer either by achieving a sufficient size to vertically integrate into input distribution, or by making the seller dependent on the farmer's business for survival.

Vertical integration occurs when a firm combines more than one level of the marketing, production, or processing channel under its management. For example, backward integration would occur if a farmer acquired an input supply business. Forward integration would occur if a processing or marketing firm was acquired. By integration a farmer potentially could buy inputs at a lower price than is available in the open market and/or capture added cost savings frequently associated with integrated systems of production. Integration may also be accomplished either through cooperatives or through forming a separate corporate entity.

Prices for inputs vary throughout a production year depending on the supply-demand and structural relationships in the supplying firm market at both the wholesale and retail market levels. Therefore, producers who purchase inputs during periods of depressed prices, or before prices rise, lower their costs of production relative to other producers.[4] Thus, time of purchase can play a major role in achieving pecuniary economies for producers who can purchase sufficient quantities at a low enough price to offset capital and storage costs. In most instances, larger farms are better able to take advantage of such gains.

General Input Pricing Policies

Strong preferences existed among farm supply businesses in the study area to price their goods to all commercial farmers at the same price. While 38% of the suppliers of fuel, seed, herbicide, fertilizer, and machinery indicated they had some form of discount program, the volume of purchases necessary to elicit such discounts were obtainable by all commercial farmers.[5]

The clear consensus from input suppliers indicated that they would rather deal with 100 middle-size farmers (400-1,000 acres) than with a few large-scale producers. If their business depended only on a few large-scale farmers, risk of volume loss would

[4]Savings in price, of course, must be sufficiently lower to cover the capital and storage costs.

[5]A commercial farm as defined in this study is a farm where income from agriculture is important to the survival of the farm operation. Products from the farm operation are produced for their income-earning potential.

increase greatly. Input suppliers generally felt that if they made better deals to the larger-volume buyers, it would cause discontent among the smaller-scale farmers who are the mainstay of their business.

Underlying the attitude against quantity discounts may have been the concern that any discount given to large-volume buyers would spread to all producers. In addition, cooperative principles traditionally suggest that all producers pay the same price. The reluctance to give volume discounts could be the impetus for integration by larger-scale producers.

Variable Input Costs

Fuels

The major fuels used in cotton production are diesel, gasoline, and propane. Diesel fuel is used in greater volume due to tractor requirements. Approximately 25% of the fuel suppliers indicated they offered volume discounts in the 5% range. However, the volume required for the discount was sufficiently small as to be obtained by all commercial-size farms. The only substantial discounts for commercial farms occurred when a farm was able to buy and store bulk purchases of approximately 8,000 gallons. Only farms in the largest size group (4,400+ acres) indicated purchases of fuel in quantities sufficient to gain such discounts. Table 3 summarizes fuel use and prices paid by farm size.

Diesel was the predominant farm fuel on all farm sizes except the smallest, where gasoline use was slightly more important. The survey reported diesel prices ranging from a low of 92 cents per gallon for the 4,400+ acre category to a high of 99 cents for the 1,601-2,560 acre farm size. It is of interest to note that the next to the lowest diesel price was reported by the smallest farm category (0-320 acre) at 94 cents per gallon. In an attempt to explain the farm price differences among size categories, a major fuel distributor in the region was consulted. He indicated that although the survey asked for the price paid for diesel around June 15, 1980, diesel prices within the month of June varied from 90 cents a gallon to 101 cents with prices shifting up every few days. Therefore, it is hypothesized that the smaller-size and the two largest-size farms may have reported lower prices because storage capacity relative to farm requirements were great enough to carry the farm operations over a week or so without repeat purchases, thus resulting in a lower price being reported.

No price discounts were reported by diesel fuel suppliers for any farm size except the 4,400+ category where farms were able to accept truckload shipments. These producers received discounts approximately equal to the savings in hauling costs associated with the volume purchases, about 5% of the wholesale price. The largest farms thus paid 92 cents per gallon, 2 cents lower than any other size group.

Gasoline and propane use are highly variable over all farm sizes because they are used primarily for cars, pickups, and large trucks, and not, in most cases, for crop cultivation. Therefore, quantities of either gasoline or propane used do not necessarily increase for larger farms. The average price paid for gasoline was fairly constant across all farm sizes, as was propane, with the exception of the 1,601-2,560 acre farms. The higher 55-cent-per-gallon propane price reported by this group could not be explained from available data. None of the farms surveyed reported any discounts on either gasoline or propane.

Irrigation fuel costs, both electric and natural gas, could not be determined from the producer questionnaire. A fuel cost of $1.71 per acre-inch was charged against all irrigated land on the assumption that 10 acre-inches of water were applied. The cost per acre-inch was derived from work done by Leon New, extension irrigation specialist, for the study area (1981).

Seed

Seventy-five percent of the cottonseed dealers surveyed indicated they offered some volume discounts, but all commercial farmers were large enough to obtain the discount. The major distributors gave volume discounts to their dealers amounting to from 4% to 10%. Thus, if a business organization (farmer, gin, etc.) could meet the dealer qualifications established by the suppliers (i.e., terms of volume and trade practices), it could receive this discount. The

TABLE 3. AVERAGE ANNUAL VOLUME AND PRICE PAID FOR DIESEL, GASOLINE AND PROPANE BY FARM SIZE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Diesel Volume (1,000 gal)	Diesel Price ¢/gal	Gasoline Volume (1,000 gal)	Gasoline Price ¢/gal	Propane Volume (1,000 gal)	Propane Price ¢/gal
0-320	189	2.3	94	2.6	108	1.0	52
321-640	511	4.1	98	2.6	109	2.9	52
641-960	793	9.5	98	4.6	109	1.6	52
961-1,280	1,088	11.5	96	5.0	109	2.9	53
1,281-1,600	1,457	13.4	96	4.2	107	1.7	53
1,601-2,560	2,019	23.4	99	7.3	108	2.5	55
2,561-4,400	3,383	26.5	95	7.3	107	5.9	53
4,400+	5,570	54.8	92	20.7	107	8.6	51

TABLE 4. AVERAGE VOLUME AND PRICE FOR COTTONSEED BY FARM SIZE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Average Volume (1,000 lb)	Average Price (¢/lb)
0-320	189	5.5	.33
321-640	511	10.4	.32
641-960	793	21.0	.28
961-1,280	1,088	24.6	.30
1,281-1,600	1,457	33.0	.35
1,601-2,560	2,019	38.9	.32
2,561-4,400	3,383	58.1	.28
4,400+	5,570	138.5	.32

TABLE 5. AVERAGE VOLUME PRICE PAID FOR 20-15-5[a] FERTILIZER BY FARM SIZE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Average Volume (tons)	Average Price (¢/ton)
0-320	189	12.6	209
321-640	511	31.7	231
641-960	793	50.2	184
961-1,280	1,088	59.5	175
1,281-1,600	1,457	80.6	192
1,601-2,560	2,019	107.7	179
2,561-4,400	3,383	164.6	216
4,400+	5,570	345.4	221

[a]20-15-5 refers to 20% nitrogen, 15% phosphorus, and 5% potassium.

price per pound of cottonseed as reported by the producers shows no apparent economies to size in cottonseed purchases (Table 4).

Fertilizer

Fertilizer use was not homogeneous from farm to farm across the area either in terms of quantity used or N-P-K analysis. The producer surveys reported 61 different fertilizer formulations with a variety of usage rates, making it difficult to isolate prices for any specific formulation. Major fertilizer suppliers for the area were surveyed as to average formulation and prices for nitrogen (N), phosphorus (P), and potassium (K) used in the mix. The fertilizer dealers reported average prices of 25, 30, and 21 cents per pound for N, P, and K, respectively. Nitrogen prices paid by farmers were derived by subtracting the cost of phosphorus and potassium with the residual applied to nitrogen cost. This method estimated an average price for nitrogen at 22.3 cents per pound, slightly lower than dealers' average price quotation of 25 cents per pound. This method, when applied to surveys within each farm size, was used to estimate the cost per ton of an average 20-15-5 fertilizer mix based on 200 pounds per irrigated cotton acre and 100 pounds per dryland cotton acre (Table 5). The average price per ton paid by farmers indicate that prices are higher for the two smallest and two largest farm sizes and lower for those in between.

Twenty-five percent of the fertilizer suppliers surveyed indicated they gave volume discounts, but most farmers would have the volume necessary to receive the discount. The major fertilizer companies did indicate that significant discounts (15% to 30%) were available to those farmers or farmer groups who had the facilities to handle bulk shipments. Of the farms surveyed, only one was a fertilizer dealer. However, several farmers had ownership in gins which handled fertilizer. (The effect of vertical integration on input prices will be discussed later.) It was concluded that a partial reason for the higher price quoted by large producers resulted from these producers reporting their retail price without considering any subsequent discounts they might receive through integration, either in the form of profit distributions or asset value appreciation.

TABLE 6. AVERAGE VOLUME AND PRICE PAID FOR HERBICIDE BY ACRE, BY FARM SIZE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Average Volume (pints)	Average Price Per Pint Applied ($/pint)
0-320	189	211.7	3.22
321-640	511	541.7	4.67
641-960	793	1,007.1	4.32
961-1,280	1,088	903.0	4.95
1,281-1,600	1,457	1,457.0	4.00
1,601-2,560	2,019	1,675.0	3.78
2,561-4,400	3,383	2,199.0	3.47
4,400+	5,570	2,506.5	3.47

Chemicals

As with fertilizer, chemicals (herbicides, insecticides, and nematicides) vary in formulation and application to such extent that comparison of price as related to volume was difficult. For cotton production on the South Plains there is very little use of chemicals other than herbicides. Herbicide prices were calculated based on applied cost per unit of the most frequently used herbicides (Table 6).

Herbicide prices vary from a high of $4.95 per applied pint for farms in the 961-1,280 acre range to $3.22 per applied pint on farms in the smallest size group. However, it was evident from the surveys that farmers in the mid-size range obtained substantial application services. Due to this fact, it was impossible to separate cost per acre into a cost for the actual chemical and a cost for application. As a result, no economies of size for herbicide purchases could be determined.

Chemical dealers denied offering any volume discounts on chemical purchases. Chemicals were carried largely as a service on which very little markup was charged, therefore making any further discount impossible.

Labor

Expenditures on full- and part-time labor were obtained from the producer surveys (Table 7). Examination of the data revealed that, in general, as

TABLE 7. AVERAGE EXPENDITURE IN FULL- AND PART-TIME LABOR BY FARM SIZE ON THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Full-Time Labor (man-year)	Inputed Operator Labor (man-year)	Expenditure Per Worker ($/year)	Expenditure On Part-Time Labor ($/year)	Labor Cost Per Harvested Acre ($/acre)
0-320	189	0.00	0.50	10,592	1,111	40.68
321-640	511	0.47	0.70	10,592	2,499	35.98
641-960	793	0.57	1.00	12,501	3,559	35.80
961-1,280	1,088	0.77	1.00	12,627	4,470	31.88
1,281-1,600	1,457	1.08	1.00	13,201	6,716	30.20
1,601-2,560	2,019	2.25	1.00	12,295	8,529	31.32
2,561-4,400	3,383	3.13	1.00	13,638	12,033	27.18
4,400+	5,570	6.25	1.00	14,557	20,121	27.85

farm size increased so did the annual expenditure per full-time laborer. This conclusion agrees with conventional wisdom suggesting that as farms become larger at least some higher-skilled labor must be employed in their management. However, before drawing any conclusions regarding economies of size, the problem of how to account for operator labor must be discussed.

Miller et al. (1981, pp. 7-8) discuss the difficulties of imputing opportunity cost for operator labor. They conclude that since the opportunity cost of operator labor probably varies by farm size and is nonobservable, it would be difficult to measure empirically. They point out further that since 60% of farm-family income comes from off-farm sources, with the percentage being greater for the smaller farms, full-time equivalent opportunity cost should not be charged against the small farm.

The approach taken in this research was to allocate operator labor based on the farm and agribusiness interviews, in proportion to the time devoted to the farm operation. Opportunity costs[6] were allowed to vary depending on the rate paid for a full-time laborer in the respective farm size category. Operators of farms greater than 640 acres were assumed to be fully employed and one man-year of labor was imputed to the farm. Smaller farms were assumed to warrant less than full-time employment and the man-year requirements were set at 50% and 70% for the 189- and 511-acre farms, respectively. This procedure acknowledges the problem and alleviates somewhat the criticism concerning the treatment of operator labor.

Although annual expenditure per full-time farm laborer increases with farm size, cost per harvested acre declines from $40.68 on the 189-acre farm, to $27.18 for the 3,383-acre farm before increasing slightly for the largest farm. This 30-plus percent decline in labor cost per acre suggests that although cost per man-year of labor is greater for the larger farms, the increased cost is more than offset by efficiencies resulting from specialization and skill level.

[6]Opportunity cost is the value of a resource in an alternative use.

Capital

Most financial institutions indicated there was no differential in interest rates based on size of loan. They contend that each farmer is judged on his personal character, financial position, and past history before loan commitments are made.

The average interest rate for operating loans of all farmers surveyed was 14.2%. Although relatively few differences in interest rates could be ascertained, larger farms were apparently in a better position to get all the capital they needed. Of the farms surveyed, 17% indicated they borrowed no money for operating capital. Fifty-six percent of these responses were from farms having less than 640 acres, while the remaining 44% of the farms were between 641 and 2,560 acres. None of the farms greater than 2,561 acres were financed solely by retained earnings or off-farm income sources. The survey indicated 62% of the farmers were financed through nongovernmental sources and 21% were financed in some part through government lending agencies including the Farmers Home Administration and the Small Business Administration. Of the 83% which obtained financing, 72% of those under 2,560 acres were financed through commercial lending agencies while 92% of the larger farms were commercially financed. These percentages relate only to the farms in the survey, and since the sample was stratified they may not reflect the actual market shares for the population.

Table 8 indicates the financial characteristics of farms in the study. These data were obtained from major lending institutions in the area. Farm assets increased from $107,084 on the smallest farm size to over $2 million for the largest. The leverage ratios[7] indicate farms in the 1,601-2,560 acre range are the most highly leveraged with the least leverage occurring on the smallest farms. Farm sizes greater than 641 acres show leverage ratios larger than 0.60 which indicates that at least 60% of their equity is matched by debt. These higher leverage ratios for farms in the middle range of farm sizes suggest these farms may have experienced the most recent growth.

[7]Leverage ratio is a financial term indicating the ratio between total debts and total net worth.

Machinery

Cost of machinery could not be obtained from the producer surveys; however, typical machinery complements and their values were obtained from financial institutions. Table 9 shows per acre investment in machinery, machinery size, and complements, as reported by financial sources. The data indicate that investment per acre decreases as farm size increases with the exception of the 2,019- and 5,570-acre farm sizes. This increase for the 2,019- and 5,570-acre farms is due to the decreasing proportion of land irrigated over the entire spectrum until the very largest size category and the lumpiness of machinery purchases (i.e., full complements of eight-row equipment). Producers in the area can handle up to approximately 1,800 acres with two eight-row machinery complements. Therefore, the 2,019-acre average farm size required three machinery complements. The additional machinery was not fully utilized, thus increasing the investment per acre. The desire to expand and fully utilize this equipment may have been one of the contributing factors to the highest leverage ratio for this farm size.

Interviews with farmers did not reveal any pecuniary economies as far as machinery purchases were concerned. The same results were obtained when suppliers of farm machinery were interviewed. Machinery dealers indicated volume discounts are available; however, as many as five tractors have to be purchased at once to obtain a discount. Even the largest farmers did not buy that many tractors at once. Some dealers did indicate farmers who traded equipment more often could obtain better deals on trade-ins although the magnitude of such savings could not be determined.

Ginning

Ginning includes costs for ginning, bagging, and ties. These costs were developed from surveys of both cooperative and independent gins in the study area. The survey indicated average ginning costs of $2 per hundredweight (cwt) of field weight cotton. It

TABLE 8. FARM SIZE, ASSETS, AND LIABILITIES FOR REPRESENTATIVE FARMS ON THE SOUTHERN TEXAS HIGH PLAINS

	FARM SIZES							
	0-320	321-640	641-960	961-1,280	1,281-1,600	1,601-2,560	2,561-4,400	4,400+
Cultivated Acres	189	511	793	1,088	1,457	2,019	3,383	5,570
Acres Owned	110	261	357	381	539	646	1,048	3,453
				ASSETS AND LIABILITIES				
Total Assets ($)	107,084	198,200	299,736	463,400	589,964	794,964	867,235	2,036,032
Long-Term Assets	38,819	108,310	173,596	307,548	406,229	521,080	542,132	1,391,301
Intermediate Assets (used machinery) ($)	68,265	89,890	126,140	155,852	183,735	273,884	325,103	644,731
Total Liabilities ($)	27,309	67,854	132,397	191,903	237,842	374,479	369,452	766,679
Long-Term Liabilities ($)	7,373	24,427	52,959	84,437	64,217	149,792	107,141	337,339
Intermediate Liabilities ($)	19,936	43,427	79,438	107,466	173,625	244,687	262,311	429,340
Net Worth ($)	79,775	130,346	167,339	271,497	352,122	420,485	497,783	1,269,353
Debt/Asset	.26	.34	.44	.41	.40	.47	.43	.38
Leverage Ratio	.34	.52	.79	.70	.67	.89	.74	.60
Total Assets ($/acre)	566	388	378	426	405	394	256	366
Total Liabilities ($/acre)	144	133	167	176	163	185	109	138
Net Worth ($/acre)	422	255	211	250	242	208	147	228

TABLE 9. AVERAGE INVESTMENT AND MACHINERY COMPLEMENT BY FARM SIZE ON THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Average Machinery Investment ($/acre)	Size of Equipment (row)	Number of Machinery Complements	Percent of Irrigated Land
0-320	189	361	6	1	50
321-640	511	176	8	1	43
641-960	793	159	8	1	45
961-1,280	1,088	143	8	2	32
1,281-1,600	1,457	126	8	2	33
1,601-2,560	2,019	136	8	3	30
2,561-4,400	3,383	96	8	4	23
4,400+	5,570	116	8	6	43

takes approximately 2,182 pounds of field weight cotton to yield a 480-pound bale (a 22% turnout). Thus, the ginning cost for a 480-pound bale of cotton would be $43.64. This cost is assumed for all farm sizes since no evidence of volume discounts were found from interviewing farmers and ginners.

Equipment Repair

Equipment and irrigation repair costs were based on the reported machinery complements and the engineering coefficients for repair costs in Oklahoma State University Budget Generator (Kletke 1975).

TABLE 10. COMPARISON OF ACTUAL TOTAL COST AND AVERAGE COST PER POUND OF COTTON LINT, BY FARM SIZE IN THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Actual Total Cost (¢/lb)	Average Total Cost (¢/lb)	Average Cost ÷ Actual Cost
0-320	189	89.4	89.0	1.00
321-640	511	67.3	66.0	.98
641-960	793	66.6	67.0	1.01
961-1,280	1,088	63.7	64.6	1.01
1,281-1,600	1,457	59.7	59.3	.99
1,601-2,560	2,019	60.7	60.9	1.00
2,561-4,400	3,383	54.7	55.2	1.01
4,400+	5,570	55.7	55.8	1.00

These coefficients were assumed to accurately reflect repair costs for the Texas Southern High Plains.

Interest on operating capital was calculated charging a 14.2% interest rate on all variable cost for half a year. The 14.2% interest rate was the average obtained from the financial data and producers survey.

Total Production Cost

Based on survey results, it was concluded that larger-scale farmers purchasing inputs from farm input suppliers in the open market could not generally obtain volume discounts. To verify this conclusion, unit costs of production were computed for each farm size based on:

- the actual input prices paid by each farm size, and
- the average input prices paid across all farm sizes.

The use of average input prices for all farm sizes is typical of economies of size studies that do not consider pecuniary economies. The results of comparing actual production costs to average input costs are summarized in Table 10. The clear conclusion is there were no significant cost differences and thus there were generally no pecuniary economies available to farmers through quantity discounts in the open market.

TABLE 11. ACTUAL PRODUCTION COST PER POUND OF COTTON LINT BY FARM SIZE IN THE TEXAS SOUTHERN HIGH PLAINS

Type of Cost	Farm Size (Acres)							
	0-320 (189)[a]	321-640 (511)[a]	641-960 (793)[a]	961-1,280 (1,088)[a]	1,281-1,600 (1,457)[a]	1,601-2,560 (2,019)[a]	2,561-4,400 (3,383)[a]	4,400+ (5,570)[a]
					(¢/lb)			
Variable Cost								
Cottonseed	3.2	2.3	2.6	2.7	3.1	2.5	2.0	2.8
Herbicide	1.2	1.8	1.9	1.6	1.7	1.3	1.0	.6
Fertilizer	4.7	5.1	4.1	3.7	4.1	3.8	4.5	4.9
Fuel	12.8	8.5	9.4	8.6	7.1	8.4	6.3	4.9
Labor	11.4	10.3	10.3	9.3	9.1	9.7	8.5	8.0
Ginning	9.1	9.1	9.1	9.1	9.1	9.1	9.1	9.1
Equipment Repair	13.6	6.6	5.6	5.6	4.0	3.5	2.9	2.2
Irrigation Repair	4.6	1.8	2.3	1.9	1.3	1.5	1.3	1.6
Interest Operating Capital	4.3	3.2	3.2	3.0	2.8	2.8	2.5	2.6
Total Variable	64.9	48.7	48.5	45.5	42.3	42.6	38.1	39.3
Fixed Cost								
Opportunity Cost Intermediate Assets	12.2	6.3	5.6	5.6	4.9	5.4	4.1	4.1
Taxes-land	.7	.8	.8	.8	.8	.9	.9	.8
Land	11.6	11.5	11.7	11.8	11.7	11.8	11.6	11.5
Total Fixed Cost	24.5	18.6	18.1	18.2	17.4	18.1	16.6	16.4
Total Cost	89.4	67.3	66.6	63.7	59.7	60.7	54.7	55.7

[a]Average size farm within specified range.

Table 11 provides the breakdown of costs used to prepare the data for Table 10 when actual input prices paid were used. Since these costs will subsequently be compared with those of farmers who were vertically integrated into farm supply and marketing, more detailed comments on their preparation is warranted.

Opportunity costs for intermediate assets were assumed at 10%. This assumption was based on the cost of capital for intermediate purchases as reported by the lending institutions adjusted for an annual 1% appreciation in nominal equipment value. Machinery market values for intermediate assets were developed from data supplied by financial institutions.

Taxes on farmland were derived from financial institutions and local tax offices. Income taxes were not included in Tables 10 and 11.

The opportunity cost of land was based on the typical crop-share lease used in the area. Traditionally, cotton cropland is leased for a one-fourth share of the product less the landlord's contribution of one-fourth the value of fertilizer and ginning. Therefore, the total cost in Table 11 represents actual as well as imputed opportunity cost with the residual claimant being a return to the owner-operator's management.

The total cost figures from Table 11 are presented in Figure 4. Costs decline sharply from 89.4 cents per pound on the smallest farm size (0-320 acres) to 59.7 cents per pound for the 1,281-1,600 acre farms. While costs rise somewhat for the 1,601-2,560 acre farm, largely due to the lumpiness of machinery purchases, they subsequently decline another 5 cents per pound to 54.7 cents at the 2,561-4,400 acre level. Costs subsequently rise somewhat for farms having over 4,400 acres to 55.7 cents per pound.

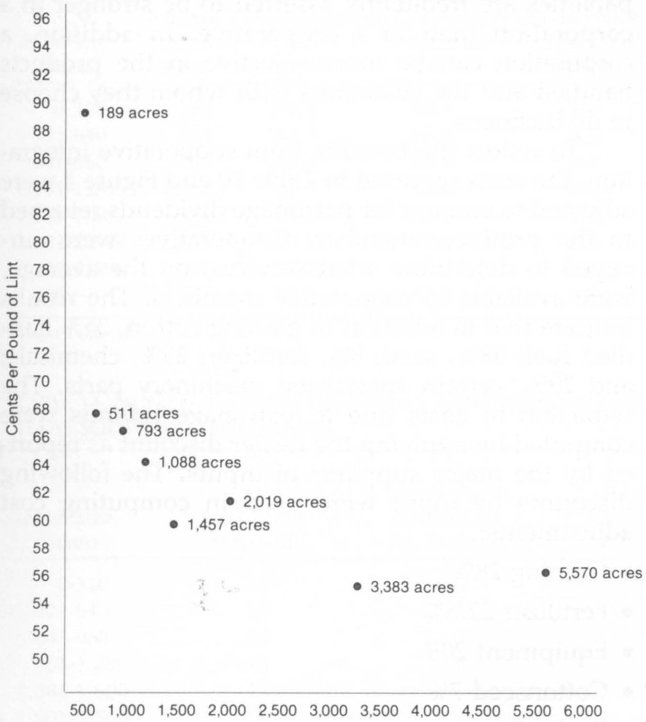

Figure 4. Cost of production by farm size for the Texas Southern High Plains.

It would be possible to fit a curve through the points in Figure 4 that would closely resemble those derived in earlier studies (Madden 1967; Miller et al. 1981). However, the points in Figure 4 are points on individual short-run average cost curves that represent the average cost of cotton production for these farm sizes in the Texas South Plains. It would, therefore, not be theoretically appropriate to draw an envelope or planning curve through these points.

It is important, however, to note that this study includes farm sizes much larger than the 974-acre farm analyzed in the Miller et al. study. The Miller et al. study concluded there were few, if any, potential economies beyond the 395-acre farm. The key here is *potential*. Although potentially few economies can be achieved beyond 395 acres, in reality, the results of this study indicate that the 3,383- and 5,570-acre farms have substantially lower costs than any of the smaller-size farms.

VERTICAL INTEGRATION

As mentioned previously, producers could attain additional benefits in lowering their costs of production by integrating segments of the production-marketing channel into a farm operation. Two basic methods exist for integration by producers:

1. They could become a member of a supply or marketing cooperative.
2. They could acquire ownership interest in a supply or marketing firm.

Such a firm normally would be organized as a regular corporation. The degree of integration by producers using either of these methods was determined from the producer surveys. Potential benefits were then imputed to farmers who were engaged in various degrees of integration.

An example of the benefits a producer could gain from integration is illustrated in Figure 5. Assume

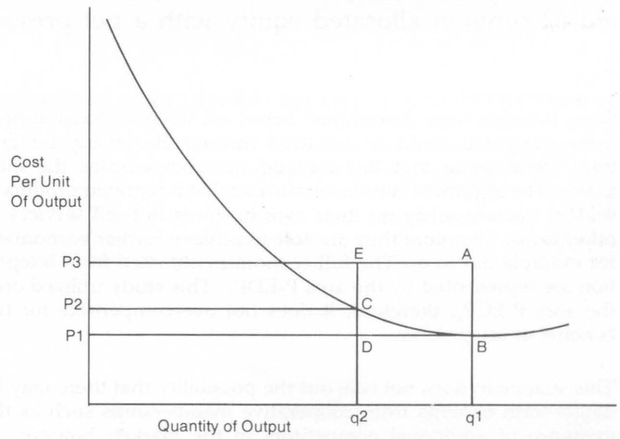

Figure 5. Long-run average cost of production in an integrated segment of the marketing channel.

this is the long-run average cost curve for a cotton gin and the gin has sufficient business to operate at its most efficient level q_1. However, due to the structure of the industry, assume that the ginner is charging the producer P_3 for his services and collecting economic rents equal to area P_3ABP_1. Further assume that a single operator (or group) supplies q_2 amount of the firm's total business. Therefore the producer(s) could purchase a cotton gin and the cost of ginning would be reduced from P_3 to P_2. The total gain to the producer from integration would be area P_3ECP_2 and it is this savings in cost that accrues to the integrated producer.[8]

Cooperatives

Sixty-six percent of the producers surveyed were members of farm supply or marketing cooperatives. Most cooperatives in the counties studied have cotton gins as the core of their operations. For farms having less than 2,560 acres, 72% of the producers belong to a cooperative. For farms with over 2,561 acres only 31% had cooperative membership (Table 12).

A survey of 44% of the cooperative gins in the area indicated cooperatives averaged 28% of their gross sales as net income. Cooperatives normally distribute their net income to members either in cash or in allocated equity capital. Unallocated net income would be taxed at the corporate rate. The cooperatives in the survey indicated they distributed net margins by giving the producer-member 38% of the net margin in cash and 62% in allocated equity. However, the farmers must pay taxes on the total patronage dividends. On the average, allocated equity was retained in the business for seven years. For a farmer to realize year-to-year benefits from belonging to a cooperative, the present value of cash and allocated equity must exceed the farmer's marginal tax rate. Otherwise, when paying identical prices for inputs, the farmer would lose money on an annual basis from doing business with a cooperative.[9]

For example, the net present value of $1 paid seven years from now discounted at 15% is worth 38 cents today. Producers who receive 38 cents in cash and 62 cents in allocated equity with a net present value of approximately 23 cents, pay taxes on the $1 but in essence, only receive 61 cents. Thus, a person who has a marginal income tax rate greater than 38% would pay more in taxes today than was received in cash; however, it would take a marginal tax rate greater than 61% for a farmer to actually lose money by being a member of the cooperatives. This may be one of the reasons operators of larger farms use cooperatives less than their counterparts on smaller-size farms. A second reason could be the likelihood that direct ownership integration has the potential for asset appreciation while cooperative allocated equity does not appreciate in value.

TABLE 12. NUMBER OF FARM OPERATORS WITH COOPERATIVE MEMBERSHIP BY FARM SIZE IN THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Total Farms Surveyed	Number with Cooperative Membership	Percent of Farms in Size Category
0-320	16	12	75
321-640	15	9	60
641-960	14	10	71
961-1,280	13	9	69
1,281-1,600	12	8	67
1,601-2,560	15	13	87
2,561-4,400	8	3	38
4,400+	5	1	20
Total	98	65	66

A third possibility for large-scale farmer involvement in corporate integration ventures is a wider net profit margin. Profit incentives and management capabilities are frequently asserted to be stronger in a corporation than in a cooperative. In addition, a corporation can be more selective in the products handled and the customers with whom they choose to do business.

To reflect the benefits from cooperative integration, the costs reported in Table 10 and Figure 4 were adjusted to account for patronage dividends returned to the producer member. Cooperatives were surveyed to determine what services, on the average, were available to cooperative members. The results indicate that in addition to ginning cotton, 35% handled fuel; 58%, seed; 8%, fertilizer; 25%, chemicals; and 29%, certain specialized machinery parts. The reduction in costs due to patronage refunds were computed by applying the dealer discount as reported by the major suppliers of inputs. The following discounts by input were used in computing cost adjustments:

- Ginning 28%
- Fertilizer 22.5%
- Equipment 20%
- Cottonseed 7%
- Fuel 6.5%
- Chemical 5%
- Equipment Repair 20%

[8]Since benefits were determined based on what regional supply firms suggested could be achieved through dealership integration, some argue that this method overcompensates the integrator. The argument centers on the fact that integrated producers seldom operate solely on their own business but sell services to other firms. Therefore they are able to achieve further economies, for example out to q_1. The full economies obtained from integration are represented by the area P_3EDP_1. This study utilized only the area P_3ECP_2; therefore, it does not overcompensate for the benefits of integration.

[9]This statement does not rule out the possibility that there may be longer-term benefits from cooperative memberships such as the existence of additional competitors in the market; however, it recognizes that farmers emphasize shorter-term price advantages in their patronage decision. It also recognizes that such benefits can be captured by both members and nonmembers.

Since the average present value of each dollar of patronage refund is 61 cents, the above values were adjusted accordingly. This value was then used in conjunction with the percentage of cooperative memberships in each farm size, and the total services offered by the area cooperatives in determining adjusted cost of production (Table 13). It is interesting, and not totally unexpected, to note that the smaller farm sizes benefit more from cooperative integration than do farms larger than 1,600 acres. This occurs because a larger proportion of smaller farmers do business with cooperatives.

Non-Cooperative Private Integration

Fourteen percent of the producers surveyed had a significant ownership interest in a farm-related proprietary agribusiness supply or marketing firm (Table 14). Sixty-four percent of the integrated farms were larger than 1,600 acres, with the heaviest concentration occurring in the 4,400+ acre group where 4 of the 5 farms surveyed had some ownership interest in at least one farm production (input) related agribusiness firm.

Integration into non-cooperative cotton gins was predominant, with 11 of 13 producers having from 10% to 100% ownership in gins. One farmer had an interest in a fertilizer and chemical business, one in a farm implement business, and one had an interest in a grain elevator as well as a gin.

Nineteen farmer-owned cotton gins, not organized as cooperatives, were surveyed to determine the services provided the owners and their customers. In addition to ginning, the survey indicated 53% handled seed; 32%, fertilizer; 47%, chemicals; 13%, fuel; and 42%, certain specialized machinery parts. Although the gins reported selling inputs to all customers for the same price, it would be a fallacy not to attribute at least the discounts reported by input suppliers to the integrated farms production cost. Such cost savings were imputed only on inputs and services provided to the farm business. No allowance was made for returns earned on sales to other farmers.

Using the same procedures developed for cooperative integration, imputations for returns on investment for these integrated producers were applied to the cost of production figures from Table 10. The resulting cost of production per pound of cotton lint after adjustments for vertical integration are provided by farm size in Table 15. As expected, the operators of farms larger than 2,560 acres received the greatest average benefit from non-cooperative integration.

The cost reductions developed for corporate integrated farms using these procedures were conservative. The adjustments based on the percentage integration by farm size dilutes the impact on an individual integrated producer. For example, a producer in either of the largest two categories who has ownership interests in a ginning facility that additionally carries dealer status in the selected inputs previously discussed could lower his cost of production by 4.2 cents per pound of cotton lint, a 7.6% cost reduction. Such a reduction would mean a net benefit to the largest farms of from $33,348 to $65,611. Unlike cooperative ownership, an independent vertically integrated business can gain from appreciation in assets as well as certain tax advantages (not included here because of measurement difficulty). If measured, the per unit cost reduction may be even greater.

TABLE 13. PRODUCTION COST PER POUND OF COTTON LINT DUE TO COOPERATIVE INTEGRATION FOR FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Actual Production Cost[a] (¢/lb)	Production Cost Adjusted for Cooperative Integration (¢/lb)	Reduction due to Cooperative Integration (¢/lb)
0-320	189	89.4	88.1	1.3
321-640	511	67.3	66.5	0.8
641-960	793	66.6	65.9	0.7
961-1,280	1,088	63.7	62.8	0.9
1,281-1,600	1,457	59.7	58.9	0.8
1,601-2,560	2,019	60.7	59.8	0.9
2,561-4,400	3,383	54.7	54.1	0.6
4,400+	5,570	55.7	55.3	0.4

[a]From Table 10.

TABLE 14. NUMBER OF FARM OPERATORS WITH SOME PROPRIETARY INTEREST IN AGRICULTURAL-RELATED BUSINESSES BY FARM SIZE, TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Total Farms Surveyed	Number with Interest in Ag. Business	Percent of Farms in Size Categories	Number by Type Agribusiness			
				Gins	Fertilizer & Chemical	Implement Dealers	Elevator
0-320	16	0	0				
321-640	15	2	13	2			
641-960	14	0	0				
961-1,280	13	1	8	1			1
1,281-1,600	12	1	8	1			
1,601-2,560	15	3	20	2		1	
2,561-4,400	8	2	25	2			
4,400+	5	4	80	3	1		
Total	98	14	14	11	1	1	1

TABLE 15. PRODUCTION COST PER POUND OF COTTON LINT DUE TO PRIVATE FARMER INTEGRATION, TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Actual Production Cost[a] (¢/lb)	Cost Adjusted for Integration (¢/lb)	Reduction due to Non-Cooperative Integration (¢/lb)
0-320	189	89.4	89.4	0.0
321-640	511	67.3	66.9	0.4
641-960	793	66.6	66.6	0.0
961-1,280	1,088	63.7	63.5	0.2
1,281-1,600	1,457	59.7	59.5	0.2
1,601-2,560	2,019	60.7	60.2	0.5
2,561-4,400	3,383	54.7	53.9	0.8
4,400+	5,570	55.7	53.6	2.1

[a]Totals from Table 10.

TABLE 16. ACTUAL PRODUCTION COST PER POUND OF COTTON LINT BEFORE AND AFTER REDUCTIONS DUE TO COOPERATIVE AND NON-COOPERATIVE INTEGRATION FOR FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Actual Production Cost[a] (¢/lb)	Cost Adjusted for Integration (¢/lb)	Reduction due to Integration (¢/lb)
0-320	189	89.4	88.1	1.3
321-640	511	67.3	66.1	1.2
641-960	793	66.6	65.9	0.7
961-1,280	1,088	63.7	62.6	1.1
1,281-1,600	1,457	59.7	58.7	1.0
1,601-2,560	2,019	60.7	59.3	1.4
2,561-4,400	3,383	54.7	53.3	1.4
4,400+	5,570	55.7	53.2	2.5

[a]Totals from Table 10.

Total Cost Adjustment for Integration

When the actual production cost as reported in the surveys was adjusted for both cooperative and non-cooperative integration, total production costs were reduced to the levels reported in Table 16. Actual integration amounts to approximately a 1.2 cent reduction in cost per pound of lint in all farm sizes except the largest, where a 2.5 cents per pound cost reduction is achieved. Interestingly, the lowest level of integration benefits of 0.7 cents per pound accrue to the 641-960 acre farm, which is frequently considered to be a typical High Plains family farm. The farmers apparently shop around, but there is no evidence they receive a lower input price as a result of this search process.

Implications for Farm Structure

Evidence indicates that, in general, no pecuniary economies are available to farms who purchase supplies in the open market. There is evidence that large farms are able to take advantage of discounts on selected inputs but that in general, input suppliers fail to give warranted volume discounts for fear of the repercussions they might cause among their smaller volume customers and the potential overall reduction in market prices for inputs. This form of market failure may account for the fact that a signifcant number of farmers have integrated into either cooperative or privately owned farm-related agribusinesses, in an effort to reduce costs through the pecuniary advantages of volume buying.

Other studies have suggested that as farm operations become larger they might tend to bypass the locally owned suppliers and negatively impact rural communities (Carter et al. 1980; Krenz et al. 1974). However, in most instances, those farms which have integrated tend to compete for the business of all producers in the area. Therefore, total competition in the area might actually be enhanced in the intermediate term as new firms are added. In the longer run, however, the Carter and Krenz implications may still hold.

Cost of production per pound of cotton lint declines by 34.9 cents from the smallest to the largest farm, when considering adjustments for integration. This conclusion indicated that substantial economies exist up to at least the 2,560-acre farm size. The largest category of farms, 4,400+ acres, do not appear to gain additional economies but also do not have higher costs as suggested by the cost of production analysis alone. Pecuniary economies are, however, available up to 4,400 acres but are not realized unless a firm integrates. Cooperative integration is more likely to occur by the smallest farms while the largest farms are more likely to invest in an agribusiness over which they have more direct control. Corporate integration advantages were conservatively stated. An individual farm that is corporate integrated may easily realize advantages of at least 2 cents per pound more than indicated in these averages.

MARKET ECONOMIES

As with pecuniary economies from input purchases, product prices received by farm size were examined. Before explaining the results of the survey, it is desirable to describe cotton marketing channels.

Figure 6 shows the flow of cotton as it moves from the producer to the final consumer. Producers in general have the following five major alternatives for selling their cotton:

1. *F.O.B. buyers.* A majority of the cotton is sold to or through f.o.b. buyers. These buyers normally serve a procurement function for the shippers although some sell directly to domestic mills.
2. *Cooperatives.* Some cooperatives function in a similar manner as the f.o.b. buyers in that they directly purchase the cotton in competition with other buyers at the going market price.
3. *American Cotton Growers.* The ACG owns a cotton mill and directly processes some of its members' cotton and sells the rest. The member producers are paid a pooled price based on profits on sales from both sources.
4. *Commodity Credit Corporation.* In times of surpluses the Commodity Credit Corporation (CCC) nonrecourse loan is an alternative market available to producers. During the 1960's the CCC acquired large quantities of South Plains cotton through producers forfeiting commodities under loan. However, in the 1970's, it was used more as a tool to hold cotton until a more favorable price could be obtained. Cooperatives also use the Form G CCC loan program extensively to hold pooled cotton in storage until it can be favorably marketed or forfeited to the CCC.
5. *Direct Sale.* Some producers bypass the f.o.b. buyers and sell directly to the major shippers. The larger shipping firms indicate most of their cotton is purchased from f.o.b. buyers but that they do purchase some cotton directly from producers. A majority of the South Plains cotton crop ultimately is purchased by 8 or 10 shippers.

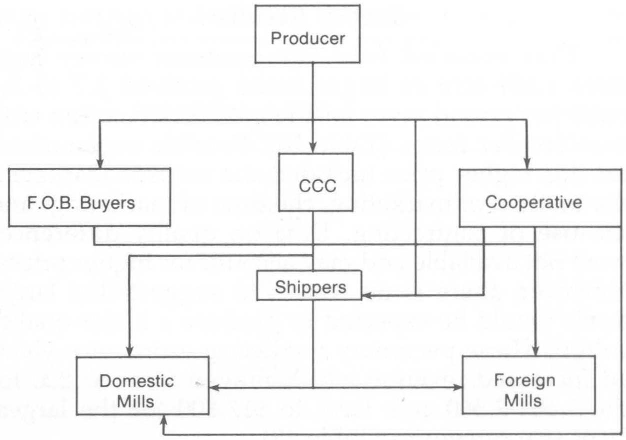

Figure 6. Marketing flow for Texas Southern High Plains cotton.

Producers sell cotton to f.o.b. buyers by means of direct negotiation, brokers, agents, or over the Telcot system. The first three are self-explanatory while the fourth warrants discussion.

The Telcot system is a computer-operated telecommunication network by which farmers may sell their cotton. The Plains Cotton Cooperative Association (PCCA) initiated the Telcot system for marketing members' cotton (Boggs and Davis 1980). However, since Telcot became operative in 1975, members have entered into a joint venture agreement with a private non-cooperative corporation known as Commodity Exchange Services (CXS). Thus, both cooperative and non-cooperative farm operators have access to the Telcot system. Table 17 shows the share of Texas and Texas High Plains upland cotton traded over the Telcot system since 1975. In 1980, over 40% of the Texas High Plains cotton crop was marketed via the Telcot system. These figures are somewhat biased on the high side since separate data for Telcot marketings in Southwest Oklahoma could not be determined. Such an adjustment would likely lower the Telcot market share by no more than two percentage points. In any event the Telcot system has captured a significant share of High Plains cotton marketing.

TABLE 17. TEXAS AND HIGH PLAINS UPLAND COTTON PRODUCTION AS WELL AS MARKETINGS OVER THE TELCOT SYSTEM, 1975-1980

Year	Total Texas Production (1,000 bales)	Total High Plains Production (1,000 bales)	Telcot Marketing (1,000 bales)	Percentage of Texas Crop Marketed over Telcot (%)	Percentage of High Plains Crop Marketed over Telcot (%)
1975	2,382	1,947	230	9.7	11.8
1976	3,307	2,568	361	10.9	14.1
1977	5,465	4,210	844	15.4	20.0
1978	3,792	2,737	863	22.8	31.5
1979	5,515	4,034	1,600	29.0	39.7
1980	3,320	2,419	976	29.4	40.3

Source: Telcot data reported by PCCA Lubbock, Texas.

[a]Total Crop Production for Texas and High Plains (Regions 1N, 2N, 1S, 2S) as reported by Texas Crop and Livestock Reporting Service.

Survey Results

Data obtained from the producer survey indicates 1,601-acre or larger farms received 1.7 to 3.4 cents per pound more for their 1979-1980 cotton crop than smaller farms (Table 18). Possible explanations for this higher price included the volume marketed, the method of marketing, the time of marketing, and the use of contracting. Data on quality differences were not available and may account for higher prices. However, there is no reason to suggest that larger farms would be expected to produce a better-quality cotton. These pecuniary marketing economies yielded increased revenue which ranged from $7,800 for the 1,601-2,560 acre farm to $17,800 for the largest farm size categories (Table 18).

Volume Marketed

One might initially assume that a larger volume of cotton marketed would command a premium price. A 1980 study by Ling on the Telcot system, however, concluded that the size of the cotton lot offered for sale was not important in influencing price received by farmers. Interviews with major buyers in the area indicated volume will sometimes command a premium, but on the average it is in the range of from only 25 to 50 points for even running lots of 100 or more bales.[10]

Method of Marketing

Thirty-five percent of the cotton sold by producers in the survey was marketed over the Telcot system, 6% was sold through the American Cotton Growers cotton pool, and the remaining 59% was sold to buyers directly. There is a general feeling among people familiar with cotton marketing that producers could receive a higher price for their cotton if they sold it directly to the buyers instead of over the Telcot system. Most shippers who were interviewed indicated they did pay a premium due to the fact they had to protect the f.o.b. buyers on whom they could depend for delivery. These shippers would normally negotiate with producers over approximately 50 points that they would have to pay as commission for cotton purchased on the Telcot system. The major shippers indicate they sometimes have commitments for cotton to buyers. To meet these commitments they would sometimes pay a premium over the Telcot price.

Some feel a better price can be obtained for cotton sold directly because of the buyers' aversion to the Telcot system. Survey data indicate cotton over the Telcot system sold for from 1 to 2 cents per pound over other cotton for the two smallest size categories and the 2,561-to-4,400-acre size category. Cotton sold over the system brought the same price in the 1,601-to-2,560-acre category and was from 2 to 3 cents per pound less than the non-Telcot cotton in the four remaining categories. Therefore, no evidence could be obtained from the producer data which would indicate conclusively that cotton sold over the Telcot system brought any different price.

Time of Marketing

Since prices fluctuate through a marketing year, time of marketing could have an effect on the price received by different-size producers. Large producers might be better at picking the right time to market since they generally received a 1 to 2 cent premium. However, Table 19 does not give evidence of any one farm size receiving a better price due to time of sale.

Contracting-Futures

Contracting and use of the futures market could have an effect on the price received by producers. The producer survey indicated virtually no use of the futures market and only 14.7% of the 1979-80 crop was marketed under contract. No perceptible effect on the average price received by farm size could be determined, even though the largest farms in the size category contracted 40.5% of their volume. Historically, contracting has led to higher producer returns in some years. In other years, producers who did not contract received higher returns.

TABLE 18. AVERAGE PRICE RECEIVED FOR COTTON BY FARM SIZE ON THE TEXAS SOUTHERN HIGH PLAINS, 1979-1980

Farm Size (acres)	Average Farm Size (acres)	Average Price Received (¢/lb)	Pecuniary Marketing Economies	Average Volume (1,000 lbs)	Extra Revenues Obtained ($)
0-320	189	50.2	0	53.9	0
321-640	511	50.2	0	111.9	0
641-960	793	50.6	.4	229.4	918
961-1,280	1,088	50.5	.3	181.9	546
1,281-1,600	1,457	50.3	.1	254.1	254
1,601-2,560	2,019	52.2	2.0	391.2	7,824
2,561-4,400	3,383	53.6	3.4	515.9	17,541
4,400+	5,570	51.9	1.7	1,047.2	17,802

[10]An even running lot is one that is of uniform quality and a point is 1/100th of a cent per pound of cotton. Therefore, 100 points equals 1 cent.

Implications of Marketing Economies for Farm Structure

Although the previously discussed possibilities likely had some effect on the price received by farmers and could have contributed to the higher price received by the larger-scale farmers, no definite determination can be made on the precise reason for higher returns. A possible explanation is that larger-scale farmers, due to labor specialization, are able to free themselves from the physical aspects of the farm operations, analyze their marketing options, and shop around for the best price for their crop. They are able to spend more time in marketing and thus gain greater premiums. Although the market may operate in a narrow range for any specific quality of cotton, a 1 or 2 cent premium will justify the time spent on marketing for these larger-scale producers. For a

TABLE 19. TIME OF SALE FOR COTTON FARMS OF THE TEXAS SOUTHERN HIGH PLAINS BY FARM SIZE, 1979-1980

Farm Size (acres)	Average Farm Size (acres)	Percentage Marketed Prior to January 1, 1980 %	Percentage Marketed After January 1,1980 %	Average Price Received (¢/lb)
0-320	189	22	78	50.2
321-640	511	40	60	50.2
641-960	793	31	69	50.6
961-1,280	1,088	59	41	50.5
1,281-1,600	1,457	54	46	50.3
1,601-2,560	2,019	54	46	52.2
2,561-4,400	3,383	44	56	53.6
4,400+	5,570	45	55	51.9

farmer marketing over 1,000 bales of cotton, the extra revenue from effective marketing could be over $6,000.

TOTAL BENEFITS BY FARM SIZE

This section provides insight into the combined effect of technical, pecuniary input, and marketing economies, on total revenue and cost by farm size. Table 20 and Figure 7 indicate the total benefit accruing to a farm due to vertical integration (cooperative and non-cooperative) and marketing economies in both cents per pound of lint and before-tax net revenue. Although a few cents per pound of cotton may seem insignificant, it translates into substantial increased earnings when multiplied by total farm production on the larger-size farms (Figure 7). Benefits increase from $728 on the smallest farm to $65,605 for the largest farm (Table 20). These increased earnings provide substantial economic incentives for larger-scale farmers to find methods of obtaining them.

Figure 8 shows net revenue per pound of cotton, by farm size, after adjustments for vertical integration, and marketing, and the price of cottonseed (9.2 cents per pound of lint). Notice that revenue after these adjustments increases from -28.7 cents per pound to 9.5 cents per pound as average farm size increases from the 189-acre to the 2,561-to-4,400-acre category before leveling off for the largest-size farms.

These data suggest that increasing net revenue per unit of marketing, as well as reduction in costs per unit of output, may be causal factors for farm growth through the largest farm sizes. The conclusion contradicts much of the conventional wisdom regarding the factors influencing structure.

CONCLUSIONS

Characteristics and costs of production were developed for the following eight farm sizes typical of the Texas Southern High Plains: 189, 511, 793, 1,088, 1,457, 2,019, 3,383, and 5,570 acres. Results of the analysis suggest that cost of production declined by 34.9 cents per pound of cotton lint as farms increased in size from the 189-acre to the 5,570-acre category. This decline was a function of both technical and pecuniary economies generated through backward integration in the input supply chain.

TABLE 20. AVERAGE REVENUE OBTAINED FROM VERTICAL INTEGRATION AND MARKETING ECONOMIES BY FARM SIZE FOR FARMS OF THE TEXAS SOUTHERN HIGH PLAINS

Farm Size (acres)	Average Farm Size (acres)	Vertical Integration Economies ¢/lb	Vertical Integration Economies total $	Marketing Economies ¢/lb	Marketing Economies total$	Total Extra Revenue ($)
0-320	189	1.3	728	0	0	728
321-640	511	1.2	1,720	0	0	1,720
641-960	793	0.7	1,582	0.4	904	2,486
961-1,280	1,088	1.1	3,056	0.3	833	3,889
1,281-1,600	1,457	1.0	3,754	0.1	375	4,129
1,601-2,560	2,019	1.4	7,089	2.0	10,127	17,216
2,561-4,400	3,383	1.4	11,116	3.4	26,996	38,112
4,400+	5,570	2.5	39,054	1.7	26,551	65,605

In general it was determined that no pecuniary economies were available to the farms that purchase inputs from suppliers in the open market. The apparent reason input suppliers fail to give warranted volume discounts was the fear of repercussions that may occur from their smaller-volume customers. Smaller-volume customers make up the majority of an input supplier's total business. If word got out that a larger volume buyer was getting a better deal (although warranted), the average farmer might demand equal treatment, thus creating a potential reduction in overall income to the business. The failure of the market to provide cost-justified discounts could account for the significant integration into the input supply industry observed both cooperatively and privately.

Cost adjustments due to integration revealed that most farms achieved approximately a 1.2 cents per pound of cotton lint advantage from being vertically integrated. However, the largest farm size (5,570 acres) achieved a 2.5 cents or 5% reduction in its total cost due to the vertical integration. Eighty percent of the farms having over 4,400 acres owned some proprietary interest in an input supply firm.

Marketing economies of approximately 4.2% were achieved when farms reach the 2,000-acre range. That is, large farms received an average 2.4

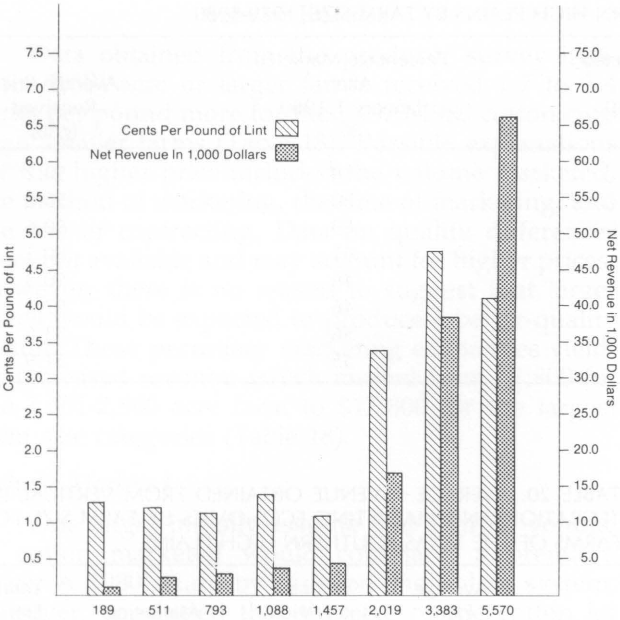

Figure 7. Net benefit due to vertical integration and marketing economies by farm size for farms of the Texas Southern High Plains.

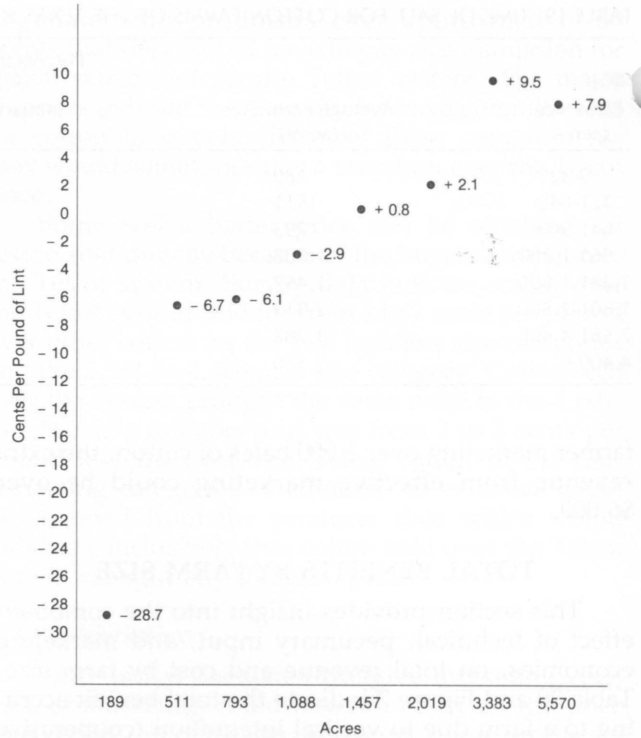

Figure 8. Net revenue per pound of cotton lint by farm size for farms of the Texas Southern High Plains after imputation for vertical integration and marketing economies.

cents per pound more for their cotton than smaller farms. Although volume, method, and time of marketing were examined as contributing factors, no conclusive evidence could support the reason for the higher returns. It was concluded that larger-scale farmers, due to labor specialization, are able to free themselves from the physical aspects of the farm operation, analyze their marketing options, and shop around for the best price for their crop.

It was therefore concluded that economies of size exist for farms up to the 3,383-acre level. At that point unit costs are relatively constant. Pecuniary economies through integration contribute to this conclusion. When the economies derived from integration are combined with the marketing economies observed at the 2,000+ acre level the result is additional net revenue to the three largest farm size groups of $17,216, $38,112, and $65,611, respectively. This extra income provides a substantial economic growth and survival advantage for large farms.

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