AN ANALYSIS OF THE AGRICULTURAL LAND MARKET IN NORTH CENTRAL OKLAHOMA

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PREFACE

This study is concerned with an analysis of the agricultural land market in north central Oklahoma during the period January, 1970 through June, 1976. The primary objectives of this study are to ascertain the levels of land values and activity in this market and to determine the important factors which influence agricultural land values. Regression analysis is employed to identify and quantify the relationships existing between these important factors and agricultural land values in north central Oklahoma.

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CHAPTER I

INTRODUCTION

Land is the largest single input of the agricultural production process. Unlike many other agricultural inputs, it can be very difficult to identify the price that a producer can and will pay for land, especially if non-agricultural producer buyers are involved in the market. It can be equally as difficult to identify the characteristics and factors that influence the price that agricultural land will bring. In this day and time when much of our rural land has non-agricultural alternative uses, the difficulty of ascertaining quality or value becomes compounded by the non-agricultural factors and characteristics which must be considered.

The agricultural land market in Oklahoma has been characterized by generally increasing prices with rapidly increasing prices in the early 1970's. In the period 1969-1975, Oklahoma farm real estate values have nearly doubled. During this same period, farm real estate values in the North Central Oklahoma Crop Reporting District have increased even more rapidly, 120 percent (9).

The price that agricultural land commands can to a great extent determine the structure and future viability of the agricultural industry in an area such as north central Oklahoma. Communities that are dependent upon agriculture for jobs and tax revenues, and lending institutions which provide the major portion of the financing for the purchase of agricultural land should be aware of the factors which determine the market value of agricultural land. Buyers and sellers of agricultural land, as well as rural appraisers and tax authorities have a great need for reliable land market information. And, of course, agricultural policy makers and land use planners need accurate up-to-date information regarding the price levels of agricultural land markets as well as changes in the factors influencing agricultural land markets for decision making purposes.

Objectives of the Study

The general objective of this study is to examine the agricultural land market in north central Oklahoma. More specifically stated that objective includes:

(1) To ascertain the volume of activity in the agricultural land market in north central Oklahoma and four specific counties of that area.

(2) To derive agricultural land values for north central Oklahoma, four selected counties of that area and for croplands and rangelands of the area for the period 1970 to 1976.

(3) To ascertain trends and changes that have occurred in these agricultural land markets.

(4) To establish bench mark data for future study of agricultural land markets in this and other areas.

(5) To identify the important factors affecting the value of agricultural land in this area.

(6) To ascertain and quantify the relationships existing between these important factors and the per acre price of agricultural land.

(7) To estimate equations for use in projecting future agricultural land prices in this area.

Methodology

Agricultural land transfer data was collected for the period 1970-1976 in Alfalfa, Garfield, Kingfisher and Woodward counties of Oklahoma. Information concerning land transfers was collected from the offices of the County Clerk and County Assessor in each of these counties.

Only land transfers meeting the following criteria were included in the study. Sales must be:

(1) Forty acres or more in size,

(2) Located outside the corporate limits of a city or town,

(3) Primarily agricultural in their highest and best use, and

(4) Bona fide or arms-length transactions. (Sales of partial ownership, settlement of estates, changes in form of ownership and intra-family transfers were excluded insofar as they could be identified from transfer records.)

Detailed information concerning improvements and land type characteristics were obtained from the County Assessor's office. Information concerning soil and land type characteristics were obtained from the county offices of the Agricultural Stabilization and Conservation Service. Demographic and location characteristics information was obtained from County General Highway Maps published by the Oklahoma Department of Highways. Soil characteristics information was obtained from County Soil Surveys published by the Soil Conservation Service.

Price was recorded as per acre price paid less the per acre value of improvements. Simple tabulations were used to derive the average price per acre paid for agricultural land in the area as well as for each of the four counties and for cropland and rangeland. Multiple regression analysis was employed to determine and test the relationships existing among hypothesized explanatory factors and between these factors and per acre price. The use of regression analysis facilitated the testing of factors to determine the direction and magnitude of these correlations. The use of these techniques also aided in the selection of the combination of explanatory factors which would minimize the difference or residual terms between actual and predicted values. From these findings trial equations were specified containing those explanatory factors which appeared to explain variation in per acre prices in a manner consistent with economic theory. Final estimated equations containing the "best" combination of explanatory factors were then selected based on the criteria of: (1) explanatory power of the equation, (2) consistency of the relationship between each explanatory factor and per acre price with economic theory, (3) the statistical significance level of the coefficient of each explanatory factor, and (4) the economic reasonableness of relationships existing among the explanatory factors.

Review of Literature

Land appraisal and the study of factors which contribute to the value of land is a subject that has interested scholars for many years. The twentieth century has produced the term land economics but the discipline existed long before. Current interest in the study of land valuation has been stimulated by the rapid increase in land prices of the last several years. The trend toward realignment of tax assessment procedures on a value in use basis has also done much to arouse new interest in the rural and agricultural land markets. Increased interest in land use planning has led many state and federal agencies to study the characteristics of and forces within rural land markets. New farm commodity programs and output increasing production policies have helped to bring developments in the agricultural land market to the attention of public officials, particularly land use planners and policy makers.

Net Rent and Land Use Theory

David Ricardo (13) in The Principles of Political Economy and Taxation (1817), explained the value of land in terms of economic rent. By rent he meant that compensation which was paid to the owner of a piece of land for the use of its original and indestructible powers. Ricardo explained rent largely in terms of differences in soil fertility. In his analysis, he assumed a newly settled country with an abundance of fertile land. This fertile land could be divided up into classes of fertility: 1, 2, 3, and 4, each higher number representing a less fertile class of land. He argued that only the most fertile land would be brought into cultivation to support the population of the country. Initially, only class 1 land would be used and there would be no rent flowing to it. It was only after class 2 land was forced to be brought into cultivation that a rent would be paid to class 1 land because of its higher fertility. This would continue so that the bringing into cultivation of the next lower class of land would require a rent to be paid to all higher classes of land based on differences in their fertility. Thus the value of land in the Ricardian way of thinking was directly proportional to its fertility or ability to produce benefits or income.

Thomas Malthus (7) differed with Ricardo in his definition of economic rent but essentially agreed with Ricardian theory on land use and land value. Malthus believed that marginal land would be brought into production only when the value of its production would cover all the factor costs ignoring land. The more productive lands, he reasoned, would have a value which was a measure of their greater fertility.

Von Thünen (21) was one of the first to approach the idea of rent arising from location. He formulated a land use theory explaining the effects of transportation costs on land utilization. Von Thünen observed that when crops were grown on soils of like fertility around a central city market, the lands that were closer to the market enjoyed a rent advantage over those lands that were farther away. This rent advantage arose out of the difference in transportation costs of shipping products to a market from two areas of unequal distance from the market.

Convential land use and economic rent theory is no longer in itself adequate in explaining the prices paid for and values placed on land. Non-monetary factors, differing human motives and the wide diffusion of non-farm people and industries into rural areas have created the need for new study and new theory in this area.

Rural and Agricultural Land Studies

Abdel-Badie and Parcher (1), in a 1967 study of rural land prices in ten western Oklahoma counties, reported that agricultural quality and acres of wheat allotment were among the important determinants of price.

They also found the proportion of mineral rights conveyed and quality of road adjacent to the tract to have significant positive influences on per acre price. Size, distance to paved road, and distance to a metropolitan area were found to vary inversely with the price paid per acre.

A 1969 study by Nelson (8) of agricultural land sales in ten Oklahoma counties for the period 1963-1966 revealed that income potential as measured by a soil productivity index was the most important factor in determining the value of a tract of agricultural land. The assessed value of improvements was found to have a very significant positive influence on price as did time as reflected in a trend variable. Results of this study also showed that as the quality of the road adjacent to the tract improved and as the distance to paved road decreased the per acre price of the tract increased.

A 1971 study of the agricultural land market in Churchill County, Nevada, revealed that 40 percent of the buyers in this market were non-farmers (14). This finding implied that factors not associated with the productive capability of agricultural land may have an ever-increasing influence on the agricultural land market. This study reported that quality of the land as measured by Land Capability Classes was the most important determinant of price paid per acre. A direct relationship was found to exist between price per acre and estimated gross returns per acre, value of buildings per acre and density of privately owned land within one-quarter mile of the subject property perimeter. The latter variable was expected to reflect the extent of non-agricultural development in the area.

A study of Georgia peanut acreage showed that the most important factor affecting the price of land was the number of months elapsed since the sale. Time elapsed since the sale was found to have a significant negative effect on the per acre price. In this study, Wise and Walker (22) also determined that the percentage of the tract in peanut allotment and the amount of class I and II land as a percentage of the total tract were important factors affecting value. This study also indicated that an inverse relationship existed between distance from the closest town the per acre price of land.

A 1974 study of the rural land market in Wayne County, New York, reported that only 15 percent of the buyers in the sample studied were farmers (3). Many non-farmer nuyers cited investment or speculation as reasons for the purchase of rural land. Results of this study show that a strong negative relationship exists between price paid per acre for rural land and its distance from a metropolitan area.

The Louisiana rural land market was studied in great detail by Ramsey and Corty (12) in 1976. After dividing the state into nine types of farming areas, they analyzed the sales occurring in 1974 for each of the areas. They found that the areas which had the highest average prices were those which contained metropolitan centers, industrial development, mineral related activities and a good network of highways. In eight of the nine farming areas, an inverse relationship was found to exist between price per acre and parcel size. A very significant inverse relationship was found to exist between price per acre and distance to a major metropolitan center.

Thus it appears that in order to account for all of the relevant factors affecting the value of land in an area a wide range of agricultural as well as non-agricultural influences will have to be examined. A totally exhaustive examination is probably not possible or feasible for one research study. In addition it should be observed that some influences that affect the purchase and sale of land such as speculation or the pleasing appearance of a possible homesite do not readily lend themselves to a quantitative analysis.

Hypothesis

It was hypothesized that at least sixteen land characteristics and factors have an important effect on the per acre value of agricultural land in north central Oklahoma. These characteristics and factors were:

Date of sale
Proportion of mineral rights conveyed
Size of the tract
Percent of the tract in cropland
Percent of the tract in rangeland
Percent of the tract in cropland of soil classes I and II
Percent of the tract in cropland of soil classes III and IV
Productivity index of the cropland contained in the tract
Productivity index of the rangeland contained in the tract
Distance to paved roads
Distance to nearest town
Distance to nearest principal market
Distance to nearest city
Population of nearest town
Population of nearest principal market
Net county property value per square mile

Data on each of these factors or land characteristics were collected and the relationship between them and per acre price analyzed. The equations estimated for each agricultural land sample studied will not necessarily include each of these factors or land characteristics as explanatory variables. The analysis of a given sample will focus on those factors and characteristics which appear to have a significant influence or would be expected to have a significant influence on agricultural land prices in that area.

Organization

In Chapter II a description of the study area is presented. Average yearly prices paid for agricultural land in north central Oklahoma and each of the four representative counties studied are also presented. Conclusions are drawn with respect to relative levels of these prices and also with respect to apparent trends.

Chapter III discusses the variables examined in determining the important factors influencing agricultural land prices. The procedure used to identify the important factors and measure their influence on per acre prices is outlined. Explanatory equations are estimated for agricultural land values and an interpretation of the influences of the factors contained in these equations are presented in this chapter.

In Chapter IV an analysis of the factors influencing agricultural land values in Alfalfa, Garfield, Kingfisher and Woodward counties is presented. Differences with respect to the important factors influencing prices in each county as well as differences in the influence of certain factors in each county are noted.

Chapter V contains an analysis of the factors influencing the per acre prices paid for cropland and rangeland. Cropland values are studied on an aggregate and county basis and rangeland values are studied as an aggregate basis.

As alternative approach to estimating land values is examined in Chapter VI. Explanatory equations for total tract values are estimated and analyzed for the aggregative four county sample as well as for the aggregate cropland and rangeland samples.

Chapter VII attempts to summarize the findings and conclusions of Chapters II through VI. An overall analysis of the agricultural land market in north central Oklahoma and the factors influencing it are presented in the way of a summary of this study.

CHAPTER II

THE STUDY AREA

Description of the Study Area

The four counties included in this study, Alfalfa, Garfield, Kingfisher, and Woodward, are located in north central Oklahoma. These counties were selected for study because they represent one of the most productive agricultural areas of the state. This area lies within the fertile wheat belt of the Great Plains.

Agriculture and related industries provide the primary source of income in north central Oklahoma. Agriculture is typified by cattle and wheat-raising enterprises. Cattle and calves rank first in the value of agricultural products sold in the area as well as in the state. Winter wheat ranks second in importance in both north central Oklahoma and the state as a whole (Table I).

Of the total land in farms in the four county area studied, approximately 60 percent of the land is cropland (Table II). This area enjoys a growing season of approximately 200 days with about 27 inches of average annual precipitation (16-19). These characteristics lend themselves well to the winter grazing of wheat pasture and the summer harvest of winter wheat. Other crops including alfalfa, grain sorghum, oats and hay are grown in the area but winter wheat is by far the most prominent. Approximately 87 percent of the cropland in Alfalfa County was planted

TABLE I

VALUE OF AGRICULTURAL PRODUCTS SOLD IN THE STUDY AREA

County	Value of All Agricultural Products Sold[a]	Value of All Crops Sold	Value of All Livestock Sold
Alfalfa	22,753,944.00	7,713,129.000	15,038,337.00
Garfield	21,656,718.00	11,324,486.00	10,330,838.00
Kingfisher	22,058,847.00	7,566,981.00	14,484,250.00
Woodward	16,316,082.00	2,598,920.00	13,715,185.00
Total	82,785,591.00	29,203,516.00	53,568,610.00

[a]Value of All Agricultural Products Sold may exceed the sum of Value of All Crops Sold and Value of All Livestock Sold due to the sale of some agricultural products which do not fit into either of these categories.

Source: 1969 Census of Agriculture, Social and Economic Statistics Administration, Bureau of the Census, U.S. Department of Commerce. Part 36, Section 1, p. 288.

TABLE II

AGRICULTURAL LAND USE IN THE STUDY AREA

County	Land in Farms (acres)	Cropland (acres)	Woodland (acres)[a]	All Other Land (acres)[b]	Irrigated Land (acres)	Average Size of Farms (acres)
Alfalfa	579,943	393,880	5,704	150,359	2,624	462.9
Garfield	739,546	528,455	7,333	203,758	1,089	397.6
Kingfisher	604,832	408,775	12,102	183,955	2,461	440.1
Woodward	818,149	239,212	10,142	568,795	3,369	849.5
Total	2,712,470	1,507,322	35,281	1,106,867	9,543	---

[a]Includes woodland pasture.

[b]Includes pastureland other than cropland and woodland pasture; rangeland, and land in house lots, barn lots, ponds, roads, wasteland, etc.

Source: U. S. Department of Commerce, Social and Economic Statistics Administration. 1969 Census of Agriculture. Part 36, Section 1, Table 1.

to winter wheat in 1975 while approximately 77, 76 and 64 percent of the cropland was planted to winter wheat in Garfield, Kingfisher and Woodward counties respectively (10). Irrigation is of only minor importance at this time with less than 10,000 acres of irrigated land being reported in the 1969 Census of Agriculture for these counties (Table II).

Crops, primarily winter wheat, account for appoximately 35 percent of the total value of agricultural products sold in the four counties. Livestock, primarily cattle and calves, account for the rest. While the value of crops sold exceeds the value of livestock sold in Garfield County, the value of crops relative to livestock in Woodward County was small (Table I). These relationships can be accounted for by noting the relative proportion of the counties in cropland (Table II).

The average wheat yields per acre harvested are indicative of the level of fertility of this area. Alfalfa and Garfield counties have normally had average yields well above the state average. Kingfisher and Woodward county average yields have normally been just under the state average (Table III). Together these four counties produce approximately one-fifth of the state's 77 county total production of wheat (Table IV). In 1975 Garfield County ranked second in the state in total production of wheat while Alfalfa, Kingfisher and Woodward counties ranked fourth, seventh and twentieth respectively. Oklahoma has ranked third nationally in the total production of all wheat in the past three crop years (10).

Besides the abundance of fertile land, north central Oklahoma is also rich in mineral reserves. Value of mineral production from the four county area totaled $136,639,000 in 1973. Kingfisher County ranked fourth among the state's 77 counties in value of mineral production with

TABLE III

AVERAGE WHEAT YIELDS IN THE STUDY AREA[a]

County	1970	1971	1972	1973	1974	1975	Five Year Average
Alfalfa	30.5	21.5	22.9	32.2	27.6	27.6	27.1
Garfield	29.0	21.6	26.4	35.3	21.8	26.9	26.8
Kingfisher	22.2	20.6	22.0	28.8	20.6	25.6	23.3
Woodward	20.8	16.1	22.7	27.5	19.3	22.9	21.6
State Average	26.0	23.0	23.0	30.0	20.1	23.3	24.2

[a]Bushels per acre harvested.

Source: Oklahoma Department of Agriculture. Oklahoma Agriculture 1970-1975. Oklahoma City: Oklahoma Crop and Livestock Reporting Service, 1971-1976.

TABLE IV

WHEAT PRODUCTION IN THE STUDY AREA

	1970		1971		1972		1973		1974		1975	
	Total Production	Rank in the State	Total Production	Rank in the State	Total Production	Rank in the State	Total Production	Rank in the State	Total Production	Rank in the State	Total Production	Rank in the State
Alfalfa County	5,743,200	4	4,805,000	5	3,957,800	6	7,609,000	5	8,222,000	4	8,521,000	4
Garfield County	7,049,900	1	5,014,000	4	6,704,400	2	11,119,000	2	8,449,000	3	10,648,000	2
Kingfisher County	3,527,600	9	3,072,000	8	3,322,000	8	6,478,000	7	5,567,000	7	7,374,000	6
Woodward County	1,343,700	25	1,317,000	19	1,654,000	22	2,723,000	23	2,889,000	19	3,295,000	20
Four County Total	17,664,400		14,208,000		15,638,200		27,929,000		25,127,000		29,838,000	
State Total	98,202,000		71,997,000		89,700,000		157,800,000		134,400,000		160,800,000	
Four County Total as a percent of State Total	18%		19.7%		17.4%		17.7%		18.7%		18.6%	

Source: Oklahoma Department of Agriculture. Oklahoma Agriculture 1970-1975. Oklahoma City: Oklahoma Crop and Livestock Reporting Services, 1971-1976.

$73,527,000. The value of mineral production in Alfalfa, Garfield and Woodward coutnies was $15,082,000, $30,364,000 and $17,666,000 respectively in 1973. Mineral deposits in their order of importance included petroleum, natural gas liquids, natural gas and sand and gravel (4).

Table V shows the population and per capita income statistics for each of the four counties according to the latest census report. Garfield County, containing the city of Enid with a 1970 population of 44,986 is by far the most populated of the four counties. Enid, the county seat of Garfield County, serves as a major center for agricultural supply and marketing needs in north central Oklahoma. With several large grain elevators located there, Enid serves as an important wheat marketing terminal for much of Oklahoma, Kansas and parts of Colorado. The county seats of each of the other three counties studied also serve farmers as important product marketing and input purchasing centers. The cities of Woodward (pop. 9,142), Kingfisher (pop. 4,042) and Cherokee (pop. 2,119) can fulfill most of the common needs of farmers and farm families. Other important trade centers located within access of the study area are Oklahoma City, Guthrie, Stillwater, and Wichita, Kansas (see Figure 1).

As shown in Table V each of the four counties in the study area rank relatively high in per capita income among the 77 counties of the state. This reflects the generally high level of affluence of this area. In Alfalfa and Kingfisher counties a large portion of the labor force is employed in agriculture. This proportion is somewhat lower in Woodward and Garfield counties which have cities in which agriculturally related manufacturing and service industries are a major part of the economy.

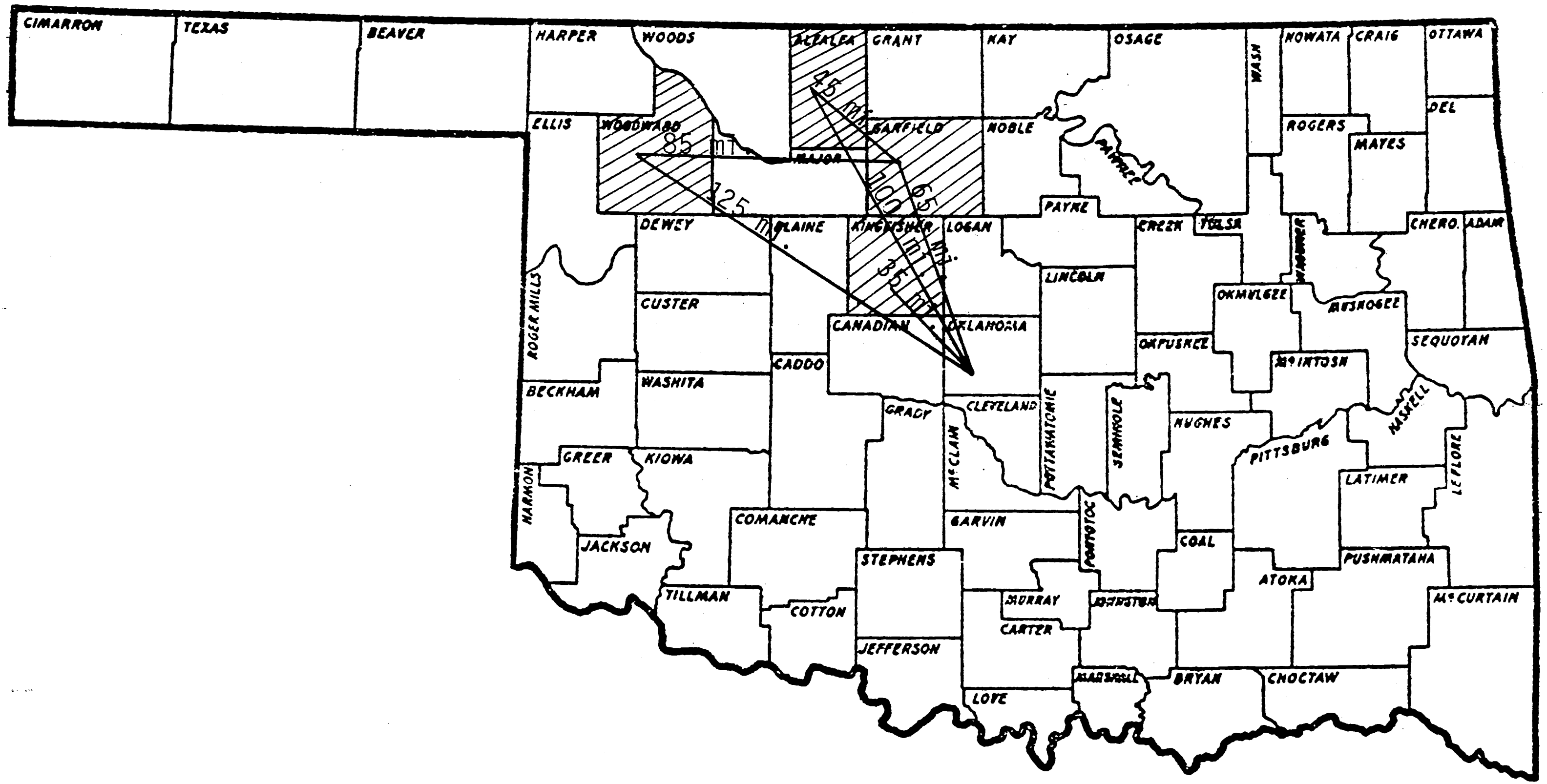

Figure 1. The North Central Oklahoma Study Area

Shaded Countied are included in the study.

Distances indicated represent distance between county seats and Oklahoma City.

TABLE V

POPULATION AND INCOME IN THE STUDY AREA

County	1974 County Population	1973 Per Capita Personal Income	1973 County Rank in the State in Per Capita Personal Income
Alfalfa	7,100	6,933	5
Garfield	57,800	4,736	22
Kingfisher	12,600	5,236	12
Woodward	15,500	4,880	21
State	2,709,000	4,566	

Source: Bureau for Business and Economic Research. Statistical Abstract of Oklahoma, 1975. Norman: University of Oklahoma Press, October, 1975.

A generally good network of highways within and through the area provide quick all-weather routes of travel to trade centers. U. S. highways 81 and 64 and state highways 35 and 40 provide excellent links between the area and Oklahoma City or Wichita.

Agricultural Land Market Activity in the Study Area

Information was obtained for 913 land sales in the four county area during the period January, 1970 through June, 1976. These sales represented 140,996 acres or 5.44 percent of the total area of the four counties. This sample included 262 sales from Alfalfa County involving 37,233 acres or 6.71 percent of the land area of the county, 271 sales from Garfield County representing 35,576 acres or 5.27 percent of the county's total land area, 224 sales from Kingfisher County involving 30,154 acres or 5.27 percent of the county area and 156 sales from Woodward County representing 38,033 acres and 4.82 percent of the county's area. Although some bona fide sales of agricultural land were probably omitted from the sample due to their not appearing in county records or due to errors in data collection, this sample was felt to be fairly indicative of the level of activity in the agricultural land market of north central Okalhoma and each of the counties. Market activity appeared to be greater in those counties having a greater proportion of total area in cropland or more productive agricultural lands.

Average and Relative Prices Paid for Agricultural Land in the Study Area

The average price of agricultural land in north central Oklahoma including the four county study area has followed a general upward trend over the past several decades. This upward trend has become much more pronounced thus far in the 1970's. Table VI shows the average per acre price of agricultural land in each county by year during the study period. The largest increase in land prices occurred in Alfalfa County. The average price for agricultural land in Alfalfa County in 1970 was \$311.02 per acre. The average price paid for the first six months of 1976 was \$951.23 per acre. This represents an increase of 206 percent in a period of less than six years.[1] Increases in the average price of agricultural land in Garfield, Kingfisher and Woodward counties were not as large. The average price increased 183 percent in Kingfisher County, 160 percent in Woodward County and 154 percent in Garfield County during the same period. The average per acre price of agricultural land in Garfield County in 1976 showed a 16.18 percent decline from the 1975 level while Alfalfa, Kingfisher and Woodward counties showed increases of 11.01 percent, 14.10 percent and 27.8 percent respectively. The averages for 1976 are based on only 6 months of data. A small sample size and because many sales are not recorded immediately in county transfer records resulted in a limited number of observations upon which to base 1976 averages. Subsequent study accompanied by more complete data for 1976 sales may provide a different interpretation of the trend in land prices, especially those in Garfield County.

TABLE VI

AVERAGE YEARLY PRICES AND OTHER CHARACTERISTICS OF AGRICUTLURAL LAND SALES BY COUNTY

	1970	1971	1972	1973	1974	1975	1976[a]
Alfalfa County							
Yearly average price	311.02	349.71	382.80	450.68	724.39	856.88	951.23
Standard deviation	122.80	120.92	117.14	185.43	346.00	391.64	412.29
Average size in acres	129.16	137.59	143.03	137.89	156.59	144.06	131.74
Percent of tract in cropland	69.25	77.72	76.62	73.06	72.80	67.33	79.51
Percent of mineral rights conveyed	75.00	85.61	75.52	70.83	61.50	64.46	50.00
Number of observations	28	33	48	48	46	50	9
Garfield County							
Yearly average price	237.93	286.13	348.63	382.35	534.17	721.87	605.10
Standard deviation	81.16	103.36	116.12	106.42	210.45	235.65	167.04
Average size in acres	134.86	124.79	129.10	136.33	146.98	116.13	122.73
Percent of tract in cropland	60.32	59.47	68.92	69.34	59.03	63.43	62.67
Percent of mineral rights conveyed	58.76	57.80	63.20	61.24	70.38	60.71	29.17
Number of observations	25	40	62	55	42	35	12
Kingfisher County							
Yearly average price	270.42	226.08	329.87	389.10	632.53	671.50	766.18
Standard deviation	81.97	70.70	94.77	124.45	179.43	202.50	194.76
Average size in acres	140.73	119.37	140.13	135.78	132.49	129.77	127.55
Percent of tract in cropland	60.13	53.50	59.97	63.74	69.94	67.73	71.80
Percent of mineral rights conveyed	28.09	23.91	26.85	18.60	25.39	14.77	35.00
Number of observations	46	23	48	43	32	22	10

TABLE VI (Continued)

	1970	1971	1972	1973	1974	1975	1976[a]
Woodward County							
Yearly average price	145.98	123.48	185.50	221.30	272.28	297.47	380.16
Standard deviation	69.80	57.62	83.54	91.86	134.13	120.05	192.16
Average size in acres	247.71	175.78	161.40	249.84	408.33	209.47	202.91
Percent of tract in cropland	41.57	32.94	42.43	28.83	41.58	43.35	71.77
Percent of mineral rights conveyed	15.80	23.75	43.44	21.97	31.35	35.48	40.92
Number of observations	15	20	20	33	26	29	13
All Counties							
Yearly average price	256.89	264.27	334.46	372.60	569.02	672.86	646.05
Standard deviation	103.90	123.27	121.00	153.81	290.43	349.94	319.02
Average size in acres	150.68	136.15	139.46	157.54	193.37	148.51	149.36
Percent of tract in cropland	59.97	58.90	65.61	61.52	62.65	61.28	70.88
Percent of mineral rights conveyed	44.72	53.12	54.50	46.33	50.77	50.75	38.23
Number of observations	114	116	178	179	146	136	44

[a]First six months only.

The average per acre price of agricultural land in the four county area was $256.89 in 1970. This increased to $646.05 in 1976, a 151 percent increase. The 1976 price showed a slight decline from the 1975 average price of $672.86 per acre. This again may be attributed to the small number of sales upon which the 1976 average was based or it may be indicative of a leveling off of the general upward trend. Evidence is inconclusive to support a definite statement concerning the trend of agricultural land prices in 1976.

Agricultural land prices in the four county area increased sharply in 1972 and again in 1974. Each county, except Woodward, registered its largest percentage increase in average price over the previous year's price in 1974. This can probably be attributed to the response of buyers to the relatively high level of wheat prices in 1973 and 1974 and to high rates of inflation which encouraged investment in nondepreciating properties.

The relative levels of prices in the four counties show that Alfalfa County agricultural land had the highest per acre price throughout the period studied. Garfield and Kingfisher county average prices were somewhat lower though not significantly different from each other until 1976. Woodward County agricultural land brought a substantially lower price than agricultural land in the other three counties. The relative level of these average prices generally reflects the quality of agricultural land in these counties. Alfalfa County sales involved land that was predominantly cropland and this cropland was largely of soil classes I and II. Agricultural land sales in Kingfisher and Garfield counties involved land that was predominantly cropland though the percentage was less than that of Alfalfa County.

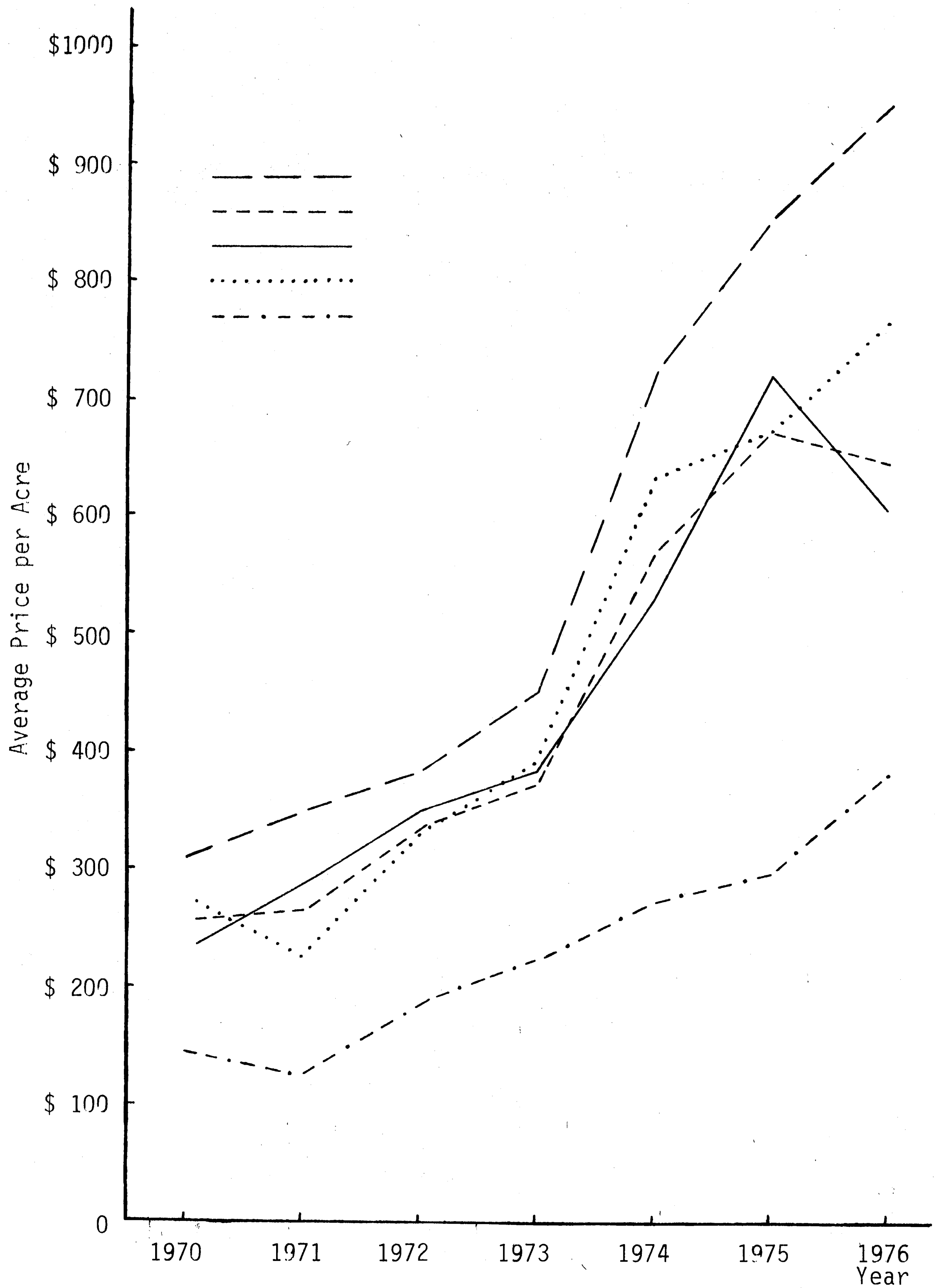

Figure 2. The Trend in Agricultural Land Prices in the North Central Oklahoma Study Area (1970-1976)*

*Includes only the first six months of 1976

Sixty-two and four-tenths percent of the agricultural land sold in the four counties was cropland. A great majority of the remaining 37.6 percent was classified as rangeland. A small portion was classified as farmstead, roads, waterways or wasteland. Table VI shows the average proportion of land sold that was in cropland for each county by year. Understandably a greater portion of the agricultural land sold in Alfalfa, Garfield and Kingfisher counties was cropland. Woodward County, which is predominantly rangeland, had the lowest proportion of agricultural land sales in cropland for each year except 1976.

Cropland Sales

The average price of cropland in the four county area was $579.32 per acre. This figure was arrived at by analyzing only those sales in which at least 90 percent of the tract was cropland. An average of 69.13 percent of the land in this sample was cropland in soil classes I and II. The average productivity index (explained in Appendix B) for this cropland was 35.43. Alfalfa County had the highest average price of the four counties, $707.06 per acre. An average of 75.41 percent of the land contained in these tracts was in soil classes I and II and the average productivity index was 45.07. Garfield County cropland sales averaged $479.21 per acre with 50.99 percent of the land being of soil classes I and II and had an average productivity index of 24.48. Kingfisher County cropland sold for an average of $489.96 per acre with an average of 65.23 percent of the land in soil classes I and II and had an average productivity index of 34.64. Cropland in Woodward County brought the lowest average price, $321.64 per acre. Only 21.85 percent of the cropland sold in Woodward County was in soil classes I and II and had an average productivity index of 13.62. The county average price of cropland appears to reflect the quality or productivity of the cropland in the county.

There has been a definite upward trend in cropland values in the four county area with the average price increasing 174 percent, from $347.36 per acre to $952.64 per acre, in the period 1970-1975. The 1976 average price, based on 17 observations, shows a 22.28 percent decline from the 1975 level. Average prices by county by year are shown in Table VII.

Rangeland Sales

The average price paid for rangeland was computed in the same manmer as cropland prices. Tracts containing at least 90 percent rangeland were used in computing these statistics. Table VIII shows the average per acre prices paid for rangeland in the four county area and each county by year. The number of observations for each county in each year was sometimes so small as to limit the meaningfulness of yearly county averages. The average price of rangeland in the four county area for the period 1970-1976 was $244.54 per acre. Rangeland values increased throughout the period with the exception of 1976, the most dramatic increase coming in 1974 when the average price paid increased 33.90 percent over the 1973 average. Throughout the period 1970-1975 rangeland prices increased 98.51 percent, substantially less than cropland values. Garfield County had the highest average price paid for rangeland, $402.49 per acre. Following Garfield County were Kingfisher County with an average price of $288.81 per acre, Alfalfa County with $283.95 per acre and Woodward County with $167.62 per acre.

TABLE VII

AVERAGE YEARLY PRICES AND OTHER CHARACTERISTICS OF CROPLAND SALES BY COUNTY

	1970	1971	1972	1973	1974	1975	1976
Alfalfa County							
Yearly average price	338.37	417.48	435.89	561.70	927.75	1155.52	1183.87
Standard deviation	123.10	91.68	109.00	194.89	343.00	251.85	259.12
Productivity index	43.56	42.62	42.23	39.55	45.79	53.82	46.78
Percent of tract in soil classes I and II	62.93	76.90	71.82	65.27	79.70	86.81	84.17
Percent of tract in soil classes III and IV	34.86	20.40	28.45	29.59	18.78	11.81	14.00
Average size in acres	111.66	134.35	141.11	123.08	137.52	110.27	131.67
Number of observations	14	20	22	22	23	26	6
Garfield County							
Yearly average price	359.86	284.35	427.84	456.66	695.57	717.14	530.61
Standard deviation	41.99	82.09	112.99	100.68	311.55	200.26	202.80
Productivity index	22.40	25.24	23.18	29.81	21.60	20.45	18.03
Percent of tract in soil classes I and II	51.00	63.25	47.46	66.80	36.25	45.13	29.00
Percent of tract in soil classes III and IV	44.67	34.75	51.85	30.00	47.50	46.88	47.00
Average size in acres	106.40	130.42	126.85	119.22	114.50	113.63	133.33
Number of observations	3	8	13	15	4	8	3

TABLE VII (Continued)

	1970	1971	1972	1973	1974	1975	1976
Kingfisher County							
Yearly average price	339.99	311.47	396.00	408.26	686.46	850.27	773.06
Standard deviation	56.27	50.81	78.23	173.10	208.65	109.55	0.00
Productivity index	30.98	29.30	33.78	34.69	40.17	38.90	31.70
Percent of tract in soil classes I and II	53.00	50.00	42.50	52.50	71.75	80.40	36.00
Percent of tract in soil classes III and IV	46.40	50.00	56.70	46.75	28.00	19.60	64.00
Average size in acres	88.47	71.30	107.20	105.52	103.99	98.48	80.00
Number of observations	9	4	10	8	8	5	1
Woodward County							
Yearly average price	165.59	118.75	272.86	229.71	362.97	276.87	445.57
Standard deviation	56.83	44.19	42.56	117.15	121.21	113.61	221.62
Productivity index	14.80	13.75	15.77	13.85	10.16	15.48	12.29
Percent of tract in soil classes I and II	0.00	48.00	47.83	27.00	6.60	12.20	19.43
Percent of tract in soil classes III and IV	98.00	41.50	52.00	73.00	81.00	85.00	74.29
Average size in acres	133.33	120.00	158.67	158.30	198.20	163.40	91.23
Number of observations	3	2	6	2	5	5	7

TABLE VII (Continued)

	1970	1971	1972	1973	1974	1975	1976
All Counties							
Yearly average price	347.36	356.11	406.84	487.93	785.39	952.64	740.42
Standard deviation	112.76	117.26	109.55	179.46	347.47	347.41	405.76
Productivity index	34.49	35.26	32.60	34.52	37.79	41.70	26.62
Percent of tract in soil classes I and II	52.10	68.82	57.04	61.96	64.63	70.02	44.94
Percent of tract in soil classes III and IV	46.00	28.50	42.73	34.49	31.28	27.39	47.59
Average size in acres	106.16	125.16	132.89	120.35	136.10	115.58	112.27
Number of observations	29	34	51	47	40	44	17

TABLE VIII

AVERAGE YEARLY PRICES AND OTHER CHARACTERISTICS OF RANGELAND SALES BY COUNTY

	1970	1971	1972	1973	1974	1975	1976
Alfalfa County							
Average yearly price	178.91	168.81	296.88	203.75	277.73	403.07	357.82
Standard deviation	15.60	32.68	0.00	23.12	147.61	101.23	0.00
Productivity index	38.15	38.70	79.30	41.27	50.76	57.12	41.90
Average size in acres	140.00	200.00	160.00	193.33	176.00	233.87	75.70
Number of observations	4	3	1	6	5	10	1
Garfield County							
Average yearly price	172.40	383.11	270.13	263.06	366.67	619.40	--
Standard deviation	0.00	286.14	42.24	44.99	0.00	191.27	--
Productivity index	50.70	62.23	48.50	19.15	65.20	42.10	--
Average size in acres	92.80	93.33	58.50	119.00	105.00	87.38	--
Number of observations	1	3	2	2	1	4	0
Kingfisher County							
Average yearly price	245.22	145.46	298.75	295.83	562.50	318.75	--
Standard deviation	95.73	11.43	121.92	88.68	53.03	0.00	--
Productivity index	39.24	38.20	32.04	28.80	40.35	21.10	--
Average size in acres	177.14	105.17	202.64	106.67	50.00	80.00	--
Number of observations	5	3	5	3	2	1	0

TABLE VIII (Continued)

	1970	1971	1972	1973	1974	1975	1976
Woodward County							
Average yearly price	110.16	129.01	118.89	199.60	198.63	198.97	186.97
Standard deviation	70.65	87.54	51.92	92.76	77.83	64.54	72.83
Productivity index	42.72	42.05	37.21	42.36	39.62	41.55	37.20
Average size in acres	89.34	130.45	109.88	274.66	634.00	305.47	559.40
Number of observations	5	8	8	14	6	10	2
All Counties							
Average yearly price	177.66	183.78	205.12	217.22	290.86	352.67	243.92
Standard deviation	85.77	151.68	115.56	81.77	158.23	181.07	111.27
Productivity index	40.87	44.34	39.64	38.62	45.53	47.05	38.77
Average size in acres	132.35	131.71	135.58	222.53	349.21	232.91	398.17
Number of observations	15	17	16	25	14	25	3

The average rangeland productivity indexes were 48.75, 46.64, 34.68 and 40.91 for Alfalfa, Garfield, Kingfisher and Woodward counties respectively. Thus Garfield County with the highest average price had only the second highest average productivity index and Woodward County with the lowest average price had only the second lowest average productivity index. It should be noted however that the Garfield County sample was based on only 13 observations and the Kingfisher County sample based on 19 observations, neither county having an observation in 1976.

Size of Tracts Sold in the Study Area

The average size of tract sold in this market for the period 1970-1976 was 154.4 acres, nearly a quarter of a section. Average size varied from county to county and from year to year. Agricultural land sales in Woodward County averaged 243.8 acres per sale while those in Alfalfa, Garfield, and Kingfisher counties averaged 142.1, 131.3, and 134.6 acres per sale. The average size of tract sold showed no discernible trend in any of the counties studied during the period 1970-1976. It is interesting to note that Woodward County, having the lowest average per acre price, had the largest average size of tract sold. Size is generally thought to have a negative influence on per acre price but at the same time lower per acre prices allow buyers to purchase larger parcels of land with the same capital outlay.

Mineral Rights Conveyed in the Study Area

An average of 49.6 percent of the mineral rights were transferred with each sale of agricultural land in the four county area. The reservation of mineral rights by the seller of agricultural land reflects the recognition of the value or potential value of mineral rights in this area. An average of 24.2 percent of the mineral rights were conveyed with the sale of agricultural land in Kingfisher County. Woodward, Garfield and Alfalfa counties averaged 30.0, 60.9 and 71.2 percent of the mineral rights conveyed with the sale of agricultural land. It is significant to note that Kingfisher County, having the highest value of mineral production of the four counties, had the lowest average proportion of mineral rights conveyed with the sale of land while Alfalfa County had the lowest value of production and the highest proportion of mineral rights conveyed. Thus it appears that mineral rights can have a definite value apart from the land. The average proportion of mineral rights conveyed in each county by years as shown in Table VI gives some evidence to indicate that the proportion of mineral rights being conveyed with the sale of land is declining. In noting 1976 figures it should be remembered that these averages are based on a limited number of observations.

Summary

North central Oklahoma including Alfalfa, Garfield, Kingfisher and Woodward counties lie within the fertile wheat belt of the Great Plains. Agriculture, particularly wheat and cattle enterprises, and related industries provide the major source of income in north central Oklahoma. Approximately 60 percent of the land in farms in the study area in cropland. Most of this cropland is annually planted to winter wheat. The proportion of farmland in cropland and the proportion of cropland planted to wheat was highest in Alfalfa County and smallest in Woodward County with Garfield County and Kingfisher County in between. The fertility or productivity of county cropland as measured by a productivity index in soil classes I and II followed the same pattern.

Mineral production was also an important source of income in the study area. Value of mineral production, particularly petroleum and natural gas, totaled over $136,000,000 in the four counties studied in 1973. Kingfisher County, in particular, ranked very high in the state in value of mineral production.

Information was collected for 913 agricultural land sales in the four counties studied for the period January, 1970 through June, 1976. Market activity as expressed by the percent of the county's total land area that was involved in bona fide sales of agricultural land was greatest in Alfalfa County and least in Woodward County. The level of activity in Garfield and Kingfisher counties was found to be about the same. There appeared to be a direct relationship between the quality of agricultural land in a county and the level of activity in the agricultural land market of that county.

Among the four counties studied, the average price of Alfalfa County agricultural land was the highest throughout the study period. Garfield and Kingfisher county agricultural land values were about the same up to 1976 when the average price of Garfield County agricultural land declined 16.18 percent. Woodward County agricultural land had the lowest average price throughout the period studied.

Average per acre prices of agricultural land increased approximately 151 percent in just less than six years in the study area. A slight decline in average per acre prices was noted for 1976 sales although this could be a result of the small sample of sales available for this period. The increase in agricultural land prices was greatest in Alfalfa County

(206 percent) followed by Kingfisher County (183 percent), Woodward County (160 percent) and Garfield County (154 percent).

Among the four counties included in the study, Alfalfa County cropland brought the highest average per acre price and Woodward County cropland brought the lowest. Average per acre prices paid for cropland in Garfield and Kingfisher counties were about the same. The average per acre price of cropland in the four county area climbed 174 percent between June 1970 and March 1976.

The average per acre price of rangeland in the study area rose over 98 percent between June 1970 and June 1975. Garfield County rangeland brought the highest average per acre prices followed by Kingfisher County, Alfalfa County and Woodward County.

The average size of tract sold in the four counties studied was 154.4 acres. Woodward County had the largest average size of tract sold, followed by Alfalfa County, Kingfisher County and Garfield County. No discernible trend in the average size of tract sold was evident during the study period.

An average of 49.6 percent of the mineral rights were transferred with the sale of agricultural land in the four counties. The average proportion of mineral rights transferred appeared to be declining. An inverse relationship appeared to exist between the value of mineral production in a county and the average proportion of mineral rights conveyed with the sales of agricultural land in that county.

Footnotes

[1]The study period (Jaunary 1970-June 1976) was six and one-half years in length. When averages for each year (yearly average presumably refers to the midpoint of each year) of the study period are used, the effective length of the study period is reduced to five and three-quarters years.

CHAPTER III

FACTORS INFLUENCING AGRICULTURAL LAND VALUES IN NORTH CENTRAL OKLAHOMA

In this chapter the variables used in estimating agricultural land values in north central Oklahoma are defined. The units of measurement for each variable as well as the reasons for considering each independent variable in this study are presented. The expected influence of each independent variable on per acre price is also discussed. The estimating procedure is outlined and the equations estimated for the four county study area for the periods 1970-1976, 1970-1973 and 1974-1976 are presented. Interpretations for each estimated equation are presented along with comparisons among the estimated equations and conclusions concerning trends and changes in the influence of certain factors on per acre prices of agricultural land.

The Variables

In estimating equations for agricultural land values, the land characteristics and factors that were hypothesized to have an important effect on the per acre price of agricultural land are used as independent or explanatory variables. The dependent variable, or variable to be explained, is price per acre. The definition of these variables, their expected influence on price and the reasons for including them among the variables to be tested are presented below.

Price per Acre

Price reflects the per acre sale price paid for land only. Sale price minus improvement value divided by size yields the price per acre variable used in this study. Prices were obtained either from direct sale prices or computed from Revenue Stamps attached to instruments of conveyance. Parcher (11) showed that Revenue Stamps provide a reliable estimate of actual sale price in Payne County, Oklahoma.

Date of Sale

This variable reflects the month during which the sale took place. It is coded such that its value ranges from 1 to 78 depending upon the date of the particular sale. A sale occurring in the first month of the study period (January, 1970) would have a value of 1 whereas a sale occurring in the last or 78th month of the study period (June, 1976) would have a value of 78. The time variable is expected to reflect the general upward trend in land prices that has been experienced thus far in the 1970's. Time serves as and was included as a proxy variable for the general influences of inflation, net rent increases, farm enlargement, expanding nonfarm use of rural lands, the increasing importance of tax breaks and advancing technology. Thus, it is expected that agricultural land prices will increase with time, other factors constant. In the discussion of each of the other independent variables the assumption that all other factors are held constant is made.

Size of the Tract

This variable is measured in acres. Only tracts of forty acres or more were included in the study since it is felt that tracts of less than forty acres will probably not be bought for primarily agricultural use. It is hypothesized that size may have a significant negative influence on per acre price due to the greater capital requirements for purchase of larger tracts and the subsequent reduction in the number of potential buyers. Initially size may have a positive influence on per acre prices as production economies of size exist. After the benefits of these economies of size, if any, are achieved a negative relationship is expected to exist between size and per acre price. It is expected that as the size of the tract increases beyond some point the per acre value of the tract will decrease.

Distance Variables

Distance to Paved Road. This variable is measured in miles. Distance to paved road reflects the degree of accessability to all-weather routes of transportation for marketing, farm supply and family needs. This distance can also be thought of as a measure of the opportunities for non-agricultural development since development of this sort is enhanced by good roads. Distance to paved road is used in lieu of a road type variable since it is felt that if both variables are used a high degree of correlation will exist. Also, the relative difficulty of classifying road types in a consistent continuous manner supported the use of this distance variable. It is expected that as the distance to a paved road increases the per acre price of agricultural land will decrease.

Distance to the Nearest Town. This variable, measured in miles, is included among the possible explanatory variables as a measure of the convenience and economy of travelling to the nearest town and the possibility of future use of the tract for urban development. A town is defined here as being any incorporated population center. In many cases the nearest town is able to provide markets for the farm produce and can serve as a source of farm supplies and family purchases such as groceries, clothing and household needs. In some cases the nearest town may be able to supply the major equipment needs of the farm and serve as the primary marketing center for farm production. As the distance from the nearest town increases the value of a tract is expected to decrease.

Distance to the Nearest Principal Market. This variable is measured in miles. Principal market is defined here as the county seat or a town with a population of at least 5,000. A principal market should be able to provide most of the supply and marketing needs of the farm owner/operator and the farm family. This variable is included in the analysis because it is a measure of the accessability of the most common market and supply needs of the farm and farm family. This variable may also reflect the possibility of future non-agricultural development. An inverse relationship is expected to exist between per acre price and distance to the nearest principal market.

Distance to the Nearest City. This variable is measured in miles. A city is defined here as having a population of at least 250,000. A city should be able to supply all of the major marketing, supply, and entertainment needs of the farm owner/operator and farm family that are not available in the nearest town or principal market. Oklahoma City is the only relevant city for the study area, so this variable may also be termed "distance to Oklahoma City". This variable is included to provide a measure of the accessability of the major needs of the farm owner/operator and farm family and is also an indicator of the possibility of future suburban development. Distance to the nearest city is expected to have a negative influence on the per acre price of agricultural land.

Population Variables

Population of the Nearest Town. This variable is measured in hundreds of population. It is included in the analysis as a measure of the amount and variety of goods, services, schools, social activities, marketing facilities and off-farm employment opportunities available in the area. Population of the nearest town could also be viewed as a measure of the future potential use of the tract for urban development. The per acre price of a tract of agricultural land is expected to vary directly with the population of the nearest town.

Population of the Nearest Principal Market. This variable is expressed in thousands of population. Population of the nearest principal market reflects the quality and extent to which educational, marketing, shopping and service facilities are available in the area. The population of the nearest principal market is expected to have a positive influence on the per acre price.

Proportion of Mineral Rights Conveyed

This variable is included since mineral exploration, particularly for oil and gas, has been widespread in this four county area. In some cases the value or potential value of mineral production may be substantial and thus affect land values in an appreciable manner. It is expected that the value of a tract of agricultural land will vary directly with the amount of mineral rights transferred.

Quality and Productivity Variables

Percent of the Tract in Cropland and Percent of the Tract in Rangeland. These variables are the ratios of the acres in each use, cropland and rangeland, within the tract to the total number of acres in the tract. These variables are included as indicators of the income producing potential of the tract. Cropland can generally be expected to have a higher income producing potential or receive a higher net rent per acre than rangeland. Thus the income producing capability of the tract is expected to vary directly with the percentage of the tract contained in cropland. Since the income producing capability of a tract of land and the price that will be paid for it are expected to vary directly, other factors constant, it is expected that the percent of the tract in cropland will have a positive influence on price per acre. Percent of the tract in rangeland is expected to have a positive though somewhat smaller influence on price.

Percent of the Tract in Cropland of Soil Classes I and II and Percent of the Tract in Cropland of Soil Classes III and IV. These variables are included in the analysis as measures of the quality and income producing capability of cropland. For the most part, cropland in the counties studied consisted of soils in the first four soil classes. Soils in classes I and II are generally more productive and capable of producing a broader range of crops than soils in classes III and IV.

A direct relationship is expected to exist between price paid per acre for agricultural land and the percentage of the tract in cropland of soil classes I and II. Although soils in classes III and IV are generally inferior in productive potential under normal management to soils in the first two classes, it is expected that the percentage of the tract in cropland of soil classes III and IV will also exert a positive influence on price. The influence on price of cropland in soils classes III and IV is expected to be somewhat smaller in magnitude than that of cropland in soil classes I and II.

Productivity Index of Cropland in the Tract. Two cropland productivity indices are used, a "within county" index and an "among counties" index. The choice of index depends upon the context in which land sales are being studied. If an intracounty analysis is being made the "within county" index is the appropriate variable and if an intercounty analysis is being made the "among counties" index is the appropriate variable. These variables are selected because they serve as a measure of the relative productivity or income producing potential of cropland within a tract. A direct relationship is expected to exist between these indices and price paid per acre for agricultural land. An explanation of the computational procedure for this variable can be found in Appendix A.

Productivity Index of Rangeland in the Tract. As with the cropland productivity indices, there are two versions of this index to fit the nature of the analysis to be made. These variables are included in the analysis as measures of the relative productivity and income producing potential of rangeland. It is expected that these indices will exert a positive influence on price per acre, though not as large in magnitude as the cropland indices. The computational procedure for these variables can also be found in Appendix A.

Net County Propoerty Value per Square Mile

This value includes rural and urban land and improvements and gross personal property for each county. These values are calculated by multiplying total gross locally assessed property for each county by the inverse of the county's assessment ratio. This variable is included among possible explanatory variables as a measure of general affluence and development of the county and is also a measure of the demand for rural tracts for non-agricultural purposes. It is expected that the net property value per square mile has a positive influence on agricultural land prices in an intercounty comparison study.

Designation of Variables

The variables discussed above are designated in the following manner. The unit of measurement for each variable is in parentheses following the variable name.

Y = Price per acre (dollars)

X_1 = Date of sale (months)

X_2 = Size of the tract (acres)

X_3 = Distance to paved road (miles)

X_4 = Distance to the nearest town (miles)

X_5 = Distance to the nearest principal market (miles)

X_6 = Distance to the nearest city (miles)

X_7 = Population of the nearest town (hundreds of population)

X_8 = Population of the nearest principal market (thousands of population)

X_9 = Proportion of mineral rights conveyed

X_{10} = Percent of the tract in cropland

X_{11} = Percent of the tract in rangeland

X_{12} = Percent of the tract in cropland of soil classes I and II

X_{13} = Percent of the tract in cropland of soil classes III and IV

X_{14} = Productivity index from cropland (among counties)

X_{15} = Productivity index for rangeland (among counties)

X_{16} = Productivity index for cropland (within county)

X_{17} = Productivity index for rangeland (within county)

X_{18} = Net county property value per square mile (thousands of dollars)

The Procedure Used to Estimate Equations

In analyzing the data collected and estimating the explanatory equations, multiple regression techniques were employed. Several procedures of the Statistical Analysis System were used for this purpose (2). Initially, a correlation procedure was utilized to identify the degree and direction of correlation between variables. The correlation procedure yields the simple correlation coefficient for every pair of numeric variables. It aided in identifying the relationship between the dependent variable and each independent or explanatory variable as well as the interrelationships among independent variables. Through study of the correlation matrix, the type of relationship existing between variables was identified along with the magnitude and significance level of that relationship.

Next, a stepwise (MAXR) procedure was employed to see how much of the variation in the dependent variable could be explained by a group of independent variables (2). The stepwise procedure yields the "best" equation based on the criteria of maximum explanation of the variation in the dependent variable. This procedure also aided in ranking the independent variables in the order of their explanatory power and gave indications of the effect of adding certain variables to an equation given that certain other variables are already in the equation.

After study of the correlation coefficients and stepwise results, trial equations were specified and regressions run. The best equations were then selected based on certain criteria. These criteria were: the amount of variation in the dependent variable explained by the equation as measured by the coefficient of determination (R^2); the significance of the equation and each variable in it; the consistency of the sign of each variable's coefficient with economic theory, and the consistency and reasonableness of relationships existing among the equation's independent variables.

Estimated Equation for the Four County Area (1970-1976)

The estimated regression equation for the four county sample along with the t-value in parenthesis for each coefficient in the equation appear below.

$$Y = -157.53 + \underset{(30.64)}{0.09X_1^2} + \underset{(0.99)}{0.08X_2} - \underset{(1.81)}{5.68X_2^{.5}} - \underset{(2.93)}{15.95X_3} + \underset{(2.83)}{1.81X_3^2} - \underset{(4.07)}{7.42X_4} - \underset{(3.17)}{2.43X_5} + \underset{(1.29)}{0.59X_9} + \underset{(14.52)}{0.04X_{12}^2} + \underset{(3.44)}{0.73X_{13}} + \underset{(6.25)}{2.57X_{14}} + \underset{(6.82)}{1.83X_{18}} - \underset{(6.66)}{0.002X_{18}^2}$$

(Equation 1 Four County, 1970-1976)

$R^2 = .7117$

Standard Deviation = 144.03

$\bar{Y} = 426.27$

Number of Observations = 913

The coefficient of determination (R^2) for this equation indicates that variation in the 14 independent variables is able to explain over 71 percent of the variation in Y, the per acre price of agricultural land. Standard deviation, as used above, is a measure of the central tendency of predicted values about the true mean ($\bar{Y}$). If the true values of Y can be assumed to be normally distributed and random then the predicted value can be expected to fall within one standard deviation of the true mean approximately 68 percent of the time and within two standard deviations 95 percent of the time upon repeated testing. Thus the predicted value will be expected to fall within the range \$282.24 to \$570.30 (426.27 ± 144.03) approximately 68 percent of the time. Mean values and standard deviations of the variables used can be found in Appendix B.

Coefficients of six of the variables (X_1^2, X_4, X_{12}^2, X_{14}, X_{18}, X_{18}^2) are statistically significant at least at the .01 percent level of probability. Four variables have coefficients statistically significant at least at the five percent level. The coefficient of $X_2^{.5}$ is significant at the ten percent probability level, the coefficient of X_9 is statistically significant at the 20 percent level of probability and the coefficients of X_2 and X_9^2 are statistically significant at the 35 percent level. The probability levels as used above indicate the probability, upon repeated testing, that a coefficient will not differ significantly from zero. For instance, a coefficient that is statistically significant at least at the one percent level will be expected to differ significantly from zero at least 99 percent of the time upon repeated testing.

Interpretation

Date of Sale

Time is the dominant variable in explaining the variation in the per acre price of agricultural land in the four county sample. Time had a very significant ($t > 30.0$) positive influence on per acre price as expected. The form of the time variable, number of months squared that have elapsed between January, 1970 and the date of sale, indicates that per acre prices have risen rapidly during the study period. This appears to be especially true during the latter portion of the period. A tract sold in January 1976, is expected to have brough $144.72, $263.52, $356.40, $423.36, $464.40 and $479.52 an acre more than tracts selling in January 1975, January 1974, January 1973, January 1972, January 1971 and January 1970 respectively, all other factors constant.

Size of the Tract

The coefficients of X_2 and $X_2^{.5}$ indicate that size has a negative influence on the per acre price of agricultural land. The coefficient of X_2 is statistically significant at least at the 35 percent level of probability and the coefficient of $X_2^{.5}$ at least at the ten percent level. Each additional one acre increase in size has a smaller and smaller negative effect on price as the total size of the tract increases. As the size of a tract increases from 40 to 41 acres, per acre price is expected to decrease $0.37 while a one acre increase in size from 160 acres to 161 acres is expected to result in only a $0.15 per acre decrease, all other factors constant. This relationship is consistent with previously stated expectations. The influence of tract size on per acre price is expressed in more common terms below. For each 20 acre increase in size, the expected reduction in per acre price from the previous tract size is given.

40 acres	----
60 acres	-$6.48
80 acres	-$5.20
100 acres	-$4.40
120 acres	-$3.82
140 acres	-$3.39
160 acres	-$3.04
180 acres	-$2.76
200 acres	-$2.52
220 acres	-$2.32
240 acres	-$2.14
260 acres	-$2.00
280 acres	-$1.85
300 acres	-$1.74
320 acres	-$1.63

Distance Variables

Distance to Paved Road. An inverse relationship exists between per acre price and distance to paved road. The magnitude and signs of the coefficients of variables X_3 and X_3^2 indicate that this relationship holds for distances up to about 4.7 miles. For distances greater than this the influence of distance to paved road upon per acre price is negligible. The coefficients of these variables also suggest that the magnitude of the negative influence of additional increases in this distance diminish as total distance to paved road becomes larger. This finding is consistent with previous reasoning and expectations. The coefficients of variables X_3 and X_3^2 are statistically significant at least at the five percent level of probability. Shown below are the expected reductions in the per acre price of agricultural land due to being located an additional one mile from paved road, all other factors constant.

Adjacent to paved road	---
1 mile to paved road	-$15.14
2 miles to paved road	-$11.52
3 miles to paved road	-$ 7.90
4 miles to paved road	-$ 4.28
5 miles to paved road	-$ 0.66

Distance to the Nearest Town. The coefficient of X_4 is negative, indicating that distance to the nearest town has a negative influence on per acre price. This coefficient may be interpreted as saying that an increase of one mile in the distance between the subject tract of land and the nearest town will reduce the per acre value of that tract by $7.42, all other factors constant. Although this is depicted as a linear relationship, common reasoning would indicate that after a certain distance is reached additional increases in the distance will have a smaller and eventually negligible effect on the per acre price. Appendix B, showing the mean and standard deviation for each variable, gives the reader an idea of the range over which the coefficient for each independent variable is applicable. The coefficient of X_4 is statistically significant at least at the .01 percent level of probability.

Distance to the Nearest Principal Market. The per acre price of agricultural land is negatively influenced by the distance to the nearest principal market as indicated by the sign of X_5's coefficient. This finding is consistent with a priori reasoning. An increase of one mile in the distance to the nearest principal market is expected to reduce the per acre value of a tract of agricultural land by $2.43. Again, although this is depicted as being a linear relationship, care should be exercised in applying this coefficient to unusually long distances. The coefficient of X_5 was statistically significant at least at the five percent level of probability.

Proportion of Mineral Rights Conveyed

The proportion of mineral rights conveyed with the sale of a tract of agricultural land exerts a positive influence on the per acre price paid for the tract, other factors constant. This relationship agrees with previous expectations. The magnitude and signs of the coefficients of X_9 and X_9^2 indicate that additional percentage increases in mineral rights conveyed add less and less to per acre price. The coefficients of these variables suggest that the positive influence of the conveyance of an additional percent of mineral rights exists for conveyances up to about 70 percent, beyond which the influence becomes negligible. The coefficient of X_9 is statistically significant at least at the 20 percent level of probability while the coefficient of X_9^2 is significant at the 35 percent level. Shown below are the expected additions to per acre price, all other factors constant, of additional ten percent increments of mineral rights conveyed with the sale of a tract of agricultural land.

First ten percent conveyed	+$5.50
Second ten percent conveyed	+$4.70
Third ten percent conveyed	+$3.90
Fourth ten percent conveyed	+$3.10
Fifth ten percent conveyed	+$2.30
Sixth ten percent conveyed	+$1.50
Seventh ten percent conveyed	+$0.70

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. X_{12}^2, percent squared of the tract in cropland of soil classes I and II, was found to have a very significant positive influence on the per acre price of agricultural land. Next to the time variable, this variable explained the largest proportion of variation in per acre prices. The value of a tract of agricultural land is increased $0.04 times the percent squared of the tract contained in cropland of soil classes I and II. The squared form of this variable suggests that the positive influence becomes greater as a larger proportion of the tract is contained in cropland of soil classes I and II. The coefficient of X_{12}^2 is statistically significant at least at the .01 percent level of probability. Shown below are the expected additions to the per acre value of agricultural land, all other factors constant, due to additional ten percent increments of the tract contained in cropland of soil classes I and II.

First ten percent	+$4.00
Second ten percent	+$12.00
Third ten percent	+$20.00
Fourth ten percent	+$28.00
Fifth ten percent	+$36.00
Sixth ten percent	+$44.00
Seventh ten percent	+$52.00
Eighth ten percent	+$60.00
Ninth ten percent	+$68.00
Tenth ten percent	+$76.00

Percent of the Tract Contained in Cropland of Soil Classes III and IV. A direct relationship was found to exist between the proportion of a tract of agricultural land in cropland of soil classes III and IV and the per acre price paid for the tract. For each additional percent of the tract contained in cropland of soil classes III and IV it is expected that the per acre value of the tract will increase approximately \$0.73. The coefficient of X_{13} is statisticaliy significant at least at the one percent probability level.

Cropland Productivity Index. The income producing potential of cropland contained within a tract of agricultural land, as measured by the cropland productivity index, was found to be directly related to the per acre price paid for the tract. The coefficient of X_{14} indicates that \$2.57 is added to the per acre value of a tract of agricultural land for each one point increase in the among counties cropland pro ductivity index of the tract. The coefficient of X_{14} is statistically significant at least at the .01 percent probability level.

Each of the three quality or productivity variables included in the four county equation was found to have a positive influence on the per acre price of agricultural land, as expected. In comparing the coefficients of the three variables, it is evident that variable X_{12}^2 (percent squared of the tract in cropland of soil classes I and II) had the greatest influence on per acre prices. This is consistent with a priori reasoning which suggested that the more productive land would have the greatest positive influence on the per acre value of agricultural tracts. The combined influence of the three quality or productivity variables is expected to account for a major portion of the variation in per acre prices paid for agricultural land. It is interesting to note the absence of the quality variable relating to rangeland (X_{15}). The coefficient for X_{15} was not significant, nor was the sign of the coefficient consistently the same when tested in equations for this sample. This indicates that quality of cropland is more important than quality of rangeland in the sample area in determining the prices paid for agricultural land. This was expected considering both that agriculture is typical of the area and that a relatively high proportion of agricultural land in the study area is cropland.

Net County Property Value per Square Mile

The coefficients of X_{18} and X_{18}^2 indicate that the net county property value per square mile, up to approximately $455,000.00 per square mile, of the county in which a tract is located has a positive influence on the per acre prices paid for agricultural land. This positive effect diminished as the county value rose. If the net county property value exceeds $455,000.00 per square mile, further additions to the county value above this level are expected to have a negative influence on per acre prices paid. One explanation for this might be the expected increase in property taxes resulting from an increase in the assessed value of agricultural land. This apparently indicates that after a certain level of development is reached by a county, additional increments of wealth have little positive effect on agricultural land prices. This is consistent with a priori reasoning that the most dramatic increases in agricultural land values, as a result of county wealth, will be in those counties where development is in earlier stages as opposed to those counties where industrial and urban development are already widespread, other factors constant. The 1974 net county property value in Alfalfa County was $279,000.00 per square mile, in Garfield County it was $788,000.00 per square mile, in Kingfisher County it was $349,000.00 per square mile, and in Woodward County it was $209,000.00 per square mile. The magnitude and signs of the coefficients of X_{18} and X_{18}^2 indicate that, all other factors constant, Kingfisher County agricultural land sold in 1974 is expected to have brought approximately \$194.92 an acre more than Garfield County agricultural land, \$40.18 an acre more than Alfalfa County agricultural land and \$99.96 an acre more than Woodward County agricultural land due to the influences of county wealth and the level of development in the county. The coefficients of X_{18} and X_{18}^2 are both statistically significant at least at the .01 percent level of probability.

It should be noted that variables X_6, (distance to the nearest city), X_7 (population of the nearest town), X_8 (population of the nearest principal market), X_{10} (percent of the tract in cropland), X_{11} (percent of the tract in rangeland) and X_{15} (rangeland productivity index) were not included in the estimated equation for the four county study area. Each of these variables was tested but not included in the final estimated equation for one or more of the following reasons: the sign of the variable's coefficient did not agree with economic theory, the variable's coefficient was not deemed statistically significant or there existed a high intercorrelation between the variable and other independent variable(s) which were deemed to be better explanatory variables.

Estimated Equations for the Four County Area (1970-1973 and 1974-1976)

Two additional equations were estimated for the four county sample for the periods 1970-1973 and 1974-1976. The same explanatory variables used in equation 1 (four county, 1970-1976) were included in these equations. This was done in order to determine if there were any significant changes in the relationships between the independent variables and price per acre during the 1970-1976 time period studied. These equations are shown below. Equation 2 represents the 1970-1973 time period and equation 3 represents the 1974-1976 period.

$$\begin{array}{llllll} Y = -26.48 & + \; 0.08X_1^2 & + \; 0.06X_2 & - \; 3.15X_2^{.5} & - \; 14.15X_3 \; + \\ & (14.36)^1 & (0.47)^2 & (0.86)^2 & (3.50)^3 \end{array} \qquad \text{(Equation 2 Four County, 1970-1973)}$$

$$\begin{array}{llllll} 1.14X_3^2 & - \; 4.80X_4 & - \; 2.16X_5 & + \; 0.38X_9 & - \; 0.003X_9^2 \; + \\ (2.78)^3 & (3.42)^4 & (3.89)^5 & (1.12)^9 & (0.91)^9 \end{array}$$

$$\begin{array}{lllll} 0.02X_{12}^2 & + \; 0.72X_{13} & + \; 1.18X_{14} & + \; 1.31X_{18} & - \; 0.001X_{18}^2 \\ (13.25)^{12} & (4.59)^{13} & (3.95)^{14} & (6.54)^{18} & (6.47)^{18} \end{array}$$

R^2 = .6295

Standard Deviation = 84.84

$\bar{Y}$ = 317.16

Number of Observations = 587

$$\begin{array}{llllll} \bar{Y} = 55.39 & + \; 0.12X_1^2 & + \; 0.15X_2 & - \; 9.38X_2^{.5} & - \; 18.38X_3 \; + \\ & (3.11)^1 & (1.29)^2 & (1.66)^2 & (1.99)^3 \end{array} \qquad \text{(Equation 3 Four County, 1974-1976)}$$

$$\begin{array}{llllll} 2.08X_3^2 & - \; 3.06X_4 & - \; 5.04X_5 & + \; 0.54X_9 & - \; 0.009X_9^2 \; + \\ (0.88)^3 & (0.84)^4 & (3.10)^5 & (0.58)^9 & (0.10)^9 \end{array}$$

$$\begin{array}{lllll} 0.05X_{12}^2 & + \; 1.30X_{13} & + \; 4.60X_{14} & + \; 2.00X_{18} & - \; 0.002X_{18}^2 \\ (10.37)^{12} & (2.86)^{13} & (5.40)^{14} & (3.55)^{18} & (3.34)^{18} \end{array}$$

R^2 = .7265

Standard Deviation = 172.72

$\bar{Y}$ = 622.74

Number of Observations = 326

The coefficients of determination indicate that equation 2 explained approximately 63 percent of the variation in per acre price for the period 1970-1973 while equation 3 explained approximately 73 percent of the variation in per acre price for the period 1974-1976. Equation 1 explained approximately 71 percent of the variation in per acre price for the combined periods, 1970-1976. Thus it appears that the 14 independent variables included in these equations, do a somewhat better job of explaining variation in per acre prices in the latter portion of the study period.

In order to determine if the equations estimated for the subperiods, 1970-1973 and 1974-1976, are structurally different from the equation estimated for the period 1970-1976, a Chow test was employed. This test is designed to test whether the regression coefficients estimated by assigning subsets of a given set of observations to two or more different structures do in fact belong to the same structure. Different structures refers to estimated equations containing the same explanatory variables whose coefficients differ significantly.

The F value resulting from this test, when subperiods 1970-1973 and 1974-1976 are used, exceeds the tabular F value for 15 and 883 degrees of freedom indicating that the difference between estimated regression coefficients is statistically significant and that the two structures are inferred to be different at the 99 percent confidence level. Equations estimated for the two subperiods are therefore deemed to be superior to the equation estimated for the total study period in explaining variation in per acre prices in each of the two respective subperiods.

Interpretation

Date of Sale

The time variable was found to explain the largest proportion of variation in the dependent variable in the estimated equation for the 1970-1973 time period. The time variable was an important explanatory variable in the estimated equation for the 1974-1976 time period though not as important as some other variables included in that equation. The relative magnitude of the coefficients of the time variable (X_1^2) in the estimated equations for the two time periods indicate that the positive influence of the factors represented by this variable on per acre prices was greater in the later time period. The per acre value of agricultural land sold in the earlier time period in the four county study area increased $0.08 times the number of months squared that had elapsed between January 1974 and the date of sale. The difference in the magnitude of these coefficients suggests that agricultural land prices have been rising relatively more rapidly in the latter portion of the study period, which seems evident upon examination of Figure 2 in Chapter II.

<u>Size of the Tract</u>

The negative influence of tract size upon the per acre price paid for a tract of agricultural land appeared to be more dramatic in the 1974-1976 time period than during the 1970-1973 period in the study area. This is reflected through the relative size of the coefficients of $X_2^{.5}$ in the estimated equations for the two time periods. Whereas an 80 acre tract is expected to bring $24.58 an acre less than a 40 acre tract in the later period, this difference was only $8.25 for the 1970-1973 period. The coefficient of $X_2^{.5}$ is significant at least at the ten percent level of probability in the estimated equation for the 1974-1976 period but only at the 40 percent level in the estimated equation for the 1970-1973 period. Thus it appears that tract size is a more significant determinant of per acre price in the later period. Higher borrowing costs are one probable reason for this.

Distance Variables

Distance to Paved Road. The negative influence of distance to paved road on the per acre prices paid for agricultural land in the study area in the 1970-1973 and 1974-1976 time periods is only slightly different. The magnitude and signs of the coefficients of X_3 and X_3^2 indicate that the expected per acre price of a tract located one mile from paved road is \$13.01 less than the expected per acre price of a tract located adjacent to a paved road for sales occurring in the period 1970-1973 and \$14.88 for sales occurring in the period 1974-1976. The difference in the magnitude of the negative influence of this factor between the two periods declines as the distance to paved road increases. Distance to paved road has a negative influence on per acre prices for distances up to 6.2 miles in the 1970-1973 periods and for distances up to 4.1 miles in the 1974-1976 period. The coefficient of X_3 is statistically significant at least at the .1 percent level of probability in the estimated equation for the 1970-1973 period and at least at the 25 percent level in the estimated equation for the 1974-1976 period. The coefficient of X_3^2 is significant at the one percent level in the earlier period but only at the 40 percent level in the later period. It appears that proximity to paved roads as a determinant of per acre prices paid for agricultural land has declined during the study period. This finding may be a result of the ever-increasing quality of non-paved roads in the study area.

Distance to the Nearest Town. The expected per acre price of agricultural land was found to decline \$4.80 for each mile that it was removed from the nearest town in the 1970-1973 time period. Expected per acre price declined only \$3.06 for each mile that a tract was located from the nearest town in the 1974-1976 time period. The coefficient of X_4 is statistically significant at least at the .1 percent level of probability in the estimated equation for the 1970-1973 period but only at the 40 percent level in the estimated equation for the 1974-1976 period. This suggests that proximity to the nearest town has declined in importance as a determinant of the per acre value of agricultural land.

Distance to the Nearest Principal Market. Distance to the nearest principal market was found to have a somewhat larger negative influence on per acre prices paid for agricultural land in the 1974-1976 time period than in the 1970-1973 period. The expected per acre price of a tract of agricultural land declined \$5.04 for each mile that the tract was removed from the nearest principal market in the later period and only \$2.16 in the earlier period. The coefficient of X_5 is statistically significant at the .01 percent level in the estimated equation for the 1970-1973 period and at the one percent level in the estimated equation for the 1974-1976 period. The importance of distance to the nearest principal market as a determinant of agricultural land values appears to have grown during the study period.

In looking at the effects on expected per acre prices of agricultural land of the three distance variables included in the estimated equations, it appears that proximity to paved roads and the nearest town have declined in importance while proximity to the nearest principal market has grown in importance. This comes about as a result of improved roads, making larger more distant market centers more easily accessible and partly as a result of the growing affluence of rural residents who increasingly demand goods and services which in many instances can not be provided by smaller, nearby towns. Higher fuel costs may account for the increased negative influence of distance to the nearest principal market.

Proportion of Mineral Rights Conveyed

The positive influence of the proportion of mineral rights conveyed with the sale of a tract of agricultural land on the per acre price paid for the tract appears to have grown during the study period. The conveyance of 50 percent of the mineral rights with the sale of a tract during the period 1970-1973 would have the expected effect of increasing per acre price by $11.60, other factors constant. This expected effect increased to $24.75 an acre for sales occurring during the 1974-1976 period. In addition, the conveyance of mineral rights in excess of 63 percent of the total rights were found to have no appreciable effect on the expected per acre price in the 1970-1973 period. An increase in the influence of mineral rights conveyed in the later period can be attributed to the increased interest in mineral production and energy needs. The coefficients of X_9 and X_9^2 are statistically significant at the 30 and 40 percent levels of probability respectively in the estimated equation for the 1970-1973 time period. In the estimated equation for the 1974-1976 time period neither of these variables has a coefficient that is statistically significant at the 50 percent level of probability.

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. X_{12}^2 was found to be the most important variable in explaining variation in per acre prices paid for agricultural land in the study area during the 1974-1976 time period. This variable was second only to the time variable in its importance in explaining variation in per acre prices in the earlier period. The positive influence of this variable appears to have grown during the study period. During the 1970-1973 period, the expected per acre value of a tract containing cropland of soil classes I and II was increased $0.02 times the percent squared of that tract contained in cropland of soil classes I and II over the expected per acre value of a tract containing no cropland of soil classes I and II, all other factors constant. This positive influence increased to $0.05 times the percent squared of the tract contained in cropland of soil classes I and II in the 1974-1976 time period. The coefficient of X_{12}^2 is statistically significant at least at the .01 percent level of probability in both of the equations.

Percent of the Tract in Cropland of Soil Classes III and IV. The expected per acre price of a tract of agricultural land sold during tha 1970-1973 period was increased $0.72 for each additional percent of the tract contained in cropland of soil classes III and IV, all other factors constant. This increased to $1.30 an acre for each additional percent of the tract contained in cropland of soil classes III and IV for tracts sold during the 1974-1976 period. The coefficient of this variable, X_{13}, is statistically significant at least at the .01 percent level in the estimated equation for the 1970-1973 period and at least at the one percent level in the estimated equation for the 1974-1976 period.

Cropland Productivity Index. As with the other two quality or productivity variables included in these estimated equations, the cropland productivity index of a tract of agricultural land was found to have a greater positive influence on the per acre price paid for a tract in the 1974-1976 portion of the study period than in the 1970-1973 portion. The expected per acre price paid for agricultural land in the study area during the period 1970-1973 increased $1.18 for each one point increase in the among counties cropland productivity index, all other factors constant. During the 1974-1976 period, the expected per acre price increased $4.60 in response to a one point increase in the index. Thus it appears that income producing potential has increased in importance as a determinant of the per acre value of agricultural land. The coefficient of X_{14} is statistically significant at least at the .01 percent level in the estimated equations for both periods.

Net County Property Value per Square Mile

The coefficients for the net county property values are highly significant in both equations. The positive influence of X_{18} on agricultural land values appears to have increased in the later period studied. This may reflect the increased use of rural lands for non-agricultural development or investment.

Summary

Time and quality of cropland were the most important factors in explaining variation in the price paid per acre for agricultural land in north central Oklahoma. Time, as measured by the number of months squared elapsed since the beginning of the study period, exerted a strong positive influence on price. The positive influence of the factors represented by the time variable was found to be greater in the latter portion of the study period. Quality differences were best expressed in terms of the percent squared of the tract in cropland of soil classes I and II, the percent of the tract in cropland of soil classes III and IV and a productivity index of the cropland contained in the tract. These quality variables are indicative of the income-producing potential of a tract of land used primarily in agriculture. The positive influence of the quality factor appeared to increase during the study period.

Distances to paved road, to the nearest town and to the nearest principal market all had significant negative influences on per acre price in the 1970-1976 study period. Per acre prices declined more drastically as distance to the nearest market increased in the later portion of the period. Thus it appears that proximity to a principal market has grown in importance relative to proximity to the nearest town and to paved roads as a determinant of the per acre price that is paid for agricultural land.

The amount of mineral rights conveyed with the sale of a tract of agricultural land appeared to influence the price paid per acre for the tract in a positive manner. The amount of mineral rights accompanying the sale appeared to grow in importance in the latter portion of the study period.

A direct relationship existed between the net county property value of the county in which a tract was located and the per acre price that a tract of agricultural land brought. The magnitude of this relationship was larger in the 1974-1976 portion of the study indicating the growing importance of rural lands for use in non-agricultural development.

CHAPTER IV

AN ANALYSIS OF AGRICULTURAL LAND VALUES IN FOUR NORTH CENTRAL OKLAHOMA COUNTIES

In this chapter the factors affecting the per acre price of agricultural land in each of the four counties studied is analyzed. The Chow test for structural stability was utilized to determine if equations estimated for each county were structurally different from the equation estimated for the four county sample for the study period 1970-1976.[1] Results of this test indicated that the difference between estimated regression coefficients in each of the individual county equations and the aggregate equation were statistically significant at least at the .99 level of confidence. This finding led to the inference that the structure of each equation was in fact different.

In view of this and in order to determine if different factors might be influencing agricultural land values in each county, separate equations were estimated for each of the four counties. The "best" estimated equation for each county may include variables that were not included in the aggregate equation and after repeated testing, some variables that were included in the aggregate equation may have been dropped from the estimated county equations.

Alfalfa County

The Estimated Equation

$$\hat{Y} = 15.81 + \underset{(19.66)}{0.12X_1^2} - \underset{(0.87)}{3.16X_2^{.5}} - \underset{(2.00)}{17.24X_3} + \underset{(0.92)}{1.01X_9} - \underset{(1.06)}{0.01X_9^2} + \underset{(9.52)}{0.04X_{12}^2} + \underset{(3.59)}{1.81X_{13}} + \underset{(5.03)}{2.96X_{16}}$$

(Equation 4 Alfalfa County, 1970-1976)

$R^2 = .7914$

Standard Deviation = 156.44

$\bar{Y} = 553.37$

Number of Observations = 262

Interpretation

Date of Sale. The estimated equation for Alfalfa County indicates that the factors represented by the time variable (X_1^2) accounted for the largest amount of variation in the per acre prices paid for agricultural land in that county. The form of the time variable, number of months squared that have elapsed between the date of sale and January, 1970, indicates that the per acre value of agricultural land in Alfalfa County has been increasing rapidly during the study period. The coefficient of X_1^2, statistically significant at least at the .01 percent probability level, suggests that expected per acre price is increased \$0.12 times the number of months squared that have elapsed between the date of sale and January, 1970, all other factors constant. A tract of Alfalfa County agricultural land sold in January, 1976 is expected to have brought \$622.08 an acre more than a tract sold in January, 1970, all other factors constant.

Size of the Tract. An inverse relationship exists between tract size and the per acre price paid for a tract of agricultural land in Alfalfa County. The form of the size variable ($X_2^{.5}$) suggests that as the size of the tract increases, additional one acre increases in size have a smaller and smaller negative effect on per acre price. A 160 acre tract would be expected to bring \$11.71 an acre less than an 80 acre tract and \$19.98 an acre less than a 40 acre tract. The coefficient of $X_2^{.5}$ is statistically significant at least at the 40 percent level of probability.

Distance to Paved Road. Per acre prices paid for tracts of agricultural land in Alfalfa County were found to be negatively influenced by the distance that the tract was located from paved road. For each mile that a tract is located from paved road its expected per acre price is reduced \$17.24, all other factors constant. The coefficient of X_3 is statistically significant at least at the five percent level of probability. This was the only distance variable found to have a significant influence on per acre prices paid for Alfalfa County agricultural land.

Proportion of Mineral Rights Conveyed. The proportion of mineral rights conveyed with the sale of a tract exerts a positive influence on the prices paid for Alfalfa County agricultural land. The magnitude and signs of the coefficients of variables X_9 and X_9^2 suggest that expected per acre price is increased for conveyances of up to 51 percent of the mineral rights, after which the conveyance of additional rights have a negligible effect on expected per acre price. The conveyance of ten percent of the mineral rights is expected to increase the per acre value of Alfalfa County agricultural land by \$9.10 and the conveyance of 50 percent of the mineral rights is expected to increase per acre value by \$25.50, all other factors constant. The coefficient of X_9 is statistically significant at the 40 percent level of probability and the coefficient of X_9^2 at the 30 percent level.

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. A direct relationship exists between per acre prices paid for tracts of Alfalfa County agricultural land and the percent squared of the tract contained in cropland of soil classes I and II. The expected per acre value of a tract of Alfalfa County agricultural is increased \$0.04 times the percent squared of the tract contained in cropland of soil classes I and II, all other factors constant. The form of this variable (X_{12}^2) suggests that additional percentage increases in the proportion of a tract contained in cropland of this category have an increasingly greater positive influence on expected per acre price. The first ten percent of a tract contained in cropland of soil classes I and II is expected to increase per acre price by \$4.00 while the fifth ten percent of the tract contained in cropland of soil classes I and II is expected to increase per acre price by \$36.00. The coefficient of X_{12}^2 is statistically significant at least at the .01 percent level of probability.

Percent of the Tract in Cropland of Soil Classes III and IV. Per acre prices paid for Alfalfa County agricultural land were found to be positively influenced by the percent of the tract contained in cropland of soil classes III and IV. An additional percent increase in the proportion of a tract contained in cropland of soil classes III and IV is expected to increase per acre price by $1.82, all other factors constant. The coefficient of X_{13} is statistically significant at least at the .1 percent level of probability.

Cropland Productivity Index. A direct relationship exists between the cropland productivity index, reflecting income producing potential, of cropland contained within a tract of Alfalfa County agricultural land and the per acre price paid for the tract. A one point increase in this index for a tract is expected to increase the per acre value of the tract by $2.96, all other factors constant. The coefficient of this variable (X_{16}) is statistically significant at least at the .01 percent level of probability.

The quality or productivity factor, as represented by the three quality and productuvity variables included in the estimated equation, was second in importance to the factors represented by the time variable in explaining variation in per acre prices paid for agricultural land in Alfalfa County. Each of the three quality or productivity variables had a highly significant positive influence on expected per acre price. It may seem unreasonable that the coefficient of X_{13} is larger than that of X_{12}^2. The correlation between X_{16} and X_{12}^2 is quite high, 0.7 It is logical to assume that the more productive cropland (classes I and II) would contribute heavily to the productivity and income potential of cropland contained in the tract. Thus part of the expected influence of X_{12}^2 is reflected through the effect of X_{16}, in addition the importance of X_{12}^2 increases as a greater proportion of the tract is contained in cropland of soil classes I and II.

Garfield County

The Estimated Equation

$$\bar{Y} = 251.19 + \underset{(20.65)_1}{0.10X_1^2} - \underset{(1.90)_2}{0.84X_2} + \underset{(1.15)_2}{0.002X_2^2} - \underset{(0.98)_3}{15.04X_3} - \underset{(0.61)_3}{1.93X_3^2} - \underset{(2.58)_4}{9.80X_4} - \underset{(2.72)_5}{4.20X_5} + \underset{(2.48)_9}{1.82X_9} - \underset{(2.13)_9}{0.01X_9^2} + \underset{(7.48)_{12}}{2.35X_{12}} + \underset{(1.94)_{13}}{0.70X_{13}} + \underset{(1.81)_{17}}{0.55X_{17}}$$

(Equation 5 Garfield County, 1970-1976)

R^2 = .6935

Standard Deviation = 199.91

$\bar{Y}$ = 424.35

Number of Observations = 271

Interpretation

Date of Sale. The time variable (X_1^2) was found to be the most important variable in the estimated equation for Garfield County in explaining variation in per acre prices paid for agricultural land in that county. The form of this variable, number of months squared that have elapsed between the date of sale and January, 1970, indicates that the study period has been a time of rapidly increasing agricultural land prices in Garfield County. The coefficient of X_1^2, suggests that the expected per acre price of agricultural land in Garfield County is increased \$0.10 times the number of months squared that have elapsed between the date of sale and January, 1970. A tract of Garfield County agricultural land sold in January 1976 is expected to have brought \$518.40 an acre more than a tract sold in January 1970, all other factors constant. The coefficient of X_1^2 is statistically signficant at least at the .01 percent probability level.

Size of the Tract. An inverse relationship exists between tract size and per acre price as indicated by the magnitude and signs of the coefficients of X_2 and X_2^2 in the estimated equation for Garfield County. The form of the size variable suggests that as the total size of the tract increases, up to about 253 acres, additional one acre increases in size have a smaller and smaller negative effect on per acre price. A 160 acre tract of Garfield County agricultural land is expected to bring $28.80 an acre less than an 80 acre tract and $52.80 an acre less than a 40 acre tract. The coefficient of X_2 is statistically significant at least at the ten percent level of probability and the coefficient of X_2^2 at least at the 25 percent level.

Distance Variables

Distance to Paved Road. Per acre prices paid for tracts of Garfield County agricultural land and the distance to paved road were found to vary inversely. The inclusion of X_3 with a negative coefficient and X_3^2 with a positive coefficient in the estimated equation for Garfield County indicates that as the total distance to paved road increases, the magnitude of the negative effect on expected value of a one mile increase in this distance will diminish. The inverse relationship between expected per acre value and distance to paved road holds for distances up to about four miles. The first mile that a tract of Garfield County agricultural land is removed from paved road will decrease its expected per acre value by $13.11 and the fourth mile will decrease expected per acre value by $1.53. The coefficient of X_3 is statistically significant at least at the 35 percent level of probability. The coefficient of X_3^2 is not statistically significant at the 50 percent level of probability.

Distance to the Nearest Town. A one mile increase in the distance to the nearest town will have the expected effect of decreasing the per acre value of Garfield County agricultural land by $9.80. A tract of Garfield County agricultural land located adjacent to the corporate limits of a town is expected to bring $98.00 an acre more than a tract located ten miles from the corporate limits of the nearest town, all other factors constant. The coefficient of X_4 is statistically significant at least at the five percent level of probability.

Distance to the Nearest Principal Market. An inverse relationship was also found to exist between distance to the nearest principal market and per acre price in Garfield County. The coefficient of X_5 in the estimated equation for that county reveals that the expected per acre price declines $4.20 for each additional mile to the nearest principal market. Thus a tract located adjacent to the corporate limits of the nearest principal market will have an expected per acre value that is $84.00 more than the expected per acre value of a tract located 20 miles from the nearest principal market.

Proportion of Mineral Rights Conveyed. The conveyance of up to about 65 percent of the mineral rights with the sale of a tract of Garfield County agricultural land has a positive influence on the expected per acre price of that tract. The conveyance of additional mineral rights in excess of 65 percent of the total rights is expected to have a negligible effect on per acre prices. The positive sign of the coefficient of X_9 and the negative sign of the coefficient of X_9^2 indicates that the positive influence of mineral rights diminish as additional increments of rights are conveyed. The conveyance of a first ten percent of mineral rights is expected to increase per acre price by about \$17.20 and the conveyance of a sixth ten percent is expected to increase per acre price by about \$7.20. The coefficients of X_9 and X_9^2 are statistically significant at least at the five percent level of probability.

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. The expected per acre price of a tract of Garfield County agricultural land is increased \$2.35 for each additional percent of the tract contained in cropland of soil classes I and II. This direct relationship between cropland quality and expected per acre price agrees with previous expectations. An 80 acre tract containing 40 acres of cropland of soil classes I and II is expected to bring \$117.50 an acre more than a tract containing no cropland of soil classes I and II, all other factors constant. The coefficient of X_{12} is statistically significant at the .01 percent probability level.

Percent of the Tract in Cropland of Soil Classes III and IV. Seventy cents is added to expected per acre price for each percent of a tract of Garfield County agricultural land that is contained in cropland of soil classes III and IV. The magnitude of the direct relationship between per acre price and this quality measure is smaller than that between per acre price and percent of the tract contained in cropland of soil classes I and II. This finding is consistent with previous expectations that better quality cropland will contribute a relatively greater amount to expected per acre price. The coefficient of X_{13} is statistically significant at least at the ten percent level of probability.

Rangeland Productivity Index. X_{17}, a measure of the productivity of rangeland, is included in the estimated equation for Garfield County. The inclusion of this variable, whose coefficient is significant at the ten percent probability level, indicates that the productivity of rangeland has a positive influence on the per acre price of Garfield County land. As indicated in Chapter II, Garfield County has the highest average price paid for rangeland in the four county sample.

Kingfisher County

The Estimated Equation

$$\hat{Y} = 259.38 + \underset{(19.07)}{0.09X_1^2} + \underset{(1.19)}{0.68X_2} - \underset{(1.33)}{18.65X_2^{.5}} - 12.65X_3 + \underset{(0.30)}{1.25X_3^2} - \underset{(2.12)}{2.24X_5} + \underset{(1.92)}{1.17X_7} + \underset{(0.99)}{2.95X_8} + \underset{(8.84)}{0.03X_{12}^2} + \underset{(4.17)}{1.49X_{13}} + \underset{(2.34)}{0.87X_{17}}$$

(Equation 6 Kingfisher County, 1970-1976)

$R^2 = .7292$

Standard Deviation = 113.24

$\bar{Y} = 414.64$

Number of Observations = 224

Interpretation

Date of Sale. A very significant positive relationship exists between the factors represented by the time variable (X_1^2) and per acre prices paid for Kingfisher County agricultural land during the study period. The coefficient of X_1^2 in this estimated euqation suggests that the expected per acre price paid for a tract of Kingfisher County agricultural land is increased $0.09 times the number of months squared that have elapsed between January, 1970 and the date of sale, all other factors constant, due to the influence of the factors represented by the time variable. Inflation, the expectation of higher agricultural commodity prices and expanding non-agricultural use of rural lands are probably the more important factors represented by this variable. An average tract of Kingfisher County agricultural land sold in January, 1976 is expected to have brought $466.56 an acre more than a tract sold in January, 1970, all other factors constant. The coefficient of X_1^2 is statistically significant at least at the .01 percent probability level.

Size of the Tract. The size of the tract has a negative influence on per acre price in Kingfisher County. With X_2 and $X_2^{.5}$ in the estimated equation, the negative influence of a one acre increase in size is diminished as total size increases, up to about 186 acres. A 160 acre tract of Kingfisher County agricultural land is expected to bring $14.70 an acre less than an 80 acre tract and $36.36 an acre less than a 40 acre tract. The coefficient of X_2 is statistically significant at least at the 25 percent level of probability and the coefficient of $X_2^{.5}$ at least at the 20 percent level.

Distance Variables

Distance to Paved Road. An inverse relationship was found to exist between distance to paved road, for distances of up to about five miles, and the per acre prices paid for tracts of Kingfisher County agricultural land. The negative effect on per acre price of additional one mile increases in this distance diminish as the total distance becomes greater. A tract located one mile from paved road would be expected by bring $11.40 an acre less than a tract located on or adjacent to paved roads, all other factors constant. The coefficient of X_3 is statistically signifiant at least at the 50 percent level of probability while the coefficient of X_3^2 is not statistically significant even at this level.

Distance to the Nearest Principal Market. The expected per acre price of Kingfisher County agricultural land was found to decline $2.24 for each mile that it was located from the nearest principal market, all other factors constant. The coefficient of X_5 is statistically significant at least at the five percent level of probability in the estimated equation for Kingfisher County.

Population Variables

Population of the Nearest Town. A direct relationship exists between population of the nearest town and the per acre prices paid for Kingfisher County agricultural land. An increase of 100 in the population of the nearest town, all other factors constant, is expected to increase the per acre value of a tract of Kingfisher County agricultural land by $1.17. The coefficient of X_7 is statistically significant at least at the ten percent probability level.

Population of the Nearest Principal Market. A direct relationship also exists between population of the nearest principal market and the per acre prices paid for Kingfisher County agricultural land. An increase of 1000 in the population of the nearest principal market, all other factors constant, is expected to increase the per acre value of a tract of Kingfisher County agricultural land by $2.95. The coefficient of X_8 is statistically significant at the 35 percent probability level.

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. The coefficient of X_{12}^2 in the estimated equation for Kingfisher County indicates that $0.03 is added to expected per acre price for each additional percent squared of cropland in soil classes I and II contained in a tract of agricultural land. Expected per acre price is increased $3.00 in response to the first ten percent of the tract contained in cropland of this type, all other factors constant. A fifth ten percent of the tract contained in cropland of soil classes I and II would be expected to increase the per acre value of the tract by $27.00. The coefficient of X_{12}^2 is statistically significant at least at the .01 percent probability level.

Percent of the Tract in Cropland of Soil Classes III and IV. Expected per acre price increases in response to an increase in the amount of cropland of soil classes III and IV contained in a tract of Kingfisher County agricultural land. For each additional percent of the tract contained in cropland of this type, expected per acre values increase $1.49, all other factors constant. The coefficient of X_{13} is statistically significant at least at the .01 percent level of probability.

Rangeland Productivity Index. The quality of rangeland, as measured by the within county rangeland productivity index, contained in a tract was found to have a positive influence on the per acre price of agricultural land in Kingfisher County. A one point increase in this index, all other factors constant, is expected to increase the per acre value of a tract by $0.87. The coefficient of X_{17} is statistically significant at least at the five percent level of probability.

Woodward County

The Estimated Equation

$$
\begin{aligned}
Y = 203.83 &+ \underset{(10.47)^{1}}{0.04X_1^2} + \underset{(1.09)^{2}}{0.07X_2} - \underset{(1.54)^{2}}{5.32X_2^{.5}} - \underset{(1.44)^{3}}{14.63X_3} + \\
&\underset{(2.26)^{3}}{1.26X_3^2} - \underset{(1.70)^{4}}{4.11X_4} - \underset{(0.93)^{5}}{1.46X_5} + \underset{(1.53)^{7}}{0.44X_7} + \underset{(1.92)^{9}}{1.26X_9} - \\
&\underset{(2.23)^{9}}{0.02X_9^2} + \underset{(1.60)^{12}}{1.94X_{12}} - \underset{(0.79)^{12}}{0.01X_{12}^2} + \underset{(3.23)^{16}}{1.04X_{16}}
\end{aligned}
\qquad \text{(Equation 7 Woodward County, 1970-1976)}
$$

$R^2 = .6123$

Standard Deviation = 85.53

$\bar{Y} = 232.82$

Number of Observations = 156

Interpretation

Date of Sale. A direct relationship was found to exist between the per acre price paid for Woodward County agricultural land and the date of sale, as measured by the number of months squared that have elapsed between January, 1970 and the sale date, during the study period. The expected per acre value of agricultural land in Woodward County increased \$0.04 times the number of months squared that elapsed between January, 1970 and the date of sale as indicated by the coefficient of variable X_1^2 in the estimated equation for that county. Thus a tract sold in Janaury 1976 is expected to have brought \$213.12 an acre more than a tract sold in January, 1970, all other factors constant. X_1^2 is the most significant independent variable in the estimated equation for Woodward County in terms of explaining variation in per acre prices paid for agricultural land in that county.

Size of the Tract. The per acre prices paid for Woodward County agricultural land vary inversely with the size of the tract, all other factors constant. With the inclusion of X_2 and $X_2^{.5}$ in the estimated equation for Woodward County, it appears that the negative influence of additional one acre increases in size diminish as the total size of the tract increases. A 160 acre tract is expected to bring $14.11 an acre less than an 80 acre tract and $25.54 an acre less than a 40 acre tract, all other factors constant. The coefficient of X_2 is statistically significant at least at the 30 percent level of probability and the coefficient of $X_2^{.5}$ is statistically significant at least at the 15 percent level.

Distance Variables

Distance to Paved Road. An inverse relationship between per acre prices paid for Woodward County agricultural land and distance to paved road exists for distances up to about 5.8 miles. The magnitude of the negative effect of additional one mile increases in this distance is of a diminishing nature. The expected per acre value of a tract located on or adjacent to paved roads is $13.37 an acre more than a tract located one mile from paved road and $42.42 an acre more than a tract located six miles from paved roads, all other factors constat. The coefficients of X_3 and X_3^2 are statistically significant at least at the five percent level of probability.

Distance to the Nearest Town. Distance to the nearest town was found to vary inversely with the per acre prices paid for Woodward County agricultural land. The coefficient of X_4 indicates that for each increase of one mile in distance that a tract of Woodward County agricultural land is located from the nearest town, the sale price will be expected to decrease by $4.11 an acre, all other factors constant. The coefficient of X_4 is statistically significant at least at the ten percent probability level.

Distance to the Nearest Principal Market. Expected per acre prices are also negatively influenced by the distance to the nearest principal market in the estimated equation for Woodward County. The coefficient of X_5 indicates that the expected per acre price of a Woodward County tract is reduced $1.46 for every mile that it is removed from the nearest principal market. The coefficient of X_5 is statistically significant at only the 40 percent level of probability.

Population of the Nearest Town. A direct relationship is evident between population of the nearest town and per acre prices paid for Woodward County agricultural land. Forty-four cents is added to per acre value for each additional 100 of population of the nearest town, all other factors constant. The coefficient of X_7 is significant at the 15 percent level of probability.

Proportion of Mineral Rights Conveyed. Per acre prices paid for agricultural land in Woodward County vary directly with the proportion of mineral rights conveyed with the sale. An increase in the proportion of mineral rights conveyed, up to about 40 percent, increases the value of a tract of agricultural land in Woodward County. Per acre price may be increased by as much as $25.00 with the conveyance of mineral rights. The coefficient of X_9 is significant at least at the ten percent level and the coefficient of X_9^2 at least at the five percent level.

Quality and Productivity Variables

Percent of the Tract in Cropland of Soil Classes I and II. The proportion of the tract in cropland of soil classes I and II has a positive effect on per acre prices of agricultural land in the Woodward County sample. The second degree polynominal form of X_{12} in this equation suggests that for each additional percent of the tract contained in cropland of soil classes I and II, per acre price will increase but not by as much as the previous percent increase. A first ten percent of the tract contained in cropland of soil classes I and II will add \$18.40 to per acre price whereas a second ten percent will add only \$16.40 an acre. The coefficient of X_{12} is significant at the 15 percent level of probability while the coefficient for X_{12}^2 is significant at the 45 percent level.

Cropland Productivity Index. The productivity index of cropland contained in the tract was also found to exert a positive influence on the price that is paid for agricultural land in Woodward County. A one point increase in this index, representing the income potential of cropland within the tract, is expected to increase the per acre price by \$1.04. The coefficient of X_{16} is statistically significant at the one percent level.

Use of the Estimated Equations

In order to illustrate how the estimated equations for agricultural land values might be used, two hypothetical farms are presented below and their estimated values calculated as of June 30, 1976, using the appropriate county equations.

Farm 1: Located in Alfalfa County; size of farm 160 acres; located one mile from paved road; located 5 miles from the nearest town (population 500); located 12 miles from the nearest principal market (population 2200); located 115 miles from Oklahoma City; 50 percent of the mineral rights are conveyed; 136 acres of cropland of which 104 acres is in soil classes I and II and 32 acres are in soil classes III and IV; 24 acres of rangeland; within county productivity index for cropland = 84; (as shown in Appendix A).

Since the subject farm is located in Alfalfa County, equation 4 will be used to estimate its per acre value. Equation 4 and the values of the independent variables included in it are shown below along with the calculation of estimated per acre value.

$$Y = 15.81 + 0.12X_1^2 - 3.16X_2^{.5} - 17.24X_3 + 1.01X_9 - 0.01X_9^2 + 0.04X_{12}^2 + 1.82X_{13} + 2.96X_{16}$$

$$X_1^2 = (78.0)^2 = 6084.0$$

$$X_2^{.5} = (160.0)^{.5} = 12.65$$

$$X_3 = 1.0$$

$$X_9 = 50.0$$

$$X_9^2 = 2500.0$$

$$X_{12}^2 = ((104.0/160.0)100)^2 = 4225.0$$

$$X_{13} = ((32.0/160.0)100) = 20.0$$

$$X_{16} = 84.0$$

$$Y = 15.81 + 0.12(6084.) - 3.16(12.65) - 17.24(1.0) + 1.01(50.0) - 0.01(2500.0) + 0.04(4225.0) + 1.82(20.0) + 2.96(84.0)$$

$$Y = 15.81 + 730.08 - 39.97 - 17.24 + 50.50 - 25.00 \_ 169.0 + 36.40 + 248.64 = \$1168.22$$ per acre or a total tract value of $186,915.20

Farm 2: Located in Woodward County; size of farm 160 acres; located 2 miles from paved road; located 8 miles from the nearest town (population 300); located 18 miles from the nearest principal market (population 9400); located 130 miles from Oklahoma City; 25 percent of mineral rights conveyed; 60 acres of cropland of which 20 acres is in soil classes I and II and 40 acres is in soil classes III and IV; 100 acres of rangeland; within county productivity index for cropland = 45.3; (as shown in Appendix A).

Since the subject farm is located in Woodward County, equation 7 will be used to estimate its per acre value. Equation 7 and the values of the independent variables included in it are shown below along with the calculation of estimated per acre value.

$$Y = 152.42 + 3.53X_1 + 0.08X_2 - 5.71X_2^{.5} - 16.80X_3 + 1.32X_3^2 - 3.74X_4 - 1.34X_5 + 0.41X_7 + 1.04X_9 - 0.01X_9^2 + 2.10X_{12} - 0.02X_{12}^2 + 1.10X_{16}$$

$X_1 = 78.0$

$X_2 = 160.0$

$X_2^{.5} = (160.0)^{.5} = 12.65$

$X_3 = 2.0$

$X_3^2 = (2.0)^2 = 4.0$

$X_4 = 8.0$

$X_5 = 18.0$

$X_7 = 3.0$

$X_9 = 25.0$

$X_9^2 = (25.0)^2 = 625.0$

$X_{12} = ((20.0/160.0)100) = 12.5$

$X_{12}^2 = ((20.0/160.0)100) = 156.25$

$X_{16} = 45.3$

$$Y = 152.42 + 3.53(78.0) + 0.08(160.0) - 5.71(12.65) - 16.80(2.0) + 1.32(4.0) - 3.74(8.0) - 1.34(18.0) + 0.41(3.0) + 1.04(25.0) - 0.01(625.0) + 2.10(12.5) - 0.02(156.25) + 1.10(45.3)$$

$$Y = 152.42 + 275.34 + 12.80 - 72.23 - 33.60 + 5.28 - 29.92 - 24.12 + 1.23 + 26.0 - 6.25 + 26.25 - 3.12 + 49.83$$

$= \$379.91$ per acre or a total tract value of $\$60,785.60$

Comparison of the Estimated County Equations

Time squared was by far the most important explanatory variable in each estimated county equation both in terms of the proportion of average price that it accounted for and the statistical significance of its coefficient. In the estimated equation for each county, the time factor was best expressed as X_1^2 or the number of months squared that had elapsed between the date of sale and the beginning of the study period (January, 1970). The factors represented by the time variable have had a somewhat more dramatic effect on the per acre prices paid for agricultural land in Alfalfa County than in Garfield, Kingfisher and Woodward counties. A look at the trend in agricultural land prices in these counties as shown in Figure 2 in Chapter II supports this finding.

The size of tract sold has a negative influence on the per acre price paid in all of the estimated county equations. Size was found to exert a negative influence which diminishes as total farm size increases.

An inverse relationship exists between the distance of a tract from a paved road and the per acre price paid for the tract in each county studied. The price paid per acre for agricultural land in Garfield and Woodward counties varies inversely with the distance between the tract sold and the nearest town. Distance to the nearest principal market has a negative influence on agricultural land values in Garfield, Kingfisher and Woodward counties. Alfalfa County is the only county for which an equation was estimated that did not include at least one "distance to population center" explanatory variable.

Population of the nearest principal market has a positive influence on agricultural land prices in Kingfisher and Woodward counties.

Population of the nearest town also has a positive influence on Kingfisher County agricultural land values.

The proportion of mineral rights conveyed with the sale of a tract of agricultural land is included as an explanatory variable and has a positive influence on agricultural land prices in the estimated equations for Alfalfa, Garfield and Woodward counties. The probable reason for this variable not being included in the Kingfisher County equation and having a significant influence on agricultural land prices in that county is the high level of mineral production and subsequent low level of mineral rights transfer in that county.

An agricultural quality or income-producing potential variable was the second most important variable in explaining variation in agricultural land prices in each of the four estimated county equations. In the estimated equations for Alfalfa and Kingfisher counties the positive influence of quality was best reflected through X_{12}^2 (percent of the tract contained in cropland of soil classes I and II squared). In each of these two equations, X_{13} (percent of the tract contained in cropland of soil classes III and IV) also had a highly significant positive influence on per acre prices paid. The explanatory variable ranking second in importance in the Garfield County equation was X_{12} and in the Woodward County equation X_{16} (within county productivity index for cropland). Some form of the variable X_{12} appeared in each estimated equation. The within county productivity index for rangeland was found to have a significant positive influence on agricultural land values in Garfield and Kingfisher counties. Thus, it appears that the quality of the land, particularly that of cropland, is second only to the factors represented by the time variable in determining the per acre price that will be paid for agricultural land.

Footnotes

[1]The aggregate equation tested in this chapter differed from the equation used in Chapter III in that it did not contain the variables relating to net county property value per square mile (X_{18} and X_{18}^2). These variables were omitted since they are capable of explaining vatiation in per acre land prices only on an intercounty basis.

CHAPTER V

AN ANALYSIS OF CROPLAND AND RANGELAND VALUES IN NORTH CENTRAL OKLAHOMA

"Agricultural land" is a broad category that can encompass several different types of land that are utilized primarily for agricultural production. With the many diverse enterprises included in agricultural production it is easy to imagine the broad range of land types that may be considered. These land types have different values depending upon their best use and range of potential uses. In view of this it is constructive to analyze agricultural land values according to type or use.

In this study, agricultural land is separated into two broad types: cropland and rangeland. These classifications were made according to the current use of the land at the time of sale. Current use was felt to accurately reflect the best use of the land since set aside programs and other land idling conservation programs were no longer in widespread use during the study period. Since assigning a per acre price paid for cropland and rangeland contained in a tract of agricultural land would involve a subjective allocation of the total price paid for the tract among the two land types, only tracts containing at least 90 percent cropland or rangeland are used in this analysis.

Among the 913 agricultural land sales in the four county sample, 262 sales fell into the cropland classification and 115 sales fell into the rangeland category. One-hundred and thirty three of the cropland observations were from Alfalfa County, 54 from Garfield County, 45 from Kingfisher County and 30 from Woodward County. Of the 115 rangeland observations, 30 sales were from Alfalfa County, 13 from Garfield County, 19 from Kingfisher County and 53 from Woodward County. Average per acre price, quality and other characteristics for each land type in each county are shown in Tables VII and VIII in Chapter II.

With a disproportionate share of the cropland observations coming from Alfalfa County and a disproportionate share of the rangeland observations coming from Woodward County it is possible that the four county aggregate averages could be biased towards one extreme or the other. The number of observations available for each land type in each county was sometimes so small as to limit the meaningfulness of the analysis if pursued on a county by county basis, particularly for rangeland.

Cropland

Presented below is the "best" estimated equation for cropland values in the four county study area. Equations were also estimated for cropland values in each of the four counties. Each of the factors that was hypothesized to have an influence on the per acre sale price of cropland was tested and those factors which were found to have a significant influence on cropland prices or were expected to have a significant influence were included in the "best" equation.

The Estimated Cropland Equation

$$Y = -449.09 + \underset{(17.53)^1}{0.11X_1^2} + \underset{(0.40)^2}{0.15X_2} - \underset{(0.63)^2}{0.0005X_2^2} - \underset{(0.84)^3}{22.06X_3} + \underset{(0.93)^3}{6.45X_3^2} - \underset{(2.11)^4}{10.32X_4} - \underset{(1.03)^5}{1.77X_5} + \underset{(1.49)^9}{1.78X_9} - \underset{(1.52)^9}{0.02X_9^2} + \underset{(3.88)^{12}}{0.03X_{12}^2} + \underset{(1.85)^{13}}{1.87X_{13}} + \underset{(7.07)^{14}}{7.43X_{14}} + \underset{(2.15)^{18}}{1.66X_{18}} - \underset{(2.06)^{18}}{0.002X_{18}^2}$$

(Equation 8 Aggregate Cropland, 1970-1976)

R^2 = .7411

Standard Deviation = 173.91

$\bar{Y}$ = 579.32

Number of Observations = 262

The coefficient of determination (R^2) for the estimated cropland equation indicates that approximately 74 percent of the variation in per acre prices paid for cropland in the four counties studied during the period 1970-1976 is explained by the 14 independent variables contained in the estimated equation.

Interpretation

Date of Sale. The time variable in the estimated cropland equation explained the largest amount of variation in the dependent variable, price paid per acre for cropland. The form of this variable, number of months squared that have elapsed between the date of sale and January, 1970, indicates that the study period was a time of rapidly increasing cropland prices. Among other factors, this trend can be attributed to generally higher grain prices and the expectation of higher net rents and farm incomes by those involved in the agricultural land market. The coefficient of the variable X_1^2 suggests that expected per acre price is increased $0.11 times the number of months squared that have elapsed between the date of sale and January, 1970. A tract of cropland sold in January, 1976 is expected to have brought approximately $586.08 an acre more than a tract of cropland sold in January, 1970, all other factors constant. The coefficient of X_1^2 is statistically significant at least at the .01 percent probability level.

Size of the Tract. Tract size was found to be an unimportant determinant of per acre prices paid for cropland. A direct relationship between tract size and per acre prices paid for cropland in the study area exists for tracts up to about 150 acres in size, after which an inverse relationship is expected to exist between tract size and per acre prices paid. The magnitude of this relationship, as reflected by the coefficients of variables X_2 and X_2^2, is small. A 160 acre tract of cropland is expected to sell for only $5.80 an acre more than a 40 acre tract, all other factors constant. The possibility of production economies of size in farming larger tracts of cropland is one probable reason for an inverse relationship not existing between tract size and expected per acre cropland prices. Neither the coefficient of X_2 or X_2^2 is statistically significant at the 50 percent probability level.

Distance Variables

Distance to Paved Road. The distance that a tract of cropland is located from paved road has a negative influence on the expected per acre value of the tract. This inverse relationship is expected to exist for distances up to about 1.8 miles, after which the influence of distance to paved road on expected per acre value is negligible. The coefficients of variables X_3 and X_3^2 suggest that a tract of cropland located one mile from paved road is expected to sell for $15.61 an acre less than a tract located on paved road, all other factors constant. The coefficients of X_3 and X_3^2 were both statistically significant at the 40 percent level of probability.

Distance to the Nearest Town. An inverse relationship exists between distance to the nearest town and per acre prices paid for cropland in the study area. For each additional mile that a tract of cropland is located from the nearest town, expected per acre price is reduced \$10.32. A tract of cropland located five miles from the corporate limits of the nearest town is expected to sell for \$51.25 an acre less than a tract of cropland located adjacent to the corporate limits of the nearest town, all other factors constant. The coefficient of X_4 is statistically significant at least at the five percent probability level.

Distance to the Nearest Principal Market. Per acre prices paid for cropland were found to be negatively influenced by the distance to the nearest principal market. An increase of one mile in the distance that a tract of cropland is located from the nearest principal market is expected to reduce its per acre value by \$1.77, all other factors constant. The coefficient of X_5 is statistically significant only at the 35 percent level of probability in the estimated cropland equation.

Proportion of Mineral Rights Conveyed. A direct relationship exists between the proportion of mineral rights conveyed with the sale of a tract of cropland and the per acre price paid for the tract in the study area. This direct relationship holds for conveyances of up to about 44 percent of the mineral rights. The conveyance of rights in excess of 44 percent of the total rights appear to have a negligible influence on per acre price. The coefficients of variables X_9 and X_9^2 suggest that the positive influence of the conveyance of an additional percent of mineral rights diminishes as the size of the total conveyance increases. A tract of cropland selling with 40 percent of the mineral rights is expected to bring $39.20 an acre more than a tract of cropland selling with no mineral rights, all other factors constant. The coefficients of X_9 and X_9^2 are statistically significant at the 15 percent level of probability.

Quality and Productivity Variables

Percent of the Tract in Soil Classes I and II. Per acre prices paid for tracts of cropland in the study area vary directly with the percent of the tract in soil classes I and II. Expected per acre price is increased $.03 times the percent squared of the tract contained in soil classes I and II. An additional percent of the tract contained in cropland of this category is expected to have an increasingly greater influence on per acre value as the total percent of the tract in soil classes I and II increases. A first ten percent of a tract contained in soil classes I and II is expected to increase its per acre value by $3.00 while a fifth ten percent is expected to add $27.00. The coefficient of X_{12}^2 is statistically significant at least at the .01 percent probability level.

Percent of the Tract in Soil Classes III and IV. Per acre prices paid for tracts of cropland in the study area also vary directly with the percent of the tract contained in soil classes III and IV. Expected per acre price is increased $1.87 for each additional percent of the tract contained in soil classes III and IV, all other factors constant. The coefficient of X_{13} is statistically significant at least at the ten percent probability level.

Cropland Productivity Index. A direct relationship exists between the expected per acre value of a tract of cropland and the productivity index of the tract. A one point increase in this index for a tract is expected to result in a $7.43 increase in the per acre value of the tract, all other factors constant. This variable was found to be the second most important variable in the estimated equation in explaining variation in per acre prices paid for cropland in the study area. The coefficient of X_{14} is statistically significant at least at the .01 percent level of probability.

Net County Property Value per Square Mile. A direct relationship exists between per acre prices paid for tracts of cropland and the net county property value per square mile of the county in which the tract is located. This direct relationship holds for net county property values of up to approximately $554,000 per square mile. The magnitude and signs of the coefficients X_{18} and X_{18}^2 indicate that, all other factors constant, Kingfisher County cropland sold in 1974 is expected to have brought approximately $18.67 an acre more than Garfield County cropland, $50.47 an acre more than Alfalfa County cropland and $115.64 an acre more than Woodward County cropland due to the influences of county wealth and the level of development in the county. The coefficients of X_{18} and X_{18}^2 are statistically significant at the five percent level of probability.

Estimated Cropland Equations by County

Equations were estimated for per acre cropland values for each of the four counties studied. The equations along with a brief discussion of the variables included in each equation are presented below. Since different variables may be included in the "best" estimated equation for each county's cropland, a direct comparison of the influences of certain factors on the per acre prices paid for cropland in each county is not possible.

Alfalfa County Cropland

The Estimated Equation.

$$Y = -2.25 - \underset{(17.10)^1}{0.15X_1^2} + \underset{(.13)^2}{0.10X_2} - \underset{(.35)^2}{7.32X_2^{.5}} - \underset{(.33)^3}{11.87X_3} + \underset{(.33)^3}{3.20X_3^2} + \underset{(2.36)^9}{4.42X_9} - \underset{(2.51)^9}{0.04X_9^2} + \underset{(5.03)^{12}}{0.03X_{12}^2} + \underset{(4.89)^{16}}{4.50X_{16}}$$

(Equation 9 Alfalfa County Cropland 1970-1976)

$R^2 = .8254$

Standard Deviation = 163.39

$\bar{Y}$ = 708.33

Number of Observations = 133

Interpretation. The factors represented by the time variable are the most important in explaining variation in the per acre prices paid for Alfalfa County cropland. An inverse relationship exists between tract size and the expected per acre value of Alfalfa County cropland, although the coefficients of the size variables are not statistically significant. An inverse relationship also exists between expected per acre value and distance to paved road but again the coefficients of these explanatory variables are not statistically significant. The proportion of mineral rights conveyed has a positive influence on per acre prices paid for Alfalfa County cropland. Quality and productivity, as reflected by variables X_{12}^2 (percent squared of the tract contained in soil classes I and II) and X_{16} (cropland productivity index), have a very significant positive influence on the expected per acre value of tracts of Alfalfa County cropland.

Garfield County Cropland

The Estimated Equation.

$$Y = 110.76 + \underset{(7.99)_1}{0.10X_1^2} - \underset{(1.44)_2}{2.66X_2} + \underset{(1.22)_2}{50.36X_2^{.5}} - \underset{(1.50)_3}{72.81X_3} +$$

$$\underset{(1.41)_3}{19.98X_3^2} - \underset{(2.84)_4}{24.54X_4} - \underset{(1.54)_6}{2.95X_6} + \underset{(1.44)_8}{3.70X_8} + \underset{(0,84)_9}{1.55X_9} -$$

$$\underset{(0.83)_9}{0.01X_9^2} + \underset{(1.54)_{12}}{1.41X_{12}} + \underset{(0.75)_{16}}{1.33X_{16}}$$

(Equation 10 Garfield County Cropland, 1970-1976)

R^2 = .7023

Standard Deviation = 121.61

$\bar{Y}$ = 479.21

Number of Observations = 54

Interpretation. The time variable explained the greatest proportion of variation in the per acre prices paid in the estimated equation for Garfield County cropland. An inverse relationship exists between expected per acre value and tract size for tracts up to about 90 acres in size. An inverse relationship also exists between expected per acre value and distances to paved road, to the nearest town and to the nearest city. Population of the nearest principal market has a positive influence on the expected per acre value of Garfield County cropland as does the proportion of mineral rights conveyed. Quality and productivity of the tract have a positive influence on the per acre prices paid for cropland in Garfield County.

Kingfisher County Cropland

The Estimated Equation.

$$Y = 221.31 + \underset{(7.44)^1}{0.10X_1^2} + \underset{(0.74)^2}{3.28X_2} - \underset{(0.70)^2}{61.68X_2^{.5}} - \underset{(1.30)^3}{19.86X_3} - \underset{(.90)^4}{6.65X_4} - \underset{(1.75)^5}{4.06X_5} + \underset{(1.12)^8}{24.01X_8} + \underset{(0.65)^9}{1.34X_9} - \underset{(0.57)^9}{0.01X_9^2} + \underset{(2.12)^{12}}{0.04X_{12}^2} + \underset{(1.55)^{13}}{3.44X_{13}} + \underset{(0.75)^{16}}{1.33X_{16}}$$

(Equation 11 Kingfisher County Cropland, 1970-1976)

R^2 = .8024

Standard Deviation = 115.49

$\bar{Y}$ = 489.95

Number of Observations = 45

Interpretation. The time variable was the best explanatory variable in the estimated equation for Kingfisher County cropland. Tract size, up to about 88 acres, has a negative influence on the expected per acre value of Kingfisher County cropland. Distances to paved road, to the nearest town and to the nearest principal market all have a negative influence on the expected per acre value of cropland in Kingfisher County. A direct relationship exists between population of the nearest principal market and expected per acre value. The proportion of mineral rights conveyed appears to vary directly with the per acre prices paid for Kingfisher County cropland although the coefficients of

X_9 and X_9^2 were not statistically significant even at the 50 percent probability level. Quality and productivity, as reflected by X_{12}^2 (percent squared of the tract in soil classes I and II), X_{13} (percent of the tract in soil classes III and IV) and X_{16} (cropland productivity index) have a positive influence on the per acre prices paid for cropland in Kingfisher County.

Woodward County Cropland

The Estimated Equation.

$$Y = 930.45 + \underset{(3.26)}{0.04X_1^2} + \underset{(1.26)}{1.60X_2} - \underset{(0.99)}{34.66X_2^{.5}} - \underset{(1.05)}{60.03X_3} + \underset{(0.81)}{14.58X_3^2} - \underset{(2.29)}{6.36X_6} + \underset{(1.64)}{1.37X_7} + \underset{(0.93)}{0.03X_{12}^2} + \underset{(1.07)}{2.89X_{13}}$$

(Equation 12 Woodward County Cropland, 1970-1976)

$R^2 = .6736$

Standard Deviation = 110.94

$\bar{Y} = 321.64$

Number of Observations = 30

Interpretation. The factors represented by the time variable are the most significant in explaining variation in per acre prices paid for cropland in Woodward County just as they were in each of the other estimated equations for county cropland values. Tract size, up to about 117 acres, has a negative influence on per acre cropland values in Woodward County. Distance to paved road and distance to the nearest city were also found to have a negative influence on the expected per acre value of Woodward County cropland. Per acre prices paid for Woodward County cropland varied directly with the population of the nearest town. The per acre prices paid for tracts of Woodward County cropland are also expected to vary directly with the quality or productivity of the tracts as measured by variables X_{12} and X_{13}, percent of the tract in soil classes I and II and soil classes III and IV.

Rangeland

Presented below is the "best" estimated equation for rangeland values in the four county study area. Due to the small sample size of rangeland sales available for Alfalfa, Garfield and Kingfisher counties, individual county equations were not estimated for rangeland values. The small number of observations available for several county samples would severely limit the statistical credence of any equations estimated from them. Each of the factors that was hypothesized to have an influence on the per acre sale price of rangeland was tested and those factors which were found to have a significant influence on rangeland prices or were expected to have a significant influence were included in the final equation.

<u>The Estimated Rangeland Equation</u>

$$
\begin{aligned}
Y = -258.62 &+ \underset{(7.75)}{0.04X_1^2} + \underset{(2.18)}{0.18X_2} - \underset{(2.76)}{12.20X_2^{.5}} - \underset{(1.43)}{13.97X_3} + \\
&\underset{(1.02)}{1.01X_3^2} - \underset{(1.07)}{1.52X_5} + \underset{(0.77)}{0.72X_9} - \underset{(1.01)}{0.01X_9^2} + \underset{(3.65)}{2.67X_{15}} + \\
&\underset{(5.48)}{2.35X_{18}} - \underset{(4.75)}{0.002X_{18}^2}
\end{aligned}
$$

(Equation 13 Aggregate Rangeland, 1970-1976)

$R^2 = .6245$

Standard Deviation = 94.79

$\bar{Y} = 244.54$

Number of Observations = 115

Interpretation

Date of Sale. The factors represented by the time variable accounted for a large portion of the variation in prices paid for rangeland in the study area during the study period 1970-1976. The form of the time variable, number of months squared that have elapsed between January, 1970 and the date of sale, indicated that rangeland values have been increasing during the study period. The coefficient of X_1^2 in the estimated rangeland equation suggests that the expected per acre price paid for rangeland has increased approximately $0.04 times the number of months squared that have elapsed between January, 1970 and the date of sale. This would indicate that a tract of rangeland sold in January, 1976 is expected to have brought $213.12 an acre more than a tract sold in January, 1970, all other factors constant. Although the coefficients of X_1^2 in the estimated equations for cropland and rangeland can not be compared in a strict sense, it appears that cropland values have been more strongly influenced by the time factor than rangeland values. A probable explanation for this is that the influences of inflation are greatest on those properties with the highest income producing potential. Thus cropland values have increased relative to rangeland values during the study period. The coefficient of X_1^2 is statistically significant at least at the .01 percent probability level in the estimated rangeland equation.

Size of Tract. An inverse relationship exists between tract size and per acre prices paid for rangeland in the study area. The coefficients of X_2 and $X_2^{.5}$ indicate that the negative influence of additional one acre increases in size diminish as total tract size increases. A one acre increase in size from 40 to 41 acres is expected to decrease per acre value by $0.78 whereas a one acre increase in size from 160 acres to 161 acres is expected to decrease per acre value by only $0.30, all other factors constant. A 160 acre tract of rangeland is expected to bring $30.80 an acre less than an 80 acre tract and $55.56 an acre less than a 40 acre tract. The coefficient of X_2 is statistically significant at least at the five percent level of probability and the coefficient of $X_2^{.5}$ at least at the one percent level.

Distance Variables

Distance to Paved Road. Per acre prices paid for rangeland in the study area are negatively influenced by the distance to paved road. This inverse relationship holds for distances up to about seven miles. The negative influence on per acre value of additional one mile increases in this distance diminish as the total distance from paved road increases. A tract of rangeland located on or adjacent to paved road is expected to bring $12.96 an acre more than a tract located one mile from paved road. The coefficient of X_3 is statistically significant at least at the 20 percent level of probability and the coefficient of X_3^2 at least at the 35 percent level.

Distance to the Nearest Principal Market. An inverse relationship exists between the per acre value of rangeland and distance to the nearest principal market. A one mile increase in the distance that a tract is located from the nearest principal market is expected to result in a $1.52 decrease in its per acre value, all other factors constant. The coefficient of X_5 is statistically significant at the 30 percent level of probability.

Proportion of Mineral Rights Conveyed. Per acre prices paid for rangeland in the four county study area are influenced in a positive manner by the proportion of mineral rights conveyed. The conveyance of an additional percent of mineral rights, up to about 35 percent of the total rights, is expected to increase the per acre value of rangeland. The coefficients of X_9 and X_9^2 suggest that the positive influence of the conveyance of an additional percent of mineral rights declines as the size of the total conveyance increases. The conveyance of a first ten percent of the mineral rights with the sale of a tract of rangeland is expected to increase per acre price by $6.20 while the conveyance of a third ten percent is expected to increase per acre price by only $2.20, all other factors constant. The proportion of mineral rights conveyed does not have a large effect on rangeland values in the study area. The coefficient of X_9 is statistically significant at the 45 percent level of probability and the coefficient of X_9^2 at the 35 percent leve.

Rangeland Productivity Index. A one point increase in the productivity index of a tract of rangeland is expected to increase its per acre value by $2.67. Thus a direct relationship exists between the income producing potential of rangeland, as measured by this index, and the per acre prices paid for it. A tract of rangeland with a productivity index of 50 is expected to sell for $26.70 an acre more than a tract with a productivity index of 40, all other factors constant. The coefficient of X_{15} is statistically significant at least at the .1 percent probability level.

Net County Property Value per Square Mile. A direct relationship exists between rangeland values and the net county property value per square mile of the county in which they are located. Rangeland value increases as the level of wealth or development, as measured by variable X_{18}, of the county in which it is located increases. The coefficients of X_{18} and X_{18}^2 suggest that, all other factors constant, Garfield County rangeland sold in 1974 is expected to have brought $33.36 an acre more than Kingfisher County rangeland, $109.94 an acre more than Alfalfa County rangeland and $206.12 an acre more than Woodward County rangeland. The coefficients of X_{18} and X_{18}^2 are both statistically significant at least at the .01 percent probability level. The factor of county wealth or development is the second most important factor in the estimated rangeland equation in explaining variation in the per acre prices paid.

Summary

Time or the factors represented by time are the most important determinants of price in the cropland and rangeland samples studied. A direct relationship exists between the per acre prices paid for both cropland and rangeland and the number of months squared that have elapsed between the date of sale and the beginning of the study period (January, 1970). The positive influence of the time variable appeared to be greater for cropland, particularly for cropland in Alfalfa County. This finding is consistent with the trend in agricultural land prices that was noted in Chapter II.

The size of the tract did not appear to have a significant effect on the per acre prices paid for cropland in the study area. Tract size was an important explanatory variable in the estimated equation for rangeland sales in the study area, where it was found to have a negative influence on per acre prices paid. This may be a result of the relatively large rangeland tracts commonly sold as opposed to somewhat smaller tracts of cropland.

An inverse relationship exists between the price paid per acre for both rangeland and cropland and the distance to paved road. Distance to paved road is not one of the more important explanatory variables probably because most of the county roads in the study area that are not paved are of a high enough quality to provide all-weather routes of transportation.

All of the estimated equations for cropland samples except Alfalfa County cropland contain at least one "distance to population center" variable. In the aggregate cropland sample, distance to the nearest town has an important negative influence on per acre price. Distance to the nearest principal market also exerts a negative influence on price although it is not nearly as significant as the influence of distance from the nearest town. Distance to the nearest principal market has a negative influence on the per acre price paid for rangeland in the four county study area, although it is not one of the more important explanatory variables in the estimated equation for that sample.

Population of the nearest principal market is included in the estimated equations for aggregate cropland, and Garfield and Kingfisher County cropland samples. A direct relationship exists between population of the nearest principal market and the per acre price paid for cropland in these samples although population of the nearest principal market is not one of the more important determinants of prices paid.

A direct relationship exists between the proportion of mineral rights conveyed and per acre prices paid in each of the samples except Woodward County cropland. This variable is one of the more significant determinants of price in only the Alfalfa County cropland sample and to a lesser degree in an aggregate cropland sample. These findings come about probably because of the limited amount of mineral rights conveyed with the sale of agricultural land, particularly in counties such as Kingfisher where the value of mineral production is relatively large.

Agricultural quality or productivity is a very important determinant of per acre prices paid for cropland and rangeland. In the estimated equation for each of these samples, quality variables are the second most important determinants of price. The productivity index of rangeland has a positive influence on rangeland prices in the four county study area. A direct relationship was also found to exist between the cropland quality variables, which were a measure either of the income potential or the amount of cropland in different soil classes, and prices paid per acre for cropland.

The per acre prices of both cropland and rangeland in the study area vary directly with the net county property value per square mile of the county in which they are located. The magnitude of this influence is somewhat larger on rangeland values. This is probably because agricultural quality or productivity is an unimportant attribute of land that is to be used for non-agricultural development, therefore relatively less productive and less expensive rangeland will be used whenever possible.

CHAPTER VI

AN ALTERNATIVE APPROACH TO ESTIMATING AGRICULTURAL LAND VALUES

In this chapter an alternative way of estimating the value of agricultural land will be examined. Most studies in which land values are estimated utilizing multiple regression analysis techniques focus on estimating per acre values. When per acre values are estimated, these estimates are multiplied by the number of acres in the tract to yield the estimated total tract value. Total tract value can, however, be estimated directly by incorporating the size of the tract into each of the independent explanatory variables. Estimated equations for total tract value can be very useful when they are based on a relatively homogeneous sample, especially in terms of size, and used to estimate the value of tracts similar in size and other characteristics to that sample. Results of equations estimated in this manner can serve as a check or basis of comparison for values obtained through other estimating procedures.

Equations estimated for total tract value may not be appropriate for estimating the value of tracts of agricultural land that have unusual characteristics or are unusually large or small. This is ture, to varying degrees, when using any estimated equation to predict the value of a unique observation. The judgment of the individual appraiser should be exercised in determining the appropriate approach to be followed in estimating the value of a tract of agricultural land and to temper the estimate obtained through any approach.

The Variables

The independent or explanatory variables used to predict or explain the variation in agricultural land prices in the total tract value approach are much the same as those utilized to predict per acre prices paid in earlier chapters. The basic difference in the independent variables used in the two approaches is that each of the variables used in the total tract value approach embody the size of the tract within them. If the total value of a tract were to be estimated using the independent variables used in Chapters III-V, size of the tract would surely be the largest single determinant of value to the exclusion of all other variables. For instance, the independent variable distance to the nearest town is expressed in acre-miles where the value of this variable is equal to the number of acres in the tract times the number of miles that the tract is located from the nearest town. In similar fashion, the proportion of the tract in cropland of soil classes I and II is expressed as the number of acres within the tract that are in cropland of soil classes I and II in the total tract value approach. The dependent variable, total price paid for the tract, used in estimating the total tract value is equal to the total price paid for the tract of agricultural land less the value of improvements on the tract. An explanation of each of the variables used in this approach is given below along with the units in which each independent variable is expressed.

Y_0 = Total Price (dollars)

X_{01} = Date of sale (acre months)

X_{03} = Distance to paved road (acre miles)

X_{04} = Distance to the nearest town (acre miles)

X_{05} = Distance to the nearest principal market (acre miles)

X_{06} = Distance to the nearest city (acre miles)

X_{07} = Population of the nearest town (acre population)

X_{08} = Population of the nearest principal market (acre population)

X_{09} = Acres of mineral rights conveyed (acres)

X_{010} = Acres of cropland in the tract (acres)

X_{011} = Acres of rangeland in the tract (acres)

X_{012} = Acres of cropland of soil classes I and II contained in the tract (acres)

X_{013} = Acres of cropland of soil classes III and IV contained in the tract (acres)

X_{014} = Productivity index for cropland, among counties (acre points)

X_{015} = Productivity index for rangeland, among counties (acre points)

X_{016} = Productivity index for cropland, within counties (acre points)

X_{017} = Productivity index for rangeland, within counties (acre points)

X_{018} = Net county property value per square mile (acre dollars)

Procedure

The procedure followed in estimating the total tract value equations was much the same as that followed in estimating equations for per acre values in earlier chapters. The correlation among variables was first studied. A stepwise (MAXR) procedure was then utilized to rank the independent variables in the order of their explanatory abilities and finally equations were specified and tested. The best equations were selected based on the same criteria used earlier.

The Estimated Total Tract Value Equation

The estimated equation for total tract value in the aggregate four county sample is presented below.

$$\begin{aligned} Y_0 = {} & 3226.83773 + \underset{(24.78)}{5.53957X_{01}} - \underset{(8.21)}{0.00001X_{01}^2} - \underset{(2.21)}{2.92772X_{04}} - \\ & \underset{(6.30)}{3.73515X_{05}} - \underset{(2.43)}{0.33019X_{06}} + \underset{(2.04)}{21.76967X_{09}} + \\ & \underset{(4.12)}{106.05748X_{010}} + \underset{(4.30)}{104.16678X_{011}} + \underset{(5.72)}{159.48994X_{012}} + \underset{(8.97)}{5.87143X_{014}} \end{aligned}$$

(Equation 14 Four County, 1970-1976)

$R^2 = .7644$

Standard Deviation = 22863.01

$\bar{Y}_0 = 59620.00$

Number of Observations = 913

The coefficient of determination for the above estimated equation indicates that over 76 percent of the variation in total tract prices is explained by the ten explanatory variables included in the equation.

Interpretation

Date of Sale

The factors represented by the time variables in the above estimates equation are the most important in explaining variation in total prices paid for tracts of agricultural land in the four county study area during the period 1970-1976. The coefficients of X_{01} and X_{01}^2

in the estimated equation suggest that total tract prices have increased rapidly throughout the study period but that the rate of increase may be slowing somewhat. A 160 acre tract sold in January 1976 is expected to have brought \$10,207.06, \$20,487.84, \$30,842.33, \$41,270.56, \$51,772.52, and \$62,348.21 more than 160 acre tracts selling in January 1975, January 1974, January 1973, January 1972, January 1971, and January 1970, respectively, all other factors constant. The coefficients of X_{01} and X_{01}^2 are statistically significant at least at the .01 percent probability level.

Distance Variables

Distance to the Nearest Town. An inverse relationship was found to exist between distance to the nearest town and total tract price. The coefficient of X_{04} indicates that expected total tract price is reduced approximantely \$2.93 for each acre mile that a tract is located from the nearest town. A 160 acre tract located ten miles from the nearest town will be expected to sell for \$4,684.35 less than a 160 acre tract located adjacent to the corporate limits of the nearest town, all other factors constant. The coefficient of X_{04} is statistically significant at least at the five percent level of probability.

Distance to the Nearest Principal Market. Expected total tract price is negatively influenced by the distance to the nearest principal market. The coefficient of X_{05} suggests that expected total price is reduced approximately \$3.74 for each acre mile that a tract is located from the nearest principal market. A 160 acre tract located 20 miles from the nearest principal market is expected to sell for \$11,952.48 less than a 160 acre tract located adjacent to the corporate limits of the nearest principal market, all other factors constant. The coefficient of X_{05} is statistically significant at the .01 percent probability level.

Distance to the Nearest City. An inverse relationship exists between total tract price and distance to the nearest city in the study area. The coefficient of X_{06} suggests that total price is reduced approximately $0.33 for each acre mile that a tract is located from the nearest city (Oklahoma City). A 160 acre tract located 100 miles from Oklahoma City is expected to sell for $5,284.64 less than a 160 acre tract located adjacent to the corporate limits of Oklahoma City, all other factors constant. The coefficient of X_{06} is statistically significant at least at the five percent level of probability.

Location of a tract with respect to the nearest principal market apparently influences total tract value to a greater extent than either location with respect to the nearest town or the nearest city. It should also be noted that distance to paved road was not found to have a significant influence on total tract prices. This distance variable was, in some instances, found to be an important determinant of per acre prices in equations estimated in earlier chapters.

Acres of Mineral Rights Conveyed

A direct relationship was found to exist between the number of acres of mineral rights conveyed with the sale of a tract of agricultural land and the total price paid for it in the four county study area. As indicated by the coefficient of X_{09} in the estimated equation, total tract price is expected to increase approximately $21.77 for each additional acre of mineral rights conveyed. This suggests that a tract selling with 50 acres of mineral rights is expected to bring $1,088.48 more than a tract selling with no mineral rights, all other factors constant. The coefficient of X_{09} is statistically significant at the five percent probability level.

Number of Acres of Cropland and Rangeland in the Tract

Cropland. The number of acres of cropland contained within a tract of agricultural land has a positive influence on the total value of that tract. The coefficient of X_{010} indicates that expected total tract price is increased approximately $106.06 for each additional acre of cropland added. The coefficient of X_{010} is statistically significant at least at the .01 percent level of probability.

Rangeland. A direct relationship was found to exist between total tract price and the number of acres of rangeland contained in the tract. As indicated by the coefficient of X_{011}, expected total tract price is increased approximately $104.17 for each additional acre of rangeland added to the tract, all other factors constant. The coefficient of X_{011} is statistically significant at least at the .01 percent level of probability.

Quality and Productivity Variables

Acres of Cropland of Soil Classes I and II in the Tract. Expected total tract price is influenced in a positive manner by the number of acres of cropland of soil classes I and II contained in the tract. An additional acre of cropland of this category is expected to increase total tract price by approximately $159.49. A tract containing 40 acres of cropland of soil classes I and II will be expected to bring $6,379.60 more than a tract containing no cropland of this category, all other factors constant. The coefficeint of X_{012} is statistically significant at least at the .01 percent level of probability.

Cropland Productivity Index. A direct relationship exists between total tract price and the productivity index of cropland contained in a tract of agricultural land. Total tract price is expected to increase approximately $5.87 for each acre point increase in this index for a tract. A 160 acre tract containing 100 acres of cropland with a productivity index of 40 is expected to bring $5,871.43 more than a 160 acre tract containing the same amount of cropland with a productivity index of 30, all other factors constant. The coefficient of X_{014} is statistically significant at the .01 percent probability level.

The inclusion of the two quality or productivity variables relating to cropland contained in a tract accounts for the magnitude of the coefficient of X_{010} (cropland acres) relative to the magnitude of X_{011} (rangeland acres). It was expected that an acre of cropland would add more to total tract price than an acre of rangeland. From the coefficients of X_{010} and X_{011} it appears that an acre of cropland and an acre of rangeland add approximately the same amount to total tract price. An acre of cropland, depending upon its quality or productivity, can add substantially more to total tract price as indicated by the coefficients of X_{012} and X_{014}. The productivity variable relating to rangeland, X_{015}, did not have a significant influence on total tract price.

In addition to X_{03} (distance to paved road), neither of the population variables were included in the final estimated equation for total tract value in the study area. The variables relating to net county property value per square mile (X_{018}) and cropland of soil classes III and IV (X_{013}) were not found to significantly influence total tract price as they had been found to do so in the estimated equation for per acre price.

Estimated Total Tract Value Equations by County

Equations were estimated for total tract value for each of the four counties studied. This was done in an attempt to determine differences in the factors influencing total tract values in each county. The "best" estimated equation for each county differs in structure. Thus a direct comparison of the relationships between certain variables and total tract prices in each county is not possible. The discussion will focus on which factors appear to influence total tract prices in each county.

Alfalfa County

The Estimated Equation.

$$Y_0 = 8347.78924 + \underset{(19.45)}{8.18952X_{01}} - \underset{(6.11)}{7.99258X_{05}} + \underset{(17.61)}{476.76426X_{012}} + \underset{(3.37)}{145.76033X_{013}}$$

(Equation 15, Alfalfa County, 1970-1976)

$R^2 = .7652$

Standard Deviation = 25394.20

$\bar{Y}$ = 74958.02

Number of Observations = 262

Interpretation. The factors represented by the time variable account for a very large proportion of the variation in total tract prices in Alfalfa County. Distance to the nearest town, as measured in acre miles, has a negative influence on total tract prices of Alfalfa County agricultural land. A direct relationship exists between total tract price and both acres of cropland of soil classes I and II contained in the tract and acres of cropland of soil classes III and IV contained in the tract.

Garfield County

The Estimated Equation.

$$Y_0 = 5822.92547 + \underset{(19.62)}{8.09292X_{01}} - \underset{(3.63)}{12.07952X_{04}} - \underset{(2.80)}{4.15715X_{05}} + \underset{(1.77)}{36.00604X_{09}} + \underset{(2.01)}{81.71437X_{010}} + \underset{(1.08)}{47.25687X_{011}} + \underset{(4.62)}{164.33568X_{012}}$$

(Equation 16, Garfield County, 1970-1976)

$R^2 = .7632$

Standard Deviation = 17794.89

$\bar{Y} = 54366.06$

Number of Observations = 271

Interpretation. Variation in total tract price in Garfield County is largely explained by variation in the factors represented by the time variable (X_1). Distance to the nearest town and to the nearest principal market both have a significant negative influence on total tract prices in Garfield County. A direct relationship exists between the proportion of mineral rights conveyed and total tract value. Both the number of acres of cropland and rangeland contained in a tract of agricultural land have a positive influence on total tract prices in Garfield County. Expected total tract price is further increased by the influence of the number of acres of cropland of soil classes I and II in the tract.

Kingfisher County

The Estimated Equation.

$$Y_0 = 1198.34434 + \underset{(15.36)}{5.87186X_{01}} - \underset{(4.03)}{3.70909X_{05}} + \underset{(0.92)}{2.71221X_{08}} + \underset{(5.37)}{218.25162X_{010}} + \underset{(3.75)}{133.29218X_{011}} + \underset{(5.67)}{199.87227X_{012}}$$

(Equation 17, Kingfisher County, 1970-1976)

$R^2 = .7945$

Standard Deviation = 17323.13

$\bar{Y} = 54428.93$

Number of Observations = 224

Interpretation. In the estimated equation for Kingfisher County, time was again found to be the dominant variable in explaining variation in total tract prices paid for agricultural land. Distance to the nearest principal market has a negative influence on total tract prices in this county, while population of the nearest principal market influences total tract prices in a positive manner. The number of acres of cropland and the number of acres of rangeland contained in a tract of Kingfisher County agricultural land are both directly related to expected total tract price. Expected total tract value is further enhanced by the number of acres of cropland of soil classes I and II in the tract

As in the estimated equations for Alfalfa and Garfield counties, X_{012} is second to the time variable in its importance in explaining variation in total tract prices.

Woodward County

The Estimated Equation.

$$\begin{aligned} Y_0 = {} & 4129.07257 + \underset{(10.25)}{2.79656X_{01}} - \underset{(5.14)}{0.000009X_{01}^2} - \\ & \underset{(6.87)}{4.37110X_{05}} - \underset{(1.14)}{0.36490X_{06}} + \underset{(1.30)}{115.54833X_{010}} + \\ & \underset{(4.34)}{206.34614X_{011}} + \underset{(2.27)}{107.25692X_{012}} + \underset{(2.94)}{3.71618X_{016}} \end{aligned} \qquad \text{(Equation 18, Woodward County, 1970-1976)}$$

R^2 = .9322

Standard Deviation = 15761.90

$\bar{Y}$ = 50440.89

Number of Observations = 156

Interpretation. As in the other three estimated county equations for total tract value, the time variable is the most important variable in explaining variation in total tract prices paid in Woodward County. In the estimated equation for Woodward County total tract values, the time factor is represented by variables X_{01} and X_{01}^2. The coefficients of these variables indicate that total tract prices have been increasing during the study period in Woodward County but that the rate of increase may be slowing somewhat. Distance to the nearest principal market and distance to the nearest city both influence total tract price in a negative manner. Expected total tract price is increased by the influence of the number of acres of cropland and the number of acres of rangeland in the tract. The positive influence of the number of acres of rangeland in the tract is larger than that of the number of acres of cropland in the tract but this is due to the inclusion of two cropland quality or productivity variables in the estimated equation. The added influence of these two variables (X_{012} and X_{016}) will in most cases result in an additional acre of cropland adding more to total tract value than an additional acre of rangeland.

Estimated Total Tract Value Equations for Tracts of Cropland and Rangeland

In an effort to determine the factors which influence the total tract value of tracts of cropland and rangeland, equations were estimated for tracts containing 90 percent or more cropland or rangeland. The two estimated equations that are presented in this section not only represent different samples but will also differ significantly in structure. Thus a direct comparison of the influence or relationship between certain factors and total tract value in each sample is inappropriate.

Cropland

The Estiamted Equation.

$$Y = 3943.27982 + \underset{(18.28)}{8.94198X_{01}} - \underset{(4.49)}{19.65146X_{04}} - \underset{(1.76)}{2.72217X_{05}} + \underset{(3.14)}{150.36010X_{012}} + \underset{(6.09)}{5.96344X_{014}} \quad \text{(Equation 19, Cropland, 1970-1976)}$$

R^2 = .7873

Standard Deviation = 24409.94

Y_0 = 69901.30

Number of Observations = 262

Interpretation. The factors represented by the time variable (X_{01}) appear to account for the largest proportion of variation in total tract prices paid for tracts of cropland in the study area. Expected total tract prices of cropland increased rapidly during the study period due to the influence of these factors. An inverse relationship exists between total tract prices of cropland and the distance to the nearest town and the distance to the nearest principal market. Quality and productivity were found to be very important determinants of total tract prices paid for cropland. The productivity index of cropland is second in importance to the time variable in explaining variation in total tract prices. The number of acres in a tract of soil classes I and II has a significant positive influence on total tract value.

Rangeland

The Estimated Equation.

$$Y = 5626.27668 + \underset{(1.61)}{0.62677X_{01}} - \underset{(2.52)}{0.42451X_{06}} + \underset{(5.32)}{3.03738X_{015}} + \underset{(3.70)}{0.28366X_{018}}$$

(Equation 20, Rangeland, 1970-1976)

R^2 = .8985

Standard Deviation = 18590.11

Y_0 = 43703.65

Number of Observations = 115

Interpretation. A direct relationship exists between the total tract prices paid for rangeland in the study area and the number of months elapsed between January, 1970 and the date of sale as reflected by the coefficeint of variable X_{01}. This relationship between price and time is not nearly as significant as it was found to be in other estimated total tract value equations. An inverse relationship exists between distance to the nearest city and total tract price. The productivity index of rangeland has a very significant positive influence on expected total tract price. This variable (X_{015}) is the most important variable in the estimated equation in explaining variation in total tract prices paid for rangeland. Variable X_{018}, net county property value per square mile, also has a significant positive influence on total tract prices.

Use of the Estimated Equations

In order to illustrate how the equations estimated for total tract values might be used, two hypothetical farms are presented below and their estimated values calculated as of June 30, 1976 using the appropriate county equations. The hypothetical farms presented below are the same as those used in Chapter IV so that a comparison of the values obtained through the use of total tract value and per acre value approaches might be made.

> Farm 1: Located in Alfalfa County; size of farm 160 acres; located one mile from paved road; located 5 miles from the nearest town (population 500); located 12 miles from the nearest principal market (population 2200); located 115 miles from Oklahoma City; 50 percent of the mineral rights are conveyed; 136 acres of cropland of which 104 acres is soil classes I and II and 32 acres are in soil classes III and IV: 24 acres of rangeland; within county productivity index for cropland = 84; (as shown in Appendix A).

Since the subject farm is located in Alfalfa County, equation 15 will be used to estimate its total value. Equation 15 and the values of the independent variables included in it are shown below along with the calculation of estimated total tract value.

$Y_0 = 8347.78924 + 8.18952X_{01} - 7.99258X_{05} + 476.76426X_{012} +$
$145.76033X_{013}$

$X_{01} = 160.0 \times 78.0 = 12480.0$

$X_{05} = 160.0 \times 12.0 = 1920.0$

$X_{012} = 104.0$

$X_{013} = 32.0$

$Y_0 = 8347.78924 + 8.18952(12480.0) - 7.99258(1920.0) + 476.76426$
$(104.0) + 145.76033(32.0)$

$Y_0 = 8347.78924 + 102205.20 - 15345.75 + 49583.48 + 4664.33 =$
$149.455.05 = Total Tract Value

Total tract value estimated using the per acre value approach (equation 4) was $186,915.20.

Farm 2: Located in Woodward County; size of farm 160 acres; located 2 miles from paved road; located 8 miles from the nearest town (population 300); located 18 miles from the nearest principal market (population 9400); located 130 miles from Oklahoma City; 25 percent of mineral rights are conveyed; 60 acres of cropland of which 20 acres is in soil classes I and II and 40 acres is in soil classes III and IV; 100 acres of rangeland; within county productivity index for cropland = 45.3; (as shown in Appendix A).

Since the subject farm is located in Woodward County, equation 18 will be used to estimate its total value. Equation 18 and the value of the independent variables included in it are shown below along with the calculation of estimated total tract value.

$Y_0 = 4129.07257 + 2.79656X_{01} - 0.000009X_{01}^2 - 4.37110X_{05} -$
$0.36490X_{06} + 115.54833X_{010} + 206.34614X_{011} - 107.25692X_{012} +$
$3.71618X_{016}$

$X_{01} = 160.0 \times 78.0 = 12480.0$

$X_{01}^2 = (160.0 \times 78.0)^2 = 155750400.0$

$X_{05} = 160.0 \times 18.0 = 2880.0$

$X_{06} = 160.0 \times 130.0 = 20800.0$

$X_{010} = 60.0$

$X_{011} = 100.0$

$X_{012} = 20.0$

$X_{016} = 60.0 \times 45.3 = 2718.0$

$$Y_0 = 4129.07257 + 2.79656(12480.0) - 0.000009(155750400.0) - 4.37110(2880.0) - 0.36490(20800.0) + 115.54833(60.0) + 206.34614(100.0) + 107.25692(20.0) + 3.71618(1800.0)$$

$$Y_0 = 4129.07257 + 34901.07 - 1401.75 - 12588.77 - 7589.92 + 6932.90 + 20634.61 + 2145.15 + 10100.58 = \$57,262.93 = \text{Total Tract Value}$$

Total tract value estimated using the per acre value approach (equation 7) was $60,785.60.

Summary

Most conventional approaches to estimating the market value of a tract of agricultural land focus on per acre values at least as a step in deriving total value. An alternative approach to estimating the market value of a tract is to estimate the total tract value directly. The explanatory variables used in this alternative approach are much the same as those used in the per acre analysis except that each variable also has the size of the tract incorporated into it. Thus size or the number of acres in the tract is not a direct determinant of value but instead its influence is implicitly reflected through each of the independent variables.

The value of an alternative approach lies not so much in showing that the results of another approach are right or wrong but in serving as a check for the results of other approaches. Although the two approaches presented in this study may yield widely divergent market value estimates, they can still be very useful in that they give the user a range of values to work with. A subjective element persists in that the individual appraiser must determine which of alternative approaches best fits the appraisal situation.

As in the per acre valuation approach, the factors of time and agricultural quality of the land were the most significant determinants of prices paid for agricultural land. The time variable, number of months elapsed between the date of sale and January, 1970, is the most important explanatory variable in each of the estimated county equations, the aggregate equation and the estimated equation for the aggregate cropland sample. The positive influence of time was greatest in the estimated equations for the aggregate cropland and Alfalfa County samples. The influence of time was the smallest in the aggregate rangeland and Woodward County samples. It appears that a period of rising prices, particularly agricultural commodity prices, will have its greatest impact on the value of those lands that are of a relatively high quality in terms of productivity and income generating potential from agricultural production.

"Distance to population center" variables proved to be important factors in determining total tract prices just as they had been found to be important determinants of per acre prices paid. Distance to the nearest principal market was included as an explanatory variable in all but one of the equations estimated using the total tract value approach. Although distance to the nearest town and distance to the nearest city appeared in three estimated equations, it appeared that distance to the nearest principal market was the most important distance variable in determining total tract value.

The amount of mineral rights conveyed with the sale of a tract of agricultural land was found to exert a significant positive influence on the price paid for that tract only in the Garfield County and aggregate samples. The low level of mineral rights transfer in the more mineral rich areas accounts for the relative unimportance and subsequent absence of this variable in most of the estimated equations.

The number of acres of cropland and the number of acres of rangeland in a tract had a positive influence on total tract prices paid in the Garfield County, Kingfisher County, Woodward County and aggregate samples. When both the number of acres in each use and the quality variables were considered, it was evident that the contribution to total tract value of an additional acre of cropland was far in excess of the contribution of an additional acre of rangeland.

Each of the six estimated equations for samples containing cropland included the number of acres of cropland in soil classes I and II as an explanatory variable. This variable was second only to the time variable in the amount of variation in total tract prices explained in the Alfalfa County, Garfield County and Kingfisher County samples. A very significant direct relationship between total tract prices paid and the productivity index of the tract existed. This finding lended further support to the idea that the agricultural production capability of the tract is one of the most important determinants of tract value.

CHAPTER VII

SUMMARY, CONCLUSIONS AND NEED FOR FURTHER RESEARCH

Summary

The general objective of this study was to examine the agricultural land market in north central Oklahoma, with special emphasis on deriving agricultural land values in this area for the period 1970-1976 and determining the important factors which influence agricultural land values in this area. In addition, agricultural land values in each of four selected representative counties of north central Oklahoma were analyzed along with cropland and rangeland values in this area. An alternative approach to estimating agricultural land values was also examined and presented.

The data employed in this study came from information obtained from bona fide sales of agricultural land during the period January, 1970 - June, 1976 in the four study counties. In all, 913 sales of agricultural land were analyzed. This sample included 262 sales from Alfalfa County, 271 sales from Garfield County, 224 sales from Kingfisher County and 156 sales from Woodward County.

<u>Agricultural Land Market Activity in North Central Oklahoma</u>

The agricultural land sales analyzed in this study for the period January, 1970 through June, 1976 involved approximately 141,000 acres or 5.44 percent of the total area of the four counties studied. Agricultural land sales studied accounted for 6.71 percent of the total area of Alfalfa County, 5.27 percent of the total area of Garfield County, 5.27 percent of the total area of Kingfisher County and 4.82 percent of the total area of Woodward County. Market activity, as represented by the proportion of total county area involved in agricultural land sales, appeared to vary directly with the general productivity level of county agricultural lands.

<u>The Level of Agricultural Land Values in North Central Oklahoma</u>

The average price paid for all agricultural land in the four north central Oklahoma counties studied for the 1970-1976 period was $426.27 an acre. The average price paid in 1970 was $256.89 an acre and the average price paid in the first six months of 1976 was $646.05 an acre. This represents a 151 percent increase in the average value of agricultural land in the four county study area in 5.75 years. The largest increase in agricultural land values came in 1974 when the average value climbed 53 percent over the 1973 level.

The average price paid for Alfalfa County agricultural land during the study period was $553.37 an acre. The average price paid in the first six months of 1976, $951.23 an acre, represented a 206 percent increase over the average price paid in 1970, $311.02 an acre. The average price paid for Garfield County agricultural land rose 203 percent in five years, from an average price paid in 1970 of $237.93 an acre to an average price paid in 1975 of $721.87 an acre. The average price paid for Garfield County agricultural land in the first six months of 1976 declined approximately 16 percent from the 1975 level, from

$721.87 an acre to $605.10 an acre. This finding may be a result of the small sample of sales available for the first six months of 1976 or it may indicate a leveling off of the general upward trend of agricultural land values in that county. The average price paid for agricultural land in Garfield County during the study period was $424.35 an acre. The average price paid for Kingfisher County agricultural land during the study period was $414.64 an acre. The average price paid in the first six months of 1976, $766.18 an acre, represented a 183 percent increase over the average price paid in 1970, $270.42 an acre. Woodward County agricultural land brought an average price of $232.82 an acre during the 1970-1976 period studied. The average price paid for agricultural land in that county in the first six months of 1976, $380.16 an acre, represented a 160 percent increase in agricultural land values over the 1970 level, $145.98 an acre.

As with the level of market activity, it appeared that county agricultural land values vary directly with the general level of productivity of county agricultural lands. As shown by the measures used in this study, Alfalfa County had the most productive agricultural land, the largest amount of market activity and the highest agricultural land values. Garfield and Kingfisher counties were roughtly the same in each of these categories while Woodward County ranked last in the four counties studied in each of the measures.

Average cropland and rangeland values were derived by analyzing agricultural land sales which contained 90 percent or more cropland or rangeland. Two hundred sixty-two cropland and 115 rangeland sales were analyzed. The average price paid for cropland in the four county study area for the period 1970-1976 was $579.32. Between 1970 and 1975, the average value of cropland increased 174 percent, from $347.36 an acre to $952.64 an acre. The average price paid for cropland declined 22 percent in the first six months of 1976 from the 1975 level, to $740.42. Again this may have been a result of the small sample of sales available for the first half of 1976 or it may indicate a reversal or slowdown in the upward trend of cropland values.

The average value of rangeland in the four county study area increased approximately 99 percent during the period 1970-1975, from an average value of $177.66 an acre in 1970 to $352.67 an acre in 1975. The average value of rangeland during the study period was $244.54 an acre.

Just as agricultural land values were found to increase relatively more rapidly in those counties with the more productive agricultural land, the value of cropland in the study area has increased relative to the value of generally less productive rangeland. It appeared that increases in agricultural land values were directly related to the productivity or income producing potential of the land.

Other Characteristics of Agricultural Land Sales

Tract Size. The average size of agricultural tract sold in the four county study area during the period 1970-1976 was 154.4 acres. Agricultural land sales averaged 142.1, 131.3, 134.6 and 243.8 acres in Alfalfa, Garfield, Kingfisher and Woodward counties respectively. The average size of tracts sold showed no discernible trend in any of the counties during the study period.

Proportion of Mineral Rights Conveyed. An average of 49.6 percent of the mineral rights were transferred with the sale of agricultural land in the study area. There was some evidence to indicate that the proportion of mineral rights being conveyed with the sale of agricultural land is declining. An inverse relationship appeared to exist between the value of mineral production in a county and the proportion of mineral rights conveyed with the sale of agricultural land in that county.

Factors Influencing the Value of Agricultural Land in North Central Oklahoma

Multiple regression analysis was employed to determine the direction, magnitude and significance of relationships existing between prices paid per acre for agricultural land and hypothesized explanatory variables. Equations were estimated to explain or predict per acre prices in the four county study area for the time periods 1970-1976, 1970-1973 and 1974-1976. Equations were also estimated for agricultural land values in each of the four counties studied and for cropland and rangeland. Previous studies of agricultural and rural land values guided the choice of factors to be analyzed in these estimated equations.

Four County Equations. The time variable included in the estimated equation for agricultural land values in the four county study area for the period 1970-1976 proved to be the most important variable in that equation in explaining variation in per acre prices paid for agricultural land. This variable was included to reflect the general influences of inflation, net rent increases, farm enlargement, expanding non-farm use of rural lands, the increasing importance of tax breaks and advancing technology. Tract size and per acre prices paid for agricultural land were found to vary inversely. Distances to paved road, the nearest town and the nearest principal market were found to have a negative influence on agricultural land values. The proportion of mineral rights conveyed with the sale of a tract of agricultural land was found to have a positive influence on its per acre value. Quality and productivity factors, as reflected by the percent of the tract in cropland of soil classes I and II or soil classes III and IV and the cropland productivity index, were found to have a very significant positive influence on agricultural land values. The quality or productivity factor was second in importance to the time factor in explaining variation in per acre prices paid for agricultural land. The value of agricultural land was also found to vary directly with the net county property value per square mile of the county in which it was located.

The estimated equations for agricultural land values in the four county study area for the periods 1970-1973 and 1974-1976 indicated that the importance of the influence of certain factors had changed during the study period. Time was not as important as an explanatory variable in the estimated equation for the later period. Tract size appeared to be a more significant determinant of per acre value in the later period. Proximity to paved roads and to the nearest town as determinants of per acre value of agricultural land appeared to decline in importance during the study period. However, the importance of distance to the nearest principal market as a determinant of agricultural land values appeared to have grown. The positive influence of each of the variables reflecting the quality or producivity factor increased from the first subperiod to the second indicating the importance of quality or productivity as a determinant of agricultural land values had grown. The coefficients of determination of the estimated equation for the two subperiods indicated that a relatively greater proportion of the variation in prices paid for agricultural land was unaccounted for by variation in the explanatory variables in the 1970-1973 period.

County Equations

Alfalfa County. The time variable represented the most important factors which accounted for variation in Alfalfa County agricultural land values. Tract size was found to have a negative influence on per acre values, although this variable was not nearly as significant a determinant of per acre prices paid as other variables included in this county equation. Distance to paved road was found to be the only distance variable to significantly affect agricultural land values in Alfalfa County. The proportion of mineral rights conveyed was found to have a positive influence on the value of agricultural land. The quality or productivity factor was very important in determining agricultural land values in this county.

Garfield County. The factors of time and quality or productivity were found to be the important determinants of agricultural land values in Garfield County. An inverse relationship was found to exist between per acre prices paid for Garfield County agricultural land and tract size. Distance to paved road, the nearest town and the nearest principal market were also found to exert a negative influence on agricultural land values. Distance to the nearest principal market was found to be the most important of these distance factors in explaining variation in per acre prices paid for agricultural land in Garfield County. The proportion of mineral rights conveyed exerted a significant positive influence on agricultural land values in this county. Measures of productivity for both cropland and rangeland were found to be significant determinants of Garfield County agricultural land values.

Kingfisher County. Variation in Kingfisher County agricultural land values was best explained by the time variable included in the estimated equation for that county. An inverse relationship was found to exist between tract size and the per acre prices paid for agricultural land. An inverse relationship was also found to exist between per acre prices paid for agricultural land and distances to paved road and the nearest principal market. Agricultural land values in Kingfisher County varied directly with the population size of the nearest town and principal market. Quality or productivity factors for both cropland and rangeland were important determinants of Kingfisher County agricultural land.

Woodward County. The time variable represented the most important factors which accounted for variation in Woodward County agricultural land values. The per acre value of agricultural land was found to be influenced in a negative manner by tract size. Also exerting a negative influence on the per acre prices paid for Woodward County agricultural land were distance to paved road, distance to the nearest town and distance to the nearest principal market. Of these distance factors, distance to paved road was found to be the most important in explaining variation in prices paid for Woodward County agricultural land.

Cropland and Rangeland Equations

Cropland. The factors of time and productivity were the most important factors determining the value of cropland in the study area.

Both of these factors were found to influence per acre prices paid for cropland in a very significant manner. Tract size was found to have a negative influence on per acre value although the size factor was relatively unimportant in explaining variation in per acre values. Distances to paved road, to the nearest town and to the nearest principal market all had a negative influence on per acre prices paid for cropland. Distance to the nearest town was found to be the most important of these distance factors in determining per acre values of cropland. A direct relationship was found to exist between the proportion of mineral rights conveyed and the per acre value of cropland in the study area. In addition to the productivity factor, the percent of the tract contained in soil classes I and II and soil classes III and IV had a significant positive influence on per acre prices paid for cropland. Cropland values were also found to vary directly with the net county property value per square mile of the county in which a tract is located.

Rangeland. Variation in the per acre values of rangeland in the study area was best explained by the factors represented by the time variable. Net county property value per square mile of the county in which a tract of rangeland is located was the second most important variable in the estimated rangeland equation in explaining variation in per acre prices paid for rangeland. Each of these factors was found to have a very significant positive influence on rangeland values. Tract size was a relatively important determinant of per acre prices paid for rangeland. Per acre prices was found to vary inversely with tract size. Distance to paved road and distance to the nearest principal market were both found to influence the per acre value of rangeland in a negative manner. Per acre prices paid for rangeland in the study area were found to vary directly with the proportion of mineral rights conveyed. A very significant direct relationship existed between rangeland values and the productivity factor, as measured by the among counties rangeland productivity index.

An Alternative Approach to Estimating Agricultural Land Values

An alternative or complementary approach to estimating agricultural land values was presented. This approach involved estimating total tract values directly. Tract size was not treated as an explanatory variable in this approach but was instead indirectly reflected through each of the other explanatory variables. This was accomplished by multiplying each of the other variables by size so that the dependent variable was expressed as total tract price and each of the explanatory variables was expressed in acre units.

The estimated equation for total tract values in the study area indicated that the factors of time and quality or productivity were the most important in explaining variation in prices paid for agricultural land just as they were found to be in the more conventional per acre value approach. These factors were found to have very significant positive influences on total tract prices paid for agricultural land. An inverse relationship was found to exist between total tract value and distances to paved road, to the nearest town, to the nearest principal market and to the nearest city. The proportion of mineral rights conveyed was found to exert a positive influence on total tract prices paid for agricultural land. A direct relationship was also found to exist between total tract prices paid and the number of acres of cropland and the number of acres of rangeland in the tract.

The estimated equation for total tract value appeared to explain a slightly greater proportion of the variation in total tract prices of agricultural land than the estimated equation for per acre values explained in per acre prices. The total tract value approach can be useful, when used in conjunction with other approaches, in providing a check for estimated values derived using other approaches and in providing the appraiser with a range of estimated values to work with.

Conclusions

The Trend

Agricultural land values in north central Oklahoma have increased dramatically in the first half of this decade. The trend that agricultural land values will follow for the remainder of the decade is not clearly evident from this study. Some evidence of this study indicates that agricultural land values are not likely to continue increasing at the rapid rate at which they did in the period 1970-1975; note Figure 2 in Chapter II, showing a decline in average prices for the first six months of 1976.

The upward trend in agricultural land values was greatest in those counties with the more productive agricultural land, and for the more productive types of agricultural land. Changes in the trend of agricultural land values will be reflected first and most dramatically in those areas and for those types of agricultural land which are more productive, have a higher income producing potential and a higher per acre value.

Agricultural land values in less productive areas and for less productive types of agricultural land will follow the pattern set by values of more productive lands in a somewhat lagged fashion.

The Factors

The factors represented by the time variable used in this study were found to explain the greatest proportion of variation in agricultural land values. Inflation, net rent increases, expanding non-farm use of rural lands and advancing technology are the most important factors represented by this variable. Expectations of both farmers and non-farmers of the levels or changes in the levels of these factors are expected to play a major role in determining agricultural land values. Increases in the expected rate of inflation should draw into the agricultural land market more potential buyers who view the ownership of agricultural land as a safe hedge against inflation. Expected increases in the net rents that can be earned by agricultural land should result in the bidding of higher prices for agricultural land by both farmers and non-farmer investors. Further expansion of the use of agricultural lands for residential, commercial and industrial purposes should result in the value of agricultural lands being bid up as the range of potential uses of these lands shifts away from strictly agricultural. This effect is expected to be greatest in those areas which are more densely populated and developed. Further advances in the technology available to agricultural producers should result in higher agricultural land values as the relative costs of other inputs required to produce a given amount of agricultural commodities declines making land a more and more limited resource. Technological advances enabling producers to achieve greater economies of size is expected to increase the demand for agricultural lands.

Tract size has become an increasingly important determinant of the per acre prices that are paid for agricultural land. Greater capital outlay requirements for purchasing a given size tract of agricultural land should result in a reduction of the number of potential buyers able to bid on tracts of agricultural land.

Proximity to paved roads and population centers are important determinants of agricultural land values. These factors reflect the potential demand for agricultural land and rural residences, suburban development and commercial and industrial development. The importance of proximity to paved roads as a determinant of agricultural land values has declined in recent years. This, presumably, has come about as a result of improved county road systems. Proximity to the nearest town has declined while proximity to the nearest principal market has increased in importance as a determinant of agricultural land values. Improved county road systems, making more distant market and supply centers more readily accessible, and the growing affluence of north central Oklahoma residents, who increasingly demand goods and services not readity available in smaller towns, have resulted in proximity to the nearest principal market becoming a major factor influencing agricultural land values.

The value of tracts of agricultural land will vary directly with the quality or income producing characteristics of the tracts, other factors constant. This is particularly true for cropland and for land located in areas where there are few or no alternative uses other than agricultural. The productivity of cropland, which is a measure of both the range of alternative crops that can be grown on it and its income producing potential, has become an increasingly important determinant of cropland values in a time when agricultural commodity prices have been highly volatile and non-land input prices uncertain. The importance of the quality or productivity factor is intensified in areas where the non-farm demand for agricultural land is low or nonexistent.

Agricultural land values will vary directly with the level of affluence or development of an area. Net county property value per square mile was used to quantify this factor in this study. The level of affluence or development of an area will reflect the number and range of non-farm activities bidding for the use of agricultural land.

Factors external to the agricultural industry are having an increasingly greater influence on agricultural land prices. Human motives on the part of buyers and sellers such as speculation and pride of ownership or other aesthetic values will always account for some portion of the variation in agricultural land values.

Limitations and the Need for Further Research

Before the regression equations estimated in this study can be asserted to be an improved method of appraising agricultural land, some limitations of this approach should be noted. (1) The use of revenue stamps attached to instruments of conveyance to derive sale prices is a common practive, however, continued research to compare revenue stamps with known sale prices is needed to insure accuracy. (2) Regression analysis is most useful in analyzing historical data, before equations estimated in this manner are applied in actual use they should be tested on new sales in the area in which they are to be used. (3) Equations estimated based on sales from a particular area may not be appropriate for use in estimating values in another area. (4) An estimated equation of this kind can not take into consideration all of the factors influencing land values. The judgment of the individual appraiser should be exercised in each application of these equations and allowances should be made for unique characteristics of individual tracts.

Further research into the influences of inflation and farm income expectations on agricultural land values is needed. As the rate of inflation and the level of agricultural commodity prices change or stabilize, it would be informative to learn what changes occur in agricultural land prices. Yearly expectations of inflation and farm incomes may best be reflected by the previous year's level of these factors.

It should prove interesting if the relationships between agricultural land prices and different motives of buyers and sellers could be determined. These motives would need to be quantified and assigned values on continuum.

Lengthening the time period studied and analyzing sales on a year to year basis should provide some insight into changes in the relationship between agricultural land values and important factors influencing them. A year by year analysis would provide a better understanding of trends in the importance of certain factors in determining agricultural land values.

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APPENDICES

APPENDIX A

PRODUCTIVITY INDICES

PRODUCTIVITY INDICES

Productivity indexes were calculated for each tract of land in the sample with the use of county soil curveys. These soil surveys relate common crop yields that can be expected for each soil type under ordinary and improved management and forage yields that can be expected from native range for each soil type in favorable and unfavorable years. For the purposes of this study, yields under ordinary management were used in calculating cropland indices and forage yields in favorable years were used in calculating native range indices.

The productivity index for each soil type was constructed by computing the ratio of the gross value of expected production in the most valuable use or crop to the gross value of expected production of the most fertile soil. Value of production was computed using a five year (1970-1974) average of prices received by Oklahoma farmers (Table 1). Two indices were computed, one using the highest producing soil of each county as the denominator and the other using the highest producing soil of the four county sample as the denominator. These indices were termed "within county index" and "among counties index" respectively. A within county index is used when evaluating the tracts of land sold in one county and the among counties index is used when evaluating tracts of land sold in several counties.

The number of acres of each soil type in each use, cropland and native range were approximated with the use of county soil surveys and

TABLE IX

AVERAGE PRICES OF COMMON CROPS IN OKLAHOMA

Crop	Average Price
Alfalfa	40.67/ton
Barley	1.35/bu.
Forage Sorghum (dry weight)	35.00/ton
Grain Sorghum	1.82/bu.
Oats	1.01/by.
Wheat	2.39/bu.

Agricultural Prices, USDA-SRS: Prices received by Oklahoma farmers, an average for the last five years, (1970-1974).

information obtained through county assesors or county ASCA offices.

With a productivity index for each soil type in each use and an approximation of the number of acres of each soil type in each use for each tract of land, a measure of productivity is computed for each tract of land sold. A weighted average of the indices of the soil types in each use appearing in a tract of land is used for this measure. For instance, a 160 acre tract of Alfalfa County agricultural land containing 136 acres of cropland of which 104 acres were of soil type DaA and 32 acres were of soil type GrC would have a within county cropland index of $\frac{(104 \times 100) + (32 \times 32)}{136} = 84.0$ and an among counties cropland productivity index of $\frac{(104 \times 100) + (32 \times 32)}{136} = 84.0$. A 160 tract of Woodward County agricultural land containing 60 acres of cropland of which 20 acres were of soil type CaB and 40 acres were of soil type NbC would have a within county cropland productivity index of $\frac{(20 \times 66) + (40 \times 35)}{60} =$ 45.3 and an among counties cropland productivity index of $\frac{(20 \times 22) + (40 \times 12)}{60} = 15.3$.

TABLE X

ALFALFA COUNTY

PRODUCTIVITY INDICES

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Albion sandy loam, 0-1% slopes	AbA	45.50	32	32	4500	50	50
Albion sandy loam, 1-3% slopes	AbB	45.50	32	32	4500	50	50
Albion sandy loam, 3-5% slopes	AbC	36.40	26	26	4500	50	50
Albion sandy loam, 5-15% slopes	AbE				4500	50	50
Albion-Grant complex, 3-5% slopes	AgC	45.50	32	32	4500-5000	53	53
Albion-Grant complex,3-5% slopes, eroded	AgC2	36.40	26	26	4500-5000	53	53
Albion-Grant complex, 5-8% slopes,eroded	AgD2	27.30	19	19	4500-5000	53	53
Aline fine sand, 0-3% slopes	AlB	27.30	19	19	4000	44	44
Aline-Tivoli complex, 5-12% slopes	AnE				4000	44	44
Attica loamy find sand, 0-3% slopes	AsB	40.67	29	29	4000	44	44
Attica fine sandy loam, 0-3% slopes	AtB	61.00	43	43	4500	50	50
Attica fine sandy loam, 3-5% slopes	AtC	32.76	23	23	4500	50	50
Brewer silt loam	Br	122.01	86	86	7500	83	83
Brewer-Drummond complex	Bu	101.68	71	71	7000-7500	81	81
Carwile-Attica complex, 0-3% slopes	CaB	61.00	43	43	4500	50	50
Crisfield fine sandy loam	Cr	101.68	71	71	7500	83	83
Dale silt loam, 0-1% slopes	DaA	142.34	100	100	7500	83	83
Dale silt loam, saline	De	113.88	80	80	7500	83	83
Dale Soils, 3-8% slopes	DlD	81.34	57	57	7500	83	83
Dillwyn loamy fine sand	Dm	61.00	43	43	9000	100	100
Dougherty fine sand, 0-3% slopes	DoB	32.76	23	23	4000	44	44
Drummond soils, 0-3% slopes	DrB				7000	78	78
Drummond-Pratt complex, 0-3% slopes	DtB				4000-7000	61	61
Goltry fine sand, 0-3%, slopes	GoB	36.40	26	26	9000	100	100

TABLE X (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Gracemont soils	Gp				7500	83	83
Grant silt loam, 1-3% slopes	GrB	81.34	57	57	5000	56	56
Grant silt loam, 3-5% slopes	GrC	45.50	32	32	5000	56	56
Grant silt loam, 3-5% slopes, eroded	GrC2	36.40	26	26	5000	56	56
Grant-Nash complex, 3-8% slopes, eroded	GtD2	32.76	23	23	5000	56	56
Grant-Port complex, 0-12% slopes	GuE				5000-7500	69	69
Lincoln soils	Ls				3500	39	39
McLain silt loam	Mc	122.01	86	86	7500	83	83
Miller clay	Mr	48.80	34	34	4500	50	50
Pond Creek silt loam, 0-1% slopes	PcA	81.34	57	57	5000	56	56
Pond Creek silt loam, 1-3% slopes	PcB	73.21	51	51	5000	56	56
Port silt loam	Pr	122.01	86	86	7500	83	83
Pratt loamy fine sand, 0-3% slopes	PtB	45.50	32	32	4000	44	44
Pratt loamy fine sand, 3-8% slopes	PtC	36.40	26	26	4000	44	44
Quinlan-Woodward complex, 3-5% slopes	QwC	32.76	23	23	2500-5000	42	42
Quinlan-Woodward complex, 5-30% slopes	QwE				2500-5000	42	42
Reinach very fine sandy loam	Ra	122.01	86	86	7500	83	83
Renfrow silt loam,0-2% slopes	RcA	38.24	27	27	4000	44	44
Ruella loam, 0-2% slopes	RuA	54.60	38	38	5000	56	56
Salorthids	Sa						
Shellabarger fine sandy loam, 1-3% slopes	ShB	61.00	43	43	4500	50	50
Tabler silty clay loam, 0-1% slopes	TaA	61.00	43	43	4000	44	44
Tivoli fine sand	Tr				2200	24	24
Woodward-Quinlan complex, 1-3% slopes	WuB	36.40	26	26	2500-5000	42	42
Yahola	Ya	54.60	38	38	7500	83	83
Yahola and Port soils, frequently flooded	Yp				7500	83	83

TABLE XI

GARFIELD COUNTY

PRODUCTIVITY INDICES

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Bethany silt loam, 0-1% slopes	BeA	61.00	43	50	5000	56	67
Breaks-Alluvial land complex	Bk				5000-7500	69	83
Broken alluvial land	Br				7500	83	100
Carwile loam	Ca	49.14	35	40	5000	56	67
Drummond soils	Dr				6500	72	87
Eroded clayey land	Ec				1000	11	13
Grant silt loam, 0-1% slopes	GaA	81.34	57	67	5000	56	67
Grant silt loam, 1-3% slopes	GaB	61.00	43	50	5000	56	67
Grant silt loam, 3-5% slopes	GaC	41.86	29	34	5000	56	67
Grant silt loam, 3-5% slopes, eroded	GaC2	33.46	24	27	5000	56	67
Grant-Nash silt loams, 5-8% slopes	GnD	23.90	17	20	5000	56	67
Grant-Nash silt loams, 5-8% slopes, eroded	GnD2	21.51	15	18	5000	56	67
Grant-Nash silt loams, 8-20% slopes	GnE				5000	56	67
Grant-Nash silt loams, 8-20% slopes, eroded	GnE2				5000	56	67
Kingfisher silt loam, 1-3% slopes	KfB	48.80	34	40	5000	56	67
Kingfisher silt loam, 2-5% slopes, eroded	KfC2	31.07	22	25	5000	56	67
Kingfisher-Lucien complex, 5-8% slopes eroded	KlD2	21.51	15	18	3000-5000	44	53
Kirkland silt loam, 0-1% slopes	KnA	40.04	28	33	4000	44	53
Kirkland-Renfrow silt loams, 1-3% slopes	KrB	33.46	24	27	4000	44	53
Kirkland-Slickspots complex, 0-1% slopes	KsA	29.12	20	24	1800-4000	32	39
Lucien very fine sand loam, 3-5% slopes	LmC	21.51	15	18	3000	33	40
Meno Loamy fine sand, undulating	MeB	61.00	43	50	4500	50	60
Miller clay	Mr	50.96	36	42	5500	61	73

TABLE XI (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Miller-Slicksposts complex	Ms	40.04	28	33	5500	61	73
Nash silt loam, 1-3% slopes	NaB	40.04	28	33	5000	56	67
Nash silt loam, 3-5% slopes	NaC	32.76	23	27	5000	56	67
Norge loam, 1-3% slopes	NoB	61.00	43	50	5000	56	67
Norge loam, 3-5% slopes	NoC	41.86	29	34	5000	56	67
Norge loam, 3-5% slopes, eroded	NoC2	28.68	20	24	5000	56	67
Norge loam, 5-8% slopes	NoD	26.29	18	22	5000	56	67
Norge loam, 5-8% slopes, eroded	NoD2	21.51	15	18	5000	56	67
Pond Creek silt loam, 0-1% slopes	PcA	81.34	57	67	5000	56	67
Pond Creek silt loam, 1-3% slopes	PcB	61.00	43	50	5000	56	67
Port clay loam	Po	122.01	86	100	7500	83	100
Port silt loam, 0-1% slopes	PrA	122.01	86	100	7500	83	100
Port silt loam, 1-3% slopes	PrB	81.34	57	67	7500	83	100
Pratt loamy fine sand, undulating	PsB	32.76	23	27	4500	50	60
Pratt loamy fine sand, jummocky	PtC	25.48	18	21	4500	50	60
Pulaski fine sandy loam	Pu	89.47	63	73	7500	83	100
Reinach loam	Rc	101.68	71	83	7500	83	100
Reinach-Slickspots complex	Re	73.21	51	60	4000-7500	64	77
Renfrow clay loam, 0-1% slopes	RfA	38.24	27	31	4000	44	53
Renfrow clay loam, 1-3% slopes	RfB	33.46	24	27	4000	44	53
Renfrow silt loam, 3-5% slopes	RsC	26.29	18	22	4000	44	53
Renfrow-Veronon complex, 3-5% slopes eroded	RvC2	23.90	17	20	2500-4000	36	43
Shellabarger fine sandy loam, 0-1% slopes	ShA	61.00	43	50	5000	56	67
Shellabarger fine sandy loam, 1-3% slopes	ShB	48.80	34	40	5000	56	67
Shellabarger-Carwile fine sandy loams, undulating	SrB	66.00	43	50	5000	56	67

TABLE XI (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Tabler silt loam, 0-1% slopes	TaA	38.22	27	31	4000	44	53
Vernon clay loam, 3-5% slopes, eroded	VcC2	21.51	15	18	2500	28	33
Vernon soils, 5-12% slopes	VrD				2500	28	33
Vernon soils and Rock outcrop	Vs				800	9	11
Weymouth-Ost loams undulating	WoB	41.86	29	34	5000	56	67
Zaneis loam, 1-3% slopes	ZaB	40.04	28	33	5000	56	67
Zaneis loam, 3-5% slopes	ZaC	31.07	22	25	5000	56	67
Zaneis loam, 3-5% slopes, eroded	ZaC2	28.68	20	24	5000	56	67

TABLE XII

KINGFISHER COUNTY

PRODUCTIVITY INDICES

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Alluvial and broken land	Ab				2500	28	33
Bethany silt loam, 0-1% slopes	BeA	77.00	54	73	3500	39	47
Broken alluvial land	Br				7500	83	100
Carwile loamy fine sand	Ca	63.00	44	60	4000	44	53
Clayey saline alluvial land	Cv	42.00	30	40	4000	44	53
Dougherty-Eufaula loamy fine sands, undulating	DeB	56.00	39	53	3800	42	51
Dougherty-Eufaula loamy fine sands, hummocky	DeC	52.50	37	50	3800	42	51
Drummond soils	Dr				1800	20	24
Eufaula fine sand	Eu				3800	42	51
Kingfisher silt loam, 1-3% slopes	KfB	70.00	49	66	4500	50	60
Kingfisher silt loam, 3-5% slopes	KfC	63.00	44	60	4500	50	60
Kingfisher-Lucien complex, 5-8% slopes, eroded	KgD3	56.00	39	53	4500	50	60
Kingfisher-slickspot complex, 1-3% slopes	KhB	56.00	39	53	1800	20	24
Kingfisher-slickspot complex, 3-5% slopes	KhC	49.00	34	46	1800	20	24
Kirkland silt loam, 0-1% slopes	KrA	70.00	49	66	3500	39	47
Lincoln loamy fine sand	Lc	77.00	54	73	4000	44	53
Lincoln sand	Ln				4000	44	53
Norge fine sandy loam, 0-1% slopes	NoA	87.50	61	83	4500	50	60
Norge fine sandy loam, 1-3% slopes	NoB	70.00	49	66	4500	50	60
Norge-slickspot complex, 1-3% slopes	NsB	63.00	44	60	1800	20	24
Norge-slickspot complex, 3-5% slopes, eroded	NsC3	56.00	39	53	1800	20	24
Pond Creek Silt loam, 0-1% slopes	PcA	84.00	59	79	4500	50	60
Pond Creek silt loam, 1-3% slopes	PcB	84.00	59	79	4500	50	60

TABLE XII (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Pratt loamy fine sand, undulating	PfB	70.00	49	66	3800	42	51
Pratt loamy fine sand, hummocky	PfC	63.00	44	60	3800	42	51
Port clay loam, 0-1% slopes	PoA	98.00	69	100	7500	83	100
Port silt loam, 0-1% slopes	PsA	98.00	69	96	7500	83	100
Port silt loam, 1-3% slopes	PsB	98.00	69	93	7500	83	100
Renfrow clay loam, 0-1% slopes	RcA	56.00	39	53	3500	39	47
Renfrow clay loam, 1-3% slopes	RcB	49.00	34	46	3500	39	47
Rough broken land	Rg				1800	20	24
Sand dunes, Lincoln material	Sa				4000	44	53
Shellabarger fine sandy loam, 0-1% slopes	ShA	73.50	52	70	4000	44	53
Shellabarger fine sandy loam, 1-3% slopes	ShB	63.00	44	60	4000	44	53
Shellabarger fine sandy loam, 3-5% slopes	ShC	56.00	39	53	4000	44	53
Shellabarger fine sandy loam, 5-8% slopes, eroded	ShD3	19.12	13	18	4000	44	53
Tabler clay loam	Ta	28.68	20	27	3500	39	47
Tabler-slickspot complex	Ts	22.95	16	22	1800	20	24
Tivoli fine sand	Tv				2500	28	33
Vernon clay loam, 1-3% slopes	VcB	35.00	25	33	2500	28	33
Vernon clay loam, 3-5% slopes, eroded	VcC3	16.73	12	16	2500	28	33
Vernon soils and Rock outcrop	Vr				800	9	11
Wet alluvial land	Wa				7000	78	93
Yahola fine sandy loam	Ya	89.47	61	85	4000	44	53

TABLE XIII

WOODWARD COUNTY

PRODUCTIVITY INDICES

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Brownfield fine sand, 1-3% slopes	BfB	21.84	15	46	4500	50	50
Carey silt loam, 1-3% slopes	CaB	31.07	22	66	4200	47	47
Carey silt loam, 3-5% slopes	CaC	26.29	18	56	4200	47	47
Carey silt loam, 5-8% slopes	CaD	21.84	15	46	4200	47	47
Carey silt loam, 5-8% slopes, eroded	CaD2	21.84	15	46	4200	47	47
Carwile-Pratt complex	Cp	28.68	20	61	4500	50	50
Elsmere loamy fine sand	Ee				9000	100	100
Enterprise fine sandy loam, undulating	EfB	34.58	24	73	4500	50	50
Enterprise loam, 3-5% slopes	EmC	26.29	18	56	4200	47	47
Enterprise-Pratt complex, 5-8% slopes	EpD	21.84	15	46	4500	50	50
Enterprise-Pratt complex, 8-20% slopes	EpE				4500	50	50
Holdrege loam, 1-3% slopes	HoB	34.58	24	73	4200	47	47
Las Animas soils	La				9000	100	100
Leshara loam	Le	31.07	22	66	5000	56	56
Lincoln loamy fine sand	Lf	21.84	15	46	5300	59	59
Lincoln soils	Ln				5300	59	59
Mansker loam, 1-3% slopes	MbB	27.30	19	58	3000	33	59
Mansker loam, 3-5% slopes	MbC	21.84	15	46	3000	33	33
Mansker-Potter loams, 5-12% slopes	McD				2000-3000	28	28
Miles fine sandy loam, 1-3% slopes	MfB	36.40	26	77	4500	50	50
Miles fine sandy loam, 3-5% slopes	MfC	30.94	22	65	4500	50	50
Nobscot-Brownfield fine sands, 3-5% slopes	NbC	16.38	12	35	4500	50	50
Nobscot-Brownfield complex, severely eroded	Nc3				4500	50	50
Nobscot-Eufaula fine sands, 5-12% slopes	NeD				4500	50	50

TABLE XIII (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Nobscot-Pratt complex, hummocky	NpC	23.66	17	50	4500	50	50
Nobscot-Pratt complex, duned	NpE				4500	50	50
Otero loamy fine sand, undulating	OtB	21.84	15	46	3000	33	33
Port loam	Pa	47.32	33	100	5000	56	56
Pratt fine sandy loam, undulating	PbB	34.58	24	73	4500	50	50
Pratt fine sandy loam, hummocky	PbC	27.30	19	58	4500	50	50
Pratt loamy fine sand, undulating	PfB	25.48	18	54	4500	50	50
Pratt loamy fine sand, hummocky	PfC	21.84	15	46	4500	50	50
Pratt-Tivoli loamy fine sands	Pt				1800-4500	35	35
Quinlan loam	Qm				3100	34	34
Quinlan-Woodward loams, 3-5% slopes, eroded	QwC2	18.20	13	38	3100-4200	41	41
Quinlan-Woodward loams, 5-12% slopes	QwD				3100-4200	41	41
Quinlan-Woodward loams, 5-12% slopes, eroded	QwD2				3100-4200	41	41
Rough broken land	Rb				1800	20	20
St. Paul silt loam, 0-1% slopes	SaA	35.85	25	76	3500	39	39
St. Paul silt loam, 1-3% slopes	SaB	31.07	22	66	3500	39	39
St. Paul silt loam, 3-5% slopes	SaC	26.29	18	56	3500	39	39
Sweetwater soils	Sw				9000	100	100
Tivoli fine sand	Tv				1800	20	20
Treadway clay	Tw				2500	28	28
Vernon clay loam, 0-3% slopes	VcB	21.51	15	45	3500	39	39
Vernon clay loam, 3-5% slopes	VcC	16.73	12	35	3500	39	39
Vernon clay loam, 5-12% slopes	VcD				3500	39	39

TABLE XIII (Continued)

Soil Name	Soil Symbol	Gross Revenue From Best Crop Under Ordinary Management	Among County Cropland Index	Within County Cropland Index	Forage Yield in Favorable Years	Among County Rangeland Index	Within County Rangeland Index
Vernon-badland complex	Vm				500-3500	22	22
Vernon-Cottonwood complex	Vp				1000-3500	25	25
Wann fine sandy loam	Wf	30.94	22	65	5000	56	56
Woodward loam, 1-3% slopes	WoB	29.12	20	62	4200	47	47
Woodward loam, 3-5% slopes	WoC	25.48	18	54	4200	47	47
Woodward loam, 5-8% slopes	WoD	21.84	15	46	4200	47	47
Woodward-Quinlan loams, 3-5% slopes	WwC	18.20	13	38	3100-4200	41	41
Yahola fine sandy loam	Ya	30.94	22	65	5000	56	56
Yahola fine sandy loam, high	Yh	30.94	22	65	5000	56	56

APPENDIX B

MEANS AND STANDARD DEVIATIONS OF VARIABLES

TABLE XIV

MEANS AND STANDARD DEVIATIONS OF VARIABLES

Variable	Mean	Standard Deviation
	Aggregate (1970-1976)	
Y	426.2689	266.1666
X_1^2	1974.7897	1659.1751
X_2	157.4327	157.4074
$X_2^{.5}$	11.8114	3.8652
X_3	1.5814	1.6703
X_3^2	5.2880	14.5534
X_4	5.3357	3.4072
X_5	14.3037	7.9162
X_9	49.5627	42.3544
X_9^2	4248.3916	4365.5513
X_{12}^2	2136.1356	2927.3791
X_{13}	27.5248	26.2810
X_{14}	26.4460	17.1496
X_{18}	435.2968	233.6062
X_{18}^2	243995.4282	246341.3182
Y_0	59620.0023	46842.1708
X_{01}	6231.2845	8613.4530

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_{01}^2	112940767.1150	1018011661.4500
X_{04}	912.6424	1694.6840
X_{05}	2389.6738	3644.3749
X_{06}	14998.6147	21306.8562
X_{09}	7167.3973	10002.8971
X_{010}	86.2158	60.7348
X_{011}	67.4867	154.3863
X_{012}	4360.0344	5116.3466
X_{014}	2636.9292	2490.3111
	<u>Aggregate (1970-1973)</u>	
Y	317.1566	137.7041
X_1^2	898.6729	674.6850
X_2	146.4993	102.6006
$X_2^{.5}$	11.6416	3.3152
X_3	1.5732	1.7381
X_3^2	5.4942	16.6064
X_4	5.3458	3.2521
X_5	14.1951	8.0016
X_9	49.8369	42.4522
X_9^2	4282.8310	4375.3994
X_{12}^2	1988.4443	2737.2176
X_{13}	28.1213	25.9273
X_{14}	26.1954	16.3010

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_{18}	445.4020	23.4099
X_{18}^2	253091.8790	248085.8729
	Aggregate (1974-1976)	
Y	622.7381	323.0916
X_1	14.0184	8.1475
X_1^2	262.6933	246.6518
X_2	168.7177	224.1186
$X_2^{.5}$	12.1171	4.6862
X_3	1.5945	1.5433
X_3^2	4.9169	9.8434
X_4	5.3175	3.6750
X_5	1.4499	7.7685
X_9	49.0690	42.2384
X_{12}^2	2402.0707	3229.2156
X_{13}	26.4508	26.9132
X_{14}	26.9873	18.5978
X_{18}	417.1012	231.9652
X_{18}^2	227616.2362	242686.9534
	Alfalfa County	
Y	553.3717	337.2789
X_1^2	2068.6107	1625.1999

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_2	142.1121	72.9122
X_2^2	25491.7496	36295.3687
X_3	1.3595	1.1818
X_9	71.1908	37.4399
X_9^2	6464.5344	4229.6315
X_{12}^2	3811.8041	3599.8545
X_{13}	21.3590	23.9184
X_{15}	46.0347	24.5310
Y_0	74958.0201	52002.6934
X_{01}	5894.5123	4534.3528
X_{05}	2146.2433	1463.1819
X_{012}	6540.6228	6226.3117
X_{013}	2955.3167	3784.5671
	<u>Garfield County</u>	
Y	424.3535	211.7100
X_1^2	1899.3764	1580.8876
X_2	131.2771	53.5770
X_2^2	20093.5897	16544.2773
X_3	1.4018	1.3240
X_3^2	3.7117	6.5289
X_4	4.0749	2.8406
X_5	9.4502	6.0820

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_9	60.8801	40.4889
X_9^2	5339.6854	4369.7072
X_{12}	31.3657	27.3587
X_{13}	28.7566	23.2655
X_{17}	34.7541	19.1290
Y_0	54366.0576	36091.9577
X_{01}	5133.7542	3410.4979
X_{04}	544.7830	459.4527
X_{05}	1254.5308	1039.3166
X_{09}	8109.1328	6691.1520
X_{010}	85.0919	48.9235
X_{011}	45.5609	37.3113
X_{012}	4117.1782	4219.1204
Kingfisher County		
Y	414.6439	212.1568
X_1^2	1707.8750	1619.3396
X_2	134.6165	65.9359
$X_2^{.5}$	11.2848	2.7022
X_3	1.4509	1.2967
X_3^2	3.7790	5.3809
X_5	17.5446	8.1389
X_7	13.6696	13.8178

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_8	4.3214	2.5839
X_{12}^2	1815.5768	2626.0221
X_{13}	31.7540	26.7092
X_{17}	42.3174	21.8807
Y_0	54428.9529	37700.2247
X_{01}	4751.6629	3875.5738
X_{05}	2405.2652	1942.2063
X_{08}	580.0482	480.5298
X_{010}	81.8098	49.6953
X_{011}	52.4996	54.7291
X_{012}	3914.8704	4329.6726
	Woodward County	
Y	232.8214	131.4667
X_1	43.1795	21.6802
X_2	243.8045	340.2615
$X_2^{.5}$	13.9920	6.9525
X_3	2.4539	2.7679
X_3^2	13.6336	31.5816
X_4	7.1827	4.3877
X_5	128.2628	11.2030
X_7	22.6026	35.9242
X_9	30.0112	36.9139

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_9^2	2182.2151	3351.2551
X_{12}	9.1528	20.1822
X_{12}^2	488.4825	1438.5310
X_{15}	35.5167	26.5618
Y_0	50440.8948	58932.6728
X_{01}	10828.0811	18257.1204
X_{01}^2	448433102.5910	2435461922.8600
X_{05}	4748.0717	7699.4459
X_{06}	31517.9360	44822.7153
X_{010}	76.2070	81.6069
X_{011}	167.2885	335.2764
X_{012}	1758.8589	3940.6285
X_{016}	4153.6028	4785.3799
	Aggregate Cropland	
Y	579.3201	332.5286
X_1^2	2089.9389	1751.0891
X_2	122.9262	66.1498
X_2^2	19469.7032	31712.4858
X_3	1.1821	1.0694
X_3^2	2.5365	4.0173
X_4	4.1908	2.6562
X_5	13.3321	7.4585

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_8	13.9237	17.7973
X_9	59.3168	43.4751
X_9^2	5401.3550	4565.5567
X_{12}^2	4778.4542	3644.8722
X_{13}	34.6742	32.4569
X_{14}	35.4336	16.5730
X_{18}	387.9160	207.6123
X_{18}^2	193417.1908	219282.1579
Y_0	69901.3037	52421.3091
X_{01}	4985.0049	3775.5514
X_{04}	519.9992	427.6343
X_{05}	1657.9927	1380.1020
X_{012}	7386.9263	6242.6291
X_{014}	4194.1901	3066.4257
	<u>Alfalfa County Cropland</u>	
Y	708.3261	377.4213
X_1^2	2120.0677	1716.7558
X_2	126.9353	65.6945
$X_2^{.5}$	10.9623	2.6106
X_3	1.2120	1.0204
X_3^2	2.5024	3.7785
X_9	77.1729	36.8355

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
X_9^2	7302.3158	4092.5399
X_{12}^2	6217.7013	3245.0719
X_{15}	57.9301	19.1709
	Garfield County Cropland	
Y	479.2118	196.0216
X_1^2	1938.2593	1601.3626
X_2	121.6093	59.4474
$X_2^{.5}$	10.7172	2.6228
X_3	1.0370	1.0180
X_3^2	2.0926	3.4873
X_4	3.2870	2.4622
X_6	73.9074	10.5603
X_8	42.5556	7.4344
X_9	57.1667	41.0645
X_9^2	4923.0926	4327.9195
X_{12}	50.9908	30.3291
X_{15}	36.7148	14.5266
	Kingfisher County Cropland	
Y	489.9556	221.5885
X_1^2	1695.2889	1596.8398
X_2	97.8200	43.8734

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
$X_2^{.5}$	9.6427	2.2245
X_3	1.3222	1.2575
X_4	5.9778	2.7674
X_5	17.5333	9.2179
X_8	4.1333	0.8944
X_9	20.5556	35.0685
X_9^2	1625.0000	3221.2452
X_{12}^2	4255.5015	3808.6451
X_{13}	41.5713	36.3305
X_{15}	59.9689	15.9866
	<u>Woodward County Cropland</u>	
Y	321.6356	161.2628
X_1^2	2821.3667	2187.2874
X_2	145.1733	93.7649
$X_2^{.5}$	11.5487	3.4938
X_3	1.1000	1.0860
X_3^2	2.3500	3.5071
X_6	124.7500	10.3871
X_7	25.2667	38.7823
X_{12}^2	1478.2562	2701.8814
X_{13}	71.6952	30.6329

TABLE XIV (Continued)

Variable	Mean	Standard Deviation
	Aggregate Rangeland	
Y	244.5405	147.0365
X_1^2	1982.8783	1674.6281
X_2	207.5058	347.8153
$X_2^{.5}$	12.7539	6.7258
X_3	2.5652	2.4589
X_3^2	12.5739	22.9401
X_5	17.5043	8.8577
X_9	40.9457	43.1899
X_9^2	3525.6918	4246.9929
X_{16}	42.5774	13.1541
X_{18}	315.8435	176.8324
X_{18}^2	130754.9043	177977.6275
Y_0	43703.6510	57313.3571
X_{01}	9359.7035	19178.4805
X_{06}	24481.5981	45438.4838
X_{015}	8789.1001	13516.7515
X_{018}	56140.6603	73931.3131

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