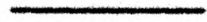
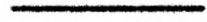


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AN ECONOMIC ANALYSIS OF ADJUSTMENTS BY A
SAMPLE OF FARMS IN NORTHEAST MISSOURI
FROM 1962 TO 1965



A Thesis
Presented to
the Faculty of the Graduate School
University of Missouri



In Partial Fulfillment
of the Requirements for the Degree
Master of Science



by
Jim D. Lucie

The undersigned, appointed by the Dean of the Graduate Faculty, have
examined a thesis entitled

AN ECONOMIC ANALYSIS OF ADJUSTMENTS BY A
SAMPLE OF FARMS IN NORTHEAST MISSOURI
FROM 1962 TO 1965

presented by

Jim D. Lucie

a candidate for the degree of

Master of Science

and hereby certify that in their opinion it is worthy of acceptance.

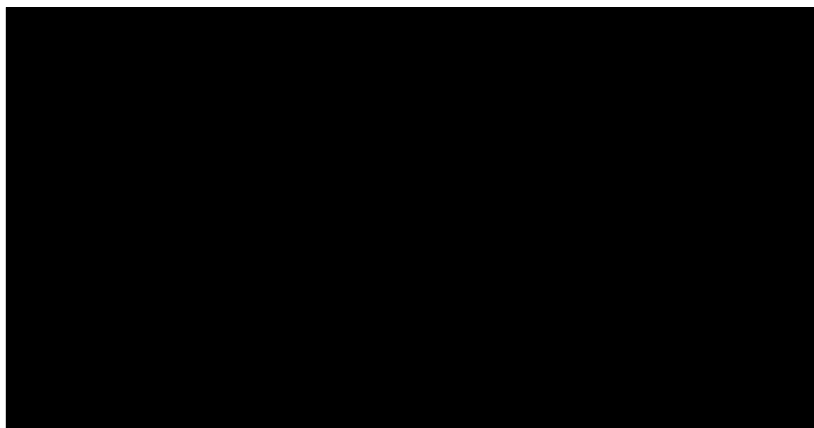


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CHAPTER I

INTRODUCTION

Changes in sizes of farms, types of farms, and the productivities of inputs in relation to past changes are becoming increasingly important in the future of agriculture. The rapidity at which this is taking place seem to be increasing at a faster rate than ever before.

U.S. agriculture has moved progressively along the trail from primitive to industrial sketched above. It did so first at a walk and then at a jog-trot. In recent years its motion has quickened to a dash. As such it has progressively taken on more of the characteristics of an industrial economy. This is the heart of the economic aspect of the technological revolution in agriculture. 1/

It appears that the change in a three or four year period today may be equivalent to the changes of a ten year period only a mere decade ago. These changes find a vast number of farms disappearing while those remaining grow larger and more specialized. The productivity of the different farm inputs is changing in importance. Today, capital is replacing both labor and land in importance at a rapid rate, showing the growing movement toward purchased inputs in agriculture, which should mean more control over the

¹Harold F. Breimyer, "The Three Economies of Agriculture," Journal of Farm Economics, Volume XLIV, August 1962, p. 685.

productive capacity of the farm by the farmer.

Objectives

This study was undertaken to study the adjustments and economic consequences of those adjustments for typical Missouri farm operations of various types in recent years. Specifically, the objectives of this study are as follows:

- 1) To examine the rate of change (adjustment) on farms.
- 2) To examine adjustments of size, farm type and group changes for a known sample of operators to gain insights into the adjustment process.
- 3) To determine changes taking place in resource productivities.

The use of production function analysis is used to analyze some of the changes in resource allocation that have taken place in Northeast Missouri between the years 1962 to 1965. This indicates changes in efficiency of given inputs, shows which inputs have become more important, and points out the direction of the changes. By comparing the same sample farms between the two years, the shifts among the types of farming operations can be observed. Such changes can be important in formulating policy recommendations for agriculture in the future.

Review of 1962 Study

Data and results of a 1962 study are reported in part in an unpublished M.S. thesis, Production Function Analysis of North Missouri Farms, 1962 by Francis Brees. This study was part of a project jointly sponsored by the North Central Regional Experiment Stations and the United States Department of Agriculture concerning adjustments and supply response in the feed grain, hogs, and beef cattle sectors of corn belt agriculture. Additional information on the study is available from research bulletins of the various states involved.² The data for the Brees study was fitted with a Cobb-Douglas function to find the resources which influence gross income and to determine the types of adjustments needed to improve the profitability of the farming operations.

His analysis was developed for three areas--Northwest Missouri, North Central Missouri, and Northeast Missouri. The model used the Cobb-Douglas function where the dependent variable was gross revenue. The independent variables were:

²Francis M. Brees and Dale Colyer, Aggregate Production Functions for Farms in Northern Missouri, Research Bulletin 894, Agriculture Experiment Station, University of Missouri, Columbia, Missouri, September 1965 and Dale Colyer and George D. Irwin, Beef, Pork, and Feed Grains in the Corn Belt, North Central Regional Research Publication 178, Missouri Agricultural Experiment Station Research Bulletin 921 (In Process). See also: Missouri Agricultural Experiment Station Research Bulletin 872, 877, and 890.

land, labor, major equipment investment, livestock and crop inventory, and cash expenses.

This function was fitted with data from all 585 sample farms in the 44 northern Missouri counties. The farms were then broken down according to the three census economic areas; Northeast Missouri, 222 farms; North Central Missouri, 174 farms; and Northwest Missouri, 188 farms. This allowed for a comparison of the three areas. The farms also were divided into cash-grain, mixed-livestock, beef, hog, and dairy categories. These classifications were made according to the enterprise which accounted for fifty per cent or more of gross farm sales. Farms were further classified according to size, by dividing the farms equally into small, medium, and large categories on the basis of acres of tillable land.

The first model was fitted with the cash expenses variable including only feed and fertilizer. The coefficients of determination were found along with the elasticities of production. The marginal value productivities were computed to determine how much the addition of one unit of a particular resource would increase gross revenue.

The same computations were next made with the addition of purchased livestock to cash expenses. The findings indicated that the importance of purchased livestock was least in the northeast area, although its inclusion

increased the per cent of explained variation in all areas. However, the computation based on classification by farm size had low coefficients of determination, indicating a relatively incomplete model in both cases.

Finally an analytic function was developed for the models using the averages of the different specific independent variables and applied only for the one year. It was developed to provide guidelines for a better understanding of the allocation of resources.

The study provided a look at the efficiency of inputs in the area and showed general problems typical of the study area. By use of the results policy makers can better understand adjustments that might be needed in the future. It was concluded that further adjustments were needed in North Missouri and that reallocation of resources would continue. The reallocation, it was thought, would occur in much the same pattern as in the past with the trend toward larger and more efficient farms and with less labor used relative to the level of other resources.

Procedure of the Analysis

The current study was undertaken to determine changes that have occurred since 1962. A survey was made for only the 16 Northeast counties using the same sample segments as for the 1962 study.

The farms were classified according to size and type by the same procedures as in the 1962 study. The Cobb-Douglas model was fitted with data which was as close as possible to the 1962 data for the same variables. Certain discrepancies exist due to changes in the sample questions on the questionnaire. The movements between 1962 and 1965 with respect to size and class were analyzed to give a clearer understanding of adjustments by farms in the area. Changes in the mean values for the important variables were used to determine significant changes in the organization of the farms between 1962 and 1965.

CHAPTER II

AREA AND SAMPLE

This study of farm adjustments and resource productivity was based on a sample survey of farms in Northeast Missouri where the data was obtained from the same set of segments for which data also was collected in 1963. The original sample of 260 segments was completed for the three census economic areas in 44 counties of northern Missouri by interview in 1963 to obtain 1962 farm data.¹ In 1966, farmers in the same sample segments from the 16 counties in Northeast Missouri were re-interviewed to obtain 1965 farm data.

Survey Procedures

The original study was set up to include only commercial farms as defined by the Bureau of the Census. This definition is as follows:

In general, all farms with a total value of products sold amounting to \$2,500 or more are classified as

¹The sample was drawn by the Statistical Laboratory at Iowa State University at Ames, Iowa. The first segment was selected at random and subsequent segments were selected in a geographically systematic manner from the first to assure representation of all counties included in the survey. The segments are small blocks of land in which the household is located. Land operated is not necessarily located in the segment.

commercial. Farms with sales of \$50 to \$2,499 are classified as commercial if the farm operator was under 65 years of age and (1) he did not work off the farm 100 or more days during the year and (2) the income received by the operator and members of his family, from nonfarm sources was less than the value of all products sold. ^{2/}

The questionnaire as set up in 1965 was intended to include in the survey all census farms as defined by the Bureau of the Census. This definition is as follows:

Census farms comprise places on which agriculture operations were conducted at any time under the control or supervision of one person, partnership or a manager. Places of less than 10 acres were counted as farms if the estimated sales of agriculture products for the year amounted, or normally would amount to at least \$250. Places of 10 or more acres were counted as farms if the estimated sales of agriculture products for the year amounted or would normally amount to at least \$50. ^{3/}

A total of 268 questionnaires were completed for the 1965 farm operations in the 16 counties. To make comparisons with the 1962 survey data, census definition was used to noncommercial farms from those in the 268 completed questionnaires. From this total, 45 farms did not classify as commercial farms and were excluded. A total of 20 farm operations were combined into partnerships, reducing the total farm numbers by 10 more. A total of 19 farms were excluded due to lack of information in the questionnaires.

^{2/}United States Census of Agriculture, Bureau of the Census, U. S. Department of Commerce, Washington, D.C., 1964, p. 1.

^{3/}Ibid., p. 1.

These were considered as refusals and were rejected for the comparative analysis, leaving a total of 194 commercial farms.

The Study Area

The sampled area consists of the 16 counties located in Northeast Missouri lying from the Missouri-Iowa border southward to the Missouri River and east to the Mississippi River (see Figure 1). Five soil types predominate in the area.⁴ The most prevalent is Putnam-Mexico, a level prairie soil, which is a remarkably uniform soil derived from loess. This soil is easily tilled and is suited for cultivation of corn, oats, wheat, soybeans, and grasses. A general type of farming with emphasis on livestock production has prevailed. Limestone and fertilizers are important inputs if the soils are to be productive. They can be used extensively on this soil type and have become an important influence on the types of farm operations developing in the area.

The next most prevalent soil is Lindley, a rolling forest land soil, which borders the many streams in the area. The loess deposit has been removed by erosion and glacial till is the soil forming material. Because of the

⁴H. H. Krusekopf, Major Soil Areas of Missouri, 1962, University of Missouri Agricultural Experiment Station, Bulletin 785, May 1962.

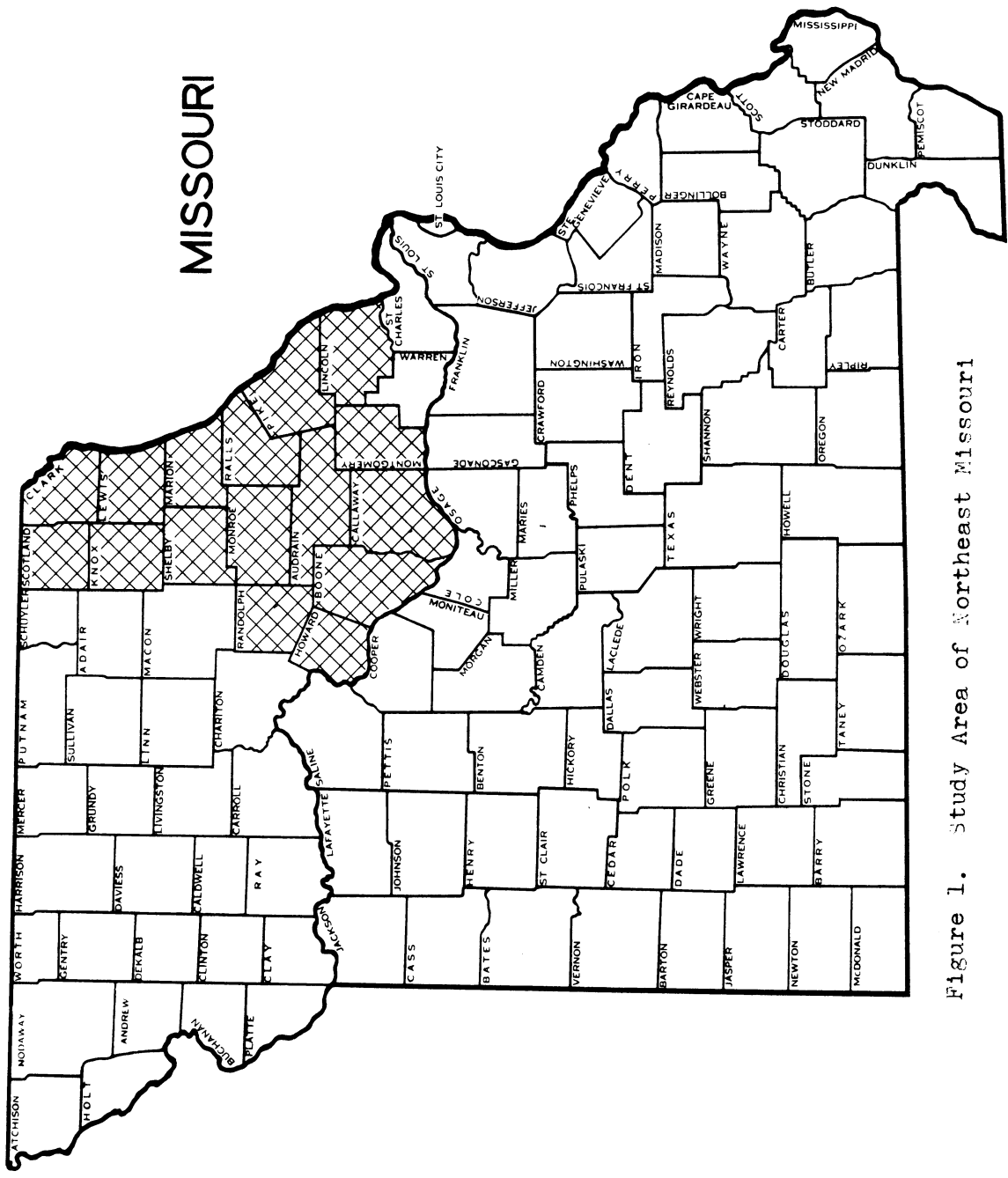


Figure 1. Study Area of Northeast Missouri

steepness of the slopes and the many gullies, less than fifty per cent of this soil type is suitable for cultivation. However, most is suitable for pasture and an estimated 15 per cent remains forested. Much of this soil is difficult to improve through fertilization due to the slope and resulting erosion problems.

Another common soil type is Menfro, found in the hills surrounding the rivers and generally known as "river hills" soil. It has a thick mantle of loess but because of steep slopes and permeable nature of the soil is subject to severe erosion which greatly limits its use. It is highly responsive to fertilization and what small areas are suitable for cultivation can be used for a great variety of crops. However, due to the severe erosion problems much of the Menfro soil type can not be cultivated and is used for pasture.

Bottomland or alluvial soils are found beside the rivers and streams in Northeast Missouri. It is the single most uniformly fertile soil area in the state and is intensively cultivated. Its crop yields are high and it has the capacity for even higher production and more specialized farming. A characteristic of this bottomland, sometimes called "gumbo," is its clay texture. Drainage is often insufficient and flooding may occur but this soil type contributes an important part of the crop production in North Missouri.

A fifth soil type, found in the western one-fourth of Randolph County and the northwest corner of Howard County, is known as Shelby or "rolling prairie" soil. It is derived from glacial till and is inherently fertile, but limited in use because of erosion on the steeper slopes. Corn and oats are the major crops with much of the land in permanent grass pastures. Erosion is the main limiting factor in its use.

Thus, the Northeast Missouri counties are dominated by glacial and loess soil types which generally have a high inherent level of productivity. Therefore, the region has a fairly high farm production potential. The main factor limiting the productive capacity of these soils, once adequate fertilizer is applied, is the rolling nature of the ground which tends to cause erosion.

Changes in Farm Numbers

The following changes, based on the Census of Agriculture, occurred between the years of 1959 and 1964 in the 16 counties of the Northeast Missouri economic area. The number of farms in this area dropped from 22,060 in 1959 to 19,383 in 1964, a 12 per cent decrease. The average size of farm increased from 226.4 acres in 1959 to 252.5 acres in 1964, a 12 per cent increase. The number of commercial farms has gone from 15,200 to 13,745--a 10 per cent

decrease.⁵

In the State of Missouri, the number of census farms declined from 168,672 in 1959 to 147,315 in 1964 for a 13 per cent decrease. The average size of the census farms increased from 196.6 acres to 221.9 acres, a 13 per cent increase. The number of commercial farms decreased from 106,678 in 1959 to 95,085 in 1964 for a 10 per cent decrease.⁶

Changes in the Sample Segments

The number of commercial farms in the sample segments dropped 13 per cent from 223 to 194 between 1962 and 1965, which is close to the 10 per cent decrease in the Agricultural Census. However, the average size of commercial farms in the sample did not change at all, being 341 acres in both time periods. This may indicate, assuming that the 1962 survey was accurate, that some farms were classified as commercial farms in 1965 when they should have been only census farms, thus the average acres were not as high as they should have been in 1965. On the other hand, the 1962 survey may have screened out some smaller commercial farms which would have brought the average down--which seems

⁵United States Census of Agriculture, op cit., p. 2.

⁶Ibid., p. 2.

likely since the average size of farm was large. If both surveys were accurate, the same size in both years would tend to indicate that in this area the size of the commercial farm is staying relatively stable while the land from the farms going out of production is, for the most part, lying idle or becoming part of noncommercial operations.⁷

Examination of the 130 farmers operating from the same households in both 1962 and 1965 revealed that they did increase their average acreage from 349 in 1962 to 361 in 1965—a 3 per cent increase. The newly interviewed farm units in the segment were smaller, averaging only 141 acres. Since there were 64 of these units, they tended to hold down the average increase in farm size for the survey area.

The average age of the farmers in the whole of Missouri was 51.6 years in 1959 and 52.5 years in 1964. The farmers in the 16 county area of northeast Missouri had an average age of 52.1 years in 1959 and 52.4 years in 1964. This compares with an average of 49.7 years in 1962 and 50.6 years in 1965 for the sample taken. The 130 farmers out of the sample of 194 who operated in both time periods averaged 51.8 years of age in 1965. The 64 farmers who were interviewed for the first time averaged 48.5 years of age in

⁷Land operated by farm units in the 1962 survey also could have passed to farm units with the household located outside the segments included in the survey.

1965. Thus the explanation of the lack of change in farm size for the entire sample may be due, in part, to the relatively larger number of younger farm operators who have not yet acquired farm units as large as those established earlier.

CHAPTER III

SAMPLE SURVEY CHANGES, 1962 TO 1964

In this chapter the changes that have occurred between the 1962 sample survey and the 1965 sample survey with respect to the size of the commercial farms are examined. Then the changes between the types of farms are compared and, finally, the changes within the representative farm classes for the two time periods are examined. The criteria used to divide the sample farms into size, type, and class were discussed in Chapter II.

Changes in Farm Size Groups

The changes in the numbers of farms for the small, medium, and large size groups between the 1962 and 1965 survey in the sampled area are shown in Table I. The 1962 survey covered 223 farms which were broken down into the three size groups. The 1965 survey covered the same area but only 194 farms were classified as commercial operations. The farms were broken down using the same criteria for small, medium and large size classifications.

Small Farms

In the 1962 survey, there were 77 small farms in operation compared to 63 in the 1965 sample. The 63 small farms were further broken down into 24 small farms which had

TABLE I
 CHANGES IN FARM NUMBER BY SIZE CATEGORIES, 1962-1965

	Small	Medium	Large
Number in Category in 1965	63	61	79
Number in Category in 1962	77	67	70
Number of Farms in Same Size Group	24	28	32
Number of Farms Changing From:			
Medium to Small	6	--	--
Large to Small	4	--	--
Small to Medium	--	10	--
Large to Medium	--	12	--
Small to Large	--	--	9
Medium to Large	--	--	16
Farms First Interviewed in 1965	29	11	13

operated in both time periods as small farms, 6 medium sized farms which had reduced their size of operation to the small category, 4 large farms which had become small farms and 29 farms which were first interviewed in 1965. This latter group were either farmers who moved into the survey segments, were noncommercial operators in 1962, or were farm operators who had been improperly screened out in 1962.

Medium Farms

There were 67 farms classified as medium in size in the 1962 survey compared with 61 in the 1965 survey. Of the 61 which operated in 1965, 28 had operated in both time periods under the same household head, 10 small farms had increased their size to become medium farms, 12 large farms had reduced their size to become medium farms, and 11 farms were interviewed for the first time.

Large Farms

There were 79 farms in the sample area classified as large commercial farms in 1962 with 70 farms so classified in 1965. Of these 32 had operated in both time periods as large farms, while 9 small farms moved to the large farm category, 16 farms moved from medium to large farms, and 13 were interviewed for the first time in 1965.

Changes in Farm Types

Farms from the survey were classified as cash grain, mixed livestock, beef cattle, or hog farms on the basis of their major source (or sources) of income. Considerable shifting in the classifications occurred between 1962 and 1965. These shifts are described below by type of farm.

Cash Grain Farms

In the 1962 survey 38 commercial cash grain farms were operating and in the 1965 resurvey 67 were in operation (Table II). This increase of 29 farms was the largest for any type of farm in the area. Only 14 of the 1965 total of 67 farms were cash grain units which had operated in both time periods. Twelve had been mixed livestock farms, seven had been beef cattle farms, six had been hog farms, and four had been dairy farms. There also was a total of 24 cash grain farms interviewed for the first time in 1965.

The cash grain farms are unique among the different types of farms in that there was a total increase of 29 farms in the sample. A reason for this is the realization of farmers that the higher returns on labor actually used is most frequently obtained from cash grain operations. This is only one explanation of the shift toward this type of farming in the sample area. Technological advances which permit a farmer to handle a larger acreage and others

TABLE II
CHANGES IN NUMBERS OF CASH GRAIN OPERATIONS

Cash Grain Farms in 1965	67
Cash Grain Farms in 1962	38
Cash Grain Farms which operated both in 1962 and 1965	14
Mixed Livestock Farms which moved to Cash Grain Farms	12
Beef Farms which moved to Cash Grain Farms	7
Hog Farms which moved to Cash Grain Farms	6
Dairy Farms which moved to Cash Grain Farms	4
Cash Grain Farms which were first inter- viewed in 1965	24

that increase yields per acre as well as relatively low prices for hogs, the major livestock in the area, were important influences.

Mixed Livestock Farms

In the 1962 survey, there were 69 commercial mixed livestock farms (Table III). The 1965 survey revealed a total of 42 mixed livestock farms--a decrease of 27 during the three-year period. Twenty of the 42 mixed livestock farms operated in both 1962 and 1965, while two of the 42 farms were cash grain farms in 1962, two were beef farms, and 14 were hog farms. In 1965, four farms were interviewed for the first time.

It is interesting to note that of the 20 mixed livestock farms which operated in both time periods only three were classified as a small mixed livestock farm. This implies that only the larger mixed livestock farms were able to remain in this type in both 1962 and 1965 and could have resulted from the relatively low earnings from small units of such operations. The movement of 14 hog farms to mixed livestock farms would seem to reflect the poor hog years prior to 1965, since these farms added or increased other livestock enterprises perhaps to help offset the results of lower hog prices.

TABLE III
CHANGES IN NUMBER OF MIXED LIVESTOCK OPERATIONS

Mixed Livestock Farms in 1965	42
Mixed Livestock Farms in 1962	69
Mixed Livestock Farms which operated both in 1962 and 1965	20
Cash Grain Farms which moved to Mixed Livestock Farms	2
Beef Farms which moved to Mixed Livestock Farms	2
Hog Farms which moved to Mixed Livestock Farms	14
Mixed Livestock Farms which were first interviewed in 1965	4

Beef Farms

There were 31 farms classified as beef cattle farms in 1962, while in the 1965 survey there were 25 beef cattle operations (Table IV). Nine of the 25 beef farms operated in both 1962 and 1965 as commercial beef farms. Two mixed livestock farms and one hog farm shifted to beef farms in 1965. A total of 13 farms which were interviewed for the first time in 1965 were classified as beef farms.

The difference between the 1962 and 1965 numbers of beef farms does not seem very significant. However, it is interesting to note that 16 out of the 25 beef farms in 1965 are small beef farms compared to only seven small farms of 31 beef operations in 1962. This implies that the larger commercial beef farms are declining and beef herds are being held more as a small enterprise to supplement off-farm work and other enterprises or as a retirement enterprise on the farm of older operators. Small beef herds can utilize the roughage available on many of the farms in the area but can not compete effectively as a major enterprise.

Hog Farms

In 1962, 70 commercial hog farms were in the sample and in 1965, 48 hog farms were found—a decline of 22 farms during the three-year period (Table V). A total of 24 of these operated in both 1962 and 1965 as commercial hog farms.

TABLE IV
CHANGES IN NUMBER OF BEEF CATTLE FARMS

Beef Cattle Farms in 1965	25
Beef Cattle Farms in 1962	31
Total Beef Farms which operated in 1962 and 1965	9
Mixed Livestock Farms which moved to Beef Farms	2
Hog Farms which moved to Beef Farms	1
Beef Farms which were first interviewed	13

TABLE V
CHANGES IN NUMBER OF HOG FARMS

Hog Farms in 1965	48
Hog Farms in 1962	70
Hog Farms which operated both in 1962 and 1965	24
Cash Grain Farms which moved to Hog Farms	2
Mixed Livestock Farms which moved to Hog Farms	11
Beef Farms which moved to Hog Farms	2
Hog Farms which were first interviewed in 1965	9

Two cash grain farms, eleven mixed livestock farms, and two beef cattle farms changed to hog farms between 1962 and 1965. Nine hog farms were interviewed for the first time in 1965.

The commercial hog farms had the largest proportion of farms which had operated as the same type in both years. Perhaps the higher investment in hog equipment and buildings keeps more operators in the hog business than otherwise would do so. However, along with the mixed livestock operation, the number of hog farms had the largest decrease—a reflection, in part, of the effect of relatively low hog price prior to 1965.

Dairy Farms

In 1962, 15 commercial dairy farms were operating in the same area and 12 were operating in 1965—a decrease of three. Four farms operated in both 1962 and 1965 as dairy farms. One mixed livestock farm, one beef farm, and three hog farms had changed to dairy operations. Three dairy farms were interviewed for the first time in 1965.

The number of dairy farms stayed fairly constant over the four-year period with most of the change occurring as an increase in large dairy farms and a decrease in the small dairy farms.

TABLE VI
CHANGES IN DAIRY FARM NUMBER

Dairy Farms in 1965	12
Dairy Farms in 1962	15
Dairy Farms which operated both in 1962 and 1965	4
Mixed Livestock Farms which moved to Dairy Farms	1
Beef Farms which moved to Dairy Farms	1
Hog Farms which moved to Dairy Farms	3
Dairy Farms which were first interviewed in 1965	3

Changes in Farm Classes

The classes of farms are a combination of the size and type of farms, of which there are fourteen. They are: small cash grain, small mixed livestock, small beef, small hog, small dairy, medium cash grain, medium mixed livestock, medium beef, medium hog, large cash grain, large mixed livestock, large beef, large hog, and large dairy farms. Changes occurred in the numbers of farms in nearly all of the classes. However, only the number of all sizes of cash grain farms and of small beef cattle farms increased. There were the same number of large mixed livestock and large dairy farms as in 1962. The changes by individual farm classes are described in the following sections and shown in Tables VII, VIII, IX and Appendix Table I through VI.

Small Cash Grain Farms

In 1962 there were seven small cash grain farms in the sampled area and by 1965, a total of 18 such farms were operating--an increase of 11 farms (Table VII). The seven small cash grain farms of 1962 shifted in the following ways: two remained small cash grain farms, one became a medium cash grain farm, one was screened out as a noncommercial farm, one was screened out as a noncensus farm, one was nonexistent, and one refused to be interviewed (see Appendix Table I). A total of six farms shifted to small

TABLE VII

NUMBERS OF SMALL FARMS BY SIZE AND TYPE OF FARM CLASSIFICATION IN 1965
AND CHANGES FROM 1962 CLASSIFICATION

	Small cash grain farms	Small livestock farms	Small mixed farms	Small beef farms	Small hog farms	Small dairy farms
Farms in Classification in 1962	7	31	7	24	8	8
Farms in Classification in 1965	18	5	16	19	5	5
Change from 1962 to 1965	+11	-26	+9	-5	-3	-3
1965 farms of the same class as in 1962	2	3	1	8	1	1
1965 farms that were other class in 1962	6	0	4	8	1	1
1962 farms that changed to other classes in 1965	1	16	0	7	4	4
1965 farms that were interviewed for the first time in 1965	10	2	11	3	3	3
Refusals, screened out, or nonexistent in 1965	4	12	6	9	3	3

cash grain farms from the following classes: two small mixed livestock farms, one small hog farm, two medium cash grain farms, and one large beef farm. Ten farms, interviewed for the first time in 1965, were classified as small cash grain farms (see Appendix Table IV).

Small Mixed Livestock Farms

In 1962, there were 31 small mixed livestock farms operating in the sampled area but by 1965 there were only five—a decrease of 26 over the three-year period. The small mixed livestock farms of 1962 shifted in the following ways: three remained small mixed livestock farms, two became small cash grain farms, two became small beef farms, four became small hog farms, two became medium mixed livestock farms, one became a medium hog farm, one became a large cash grain farm, two became large mixed livestock farms, one became a large hog farm, one became a large dairy farm, one was screened out as a noncommercial farm, six were screened out as noncensus farms, one refused to be interviewed, and four were nonexistent by 1965.

No farms were added to the small mixed livestock classification which had operated in a different class during 1962. Two farms, classified as small mixed livestock farms, were interviewed for the first time in 1965.

Small Beef Farms

In 1962, seven small beef farms were operating in the sampled area and in 1965, 16 farms were classified as small beef farms--an increase of nine during the period. The seven small beef farms of 1962 shifted in the following ways: one remained as a small beef farm, two were screened out as noncommercial farms, three were screened out as non-census farms, and one was nonexistent in 1965. A total of four farms shifted to the small beef from the following classes: two small mixed livestock farms, one medium beef farm, and one large beef farm. Eleven farms, interviewed for the first time in 1965, were classified as small beef farms.

Small Hog Farms

There were 24 small hog farms operating in the sampled area in 1962 and 19 such units were operating in 1965--a decrease of five farms for the three-year period. The 24 small hog farms shifted in the following ways: eight remained as small hog farms, one became a small grain farm, one became a medium grain farm, one became a medium mixed livestock farm, two became medium hog farms, one became a large hog farm, one became a large dairy farm, four were screened out as noncommercial farms, one refused, and four were nonexistent in 1965. A total of eight farms shifted

to small hog farms from the following classes: four small mixed livestock farms, one medium beef farm, two medium hog farms, and one large beef farm. Three farms, where interviews were taken for the first time in 1965, were classified as small hog farms.

Small Dairy Farms

In 1962, eight small dairy farms were operating in the sampled area and in 1965, five--a decrease of three. The eight small dairy farms had changed in the following ways: one remained a small dairy farm, two became medium cash grain farms, two became large cash grain farms, one was screened out as a noncensus farm, one refused the information, and one farm became nonexistent in 1965.

Only one farm, a large dairy unit, shifted to a small dairy farm. Three operators who were interviewed for the first time in 1965 were classified as small dairy farmers.

Medium Cash Grain Farms

In 1962, 16 medium cash grain farms were operating in the sampled area and in 1965 there were 23, for an increase of seven during the three-year period. (See Table VIII.) The 16 medium cash grain farms had changed in the following ways: one remained a medium cash grain farm, two became small cash grain farms, one became a medium hog farm, three became large cash grain farms, three were

TABLE VIII

NUMBERS OF MEDIUM FARMS BY SIZE AND TYPE OF FARM CLASSIFICATION IN 1965
AND CHANGES FROM 1962 CLASSIFICATION

	Medium cash grain farms	Medium mixed livestock farms	Medium beef farms	Medium hog farms
Farms in Classification in 1962	16	19	10	22
Farms in Classification in 1965	23	18	3	17
Change from 1962 to 1965	+7	-1	-7	-5
1965 farms of the same class as in 1962	1	3	2	3
1965 farms that were other class in 1962	16	14	0	11
1962 farms that changed to other classes in 1965	6	13	7	15
1965 farms that were interviewed for the first time in 1965	6	1	1	3
Refusals, screen outs, or nonexistent in 1965	9	3	1	4

screened out as noncensus farms, and six farms were non-existent in 1965 (see Appendix Table II). A total of 16 farms shifted to the medium cash grain farm classification. They were from the following classes: one small cash grain farm, one small hog farm, two small dairy farms, four medium mixed livestock farms, four medium beef farms, two medium hog farms, one large mixed livestock farm, and one large beef farm. Six farms, where interviews were taken for the first time in 1965, were classified as medium cash grain farms (see Appendix Table V).

Medium Mixed Livestock

Nineteen medium mixed livestock farms were operating in the sampled area in 1962 and 18 in 1965—a decrease of only one in the three year period. The 19 medium mixed livestock farms of 1962 changed in the following ways: three remained medium mixed livestock farms, four became medium cash grain farms, three became large mixed livestock farms, one became a large hog farm, one was screened out as a noncensus farm, and two were refusals. A total of 14 farms shifted to medium mixed livestock farms in 1965 from the following classes: two small mixed livestock farms, one small hog farm, six medium hog farms, two large cash grain farms, two large mixed livestock farms, and one large hog farm. One farmer who was interviewed for the first time in 1965 was classified as having a medium mixed livestock farm.

Medium Beef Farms

In 1962, ten medium beef farms were in operation and in 1965 only three--a decrease of seven. The ten medium beef farms had changed in the following ways: two remained medium beef farms, one became a small beef farm, one became a small hog farm, four became medium cash grain farms, one became a large beef farm, and one refused to complete the questionnaire. There were no medium beef farms in 1965 which had operated in a different class in 1962. Only one farmer was interviewed for the first time in 1965.

Medium Hog Farms

In 1962, there were 22 medium hog farms operating in the sampled area and in 1965 there were 17--a decrease of five for the three year period. The 22 medium hog farms of 1962 changed by 1965 in the following ways: three remained medium hog farms, two became small hog farms, two became medium cash grain farms, six became medium mixed livestock farms, one became a large cash grain farm, one became a large mixed livestock farm, one became a large hog farm, two became large dairy farms, two were screened out as non-census farms, and two became nonexistent. A total of 11 farms shifted to become medium mixed livestock farms in 1965. They were from the following classes: one small mixed livestock farm, one small hog farm, one medium cash

cash grain farm, two medium mixed livestock farms, one large cash grain farm, two large mixed livestock farms, and two large hog farms. Three farms, where interviews were taken for the first time in 1965, were classified as medium hog farms.

Large Cash Grain Farms

Fifteen large cash grain farms were operating in the sampled area in 1962 and 26 in 1965--an increase of 11 farms. The 15 large cash grain farms of 1962 changed in the following ways: five remained as large cash grain farms, two became medium mixed livestock farms, one became a medium hog farm, one became a large hog farm, two were screened out as noncensus farms, three became nonexistent (see Appendix Table III). A total of 13 farms shifted to become large cash grain farms from the following classes: one small hog farm, two small dairy farms, three medium cash grain farms, three medium mixed livestock farms, one medium hog farm, two large mixed livestock farms, and one large beef farm. Eight farms, where interviews were taken for the first time in 1965, were classified as large cash grain farms (see Appendix Table VI).

Large Mixed Livestock Farms

In both 1962 and 1965 there were 19 large mixed livestock farms operating in the sampled area. The 19 large

TABLE IX

NUMBER OF LARGE FARMS BY SIZE AND TYPE OF FARM CLASSIFICATION IN 1965
AND CHANGES FROM 1962 CLASSIFICATION

	Large cash grain farms	Large mixed livestock farms	Large beef farms	Large hog farms	Large dairy farms
Farms in Classification in 1962	15	19	14	24	7
Farms in Classification in 1965	26	19	6	12	7
Changes from 1962 to 1965	+11	-0	-8	-12	0
1965 farms of the same class as in 1962	5	5	3	5	2
1965 farms that were other classes in 1962	13	13	2	4	5
1962 farms that changed to other classes in 1965	4	7	8	8	1
1965 farms that were interviewed for the first time in 1965	8	1	1	3	0
Refusals, screen outs, or nonexistent in 1965	6	7	3	11	4

cash grain farms of 1962 changed by 1965 in the following ways: five remained as large mixed livestock farms, two became medium mixed livestock farms, two became medium hog farms, one became a medium cash grain farm, two became large cash grain farms, one was screened out as a noncommercial farm, three were screened out as noncensus farms, two were refusals, and one became nonexistent. A total of 13 farms which had operated during 1962 in a different class shifted to become large mixed livestock farms. These were from the following classes: two small mixed livestock farms, three medium mixed livestock farms, one medium hog farm, two large beef farms, and five large hog farms. There was only one farmer who was interviewed for the first time in 1965 with an operation classified as a large mixed livestock farm.

Large Beef Farms

In 1962 there were 14 large beef cattle farms in operation in the sampled area. The 1965 survey results showed that there were only six such farms remaining--a decrease of eight during the three year period. The 14 large beef farms of 1962 had changed in the following ways: three remained as large beef farms, one became a small cash grain farm, one became a small beef farm, one became a small hog farm, one became a medium cash grain farm, one became a large cash grain farm, one became a large mixed livestock

farm, one became a large dairy farm, two were screened out as noncensus farms, and one became nonexistent. A total of two farms shifted to become large beef farms from the following classes: one medium beef farm and one large hog farm. There was only one farm where an interview was taken for the first time which was classified as a large beef farm.

Large Hog Farms

In 1962 there were 24 large hog farms operating in the sampled area and by 1965 these decreased by one-half to only 12 farms. The 24 large hog farms of 1962 had changed in 1965 in the following ways: five remained as large hog farms, one became a medium mixed livestock farm, two became medium hog farms, four became large mixed livestock farms, one became a large beef farm, three were screened out as non-census farms, one was a refusal, and seven became nonexistent. A total of four farms shifted to become large hog farms from the following classes: one small mixed livestock farm, one small hog farm, one medium mixed livestock farm, and one medium hog farm. Three farms, where interviews were taken for the first time in 1965, were classified as large hog farms.

Large Dairy Farms

In both 1962 and 1965, seven large dairy farms were operating in the sampled area. The seven large dairy farms of 1962 changed in the following ways: two remained large dairy farms, one became a small dairy farm, two were refusals, and two became nonexistent. A total of five farms shifted to become large dairy farms from the following classes: one small mixed livestock farm, one small hog farm, two medium hog farms, and one large beef farm.

Implications of Changes

The overall change which seems to be reflected in this chapter is the increase in the types of enterprises which take less labor relative to their returns while those enterprises which use larger amounts of labor are on the decline. This was reflected most prominently by the cash grain farms which were the only type where all size units increased in numbers. Small beef cattle farms increased but the small mixed livestock and hog farms declined substantially in number. The medium and large mixed livestock, beef, and hog farms all decreased or held about the same in numbers, indicating that livestock farms in Northeast Missouri may have to be larger scale operations to survive any length of time.

On farms with livestock, hog operations seem to be the main enterprise with cattle used mainly to supplement

hog operations (even on most mixed livestock farms). Low hog prices in 1963 and 1964, however, caused some livestock operators to increase the size of their cattle operations and they, therefore, moved to the mixed livestock farm type.

Hog prices suddenly shifted much higher in 1965 and caused the value of the livestock inventories of the large mixed livestock and hog farms to be greatly increased. As a result many larger hog farmers increased their scale of operations but relatively few hog operations appear to have come into operation. Thus, the small part-time farmer often referred to as the "in-and-outer" may not be resuming operations as prices increase to the extent formerly common but the larger operator is increasing in size to take advantage of the prices. This process should tend to increase the length of the hog price cycle.

Movements of these types on farms also would support the concept of a changing image of the farm today. It means that the farm which formerly would shift quickly on a small scale to the type of enterprise which was at that moment enjoying high prices for its commodity is now either not operating or else has moved to grain farming or a small beef operation which requires less labor.

Beef cattle numbers appear to have been increasing in the study area but specialized cattle operations have declined. Only the small beef cattle farms increased in

numbers, probably as a result of more semi-retirement type units where older farmers tend to specialize in beef cow operations since they require relatively little labor. Cow herds increased on other farms as a supplemental or forage using enterprise. Cattle feeding does not appear to have increased appreciably if at all.

CHAPTER IV

PRODUCTION FUNCTION ANALYSIS

The production function used in this analysis was the Cobb-Douglas form, a power function which is linear in log form and therefore can be fit by ordinary least squares procedures. The procedure was the same as that used by Brees.¹

The general form of the Cobb-Douglas model is as follows:

$$Y = aX_1^{b_1} X_2^{b_2} \dots X_n^{b_n}$$

Where Y is the dependent variable (considered the output), X_1 through X_n are the independent variables (considered the inputs), a is the constant and b_1 through b_n are the transformation ratios. The equation is then used to estimate the level of the output as a function of the given inputs. The transformation ratios for the Cobb-Douglas function show the contribution that each unit of the input makes to output—they are the partial elasticities of production. By summing these transformation ratios, $b_1 + b_2 + \dots + b_n$, the total elasticity of production (percentage change in output divided by the percentage change in inputs) can be determined.

¹Francis Brees, Production Function Analysis of North Missouri Farms--1962, Unpublished M.S. thesis, University of Missouri, 1964.

For the variables in this model a total elasticity of production equal to one would indicate constant returns to scale; an elasticity of less than one would indicate decreasing returns to scale; and an elasticity of greater than one would indicate increasing returns to scale.

The Cobb-Douglas function is converted to logarithmic form for computational purposes. It is of the form:

$$\ln Y = \ln a + b_1(\ln X_1) + b_2(\ln X_2) + \dots + b_n(\ln X_n).$$

This function is fitted by the standard least squares multiple regression techniques since in this form it is linear.

Model and Variables Used

The model and variables used were identical to the 1962 Brees Analysis in so far as possible. The exact form of the Cobb-Douglas function used was:

$$Y = aX_1^{b_1}X_2^{b_2}X_3^{b_3}X_4^{b_4}X_5^{b_5}$$

Where the parameters a , b_1 , b_2 , b_3 , b_4 , and b_5 were estimated by fitting the model with data for the variables Y and X_1 through X_5 from the farm survey.

The variables used were:

Y = gross revenue in dollars

X_1 = tillable land in acres

X_2 = labor in weeks of man labor

X_3 = major equipment investment in dollars

X_4 = livestock and crop inventories in dollars

X_5 = cash expenses in dollars.

Gross Revenue

In 1962, gross revenue was determined by multiplying physical sales of livestock, crops, and other products by standard prices. In 1965, gross revenue was that actually received by the farmer from sales of livestock and crops. In both cases, returns from custom work were added and cost of purchased livestock deducted, giving the gross revenue figure in dollars. The 1965 data was obtained directly as dollar sales rather than in physical units. An attempt was made to adjust the 1965 data to 1962 price levels by multiplying the 1962 standard prices times the 1965 physical sales of livestock, crops, and other products. This production function using this proved to be unrealistic in terms of the regression coefficients and the coefficient of determination in comparison with the 1962 results.

Tillable Land

The land resource in both periods was measured in "tillable acres." In 1962 this was land plowed in the last seven years. The 1965 survey asked for all the land which the farmer considered to be tillable and this figure was used. This could perhaps result in a small error because of

the difference in the way the question was presented to the farm operators. Also it does not include permanent pastureland which is an important input for beef and dairy farming. It should, however, be a good measure of the productive land on the different farms.

Labor

Labor in both time periods was measured in weeks of labor for all kinds of labor used on the farm. All full-time, part-time, and family labor was included and summed with family labor adjusted to man-equivalents to arrive at the figure. No particular problems were encountered and the data for the two years should compare very favorably.

Major Equipment Investment

The major equipment investment was measured as the present value in dollars of farm equipment owned by the operator. In 1963 this figure was taken directly from the schedule. However, in 1962, for the farmers who had completed the schedule in 1962, a depreciated value of all equipment they had listed in 1962 had to be computed. It was determined by use of the straight line depreciation method over a ten year period. To obtain the adjusted figure thus .70 was multiplied times the 1962 figure and the current value of all machinery purchased from 1962 to 1965 was added to obtain the value of the 1965 equipment on

each farm. This could cause some difference between the two sample results when they are compared.

Livestock and Crop Inventory

The crop and livestock inventories were measured in dollar values of livestock on the farm and crops held for sale or for livestock feed at the beginning of the year. The 1962 analysis used the closing inventory of 1962 to obtain this figure, while the 1965 inventory value was obtained from the inventory held at the beginning of the year. The beginning inventory was chosen in the belief that the inventory in the beginning of the year would have more effect on the gross income (dependent variable) than would the ending inventory.

Cash Expenses

Cash expenses were measured in dollars. In 1962 physical quantities of feed, fertilizer and purchased livestock were multiplied by adjusted prices to obtain the cash expenses for the model. It was considered the weakest independent variable used since only a part of the total cash expense outlay of a farm was used. The model was set up with this variable once with only feed and fertilizer as the cash expense and a second time with purchased livestock added to the cash expenses. A large number of farms did not purchase livestock, and therefore a separate variable using

only purchased livestock could not be used.

In 1965, the data was obtained by summing all reported cash expenses, including feed, fertilizer, and purchased livestock. An attempt was made to adjust these costs to the 1962 level by multiplying the 1965 quantities times the 1962 prices, but this resulted in unrealistic regression coefficients and a low coefficient of determination.

Zero Levels of Resource

As in the 1962 study there were zero values obtained for major equipment investment, livestock and crop inventory, and cash expense in a few cases. To compensate for this, since the logarithm for zero is undefined, a one was added to each value of the observations of those variables.

Farm Samples Fitted

The function was first fitted to the 194 commercial farms. It is compared with the 1962 sample of 223 farms. The objective was to compare the over-all change of the aggregate production functions of the total sample of Northeast Missouri farms.

The farms were classified as cash grain, mixed livestock, beef, hog, and dairy farms. The model was then fitted for the 67 cash grain farms, 41 mixed livestock farms, 25 beef farms, 48 hog farms, and 13 dairy farms. This was compared with the model for 1962 where there were 38 cash

grain farms, 69 mixed livestock farms, 31 beef farms, 70 hog farms, and 15 dairy farms, enabling a look at the overall changes within these classifications during the three year period.

Next, the sample data for 130 farms whose household head operated units in both 1962 and 1965 were fitted to the model. For 1962, models also were estimated for 18 cash grain, 43 mixed livestock, 19 beef, 43 hog, and 8 dairy farms. These results were compared to the 1965 data from 35 cash grain farms, 34 mixed livestock farms, 10 beef farms, 38 hog farms, and 10 dairy farms. This allowed comparisons of the changes between the different types of farms which had the same operator over the three year period. The movements observed from this latter analysis should be more representative of the commercial, full-time farmer.

Results and Comparisons of Models

The models were fitted and the arithmetic means, coefficients of determination and regression coefficients were computed. The results and comparisons between 1962 and 1965 for the (1) arithmetic means, (2) coefficients of determination and (3) regression coefficients are examined in the following section of this chapter.

Arithmetic Means

The arithmetic means were computed by dividing the total units in each variable by the number of farms in the sample to find the average for the farms in that sample.

Income. The average increase in gross income per farm from 1962 to 1965 was \$5,743 (Table X). The change was significant at the .005 probability level.² By far the largest increase was for the mixed livestock farms which had increased gross incomes of around \$17,446 (significant at

²The test for the significance of change between the means for 1962 and 1965 were all calculated in the following manner for all the variables.

$$\text{The formula--- } t = \frac{\bar{X}_1 - \bar{X}_2}{Sp \sqrt{1/N_1 + 1/N_2}}$$

$$\text{where } Sp = \frac{(N_1-1)S_1 + (N_2-1)S_2}{N_1+N_2-2} .$$

The test for significance of the change for the mean of the variable gross income between 1962 and 1965 for total farms where purchased livestock was not added to cash expense was calculated as follows:

$$Sp = \frac{(222) 13,742 + (193) 20,858}{415} = 17,051$$

$$t = \frac{5743}{17,051 \sqrt{1/223 + 1/194}}$$

$$t = 3,458 \quad t \text{ for } .005 = 2.576.$$

The change between the two means is thus significant statistically at the .005 probability level. This means that a difference as large as indicated would occur by chance only 5 times out of 1,000.

TABLE X
ARITHMETIC MEAN AND STANDARD DEVIATION
FOR GROSS FARM INCOME

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	13,842	19,585	+ 5743	13,742	20,858
Cash Grain	10,736	13,829	+ 3093	6,913	12,185
Mixed Livestock	12,127	29,573	+17446	13,238	28,468
Beef	16,927	18,863	+ 1936	20,891	30,505
Hog	18,840	19,851	+ 1011	26,327	13,973
Dairy	13,532	16,576	+ 3044	9,423	15,691
Same Operators in 1962 and 1965					
All Farms	14,946	21,794	+ 6848	14,530	20,966
Cash Grain	12,361	15,162	+ 2801	7,158	12,242
Mixed Livestock	13,331	31,461	+18130	14,281	28,843
Beef	20,750	19,898	- 852	24,442	28,788
Hog	15,184	20,630	+ 5446	11,754	14,731
Dairy	14,025	19,834	+ 5809	8,372	17,120

.005 probability level)--much above the average increase. The other farms had average increases of from \$1,011 for hog farms, to \$3,093 for cash grain farms. The mixed livestock farms had such a large increase in gross income because there were relatively few small farms in 1965 but had been a large number of small mixed livestock farms in 1962. This, also, can be seen by looking at the means of the other variables which show mixed livestock as the largest in almost all the categories.

The results of the income changes for the 130 farmers who operated in both years showed an increase of 6,848 dollars (significant at .005 level) between the two years-- a little over a 1,000 dollars more than for all farms in the two surveys. Only the beef cattle farms showed a decline in income for this period with a decline of \$852 (not statistically significant) caused by an increase in numbers of small beef farms. The pattern for increased income on the farms with the same operators, however, was similar to that for all farms.

Land. The change in crop acres per farm for the sampled area between 1962 and 1965 was a negative 18 acres (significant at .20) with an average of 211 acres operated in 1965 (Table XI). Only the mixed livestock farms had an increase in acreage. The largest declines in cropland acreage were for the dairy and beef farms which showed

TABLE XI
 MEAN AND STANDARD DEVIATION FOR CROPLAND
 ACRES OPERATED PER FARM

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	229	211	- 18	180	213
Cash Grain	255	227	- 28	173	178
Mixed Livestock	207	795	+ 88	178	301
Beef	263	161	-102	177	180
Hog	232	170	- 62	177	179
Dairy	212	97	-115	231	83
Same Operators in 1962 and 1965					
All Farms	239	231	- 8	179	230
Cash Grain	287	243	- 44	205	167
Mixed Livestock	221	318	+ 97	189	317
Beef	315	197	-118	185	184
Hog	216	173	- 43	160	199
Dairy	180	115	- 65	94	88

declines of 115 acres (significant at .05) and 102 acres (significant at .025) respectively. The reason for the increase in crop acreage for the mixed livestock farms was the decline in the numbers of small farms in the category. In 1962 many farms were in the small category whereas in 1965 almost all were of the medium or large categories.

The 130 farms which operated in both years had an average decline of only about 8 acres (not statistically significant) during this time and operated farms which had, on the average, 20 more crop acres than for all farms in the sample. Each of the different farm types which had operated also in 1962 averaged a greater number of crop acres than for the total of the respective types in 1965, but followed essentially the same pattern of change in average size between the different farm types as the total farms did.

Labor. The biggest surprise in the results occurred in the use of labor which had an average increase of five weeks of labor per farm (significant at .10 level) for all farms in 1965 over the 1962 levels (Table XII). The largest average change was a 24 week increase (significant at .005) for the mixed livestock farms. The cash grain, beef and dairy farms actually had decreased average amounts of labor used, which could be expected; their crop acreage also declined.

TABLE XII
 MEAN AND STANDARD DEVIATION FOR WEEKS OF LABOR
 USED PER FARM IN MAN EQUIVALENTS

<u>Total Farm Operators</u>					
Farm Type	<u>Mean</u>			<u>Standard Deviation</u>	
	1962	1965	Change	1962	1965
All Farms	68	73	+ 5	33	46
Cash Grain	64	62	- 2	27	33
Mixed Livestock	63	87	+24	29	57
Beef	67	62	- 5	34	33
Hog	74	81	+ 7	37	52
Dairy	83	81	- 2	44	42
<u>Same Operators in 1962 and 1965</u>					
All Farms	70	82	+12	35	49
Cash Grain	69	70	+ 1	34	33
Mixed Livestock	64	90	+16	32	60
Beef	73	76	+ 3	39	38
Hog	76	86	+10	37	56
Dairy	73	93	+20	20	35

The 130 farms with the same operators in both years had an increase in labor used for all the different types of farms with the largest increase on the dairy farms. One factor accounting for this was the increased amount of family labor used on the farms with more of the farm children becoming older and working more and with increased usefulness.

The overall increase in the use of labor combined with a decrease in crop acres and without substantially more livestock would seem to indicate a loss of efficiency of labor in this area between 1962 and 1965. The additional family labor used, however, comes at an essentially zero cost since it is available whether used or not.

Major Equipment Investment. The average value of farm equipment used per farm declined by \$1,269 (significant at .10 probability level) for all sample farms between 1962 and 1965 with only mixed livestock farms showing an increase (Table XIII). The 130 farms with same operators also had about the same decline. Relatively little new machinery was obtained by the farms in the area during the period 1962 to 1965. Depreciation of the older equipment more than offset the increased value from the newer equipment.

This decline in value of equipment could mean that gross income was increased more from the increased use of labor and other inputs in the area between 1962 and 1965

TABLE XIII
 MEAN AND STANDARD DEVIATIONS FOR INVESTMENT
 IN MAJOR EQUIPMENT

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	8535	7266	-1269	8889	7759
Cash Grain	9640	7063	-2577	8411	6455
Mixed Livestock	6925	8619	+1694	6877	8559
Beef	8322	6321	-2001	8485	9819
Hog	9219	7592	-1627	8988	7785
Dairy	11503	4326	-7177	15950	6692
Same Operators in 1962 and 1965					
All Farms	9663	8391	-1272	8786	7988
Cash Grain	11563	8989	-2574	7842	7164
Mixed Livestock	8307	8994	+ 687	7889	8637
Beef	9439	8592	- 847	8910	11972
Hog	10444	7877	-2567	9541	7227
Dairy	9156	5346	-3810	11485	7539

instead of from the increased use of capital for equipment. Also the flow of inputs from the older equipment would not have diminished. Increased capital usually is associated with increased acreages but the average farm in the sample actually decreased in size.

Livestock and Crop Inventory. A very large increase in livestock and crop inventory per farm occurred with the average per farm being \$19,850 (significant at .005) from 1965 to 1962 (Table XIV). Farmers who operated in both 1962 and 1965 increased their inventory by \$22,605 (significant at .005). These increases were accounted for by an increase in both livestock and crops held for feed and sale. The largest increase was found in crops held for feed which accounted for more than half of the inventory value. Lower prices for soybeans, corn, and wheat combined with higher prices for hogs and cattle for 1965 could account for the farmers' inclination to hold their crops and at the same time add to their livestock inventory. They feed their grains to take advantage of higher livestock prices.

Feed, Fertilizer, and Other Cash Expenses. Due to the addition in 1965 of other cash expenses to the feed and fertilizer expense a large increase between 1962 and 1965 can be observed (Table XV). The average farm in 1965 shows a \$7,199 increase over 1962. The largest increase comes from mixed livestock and hog operations which showed an increase

TABLE XIV
 MEAN AND STANDARD DEVIATION FOR LIVESTOCK
 AND CROP INVENTORIES (DOLLARS)

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	7757	27607	+19850	9199	29835
Cash Grain	3836	14125	+10289	4009	18606
Mixed Livestock	6314	45926	+39612	5282	40829
Beef	11461	28213	+16752	14688	31227
Hog	8912	30516	+21604	10238	22435
Dairy	11065	25874	+14809	10368	24898
Same Operators in 1962 and 1965					
All Farms	8401	31006	+22605	10179	30487
Cash Grain	4191	15642	+11451	4494	21740
Mixed Livestock	7280	46559	+39279	5575	39912
Beef	14031	33568	+19537	17709	22265
Hog	8522	31499	+22977	10774	23705
Dairy	9339	32233	+22894	5871	25804

TABLE XV
 MEAN AND STANDARD DEVIATION FOR FEED, FERTILIZER
 AND OTHER CASH EXPENSES (DOLLARS)

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	2300	9499	+ 7199	2514	13000
Cash Grain	1466	6161	+ 4695	1169	5445
Mixed Livestock	2081	12216	+10135	2307	14628
Beef	2278	7527	+ 5249	2469	9535
Hog	3054	13402	+10348	2924	19426
Dairy	1393	7122	+ 5729	990	6186
Same Operators in 1962 and 1965					
All Farms	2547	10929	+ 8382	2563	14803
Cash Grain	1819	6895	+ 5076	1168	4848
Mixed Livestock	2542	12829	+10287	2571	15276
Beef	2598	9153	+ 6555	2641	9602
Hog	2959	14426	+11467	3044	21718
Dairy	1736	8608	+ 6872	1112	6505

\$10,135 and \$10,348 respectively. The farmers who operated in both years followed essentially the same pattern with a slightly larger increase in expenses due to their larger operations which have greater total costs.

Because of the addition of other cash expenses to the 1965 survey a comparison between the average means of 1962 and 1965 cannot be made. Only the relative increase between the different types of farms should be noted.

Feed, Fertilizer, and Purchased Livestock Expense.

This variable was obtained by adding the value of purchased livestock to the feed and fertilizer expense previously calculated and because of the addition of other cash expenses to the 1965 figures only the relative increases between the different farm types should be noted (Table XVI). The average value for purchased livestock expense actually held very stable with an increase of only \$104 (not statistically significant) over 1962 with mixed livestock farms showing the largest increase, \$2,106 (significant at .30). The amount of purchased livestock on beef cattle farms declined on the average \$2,868 (significant at .30) while the other farm types were relatively stable. The changes would be due more to the changes in size of farming operations which occurred in these two types of operations, whereas mixed livestock farms increased in size the beef farms decreased greatly in its size of operations accounting for the

TABLE XVI
 MEAN AND STANDARD DEVIATION FOR FEED, FERTILIZER
 AND PURCHASED LIVESTOCK EXPENSES (DOLLARS)

Total Farm Operators					
Farm Type	Mean			Standard Deviation	
	1962	1965	Change	1962	1965
All Farms	4379	11682	+ 7303	7474	15754
Cash Grain	1732	6777	+ 5045	1774	5777
Mixed Livestock	4002	16243	+12241	5887	17198
Beef	10144	12525	+ 2381	15441	17977
Hog	4384	15138	+10754	4953	21680
Dairy	1452	7513	+ 6061	963	6317
Same Operators in 1962 and 1965					
All Farms	4846	13321	+ 8475	7509	17054
Cash Grain	2027	7797	+ 5770	1354	5376
Mixed Livestock	4709	16952	+12243	6243	17414
Beef	10642	14257	+ 3615	15227	16220
Hog	4242	16478	+12236	4389	24273
Dairy	1847	9122	+ 7275	1018	6546

changes in value of livestock bought.

Coefficients of Determination Without Purchased Livestock

The percentages of variation in the gross revenue explained by the variables in the models are the coefficients of determination shown in Table XVII. In 1962, these variables explained .6641 per cent of variance in gross income received by the 223 farms in the sample while in 1965 these variables explained .6196 per cent of the gross income received by the 194 farms operating in the sample area. The change of explained variation could be due to many different things some of which could be the change in techniques of production, different weather conditions, errors in the survey between 1962 and 1965, and the change in the way the data was collected. The coefficients of determination for the different farm types decreased except for the beef cattle and hog farms which had small increases. The results of beef and dairy farms cannot be considered very accurate, since there were insufficient observations in the sample and hence the degrees of freedom were low. This is particularly true of the dairy farms where there were only 15 observations.

For the farms which operated in both years the coefficients of determination changed from .6724 in 1962 to .5664 in 1965. The coefficients for the different farm

TABLE XVII

FARM SAMPLES, CONSTANT VALUES AND COEFFICIENTS OF DETERMINATION

X₅ = Feed and Fertilizer Expenses

Farm Type	1962			1965		
	No. farms in sample	Constant value	Coefficient of determination	No. farms in sample	Constant value	Coefficient of determination
All Farms	223	3.56041	.6641	194	3.04888	.6196
Cash Grain	38	3.19297	.7700	67	4.03167	.6816
Mixed Livestock	69	2.29029	.7839	42	2.37979	.7274
Beef	31	5.79025	.6176	25	2.43576	.6277
Hog	70	3.96063	.5751	48	2.64522	.6432
Dairy	15	2.16100	.7825	12	6.19991	.5548
Same Operators in 1962 and 1965						
All Farms	130	3.47957	.6724	130	3.30597	.5664
Cash Grain	17	4.97870	.7712	39	4.54332	.6412
Mixed Livestock	43	2.64780	.8628	35	3.39594	.5882
Beef	18	2.75314	.8181	10	11.40208	.6312
Hog	44	4.65224	.5550	37	1.90383	.7311
Dairy	8	-.70688	.8608	9	14.28358	.7153

types varied between the two years in approximately the same manner as for all farms in the sample.

Purchased Livestock Added to Expense Variable. The addition of purchased livestock caused the coefficients of determination to increase in 1965 in all cases except for hog and dairy farms (Table XVIII). These results are comparable to those in 1962 with the addition of purchased livestock. The changes between 1962 and 1965 were smaller than without purchased livestock with the coefficient of determination for all farms going from .6770 in 1962 to .6523 in 1965. The only increase was with the beef farms, where purchased livestock is more important and for which the coefficient went from .4940 to .6923. Other farm types had decreased coefficients with the largest decrease for dairy farms, going from .8157 to .5294.

The coefficients of determination for the farms with the same farm operators followed approximately the same pattern as for all farms, going from .6444 in 1962 to .6115 in 1965. The mixed livestock farms coefficient went from .8348 to .6750, but the equations for the cash grain, beef cattle and hog farms all had increased coefficients of determination.

TABLE XVIII

FARM SAMPLES, CONSTANT VALUES, AND COEFFICIENTS OF DETERMINATION

X₅ = Feed, Fertilizer, and Purchased Livestock Expenses

Farm Type	All Sample Farms			Coefficient of determination	No. farms in sample	Constant value	Coefficient of determination
	1962	1965	1965				
All Farms	223	3.36987	.6770	194	2.86348	.6523	
Cash Grain	38	3.06597	.7663	67	3.39234	.7584	
Mixed Livestock	69	2.20836	.7978	42	1.53920	.7793	
Beef	31	3.62258	.4940	25	2.41500	.6923	
Hog	70	3.77875	.6481	48	2.62637	.6372	
Dairy	15	2.03566	.8157	12	5.82643	.5294	
				Same Operators in 1962 and 1965			
All Farms	130	3.36990	.6444	130	2.94344	.6115	
Cash Grain	17	4.37373	.7208	39	3.95263	.7522	
Mixed Livestock	43	2.66375	.8348	35	2.48868	.6750	
Beef	18	3.19882	.5692	10	5.16436	.7553	
Hog	44	4.27434	.6619	37	2.04702	.6995	
Dairy	8	-.99424	.8762	9	15.94606	.7406	

Elasticities of Production

The regression coefficients in Tables XVII and XVIII determine the elasticities of production for the two different years. The elasticity of production is the change in output which can be attributed to the proportional and simultaneous change of all resources. The sum of the regression coefficients for all the resources in the model then gives the elasticity of production for the model.

Purchased Livestock Not Included in the Expense Variable. For the model without purchased livestock included in the cash expenses variable the elasticity of production for all sample farms in 1965 was .8540 as compared to .9357 in 1962. The coefficients and elasticities are shown in Tables XIX and XX. All coefficients were significant at the five per cent level except the coefficient for labor in 1965, which had a negative coefficient and characteristically was not significant. This seems to indicate more intensive farming for this area in 1965 than in 1962. The change in the coefficients for the different variables showed land as decreasing in importance by going from .38690 in 1962 to .27996 in 1965. This change was statistically significant at the .005 probability level.³ Cash expenses became the

³The test for the significance of change between the regression coefficients for 1962 and 1965 were all calculated in the following manner for all variables:

TABLE XIX

1962 REGRESSION COEFFICIENTS (ELASTICITIES OF PRODUCTION)

 X_5 = Feed and Fertilizer

(Total Farm Operators)

	Land Tillable Acres	Labor Weeks	Major Equipment	L.S. and Coop Invent.	Expenses	Sum
All Farms	(.0613) ^a .38690	(.0896) ^b .16184	(.0482) ^b .09368	(.0219) ^b .04499	(.0353) ^a .24831	.9357
Cash Grain	(.1647) .59996 ^a	(.1517) .195772	(.1335) .156502	(.0243) .602884	(.0782) .068571	1.0234
Mixed Livestock	(.1284) .50485 ^a	(.1511) ^b .257654	(.0912) -.024350	(.0520) .065491	(.0669) .385346 ^a	1.2108
Beef	(.1379) ^c .196494	(.2324) -.136403	(.1454) ^b .303395	(.0881) -.054938	(.0817) .132471 ^c	.4403
Hog	(.1252) .235577 ^b	(.2269) .151702	(.0937) .009918	(.0625) .087080 ^c	(.0942) ^a .369055 ^a	.8532
Dairy	(.2225) .033510	(.3432) ^b .611963 ^b	(.1316) ^b .255255 ^b	(.2446) .006146	(.1473) .313104 ^b	1.2198

TABLE XIX (continued)

	Land Tillable Acres	Labor Weeks	Major Equipment	L.S. and Coop Invent.	Expenses	Sum
Same Operators in 1962 and 1965						
All Farms	(.0760) .189980 ^a	(.0889) .050066	(.0548) .110929 ^b	(.0296) .043467 ^c	(.0584) .441358 ^a	.8357
Cash Grain	(.3278) -.011141	(.1859) .195839	(.2687) .636421	(.0530) -.007557	(.2973) .454832 ^b	.6684
Mixed Livestock	(.1003) .330092 ^a	(.1294) .239472 ^b	(.0855) -.051679	(.0416) .053936	(.0726) .513637 ^a	1.0854
Beef	(.2785) -.094369	(.1799) -.027747	(.1701) -.067791	(.0937) .19175	(.2270) 1.041386 ^a	.8710
Hog	(.1484) .122011	(.2528) -.081491	(.1050) .164801 ^c	(.0724) .102625 ^c	(.1127) .282407 ^a	.5903
Dairy	(.3066) .103449	(.6398) 1.280601 ^b	(.1656) .170968	(.3932) .157991	(.2678) .172221	1.8850

^aSignificant at .01 level.

^bSignificant at .05 level.

^cSignificant at .10 level.

TABLE XX

1965 REGRESSION COEFFICIENTS (ELASTICITIES OF PRODUCTION)

X₅ = Feed and Fertilizer

(Total Farm Operators)

	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses	Sum
All Farms	(.0558) .279965 ^a	(.0793) -.003246	(.0285) .061666 ^b	(.0214) .043046 ^b	(.0637) .472735 ^a	.8540
Cash Grain	(.1069) .513262 ^a	(.0956) .063361	(.0801) -.005010	(.0223) -.002422	(.1127) .278432 ^a	.8476
Mixed Livestock	(.2015) .511071 ^a	(.1744) -.237012	(.0953) .245226 ^a	(.1072) .116699	(.1714) .274693 ^c	.9105
Beef	(.1785) .208404	(.3784) -.071052	(.1121) .073527	(.2480) .320824	(.2625) .273644	.8053
Hog	(.1029) .126965	(.1725) .073167	(.0337) .034476	(.0914) .216256 ^b	(.1282) .399807 ^a	.8508
Dairy	(.4389) .742194 ^c	(.7323) -1.256181	(.2548) -.350040	(.5875) 1.267665 ^b	(.4786) -.486586	-.0829

TABLE XX (continued)

	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses	Sum
Same Operators in 1962 and 1965						
All Farms	(.0708) .273986 ^a	(.1071) -.105593	(.0393) .021635	(.0250) .051388 ^b	(.0821) .527492 ^a	.7687
Cash Grain	(.1534) .426362 ^a	(.2291) -.0720700	(.1146) .011163	(.0313) .010088	(.2008) .311268 ^c	.6869
Mixed Livestock	(.2370) .410434	(.1783) -.273773	(.1892) .141314	(.1198) .161469 ^c	(.2078) .292683 ^c	.7329
Beef	(1.0002) 1.268502	(.9873) .528233	(.4021) .197023	(1.2439) -.821948	(.9285) -.431330	.7405
Hog	(.1016) .07791	(.2092) -.114547	(.0413) -.004982	(.0890) .231715 ^a	(.1369) .613112 ^a	.8031
Dairy	(.4431) .580687	(2.2614) -2.802130	(.3329) -.089705	(.6311) 1.41393 ^b	(.5737) -.901273	-1.7985

^aSignificant at .01 level.

^bSignificant at .05 level.

^cSignificant at .10 level.

most important variable, changing from .24831 in 1962 to .47473 in 1965 and was significant at the .005 level, however, the change in composition of the variable makes comparisons difficult. The most significant change was the negative coefficient for labor in 1965, -.00324, as opposed to a coefficient of .16184 in 1962. The change was significant at the .005 level. The lessening in value is logical since observation of the arithmetic means showed there was an increase in the amount of labor used and a decrease in acres planted. Thus the loss of efficiency of the labor variable could be expected.

Of the different farm types, the beef and dairy farms had such small numbers in the sample that little can be

$$\text{The formula---} t(b_1, b_2) = \frac{b_1 - b_2}{\text{Se}/N_1 + \text{Se}/N_2}$$

is used.

The test for significance for the variable land (acres) between 1962 and 1965 for total farms where purchased livestock was not added to cash expenses was calculated as follows:

$$t = \frac{(.2869) - (.2799)}{\frac{.0613}{223} + \frac{.0558}{194}}$$

$$t = 5.35 \quad t \text{ for } .005 = 2.576.$$

The change between the two coefficients is thus significant at the .005 probability level. This means that in only 5 cases out of 1,000 a difference as large as observed could be expected by chance.

inferred from their coefficients, which generally were not statistically significant. The cash grain farms total elasticity of production changed from 1.0234 in 1962 to .8476 in 1965. Land remained as the most important variable though it decreased slightly from .59996 to .51328 (not statistically significant). Cash expenses showed the largest increase going from .06857 to .27843 (significant at .005). A surprising change was the negative coefficient of $-.00501$ in 1965 for major equipment investment as opposed to .15650 in 1962 (significant at .01).

The mixed livestock farms elasticity of production changed from 1.2108 in 1962 to .9105 in 1965. Land remained as it most important variable while labor became a negative coefficient in 1965 and major equipment investment went from $-.02435$ in 1962 to .24522 in 1965 (significant at .001) While these farms increased in size, the input of labor increased at an even greater rate.

The elasticity of production for the hog farms changed very little between 1962 and 1965. Cash expenses remained as the most important input and all the variables remained approximately the same between 1962 and 1965.

The elasticity of production for all farms with the same operator in both 1962 and 1965 changed from .8257 to .7687. The coefficients were somewhat lower than for all farms in the sample, which could result from more intensive

farming in 1965. The main difference between the individual variables in 1962 and 1965 for the same operator group compared with the total farm sample was an increase in the coefficient for land of .18998 in 1962 to .27398 in 1965 (significant at .005).

Purchased Livestock Included in the Expense Variable.

When the models included purchased livestock in the cash expenses variable, the changes in the elasticity of production between 1962 and 1965 for all sample farms went from .9239 to .8581 (Tables XXI and XXII). The values changed in approximately the same pattern as when purchased livestock was not included except the coefficient for cash expenses which increased a little more than for the other variables.

Coefficients for the different farm types changed similarly to those models which did not include purchased livestock in almost all cases. The numbers of sample farms for the beef and dairy farms were still too small for the results to be of any statistical significance in the model.

The elasticity of production for all farms with the same operator in both 1962 and 1965 changed from .8221 to .8774. The principle cause for the increase came from the cash expenses variable which increased from .29042 in 1962 to .57106 in 1965 (significant at .005). This implies that purchased livestock for the farms which stayed in

TABLE XXI

1962 REGRESSION COEFFICIENTS (ELASTICITIES OF PRODUCTION)

 X_5 = Feed, Fertilizer and Purchased Livestock

	(Total Farm Operators)					
	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses	Sum
All Farms	(.0696) ^a .31763	(.0858) ^b .17062	(.0467) ^a .14709	(.0210) ^b .05318	(.0300) ^a .23547	.92399
Cash Grain	(.1661) .598772 ^a	(.1508) .213394 ^c	(.1371) .185446 ^c	(.0245) .002114	(.0767) .040353	1.0401
Mixed Livestock	(.1258) .454356 ^a	(.1461) .260748 ^b	(.0870) -.013696	(.0508) .106513 ^b	(.0557) .350969 ^a	1.1588
Beef	(.2718) .556580 ^b	(.2324) -.103783	(.1551) .337941 ^b	(.0878) -.024266	(.0859) .053347	.8196
Hog	(.1244) .308299 ^a	(.2040) .044359	(.0832) .022093	(.0579) .069775 ^c	(.0743) .394021 ^a	.8386
Dairy	(.1918) .119123	(.3072) .543940 ^b	(.1189) .227741 ^b	(.2240) -.002272	(.1279) .337425 ^a	1.2258

TABLE XXI (continued)

	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses	Sum
Same Operators in 1962 and 1965						
All Farms	(.0812) ^b .144154	(.0920) .096849	(.0534) .205710 ^a	(.0303) .085008 ^a	(.0444) .290422 ^a	.8221
Cash Grain	(.3616) .018540	(.1962) .283567 ^c	(.2943) .159623	(.0601) .001930	(.2142) .299763 ^c	.7505
Mixed Livestock	(.1503) .406217 ^a	(.1417) .202693 ^c	(.0904) -.015429	(.0477) ^b .082966	(.0730) .382655 ^a	1.0590
Beef	(.5552) .037994	(.2859) -.119032	(.2287) .318115 ^c	(.1966) .172220	(.2377) .275428	.6847
Hog	(.1284) .162202	(.2161) -.073167	(.0904) .135543 ^c	(.0634) .091643 ^c	(.0744) .334983 ^a	.6511
Dairy	(.2637) .182627	(.6029) 1.178498 ^b	(.1549) .153067	(.3529) .169698	(.2597) .219790	1.9034

^aSignificant at .01 level.

^bSignificant at .05 level.

^cSignificant at .10 level.

TABLE XXII

1965 REGRESSION COEFFICIENTS (ELASTICITIES OF PRODUCTION)

 X_5 = Feed, Fertilizer and Purchased Livestock

	(Total Farm Operators)						Sum
	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses		
All Farms	(.0534) .258675 ^a	(.0751) -.000070	(.0273) .055667 ^b	(.0206) .032947 ^c	(.0579) .511163 ^a		.8581
Cash Grain	(.1161) .864572 ^a	(.0845) -.051072	(.0679) -.003126	(.0190) -.012860	(.1013) .195087 ^b		.9927
Mixed Livestock	(.1823) .321793 ^b	(.1616) -.120416	(.0841) .229878 ^a	(.0961) .102773	(.1299) .443118 ^a		.9769
Beef	(.1638) .163211	(.3437) -.175233	(.1016) .083294	(.2232) .209629	(.1967) .453811 ^a		.7346
Hog	(.1038) .130647 ^c	(.1731) .087012	(.0341) .028486	(.0922) .218300 ^a	(.1312) .390860 ^a		.8551
Dairy	(.4205) .645763 ^c	(.7347) -1.162135	(.2463) -.299052	(.5908) 1.175996 ^b	(.4726) -.381897		.0787

TABLE XXII (continued)

	Land Tillable Acres	Labor Weeks	Major Equipment Investment	L.S. and Coop Invent.	Expenses	Sum
Same Operators in 1962 and 1965						
All Farms	(.0669) .257760 ^a	(.0988) -.069050	(.0374) .007497	(.0237) .042612 ^b	(.0734) .571060 ^a	.8774
Cash Grain	(.1811) 1.055977 ^a	(.1776) -1.175830	(.0892) -.005042	(.0250) -.007331	(.1717) .070326	.9381
Mixed Livestock	(.2097) .297481 ^c	(.1660) -1.133810	(.1616) .051219	(.1061) .147358 ^c	(.1507) .482566 ^a	.8446
Beef	(.8281) .235196	(.7597) -.589608	(.3316) .015765	(1.0106) -.330311	(.6313) .968896 ^c	.2997
Hog	(.1074) .088164	(.2163) -.031677	(.0437) -.013038	(.0943) .240790 ^a	(.1414) .542013 ^a	.8262
Dairy	(.4115) .432261	(2.1703) -3.151267	(.2939) .015784	(.6165) 1.485115 ^b	(.5776) -1.000440	-2.2186

^aSignificant at .01 level.

^bSignificant at .05 level.

^cSignificant at .10 level.

operation is more important than for the total farms in the survey, since although the cash expenses variable was different between years the only difference within a year was the addition of purchased livestock.

The numbers of units of the different farm types which operated in both time periods were too small for the estimates to be statistically significant.

Marginal Value Productivities

The marginal value productivities represent what one additional unit of a particular resource would add to gross revenue. For the resources of the various models the marginal value productivities were calculated at the geometric means of the resources. The geometric means are given in Appendix Tables VII and VIII. The marginal value productivities are computed by multiplying the regression coefficient of the given resource times the ratio of the geometric mean of gross revenue to the geometric mean of the given resource.⁴ An example of the marginal value product of land for all farms in the sample for 1965 was:

$$\text{MVP} = (.2799) \frac{12600}{141} = \$21.60 \text{ per tillable acre.}$$

⁴Earl R. Swanson, "Determining Optimum Size of Business from Production Functions," Resource Productivity, Returns to Scale and Farm Size, Edited by Heady, Johnson, and Hardin, Iowa State College Press, Ames, Iowa, 1956, p. 136.

The marginal value productivities for all resources are shown in Tables XXIII through XXVII. The marginal value products for the individual farm types of the 130 operators which operated in both years must be discounted because the lack of sufficient numbers of farms in each type tends to make the computations statistically significant.

MVP Land. The marginal value product for land was measured in dollar returns per tillable acre added to the model. The marginal products for the model without purchased livestock added to the expense variable for all farms went from \$21.60 in 1962 to \$25.01 in 1965 and changed from \$17.23 to \$23.11 where purchased livestock was added to the expense variable. This may have resulted from a fall in crop acres which were cropped more intensively.

The marginal value products for land in the different farm types all increased from 1962 to 1965 except for the hog farms which went from \$17.17 to \$16.32 when purchased livestock was not added and from \$22.48 to \$16.79 when purchased livestock was added to the expense variable. Hog farms, on the average, were considerably larger in 1965 than in 1962.

It appears, since the annual per acre cost to the operator to acquire additional land is approximately \$15 to \$20 for \$200 land, that it would still pay the average farm to acquire additional crop acres. This would be particularly

TABLE XXIII

MARGINAL VALUE PRODUCTIVITIES

(X₅ = Feed and Fertilizer Expenses)

	Land Tillable Acres X ₁	Labor Weeks X ₂	Major Equipment Investment X ₃	L.S. and Crop Invent. X ₄	Cash Expenses X ₅
Total--1962	\$21.60	\$24.77	\$.18	\$.11	\$1.84
Total--1965	25.01	-.65	.24	.05	.97
130 same operators--1962	11.04	8.36	.20	.10	2.84
130 same operators--1965	25.85	-22.43	.07	.06	1.06

TABLE XXIII (continued)

MARGINAL VALUE PRODUCTIVITIES

(X_5 = Feed, Fertilizer, and Purchased Livestock Expense)

	Land tillable acres X_1	Labor weeks X_2	Major equipment investment X_3	L.S. and crop invent. X_4	Cash expenses X_5
Total--1962	\$17.73	\$26.12	\$.29	\$.14	\$1.23
Total--1965	23.11	-.02	.22	.04	.89
130 same operators--1962	8.38	16.18	.37	.20	1.31
130 same operators--1965	24.32	-14.67	.03	.05	.95

TABLE XXIV

MARGINAL VALUE PRODUCTIVITIES TOTAL FARMS

(X₅ = Feed, Fertilizer, and Purchased Livestock)1962

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	24.21	30.55	.25	.02	.39
Mixed Livestock	23.02	33.58	-.03	.20	1.51
Beef	33.17	-16.56	.84	-.05	.17
Hog	22.48	8.20	.05	.20	1.91
Dairy	8.66	80.15	.47	-.01	3.29

1965

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	50.59	- 9.12	-.01	-.04	.37
Mixed Livestock	29.80	-32.27	.84	.07	.82
Beef	15.37	-26.28	.39	.11	.65
Hog	16.79	-18.74	.17	.15	.57
Dairy	139.70	-200.42	-2.97	.93	-.81

TABLE XXV

MARGINAL VALUE PRODUCTIVITIES TOTAL FARMS

(X₅ = Feed and Fertilizer)1962

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	24.25	28.03	.21	.03	.72
Mixed Livestock	25.57	33.18	-.04	.13	2.46
Beef	11.70	-21.77	.75	.10	1.55
Hog	17.17	28.08	.02	.25	2.32
Dairy	2.43	90.17	.53	.01	3.25

1965

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	\$ 30.03	\$11.32	-.01	-.01	.62
Mixed Livestock	47.33	-63.51	.89	.08	.64
Beef	19.62	-10.65	.35	.17	.52
Hog	16.32	15.75	.20	.15	.67
Dairy	160.56	-216.63	-3.47	1.00	-1.08

TABLE XXVI
MARGINAL VALUE PRODUCTIVITIES 130 SAME OPERATORS

1962

	Land tillable acres X_1	Labor weeks X_2	Major equip. invest. X_3	L.S. & crop invent. X_4	Cash expenses X_5
Cash Grain	- .47	33.61	.04	-.04	3.75
Mixed Livestock	19.80	35.91	-.10	.95	2.83
Beef	- 4.39	- 5.44	-.16	.03	7.79
Hog	8.37	-13.75	.29	.29	1.71
Dairy	8.11	216.44	.43	.23	1.48

1965

	Land tillable acres X_1	Labor weeks X_2	Major equip. invest. X_3	L.S. & crop invent. X_4	Cash expenses X_5
Cash Grain	\$ 26.12	\$-11.92	\$.02	\$.04	\$.66
Mixed Livestock	39.03	-82.11	.50	.12	.73
Beef	100.69	81.98	.74	-.31	-.76
Hog	10.83	-23.95	-.02	.17	1.01
Dairy	131.30	-468.06	-1.09	1.00	-1.91

TABLE XXVII

MARGINAL VALUE PRODUCTIVITIES 130 SAME OPERATORS

(X₅ = Feed, Fertilizer, and Purchased Livestock)1962

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	.78	48.66	.19	-.01	2.27
Mixed Livestock	24.37	30.39	-.03	.15	1.44
Beef	1.77	-23.61	.74	.31	.90
Hog	11.12	-12.35	.24	.26	1.57
Dairy	14.32	199.34	.39	.25	1.68

1965

	Land tillable acres X ₁	Labor weeks X ₂	Major equip. invest. X ₃	L.S. & crop invent. X ₄	Cash expenses X ₅
Cash Grain	64.70	-29.12	-.01	-.03	.12
Mixed Livestock	28.29	-40.14	.18	.11	.93
Beef	18.66	-91.52	.06	-.13	1.33
Hog	12.29	- 6.61	-.06	.18	.76
Dairy	97.74	-526.39	.19	1.05	-2.00

so for cash grain and mixed livestock farms. Dairy farms showed a very high MVP for land but due to the lack of numbers it cannot be interpreted with confidence. The increase in productivity for land over the three years, however, probably has been offset by the rise in land prices, taxes, and interest through this time period.

MVP Labor. The marginal value productivity for labor was measured by the dollars returns per week of labor. The marginal productivity of all farms when purchased livestock was not added to the expense variable changed from \$24.77 in 1962 to \$-.65 in 1965, and from \$26.12 in 1962 to \$-.02 in 1965 when purchased livestock was added to the expense variable. This reflects the increased amount of labor used on a smaller number of crop acres which implies that more labor has been added to an already excess amount of labor. Returns to a week of labor in 1962 were already very low.

The marginal value productivity of labor on all the different farm types decreased. Only when purchased livestock were not added to the expense variable for the cash grain and hog farms did the 1965 MVP stay above a negative figure. However, very few labor coefficients were statistically different from zero, which indicates that there is room for much adjustment. However, most of the labor input increase came from family members. Thus the variable

cost of the added labor was small or nonexistent, assuming that the family members had no satisfactory alternative use for their labor.

MVP Major Equipment. The marginal value product for equipment was measured in dollar returns per dollar invested. The marginal productivity for all farms without purchased livestock added to expenses went from \$.18 in 1962 to \$.24 in 1965. For all farms when purchased livestock were added to expenses the marginal productivity went from \$.24 in 1962 to \$.22 in 1965.

The marginal value products for the different farm types decreased in all cases except for mixed livestock farms which increased from \$-.04 in 1962 to \$.89 in 1965 when purchased livestock was not added to cash expenses and from \$-.03 to \$.84 when purchased livestock was added. These changes reflect the increased size of the mixed livestock farms while the other farm types had decreased in size.

Assuming the only costs to be covered were five per cent interest and straight line depreciation for 10 years, the yearly factor cost would be \$.15 per dollar investment. Where the marginal value product equals the marginal factor cost (\$.15) is the optimum point of allocation, so it would appear that increases of machinery and equipment investment could be justified.

MVP Livestock and Crop Inventory. The returns to livestock and crop inventories were measured in dollars per dollar of investment. The marginal productivity for all farms went from \$.11 in 1962 to \$.05 in 1965 without purchased livestock added to the expense variable, and changed from \$.14 in 1962 to \$.04 in 1965 with purchased livestock. This probably resulted from large increases by farms of all types in the inventories of crop products and livestock.

The marginal value products for the different farm types declined in most cases. The beef and dairy farms did have increased marginal value products for livestock and crop inventories.

If one assumed a five per cent interest change as the only cost, the yearly factor cost would be \$.05 per dollar of investment. It would then appear that in most cases for the individual farm types further use of this resource also would be justified.

MVP Cash Expenses. The marginal value productivity for expenses was measured by the dollar returns per dollar spent for feed and fertilizer in one model and feed, fertilizer and purchased livestock in another model for 1962 and for all cash expenses, with and without livestock, for 1965. The marginal productivity for all farms where purchased livestock were not added went from \$1.84 in 1962

to \$.97 in 1965 while the marginal productivity for all farms where purchased livestock were included in cash expenses went from \$1.23 in 1962 to \$.89 in 1965.

In all cases the marginal value products for the farm types decreased from 1962 to 1965, being in all cases less than \$1.00. This implies that further use of this input would actually increase gross incomes for the average farm by less than the cost of the inputs. Part or all of the change between 1962 and 1965 could have resulted from the inclusion of more expenses in the 1965 variable. Thus, few inferences can be drawn from the interyear comparison. However, the low MVPs for 1965 do imply a relative misallocation with too many cash expenses on an aggregative basis.

CHAPTER V

SUMMARY AND CONCLUSIONS

The Cobb-Douglas function provides, at best, only rough approximation of resource efficiency and, by comparing data from different time periods, of the changes which have occurred. It can provide suggestions as to the direction of resource allocation but the resource categories usually are too aggregative to allow specific recommendations for adjustments to be made. The results, however, can be used for general recommendations as to the economic efficiency within the sample.

A major difficulty in trying to compare the functions and arithmetic means for two separate years for the current study was the different methods of obtaining the data used for some of the same variables in the different years. This could cause biases which would be reflected as changes even though there may not have been any. Also, the variables used in 1962 may not be the best that could have been used in 1965 and this could cause different relationships between the variables as they changed between the two years.

The changes which occurred in the sizes of the operations and the farm types seem to support the image of the changing face of agriculture. The small farms in this area appear to be shifting toward the enterprise types

which use less labor and obtain from the smaller amount of labor, a higher return. Many of these are older farmers and those with some off farm employment.

The livestock farms, particularly the mixed livestock and hog farms, show a trend toward larger enterprises, increasing the scale of their operations to obtain a higher income. The "in-and-outer" farm enterprise seems to be less important than in the past. If this is the situation, the livestock farm will be able to control its production to a greater degree and will be less influenced by wide swings in market prices. Another important aspect of the decline of the "in-and-outer" would be increased accuracy of the prediction in livestock numbers for the future, which would help in predicting prices and thus partially eliminate one of the causes for larger price fluctuations from year to year.

The cash grain farm numbers have increased at all levels in Northeast Missouri. This is an important change in today's agriculture. Many farmers are now looking for the enterprise which returns the most for the amount of labor supplied which in the past was not necessarily so. The trend can be expected to continue in the future with those farmers who do not become large livestock operators turning to the cash grain farming as either full or part-time operators.

Specialized beef cattle farms in the area are declining in numbers although beef cow numbers may not be decreasing. The larger farmers have gone more to a mixed livestock organization leaving very few units of any size as beef cattle operations. The beef cattle operation in this area usually is a supplementary enterprise for the farming unit as a whole. The smaller farmer seems to regard a beef cattle operation as the best livestock enterprise to go along with off-farm work and semi-retirement, which explains the increase in numbers of the small beef cattle farms in the area. Beef can be expected to continue as an enterprise on many farms because of the existence of large quantities of otherwise unusable roughage.

The number of dairy cattle farms is about the same as in 1962 but, with an increase in the number of dairy cattle per farm. Dairy farms are still relatively few in number in the area and very few farms of other types seem to shift to dairy farms.

The functional analysis, using the Cobb-Douglas function, used purchased livestock as part of the cash expense variable and also was made with purchased livestock left out of the variable. The models were run using the total farms in the samples for both years and then dividing the farms into the different farm types. Next the 130 farmers who operated on the same farm unit in both 1962 and 1965

were set up as a separate model and run both as a total group and then in their different farm types.

In most cases the elasticity of production for each model was less than one indicating diminishing returns to scale. The variables of land and cash expenses were in most cases the most important coefficients in each model. The major change between 1962 and 1965, however, was that the coefficient for cash expenses became greater while that for land either declined or remained at about the same magnitude as in 1962. The other variable, livestock and crop inventory and major equipment investment, seemed to remain about the same in relative importance between the two years. The coefficient for the labor was negative in most cases in 1965 and also was very low for 1962.

Changes in the arithmetic means showed crop acres decreased slightly while labor used increased. This would seem to support the low coefficient for labor. A negative coefficient would mean that too much labor is being used in this area and any addition to labor would decrease gross income in the models given. However, the labor coefficient was not statistically significant and thus could be assigned to zero.

The models which included only farmers who operated in both 1962 and 1965 showed approximately the same results as where the entire sample was used, except for slightly

lower coefficients due, probably, to their having more intensive farming systems on their units. These farmers were on the average slightly older and were on the larger farms. They also had increased the size of their farms.

Adding purchased livestock to the expense variable had a visible effect on most models. The mixed livestock, beef cattle, and hog farms showed an increase in their cash expense coefficient and a higher summed coefficient in almost all cases. Purchased livestock seemed to have more of an impact, when comparing between 1962 and 1965, on the farmers who were in operation during both of these years as opposed to the total farms in both years. This suggests an area of research that could be developed as to the importance of purchased livestock for the different farm types.

Another area would be a more detailed study as to why there has been a large increase in numbers of cash grain farms in this area while the other farm types decreased in numbers.

The results of the study seem to indicate that the cash expenses variable increased in importance, and currently are earning less than their costs on an aggregative basis. What is surprising, however, is the seeming slowdown of the substitution of capital for labor with the amount of labor actually increasing while capital investments declined for the sample farmers. Future studies over the

same area may find this to be only a short run phenomenon and that the general trend in agriculture of substituting capital for labor is continuing.

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APPENDIX

APPENDIX TABLE I

1965 CLASSIFICATION OF 1962 SMALL COMMERCIAL FARMS--BY 1962 CLASS

1965 Survey Classification	1962 Class of Operation				
	Small cash grain farms	Small mixed livestock farms	Small beef farms	Small hog farms	Small dairy farms
Small Cash Grain Farms	2	2	0	1	0
Small Mixed Livestock Farms	0	3	0	0	0
Small Beef Farms	0	2	1	0	0
Small Hog Farms	0	4	0	6	0
Small Dairy Farms	0	0	0	0	1
Medium Cash Grain Farms	1	0	0	1	2
Medium Mixed Livestock Farms	0	2	0	1	0
Medium Beef Farms	0	0	0	0	0
Medium Hog Farms	0	1	0	2	0
Large Cash Grain Farms	0	1	0	0	2
Large Mixed Livestock Farms	0	2	0	0	0
Large Beef Farms	0	0	0	0	0
Large Hog Farms	0	1	0	1	0
Large Dairy Farms	0	1	0	1	0
Commercial Farm Screen Outs	1	1	2	4	0
Census Farm Screen Outs	1	6	3	0	1
1965 Refusals	1	1	0	1	1
Non-existent Farms in 1965	1	4	1	4	1
Total Farms in Class in 1962	7	31	7	24	6

APPENDIX TABLE II

1965 CLASSIFICATION OF 1962 MEDIUM COMMERCIAL FARMS--BY 1962 CLASS

1965 Survey Classification	1962 Class of Operation				
	Medium cash grain farms	Medium mixed livestock farms	Medium beef farms	Medium hog farms	Medium hog farms
Small Cash Grain Farms	2	0	0	0	0
Small Mixed Livestock Farms	0	0	0	0	0
Small Beef Farms	0	0	1	0	0
Small HOG Farms	0	0	1	2	0
Small Dairy Farms	0	0	0	0	0
Medium Cash Grain Farms	1	4	4	2	2
Medium Mixed Livestock Farms	0	3	0	6	0
Medium Beef Farms	0	0	2	0	0
Medium Hog Farms	1	2	0	3	0
Large Cash Grain Farms	3	3	0	1	1
Large Mixed Livestock Farms	0	3	0	1	1
Large Beef Farms	0	0	1	0	0
Large Hog Farms	0	1	0	1	1
Large Dairy Farms	0	0	0	2	2
Commercial Farm Screen Outs	0	0	0	0	0
Census Farm Screen Outs	3	1	0	2	2
1965 Refusals	0	2	1	0	0
Non-existent in 1965	6	0	0	0	2
Total Farms in Class in 1962	16	19	10	22	22

APPENDIX TABLE III

1965 CLASSIFICATION OF 1962 LARGE COMMERCIAL FARMS--BY 1962 CLASS

1965 Survey Classification	1962 Class of Operation					
	Large cash grain farms	Large mixed livestock farms	Large beef farms	Large hog farms	Large dairy farms	Large
Small Cash Grain Farms	0	0	1	0	0	0
Small Mixed Livestock Farms	0	0	0	0	0	0
Small Beef Farms	0	0	1	0	0	0
Small Hog Farms	0	0	1	0	0	0
Small Dairy Farms	0	0	0	0	0	1
Medium Cash Grain Farms	0	1	1	0	0	0
Medium Mixed Livestock Farms	2	2	0	1	0	0
Medium Beef Farms	0	0	0	0	0	0
Medium Hog Farms	1	2	0	2	2	0
Large Cash Grain Farms	5	2	1	0	0	0
Large Mixed Livestock Farms	0	5	2	4	0	0
Large Beef Farms	0	0	3	1	0	0
Large Hog Farms	1	0	0	5	0	0
Large Dairy Farms	0	0	1	0	2	2
Commercial Farm Screen Outs	0	1	0	0	0	0
Census Farm Screen Outs	2	3	2	3	0	0
1965 Refusals	1	2	0	1	2	2
Non-existent Farms in 1965	3	1	1	7	2	2
Total Farms in Class in 1962	15	19	14	24	7	7

APPENDIX TABLE IV

1965 CLASSIFICATION OF SMALL COMMERCIAL FARMS IN 1965---BY 1962 CLASS

1962 Survey Classification	1965 Class of Operation						
	Small cash grain farms	Small mixed livestock farms	Small beef farms	Small hog farms	Small dairy farms	Small	Small
Small Cash Grain Farms	2	0	0	0	0	0	0
Small Mixed Livestock Farms	2	3	2	4	0	0	0
Small Beef Farms	0	0	1	0	0	0	0
Small Hog Farms	1	0	0	8	0	0	0
Small Dairy Farms	0	0	0	0	0	1	1
Medium Cash Grain Farms	2	0	0	0	0	0	0
Medium Mixed Livestock Farms	0	0	0	0	0	0	0
Medium Beef Farms	0	0	1	1	0	0	0
Medium Hog Farms	0	0	0	2	0	0	0
Large Cash Grain Farms	0	0	0	0	0	0	0
Large Mixed Livestock Farms	0	0	0	0	0	0	0
Large Beef Farms	1	0	1	1	0	0	0
Large Hog Farms	0	0	0	0	0	0	0
Large Dairy Farms	0	0	0	0	0	0	1
Commercial Farms first interviewed in 1965	10	2	11	3	11	3	3
Total Farms in Class in 1965	18	5	16	19	16	19	5

APPENDIX TABLE V

1965 CLASSIFICATION OF MEDIUM COMMERCIAL FARMS IN 1965---BY 1962 CLASS

1962 Survey Classification	1965 Class of Operation				
	Medium cash grain farms	Medium mixed livestock farms	Medium beef farms	Medium hog farms	Medium hog farms
Small Cash Grain Farms	1	0	0	0	0
Small Mixed Livestock Farms	0	2	0	0	1
Small Beef Farms	0	0	0	0	0
Small Hog Farms	1	1	0	0	2
Small Dairy Farms	2	0	0	0	0
Medium Cash Grain Farms	1	0	0	0	1
Medium Mixed Livestock Farms	4	3	0	0	2
Medium Beef Farms	4	0	2	0	0
Medium Hog Farms	2	6	0	0	3
Large Cash Grain Farms	0	2	0	0	1
Large Mixed Livestock Farms	1	2	0	0	2
Large Beef Farms	1	0	0	0	0
Large Hog Farms	0	1	0	0	2
Large Dairy Farms	0	0	0	0	0
Commercial Farms first interviewed in 1965	6	1	1	1	3
Total Farms in Class in 1965	23	18	3	3	17

APPENDIX TABLE VI

1965 CLASSIFICATION OF LARGE COMMERCIAL FARMS IN 1965--BY 1962 CLASS

1962 Survey Classification	1965 Class of Operation					
	Large cash grain farms	Large mixed livestock farms	Large beef farms	Large hog farms	Large dairy farms	
Small Cash Grain Farms	0	0	0	0	0	0
Small Mixed Livestock Farms	0	2	0	1	1	1
Small Beef Farms	0	0	0	0	0	0
Small Hog Farms	1	0	0	1	1	1
Small Dairy Farms	2	0	0	0	0	0
Medium Cash Grain Farms	3	0	0	0	0	0
Medium Mixed Livestock Farms	3	3	0	1	0	0
Medium Beef Farms	0	0	1	0	0	0
Medium Hog Farms	1	1	0	1	2	2
Large Cash Grain Farms	5	0	0	0	0	0
Large Mixed Livestock Farms	2	5	0	0	0	0
Large Beef Farms	1	2	3	0	1	1
Large Hog Farms	0	5	1	5	5	2
Large Dairy Farms	0	0	0	0	0	0
Commercial Farms first interviewed in 1965	8	1	1	3	0	0
Total Farms in Class in 1965	26	18	6	12	7	7

APPENDIX TABLE VII

GEOMETRIC MEANS

	Land X_1 (acres)	Labor X_2 (weeks)	Machinery X_3 (\$)	L. S. & crop invent. X_4 (\$)	Feed, fert., and purchased livestock X_5 (\$)	Gross income Y (\$)
All Farms---1962	170	62	4870	3741	1812	9490
All Farms---1965	141	62	3250	10900	7220	12600
Same Operators---1962	184	64	5930	4444	2360	10700
Same Operators---1965	160	71	4340	13400	9000	15100
(All Farms, 1962)						
Cash Grain	209	59	6200	869	871	8450
Mixed Livestock	150	59	4120	3980	1760	7600
Beef	158	59	3790	5000	2940	9420
Hog	170	67	5620	4270	2560	12400
Dairy	154	76	5400	8530	1150	11200
(All Farms, 1965)						
Cash Grain	162	53	3860	2950	4940	9480
Mixed Livestock	217	75	5520	30400	10900	20100
Beef	86	54	1710	15000	5640	8100
Hog	119	71	2630	21400	10400	15300
Dairy	55	69	1200	15000	5600	11900

APPENDIX TABLE VIII

GEOMETRIC MEANS

	Land X_1 (acres)	Labor X_2 (weeks)	Machinery X_3 (\$)	L. S. & crop invent. X_4 (\$)	Feed, fert. X_5 (\$)	Feed, fert., and purchased livestock X_5 (\$)	Gross income Y (\$)
(Same farm operators both years)							
<u>1962</u>							
Cash Grain	243	60	8730	1790	1250	1360	10300
Mixed Livestock	145	58	4550	4930	1580	2310	8700
Beef	268	63	5360	6900	1670	3830	12500
Hog	175	71	6840	4200	1980	2560	12000
Dairy	153	71	4730	8070	1400	1570	12000
<u>1965</u>							
Cash Grain	173	64	4950	3020	4960	6210	10600
Mixed Livestock	246	78	6530	32200	9430	12100	23400
Beef	131	67	2750	26800	5890	7580	10400
Hog	114	76	3670	21400	9680	11200	15900
Dairy	65	88	1200	20700	6930	7350	14700

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