AN ECONOMIC ANALYSIS OF FACTORS AFFECTING COTTON ACREAGE IN SOUTHWESTERN OKLAHOMA

By

ROGER POST HILL

Bachelor of Science

North Carolina State College

Raleigh, North Carolina

1957

Submitted to the faculty of the Graduate School of the
Oklahoma State University of Agriculture and
Applied Science in partial fulfillment
of the requirements for the degree of
MASTER OF SCIENCE
May, 1960

AN ECONOMIC ANALYSIS OF FACTORS AFFECTING COTTON ACREAGE

IN SOUTHWESTERN OKLAHOMA

Thesis Approved:

Leo V. Blakley
Thesis Advisor

Mark L. Fowler

John MacLean
Dean of the Graduate School

ACKNOWLEDGMENT

The author wishes to express his sincere appreciation to Professor Leo V. Blakley, Graduate Committee Chairman, for his advice, counsel, and encouragement during the graduate program and the preparation of this thesis.

Appreciation is extended to Professors J. S. Plaxico and Mark L. Fowler, Graduate Committee members, for their helpful suggestions and constructive criticisms.

I am indebted to the Department of Agricultural Economics of Oklahoma State University, Stillwater, Oklahoma, for making this study possible.

Acknowledgment is made of the assistance received from the secretarial and statistical staff of the Department of Agricultural Economics, and to Mrs. Gwendol Martin for her cooperation in the typing of the final manuscript.

Finally, a special word of thanks to my wife, Ann, for her patience, understanding, and occasional prodding during the graduate program and the preparation of this thesis.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

During the period 1925-29, Oklahoma cash income from cotton lint averaged 122 million dollars annually. This was approximately 59 percent of the cash receipts from crops and almost 40 percent of the total cash farm receipts. Since this period, cotton has been moving out of Oklahoma agriculture. In 1957, the cash income from cotton lint was only 22 million dollars, or 13 percent of the cash receipts from crops and five percent of the total cash farm receipts. This is a decrease in cash receipts from cotton lint of 100 million dollars, or approximately 82 percent.

In Crop Reporting District VII in Southwestern Oklahoma, cotton acreage declined from a high of 1,429,000 acres in 1929 to 351,000 acres in 1957. This was a decrease in acreage of over one million acres, or approximately 75 percent.

During most of the period from 1929 through 1957 government price support and production adjustment programs have been in operation or in a stand-by position. In the 29-year period, acreage control programs have been in effect 13 years. The allotment years were 1934, 1935, 1937 through 1942, 1950 and 1954 through 1957.

In addition to these allotment years, there was a plow-up campaign in 1933. Cotton option contracts were provided for making payments to growers who destroyed part of their 1933 crop. Some type of price support program has been in continuous operation since 1933. This has been through a support price, loan rate, or some type of payment for diverting cotton land to other uses.

Purpose and Objectives of Study

The primary purpose of this study is to analyze and appraise the effects of economic, physical, and institutional factors upon cotton acreage in Southwestern Oklahoma. Southwestern Oklahoma is defined to include the following eight counties: Caddo, Comanche, Cotton, Greer, Harmon, Jackson, Kiowa and Tillman.

Specific objectives to be investigated include:

1. The appraisal of the general physical and economic characteristics of the area and changes that have occurred since 1929.
2. The development of economic and statistical relationships of the cotton producers' acreage response in Southwestern Oklahoma for:
   - A. The total 29 year period of the study
   - B. The allotment years
   - C. The non-allotment years.
3. The evaluation of the effects of governmental control programs upon cotton acreage in Southwestern Oklahoma through:
   - A. Acreage allotments
   - B. Changes in relative prices.

In an analysis of changes that have occurred in cotton acreage since 1929, it will be necessary to use various estimating procedures. One technique commonly used is that of estimating statistical relationships such as supply elasticities to determine how cotton producers respond to changes in various factors. Price elasticity estimates for different institutional arrangements might provide some basis for evaluating the effects of government programs on cotton acreage.

Most previous studies of price elasticities of supply suggest that cotton producers respond very little to changes in price in planning their acreage. Walsh, using the two periods 1910-24 and 1925-33, found that the elasticity of acreage with respect to last year's deflated price, while significantly greater than zero, was of the order of only 0.2.[1] Nerlove obtained similar results considering the period 1910 to 1933.[2]

These numerical estimates seem to be contradicted by experience under the support programs. In 1948, about 36 percent of the cotton crop was placed under loan. This would suggest that either support prices were greatly in excess of equilibrium price or that the supply elasticities were not as low as had been estimated. It seems more reasonable that supply elasticities are higher than previous measurements would suggest. As further evidence that previous estimates may have been low, Heady found that, on the individual farm, substitution among crops is relatively easy.[3] This means that on typical farms small changes in the relative price of crops may cause large changes in the cropping systems that are profitable.

---

[1] Robert M. Walsh, "Response to Price in the Production of Cotton and Cottonseed," Journal of Farm Economics, Vol. 26, (May, 1944), pp. 359-72.

[2] Marc Nerlove, The Dynamics of Supply, (Baltimore, 1958), p. 201.

[3] E. O. Heady, "The Supply of U. S. Farm Products Under Conditions of Full Employment," American Economic Review, Vol. 45, (May, 1955) p. 230.

Most of the elasticity estimates have been based on large economic areas or the entire cotton belt. This is the first study undertaken in Oklahoma to estimate supply elasticities and attempt to measure the effects of government programs on cotton acreage in a specific area. Somewhat similar studies are currently underway in Mississippi and Arkansas.

Procedure

In the development of economic and statistical relationships for Area VII, it will be necessary to examine the physical characteristics, changes in the cropping system in the area, and the types of governmental programs which have been in operation. On the basis of these characteristics, changes, and programs, economic relationships will be developed to show how producers adjust cotton acreage to changes in various factors.

Data will be obtained to represent each measurable factor in the economic model for use in a statistical model of acreage response. The statistical model will utilize the method of least squares. Acreage response will be estimated for the total period, allotment years and non-allotment years.

Cotton acreage in Area VII, the absence of governmental programs, will be estimated for alternative price conditions from these statistical equations. The evaluation of the effect of governmental control programs will be based on these acreage estimates and on the price elasticities of acreage response indicated in the equations.

Limitations of Study

Probably the principal limitation of this study is the fact that the analysis is based on time series data. This means that the data are averaged across different physical and economic resource situations. There are also limitations stemming from inadequacy of data. For example, the support price selected for the analysis was based on a particular grade and staple of cotton. Cotton produced in this area consists of many different qualities and staple lengths and a particular grade and staple length can at best only approximate the general level of cotton prices over the time period considered. Similar problems existed for data representing other variables. In addition, there may be variables affecting the supply of cotton which have been omitted from the analysis.

CHAPTER II

CHARACTERISTICS OF AREA

The area under consideration is located in Southwestern Oklahoma and is shown as the shaded area in Figure 1. Crop Reporting District VII contains a total land area of approximately 4.4 million acres, ninety percent of which was in farmland in 1954.

The area, frequently referred to as the Low Rolling Plains, lies in a sub-humid rainfall zone and ranges in topography from level to steeply rolling. Soil types range from sandy to fine textured clays. The variation in topography and soil type probably accounts for much of the difference in farming systems and crop adaptability.

Land Use

The total land area in District VII has remained constant at 4,373,760 acres since 1940. While the land in farms has varied from a high of 4,095,948 acres in 1935 to a low of 3,951,539 acres in 1954, the proportion of land in farms has remained relatively constant at slightly more than 90 percent of the land area (Table I).

Difficulty was encountered in determining land use, since there was a change in classification of use by the Bureau of the Census. In some census years, the pasture land included only plowable pasture, while in other years it included both plowable pasture and woodland pasture. At the same time total cropland included plowable pasture in some years and did not include it in other years. Even with this inconsistent

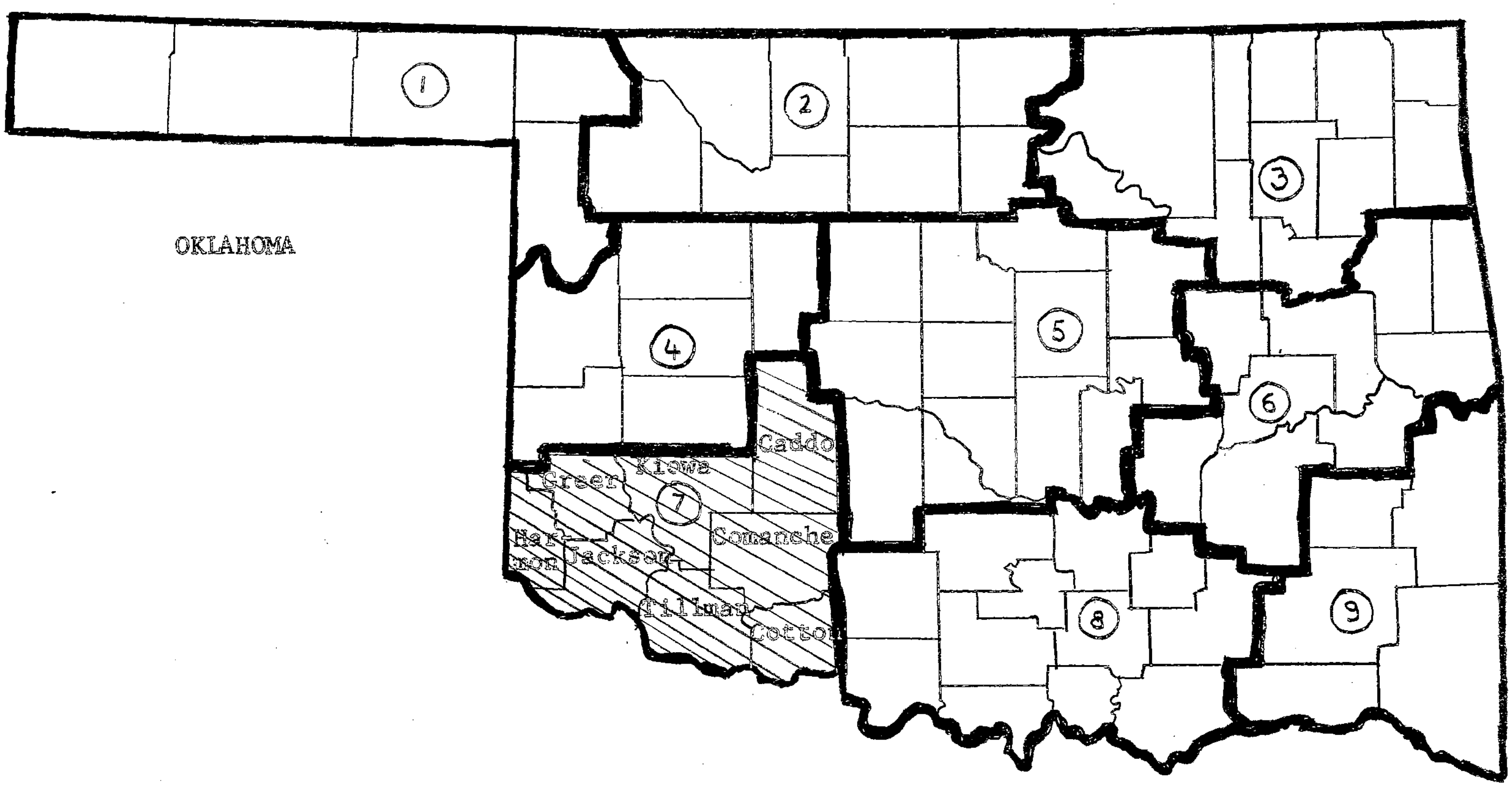


Figure 1. Crop Reporting Districts of Oklahoma and Location of the Area Under Study

classification, it appeared that land in pasture was increasing during the period. The low in total pasture land of 472,000 acres in 1940 included only plowable pasture land and did not include woodland pasture. The change in classification was responsible for much of the decline from 1935. Total pasture land including woodland pasture reached a high for the period of 1,768,944 acres in 1954. Total cropland reached a peak of 2,464,634 acres in 1930 and declined to 2,149,916 acres in 1954 (Table I).

TABLE I

LAND AREA, LAND IN FARMS, PROPORTION OF LAND AREA IN FARMS, NUMBER OF FARMS, CROPLAND AND PASTURE LAND, OKLAHOMA AREA VII, 1930-1954

Year	Land Area (Acres)	Land in Farms (Acres)	Proportion in Farms (Percent)	Number of Farms (No.)	Crop-land (Acres)	Pasture-land (Acres)
1930	4,414,080	3,993,156	90.4	24,327	2,464,634	1,350,374
1935	4,401,920	4,095,948	93.0	22,224	2,454,897	1,441,578
1940	4,373,760	4,018,153	91.8	17,693	2,235,007	472,001[a]
1945	4,373,760	4,084,527	93.3	15,234	2,371,106	1,667,110
1950	4,373,760	3,974,526	90.8	14,073	2,383,699	1,562,279
1954	4,373,760	3,951,539	90.3	11,939	2,149,916	1,768,944

[a]This does not include woodland pasture.

Source: <u>United States Census of Agriculture</u>, U. S. Department of Commerce. Bureau of the Census, 1930-1954.

Number and Size of Farms

The number of farms in Area VII reached a peak of 24,327 in 1930 and steadily decreased to a low of 11,939 in 1954. This was a decrease of 51 percent in the number of farms since 1930 (Table I).

With no significant change in amount of land in farms and with a decline in number of farms, the size of farms has been increasing (Table II). The average size farm in Area VII increased from 164 acres in 1930 to 331 acres in 1954. This increase is larger than for the state as a whole.

TABLE II

NUMBER FARMS BY SIZE CLASSIFICATION, OKLAHOMA AREA VII 1930-1954

	Farm Size							Average Size Farm
	0-9.9	10-49	50-99	100-179	180-499	500-999	1000 and Over	
Year	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(No.)	(Acres)
1930	534	2,966	4,416	10,988	4,825	477	121	164
1935	457	1,680	3,638	11,035	4,712	563	139	184
1940	787	1,003	2,265	7,430	5,045	895	268	227
1945	1,027	897	1,647	6,006	4,514	869	274	268
1950	406	779	1,360	4,666	5,269	1,213	380	282
1954	406	553	964	3,252	4,823	1,482	459	331

Source: United States Census of Agriculture, U. S. Department of Commerce, Bureau of the Census, 1930-1954.

The number of farms were classified into seven categories according to size and are included in Table II. There has been considerable variation in the number of very small farms classified from 0-9.9 acres; however, the variation has been such that no definite upward or downward trend could be established. The number appears to have stabilized at about 400.

The number of farms in the 10-49 acre classification has been steadily declining since 1930. Similarly the numbers of farms in the 50-99 acre and in the 100-179 acre classifications have been declining. The decreases in the number of farms in the latter two classifications are quite important since these two groups comprised over 61 percent of the total number of farms in 1930.

The variation in the number of farms in the 180-499 acre classification has not been over a very wide range and no definite trend could be established. In the last two classifications of 500-999 acres and 1000 acres and over, the numbers have been increasing quite rapidly since 1930. Although the last two classifications do not contain a large number of farms, they do contain a large percentage of the total land in farms.

Tenure Arrangements

From 1930 to 1954 the total number of farm operators decreased by approximately 50 percent (Table III). In 1930, the predominant tenure arrangement was sharecropping. However, during the past twenty-five years the number of tenants decreased by almost one-half.

The number of full-owners has been decreasing slightly, but the percentage of full-owners has remained relatively stable. The percentages of operators are only approximate in 1950 and 1954 since the figures apply to farms operated rather than number of operators. Part-owners have been increasing both absolutely and relatively since 1930. Part-owners increased from 10 percent of all operators in 1930 to 18 percent in 1945. The percentage has increased since 1945 but the figures are only approximate because of the change in census classification in 1950 and 1954. Although sharecropping was predominant in the past, it appears that part or full-ownership has become increasingly important and the trend seems to be in that general direction.

The number of managers decreased from 1930 to 1954. However, this does not seem to be a significant development in view of the small percentage of managers.

TABLE III

NUMBER OF FARM OPERATORS BY OWNERSHIP, OKLAHOMA
AREA VII 1930-1954

Year	Full-Owners	Part-Owners	Managers	Tenants	Total Operators[a]
1930	6,455	2,393	77	15,393	24,317
1935	6,683	2,178	79	13,270	22,210
1940	5,462	2,844	66	9,430	17,802
1945	6,008	2,867	56	7,329	16,260
1950	5,001[b]	3,721[b]	28	5,050	13,800[b]
1954	4,382[b]	3,615[b]	23	4,190	12,212[b]

[a]This could differ from number of farms since one operator could operate more than one farm.

[b]This figure is the number of farms operated by ownership rather than the number of farm operators.

Source: United States Census of Agriculture, U. S. Department of Commerce, Bureau of the Census, 1930-1954.

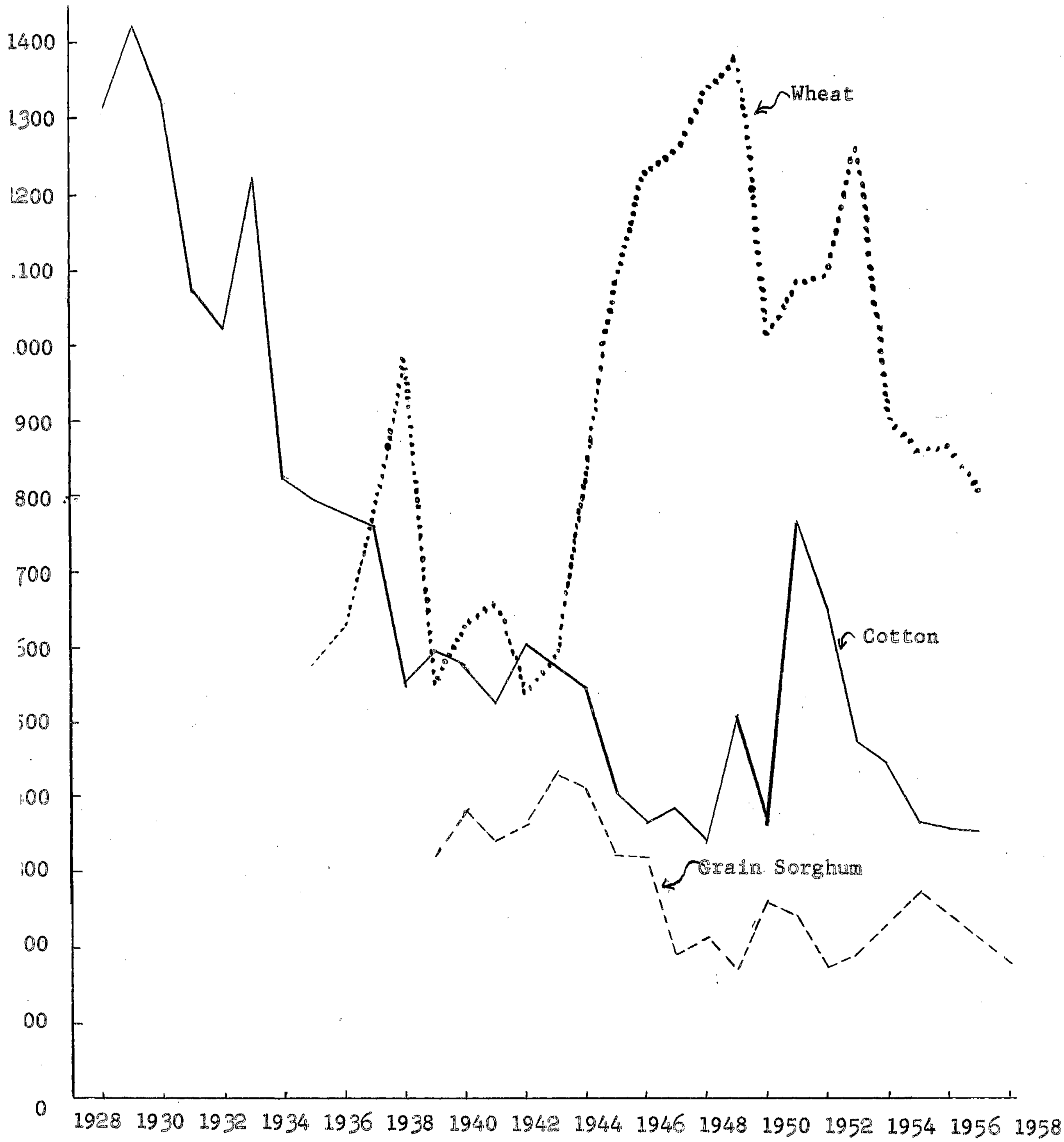
Major Crops

Area VII is considered the main cotton growing section of Oklahoma. In 1954 approximately 46 percent of the state's cotton acreage was concentrated in this area. Within the area, the three most important crops are cotton, wheat and grain sorghum. Cotton is of greatest importance on the sandier soils and of least importance on the finely textured clays. Farmers can and have shifted from one major cash crop to another with a minimum reallocation of resources in response to varying economic conditions. Historically, cotton is probably the most important crop measured in terms of gross income followed by wheat and grain sorghum in that order. From the standpoint of acres devoted to each crop, wheat is most important followed by cotton and grain sorghum in that order.

Changes that have taken place in the acreages of these three major crops are presented in Figure 2 and Table IV. From a peak of 1,429,600 acres in 1929, cotton acreage declined to reach a low of 351,500 acres in 1957. This was a decrease of approximately 75 percent. Comparable declines in cotton acreage have occurred over the state as a whole. Since almost one-half of the state's cotton is grown in this area, the seriousness of this decline is apparent to the cotton industry in Oklahoma. Most of this decline had occurred by 1941 when government acreage allotment programs were in full effect (Table IV).

The first wheat acreages available on a county basis were in 1935. In this year 580,000 acres of wheat were in cultivation in Area VII. On the basis of the available data, wheat acreage planted was at a low of 535,000 in 1942 and by 1949 had climbed to an all-time record of 1,374,000 acres. The increased wheat acreage was greater than the decrease in cotton acreage for the same period of time.

Grain sorghum acreages were reported for the first time in 1939 when 329,206 acres were in cultivation. Sorghum acreage was at a high of 431,800 acres in 1943 and declined to reach a low of 171,000 acres in 1949.



'igure 2. Acreage of Cotton in Cultivation July 1 and Planted Acreage of Wheat and Grain Sorghum, Oklahoma Area VII, 1928-57

ource: Oklahoma Crop and Livestock Reporting Service

TABLE IV

COTTON ALLOTMENT AND ACREAGE IN CULTIVATION JULY 1 AND WHEAT AND GRAIN SORGHUM PLANTED ACREAGES, OKLAHOMA AREA VII 1928-1957

Year	Cotton Allotment (1,000 Acres)[1]	Cotton in Cultivation July 1 (1,000 Acres)[2]	Wheat Planted Acreage (1,000 Acres)[2]	Grain Sorghum Planted Acreage (1,000 Acres)[2]
1928	--	1,316.9	na	na
1929	--	1,429.6	na	na
1930	--	1,324.2	na	na
1931	--	1,076.9	na	na
1932	--	1,021.8	na	na
1933	--	1,223.0	na	na
1934	904.8[a]	825.0	na	na
1935	904.8[a]	793.7	580.0	na
1936	--	777.9	625.6	na
1937	782.2	756.8	782.6	na
1938	662.2	558.2	986.3	na
1939	643.3	595.3	550.0	329.2
1940	655.3	579.3	623.5	386.0
1941	647.0	523.2	656.0	342.6
1942	600.2	606.1	535.0	366.4
1943	--	573.5	589.0	431.8
1944	--	546.0	820.0	411.1
1945	--	400.5	1,084.0	324.4
1946	--	364.9	1,230.0	319.1
1947	--	386.0	1,258.0	191.3
1948	--	344.5	1,337.0	212.4
1949	--	505.2	1,374.0	171.0
1950	402.4	363.6	1,012.0	264.4
1951	--	764.6	1,081.0	243.6
1952	--	644.5	1,093.0	178.4
1953	--	471.4	1,256.0	191.7
1954	478.4	446.3	909.0	230.8
1955	373.7	364.6	859.0	278.0
1956	366.0	357.0	865.0	242.5
1957	364.9	351.5[b]	802.0	219.0

[a]Based on percentage relationship between Area VII and State data.

[b]Includes acreage in acreage reserve program.

[na]Not available.

Source: [1]Oklahoma State Agricultural Stabilization and Conservation records.

[2]Oklahoma Crop Reporting Service.

Competitive Position of Cotton

From 1943 through 1949 there was a considerable shift from cotton production to wheat in the area. There are several basic reasons for this. Probably the most important reason was the increase in the price of wheat. During this period the price received for wheat averaged about 75 cents per bushel more than the average price in the five-year period immediately preceeding 1943.

Technical changes were also occurring in this period which decreased the competitive position of cotton. Wheat and grain sorghums were better adapted to mechanization than cotton and thus were in a better competitive position. This may be partly explained by the fact that both wheat and grain sorghum were labor-extensive crops in this period while cotton was a labor-intensive crop. There were many operations which had to be performed on cotton, such as thinning, cultivating and hoeing that required manual labor. Also most of the cotton at that time was harvested by hand which required considerable labor. Manual labor requirements were considerably less for wheat and grain sorghum production.

The comparison of monthly or seasonal labor requirements for cotton, wheat and grain sorghum production is probably of greater importance to the farmer than is total labor requirements. Seasonal requirements may indicate points of greatest competition between the crops (Figure 3). The greatest potential labor conflict occurs during the month of June when cotton must be chopped and cultivated, wheat combined, and grain sorghum planted. The least potential conflict occurs during the month of December when usually only the last part of the cotton harvesting operation remains.

Figure 3. Monthly Distribution of Usual Labor Requirements for Cotton, Wheat, and Grain Sorghum, Southwestern Oklahoma, 1947

Source: William F. Lagrone, Cotton Growing in Southwestern Oklahoma, USDA Bulletin No. B-350, June, 1950. p. 15.

On an individual crop basis, the greatest labor requirement for cotton occurs in the months of June, October and November. The greatest labor requirement months for wheat are June, July, August and September. Labor requirements for sorghum are highest in February and June.

Based on the competition between the crops in June, cotton would require 7.2 hours of labor per acre, wheat 0.98 hours per acre, and grain sorghum 0.87 hours per acre. If a producer hired 100 hours of labor in June and as much as needed in the other months, he could produce approximately 13 acres of cotton, 102 acres of wheat, or 114 acres of grain sorghum. This assumes that the farm operator act as manager only and provides no labor. For these acreages, the total yearly labor requirements would be 393 hours for cotton, 321 hours for wheat, and 489 hours for grain sorghums.

Ordinarily, the farm operator would provide some labor. Assuming that the farm operator is to supply all tractor-driving labor and hire the remaining labor needed, labor competition between the three crops would be greatest in June. For each 100 hours of operator's labor available in June or other peak months for tractor-driving, 75 acres of cotton, 149 acres of wheat and 113 acres of grain sorghum could be produced. Total yearly operator labor required for these acreages would be 388 hours for cotton, 407 hours for wheat and 436 hours for grain sorghum. However, the farm operator would need to hire 1,877 hours of labor for cotton, 63 hours for wheat and 49 hours for grain sorghum.

Custom harvesting and hauling is an accepted practice for wheat and grain sorghum in Southwestern Oklahoma. In the previous computation, labor competition is considered only up to harvest time for wheat and grain sorghum. If the operator used custom harvesting for wheat and grain sorghum the total operator's labor required would be reduced from 407 to 317 hours for wheat and from 436 to 389 hours for grain sorghum.[4] The remaining operations would be hired on a custom basis which would increase the hours of hired labor.

Although the labor requirement estimates are based on 1947 figures, and mechanization of cotton has improved considerably since, they do indicate the relatively weak competitive position of cotton during the 1940's. The average farmer could expect to handle twice the acreage of wheat as cotton with the same amount of his own labor and increase this advantage several times by hiring a small amount of additional labor. In addition, the trouble and expense of hiring a relatively large quantity of labor for cotton chopping and harvesting, if labor is available, is avoided.

---

[4]William F. Lagrone, Cotton Growing in Southwestern Oklahoma, Oklahoma Agricultural Experiment Station Bulletin No. B-350 (June, 1950), pp. 5 and 25-27.

CHAPTER III

GOVERNMENT PROGRAMS FOR COTTON

The series of events which furnished the main pressure for price-support legislation and the strong accent on price supports in the whole system of agriculture policy are: the sharp agricultural price declines in the early 1920's, the subsequent gradual decline in agricultural prices, and the major depression of the 1930's. Generally the farm sector of the economy was in an almost continuous depressed condition from 1920 through 1941.

Characteristically, farm prices drop faster and farther than industrial prices in a depression. In a one-year period of the major depression, 1930 to 1931, farm prices dropped 30 percent while wholesale prices of manufactured products dropped only 12 percent. Over three years, from 1929 to 1932, farm prices dropped 54 percent while industrial prices declined only 25 percent. Similarly, in the 1938 recession, farm prices dropped 22 percent as compared with a decline of seven percent in industrial prices.[5]

The vulnerability of farm prices in a depression stems largely from the fact that farmers generally maintain production despite a drop in consumer demand and price. During the major depression, the index of agricultural production (1935-39 = 100) remained virtually unchanged while industrial production decreased 47 percent.

[5]Agricultural Outlook, USDA, (October, 1949), p. 1.

The economic implications of this difference between adjustments in agricultural and industrial output are very important. It means that the short run price elasticity of supply of all farm products is very low, especially when farm prices decline. This means then that very low farm prices do not motivate farmers to reduce aggregate output and neither can high prices be counted on to bring forth a large output increase.[6] Apparently the fixity of resources in agriculture, technological progress and weather are more important in their effect upon farm production than is the level of farm prices.

Types of Farm Price Programs

In almost every session of Congress since the 1920's there has been some type farm price legislation passed or under consideration. Many of the farm programs have attempted to raise the price of farm products and have been combinations of features of "pure support" programs and "restricted output" programs with either an attempt to withhold part of the supply from the market, or restrict the output of farm products, or both. In recent years, emphasis has also been placed on programs which are designed to increase aggregate demand, reduce marketing margins to affect the derived demands for agricultural products, and increase farm prices through discriminatory pricing schemes.

Two specific types of programs affecting price are illustrated in Figure 4, where the relative amounts of government expenditures, consumers' gains or

---

[6] Rainer Schickele, Agriculture Policy (New York, 1954), pp. 153-166.

losses, and producers' gains or losses are shown. Other types of governmental support programs could be analyzed in a similar manner but the extent of gains or losses incurred by producers, consumers, and society would depend on the specific assumptions used in the analysis.

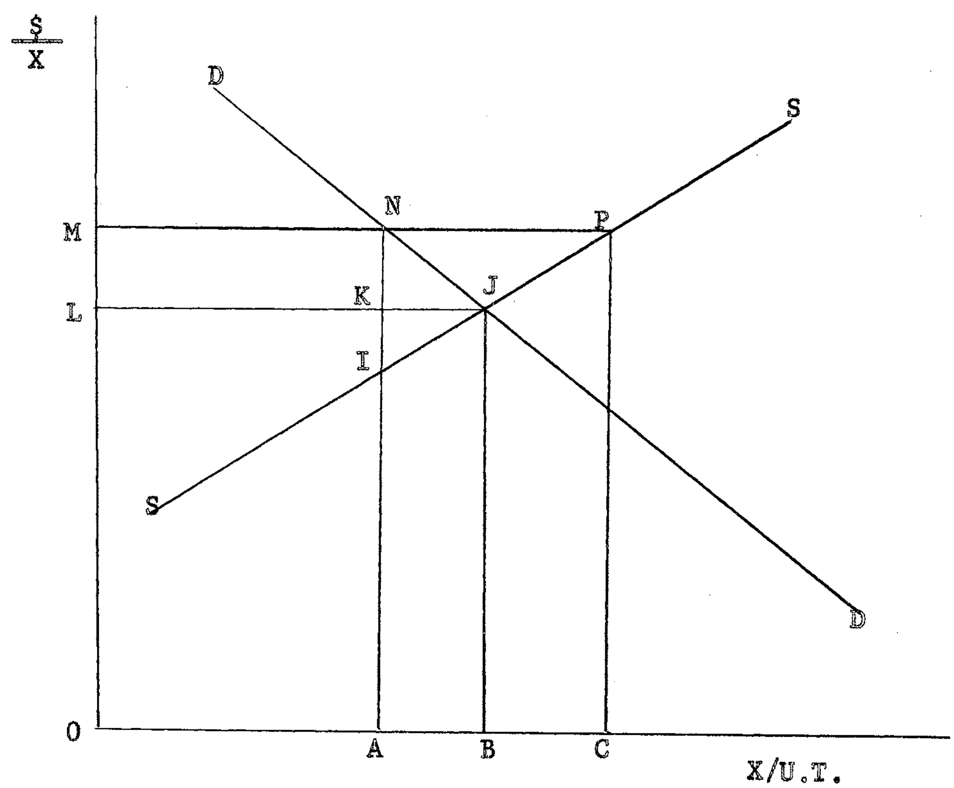


Figure 4. Diagram of Welfare Losses Under Alternative Price Support Programs

For the illustration, the curves DD and SS are the demand and supply curves respectively for commodity X. Both schedules are assumed to have a price elasticity of less than unity. They intersect at point J so that OB represents the equilibrium output and OL the equilibrium price. Under a purely competitive market, if price deviates from OL, forces are set in motion to bring it back to that level. A price above the equilibrium price would induce sellers to undercut each other in an attempt to dispose of their quantities in the market which would drive price back down to the equilibrium level. A price below the equilibrium level would result in a shortage which would cause consumers to bid the price up to equilibrium.[7]

Pure Support Program

One type of "pure support" program may be characterized as follows: The Government sets the support price at OM. At this price producers will supply OC and consumers will purchase quantity OA. This would leave an excess in supply amounting to AC. This excess supply AC would be purchased by the Government at price OM and destroyed or removed from the domestic market by gifts to a foreign country.

The effects of a "pure support" program would be as follows. Government expenditures would increase by area of the rectangle ACPN. Consumers would be paying more for a smaller quantity of the good with the net increase represented by the area of the trapezoid LJNM. Producers would be producing a larger quantity (OC), would receive a higher price (OM) per unit and producers' gross income would increase by area OCPM less area OBJL. The additional output BC could be produced, however, only at an additional cost for variable factors of production. This cost is measured by the area of the trapezoid BCPJ assuming elastic factor supply schedules; consequently, the increase in net income to producers would be the area of the trapezoid LJPM. If net losses to society are Government expenditures minus the net benefits to producers and consumers, then net loss under this type program would be measured by the area of the five-sided figure ACPJN.

---

[7]Richard H. Leftwich, The Price System and Resource Allocation, (New York, 1955) p. 32.

Restricted Output Program

A "restricted output" program may be characterized as follows: An output larger than OA is prevented by direct control. The output OA would be purchased by consumers at the price OM and no Government purchases or subsidies would be necessary. Under this program, Government expenditures would be solely administrative and were considered zero for this analysis. A quantity OA of the commodity is consumed at price OM.

The effects of a "restricted output" program would be as follows. The net increase in consumer expenditures as compared to the free market situation would be represented by the area of the trapezoid LJNM. The increase in the gross income of producers would be measured by the difference between the area of the rectangle OANM and the area of the rectangle OBJL. Some of the resources, however, used to produce the quantity AB could now be shifted to other uses where presumably they could earn an amount measured by the area of the trapezoid ABJI. Consequently, the net increment to producers would be measured by the area of the rectangle LKNM minus the area of the triangle IJK. Society losses under this type program would be measured by the area of the triangle IJN. Since the area of the triangle IJN is included in the area of the five-sided figure ACPJN in the previous section, it follows that "restricted output" programs can never involve a greater loss to society than "pure support" programs.

Farm Price Legislation

The first specific farm price program applicable in the period under study was the Agricultural Marketing Act of 1929.[8] This represented an effort to withhold a portion of the supply from the market when supplies were believed to be temporarily large relative to demand. For a particular year, this program would be similar to the "pure support" program except for storage costs. The Federal Farm Board was established under this Act to finance cooperative marketing associations in performing loan-storage functions during years of surplus production. Loaning operations on cotton were begun in October, 1929.

The funds of the Farm Board were exhausted by 1933, the supplies of cotton had not been reduced, and prices were at extremely low levels. The Board did not have the power to control output and, with demand decreasing each year under the world-wide depression, was unable to stabilize prices through storage alone. In May, 1933 the Board was abolished.

Following the unsuccessful experience of the Federal Farm Board, the Agricultural Adjustment Act of 1933 was passed which had the feature of production control in order to raise farm prices. The apparent aim of this program would be similar to the "restricted output" program except for the use of acreage rather than quantity as a basis for a restriction.

---

[8]The material for this and following paragraphs is taken primarily from: C. Curtis Cable, Jr., A Chronology of Government Programs for American Upland Cotton, Arkansas Agricultural Experiment Station Bulletin 587, (April, 1957); R. L. Tontz, "The Evolution of Agricultural Parity," (unpub. Ph.D. dissertation, Oklahoma State University, 1952), pp. 103-113; and Price Programs, Agriculture Information Bulletin No. 135, USDA (Washington, 1957), pp. 6-53.

The Act of 1933 provided government payments to producers for reducing acreage and production. The initial step in this reduction was the plow-up campaign in 1933 when more than one million producers agreed to plow under 10 million acres of cotton in return either for rental payments ranging from $7.00 to $20.00 per acre or for lower rentals plus an option to buy a quantity of Government-owned cotton equivalent to the amount not produced on the cotton acreage destroyed. It was believed that a reduction in the acreage harvested in 1933 and subsequent years would bring about the necessary adjustments in supply, and payment would provide farmers with income relief while the adjustments were being made. The allotments in Area VII were set at only two-thirds the 1929 acreage in cultivation July 1.

In 1934 the Bankhead Cotton Act was passed which provided a compulsory form of control. Cotton ginned in excess of individual farm quotas was to be taxed at 50 percent of the current average price. The proceeds of the tax was to be returned to producers complying with the program.

On January 6, 1936 the Supreme Court invalidated as unconstitutional the control and tax features of the 1933 Act and the Bankhead Act. This decision terminated production controls insofar as they were executed by individual contracts with coercive implications.

The Soil Conservation and Domestic Allotment Act was passed less than two months after the Supreme Court invalidated the control programs. The intent of the Act was to restrict the use of land for basic crops by making payments for diverting land from these crops to other uses. Producers received as "diversion" payments five cents in 1936 and 5.5 cents in 1937 for each pound of the yield which would have been harvested from acres diverted from cotton to "soil-conserving" crops. Payments were also provided for following soil improving practices. Thus allotments and rental payments of the defunct Agricultural Adjustment Act of 1933 were continued and were supposed to act as a check on overproduction.[9] In Area VII, the payments were almost as effective in limiting cotton production as the previous allotment program. Acreage in cultivation decreased in 1936 from 1935 and decreased further in 1937.

The Agricultural Adjustment Act of 1938 was passed as a long-term program to aid agriculture. There were some new features in the 1938 Act which have been retained in all subsequent farm-price legislation; however, the major portion of the Act was identical with the 1933 Act except for the tax features.

The 1938 Act placed more emphasis on price support loans and purchases than did the previous programs. Acreage allotments for basic crops (including cotton) were re-established and payments to cooperators, based on the amount of acreage in their allotment, were provided. The Act authorized the use of marketing quotas if two-thirds of the farmers voting in a referendum approved them.

The acreage allotment feature, which provided some control over supply and a means of adjusting it to expected demand could not be used for cotton unless marketing quotas were also voted into effect by producers. If quotas were approved, each cotton producer could not sell more than his authorized portion of the national total without a penalty of two cents

---

[9] C. B. Ratchford and R. Freund, What the Government Did to Cotton, (unpub. report, North Carolina State College, Raleigh, North Carolina, 1954).

per pound. However, marketing quotas for an individual producer were computed on the basis of either the normal or the actual yield of his alloted acres, whichever was higher (provided he did not over-plant his allotment for any crop). Thus, the entire crop produced on alloted acres could be marketed without penalty, and the supply control features of quotas were only partially effective. In Area VII, allotments were initially set at approximately 660 thousand acres--down more than 25 percent from the 1934 allotment. As compared with acreage in cultivation July 1, 1929, the reduction was more than 50 percent.

Nationally, the allotments were less effective in reducing production than in Area VII. By the end of the 1938 crop year, U.S. carryover stocks of cotton were 13 million bales, the highest on record up to that time. It is generally agreed that only the outbreak of war in Europe spared the governmental price-raising programs from the same failure as experienced under the Federal Farm Board program.

The allotment and control features of the Agricultural Adjustment Act of 1938 remained almost intact until 1958, with minor amendments each legislative session. However, the base for determining allotments for State and Areas was undergoing changes which were to decrease allotments in the southern and southwestern states and to increase allotments in the far-western states. By 1957, the allotment in Area VII was down to 365,000 acres. This was a decrease of 75 percent from the 1929 acreage in cultivation.

The Agricultural Act of 1948 provided a new formula for computing parity prices but was not allowed to become effective for cotton until 1957. Flexible price supports were also provided to replace the 90 percent of parity supports for the 1950 and succeeding cotton crops. This provision, however, was not allowed to become effective during the period under study.

In 1956 "acreage reserve" and "conservation reserve" programs were established to supplement existing programs. Under the "conservation reserve" program, farmers were paid to take certain basic commodities out of production and divert the land to long-term conservation practices. The producer would receive a part of the cost of establishing the conservation practice and would receive an annual payment for the term of the contract. To qualify for acreage reserve payments, cotton farmers had to comply with all allotments on his farm and reduce his cotton acreage below his cotton allotment. He also had to designate the specific acreage to be included in the acreage reserve. In Area VII about one-fifth of the allotment was under these supplemental programs.

CHAPTER IV

ECONOMIC RELATIONSHIPS AFFECTING SUPPLY

Concept of Supply

Supply may be defined as the various quantities of a good which sellers will place on the market at all possible alternative prices, other things equal.[10] The factors usually held constant when defining the supply curve in the short-run include (1) technology, (2) prices of alternative products, and (3) supply curves of factors of production. The length of run dictates the classification of fixed and variable factors. Generally, in the short run as usually defined, some factors of production are fixed in nature while others are variable. In the long-run all factors of production are considered variable.

The supply curve of a firm may be described as either (1) the maximum quantity per unit of time that will be supplied at a given price or (2) the minimum price at which a given quantity will be supplied. If a firm is in a competitive industry with horizontal supply curves of factors to each firm and if it produces only one output, then the firm's supply curve for that output is identical with its marginal cost curve when marginal cost is above average variable cost. The supply curve is identical with the average variable cost curve when marginal cost is below average variable cost. Outside the context of a competitive industry, the supply curve is

---

[10]Leftwich, p. 30.

not defined. When a firm produces more than one output, a unique cost curve is not defined, although a unique cost surface is defined.[11]

Supply of Cotton in Area VII

The supply of cotton in any given year in Area VII is an aggregation of the response of the individual firms in the area and is affected by many variables. Some of these variables are measurable while others are subject only to qualitative evaluation. In addition, some variables may be more important during certain years than in other years. In general the schema presented in Figure 5 shows the factors which are believed to affect cotton supply in Area VII.

In this schema, supply was defined as the total amount of cotton produced in Area VII in a given year. The factors believed to affect supply were classified into two time periods, current year (t) and previous year (t-1).

Producers Supply Response

Based on the physical characteristics of the area, planned production and actual production may be quite different in an individual year. Since actual production is subject to the vagaries of weather in the current year, the assumption was made that acreage in cultivation July 1 was a better measure of planned production than actual production. Therefore, one of the most important assumptions in the following analysis is that acreage in cultivation July 1 is an unbiased indicator of intended supply.

---

[11] Nerlove, pp. 29-30.

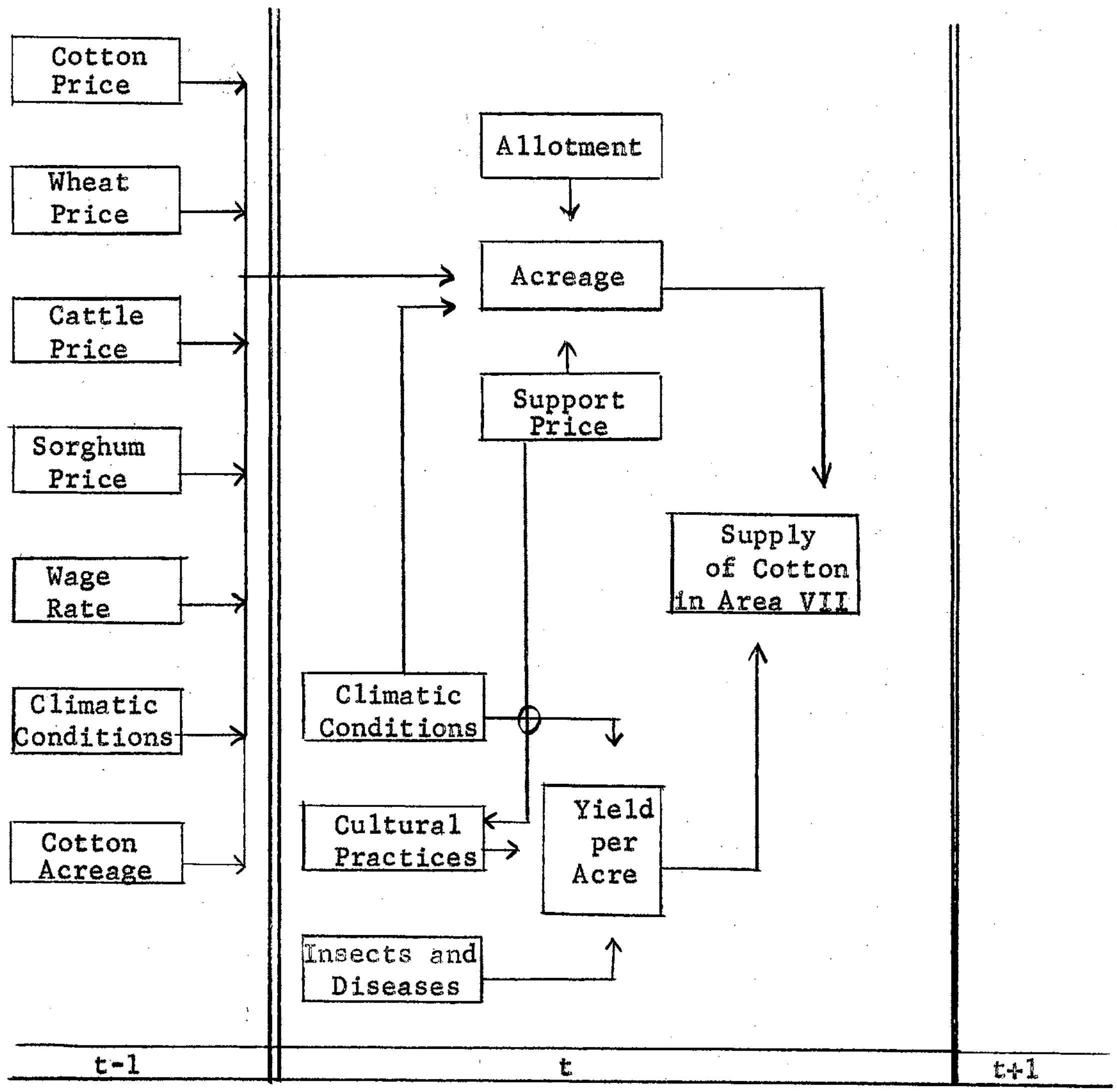


Figure 5. Schema of Factors Affecting Cotton Supply in Oklahoma Area VII

Based on this assumption, the producers' supply response may be expressed as: $Y = f(X_1, X_2, \ldots X_n)$; where Y is acreage in cultivation on July 1 and X_1 through X_n are factors that producers would consider in determining acreage. The factors included in this general equation and illustrated in Figure 5 will be examined for direction of potential effect in alternative time periods.

Cotton Allotment

The size of the cotton allotment probably is the most important factor affecting acreage in allotment years. The penalty for overplanting has been such that for all practical purposes the allotments have represented the maximum acreage. As allotments are increased, planted acreage would be expected to increase. Conversely, as allotments are decreased, planted acreage would be expected to decrease.

Level of Cotton Acreage

Cotton acreage in the previous year could be an important factor in estimating short-run changes in acreage. The effect of the level of cotton acreage would be different, depending upon whether the acreage was at a high or low level. If acreages were at a high level and all resources fully employed, this would have the effect of limiting any expansion of acreage. Conversely, if acreage were at a low level and some other factor indicated a reduction in acreage, the relative gain from transferring the highly productive cotton land to another enterprise might be small. Moreover, because of the fixity of resources in individual agricultural enterprises, large changes in acreage in an individual year may result from only drastic changes in the physical or economic environment. New technology, customs, and experience or knowledge of producers could also have some effect on dampening large changes in a short period of time. Therefore, acreage in the previous year would be expected to be positively correlated with acreage in the current year.

Price of Cotton

Normally producers would adjust their acreage up for an increase in the expected price and down for a decrease in the expected price. In years of price support programs, the expected price would be measured by the announced price support level. The adjustment in acreage caused by a change in price might be rather small during years of Government controls, since changes in the price of cotton have been rather nominal. The support price has not been high enough to encourage producers to overplant, with the heavy penalties involved nor low enough to cause a substantial underplanting.

In years without price supports, the expected price might be based on some combination of past prices. If prices were favorable in the previous year and all other factors remained constant, the producer might expect the favorable prices to continue. It was assumed that price in the previous year would be directly correlated with acreage in cultivation in the current year.

Price of Alternative Commodities

Changes in the prices of wheat, grain sorghum and beef cattle would be expected to have similar effects on the direction of change in cotton acreage since they are all considered as competing enterprises in Area VII. These prices are assumed to reflect the relative profitability of alternative enterprises. When the prices of the alternative commodities were high relative to cotton, producers could shift their resources from cotton to these enterprises. If the prices of these commodities were low relative to that of cotton, producers could shift to cotton only in the absence of allotment programs. In the absence of acreage allotments, producers would be expected to adjust their cotton acreage up for a decrease in the relative price of one or more of these competing enterprises and down for a relative increase in price.

Cost of Production

Estimates of cost of production of cotton are not available for Oklahoma or for Area VII. Consequently, the wage rate for harvesting cotton was assumed to reflect the relative cost of labor, an important factor in the production of cotton. As the wage rate increased relative to the price of cotton, the planted acreage would be expected to decrease and as wage rate decreased, planted acreage would be expected to increase. This factor probably would be more important in non-allotment years than in allotment years.

Climatic Conditions

Climatic conditions in any year would be reflected in both yields and harvested acreage as compared with planted acreage. It would appear that yield reduction data from specific causes would reflect changes in climatic conditions. Therefore, the percentage reduction from a normal yield from all causes was assumed to represent changes in climatic conditions. Yield reduction might be expected to be positively or negatively correlated with planted acreage the following year depending upon the logic used by the producer. If producers have one bad crop year due to climatic conditions, and in general expect the next year to be somewhat better, then yield reduction in t-1 would be negatively correlated with planted acreages in period t. If, however, producers think that climatic conditions come in "bunches" then the reverse logic would be applicable. Producers then would expect the first bad year to be followed by another bad year; therefore yield reduction in t-1 would be positively correlated with planted acreage in period t. No information was available to indicate how producers would react under these conditions. No attempt was made to estimate the effect of climatic conditions in period t on acreage in cultivation July 1 in period t.

The following function summarizes the way in which producers would be expected to adjust their acreage in response to a change in the factors affecting supply:

$$\hat{Y} = a + b_1X_1 + b_2X_2 - b_3X_3 - b_4X_4 \pm b_5X_5 - b_6X_6 - b_7X_7$$

where

Y = estimated cotton acreage

X_1 = cotton allotment in t or acreage in t-1

X_2 = cotton loan rate in t or price in t-1

X_3 = price of wheat in t-1

X_4 = wage rate in t-1

X_5 = yield reduction in t-1

X_6 = price of sorghum in t-1

X_7 = price of cattle in t-1

The sign attached to each b value indicates whether the direction of adjustment to changes in the independent variable is positive or negative. In the case of X_5 (yield reduction) either sign could be appropriate depending on the assumptions regarding producer expectations.

Supply Response Under Alternative Conditions

Allotment Years

The principle change in a model of adjustments in producer supply under allotment years from the general model would be the differences in X_1 and X_2 and in the number of years analyzed. In this model X_1 would represent allotments only and X_2 would represent the cotton loan rate. Allotments would be expected to be more important in this model than in the general model since they affect all years under consideration.

There might be a tendency for the competing enterprises--wheat, sorghum, and beef cattle--to be more important when their prices were high relative to cotton than when they are low relative to cotton. Producers could reduce cotton acreage under allotments but they could not increase acreage without large penalties. Similarly, high wage rates were expected to be more important in curtailing acreages than low wage rates were in providing an incentive to expand acreage above the allotment.

Non-Allotment Years

This model was developed in essentially the same manner as the general model. The principle difference was in the variable X_1 which included only the acreage in period t-1. Cotton loan rate or price of cotton in t-1 was used as X_2 since the cotton price was supported in certain non-allotment years.

The direction of adjustment for changes in the factors affecting supply would be expected to be the same as in the previous models.

However, the prices of competing enterprises probably would be more important in this model than in the other models since there were no acreage restrictions. Wage rates also might be more important.

Underplantings Model

In twelve of the thirteen years that acreage allotments have been in effect, producers have underplanted their allotments. The number of acres underplanted has ranged from a low of 9,000 acres in 1956 to as high as 122,000 acres in 1941. One underplantings model was developed to determine if the underplantings could be attributed to any measurable factor. Let $U = f(X_1 \ldots X_n)$ where U is acres underplanted and X_1 through X_n are factors that might affect underplantings.

The various factors considered in the underplantings model and the way in which these factors would be expected to influence underplantings are as follows:

Cotton Loan Rate

The level of the loan rate was expected to be negatively correlated with underplantings. As the cotton loan rate increased, producers would be expected to decrease their underplantings. As loan rate decreased, underplantings would be expected to increase.

Cotton Allotment

The size of the allotment was expected to be positively correlated with underplantings. As allotments increased, underplantings would be expected to increase. Conversely, as allotments decreased, underplantings might become smaller because of concentration of acreage on the land best suited to cotton production.

Price of Alternative Enterprises

The prices of wheat, grain sorghum, and cattle, as competing enterprises, would be expected to be positively correlated with underplantings. They would tend to be more effective when their prices were high relative to that of cotton. Producers could shift resources out of cotton production into these other uses. As the prices of the competing enterprises increased, underplantings would be expected to increase.

Cost of Production

As in the general model, changes in wage rates were assumed to reflect changes in the cost of cotton production. As wage rate increased, underplanting would be expected to increase, and as wage rate decreased, underplantings would be expected to decrease.

Climatic Conditions

The percentage reduction from full yield was used to reflect climatic conditions. No a priori direction of effect was stipulated for the yield reduction variable.

Taking these factors into consideration, the underplanting function may be expressed as follows:

$$\hat{U} = a - b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 \pm b_5X_5 + b_6X_6 + b_7X_7$$

where

$\hat{U}$ = underplantings

X_1 = cotton loan rate

X_2 = cotton allotment

X_3 = price of wheat in t-1

X_4 = wage rate in t-1

X_5 = yield reduction in t-1

X_6 = price of cattle in t-1

X_7 = price of grain sorghum in t-1

CHAPTER V

STATISTICAL ANALYSIS

Method of Analysis

The major objectives of the statistical analysis of factors affecting changes in cotton acreage are: (1) to determine if a relationship exists between the dependent variable (Y_t) and the independent variables (X_{it}) and get a measure of this relationship and (2) make a prediction of (Y_t) from (X_{it}).

A method of estimation which may be used to obtain estimates of the structural parameters of the single equation model is the method of least squares. This method of estimation consists of minimizing the sums of squares of error.

The single equation model can be written as

$$\hat{Y}_t = A + \sum_{i=1}^{n} B_i X_{it} + U_t$$

where $\hat{Y}$ represents the estimated dependent variable; A is the value of the constant; X_{it} are the independent variables (I = 1, 2, ... n); U_t is the random disturbance; and t = 1, 2, ... T, the number of observations.

To obtain best unbiased estimates by the method of least squares the U's and X's must meet certain rather rigid specifications. The usual assumptions concerning the U's are (1) the U's must follow some (not necessarily normal) probability distribution, (2) that the mean or expected value is zero, (3) that the variance of U_t be finite and independent of the particular values of the X's, and (4) that the U's be serially independent.[12]

An important assumption regarding the X's is that they be a known set of numbers or predetermined variables in contrast to a random variable. It is also assumed that the X's are independent of the U's and are measured without error. Any errors of measurement are assumed to be associated with the dependent variable and are reflected by the disturbance factor U_t. The effects of omitted variables are also assumed to be reflected in U_t.

Estimates of the structural parameters, the B_i's are obtained by minimizing the sums of squares of errors about the dependent variable. That is, the sums of squares

$$\sum_{t=1}^{t} (Y_t - \hat{Y}_t)^2$$

is minimized by the technique of least squares, where Y_t is the observed value and $\hat{Y}_t$ the estimated value of the dependent variable.

If the previous assumptions are met, then the least squares technique gives estimates of structural coefficients which possesses certain desirable statistical properties. These desirable properties are best and unbiased.[13]

---

[12] R. J. Foote, <u>Analytical Tools for Studying Demand and Price Structures</u>, Agriculture Handbook No. 146, USDA, AMS (Washington, D. C., August 1958) pp. 57-60.

[13] A best estimate is obtained when the variance is as small as possible for a given set of estimating procedures. An unbiased estimate exists when the average value obtained regardless of the sample size equals the value that would be obtained from a similar calculation based on the combined evidence of all possible samples. For further elaboration, see Foote p. 57-58.

The least squares technique was used in this analysis since the independent variables were assumed to be predetermined or exogeneous to the system. Endogenous variables lagged by one or more time periods were considered predetermined.

The statistical criteria used to determine goodness of fit of the regression equations were the coefficient of determination, students t-test and Fisher's F-test. The Durbin-Watson test of serial correlation was computed for some of the equations.

The coefficient of determination or R^2 value indicates the proportion of variability on (Y_t) explained by the variables (X_{it}). As R^2 approaches 1, the closeness of fit is improved such that if $R^2 = 1$, the regression equation would pass through every observed point and would completely characterize the data.[14]

The t_{b_i} is the symbol for the student t-test of the b_i. The b_i are regression coefficients and show the change that would occur in (Y_t) with a one unit change in the independent variables (X_{it}). The t_{b_i} value is used to determine if the regression coefficients are significantly different from zero at a given probability level. This is a test of the null hypothesis. For example, if the t_{b_i} in a given sample is significant at the five percent level, this means that $b_i \pm t_{05}\, s_{b_i}$ does not include the interval zero in the sample. If the true population parameter is equal to zero, then a significant value of t_{b_i} for a sample would be expected to occur only five percent of the time due to chance alone. The

---

[14]George W. Snedecor, Statistical Methods, (Ames, Iowa, 1956), ch. 14.

interpretation is that the intervals established on the basis of repeated sampling would contain the population parameter 95 percent of the time.

Just as the t_{b_i} value was used to test the significance of the individual b_i, the F value was used to test every b_i simultaneously equal to zero. That is, the F value is used to determine the significance of the entire equation.

Description of Data

The specific data used in the analyses of acreage response in Area VII are described in this section and presented in tabular form in Appendix Table 1.

Acreage

Cotton acreage in cultivation July 1 in Oklahoma Area VII was selected for use in the analysis. Planted acreage figures probably would be more closely associated with planned acreage but these data were not available. The acreage for 1957 includes acres devoted to the acreage reserve program.

Cotton Allotment

The cotton allotments for Area VII were obtained from Oklahoma State Agricultural Stabilization and Conservation records and used as X_2 in the analysis. Since there were no allotment figures available for 1934 and 1935, an allotment was computed such that the ratio between the Area VII allotments in 1934 and 1935 and Area VII acreage in 1929 were identical with the ratios between the state allotments in 1934 and 1935 and the state acreage in 1929.[15] There was some question about the 1937 allotment figure since it was not defined in current terminology; however since diversion payments were made on the basis of special soil-depleting bases for cotton, the figure was used as an approximation of the allotment.

Cotton Loan Rate

The loan rate used in the analysis was based on the loan rate at average locations for Middling 7/8 inch cotton. Although there was no way to determine the exact cotton classification applicable to Area VII, most of the cotton ginned in Oklahoma averaged 7/8 inch or longer during the period under study. The loan rate per pound was deflated by the index of prices received by Oklahoma farmers for all farm commodities. The index was computed from monthly data for annual crop year August through July.

Price of Cotton

The weighted season average prices received by Oklahoma farmers for the cotton marketing season August through July were used to represent the price of cotton. These prices were deflated by the cotton crop year indexes of prices received by Oklahoma farmers for all commodities.

Price of Wheat

The weighted season average prices received by Oklahoma farmers for the wheat marketing season June through May the following year were selected for use in the analysis. These season average prices were deflated by the index of prices received by Oklahoma farmers for all

---

[15] For example the Area VII allotment in 1934 was computed as follows:

$$\frac{\text{(State allotment in 1934) (Area VII Acreage in 1929)}}{\text{State Acreage in 1929}}$$

commodities. The index used in deflating wheat prices was computed from monthly data for the annual crop year June through May.

Wage Rate

The average wage rate paid by Oklahoma farmers for picking 100 pounds of seed cotton was selected. This average wage rate refers to wages paid from the beginning of picking season through the end of October. In 1941 and subsequent years the wage rate is based on rates paid for snapping bolls converted to seed cotton equivalent. These rates were deflated by the cotton crop year index of prices paid by U.S. farmers for commodities used in living and production.

Yield Reduction

Cotton yield reduction refers to the percentage reduction from a normal yield due to specific causes in Oklahoma. The figures used were for the entire state; none were available for Area VII. The specific items included in the estimates of yield reduction are deficient moisture, excessive moisture, other climatic conditions, plant diseases, boll weevil and other insects.

Price of Grain Sorghum

The weighted season average prices of grain sorghum received by Oklahoma farmers for the marketing season beginning September 1 were used in the analysis. These prices were deflated by the index of prices received by Oklahoma farmers for all farm commodities, based on the same marketing season.

Price of Cattle

The average annual prices received by Oklahoma farmers for cattle was assumed to reflect cattle prices in Area VII. These prices were deflated by the annual average index of prices received for all farm commodities in Oklahoma.

Results

Total Period

The analysis of acreage response in Area VIII was first made for the 29-year period, 1929 through 1957. The assumption was made that the relationships between the dependent variable and the independent variables were linear in natural units. The results from four models in this analysis, based on data described in a previous section, are as follows.

Model I-A.

The equation to be fitted in the model is of the form:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$$

where

$\hat{Y}$ = cotton acreage

X_1 = cotton allotment in t or acreage in t-1

X_2 = cotton loan rate in t or price in t-1

X_3 = price of wheat in t-1

X_4 = wage rate in t-1

X_5 = yield reduction in t-1

The fitted equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 224.9274 + \underset{(.0986)}{.8179^{**}} X_1 + \underset{(19.4441)}{28.0634} X_2 - \underset{(2.412)}{5.9887^{*}} X_3 - \underset{(1.2983)}{.6579} X_4 + \underset{(1.5832)}{1.8096} X_5$$

The significance of the individual b value is indicated by a single or double asterisk showing significance at the five percent level and one percent level respectively.

The signs of the significant regression coefficients, b_1 and b_3, are consistent with those expected since $\hat{Y}$ should increase with an increase in allotments or acreage and decrease with an increase in price of wheat. Although the remaining b values were not significant at the five percent level, their signs should be noted. A positive cotton price coefficient and a negative wage rate coefficient were consistent with what would normally be expected. The positive coefficient for yield reduction indicated that producers did expect some "bunching" of years of similar climatic conditions.

The R^2 value of .883 indicates that 88 percent of the variation in Y has been accounted for by the independent variables. Since the F value of 81.20 is significant at the one percent level, the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at .445. For a one percent change in price of cotton, Y or acreage would change by approximately .45 percent.

Model II-A

The only difference between this model and the previous model is that two variables, X_6 (price of sorghum in t-1) and X_7 (price of cattle in t-1) have been added. The other variables have previously been defined.

The fitted equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 424.0917 + \underset{(.1072)}{.8066^{**}} X_1 + \underset{(20.3037)}{26.4554} X_2 - \underset{(3.440)}{6.4340} X_3 - \underset{(1.380)}{.9203} X_4$$

$$+ \underset{(1.895)}{2.5630} X_5 - \underset{(1.0548)}{.7913} X_6 - \underset{(.3994)}{.12168} X_7$$

Only b_1 (acreage or allotments) is statistically significant at the one percent probability level. However, b_3 (wheat price) is significant at the 10 percent level. The signs of both b_1 and b_3 are consistent with economic expectations. A positive b_2 (cotton price), negative b_4 (wage rate), positive b_5 (yield reduction), negative b_6 (sorghum price) and negative b_7 (cattle price) are consistent with economic logic.

The R^2 value of .886 indicates that about 89 percent of the variation in Y has been accounted for by the independent variables. The inclusion of sorghum prices and cattle prices has increased the R^2 value by less than one percent. Again the F value of 23.49 is significant at the one percent level, and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at mean values is estimated at .419. This appears to be consistent with the previous model.

Model III-A

This model differs from the previous model in that two variables, X_4 (wage rate) and X_5 (yield reduction) have been excluded. The other variables have previously been defined.

The fitted equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 224.1363 + \underset{(.07997)}{.8653^{**}} X_1 + \underset{(18.353)}{20.6630} X_2 - \underset{(3.308)}{5.1469} X_3 - \underset{(.9065)}{.0435} X_6 + \underset{(.3866)}{.0147} X_7$$

The sign of the only statistically significant b value (acreage or allotments) is positive as in previous models. A positive b_2 (cotton price), negative b_3 (wheat price) and negative b_6 (sorghum price) are consistent with expectations, although they were not significant at the five percent level. A positive b_7 (cattle price) was not consistent with the theoretical development of the expected effect but the standard error was large as compared with the regression coefficient.

The R^2 value of .876 indicates that about 88 percent of the variation in Y has been accounted for by the independent variables. The omission of wage rate and yield reduction has decreased the R^2 value by only one percent from the previous model. Again the F value of 32.59 is significant at the one percent level and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at .327. This is the change that would occur in Y as a result of a one percent change in cotton price. This is slightly lower than in the previous model.

Model IV-A

All the variables except X_1, X_2 and X_3 have been excluded from this model. The fitted equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 235.0640 + \underset{(.0710)}{.8628^{**}} X_1 + \underset{(16.858)}{21.1674} X_2 - \underset{(2.3109)}{5.2865^{*}} X_3$$

All the signs of the b values are consistent with the economic model developed in a previous section. The b_1 (allotment or acreage) and b_3 (wheat price) values are significant at the five percent level. In addition, the regression coefficient for X_2 was larger than the standard error.

The R^2 value of .876 is about the same as in the previous model. Again the F value of 59.02 is significant at the one percent level and the hypothesis that all β's = 0 is rejected.

The price elasticity indicated in this equation is .335 computed at mean values.

Allotment Year Period

This analysis of acreage response in Area VII includes only those years in the 29-year period, 1929 through 1957, when government allotment or control programs were in operation. The data and assumptions are the same as in the previous analyses. There were 13 observations in this time period.

Model II-B

The equation to be fitted in this model is of the form:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where

$\hat{Y}$ = cotton acreage	X_4 = wage rate in t-1
X_1 = cotton allotment	X_5 = yield reduction in t-1
X_2 = cotton loan rate	X_6 = price of sorghum in t-1
X_3 = price of wheat in t-1	X_7 = price of cattle in t-1

The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = -686.9289 + \underset{(.2995)}{1.195^{*}} X_1 + \underset{(13.073)}{5.0848} X_2 + \underset{(1.8235)}{.34213} X_3 + \underset{(1.761)}{2.3809} X_4$$

$$+ \underset{(1.4848)}{1.687} X_5 + \underset{(.9183)}{.2640} X_6 + \underset{(.3628)}{.3786} X_7$$

The signs of only b_1 (allotment), b_2 (loan rate), and b_6 (price of grain sorghum) were consistent with the economic model. Moreover, only b_1 was significant at the five percent probability level. None of the inconsistent b values were significant at the five percent level but some regression coefficients were larger than their standard errors.

The R^2 value of .975 indicates that approximately 98 percent of the variation in $\hat{Y}$ was accounted for by the regression equation. The F value of 29.033 is significant at the one percent level, and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at .095. This indicates that a one percent increase in cotton price would cause approximately a .1 percent increase in cotton acreage.

Model III-B

The equation to be fitted in this model is of the same form as the previous model. Only variables X_4 and X_5 have been excluded.

The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = -77.1695 + \underset{(.1191)}{.8040^{**}} X_1 + \underset{(11.380)}{7.1798} X_2 - \underset{(1.767)}{.31558} X_3 + \underset{(.6699)}{.4675} X_6$$

$$+ \underset{(.2808)}{.05153} X_7$$

There is only one significant b value, b_1 (allotment). The signs of b_1 (allotment), b_2 (cotton price) and b_3 (price of wheat) are consistent with the economic model but the signs of b_6 (sorghum price) and b_7 (cattle price) were not consistent. The R^2 value was .966 and the F value was significant. The price elasticity of acreage response was .135.

Model IV-B

Only three independent variables, X_1, X_2, and X_3 were included in this model. The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = -28.213 + \underset{(.0636)}{.8819^{**}} X_1 + \underset{(9.382)}{7.463} X_2 - \underset{(1.117)}{.3758} X_3$$

The signs of all the b values in this model are consistent with the economic model, however, only b_1 (allotment) is significant at the five percent level. Apparently, only the allotment is important in determining acreage in Area VII during years with governmental controls in operation. Specific values of the test of significance are included in Appendix Table 2.

Non-Allotment Year Period

This analysis of acreage response in Area VII includes all years in the 29-year period, 1929 through 1957, when there were no allotments or control programs in operation. The data described in a previous section are used in natural units with the assumption of linearity of relationships among variables. There were 16 observations in each of the three models analyzed for this time period.

Model II-C-1

The equation to be fitted in this model is of the form:

$$\hat{Y} = a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5 + b_6X_6 + b_7X_7$$

where

$\hat{Y}$ = cotton acreage

X_1 = cotton acreage in t-1

X_2 = cotton loan rate in t or price in t-1

X_3 = price of wheat in t-1

X_4 = wage rate in t-1

X_5 = yield reduction in t-1

X_6 = price of sorghum in t-1

X_7 = price of cattle in t-1

The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 2479.9618 + \underset{(.2326)}{.5952^*} X_1 + \underset{(55.848)}{74.278} X_2 - \underset{(11.019)}{25.2025^*} X_3 + \underset{(2.643)}{.2986} X_4$$

$$+ \underset{(6.004)}{9.937} X_5 - \underset{(4.249)}{5.808} X_6 - \underset{(1.313)}{1.823} X_7$$

The signs of the two statistically significant b values, b_1 (acreage in t-1) and b_3 (price of wheat), are consistent with economic logic. The positive sign of b_4 (wage rate) was not expected since acreage would be expected to decrease as the wage rate increased. The signs of the other b values are consistent with the economic model developed in a previous section.

The R^2 value of .91 indicates that 91 percent of the variation in Y has been accounted for by the independent variables. The F value of 12.18 is significant at the one percent level and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at 1.003. This implies that for a one percent change in cotton price, cotton acreage would change by approximately one percent.

Model II-C-2

This model differs from Model II-C-1 in that X_4 (wage rate) has been excluded. The remaining variables have been defined.

The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 2433.2723 + \underset{(.209)}{.5874^*} X_1 + \underset{(52.684)}{74.1802} X_2 - \underset{(9.089)}{24.5956^*} X_3 + \underset{(5.522)}{9.7859} X_5$$

$$- \underset{(3.84)}{5.6709} X_6 - \underset{(1.159)}{1.7713} X_7$$

There are two b values significant at the five percent level, b_1 (acreage in t-1) and b_3 (price of wheat). The signs of all the b values including b_1 and b_3 are consistent with the economic model developed in Chapter IV.

The R^2 value of .91 is approximately the same as the R^2 value obtained in the equation including wage rates. The F value of 15.96 is significant at the one percent level and the hypothesis that all β's = 0 would be rejected. The Durbin-Watson statistic used in testing for serial correlation was computed for this equation. The value of $\frac{d^2}{s^2}$ was 1.13. A value this large, while outside the range of indicating definite serial correlation, was in the range where no conclusive statement could be made that serial correlation either did or did not exist.

Price elasticity of acreage response computed at the mean values is estimated at 1.046. This indicates that a one percent increase in the price of cotton would increase cotton acreage by approximately one percent.

Model III-C

In this model both X_4 and X_5 were excluded. The estimating equation with the standard deviation of the b_i shown in parenthesis is:

$$\hat{Y} = 1078.7174 + \underset{(.1883)}{.8010^*} X_1 + \underset{(48.907)}{23.923} X_2 - \underset{(7.141)}{13.300} X_3 - \underset{(3.244)}{1.295} X_6$$

$$- \underset{(.834)}{2.154} X_7$$

Only b_1 (acreage in t-1) is significant at the five percent level, although b_3 (price of wheat) is significant at the 10 percent level. The signs of all the b values are consistent with the economic model.

The R^2 value of .884 indicates that approximately 88 percent of the variation in Y has been accounted for by the independent variables. This is a decrease of approximately three percent from the previous model. The F value of 15.25 is significant at the one percent level, and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at .337. This is a reduction of two-thirds from the previous model and indicates a definite interrelationship between the prices of cotton and the values of the omitted variables.

Model IV-C

All the dependent variables except X_1, X_2 and X_3 have been eliminated from this model. The estimating equation with the standard deviation of the b_i values are shown in parenthesis:

$$\hat{Y} = 875.9751 + \underset{(.11316)}{.84968} X_1 + \underset{(34.372)}{13.90899} X_2 - \underset{(5.4704)}{13.05394} X_3$$

The signs of all the b values conform with economic logic and the regression coefficients b_1 (acreage in t-1) and b_3 (price of wheat) were significantly different from zero at the five percent probability level.

The R^2 value of .883 is about the same as for Model III-C. The F value of 29.94 is significant at the one percent level and the hypothesis that all β's = 0 would be rejected.

The price elasticity of acreage response computed at the mean values is estimated at .196. This is a further reduction from the estimate in

Model II-C and indicates that a one percent change in the price of cotton would cause only a .2 percent change in cotton acreage.

Underplantings Model

In twelve of the thirteen years that allotment programs have been in operation, cotton producers have underplanted their allotments. In the previous analysis, the size of the allotment exerted a great deal of influence upon cotton acreage; the only statistically significant variable in the explanation of cotton acreage in years of control was the size of the allotment. Consequently an attempt was made to determine how some of the factors used in previous analyses might affect underplantings.

Model V

The equation fitted in this model was:

$$\hat{U} = 83.433 + \underset{(13.24)}{5.4783}\, X_1 - \underset{(.268)}{.01322}\, X_2 + \underset{(1.521)}{.7640}\, X_3 - \underset{(1.511)}{1.7131}\, X_4 - \underset{(1.458)}{.7296}\, X_5$$

$$- \underset{(1.082)}{.28879}\, X_6 + \underset{(1.018)}{.22396}\, X_7$$

where

$\hat{U}$ = underplantings of cotton allotment

X_1 = cotton loan rate

X_2 = cotton allotment

X_3 = price of wheat in t-1

X_4 = wage rate in t-1

X_5 = yield reduction in t-1

X_6 = price of cattle in t-1

X_7 = price of sorghum in t-1

None of the b values were significant at the five percent probability level. The signs of b_2, b_3, b_4, b_5, and b_7 were consistent with the postulated directions of effect of the variables, but the R^2 value was only .623. The F value of 1.184 was not significant at the five percent probability level; therefore, the hypothesis that all β's = 0 was not rejected. Therefore, no further analyses are reported.

CHAPTER VI

IMPACTS OF GOVERNMENTAL CONTROL PROGRAMS ON ACREAGE

Producers did not respond in the same way to the same set of economic forces in allotment years as they did in non-allotment years. Consequently, the estimates of the factors obtained for the total period appeared to understate the anticipated effects for application to non-control conditions. This appeared to be the case for price elasticity as well as for the other parameters.

The price elasticity estimates for the total 29-year period varied from .328 in Model IV-A to .445 in Model I-A (Table V). If these estimates are considered as estimates of the short run price elasticity of acreage response and if a simple Nerlove adjustment model is assumed, then long run price elasticity estimates can be computed from the parameter for acreage in the previous year (X_1). Under these assumptions, the long-run price elasticity estimates for the total period varied from 2.1 in Model II-A to 2.4 in Models I-A, III-A, and IV-A (Table V). These estimates indicate that the full adjustment of acreage response to a change in the price of cotton does not occur in the first year. This appears reasonable since producers generally cannot make complete adjustments in a short period of time.

The price elasticity estimates for allotment years are shown in Table V but the parameters on which they were based were not statistically significant. In general the estimates are quite low and the primary factor affecting cotton acreage during these years was the size of the allotment.

TABLE V

SHORT-RUN AND LONG-RUN ELASTICITY ESTIMATES BY PERIODS AND MODELS

	Short-Run			Long-Run[a]	
Model	29-Year Period	Allotment Years	Non-Allotment Years	29-Year Period	Non-Allotment Years
I	.445			2.44	
II	.419	.095	1.00	2.17	2.58
II-C-2			1.05		2.53
III	.327	.135	.337	2.43	1.69
IV	.335	.140	.196	2.44	1.30

[a]Not applicable in allotment years.

The price elasticity estimates for non-allotment years varied from .19 in Model IV-C to 1.05 in Model II-C-2. There was more variation in estimates from the various models in this time period than in any other time period. Under the same assumptions regarding short-run and long-run elasticity as used for the total period, the long-run price elasticity estimates were computed. These estimates ranged from 1.3 to 2.58.

Model II-C-2 was selected for use in the evaluation of the impacts of governmental control programs. From an economic standpoint, more factors were included in this model which were believed to affect cotton acreage than were included in most of the other models. Also the signs of all the regression coefficients were consistent with the economic model developed in Chapter IV. From a statistical standpoint, all the regression coefficients were larger than their respective standard errors in this model, which was not the case in other models, and both b_1 (cotton acreage in t-1) and b_3 (wheat price in t-1) were statistically significant at the five percent probability level. Moreover, this model accounted for as much variation in cotton acreage as any of the other models for the same time period.

The price elasticity estimates from Model II-C-2 were computed for various levels of cotton prices (Table VI). In general, these estimates were about the same for prices of cotton ranging from 10 cents per pound up to 35 cents per pound. The short-run price elasticity was about unity while the long-run price elasticity was about 2.5.

TABLE VI

SHORT-RUN AND LONG-RUN ELASTICITY ESTIMATES AT VARIOUS PRICES OF COTTON USING MODEL II-C-2, OKLAHOMA AREA VII

Price of Cotton (cents)	Short-Run	Long-Run
35	1.038	2.515
30	1.044	2.530
25	1.053	2.553
20	1.067	2.587
15	1.092	2.647
10	1.144	2.774

Estimated Acreages at Actual Prices

One method of evaluating the effects of governmental control programs on cotton acreage in Area VII would be the estimation of acreage that would have been planted if acreage controls had not been in operation. In an attempt to determine the specific level of cotton acreage in the absence of allotment programs, Model II-C-2, which is based on non-allotment years, was used to compute estimated acreages for the allotment years. The data for all variables except acreage were assumed to be the same without governmental controls as actually existed under controls. This was an important assumption and probably does not reflect adequately the probable prices of cotton and the other commodities if, in fact, control programs had been eliminated. However, there was no basis for determining the probable prices, other than by pure speculation, for inclusion in such an analysis. Even if these prices are not realistic in this sense, they appear to be realistic in reflecting the economic forces affecting changes in cotton acreage.

Two methods of estimation were used. In the first method, Method 1, the removal of allotments was visualized as being effective in an individual year. For 1934, the cotton acreage in 1933 was used as X_1 to compute an estimated acreage ($\hat{Y}$). For 1935, the acreage in 1934 was used to estimate acreage that would have been planted if no allotments existed. In each subsequent allotment year, cotton acreage in cultivation in t-1 was used as X_1 in Equation II-C-2 to compute a $\hat{Y}$ value. These estimates are included in Table VII and Figure 6.

On the basis of this procedure, allotments in the pre-war period, 1937-1942, had the effect of keeping cotton acreage in cultivation at a higher level than would have been in cultivation in the absence of allotments. Although there was considerable variation, the general level of the estimated acreages was about one-third below the actual acreages. In the post-war period, 1954-1957, allotments had the opposite effect. The estimated acreages were more than one-fourth higher than the actual acreages. On the basis of this method, it appears that allotments may have held cotton acreage in the area in the pre-war period and curtailed potential cotton acreage expansion in the post-war period.

TABLE VII

ESTIMATED COTTON ACREAGES DURING ALLOTMENT YEARS, OKLAHOMA AREA VII, 1934-1957

Year	Method I[a] (1000 Acres)	Method II[b] (1000 Acres)
1934	408.097	408.097
1935	621.999	377.073
1937	502.698	502.698
1938	138.582	- 10.699
1939	604.012	269.790
1940	175.175	- 16.058
1941	492.858	143.092
1942	442.549	219.240
1950	264.279	264.279
1954	496.776	496.776
1955	682.123	717.777
1956	305.884	513.372
1957	481.644	514.762

[a]Allotments removed each year.

[b]Based on actual acreages in t-1 or acreages in t-1 estimated by the equation from the beginning of a sequence of allotment years.

Source: Computed from Model II-C-2.

In the second method, Method II, no allotments were visualized. For example, estimates of acreage for 1934 were computed from Model II-C-2 using acreage in 1933 as X_1. For 1935, the estimated acreage was computed from Model II-C-2 using the previous year's estimated acreage as X_1. This sequence was continued until an interruption occurred in the

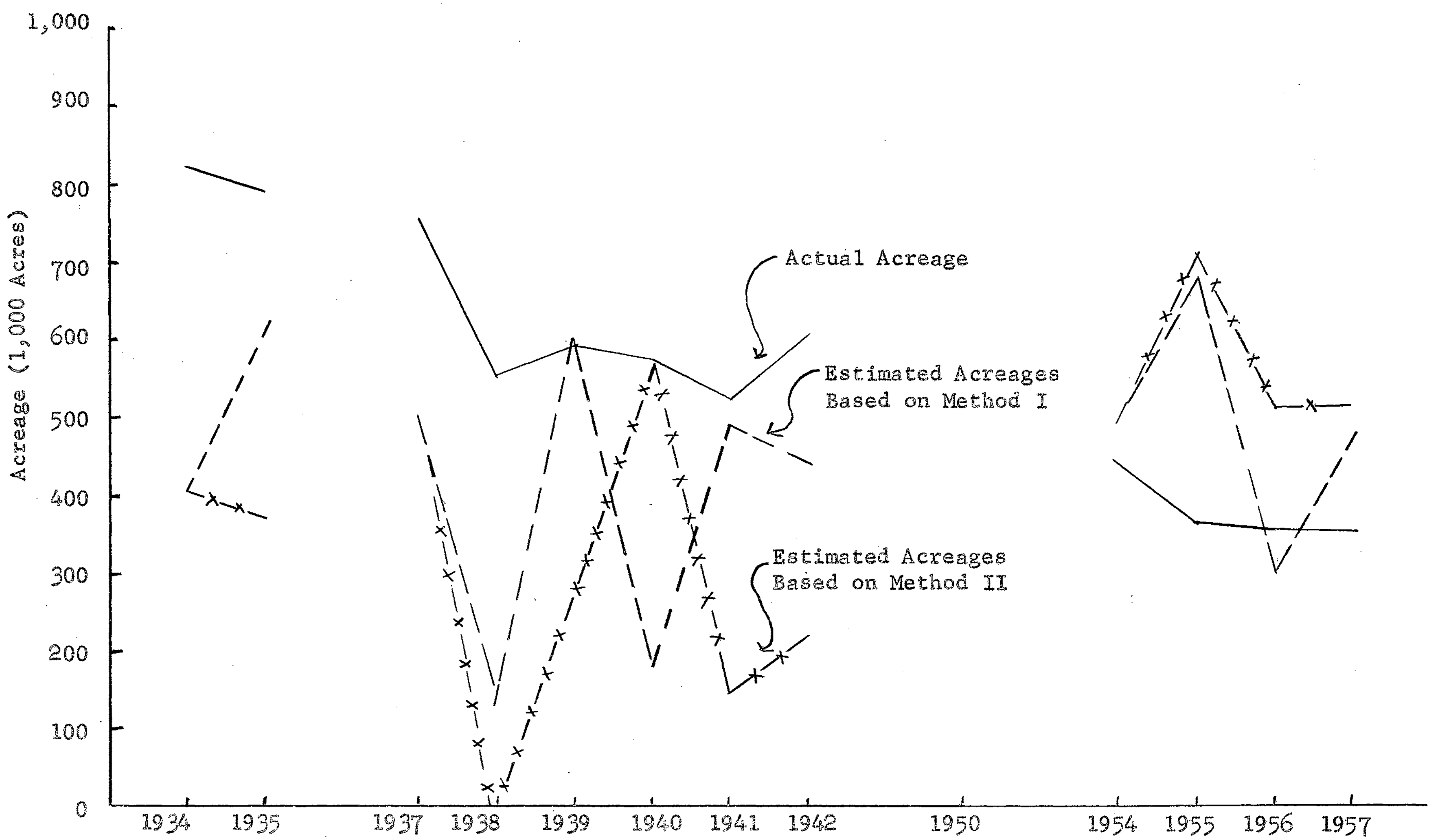


Figure 6. Cotton Acreage in Cultivation July 1, Under Allotments and Estimated Acreages Without Allotments During Allotment Years, Oklahoma Area VII, Selected Years in the Period 1934-1957

Source: Tables IV and V.

operation of governmental controls. At the beginning of a new sequence of governmental controls, the same procedure was followed. There was more annual variation in the acreages estimated by this method than in the estimates by the first method. Negative acreages from Method II were obtained for 1938 and 1940. These were the result of an unusually high relative price of wheat in 1938 and the higher prices for cattle and grain sorghum in 1940.

The general direction of effects of governmental control programs on cotton acreage, based on estimates from Method II, were about the same as the results from Method I. However, the magnitude of differences between estimated and actual acreages were greater. In the pre-war period, estimated acreages were only one-fourth as high as the actual acreages. In the post-war period, estimated acreages were almost one-half larger than actual acreages. These results indicate that allotments may have had the effect of holding acreage in cotton during the late 1930's and of curtailing potential expansion of cotton acreage in the post-war period.

Estimated Acreages at Alternative Price Combinations

A different method of evaluating the effects of governmental control programs on cotton acreage in Area VII would be the estimation of potential variation in acreage under various price relationships between cotton and alternative enterprises. Since wheat was the most important alternative, it was selected for specific consideration. The general procedure adopted was to estimate cotton acreage under various wheat and cotton prices with cattle and grain sorghum prices constant at the 1954-57 averages and with yield reduction constant at the 1953-56 average. Cotton in cultivation July 1, 1957 plus cotton acreage devoted to the acreage reserve program was used as X_1.

With a wheat price of $1.75 per bushel and a cotton price of 30 cents per pound, the estimated acreage is 952,660 acres (Table VIII). This would represent the acreage for the first year after removal of allotments and is about three times the base acreage of 1957. For each five cent decrease in the price of cotton, the estimated acreage would decline by approximately 136,000 acres. It would be necessary for the price of cotton to decline to less than 15 cents per pound with wheat at $1.75 per bushel, before estimated acreage would be below 1957 acreage. With the price of wheat at $2.00 and the price of cotton ranging from 40 to 25 cents, estimated acreages would be lower and would range from 978,210 acres down to 588,960 acres.

TABLE VIII

ESTIMATED COTTON ACREAGE WITH VARIOUS PRICES OF COTTON AND WHEAT, OKLAHOMA AREA VII

Price of Cotton (cents per lb.)	Price of Wheat (cents per lb.)	Estimated Cotton Acreage (1,000 acres)
.30	1.75	925.66
.25	1.75	816.17
.20	1.75	679.66
.40	2.00	978.21
.35	2.00	842.46
.35	2.25	621.10
.25	.90	1,579.38
.25	1.50	1,038.27
.25	2.00	588.96
.20	.90	1,433.63
.20	1.00	1,345.24
.15	1.25	987.39
.25	2.50	128.24

If it is assumed that allotments were removed from both cotton and wheat, then the price of both crops probably would decrease. If the prices were 25 cents per pound for cotton and 90 cents per bushel for wheat, the estimated acreage would be 1,579,380 acres. This is about the same as the acreage in 1929 and indicates that, at these price relationships, practically all the resources suited to cotton production would be shifted to the cotton enterprise in Area VII. Even if the price of cotton declined to 20 cents, estimated acreage would still approximate the 1929 acreage.

Various other price combinations are included in Table VIII. The only price combination in Table VIII which results in an acreage as low or lower than the 1957 acreage is $2.50 for wheat and 25 cents for cotton. The estimated acreage for this price combination is 128,240 acres.

The general results from the analysis of estimated acreages under various wheat and cotton price combinations indicate that the estimated acreage of cotton in the post-war period would be at a higher level than the 1957 base. Estimated acreages would decrease below this base only if there was a large decrease in the price of cotton relative to the price of wheat. These results are similar to the results obtained from the previous analyses.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Cotton acreage in Southwestern Oklahoma declined by almost 75 percent from 1929 to 1957. Major changes other than the decline in cotton acreage have also occurred in the agricultural sector of the area during this period. Important changes noted were an increase in the average size of farm, a decrease in the number of farm operators, and a change in the cropping system. In addition, governmental control programs have been in operation or in a stand-by position during the most of the period. The major Agricultural Acts were reviewed and the general effects of the control programs on acreage in Area VII ascertained.

Theoretical economic relationships were developed for explaining changes in cotton acreage in Area VII. The acreage of cotton in cultivation was specified as a function of cotton acreage in t-1 or cotton allotment; cotton price or loan rate; prices of wheat, grain sorghum, and cattle; cost of production; and climatic conditions.

The producers' acreage response was estimated by the least squares single equation technique for the entire 29-year period (1929-1957), the allotment years, and the non-allotment years in this period. The regression coefficients of X_1 (cotton acreage in t-1) and X_3 (price of wheat) were statistically significant at the five percent probability level for the total period. The same coefficients were statistically significant in the non-allotment year period. However in the allotment year period, only the regression coefficient for cotton allotment was statistically significant at the five percent level.

The estimated price elasticities of acreage response obtained in the various models were different. In the 29-year period, the estimate selected was about .40 while in the non-allotment years the estimate selected was approximately unity. The estimates in allotment years were considerably lower, about .15, but were based on parameters which were not statistically significant.

Three types of estimates of cotton acreages in the absence of governmental control programs were made using the non-allotment year Model II-C-2. Two methods of estimation were based on the assumption that actual prices would prevail either with or without allotments. The results from these two methods indicated that, in the absence of governmental programs, cotton acreage might have been lower in the pre-war years and higher in the post-war years.

The third type of estimate involved estimates of cotton acreage under alternative combinations of the prices of cotton and wheat, while holding other variables constant at post-war levels. It was found that the price of cotton would have to decrease below 15 cents per pound with wheat at $1.75 per bushel for estimated cotton acreage to be below the 1957 acreage. Most of the price combinations indicated a level of cotton acreage in excess of present acreages. At prices of 25 cents per pound for cotton and 90 cents per bushel for wheat, cotton acreage would approximate the same level as existed in 1929.

Although no definite statements can be made about acreages in the absence of control programs, the evidence is strong that governmental allotment programs have affected the allocation of resources in Area VII. Conclusions reached in this study are that the control programs probably resulted in additional resources committed to cotton production in the pre-war period and probably resulted in an effective barrier to the committment of additional resources to cotton in the post-war period for Area VII.

SELECTED BIBLIOGRAPHY

A Statistical Handbook of Oklahoma Agriculture, Oklahoma Agricultural Experiment Station, Misc. Pub. No. MP-14, January, 1949.

Agricultural Outlook, USDA, Washington, October, 1949.

Collins, G. P., and W. G. Hill, Prices Received by Oklahoma Farmers 1910-1957, Oklahoma Agricultural Experiment Station, Processed Series P-297, June, 1958.

Cable, C. Curtis, Jr., A Chronology of Government Programs for American Upland Cotton, Arkansas Agricultural Experiment Station, Bulletin 587, Fayetteville, Arkansas, April, 1957.

Foote, Richard J., Analytical Tools for Studying Demand and Price Structure, Agriculture Handbook No. 146, U. S. Department of Agriculture, Washington, D. C., August, 1958.

Friedman, J. and R. J. Foote, Computational Methods for Handling Systems of Simultaneous Equations, Agriculture Handbook No. 94, U. S. Department of Agriculture, Washington, D. C., May, 1957.

Heady, Earl O., "The Supply of U. S. Farm Products Under Conditions of Full Employment", American Economic Review, Vol. 45, No. 2, May, 1955.

Lagrone, William F., Cotton Growing in Southwestern Oklahoma, Oklahoma Agricultural Experiment Station Bulletin B-350, Stillwater, Oklahoma, June, 1950.

Leftwich, Richard H., The Price System and Resource Allocation, Rinehart and Company, New York, 1955.

Nerlove, Marc, The Dynamics of Supply, The John Hopkins Press, Baltimore, 1958.

Oklahoma Cotton: Planted Acreage, Planted Yield, and Production, Oklahoma Federal-State Crop and Livestock Reporting Service, Oklahoma City, Oklahoma

Ratchford, C. B. and R. Freund, What the Government Did to Cotton, unpub. report, North Carolina State College, Raleigh, North Carolina, 1954.

Schickele, Rainer, Agricultural Policy, McGraw-Hill Book Company, Inc., 1954.

Snedecor, George W., _Statistical Methods_, The Iowa State College Press, Ames, Iowa, Fifth Edition, 1956.

Tontz, R. L., _The Evolution of Agricultural Parity_, unpub. Ph.D. dissertation, Oklahoma State University, 1952.

United States Census of Agriculture, 1930-1954, U. S. Department of Commerce, Bureau of the Census, Washington, D. C., 1930-1954.

Walsh, Robert M., "Response to Price in the Production of Cotton and Cottonseed", _Journal of Farm Economics_, Vol. 26, May, 1954.

APPENDIX TABLE 1

DATA USED IN STATISTICAL ANALYSIS OF FACTORS AFFECTING COTTON ACREAGE JULY 1, OKLAHOMA AREA VII, 1929-1957

Year	Area VII Cotton Acreage: in Cultivation	Area VII Cotton Acreage: Allotment	Prices Received by Oklahoma Farmers: Cotton	Prices Received by Oklahoma Farmers: Wheat	Prices Received by Oklahoma Farmers: Grain Sorghum	Prices Received by Oklahoma Farmers: Beef Cattle	Oklahoma Yield Reduction	Cotton Loan Rate 7/8" Mid.	Wage Rate for Harvesting: Oklahoma Cotton	Index of Prices Received for All Farm Commodities by Oklahoma Farmers		Index of Prices Paid by U.S. Farmers for Commodities Used in Living and Production
	(1,000 Acres)		(Cents)	(Cents)	(Dollars)	(Dollars)	(Percent)	(Cents)	(Dollars)	(Aug-July Ave.)	(Jan-Dec. Ave.)	(Aug-July Ave.)
1928	1,316.9	--	17.5	1.04	1.39	8.40	42	--	1.28	146.8	151	145
1929	1,429.6	--	16.1	.96	1.43	8.20	45	--	1.22	133.1	146	141
1930	1,324.2	--	8.7	.68	1.02	6.20	54	--	.73	86.9	113	125
1931	1,076.9	--	5.1	.33	.55	4.30	30	--	.45	54.6	72	105
1932	1,021.8	--	6.1	.32	.54	3.40	36	--	.48	56.6	52	95
1933	1,223.0	--	9.6	.68	.93	3.00	28	10.00	.65	78.3	65	107
1934	825.0	904.8[a]	11.8	.81	1.68	3.10	72	12.00	.75	105.0	90	116
1935	793.7	904.8[a]	10.6	.86	1.16	5.00	47	10.00	.70	107.0	107	115
1936	777.9	--	11.0	.99	1.84	5.20	75	--	.75	121.1	111	122
1937	756.8	782.2	7.2	.96	.95	6.10	37	9.00	.75	97.0	116	119
1938	558.2	662.2	8.0	.56	.79	5.70	35	8.30	.70	87.0	90	120
1939	595.3	643.3	8.4	.65	1.12	6.30	41	8.70	.65	96.0	90	122
1940	579.3	655.3	9.1	.62	.91	6.60	22	8.90	.72	103.5	97	124
1941	523.2	647.0	15.5	.93	1.04	8.10	27	14.02	1.20	145.3	122	142
1942	606.1	600.2	17.3	1.11	1.55	9.50	31	17.02	1.50	171.0	155	159
1943	573.5	--	18.2	1.38	2.20	9.90	50	18.41	1.80	181.5	179	171
1944	546.0	--	18.7	1.39	1.66	8.90	23	20.03	1.95	184.0	182	177
1945	400.5	--	20.1	1.45	2.14	10.50	51	19.84	1.90	199.8	189	185
1946	364.9	--	30.1	1.80	2.41	12.20	50	22.83	2.60	263.2	223	218
1947	386.0	--	30.2	2.17	3.43	16.20	42	26.49	2.60	303.5	286	246
1948	344.5	--	28.6	1.98	2.14	20.70	38	28.79	2.65	279.1	299	246
1949	505.2	--	27.8	1.87	1.96	18.30	24	27.23	2.35	266.6	266	240
1950	363.6	402.4	38.5	2.02	1.88	22.00	59	27.90	2.65	322.0	284	263
1951	764.6	--	35.6	2.20	2.30	26.70	45	30.46	2.90	325.5	335	274
1952	644.5	--	31.3	2.12	2.86	21.70	60	30.91	2.85	280.7	310	266
1953	471.4	--	29.6	2.13	2.20	13.90	31	30.80	2.85	256.3	263	262
1954	446.3	478.4	31.2	2.18	2.20	13.80	56	31.58	2.85	256.0	256	263
1955	364.6	373.7	29.1	2.05	1.64	14.10	22	31.70	2.80	241.9	252	261
1956	357.0	366.0	28.4	2.00	2.18	13.30	54	29.34	2.55	244.5	241	270
1957	351.5[b]	364.9	22.7	1.93	1.64	15.69	--	28.81	2.50	261.8	249	--

[a]Based on percentage relationship between Area VII and State data.

[b]Includes acreage in the Acreage Reserve Program.

Sources: Cotton Acreage: Oklahoma Crop and Livestock Reporting Service.
Cotton Allotment: Oklahoma State Agricultural Stabilization and Conservation Records.
Prices of Cotton, Wheat, Grain Sorghum and Cattle and All Indices of Prices Received: "Prices Received by Oklahoma Farmers, 1910-1957," Processed Series P-297, (June, 1958).
Wage Rate and Cotton Loan Rate: Statistics on Cotton and Related Data, USDA Statistical Bulletin No. 99, (February, 1957).
Yield Reduction: Crops and Markets, USDA, AMS.
Index of Prices Paid: Oklahoma Farm Price Statistical Bulletin No. 238 and Agriculture Handbook No. 118, Vol. 1.

APPENDIX TABLE 2

RESULTS FROM STATISTICAL ANALYSES OF FACTORS AFFECTING COTTON ACREAGE JULY 1, OKLAHOMA AREA VII, 1929-1957

		Regression Coefficients and Standard Errors									Price Elasticity	
		Cotton Allotment or Acreage X_1	Cotton Price or Loan Rate X_2	Wheat Price X_3	Wage Rate X_4	Yield Reduction X_5	Grain Sorghum Price X_6	Cattle Price X_7	R^2	F Value	Short Run[a] E_p	Long Run[a] η_p
Model I	b	.81797	28.06337	-5.98872	-.65795	1.80967			.883448	81.20057	.44531	2.44636
	s_b	(.09864)	(19.44418)	(2.41228)	(1.29836)	(1.58327)						
Model II-A	b	.80660	26.45540	-6.43409	-.92032	2.56310	-.79132	-.12169	.88678	23.49748	.41980	2.17060
	s_b	(.10723)	(20.30374)	(3.44015)	(1.38028)	(1.89570)	(1.05483)	(.39943)				
Model II-B	b	1.19518	5.0848	.34213	2.38090	1.68714	-.26401	.37867	.97599	29.03328	.09563	
	s_b	(.29954)	(13.07376)	(1.82356)	(1.76114)	(1.48484)	(.91837)	(.36281)				
Model II-C-1	b	.5955	74.278	-25.2025	.2986	9.937	-5.808	-1.823	.914	12.18	1.003	2.589
	s_b	(.2326)	(55.848)	(11.019)	(2.643)	(6.004)	(4.249)	(1.313)				
Model II-C-2	b	.5875	74.18	-24.60		9.79	-5.67	-1.77	.914	15.96	1.046	2.536
	s_b	(.209)	(52.68)	(9.09)		(5.52)	(3.84)	(1.15)				
Model III-A	b	.86532	20.66307	-5.14693			-.04354	.01471	.87633	32.59606	.32788	2.43445
	s_b	(.07997)	(18.35320)	(3.30834)			(.90658)	(.38668)				
Model III-B	b	.80404	7.17987	-.13558			.46752	.05153	.96670	39.41697	.13503	
	s_b	(.11917)	(11.380)	(1.767)			(.6699)	(.2808)				
Model III-C	b	.8010	23.923	-13.300			-1.295	-.2154	.884	15.25	.337	1.69
	s_b	(.1883)	(48.907)	(7.141)			(3.244)	(.834)				
Model IV-A	b	.86282	21.16740	-5.28653					.87628	59.02187	.33589	2.44853
	s_b	(.07109)	(16.85810)	(2.31093)								
Model IV-B	b	.88193	7.46390	-.37586					.962981	168.75991	.14037	
	s_b	(.06369)	(9.38289)	(1.11745)								
Model IV-C	b	.84968	13.90899	-13.05394					.88318	29.94916	.19617	1.30497
	s_b	(.11316)	(34.37186)	(5.47040)								
Model V	b	-.0132	5.478	.7640	-1.713	-.7296	.2239	-.2887	.62	4.88		
	s_b	(.268)	(13.244)	(1.521)	(1.511)	(1.458)	(1.018)	(1.082)				

[a]Estimated at mean value of variables.

VITA

Roger Post Hill

Candidate for the Degree of

Master of Science

Thesis: AN ECONOMIC ANALYSIS OF FACTORS AFFECTING COTTON ACREAGE IN SOUTHWESTERN OKLAHOMA

Major Field: Agricultural Economics

Biographical:

Personal Data: Born in Kinston, North Carolina, August 25, 1935, the son of W. Whitford Hill and Gladys S. Hill.

Education: Attended grade and high school at Pink Hill, North Carolina; graduated from Pink Hill High School in May, 1953. Received the Bachelor of Science degree from North Carolina State College, Raleigh, North Carolina, with a major in Field Crops, in May 1957. Engaged in postgraduate study toward the Degree of Master of Science at Oklahoma State University, Stillwater, Oklahoma from September, 1958 to February, 1960.

Professional Experience: Was Assistant County Agent in Onslow county, North Carolina from June, 1957 through August, 1958. Research Assistant in the Department of Agricultural Economics at Oklahoma State University from September, 1958 to February, 1960.