LABOR UNDEREMPLOYMENT IN RURAL EASTERN OKLAHOMA, 1959

By

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CHAPTER I

INTRODUCTION

During the past decade, a great deal of emphasis in research and policy has been placed on rural resource development. There exist many problems related to the field of rural resource development as applied to low incomes of rural people. Specifically, there are two which stand out above the others:[1] (1) the transfer of resources among uses, that is, moving along the production possibilities function, and (2) resource development, or the shifting of the production possibilities function outward. This latter problem may be one which we should not wish to solve in its entirety, that is, it would be desirable to have an infinite number of these production possibilities such that we would continuously be striving to reach a higher one. It would appear that our major concern is to improve the position of our underdeveloped areas relative to the more developed areas. More specifically, the general problem in research is to identify ways in which employment and income to the rural labor force can be increased.

The Meaning of Underemployment of Labor

Excess supplies of labor occur in agriculture, service industries, and occasionally in manufacturing, especially the smaller manufacturing

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[1] C. E. Bishop, "Approaches to Rural Development," Journal of Farm Economics, XXXIX (1957), p. 271.

industries. In many of these sectors the underemployment is disguised or concealed. This is a situation where people are actually employed, but are underemployed in the sense that they do not earn wages commensurate with their alternatives elsewhere. Underemployment also appears directly in the form of outright idleness.

Simon Rottenberg lists several propositions about labor underemployment, however, only a few will be discussed at this point.[2]

The first proposition is that excess labor occurs because fewer laborers could produce the same output, the quantity of other resources remaining unchanged. This implies that labor is employed beyond the point where the marginal productivity of labor is zero. This thesis is comparable to that of N. Georgescu-Roegen.[3] The question is, Can this occur where labor receives a positive wage? S. Rottenberg says it can if the firm is composed of a family or if it stimulates a family. Children contribute little or nothing to the family income, but they consume with the family. In their earlier years they are looked upon as consumption or investment resources. With the exception of the family case the proposition becomes implausible. If the state of the arts changes then perhaps it would be possible for the reduced number of workers to produce the same output. If the state of the arts does not change, would the remaining workers produce the same output as before? If so, why were they hired in the first place and why were they allowed to remain until they left voluntarily?

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[2]Simon Rottenberg, "The Meaning of 'Excess Supplies of Labour'," Scottish Journal of Political Economy, February, 1961, pp. 65-70.

[3]See Chapter II for a résumé of this theory.

The second proposition relates to the existence of seasonal employment. It is S. Rottenberg's belief that seasonality of employment does not result, necessarily, in underemployment of labor.

Many people seem to prefer seasonal employment to regular employment; often these people will accept a lesser income to obtain seasonal employment. It is at this point that cultural, institutional, and environmental aspects begin to creep into the picture. Many other workers have a strong dislike for irregular employment and, for them, a higher wage must be paid if they are to accept this type of employment. This higher wage serves as compensation for some of the insecurity of seasonal employment. If the workers' preference is such that they prefer seasonal to regular employment, we may not be able to truthfully assert that seasonal employment results in underemployment. However, if people are forced by necessity to accept irregular employment, the case of underemployment may be defensible.

If the irregular nature of production activities cannot be corrected, there may be no avenue of escape, and higher wages may be a necessary compensation for the forced idleness. If reorganization of production does not correct the situation and employment remains seasonal, workers may seek other alternatives. If other alternatives do exist, but if they choose to remain in their present employment, we may assume they are satisfied with their lot and any lack of full employment is voluntary.

Some factors to consider at this point are that many farmers in the underdeveloped rural areas in the United States have neither the desire to migrate to locations of higher income, nor the ability to compete for these higher paying jobs. They are at an advanced age, and a great many of these farmers lack adequate education or training required to move

into higher income earning employment. Also, at the present time, information concerning job opportunities elsewhere is limited to most of these farmers. An increase in mobility could occur from the creation of information services to assist farmers in finding nonfarm employment.

Rottenberg also mentions underemployment resulting from malpricing of resources. If for some reason the price of labor is higher in public employment relative to self-employed enterprises, the workers who are barred from higher paying alternatives, or who are not worth the price in these alternatives will flock to the self-employed alternatives. This would serve to push down returns to labor in the self-employed sector and result in underemployment. This results because there are larger numbers of laborers in the self-employed sector in the sense that fewer would have been there, and the labor in the depressed sector would receive a higher wage if the excessive numbers did not exist.

Some of the general characteristics of the rural areas in the United States with underemployed labor are as follows: (1) the existence of population pressure on natural resources, (2) low average and marginal productivity of labor, (3) large birth rates which aggravate (1), (4) relatively low rates of economic development, and (5) a large portion of the population employed in agriculture. This has been a simple listing of factors influencing underemployment. They are not intended to identify cause and effect relationships. Since an adequate discussion of any one of these items would be quite lengthy, they will not be pursued further.

The Problem and Objectives

The problem of low income and underdevelopment is generally thought

to be a problem of misallocation of resources. This problem may be approached by striving to reach a higher isoquant on a production surface, or it may be solved by producing a given output with fewer resources. Both approaches were considered in this study. The first objective was to examine possibilities of increasing income to farm labor in a 24-county area of Eastern Oklahoma by holding output constant but reducing labor. This was not feasible for Adair and Cherokee Counties, so both output and labor were adjusted for these counties.

The first step in the procedure was to derive an acceptable aggregate production function for the area. Each county was a unit of observation. The principal sources of data for this analysis were the most recent Census of Agriculture and the Census of Population for Oklahoma. However, the 1959 Agricultural Statistics, the 1959 Agricultural Prices for Oklahoma, and data from a survey of the area were used to some extent.

The second step was to obtain marginal value products of the factors of production in order to identify the nature of the misallocation of resources. The variables were available labor supply, amount of farm land, current expenses, and fixed assets.[4]

The third step was to assess the possibility of increasing income to labor to selected target levels by reallocating the factors used in farming. Two income targets considered in this study were $2,000 and $2,500. The $2,000 target was used for purposes of comparing the results with those of an earlier study of the same area.[5] The $2,500

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[4]For an explanation of the meaning of the variables and how they were measured, see pp. 14-22.

[5]E.J.R. Booth, "Economic Development in Eastern Oklahoma Until 1950" (unpub. Ph.D. dissertation, Vanderbilt University, 1961), pp. 99-103.

target was used in conjunction with additional analysis of resource use and income in the area.

Because of the existence of alternative ways of measuring the variables and without strongly defensible criteria for choosing from among these alternatives, the research encompassed estimation of several production functions. From these, only two were selected for further analysis: (1) a production function with the variables measured as they were in the earlier study by E.J.R. Booth in which data for 1949 and 1950 were used, and (2) a function with results more nearly meeting theoretical specifications in respect to marginal value products of the factors. Details of the methodology, including some theoretical considerations underlying the study, are presented in Chapter II. The results follow in Chapter III.

CHAPTER II

SOME THEORETICAL CONSIDERATIONS AND PROCEDURES

A model developed by Georgescu-Roegen was written for application to agrarian economies, or agricultural economies characterized by overpopulation.[1] It considers a country or area where small amounts of capital and land are combined with much labor to obtain the agricultural output. The general theoretical basis of this study was contained in the model developed by Georgescu-Roegen; adaptations of the model, partly for operational reasons, were made.

The General Model

The development of any model must be initiated by stating the assumptions and definitions of the variables. In this model we will consider a production function,

$$X = F(L,T)$$

where X represents the aggregate product.[2] This product is assumed to be produced by an atomistic industry, and the production function for the economy is considered homogeneous of the first degree. The function is depicted in Figure 1, with L representing labor and T representing a

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[1] N. Georgescu-Roegen, "Economic Theory and Agrarian Economies," Oxford Economic Papers, New Series, 1960.

[2] Notations and symbols used are approximately the same as those used by Georgescu-Roegen.

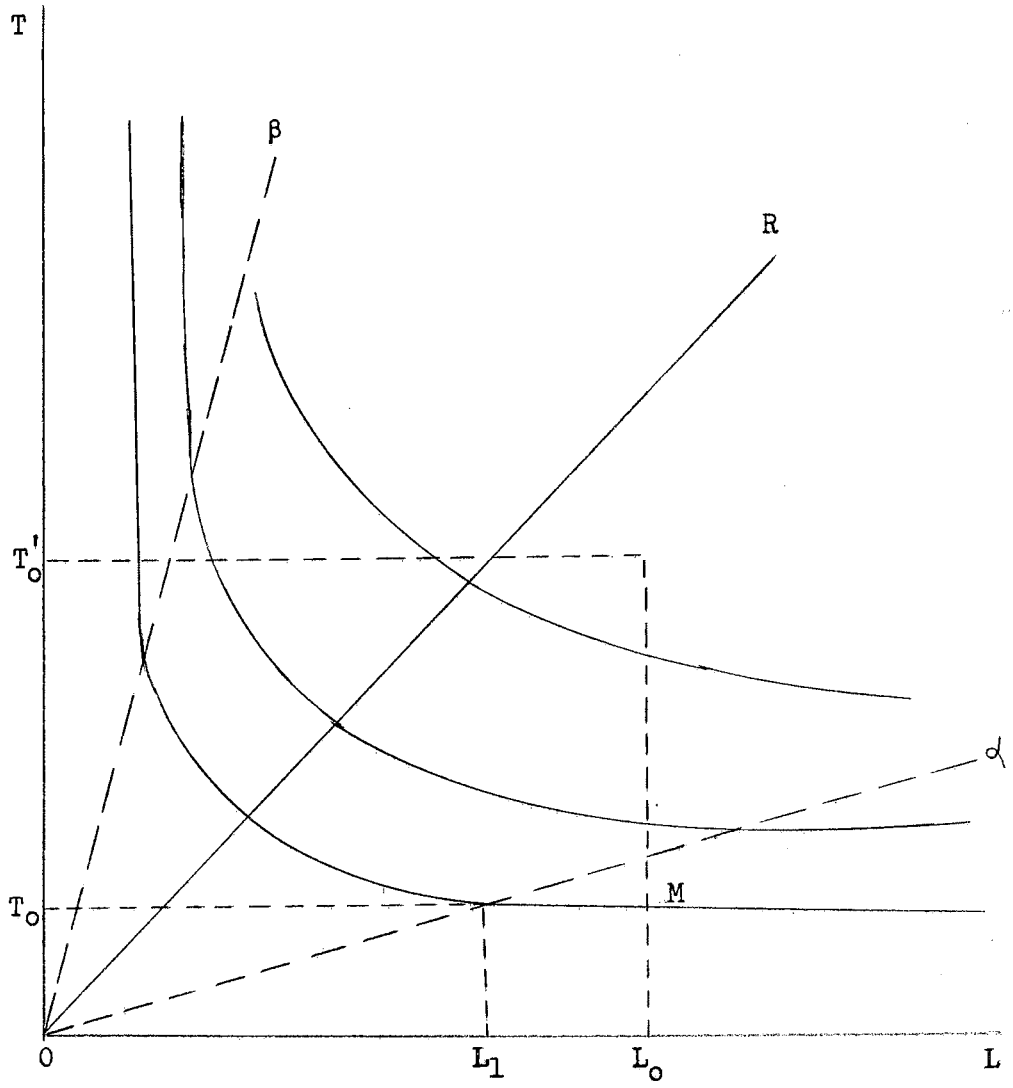

Figure 1. A General Model of an Overpopulated Economy or Area.

composite variable of land and capital.

In the usually accepted theory of production, the optimum output would be at some point on the expansion path such as OR. However, in an overpopulated economy, the labor supply is some quantity such as L_o, and land and capital is some quantity such as T_o. The locus of these quantities, M, is far off the expansion path. As depicted in the Figure, the marginal product of labor is zero in the range of labor supply L_1 L_o (or anywhere in the triangle LOα), and this quantity of labor clearly is superfluous. However, this quantity of labor must obtain a share of employment opportunities. In the area LOα, T_o, is the limitative factor in production, that is, T must be increased before output can be increased (before a higher isoquant can be attained). In a region where a factor is limitative, its marginal product is constant while that of the other is zero.[3]

Underemployment or overpopulation may be defined in various ways, but here we shall define it in terms of a marginal labor productivity of zero. Given a fixed amount of labor of L_o the proper adjustment to bring about some positive marginal value product of labor would be to increase the composite of land and capital in the direction of T_o'. However, the variable T also may be difficult to vary, and, for such economies, the generally accepted theory of adjusting factor proportions to bring about efficient factor use may be inappropriate.

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[3] N. Georgescu-Roegen cautions that the term limitative should not be confused with limitational. A factor is said to be limitational when its increase is a necessary but not sufficient condition for an increase in output.

An Adaptation of the General Model

In his study of labor underemployment in Eastern Oklahoma, E.J.R. Booth defined underemployment in terms of the needed reduction in numbers of farm workers to result in "acceptable" levels of income per worker.[4] What constitutes an acceptable income per worker is arbitrary. Various income targets may be used in identifying magnitudes of labor underemployment; Booth used a target of $2,000 per worker.

An aggregate production function for 24 Eastern Oklahoma counties was used as the model. The model was of the form:

$Y = A X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4}$ where,

Y = Value of farm output in 1949 dollars

X_1 = Available farm labor force in 1950 man years

X_2 = Useable farm land in 1949 acres

X_3 = Current expenses in 1949 dollars

X_4 = Value of fixed assets in 1949 dollars

Some Details of the Procedures were as Follows:

(a) A target income of $2,000 farm income per worker was assumed. This was to represent the return to farm labor, management, and the owners of fixed assets, less the amount of current expenses at zero interest.

(b) To attain this target farm land was assumed to be fixed at existing county levels.

(c) Current expenses and fixed assets were to be utilized in the

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[4] Booth, pp. 97-103.

proportions existing at county levels, but were allowed to vary jointly.

(d) Output was assumed constant at estimated county average levels as labor was reduced and capital was increased. Actual output was used in constructing the target restrictions.[5]

The results of the analysis disclosed that farm labor was underemployed to the extent of 58 percent. An estimated out-migration of 38,000 workers would be required to attain the income target. However, estimated adjustments in total capital appeared quite small, approximately a four percent increase.

The kind of adaptation made by Booth in the general model by Georgescu-Roegen may be demonstrated graphically (Figure 2). First, it may be postulated that the supply of labor L_1 L_0 does not exist in Eastern Oklahoma, but that the actual supply is in the vicinity of OL_1. This postulate is consistent with the functional form of the equation used. If OL_1 labor exists for the output P, its marginal product is zero, and, very likely, its average product is below some socially acceptable standard. Instead of adjusting capital for a fixed supply of labor, both the average and marginal value products of labor can be increased by reducing labor, and adjusting capital as necessary to maintain the output, P. A $2,000 per worker income target, for example, possibly could be obtained by reducing labor by the amount L_1 L_2, and increasing capital by the amount T_0 T_1.

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[5]For the algebraic method used in adjusting factor proportions, see Booth, pp. 98-100.

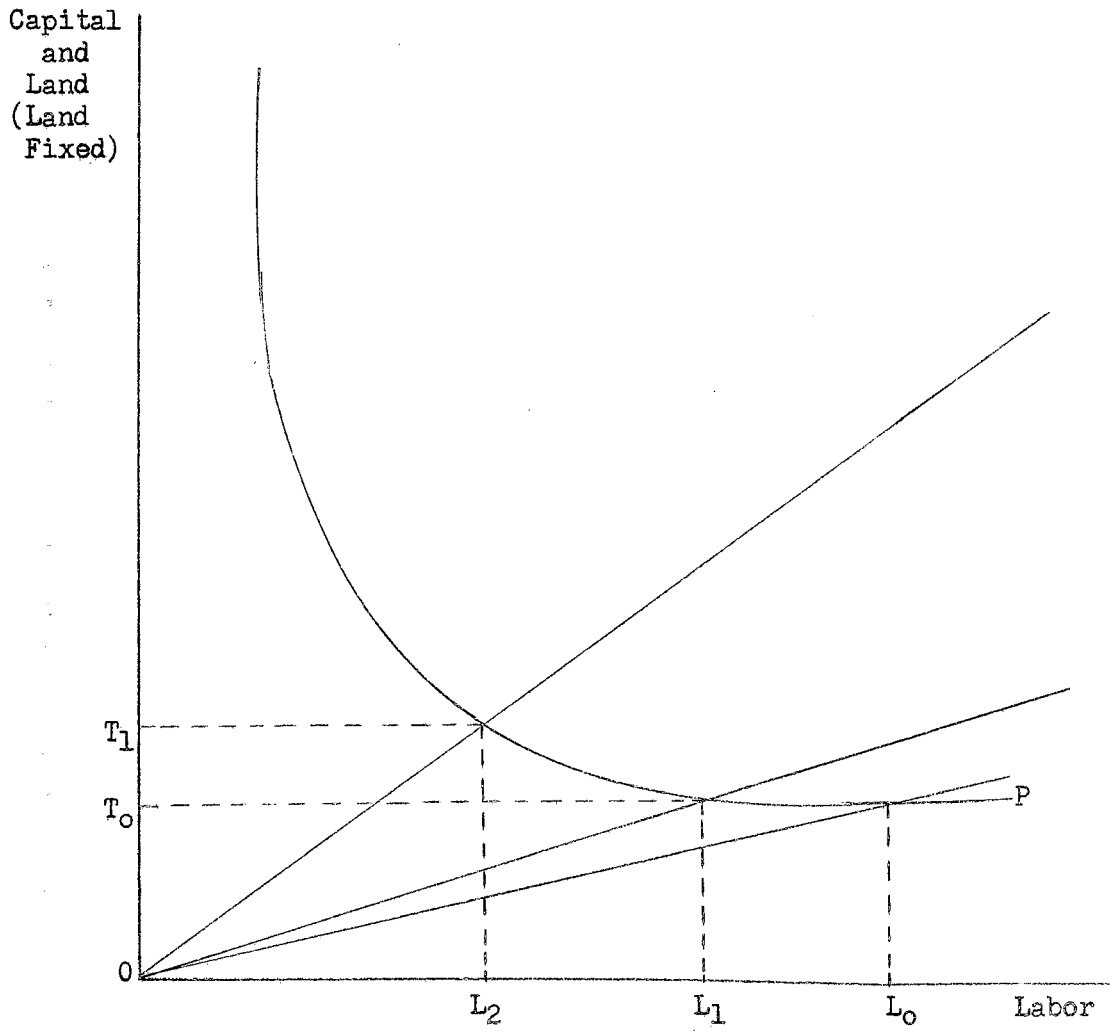

Figure 2. Illustration of Adjustment in Factor Proportions in Eastern Oklahoma to Reduce Underemployment of Labor.

Statistical Model, Specifications, and Procedure

Following Booth's procedure, the model used was of the form:

$\hat{Y} = A\ X_1^{b_1} X_2^{b_2} X_3^{b_3} X_4^{b_4}$ where,

$\hat{Y}$ = The value of farm output in 1959 dollars

X_1 = The available farm labor force in 1960 man years

X_2 = Useable farm land in 1959 acres

X_3 = Current expenses in 1959 dollars

X_4 = The value of fixed assets in 1959 dollars

Measurement of Variables

A. Value of Farm Output, 1959

1. Description

(a) The dollar value of all farm products sold in census year, plus

(b) The dollar value of home consumption, estimated by allocating the 1959 state value of home consumption by counties on the basis of their 1944 home consumption per farm and the county change in farm number, 1944-1959. For this purpose each 1944 value of county home use per farm was multiplied by the 1944 to 1959 state home use per farm ratio. The result was then multiplied by the number of 1959 farms in each county to obtain the 1959 value of home consumption.

(c) Government payments were excluded due to lack of county data.

2. Source: U. S. Census of Agriculture, 1945 and 1959.

B. Estimated Farm Labor Force, 1960

1. Description

The farm labor force in 1959 consists of:

(a) Farm operators less man-year equivalents spent off-farm on nonfarm jobs, plus

(b) Nonoperator, male rural residents, less man-years spent off the farm, plus

(c) Female rural residents, less man-years spent off-farm, modified by a lower rate of female participation in farm production, plus

(d) Hired farm workers.

2. Detailed Description

(a) Farm operators are assumed all male, and equal the 1959 number of farms.

(b) The man-years off-farm is the man-days spent off-farm in nonfarm jobs in 1959, divided by 250 days; the work year. This was estimated by applying the average days worked in each class to the two classes reported in the census. The average days worked was estimated by interpolation between the averages reported in the 1959 Census.

(c) The male rural residents 14 years and over in 1959, less the farm operators, were assumed to be working off-farm at double the rate of the operators.

(d) The female rural residents, 14 years and over in 1959, were assumed to be working off-farm at double the rate of the farm workers but working on the farm at only one-fourth the rate of the males.

(e) The hired farm workers were obtained by dividing the expenditures on hired farm workers in 1959 by 250 and multiplying this figure times the average wage rate per day in 1959.

3. Source

(a) U. S. Census of Agriculture, 1959

(b) U. S. Census of Population, 1960

C. Farms and Farm Land, 1959

1. The farms as used in this study are classified as non-abnormal farms as defined in the census.

2. Useable Farm Land

(a) Consists of total acres of land in farms, including pasture, woodland, and wasteland, minus

(b) Land classed as "other land", which includes house lots, barn lots, lanes, roads, ditches, and wasteland.

3. Adjusted Useable Farm Land

This item was adjusted to allow for the differences in land productivity between counties.

(a) The value of land and buildings by counties was divided by the useable land in the county to obtain the value per useable acre.

(b) The value of land and buildings per useable acre was divided by the ratio (a) for the 24-county area.

(c) This ratio was then multiplied by the useable farm land per county to obtain the adjusted farm land in each county.

4. Source: U. S. Census of Agriculture, 1959

D. Current Expenses and Farm Income, 1959

1. Description

(a) Current expenses as used in this study include the following items:

(1) tractor and machinery repair

(2) feed, fuel and oil, livestock purchases, machine hire, and seed purchases

(3) fertilizer

(b) Farm income is defined as the value of farm output for sale and home consumption, minus current expenses as defined above.

(c) Livestock purchases are excluded from current expenses when used in conjunction with the value of fixed assets. The value of fixed assets includes the value of livestock on farms; it is hoped that this measure will help avoid double counting between purchases and ending inventories. This adjustment will not be accurate to the extent that animals may be purchased and sold within the same year.

(d) Items such as taxes, mortgage debts, interest payment, business equipment, and expenses as other minor items have been excluded from current expenses.

2. Detailed Description

(a) The item "tractor and machinery repair" was derived by summing the items "tractor repair" and "other repair" as defined by the 1949 Census and multiplying this sum by the 1959 to 1949 ratio of index of prices paid for these items. Building repair was excluded from this item due to the

difficulty of obtaining data.

(b) The items "feed expense," "livestock purchases," "machine hire," "fuel and oil," and "seeds and trees" were obtained directly from the census. In order to adjust for the amount of custom work which is done by farmers only one-half of the item "machine hire" is included in expenses.

(c) The value of fertilizer expense includes the item "lime and limestone products". The item "lime and limestone expense" was obtained by obtaining the tons used from the census and applying a value per ton. The value per ton was obtained by local inquiry. The value per ton of prepared fertilizer was estimated by dividing the fertilizer into three use classes.

3. Source

(a) U. S. Census of Agriculture, 1949 and 1959

(b) Oklahoma State Department of Agriculture, Fertilizer Annual Report, 1959

E. The Value of Fixed Assets, 1959

1. Description

(a) Farm assets include the value of land and buildings, the value of livestock on farms, and the value of machinery and equipment.

(b) When used with adjusted useable farm land described in (C) the value of land and buildings is excluded.

(c) The value of machinery and equipment for 1959 was estimated from census data on numbers and estimates of depreciated values.

2. Detailed Description

(a) The average value of land and buildings per farm, and the number of non-abnormal farms was obtained from the census. The product of these two items yielded the value of land and building in each county.

(b) The numbers of the various classes of livestock on farms were obtained directly from the census. The price per head was an average price, also derived from the census.[6]

(c) The value of machinery and equipment was estimated as listed in Table II. The numbers of the items considered are listed in the census with the exception of tractor equipment. Each tractor is assumed to have the collection of equipment as listed under item seven.

3. Source

(a) U. S. Census of Agriculture, 1959

(b) Agricultural Statistics, 1961

(c) Agricultural Prices, 1961

(d) Charles P. Butler and Thomas A. Burch, Economic Leaflet No. 14 A Revised, Department of Agricultural Economics, South Carolina, Agricultural Experiment Station of Clemson College, April, 1959

(e) Merton S. Parson, Frank H. Robinson, and Paul E. Strickler, Farm Machinery Use, Depreciation, and Replacement, U.S.D.A. Bulletin No. 269, October, 1960

(f) Agricultural Engineers Yearbook, 1959

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[6]See Table I.

TABLE I

ESTIMATES OF VALUE OF LIVESTOCK AND POULTRY ON FARMS, 1959

Item	Number[a]	Total Value $[a]	Average Value/head $
Cattle and Calves	3,239,413	383,446,290	118.37
Horses and Mules	90,023	9,273,369	103.00
Hogs and Pigs	524,409	8,004,092	25.26
Sheep and Lambs	276,251	3,676,279	13.31
Chickens, 4 Mo. and Older	4,184,997	3,306,148	0.79
Turkeys	49,488	193,003	3.90
Goats and Kids	24,831	185,038	7.45

[a]United States Census of Agriculture, Vol. I, Part 36, Oklahoma, State Table 6, p. 9.

TABLE II

ESTIMATED 1959 FARM EQUIPMENT VALUES

	Item	1959 New Price $[a]	Average Age in 1959 Years[b]	Rate of Depreciation in Percent[c]	Diminishing Balance Value
1	Milking Machine Two units and extra equipment	1430	9	14	368.01
2	Grain Combine 6' PTO	1900	6	20	498.08
3	Corn Picker Two Row PTO	2200	6	20	576.72
4	Hay Baler Pick-up PTO	1890	10	16	337.62
5	Motor Truck Pick-up	2050	9	20	257.97
6	Tractor Two Row, 20 Hp.	1900	8	14	568.57
7	Tractor Equipment[d] Plow 2-14" Harrow 2 Sec., Spike Tooth Planter Two Row Drill 12 Hole Cultivator Two Row Mower 7' Rake, Side-delivery Wagon	2465	8	12	886.50
8	Milk Cooler, Electric 6 Can Capacity	640	4	18	224.14
9	Power Operated Elevator, Conveyer or Blower	280	6	20	73.40
10	Forage Harvester	2200	6	16	772.86
11	Crawler Tractor	13000	6	13	5,637.30

Source: [a]Item (1) obtained by inflating the value used by Booth for item by the 1949 to 1959 ratio of Index of Prices Paid for Machinery and

(Continued)

TABLE II, Source (Continued)

Equipment, Items (2), (3), (4), and (6) obtained from U.S.D.A., Agriculture Statistics, 1961, Item (7), (9), and (10) obtained from C. P. Butler and T. A. Burch, Power and Machinery Costs 1958, Agricultural Experiment Station of Clemson College, Leaflet No. 14 A Revised, April, 1959. Item (11) estimated from information provided by county agents in the area, and item (4) and (5) obtained from Agriculture Prices, Oklahoma, 1961.

[b]Items (1), (2), (3), (4), (5), (6), (7), and (10) were estimated from Merton S. Parson, Frank H. Robinson, and Paul E. Strickler, Farm Machinery, Use, Depreciation, and Replacement, United States Department of Agriculture, Bul. No. 269, October, 1960, Tables 15-18, pp. 18-21. Items (8), (9), and (11) were estimated from information provided by county agents in the area.

[c]Consistent with the maximum allowable depreciation rates as set forth in the Farmers Tax Guide for 1959, p. 37.

[d]Each tractor is assumed to be used in conjunction with the equipment listed under item (7).

Study Area, Problems, and Limitations

A. The Area of Study

Twenty-four counties consisting of five economic areas were selected as the study area. The counties were Adair, Atoka, Bryan, Cherokee, Choctaw, Coal, Creek, Delaware, Haskell, Hughes, Latimer, LeFlore, McCurtain, McIntosh, Marshall, Muskogee, Okfuskee, Okmulgee, Pittsburg, Pontotoc, Pushmataha, Seminole, Sequoyah, and Wagoner in Economic Areas 6, 7b, 8a, 8b, and 9 of the State of Oklahoma. The geographical location of the area is depicted in Figure 3.

The history and culture of the area is reasonably homogeneous, however, soil fertility is not. No area of the state which is large enough to provide variation is small enough to insure homogeneity with respect to soil fertility and climate. There exists little variation in temperature, however, average annual rainfall through the area varies from 36 to 52 inches. With two exceptions, Marshall and Bryan counties, the study areas' soils are less fertile than the state average.[7]

B. The Data Problem[8]

The data problem is a factor which accompanies nearly all research projects, this analysis is no exception. The data for this study were obtained primarily from the United States Census of Agriculture. There existed no great problem related to choice, for essentially no alternatives existed. An analysis of this type required county data and the only practical source is census material.

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[7]Booth, p. 19.

[8]Much of the information pertaining to the data problem is presented in an earlier study by Booth.

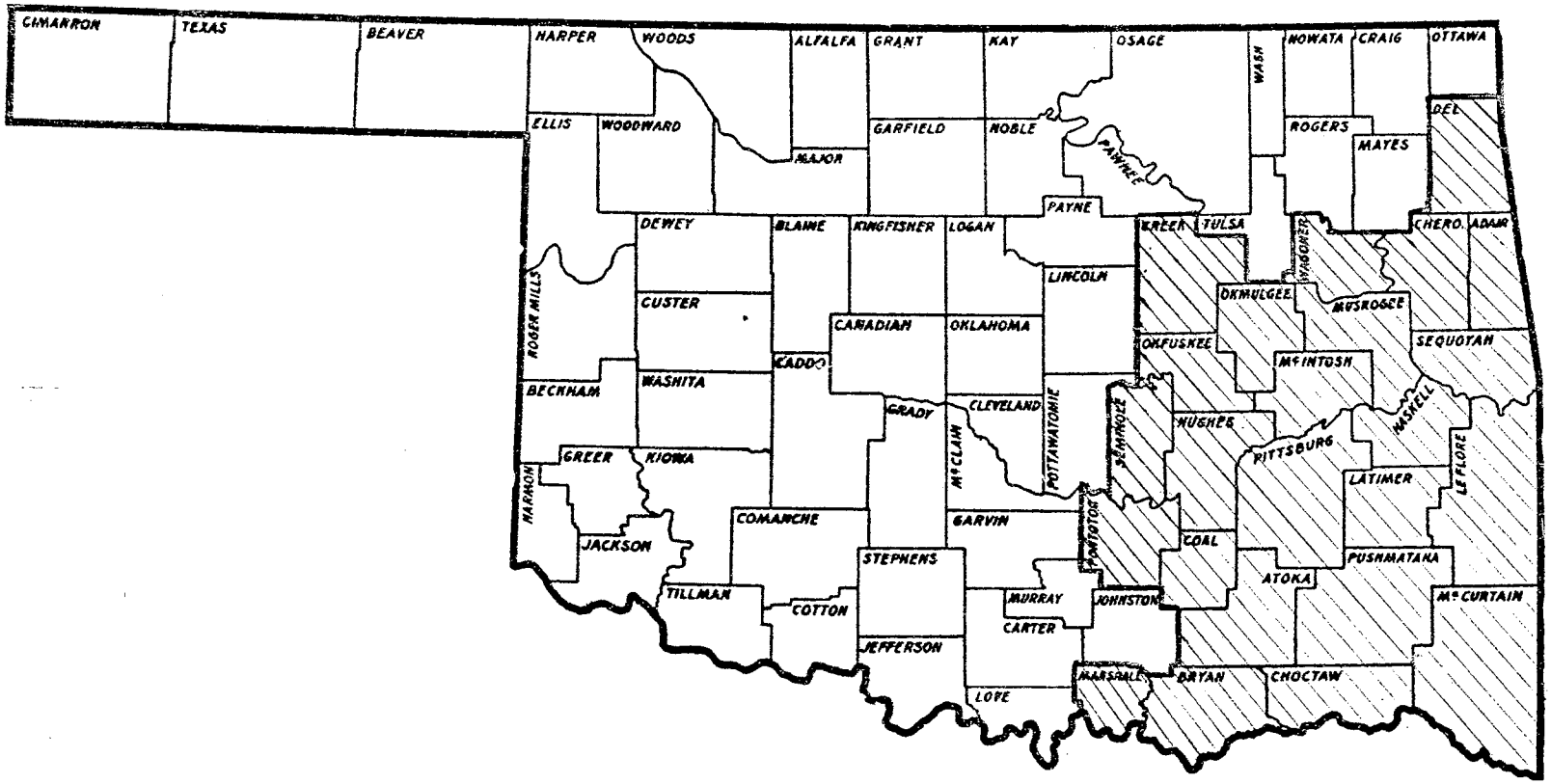

Figure 3. Area of Study.

The use of census material in research has often been criticized as being somewhat inaccurate, and inconsistent in content. It is difficult to make valid comparisons with other studies when census data are used because the manner in which the data are collected, tabulated, summarized, and presented differs from one time period to another. Due to the method of obtaining the data it is difficult to obtain information applicable to specific calendar years. Changes in definitions of items, such as farms, are other sources of complications. Further problems arise due to inconsistencies in the content of given items from one period to another.

C. Functional Form

The model used for this study was a form of the Cobb-Douglas. The Cobb-Douglas has the advantage of low degrees of freedom from parameters estimated, and apparent ability to yield parameters not inconsistent with theoretical precepts. A disadvantage is that, when fitted in logarithms, the estimates of reliability refer only to the variables regressed linearily in logarithms. With respect to theory, marginal rates of substitution (for $\beta > 0$) are always negative; for fixed factor price ratios, expansion paths are in fixed combinations of factors; and the marginal productivities are always declining at a declining rate.[9]

A Comparison with Procedures in an Earlier Study

Since one objective of this study was to compare the results of this study with the results obtained by Booth, some differences in data and

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[9]Booth recognized that these restrictions are less than realistic, but acknowledges that for small variations in factors and output, the results are useful.

procedure having a bearing on the comparability of the two studies must be identified. Especially important are the differences in the data proper and in the manner in which the data were processed.

There exists no difference in the model used in these studies. The Cobb-Douglas type function was utilized in both studies. No appreciable difference existed in the manner that output, labor, useable land, adjusted useable land, and current expenses were measured. There was a difference in the computation of fixed assets. This study included more components of fixed assets than did the study by Booth. This arose from the fact that the 1959 Census was more complete with respect to these items than was the 1949 Census. Items 8, 9, 10, 11, and the cultivator listed under item seven of Table I were not included in the fixed asset variable used by Booth. There is no way of ascertaining whether the estimates in Table I were derived in the same manner, however, it is not probable that they were.

The variables used in the one function were designed to be as comparable with the variables used by Booth as the data would permit. The variables used in the second function were modifications of the first. These variables were defined as follows:

$\hat{Y}$ = Value of farm output, per county, 1959 dollars

X_1 = Available labor force per county, man-year, 1960

X_2 = Adjusted useable land, per county, acres, 1959[10]

X_3 = Current expenses, less livestock purchases per county, 1959 dollars

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[10]See page 15 for an explanation of the adjustment in the land variable.

X_4 = Fixed assets, less value of land and buildings per county, 1959 dollars[11]

The major difference in the two equations was in the measurement of X_2, land. For the first function, land was measured in acres. Land is a heterogenous resource, and there is no existing satisfactory method of measuring it. However, it is believed that the adjustment made for the second function increased the comparability of farm land acreage among the counties.

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[11] X_4 as used here consists of the value of machinery and equipment on farms, plus the value of livestock on farms in 1959.

CHAPTER III

RESULTS

The first part of this chapter will be devoted to comparing certain elements of this analysis with results of the earlier study. A second part will be devoted to a presentation of the results of the modified equation. The latter part will briefly recapitulate an assessment of the methodology of this analysis.

A Comparative Analysis

The first equation to be considered is:[1]

$$\hat{Y} = 5.4674\ X_1^{.1256} X_2^{-.1818} X_3^{.4167} X_4^{.5368}$$

where

$\hat{Y}$ = Value of Farm Output per County, 1959 Dollars

X_1 = Available Labor Force per County, Man-Years, 1960

X_2 = Useable Farm Land per County, Acres, 1959

X_3 = Current Expenses, Less Livestock Purchases per County, 1959 Dollars

X_4 = Value of Fixed Assets per County, 1959 Dollars

Fitted in logarithms, the explanatory power was $R^2 = 0.89$. The "t" statistics are $t_1 = 1.04$, $t_2 = 1.34$, $t_3 = 2.70$, $t_4 = 2.76$. Current expenses and fixed assets were significant at high levels. The coefficients

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[1]The data for this equation are presented in Appendix Table I.

for labor and land were not significantly different from zero. The hypothesis that labor contributes little to output is not rejected. The negative coefficient for land may reflect an improper measurement of this variable. The variables used to derive this equation were as comparable to those used in Booth's study as the data would permit.

The estimating equation obtained by Booth was derived from 1949 data. This equation was:[2]

$$\hat{Y} = 0.600\ X_1^{.034} X_2^{.334} X_3^{.324} X_4^{.407}$$

The explanatory power for this equation was $R^2 = 0.89$ and the "t" statistics were $t_1 = 0.29$, $t_2 = 2.64$, $t_3 = 1.52$, $t_4 = 1.52$

The high significance of current expenses and fixed assets in this analysis as compared to Booth's study may be attributable to the large increase in the use of these items during the last decade. It appears that the whole input-output complex for the area has changed since 1950. The increase in fixed assets is due largely to the components included in this item as compared to Booth's analysis. The census provided a larger list of assets in 1959 than in 1949.

The negative coefficient for land and its low significance as compared to the relatively large coefficient and high significance of Booth's equation may be partially explained by the change in factor use. An extremely large portion of current expenses consisted of feed expense. Livestock purchases for the area were quite large. It appeared in many counties of the study area that land was changing from a relatively high intensified use to a relatively low intensified use especially with respect to vegetable production. It also appeared that a great deal of

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[2]Variables defined on page 10.

the land classified as "farm land" in 1959 was actually surplus in the sense that it was not being utilized to produce any output.

Some estimates of output, inputs used, and marginal value products for 1959 are summarized in Table III. Under the column headings of "present", the levels of resource use and output are presented for an average (geometric mean) county of the study area and for Delaware County in terms of income per worker. Booth used Marshall County in addition to those included in the Table, however, no solution for Marshall could be obtained in this study.

The farm income, as defined in this study, exceeded the $2,000 target in both Marshall County and for the geometric mean. The pattern of adjustment was not consistent with the results obtained by Booth. Only in Delaware County did the proper direction of adjustment occur, and only in this county was the existing farm income less than $2,000. The labor adjustment required to obtain $2,000 farm income in this county decreased from 1,421 workers to 1,300 workers. This change of 121 workers represents a decrease of eight and one-half percent. This would require current expenses to increase from $2,398,232 to $2,453,200, a change of $54,968, or a little over two percent increase. The fixed assets increased from $25,679,243 to $26,267,817, a change of $588,574, or slightly over a two percent increase.

The marginal value products have little economic significance in the case of the geometric mean. In this instance the target suggests that labor be increased in order to give each worker $2,000. This is a result of the target being lower than the 1959 income.

Current expenses appeared to be used in insufficient amounts in the mean and Delaware County. The marginal value product for labor of $549.92

TABLE III

INPUT-OUTPUT LEVELS AND ESTIMATED FUNCTIONAL CONSTANTS FOR DELAWARE COUNTY AND THE 24-COUNTY GEOMETRIC MEAN WITH REQUIRED INPUT LEVELS FOR A TARGET OF $2,000 FARM INCOME PER WORKER, 1959

Item	Delaware County		Geometric Mean	
	Present	Target[a]	Present	Target[a]
Levels of Output and Factors				
Output value, dollars	6,144,139	6,144,139*	4,136,000	4,136,000*
Labor, man years, number	1,421	1,300	992	1,084
Useable land, acres	264,719	264,719	307,660	307,660
Current expenses, dollars	2,398,232	2,453,200	1,400,350	1,020,400
Fixed assets, dollars	25,679,243	26,267,817	21,644,000	15,771,441
Marginal Value Products				
Labor, dollars per man	549.92	593.52	521.96	357.17
Land, dollars per acre	-4.27	-4.27*	-2.44	-2.44*
Current expenses, dollars	1.08	1.04	1.23	1.26
Fixed assets, dollars	0.13	0.12	0.10	0.10

[a](Y - X_2 - Livestock Purchased) $\div$ X_1 = 2000, assuming Y, X_2, X_3/X_4 fixed at county levels.

*Assumed identical to the present level by assumption or implication.

indicates that labor is underemployed if there exists a higher alternative use value for labor in the area elsewhere.

Similar results for Booth's estimating equation are presented in Table IV. The analysis indicates that for Marshall County labor would be required to decrease from 1,122 to 737 to attain the $2,000 income per worker. The adjustment in Delaware would require a decrease in labor from 3,138 to 736 workers. The geometric mean would be required to decrease from 2,539 to 1,060. The farm income obtained from this study indicates that the target has been attained with respect to Marshall County and the geometric mean, however, Delaware County had not reached the target by 1959.

The marginal value products were quite low for labor indicating that underemployment of the resource is prevalent in the area. The investment in current expenses for Marshall County returned three percent which is somewhat less than a normal return for this factor, however, returns to this factor for the area were 29 percent which may have indicated capital rationing, risk aversion on the part of borrowers, or the lack of knowledge about the magnitude of returns to this factor.

A Test of Predictive Accuracy of the Equations

To test the accuracy of Booth's equation as a predictive device, the 1959 production function variables were used in conjunction with his equation. The reverse was used to test the predictive accuracy of the equation for this study.

The results of these estimates are presented in Table V. The columns "observed" and "predicted" represent the actual and estimated farm income per worker for the years indicated. No effort was made to

TABLE IV

INPUT-OUTPUT LEVELS AND ESTIMATED FUNCTIONAL CONSTANTS FOR MARSHALL AND DELAWARE COUNTIES, AND THE 24-COUNTY GEOMETRIC MEAN, WITH REQUIRED INPUT LEVELS FOR A TARGET OF $2,000 OF FARM INCOME PER WORKER, 1950[a]

Item	Marshall County		Geometric Mean		Delaware County	
	Present	Target[b]	Present	Target[b]	Present	Target[b]
Levels of Output and Factors						
Output value, dollars	3,151,000	3,151,000*	3,511,000	3,511,000*	3,557,000	3,557,000*
Labor, man years, number	1,122	737	2,539	1,060	3,138	736
Useable land, acres	202,000	202,000	303,000	303,000	275,000	275,000
Current expenses, less L.P., dollars	848,000	865,000	884,000	920,000	1,309,000	1,399,000
Total fixed assets, dollars	10,451,000	10,656,000	13,006,000	13,543,000	16,564,000	17,714,000
Marginal Value Products						
Labor dollars per man	81.14	123.57	46.81	112.06	46.26	197.28
Land dollars per acre	4.45	4.45*	3.87	3.87*	5.21	5.21*
Current expenses	1.03	1.01	1.29	1.24	1.06	0.99
Fixed assets	0.10	0.10	0.11	0.11	0.11	0.10

[a]E.J.R. Booth, "Economic Development in Eastern Oklahoma Until 1950" (unpublished Ph.D. dissertation, Vanderbilt University, 1961), p. 94.

[b](Y - X_3 - Livestock Purchased) $\div$ X_1 = 2000, assuming Y, X_2, X_3/X_4 fixed at county levels.

*Assumed identical to the present level by assumption or implication.

TABLE V

OBSERVED AND PREDICTED INCOME PER WORKER, BY COUNTIES, 1959 AND 1949

County	1959 Observed $	1959 Predicted[a] $	1959 % Predicted is of Observed	1959 Deviation From Mean Error %	1949 Observed $	1949 Predicted[b] $	1949 % Predicted is of Observed	1949 Deviation From Mean Error %
Marshall	3785	2706	71.5	-64.2	1341	727	54.2	-22.7
Okmulgee	2260	3027	133.9	-01.8	1195	1172	98.1	+21.2
Muskogee	3117	2857	91.7	-44.0	1132	812	71.7	-05.2
Bryan	2153	2814	130.7	-05.0	1100	735	66.8	-10.1
Haskell	1808	3539	195.7	+60.0	1084	545	50.3	-26.6
Hughes	1826	2287	125.2	-10.5	977	613	62.7	-14.2
Seminole	1455	2765	190.0	+54.3	929	854	91.9	+15.0
Wagoner	2761	3385	122.6	-13.1	906	947	104.5	+27.6
McIntosh	1810	2585	142.8	+07.1	879	579	65.9	-11.0
Atoka	1920	2863	149.1	+13.4	863	384	44.5	-32.4
Creek	2059	4492	218.2	+82.5	832	641	77.0	+00.1
Coal	2569	2493	97.0	-38.7	832	371	44.6	-32.3
Okfuskee	1892	2654	140.3	+04.6	825	493	59.8	-17.1
Pittsburg	2066	4060	196.5	+60.8	811	517	63.7	-13.2
Pontotoc	2249	3275	145.6	+09.9	768	557	72.5	-04.4
McCurtain	2082	2722	130.7	-05.0	761	376	49.4	-27.5
Pushmataha	1677	3576	213.2	+77.5	702	474	67.5	-09.4
Latimer	1424	2865	201.2	+65.5	695	426	61.3	-15.6
Choctaw	1594	2699	169.3	+33.6	644	465	72.2	-04.7
Adair	2114	1366	64.6	-71.1	628	589	93.8	+16.9
Cherokee	1782	2043	114.6	-21.1	613	536	87.4	+10.5
Sequoyah	2255	2774	123.0	-12.7	567	394	69.5	-07.4
LeFlore	1695	2738	161.5	+25.8	545	556	102.0	+25.1
Delaware	1921	1832	95.4	-40.3	512	684	133.6	+56.7
Geometric Mean	2153	2921	135.7	.000	857	638	76.9	.000

[a]Derived by using 1949 equation and 1959 variables.

[b]Derived by using 1959 equation and 1949 variables.

analyze all 24 observations, but rather to consider the counties with the larger differences between the deviations of "observed" and "predicted" farm incomes per worker after adjusting for the average error in prediction depicted by the geometric mean. The objective is to ascertain the possible cause of such results.

The extreme observations were placed into four classifications: leading "growth" counties, leading "nongrowth" counties, high "efficiency" counties, and low "efficiency" counties.

Leading "growth" counties were counties which had actual farm incomes, in 1949 less than predicted, but actual farm incomes in 1959 greater than predicted. These counties were Adair, Delaware, Cherokee, and Wagoner.

The leading "nongrowth" counties were counties which had actual incomes in 1949 greater than predicted, but actual farm incomes in 1959 less than predicted. Haskell and Latimer counties were in this classification.

The counties classified as high "efficiency" were those with actual farm incomes exceeding those predicted by the equations in 1959 and 1949. The counties included are Marshall and Coal.

Low "efficiency" counties were those with actual income less than predicted in both 1959 and 1949. These counties were Creek, Seminole, and LeFlore.

The difference in observed and predicted farm income per worker, in general, appears to be a result of (1) a tremendous trend toward livestock farming throughout the area, and (2) the change in composition in factor inputs, primarily fixed assets and current expenses, to actually reduce efficiency in resource use. Also, the increase in the number of items

included in fixed assets in the 1959 Census exerted some influence.

Current expenses for the mean observation increased from $884,000 in 1949 to $1,400,350 in 1959. This represented an increase of 58.4 percent for the decade. Fixed assets increased from $13,006,000 to $21,644,000, or an increase of 66.4 percent.

The growth counties indicated large increases in the production of vegetables and strawberries. This was especially true of Adair County. Also, dairy farming increased in all of these counties.

Haskell and Latimer Counties exhibited higher than average trends toward less intensive farming practices. This is especially true of Latimer County where large increases have occurred in both broiler and beef production.

The high "efficiency" counties evidenced increases in farm land. This is a result, primarily, of county residents owning land in other counties.

A study of Seminole County did not provide any insight as to direction of change. However, Creek County evidenced a trend toward less intensive farming and less land in farms. LeFlore County exhibited increases in land in farms. Large holdings of land by individuals or corporations is evident in the county. It is possible that income from these holdings is either unreported, or very meager.

Apparently the predictive accuracy of functions of the sort derived in this study are limited, particularly in predicting for individual counties. Further research on this problem appears to be warranted.

The Modified Production Function

Both of the equations discussed previously were intended to be as

comparable in the way the variables were measured as the data would permit. This was done for the purpose of comparing the results and identifying trends in the area affecting development of the individual counties. The equation and analysis to be discussed in this section represented a modification of the function based upon 1959-60 data. However, the equation form remained unaltered.[3] The equation presented was:

$$\hat{Y} = 21.959\ X_1^{.1556} X_2^{.3426} X_3^{.4667} X_4^{.0096}$$

Fitted in logarithms, the explanatory power was $R^2 = 0.88$. The "t" statistics are $t_1 = 1.14$, $t_2 = 2.09$, $t_3 = 3.93$, $t_4 = 0.04$. The coefficient for X_1 does not differ significantly from zero, and the hypothesis that marginal labor contributes little to farm income is still not rejected. Therefore, the hypothesis of labor underemployment is not rejcted. Land and current expenses were significant at high levels which indicated large returns to these factors at the margin. Variations in fixed assets among the counties did not contribute significantly to the variation in output among the counties. The results suggest that perhaps fixed assets are used in excessive amounts in the area in relation to quantities of other factors used in production.

Adjustments in factor proportions and use to obtain a target income to labor of $2,000 per man-year in the earlier study with the use of 1949-50 data were obtained by iteration with a set of equations. This part of the analysis was accomplished in the same general manner except that double iteration was required due to the introduction of depreciation on machinery as a cost. The target was increased to $2,500 and the

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[3]The variables for this equation are defined on pages 13-22 of this thesis. The data are presented in Appendix Table II.

modified equation was used. The results are presented in Table VI for the geometric mean, and for Adair, Cherokee, and Delaware Counties. Under the heading of "present", the levels of resource use and output as observed are presented. Adjusted output, income per worker, and marginal value products are based upon the target income of $2,500 per worker. The farm income as defined in this section is the value of farm output for sale and consumption, minus current expenses, the value of livestock purchases, depreciation on machinery and equipment, and interest on capital at six percent.[4]

A solution for factor proportions and use to attain $2,500 per farm worker for Adair and Delaware Counties was unattainable from the function when output was held constant. In order to obtain a solution, output was increased until the desired target was attained. This adjustment in procedure may be demonstrated graphically (Figure 4). The equation first was solved for the maximum income attainable per farm worker by adjusting factor proportion on a given isoquant. For Adair County, this isoquant was from a farm output of $4,060,605. The solution indicated a reduction in labor from 1,118 to 555 workers. Since this adjustment was not sufficient to provide the $2,500 income target, output was adjusted upward (with labor held constant at 555 workers) until the target income was attained. This adjustment required that output value be increased to $4,498,177. The existence of this problem is possibly a result of the production surface being relatively flat within the region considered. The target income of $2,500 per worker in Delaware County was obtained

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[4]Appendix Table IV lists the output expenses and resulting adjusted farm income.

TABLE VI

1959 INPUT-OUTPUT LEVELS AND ESTIMATED FUNCTIONAL CONSTANTS FOR THE 24-COUNTY GEOMETRIC MEAN, ADAIR, CHEROKEE, AND DELAWARE COUNTIES WITH REQUIRED INPUT LEVELS FOR A TARGET OF $2,500 FARM INCOME PER WORKER

Item	Geometric Mean		Adair County		Cherokee County		Delaware County	
	Present	Target[a]	Present	Target[b]	Present	Target[a]	Present	Target[b]
Levels of Factors								
Labor man years, number	992	469	1,118	555	1,255	471	1,421	855
Adjusted useable land, acres	293,700	293,700*	188,712	188,712*	268,331	268,331*	357,435	357,435*
Current expenses less L.P., dols.	1,400,350	1,805,050	1,275,215	2,271,350	1,128,667	1,629,200	2,398,232	2,968,350
Fixed assets, dols.	6,010,300	7,747,272	4,144,055	7,381,186	5,531,522	7,984,601	6,875,245	8,509,658
Level of Output, dols.								
Total output	4,136,000	4,136,000*	4,060,605	4,498,177	3,825,099	3,825,099*	6,144,139	7,023,467
Adjusted output	1,583,400	1,178,700	1,946,073	1,387,500	1,681,375	1,180,843	1,828,290	2,137,500
Output per worker	1,596	2,513	1,741	2,500	1,340	2,507	1,287	2,500
Marginal Value Products								
Labor, dols. per man	665.44	1,342.19	547.88	1,138.46	505.87	1,263.66	666.34	1,115.95
Land, dols. per acre	4.87	4.72	7.15	7.37	5.21	4.88	5.82	5.88
Current expenses, dols.	1.39	1.05	1.44	0.83	1.69	1.10	1.18	0.96
Fixed assets, dols.	0.007	0.005	0.009	0.005	0.007	0.005	0.008	0.007

[a] $(Y - X_3 -$ livestock purchases $-$ annual depreciation on machinery and equipment$) \div X_1 = 2500$, assuming Y, X_2, X_4/X_3 fixed at county levels.

[b] See footnote a, assuming X_2, X_4/X_3 fixed at county levels.

*Assumed identical to the present level by assumption or implication.

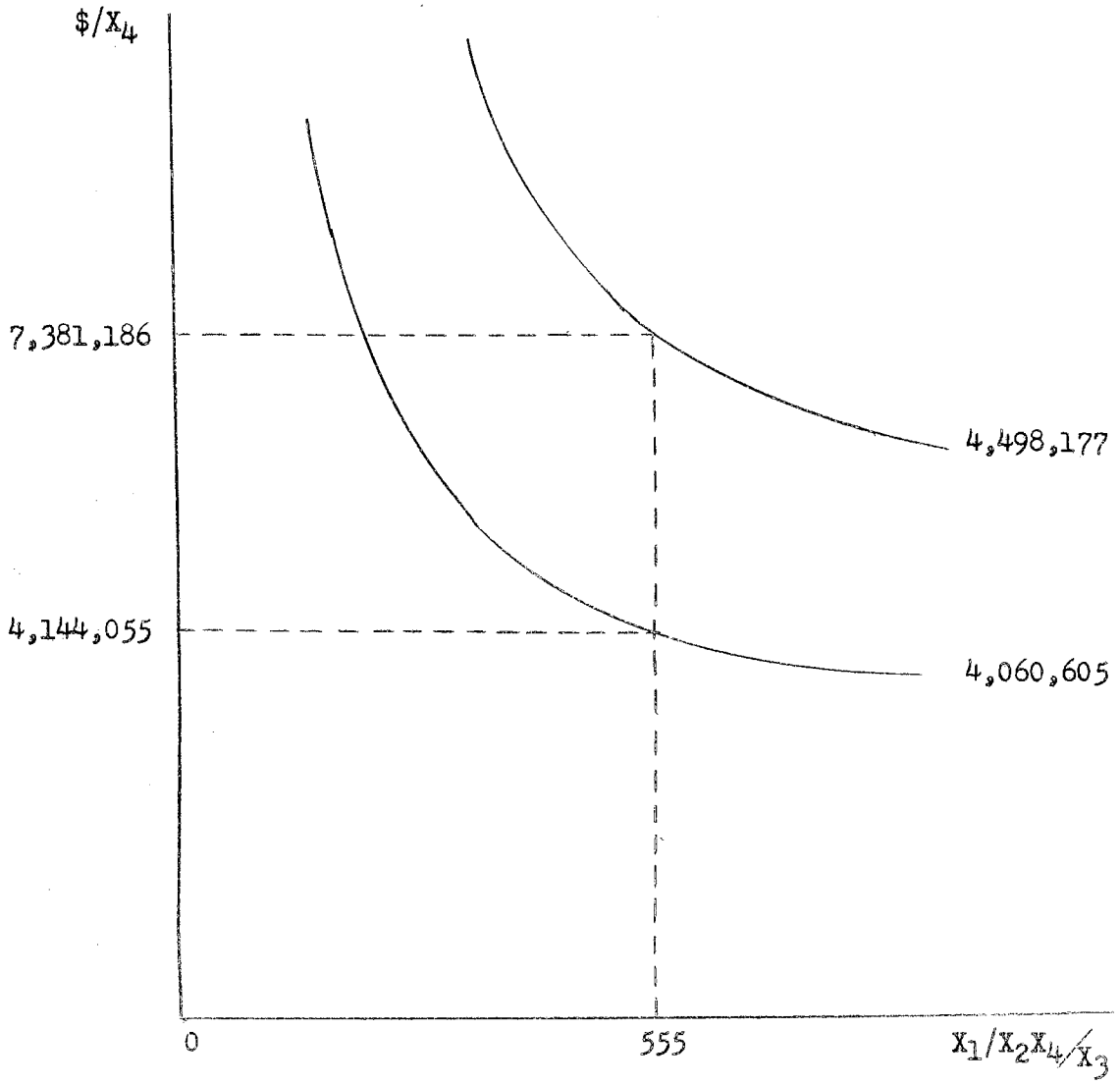

Figure 4. Illustration of Adjustment in Output to Obtain $2,500 Per Farm Worker, Adair County.

in the same way.

Major reductions in the farm labor force would be required to attain the target incomes. Except for Delaware County, these reductions amounted to more than 50 percent. Accompanying this adjustment in the labor force, capital would have to increase, particularly in Adair and Delaware Counties where the output also had to increase to attain the target incomes.

The marginal value products listed under the "target" columns are descriptive of resource productivity only since returns were imputed to the capital variables in the process of obtaining the target incomes. This description of resource productivity, however, does depict a misallocation of resources following adjustments to attain the target incomes. This misallocation was actually worsened by the adjustments made as can be observed by comparing the marginal value products for the "present" and "target" for each of the counties.

In all cases the marginal value product for labor increased, however, the target values for the other estimates did not consistently increase. The marginal value products for land increased in Adair and Delaware Counties but decreased in Cherokee and the mean county. Marginal value products for current expenses and fixed assets declined throughout. It is especially in the larger estimates for current expenses and fixed assets that implications concerning factor shares arise. If these items are to be utilized at all they must receive adequate compensation for their services. The method of deriving the resource allocation to meet the target incomes did compensate for the deficiencies in marginal returns to these factors, but in doing so, it would appear that income to labor and land bear this burden. Apparently, the appropriate

adjustments in farm resource use in the area to increase income to labor are to either (a) change the product mix or (b) change to a more efficient composition of the aggregated capital inputs. In either case, the need for a new production function is implied.

Since 1949, a great deal of adjustment in resource use has occurred in the area. This is especially true with respect to labor. In Delaware County labor decreased from 3,138 workers in 1949 to an estimated 1,421 in 1959; this represented a decrease of 54.5 percent for the decade. The geometric mean decreased in labor from 2,539 workers in 1949 to 992 in 1959, a decline of 60.9 percent. This is a greater decrease for the area than the 58.2 percent indicated by the earlier study as required to meet the income target of $2,000 per farm worker. However, as the analysis of the data for 1959 indicates, labor still is underemployed in the area, for its marginal value product does not differ significantly from zero.

A Brief Evaluation

This analysis by implication, has identified some shortcomings of the methodology used. Although the models used in this analysis have been shown to be limited in predictive accuracy, they may describe what actually existed in respect to resource allocation in a given year and the direction of needed adjustments. Many of the models used in economic analysis lack the facility to predict future events. However, this does not render them valueless. If a model or a method can provide results describing the general trend and direction of movement it has served a useful purpose. Thus, the results of this study are not to be regarded as defensible for predictive purposes, although it would be reassuring

to believe that they do provide an insight as to the nature of needed adjustments.

The possible cause of the inability of the model to accurately predict occurrences between different time periods is influenced by several factors. There has been a tremendous absolute and relative change in many of the input factors of the area. All of the area has increased its investment in livestock and large increases exist in vegetable production and dairy farming. This change in land use is so unstable with respect to areas that these factors alone could greatly influence predictive accuracy. Only with respect to increased investment in livestock is the area consistent with respect to trends. The use of other inputs vary so much from one county to another that often no trend can be identified.

The value of this study may rest in the fact that it indicates some of the problems of data as well as the need to gain additional insight into variables associated with change in parameters of the static production functions.

CHAPTER IV

SUMMARY AND CONCLUSIONS

The problem of underdevelopment and low farm income in many areas of the United States has been a matter of great concern for several decades, however, only in recent years has any appreciable amount of research been devoted to this problem.

The major objectives of this study were (1) to derive aggregate production functions for a 24-county area in Eastern Oklahoma, and (2) to estimate, from these functions, the resource use adjustment needed to increase farm income per worker in the area. The first equation was comparable to an earlier study in respect to the way the variables were measured. The second equation was a modification in the measurement of the variables.

The results of the first equation were compared with the results of the earlier study which was based upon 1949-50 data. This equation was as follows:

$$\hat{Y} = 5.4674\ X_1^{.1250} X_2^{-.1818} X_3^{.4167} X_4^{.5368} \quad \text{where,}$$

$\hat{Y}$ was estimated output, X_1 was labor in man-years, X_2 was land, X_3 was current expenses, and X_4 was fixed assets. The negative coefficient for land possibly was due to the failure to adjust land for its varying productivity throughout the area. It was the existence of this possibility that promoted the researcher to derive a second function. This function was as follows:

$\hat{Y} = 21.959\ X_1^{.1556} X_2^{.3426} X_3^{.4667} X_4^{.0096}$ where the variables were the same as the first equation except in the way they were measured.[1] This function implied that, notwithstanding the large adjustment that has occurred in the labor force in recent years, underemployment of labor still exists in the area. Labor for the mean county decreased from 2,539 in 1949 to 992 in 1959. This represents a decline of 60.9 percent for the decade. Returns to land were $4.87 per acre at the margin. Current expenses returned 39 cents per marginal dollar spent indicating possible insufficient use of this factor. Fixed assets returned less than one percent on investment. This factor evidently was used in excessive amounts throughout the area.

A target farm income of $2,500 per worker was arbitrarily selected to determine the adjustment implied by the model. Estimates for the mean county suggested that labor decreased from 992 to 469 workers to attain this target. Current expenses were required to increase from $1,400,350 to $1,805,050. The marginal value product of labor implied by the assumed target was $1,342 which represented an increase from $665 without this adjustment. Returns to current expenses decreased from $1.39 (without the target) to $1.05 (with the target). Returns to fixed factors were depressed without an applied target income, and they were further decreased to about one-half of one percent with application of the target income. The adjustment applied suggested that labor income could be increased but not without decreasing returns to other factors.

The predictive accuracy of the 1949 and 1959 functions was tested.

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[1] See pages 13 to 22 for an explanation of how the variables were measured.

The function based upon 1949 data was used to predict 1959 farm income per worker, and vice versa. Deviations from the mean error in these predictions by individual counties were calculated. Only the counties with the larger differences between the deviations of "observed" and "predicted" farm incomes (after adjusting for the mean error) were further examined. These counties were classified as leading "growth" counties, leading "nongrowth" counties, high "efficiency" counties, and low "efficiency" counties. The leading "growth" counties were Adair, Cherokee, Delaware, and Wagoner. The leading "nongrowth" counties were Haskell and Latimer. High "efficiency" counties were Coal and Marshall, and the low "efficiency" counties were Creek, Seminole, and LeFlore.

The differences in observed and predicted farm incomes per worker for the geometric mean was due to (1) increased livestock in the product mix, especially beef and broiler production, and (2) the changing composition of factor inputs, primarily fixed assets and current expenses, to result in reduced efficiency of these resources.

A great deal of adjustment has occurred in the labor force since 1949. The mean observation indicated a decrease of 60.9 percent during the decade. The mean income per worker increased from $857 in 1949 to $2,153 in 1959.

The tests of predictive accuracy for the functions indicated that they would be of limited usefulness for this purpose, particularly in predicting for individual counties. The models used in this study, however, did appear to be useful in indicating the direction of needed adjustments in resource use.

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A P P E N D I X

APPENDIX TABLE I

DATA USED FOR THE FIRST PRODUCTION FUNCTION, BY COUNTIES, 1959

	Value of Farm Output 1959	Available Labor 1960	Usable Land 1959	Current Farm Expenses Less Livestock Purchases 1959	Total Value of Fixed Assets 1959
	dollars	man-years	acres	dollars	dollars
Marshall	3,909,187	430	228,794	1,113,485	14,960,882
Okmulgee	3,627,283	856	280,149	1,095,212	20,729,784
Muskogee	8,348,226	1,808	362,402	2,103,983	41,891,805
Bryan	7,203,617	1,767	427,212	2,466,319	37,493,168
Haskell	3,152,150	755	288,161	1,303,744	19,674,629
Hughes	4,361,897	1,327	361,957	1,318,812	20,139,867
Seminole	3,364,137	749	247,041	1,710,761	16,853,152
Wagoner	5,761,501	1,046	273,021	1,964,675	35,215,402
McIntosh	4,297,269	1,407	308,791	1,365,462	27,026,380
Atoka	3,594,382	1,032	404,887	1,033,346	18,589,794
Creek	2,952,818	693	353,958	1,106,501	20,975,478
Coal	3,460,314	634	272,732	891,647	14,638,052
Okfuskee	2,768,540	819	257,332	926,692	14,365,512
Pittsburg	6,034,154	1,226	592,821	2,299,552	32,234,679
Pontotoc	6,097,193	1,021	376,339	2,113,307	33,340,796
McCurtain	4,739,687	1,228	339,771	1,574,234	24,339,658
Pushmataha	2,387,978	756	380,576	857,303	14,973,126
Latimer	1,813,627	598	214,819	798,999	10,742,283
Choctaw	3,421,377	940	321,348	1,100,714	20,205,686
Adair	4,060,605	1,118	161,605	1,275,215	14,025,292
Cherokee	3,825,099	1,255	254,505	1,128,667	19,643,450
Sequoyah	3,869,390	1,015	259,125	1,230,387	21,126,670
LeFlore	6,703,480	1,557	424,655	2,805,258	33,931,862
Delaware	6,144,139	1,421	264,719	2,398,232	25,679,243
Geometric Mean	4,136,000	992	307,660	1,400,350	21,644,000

APPENDIX TABLE II

DATA USED FOR THE MODIFIED PRODUCTION FUNCTION, BY COUNTIES, 1959

	Value of Farm Output 1959	Available Labor Supply 1960	Adjusted Usable Farm Land 1959	Current Expenses Less Volume of L.P. 1959	Fixed Assets Less Value of Land & Buildings 1959
	dollars	man-years	acres	dollars	dollars
Marshall	3,909,187	430	216,067	1,113,485	3,595,931
Okmulgee	3,627,283	856	295,590	1,095,212	5,178,564
Muskogee	8,348,226	1,808	624,016	2,103,983	9,074,731
Bryan	7,203,617	1,767	521,737	2,460,319	9,747,164
Haskell	3,152,150	755	259,260	1,303,744	5,995,397
Hughes	4,361,897	1,327	258,324	1,318,812	6,565,394
Seminole	3,364,137	749	224,412	1,710,761	5,047,042
Wagoner	5,761,501	1,046	539,330	1,964,675	6,850,618
McIntosh	4,297,269	1,407	404,253	1,365,462	5,760,606
Atoka	3,594,382	1,032	232,748	1,033,346	6,357,870
Creek	2,952,818	693	294,799	1,106,501	5,467,426
Coal	3,460,314	634	179,304	891,647	5,205,992
Okfuskee	2,768,540	819	185,706	926,692	4,596,037
Pittsburg	6,034,154	1,226	432,605	2,299,552	9,480,679
Pontotoc	6,097,193	1,021	485,202	2,113,307	7,818,668
McCurtain	4,739,687	1,228	308,989	1,574,234	8,086,102
Pushmataha	2,387,987	756	190,906	857,303	4,930,543
Latimer	1,813,627	598	140,459	798,999	3,355,159
Choctaw	3,421,377	940	275,089	1,100,714	5,734,163
Adair	4,060,605	1,118	188,712	1,275,215	4,144,055
Cherokee	3,825,099	1,255	268,331	1,128,667	5,531,522
Sequoyah	3,869,390	1,015	293,920	1,230,387	5,669,332
LeFlore	6,703,480	1,557	473,062	2,805,258	9,050,335
Delaware	6,144,139	1,421	357,435	2,398,232	6,875,245
Geometric Mean	4,136,000	992	293,700	1,400,350	6,010,300

APPENDIX TABLE III

OUTPUT, CURRENT EXPENSES, AND FARM INCOME, BY COUNTIES, PER FARM AND PER WORKER, 1959

Name	Value of Farm Sales and Home Use Per County 1959$	Value of Current Expenses and Livestock Purchases Per County 1959$	Farm[a] Income Per County 1959$	Farm Income Per Farm 1959$	Farm Income Per Worker 1959$
Marshall	3,909,187	2,281,454	1,627,733	3,759	3,785
Okmulgee	3,627,283	1,693,118	1,934,165	1,639	2,260
Muskogee	8,348,226	2,712,647	5,635,579	3,107	3,117
Bryan	7,203,617	3,399,931	3,803,686	2,506	2,153
Haskell	3,152,150	1,787,379	1,364,771	1,527	1,808
Hughes	4,361,897	1,938,623	2,423,274	2,139	1,826
Seminole	3,364,137	2,274,025	1,090,112	968	1,455
Wagoner	5,761,501	2,873,191	2,888,310	2,371	2,761
McIntosh	4,297,269	1,750,556	2,546,713	2,203	1,810
Atoka	3,594,382	1,623,441	1,970,941	1,882	1,920
Creek	2,952,818	1,525,722	1,427,096	1,228	2,059
Coal	3,460,314	1,831,442	1,628,872	2,627	2,569
Okfuskee	2,768,540	1,218,865	1,549,675	1,712	1,892
Pittsburg	6,034,154	3,501,101	2,533,053	1,634	2,066
Pontotoc	6,097,193	3,800,637	2,296,556	1,827	2,249
McCurtain	4,739,687	2,057,696	2,681,991	1,377	2,082
Pushmataha	2,387,978	1,119,792	1,268,186	1,298	1,677
Latimer	1,813,626	962,102	851,524	1,211	1,424
Choctaw	3,421,377	1,922,806	1,498,571	1,302	1,594
Adair	4,060,605	1,696,635	2,363,970	1,920	2,114
Cherokee	3,825,099	1,588,199	2,236,900	1,573	1,782
Sequoyah	3,869,390	1,580,204	2,289,186	1,681	2,255
LeFlore	6,703,480	4,063,868	2,639,612	1,326	1,695
Delaware	6,144,139	3,413,780	2,730,359	1,766	1,921
Geometric Mean	4,136,000	1,999,890	2,136,110	1,849	2,153
Area	105,898,049	52,294,950	53,603,099	1,827	2,101
State	607,536,997	254,405,380	353,131,617	3,732	3,980

[a]Farm income as presented here is defined on page 17.

APPENDIX TABLE IV

OUTPUT, CURRENT EXPENSES, DEPRECIATION ON MACHINERY AND EQUIPMENT, AND ADJUSTED FARM INCOME, 1959

Name	Value of Farm Sales and Home Use Per County	Value of Current Expenses and Livestock Purchases Per County	Value of Annual Depreciation on Machinery and Equipment Per County	Adjusted Farm Income[a] Per County	Per Farm	Per Worker
Marshall	3,909,187	2,281,454	231,372	1,396,361	3,225	3,247
Okmulgee	3,627,283	1,693,118	641,053	1,293,112	1,096	1,511
Muskogee	8,348,226	2,712,647	1,013,068	4,622,511	2,548	2,557
Bryan	7,203,617	3,399,931	1,017,759	2,785,927	1,835	1,577
Haskell	3,152,150	1,787,379	424,290	940,481	1,052	1,246
Hughes	4,361,897	1,938,623	660,328	1,762,946	1,556	1,329
Seminole	3,364,137	2,274,025	508,209	581,903	517	777
Wagoner	5,761,501	2,873,191	770,786	2,117,524	1,739	2,024
McIntosh	4,297,269	1,750,556	607,479	1,939,234	1,678	1,378
Atoka	3,594,382	1,623,441	491,312	1,479,629	1,413	1,434
Creek	2,952,818	1,525,722	572,554	854,542	735	1,233
Coal	3,460,314	1,831,442	331,400	1,297,472	2,093	2,046
Okfuskee	2,768,540	1,218,865	461,394	1,088,281	1,203	1,329
Pittsburg	6,034,154	3,501,101	740,586	1,792,467	1,156	1,478
Pontotoc	6,097,193	3,800,637	712,528	1,584,028	1,260	1,551
McCurtain	4,739,687	2,057,696	715,250	1,966,741	1,010	1,527
Pushmataha	2,387,978	1,119,792	370,420	897,766	919	1,188
Latimer	1,813,626	962,102	256,394	595,130	847	995
Choctaw	3,421,377	1,992,806	460,214	1,038,357	902	1,105
Adair	4,060,605	1,696,635	417,897	1,946,073	1,581	1,741
Cherokee	3,825,099	1,588,199	555,525	1,681,375	1,182	1,340
Sequoyah	3,869,390	1,580,204	573,032	1,716,154	1,260	1,691
LeFlore	6,703,480	4,063,868	761,227	1,878,385	943	1,206
Delaware	6,144,139	3,413,780	902,069	1,828,290	1,182	1,287
Geometric Mean	4,136,000	1,999,890	552,710	1,583,400	1,371	1,596
Area	105,898,049	52,294,950	14,196,146	39,406,953	1,343	1,544
State	607,536,997	254,405,380	71,470,807	281,660,810	2,977	3,175

[a]Adjusted farm income is defined as the value of farm output for sale and consumption, minus current expenses, the value of livestock purchases, depreciation on machinery and equipment, and interest on capital at six percent.

VITA

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