IMPACT OF HARD SURFACE ROADS AND DISTANCE TO CITIES ON RURAL OKLAHOMA LAND VALUES

By

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PREFACE

This study is an analysis of the impact of distance to hard surface roads and distance to cities on rural Oklahoma land values during the period January 1986 through December 1988. Regression analysis is employed to quantify the relationships existing between these factors and agricultural land values in Oklahoma.

I would like to express extreme appreciation to my major advisor, Dr. Darrel Kletke, for his continuous guidance, assistance and encouragement throughout my study. Appreciation is also expressed to Dr. Larry Sanders and Dr. Raymond Schatzer for their helpful suggestions and assistance in the preparation of the final manuscript.

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CHAPTER I

INTRODUCTION

Land, compared to other agricultural resources, is typically a large economic unit. It is also the largest single input of the agricultural production process. Land differs in size, productivity, degree of improvement, and location. In addition, no two tracts of land are alike; never are two sets of land in the exact same location. Because of these reasons, it can be very difficult to predict the selling price of any given parcel of land. It can be equally difficult to determine which characteristics and factors influence the selling price of land. This difficulty is made even worse when you incorporate non-agricultural alternative uses. The areas most affected are in what is called the rural-urban fringe. The rural-urban fringe includes the edge of the urban area, borders of neighboring suburbs, nearby towns, and the adjacent unincorporated countryside. Here the demand for farmland for nonfarm uses is greater and the present and expected future shifts from agriculture to urban uses are a major market phenomenon (Chicoine, 1980).

The agricultural land price, can to a great extent, determine the structure and viability of the agricultural industry. The agricultural industry in Oklahoma is no different. Communities that are dependent upon agriculture for jobs and tax revenues, and lending institutions which provide the largest amounts of the financing for the purchase of agricultural land should be concerned with the factors that determine the market value of agricultural land. Reliable land market information is a major need for both buyers and sellers of land, as well as for rural appraisers and tax authorities.

The Problem

In Oklahoma, as well as the rest of the country, large acreages of farmland are being converted to urban use each year. This conversion adds complexity to the farmland market and where current market transactions are dominated by properties transferred for a shift in use, market values may be considerably greater than farmers can pay to use the land in an agricultural use.

The contribution of location to value has long been understood (Hass, 1922). Because the services of land must be used in place, location is being marketed with the land. This factor becomes relatively more important as farmland is transferred from agricultural to urban uses. Several previous studies have investigated how blacktop roads and location to urban areas affect inter-tract variations in per acre farmland prices. For the most part, these studies have shown the variation in per acre land values to be largely explained by locational advantages (Vandeveer, 1979). These studies have demonstrated the importance of factors used in explaining land value variation but have failed to investigate the exact affect of distance to blacktop roads and urban areas upon the price of land.

With more and more farmland acres being converted to urban use each year, buyers and sellers of land, as well as rural land appraisers and tax authorities will be interested in knowing how blacktop roads and location to urban areas affect the price of land in Oklahoma. In addition, the analysis would provide all land market participants with a better understanding of how future urban expansion will affect the price of farmland.

Objectives of the Study

The general objective of this study is to examine the effect of distance to hard surface roads and distance to urban areas on the agricultural land market in Oklahoma. More specifically stated that objective includes the following components:

(1) Identify and measure agricultural land market values in Oklahoma for the period 1986 to 1989.

(2) Identify and measure the level of agricultural land market activities in Oklahoma for the period 1986 to 1989.

(3) Identify and measure trends and changes that have occurred in the Oklahoma agricultural land market for the period 1986 to 1989.

(4) Quantify the relationships existing between the distance to hard surface roads and the per acre price of agricultural land.

(5) Quantify the relationships existing between the distance to differently populated urban areas and the per acre price of agricultural land.

(6) Estimate equations for use in projecting the affects of hard surface roads and cities on the per acre price of agricultural land.

Review of Literature

Land prices and the study of factors which influence land prices have been an area of interest for many years. The early studies were primarily concerned with the economics behind the valuation process while more recent studies have concentrated on the factors that cause the price variations.

Land Use Theory

David Ricardo (1817) explained the value of land in terms of economic rent. He defined economic rent as that compensation which is paid to the owner for the use of the land. He also explained rent largely in terms of differences in soil fertility. In Ricardo's analysis, he used the assumption that a newly settled country had an abundance of fertile land. This land was divided up into four classes ranging from more fertile to less fertile classes of land. He said that only the most fertile land would originally be brought into cultivation to support the current population. This land would have no rent flowing to it until population increases enough to bring the next highest class of land into production. This process would continue so that the subsequent bringing into cultivation of the next highest class of land would add rent to all higher classes of land based on differences in their fertility. Ricardo concluded that the value of land was directly proportional to its fertility or ability to produce benefits or income.

Thomas Malthus (1836) agreed with Ricardo's thinking regarding land use and land values, but offered a different definition for economic rent. He believed that marginal land would only be brought into cultivation when the value of its production would cover all of the land's factor costs. He determined that more productive land would have a value which was a measure of that land's greater fertility.

One of the first to approach the idea of economic rent being derived from location was Von Thunen (1826). His land use theory explained the effects of transportation costs on land use. He observed that when crops were grown around a central market on like soils, the land that was nearer the market had a higher rent than those of lands that were farther away. The rent advantage, he argued, was because of a difference in transportation costs of shipping products an unequal distance to market.

Rural and Agricultural Land Studies

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 theories to go along with conventional land use and economic rent theory.

Several studies have been done concerning research into the Oklahoma land market. Ahmed and Parcher (1964), in a study of the Woods County land market, found four factors which explained a large part of the variation in per acre prices of land. They found size of tract, soil productivity, population of nearest town, and distance to the county seat explained a large percentage of the variation surrounding land prices of farmland in Woods County.

In a study of ten Western Oklahoma counties, Abdel-Badie and Parcher (1967) found land quality variables and the number of acres of wheat allotment to be highly significant in explaining land values. They also found a positive correlation between the amount of mineral rights conveyed and the quality of road adjacent to the property on the per acre values while a negative relationship was found between size of tract, distance to the nearest hard surface road, and distance to Oklahoma City on the per acre farmland price of land.

A study by Nelson (1969) of agricultural land sales in ten Oklahoma counties 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 value of improvements was found to have a significantly positive influence on price as did time as reflected as a trend variable. Nelson also showed that as the quality of the road adjacent to the tract improved and as the distance to hard surfaced roads decreased the per acre price of the tract increased.

Jennings (1976), in a study of a four county area in North Central Oklahoma, found that time explained the greatest proportion of variation in agricultural land values. The time variable represented the influence of inflation, net rent increases, increased non-farm use of rural land, and advancing technology and economic growth on land values. He also found that the nearness to paved roads and towns decline in importance due to improved county roads and that the level of affluence or economic development of the area had a positive influence on farmland values.

Vandeveer (1979), in a study of inter-tract variations in per acre price in the Western Oklahoma agricultural land market, found both positive and negative factors on the price of land. He concluded that the impact of time, tract quality, economic development, and the percentage of mineral rights conveyed had significant positive influences on per acre land values while the size of tract, distance to the nearest paved road, the percentage of pastureland in the tract, and location were found to have a different negative influence on per acre land values.

Agricultural land market studies in other areas of the country have shown both similar and different factors to influence the price of land. A cross-sectional study by Mundy (1978) found that Tennessee land values were influenced by several non-agricultural related variables. An ad valorem property tax was found to negatively affect land prices while variables measuring economic location and urban influences had positive influences on the market. Economic location and urban influence variables used in this study were the rate of change in population through time, population density per square mile, regional location of the county, and the classification of the county by its largest city or town.

Wise and Walker (1974), in a study of Southwest Georgia peanut acreage, showed that the most important factor affecting the price of land was the number of months elapsed since the sale. The time elapsed was found to have a negative effect on the per acre price. The study also showed that there was an inverse relationship between distance from the closest town and the per acre price of land.

Bryant (1974) in a study of the rural land market in Wayne County, New York, and Ramsey and Corty (1976) in a rural land market study of Louisiana had very similar conclusions. Results of their separate studies showed that a very strong negative relationship existed between price paid per acre for rural land and its distance to a metropolitan area. Also, Ramsey and Corty found an inverse relationship to exist between the price per acre and tract size.

In a study, of the farmland in the Chicago metropolitan counties, Chicoine (1980) concluded that the task of understanding and estimating farmland values in the urban fringe is complicated by forces from the urban market and the agricultural market. Factors from both markets were found to significantly influence farmland price variation. As the nearness in time and location to conversion to urban use approached, the importance of urban factors was found to increase. The influence of urban factors was found to extend outward from the urban center to where the expected population growth does not support full urban development in the foreseeable future. Results of this influence are increased farmland values.

Methodology

Agricultural land sale data was used for the period 1986 to 1989 for the entire state of Oklahoma. Information concerning the land sales was provided by the Federal Land Bank in Wichita, Kansas.

To be included in the analysis, the land sale had to be forty acres or more in size. The prices used were the per acre price paid less the per acre price of any improvements. Simple tabulations were used to derive the average price per acre paid for land in eight different Oklahoma regions, as well as for the entire state.

Distance to cities and hard surface roads was found by using County General Highway Maps published by the Oklahoma Department of Transportation. The distance values were found by counting the miles using the shortest route available through existing roads and highways.

"LOTUS 123" regression analysis was employed to determine and test the relationships existing between distance factors and per acre prices. Regression analysis is a statistical tool that uses the relation between two or more quantitative variables so that one variable can be predicted from the other. The use of regression analysis facilitated the testing of factors to determine the direction and magnitude of these correlations. The proportion of the variation of the distance variable explained by the regression is presented as the coefficient of determination or R-squared value.

Organization

The study is divided into four remaining chapters. Chapter II discusses relevant economic theory, characteristics of the study area, and average per acre prices for cropland and pastureland sales in the eight different regions.

Chapter III is an analysis of the impact of hard surface roads on Oklahoma land values. The state was divided into three areas for analysis. Regression equations were fitted for the Panhandle, Eastern Oklahoma, Western Oklahoma, and the entire state as a whole.

Chapter IV is an analysis of the impact of distance to cities on Oklahoma land values. Six different city size groups are defined. Explanatory equations are estimated to show the relationship between distance and price for each size of city.

Chapter V attempts to summarize the findings and conclusions of Chapters II, III, and IV. An overall analysis of the land market in Oklahoma and the distance factors that influence it are presented in the way of a summary of this study.

CHAPTER II

THE OKLAHOMA LAND MARKET

The dynamic nature of the agricultural land market has fascinated economists, appraisers, lenders, and landowners for many years. Each of the above groups are interested in what land values are and in what characteristics give land its values. The purpose of this chapter is to discuss relevant theory applicable to the agricultural land market and to present recent trends and values of Oklahoma agricultural land. The first section will discuss the theory behind locational and populational impacts on land value. The second section is a discussion of the Oklahoma land market for the years 1986 through 1989. The third section will explain land values dealing with eight different regional locations in Oklahoma. The fourth and final section will discuss differences between the values of cropland and pastureland.

Relevant Economic Theory

Locational theory and economic development or populational theory underlie much of the current agricultural land market research. Von Thunen (1826) was one of the first researchers to use locational theory to explain variations in land values. His studies showed distance from markets to be highly correlated with land values. The influence of economic development and increased population of the urban fringes on land values has recently received much research attention. This research has shown the demand for agricultural land is strengthened by nonfarm influences such as urban, industrial, and recreational development (Chicoine, 1980).

When these theories are combined they suggest that agricultural land values are, in general, influenced by location, population, and economic considerations. Hypotheses concerning the influence of these factors on agricultural land price variations can be explained using microeconomic theory. The following two sections will discuss locational and economic development factors from a microeconomic perspective.

Locational Impacts

Land is unique because its use is restricted to its location. This means that all other resources and farm products must be either brought to the land or transported away from the land. Therefore, the greater the transportation distance, the greater the per unit input and output costs. Using microeconomics, transportation costs can be explained through the use of short run firm cost functions. The two cost functions used are average cost and marginal cost. A firm's average cost is the total of average fixed cost plus average variable cost for each of the firm's output levels. Marginal cost can be defined as the change in total cost associated with a one unit change in output. Assuming farms are homogeneous except for location, the average and marginal cost curves for the farm with the better location with respect to its input and output markets is lower than the respective cost curves for the farm that is located less suitably in relation to the same markets. The lower cost curves associated with the better location give that farm an advantage due to lower per unit costs. Figure 1 shows the average and marginal cost curves associated with farms of different location advantages. In this figure, SAC1 and SMC1

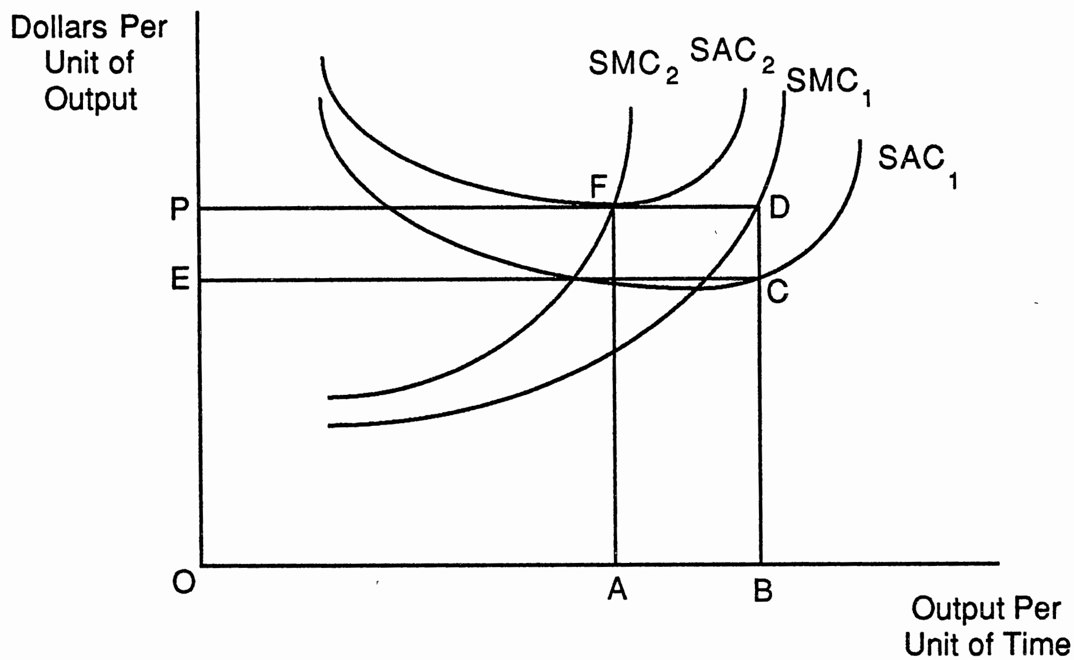

Figure 1. Short Run Average and Marginal Cost Curves for Two Similar Farms with Differing Locations.

represent short run average and marginal cost curves for the more favorably located farm while SAC2 and SMC2 represent the per unit costs associated with the less favorably located farm. The distance between the average cost curves represent per unit transportation cost differences at each level of output.

The value of land is explained by the capitalized value of the net rents from the land. Economic rent is the compensation which is paid to the owner of a piece of land for its use (Ricardo, 1817). The classical capitalization formula is: annual return divided by the capitalization rate is equal to the dollar value of the land (Return / Rate = Value). For example, assume a 160-acre farm has an annual income or return of $4,800 ($30 per acre). If one expects a six percent return to this investment, the capitalized value of the farm is $80,000 ($500 per acre).

As the income or return increases, the value of a farm goes up, and vice versa. As the capitalization rate is increased, the value of a farm goes down, and vice versa.

A key element in the capitalization formula is the selection of a capitalization rate. Conceptually, the capitalization rate should reflect the opportunity cost of money to the most likely individual buyers or owners of the land (Suter, 1974).

The capitalized net rent can be seen in Figure 1 using the firms cost curves and the price of the product represented by line PD. Figure 1 shows that the less favorably located farm produces OA units of output while the better located farm produces OB units of output. Therefore, a normal rental rate is associated with the less favorably located farm while the better located farm receives added economic rent or pure profits. Economic rent or pure profits for the better located farm is represented in Figure 1 by the area EPDC, this is the return to the farm after all costs of production have been paid. Because this economic rent is capitalized into land values, it leads to a higher price paid for farms that are favorably located. Thus a negative relationship is expected to be found between the value of land and the distance to a market center.

Population and Economic Development Impacts

Economic development and population increases, to a large extent, are complementary factors. The process by which an economy's real income increases over time is the accepted definition for economic development (Meiser, 1966). Economic growth results from an increase in kinds and quantities of resources together with improvements in production technologies. This growth usually results in population increases. The impacts of economic growth and the subsequent population increase on agricultural land values can be shown by the use of simple supply and demand curves. The demand for land generally depends upon many different factors including demand for commodities produced, incomes, taxes, economic development, and other more individualized personal preferences. The supply of land, because it is a natural resource, is generally considered to be fixed.

Figure 2 shows a demand and supply of agricultural land for some localized economy at two different points in time. The line S1 represents the fixed supply of land while line D1 represents the demand for land in the first period and line D2 represents the demand for land in the second time period. Assume the initial agricultural land market equilibrium situation has L1 units of land with a price at P1. The existence of general economic growth and the subsequent population increase will cause rural-urban fringe expansion for purposes such as industrial location, housing, transportation services, and recreational facilities. This expansion causes the demand for land to shift to line

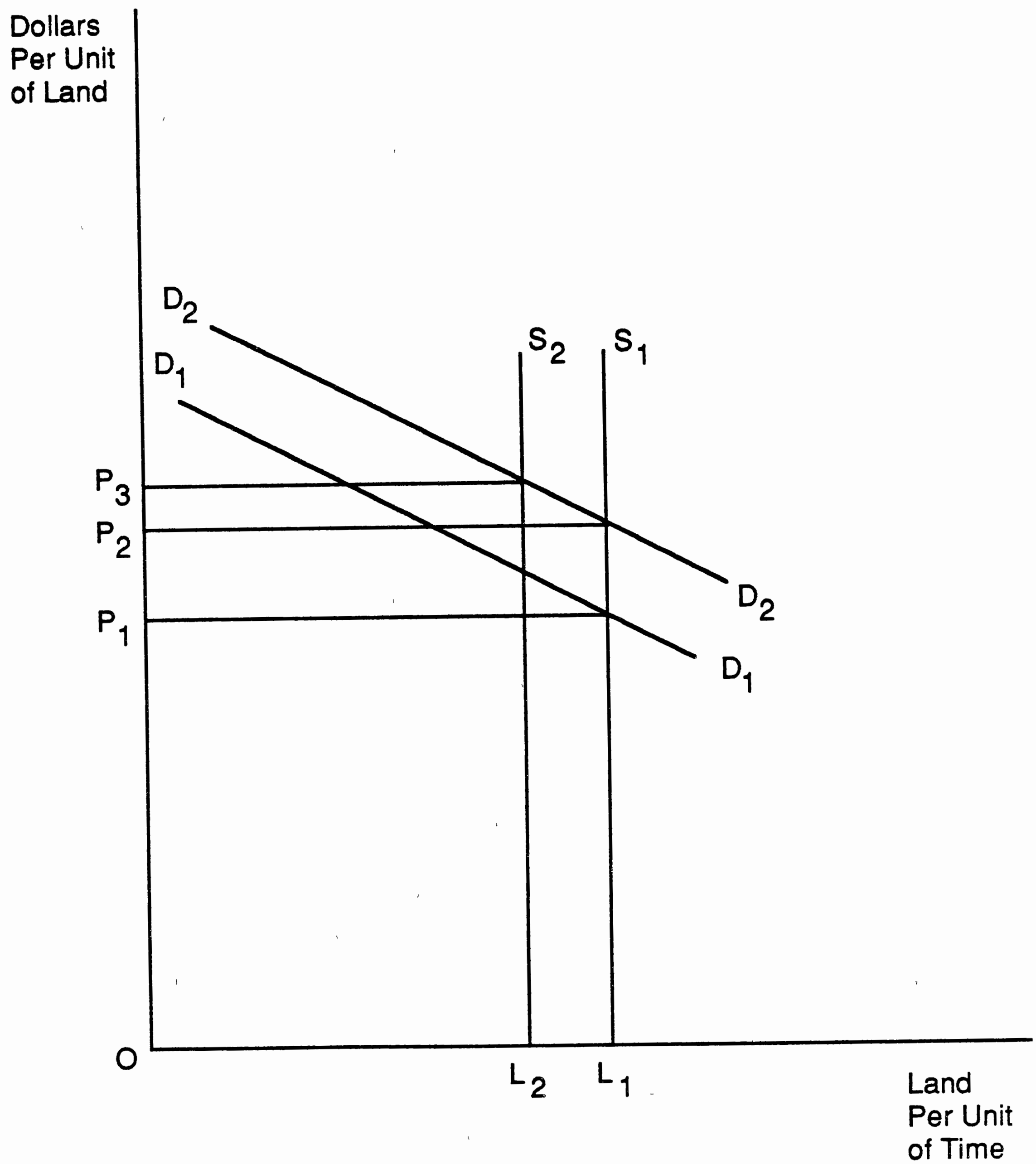

Figure 2. Demand and Supply of Agricultural Land

D2. This shift from demand 1 to demand 2 will then cause a shift in the price of the land from P1 to P2. Because land is shifted from agricultural to non-agricultural uses, the supply of agricultural land moves to the left (line S2) which in turn causes the price of agricultural land to increase even more (P3). These results show that higher land prices can result from economic development and increased population. Therefore, economic development and increases in population are expected to have a positive relationship with the price of land.

Study Area

In Oklahoma, agriculture and its related industries provide the major source of income. Oklahoma, in 1987, had 31,541,977 acres of land in farm related uses. This figure accounts for approximately 71 percent of the total land in the state. Of this thirty one million acres of farmland, 14,443,459 acres, or approximately 46 percent were considered cropland. The average size farm in Oklahoma was 449 acres while the number of farms totaled 70,228. Agriculture, in Oklahoma, was dominated by the production of both winter wheat and cattle. Winter wheat and cattle rank first and second in the value of agricultural products sold in the state (Oklahoma Department of Agriculture, 1987).

Length of the growing season and average annual precipitation are both characteristics that lend themselves well to the summer harvest of winter wheat and the winter grazing of wheat pasture. Other crops grown in Oklahoma are alfalfa, grain sorghum, oats, barley, rye, corn, cotton, peanuts, and hay. But, winter wheat is by far the most prominent crop grown. It accounts for approximately 33 percent of the crop acreage that is harvested. The next

TABLE I

CROP ACREAGE HARVESTED AND TOTAL PRODUCTION/BUSHELS

CROP	1986 Harvested Acres	1986 Bu./tons Production	1987 Harvested Acres	1987 Bu./tons Production	1988 Harvested Acres	1988 Bu./tons Production
			(Millions of Dollars)			
Winter Wheat	5.20	150.80	4.80	129.60	4.80	172.80
Other Grains	0.71	34.75	0.57	28.24	0.55	27.65
Hay	1.98	4.30	2.21	4.41	2.31	3.93

Source: Oklahoma Agricultural Statistics

TABLE II

CASH RECEIPTS OF SELECTED AGRICULTURAL PRODUCTS AND SOURCES

Year	Livestock & Products	Wheat	Other Crop	Government Payments	Total
			(Millions of Dollars)		
1986	1521.6	247.2	312.0	319.2	2400 0
1987	1834.0	257.6	383.6	324 8	2800 0
1988	2104 6	486 2	544 0	265 2	3400 0

Source: Oklahoma Agricultural Statistics highest is hay which accounts for about 15 percent of the total crop acreage harvested. (Table I).

There are estimated to be 5.2 million head of cattle and calves in Oklahoma which is the most common form of livestock raised in the state. By comparison, there are about 125,000 head of sheep and 220,000 head of hogs raised in the state each year. Livestock, cattle in particular, account for the majority of cash receipts to farmers from agricultural products. In 1986 through 1988, livestock and its related products averaged cash receipts of approximately 1.82 billion dollars. This figure represents almost 64 percent of the average cash receipts received for the three year period. (Table II).

Agricultural Land Market Activity in the Study Area

For the period January 1986 through December 1989, information was obtained on 5486 land sales in Oklahoma. The average size of tracts sold was 210 acres and these sales represented approximately 1,152,370 acres or four percent of the total acres of land that are in farm related uses. This sample included 742 sales of tracts 40 acres or less, 1540 sales between 40 and 100 acres, 2401 sales between 100 and 280 acres, and 697 sales of tracts larger than 280 acres. The 697 sales over 280 acres averaged 450 acres in size. Table III shows the number of sales and average tract size for the four size categories in years 1986, 1987, 1988, and 1989.

TABLE III

NUMBER AND AVERAGE SIZE IN ACRES
OF OKLAHOMA LAND SALES

Year	All Sales Acres		20-40 Acres		40-100 Acres		100-280 Acres		280-1000 Acres	
	Number	Average Size	Number	Average Size	Number	Average Size	Number	Average Size	Number	Average Size
1986	855	232	131	36	234	76	367	166	103	453
1987	1715	196	243	34	504	76	711	165	221	447
1988	1841	220	246	35	480	75	837	166	244	449
1989	1075	198	122	34	322	76	486	166	129	457
All four years	5486	210	742	35	1540	76	2401	166	697	450

TABLE IV

AVERAGE PRICES PER ACRE OF LAND FOR
DIFFERENT TRACT SIZES

Year	All Sales Acres	20-40 Acres	40-100 Acres	100-280 Acres	280-1000 Acres
			Dollars/Acre		
1986	436	597	503	386	301
1987	424	616	463	385	284
1988	425	611	463	391	314
1989	466	630	495	453	320
4 Yr.Avg	434	614	476	400	304

Average Prices Paid for Agricultural Land in the Study Area

The 1989 average price was 6.9 percent higher than the 1986 average. However, the price of land actually declined between 1986 and 1987. The average price of land in Oklahoma in 1986 was 436 dollars per acre. The average per acre price in 1987 was 424 dollars, a 2.7 percent decrease. In 1988, the price of land increased by 0.2 percent changing from the 1987 value of 424 dollars per acre to the 1988 value of 425 dollars per acre. The largest increase occurred between 1988 and 1989 when the price of land increased by 9.6 percent to 466 dollars per acre. Table IV shows the average per acre prices of land for all sales, as well as, sales in the four different tract size categories. The average price of land for the four year period was 434 dollars per acre. Land prices decreased as land tract size increased. The four year average per acre price of land between 20 and 40 acres was 614 dollars, while the average price of the 40 to 100, 100 to 280, and 280 to 1000 acre categories were respectively 476, 400, and 304 dollars per acre.

Regional Sales

The eight different regions in Oklahoma used in this study were developed by Dr. Darrel Kletke, professor of Agricultural Economics at Oklahoma State University. Region names and counties included are presented in Figure 3. The criteria used to determine which counties went in a region were the similarity of soil types and the similarity of crops produced. The average annual per acre price and the four-year average for each region are shown in Table V. The Panhandle region had the lowest four-year average

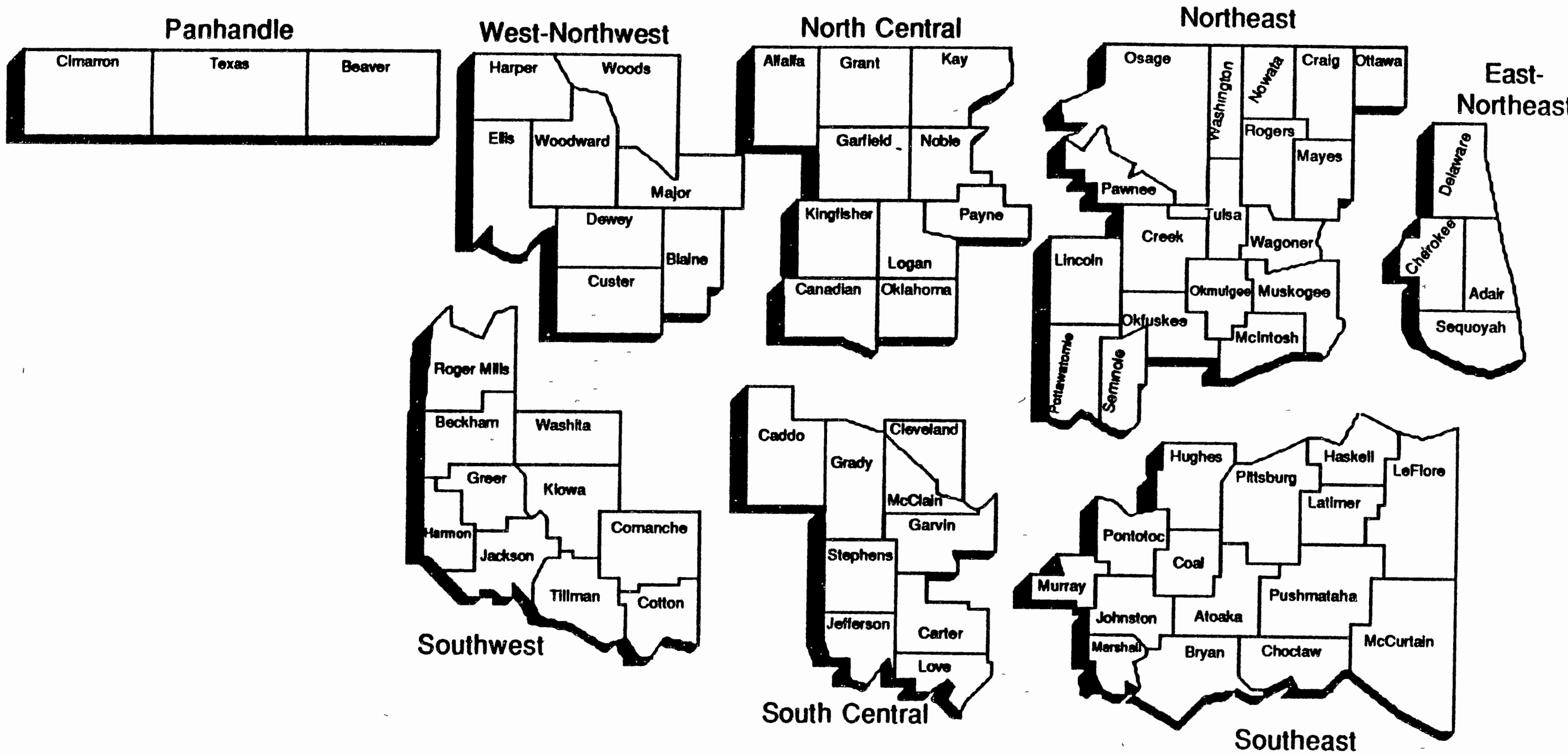

Figure 3. Oklahoma Typical Farm Regions.

TABLE V

REGIONAL AVERAGE PRICES OF OKLAHOMA LAND

Region	1986	1987	1988	1989	4 Yr. Avg
			($/acre)		
Panhandle	285	263	281	268	275
West-Northwest	342	326	393	477	379
Southwest	380	376	378	457	394
North Central	512	495	468	551	501
South Central	486	424	463	448	455
Northeast	513	457	442	486	464
East-Northeast	531	523	521	495	518
Southeast	398	394	385	367	386

price at 275 dollars per acre while the East-Northeast region had the highest four-year average price at 518 dollars per acre. The other six regions had four-year average per acre prices ranging from 379 dollars to 501 dollars.

Cropland Sales

The average price of cropland in Oklahoma for the years 1986 through 1989 was 536 dollars per acre. There was a steady upward trend in cropland values during the four-year period. The average per acre price for cropland in 1986 was 481 dollars, this increased to 500 dollars in 1987, increased again to 519 dollars in 1988, and increased again in 1989 to 675 dollars per acre. This was an average annual increase of approximately 12 percent. The majority of the increase, however, occurred in 1989 when the price of cropland increased by 30 percent. These figures were derived by analyzing only those sales which were at least 90 percent cropland. Sales of cropland were found to account for approximately 16 percent of the total sales in the state. Average prices of cropland by year and region are shown in Table VI.

Pastureland Sales

Sales of land containing at least 90 percent pastureland were used to find pastureland values. Sales that were primarily pastureland accounted for approximately 52 percent of the total sales in the state for the four-year period. The average price paid for pastureland in Oklahoma for the years 1986 through 1989 was 419 dollars per acre. Unlike cropland, which increased in value over the time period, pastureland decreased in value. The average per acre price of pastureland in 1986 was 448 dollars, this decreased to 423 dollars in 1987, decreased again in 1988 to 411 dollars, and decreased again in 1989 to 406

TABLE VI

SUMMARY OF CROPLAND VALUES BY REGION

Region	1986	1987	1988	1989	4 Yr. Avg
			($/Acre)		
Panhandle	347	318	351	425	349
West-Northwest	513	528	546	696	567
Southwest	463	468	494	644	513
North Central	556	594	590	766	622
South Central	605	569	673	740	628
Northeast	504	540	549	647	571
East-Northeast	No Sales	520	531	822	600
Southeast	563	413	541	700	489
State	481	500	519	675	536

TABLE VII

SUMMARY OF PASTURELAND VALUES BY REGION

Region	1986	1987	1988	1989	4 Yr. Avg
			($/Acres)		
Panhandle	179	197	185	160	181
West-Northwest	218	228	272	279	247
Southwest	407	359	262	288	328
North Central	506	467	387	363	433
South Central	450	394	448	414	426
Northeast	537	461	433	466	458
East-Northeast	554	522	522	479	522
Southeast	395	392	373	355	379
State	448	423	411	406	419

dollars per acre. This was an average annual decrease of approximately 3.2 percent for the four-year period. Average prices of pastureland by year and region are shown in Table VII.

Summary

The agricultural land market has been studied for years and will likely be continually studied in the future. The goal of most studies is to determine what land values are, how they have changed, and why buyers pay what they do for land. Currently, locational and populational theories underlie much of the agricultural land market research. These theories can be combined to suggest that agricultural land values are influenced by locational and populational factors. However, there is much variability in land values that remains to be explained.

Because land is restricted to its location, other resources and farm products must be transported either to or away from the land. The greater the distance of travel, the greater the costs associated with the land. This creates an inverse relationship between input and output transportation distance and the price of land.

The impacts of economic growth and population increases on agricultural land values can be shown using simple supply and demand curves. The supply of land is generally considered to be fixed. Therefore, when an area experiences economic growth and a subsequent population increase, the demand for the land increases and the price or value goes up. Because of this, an expected positive relationship exists between economic development and the price of land.

Agriculture and its related industries provide the major source of income in Oklahoma. Farm related uses account for 31,541,977 acres or approximately

71 percent of the total area of the state. Winter wheat is the major crop grown while stocker cattle is the major form of livestock raised in the state.

Information obtained from 5486 land sales in Oklahoma for the period January 1986 through December 1989 showed an average tract size of 210 acres selling for 434 dollars per acre.

The state was divided into eight regions based on the similarity of soil types and crops grown. The Panhandle region had the lowest per acre prices while the East-Northeast region had the highest per acre prices for land.

The 1989 average price for cropland in Oklahoma was 675 dollars per acre. To be considered a cropland tract, at least 90 percent of the tract had to be cropland. Sales of cropland accounted for 16 percent of the total sales.

The 1989 average price for pastureland in Oklahoma was 406 dollars per acre. To be considered pastureland, the tract had to contain at least 90 percent pastureland. Pastureland sales accounted for 52 percent of the total sales.

CHAPTER III

ANALYSIS OF THE IMPACT OF HARD SURFACE ROADS ON OKLAHOMA LAND VALUES

In this chapter the impact of hard surface roads on land values is analyzed. Land prices as impacted by the distance to the nearest hard surface road will be discussed for the Panhandle, Western Oklahoma, Eastern Oklahoma, and the entire state for the years 1986, 1987, and 1988. Due to the extreme amount of time required to gather the distance data and the lateness of receiving the 1989 land sale data, the analysis of the input of hard surface roads on Oklahoma land values was only for a three-year time period. Simple regression is used to determine if the distance to hard surface roads has a predictable or significant effect on the price of land and if prediction equations can be fitted for the data. Because land values are always changing, the price changes between distances will be expressed as percentage changes to facilitate their use when land prices, as a whole, increase or decrease. Percentage change values also permits information to be useful in areas where general land values are higher or lower than the average.

The State

The distance data for the state of Oklahoma consists of 3489 sales which are all nine miles or less from the nearest hard surface road. These distances were found by using County General Highway Maps published by the Oklahoma Department of Transportation and counting the miles between the

TABLE VIII

AVERAGE PRICES AND PRICE CHANGES AS DISTANCE INCREASES FOR THE STATE

Distance In Miles	Number of Sales	Price per acre (dollars)	Price change (dollars)	Percent change
1	1234	466	-	-
2	954	420	-46	-9.9
3	535	412	-8	-1.9
4	336	385	-27	-6.5
5	184	369	-16	-4.2
6	120	337	-32	-8.7
7	89	333	-4	-1.2
8	23	320	-13	-3.9
9	14	313	-7	-2.2

tract and nearest hard surface road. Because Interstate highways and turnpikes can only be entered and exited at various points, there existence was not a factor in determining distances.

The average per acre prices of land corresponding to the nine distance categories can be seen in Table VIII. Land within one mile of a hard surface road had an average per acre price of 466 dollars. Moving one more mile away lowered the average price by 46 dollars or 9.9 percent to 420 dollars per acre. The subsequent price changes and percentage changes for the data can also be seen in Table VIII. It can be noted that approximately 78 percent of the sales in Oklahoma are three miles or less from the nearest hard surface road while approximately 93 percent of the sales are within five miles. This is a good indication that the state of Oklahoma has a evenly distributed network of highways and other hard surface rural roads.

Estimated Equations

Linear		Square Root	
$Y = 466 - 18.5X$		$Y = 538.8 - 77.8\sqrt{X}$	
R square	= 0.95	R Square	= 0.98
Std. Error of X	= 1.55	Std. Error of X	= 3.81
t - value	= 11.94	t - value	= 20.42

Linear and square root regression functions were fitted to the average value for each distance to determine if a suitable prediction equation could be established. As shown above, the prediction equations for both the linear and square root functions had high coefficients of determination (R Square) values. This means that ninety-five and ninety-eight percent of the variability in the average prices could be explained by the distance to hard surface road variable.

TABLE IX

PREDICTED PRICES AND PRICE CHANGES FOR THE STATE

Distance to paved road (miles)	Linear			Square Root		
	Price (dollars)	$ Change (dollars)	Percent	Price (dollars)	$Change (dollars)	Percent
1	447.5	-	-	461.0	-	-
2	429.0	-18.5	-4.1	429.0	-32	-6.9
3	410.5	-18.5	-4.2	405.0	-24	-5.6
4	392.0	-18.5	-4.5	384.0	-21	-5.2
5	373.5	-18.5	-4.7	365.0	-19	-4.9
6	355.0	-18.5	-5.0	349.0	-16	-4.5
7	336.5	-18.5	-5.2	334.0	-15	-4.3
8	318.0	-18.5	-5.5	320.0	-14	-4.2
9	299.5	-18.5	-5.8	307.0	-13	-4.1

Both the linear and square root regression functions showed an inverse relationship between per acre prices paid for Oklahoma land and distance to hard surface roads. Also. both X coefficients are significant at the 0.001 level of probability.

The change in value for each additional one mile in distance is $18.50/acre for the linear function. The negative effect of additional one mile increases in distance for the square root function is of a diminishing nature. Land that is one to two miles away from the nearest hard surface road had a 32 dollar decrease in value compared to land that was within one mile of the road. Table IX shows the subsequent dollar value decreases as distance increases for both the linear and square root functions. By comparing the actual price changes in Table VIII with the predicted price changes in Table IX, one can see that the predicted values provide a very good representation of the actual average prices. Figure 4 shows a graph comparing the actual prices with those that were predicted. The square root equation provides the best predicted values, only varying an average of five dollars per acre from the actual prices. In comparison, the linear equation varies an average of $8.56 per acre.

The previous equations were determined using nine observations, the average values for tracts between one and nine miles from a paved road. When running the same regression using the 3489 actual prices, the prediction equations are very similar to the equations obtained from the averages. These equations are shown below:

Linear		Square Root	
$Y = 477.8 - 21.8X$		$Y = 541.3 - 78.6\sqrt{X}$	
R square	= 0.024	R Square	= 0.025
Std. Error of X	= 2.36	Std. Error of X	= 8.28
t - value	= 9.25	t - value	= 9.50

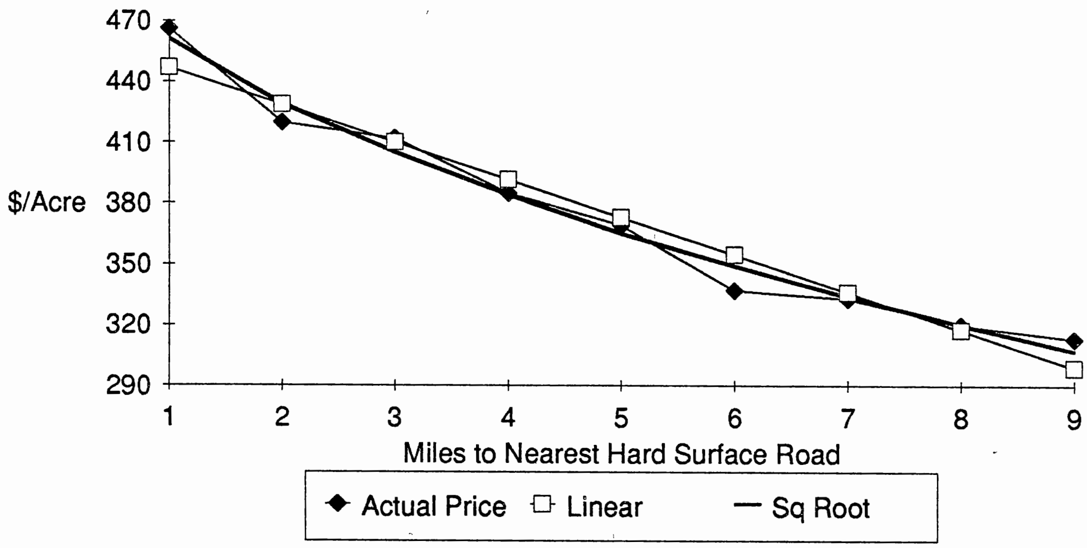

Figure 4. Actual vs. Predicted Prices for the State of Oklahoma

Both X coefficients are significant at the 0.001 level, but the R square values are very low. This low R square value, in part, can be explained by the large amounts of variation in prices for the individual distances. These variations are caused by other factors such as date of the sale, size of the tract, distance to and population of nearest town, and other quality and productivity variables.

These prediction equations can be used as a tool to help determine the price differences between tracts that are different distances from hard surface roads. But they are not tools for predicting the actual value of a tract of land.

Western Oklahoma

For this analysis, Western Oklahoma consists of the West-Northwest, Southwest, North Central, and South Central regions of Oklahoma. These regions were presented in Chapter 2 and can be seen in Figure 3. These four regions include thirty-seven counties which lie roughly west of a line extending between Ponca City and Ardmore. The distance data for the Western part of Oklahoma consists of 1888 sales which are nine miles or less from the nearest hard surface road. The average per acre prices of land corresponding to the nine distance categories can be seen in Table X. Land adjacent to or within one mile of a hard surface road had an average per acre price of 476 dollars. Moving one more mile away lowered the average price by 40 dollars or 8.4 percent to 436 dollars per acre. The remaining price changes and percentage changes can also be seen in Table X.

TABLE X

AVERAGE ACTUAL PRICES VS. PREDICTED PRICES FOR WESTERN OKLAHOMA

Distance In Miles	Number of Sales	Actual			Square Root		
		Price (dollars)	Change (dollars)	Percent	Price (dollars)	Change (dollars)	Percent
1	633	476	-	-	471	-	-
2	478	436	-40	-8.4	436	-35	-7.4
3	298	407	-29	-6.7	410	-26	-6.0
4	209	387	-20	-4.9	387	-23	-5.6
5	106	382	-5	-1.3	367	-20	-5.2
6	72	326	-56	-14.7	349	-18	-5.0
7	62	324	-2	-0.6	332	-17	-4.9
8	17	314	-10	-3.1	317	-15	-4.5
9	13	321	+7	+2.2	303	-14	-4.4

Estimated Equations

Linear		Square Root	
$Y = 475.86 - 20.22X$		$Y = 555.9 - 84.4\sqrt{X}$	
R square	= 0.916	R Square	= 0.955
Std. Error of X	= 2.32	Std. Error of X	= 6.92
t - value	= 8.73	t - value	= 12.2

Linear and square root regression function were fitted to determine if a suitable prediction equation could be established. The prediction equations have coefficients of determination (R square) values of 0.916 and 0.955. This means in both cases over ninety percent of the variability in the average prices could be explained by the distance variable.

The negative sign in the equations show that an inverse relationship exists between the per acre prices paid for land in Western Oklahoma and the distance to the nearest hard surface road. Also, the t-value shows that both X coefficients are significant at the 0.001 level of probability.

The linear prediction equation shows that for every mile increase in distance, the per acre price would fall by $20.22. That results in an average decrease in value of 4.78 percent per added mile of distance. The square root prediction equation shows changes of a diminishing nature as distance increases. Land that is one to two miles away from the nearest hard surface road had a 35 dollar decrease in value compared to land that was within one mile of the road. Table X shows the changes in dollar values and in percentages for the predicted prices created by the square root prediction equation. The predicted values given by the square root equation vary by an average of $8.33 compared to the actual prices. However, the predicted values for distances of four miles or less only vary by an average of $2 per acre compared to the actual price.

Because of this near fit, these prediction equations can be used as a tool to help determine the price differences between land that is different distances from a hard surface road. But, because of the many other variables affecting value, these equations should not be used for predicting the per acre price of a tract of land in Western Oklahoma.

Eastern Oklahoma

Eastern Oklahoma, for this study, consists of the thirty-seven counties in the Northeast, East-Northeast, and Southeast regions of Oklahoma. These regions and counties can be seen in Figure 3 in Chapter 2. The distance data for the Eastern part of Oklahoma consists of 1426 sales which are seven miles or less from the nearest hard surface road. The average per acre prices of land corresponding to the seven distance categories can be seen in Table XI. Land adjacent to or within one mile of a hard surface road had an average per acre price of 472 dollars. The price changes associated with moving additional miles away from the road can also be seen in Table XI.

Estimated Equation

Linear		Square Root	
$Y = 469.6 - 15.1X$		$Y = 518.7 - 57\sqrt{X}$	
R square	= 0.717	R Square	= 0.743
Std. Error of X	= 4.26	Std. Error of X	= 14.98
t - value	= 3.56	t - value	= 3.80

Linear and square root regression function were fitted into the data to determine if a suitable prediction equation could be established. The above equations have coefficients of determination (R square) values of 0.717 and

TABLE XI

AVERAGE ACTUAL PRICES VS. PREDICTED
PRICES FOR EASTERN OKLAHOMA

Distance In Miles	Number of Sales	Actual			Square Root		
		Price (dollars)	Change (dollars)	Percent	Price (dollars)	Change (dollars)	Percent
1	555	472	-	-	462	-	-
2	440	414	-58	-12.3	438	-24	-5.2
3	213	437	+23	+ 5.6	420	-18	-4.1
4	104	409	-28	- 6.4	405	-15	-3.6
5	65	366	-43	-10.5	391	-14	-3.4
6	31	404	+38	+10.4	379	-12	-3.1
7	18	361	-43	-10.6	368	-11	-2.9

0.743. This means in both cases only about seventy to seventy-five percent of the variability in the average prices could by explained by the distance variable.

The negative signs in the equations show that an inverse relationship exists between the per acre prices paid for land in Eastern Oklahoma and the distance to the nearest hard surface road. Also, the t-value indicates that both X coefficients are significant at the 0.02 level of probability.

The linear prediction equation shows for every mile increase in distance, the per acre value falls by $15.10. That results in an average decrease of 2.87 percent per added mile of distance. The square root prediction equation shows price changes of a diminishing nature as distance increases. Table XI shows the changes in dollar values and in percentages for the predicted prices created by the square root prediction equation.

These prediction equations, due to their lower R square and t-values, show that Eastern Oklahoma land is not influenced as much by the distance to hard surface road variable as is Western Oklahoma. Eastern Oklahoma is influenced by the distance variable, but there is more unexplained variance resulting from other variables not considered.

Panhandle of Oklahoma

The Oklahoma Panhandle is located in extreme Northwestern Oklahoma and consists of Cimarron, Texas, and Beaver Counties. There were 175 land sales that occurred in the Panhandle during the years 1986, 1987, and 1988. The average per acre prices for land corresponding to the distance to the nearest hard surface road can be seen in Table XII. The per acre price of land in the Panhandle that is adjacent to or less than one mile away from a hard surface road is 267 dollars. As the distance from hard surface roads increases,

TABLE XII

AVERAGE PRICE AND PRICE CHANGES FOR DISTANCES TO HARD SURFACE ROADS IN THE PANHANDLE

Distance In Miles	Number of Sales	Price per acre (dollars)	Price Change (dollars)	Percent Change
1	46	267	-	-
2	36	270	+ 3	+ 1.1
3	24	254	-16	- 5.9
4	23	279	+25	+ 9.8
5	13	268	-11	- 3.9
6	17	272	+ 4	+ 1.5
7	9	346	+74	+27.2
8	6	262	-84	-24.3
9	1	200	-62	-23.7

the per acre prices range from 346 dollars at the seven mile distance to 200 dollars at the nine mile distance.

Estimated Equations

Linear		Square Root	
$Y = 278 - 1.9X$		$Y = 279.5 - 5\sqrt{X}$	
R square	= 0.019	R Square	= 0.008
Std. Error of X	= 5.08	Std. Error of X	= 20.92
t - value	= .377	t - value	= .241

Linear and square root regression functions were fitted for the price and distance data to determine if a suitable prediction equation could be established. The coefficient of determination (R Square) for both functions explain less than two percent of the variation in per acre prices paid for land in the Panhandle.

Therefore, due to the lack of variation explained in the regressions and the random nature of the price changes presented in Table XII. It can be argued that the distance to hard surface roads has very little influence on the per acre price of land in the Panhandle area of Oklahoma.

Summary

The state of Oklahoma, as a whole, for the years 1986, 1987, and 1988 had 78 percent of the land sales within three miles or less of a hard surface road.

Linear and square root regression functions fitted to the whole state data showed an inverse relationship between per acre price paid for land and the distance to the nearest hard surface road. The square root equation provided the best fit. The R square value was 0.98 with the predicted values varying an average of five dollars per acre from the actual prices.

When running the same regression on the entire data set the R square value suffered greatly due to large amounts of variation caused by other factors, but the predicted equations remained very similar. All of the coefficients of the equations were significant at the 0.001 level of probability.

The linear and square root regression equations for Western Oklahoma showed an inverse relationships between the price of land and the distance to the nearest hard surface road. Both equations had high R square values and were significant at the 0.001 level of probability. The square root equation showed the best fit with a 0.955 R square value.

The prediction equations for Eastern Oklahoma had R square values of 0.717 and 0.743. The equations were significant at the 0.02 level of probability. The equations also showed an inverse relationship between the per acre prices and the distance. But the equations did not predict prices as well as for Western Oklahoma. This is due to factors not considered that apparently were more significant.

The distance to hard surface roads was found to have very little effect on the per acre price of land in the Panhandle area of Oklahoma. The regression equations had very low R square values and were not significant at the 0.5 level of probability.

CHAPTER IV

AN ANALYSIS OF THE IMPACT OF DISTANCE TO CITIES ON OKLAHOMA LAND VALUES

In this chapter, the impact of distance to groups of differently populated cities on land values will be analyzed. The distances to cities were found by using County General Highway Maps published by the Oklahoma Department of Transportation and counting the miles between the tract and the city using the shortest route available through existing roads and highways.

The cities in Oklahoma were divided into six different categories according to population. The first category consists of the Oklahoma City and Tulsa metropolitan areas or towns over 100,000 people. The metropolitan areas included the towns of Oklahoma City, Norman, Edmond, El Reno, Moore, Midwest City, Choctaw, Yukon, Tulsa, Sand Springs, Jenks, Bixby, Broken Arrow, and Owasso. All land sales within fifty miles of the center of these two areas were analyzed in this group. Category two consists of towns with populations between 25,000 and 100,000 people. Seven towns fall into this category and sales closer than twenty-five miles were used in the analysis. Category three has towns that are between 10,000 and 25,000 people. There are thirteen Oklahoma towns falling into this category. Sales within fifteen miles of the center of these towns were analyzed with this group. Nineteen towns with populations between 6,000 and 10,000 are in category four. Sales within ten miles were used in this group. Categories five and six consist of towns having populations of 3,000 to 6,000 and 500 to 3,000. Forty towns fit into category five while 217 towns fit into category six. Sales within six miles were used for category five and sales within three miles were used for category six. Simple regression is used to determine if the distances to towns and cities has a predictable or significant effect on the price of land and if prediction equations can be fitted for the data.

City 1

The City 1 category includes the Oklahoma City and Tulsa metropolitan areas. There were 501 sales within fifty miles of the center point of the two areas for the years 1986, 1987, 1988. The distance from the land sales to the city was calculated using existing roads and highways. The actual average prices and price changes of land sales corresponding to the distance to the center of the metropolitan area can be seen in Table XIII. The sale price values used are the actual selling price per acre less the per acre value of any improvements. The sales closest to the center were ten miles away and had an average price of 1008 dollars per acre. The highest average per acre price, 1686 dollars, occurred from sales that were 14 miles away. The average per acre price fell below 1000 dollars at the 20 mile distance and continued to fall until the low point of 335 dollars per acre was reached at the 50 mile distance.

Estimated Equations

Linear

$$Y = 1495.6 - 25.2X$$

R square	= 0.74
Std. Error of X	= 2.42
t - value	= 10.39

Square Root

$$Y = 2188 - 269.9\sqrt{X}$$

R Square	= 0.766
Std. Error of X	= 24.21
t - value	= 11.15

TABLE XIII

ACTUAL PRICES AND PRICE CHANGES FOR CITY 1

Distance (miles)	Number of Sales	Actual Value (dollars)	Change (dollars)	Percent Change
10	3	1008	-	-
11	1	1315	307	30.5
13	1	1025	-290	-22.1
14	3	1686	661	64.5
15	5	1366	-320	-19.0
16	5	1292	-74	-5.4
17	4	1400	108	8 4
18	8	1028	-372	-26.6
19	4	1375	347	33.8
20	11	974	-401	-29.2
21	3	669	-305	-31.3
22	4	706	37	5.5
23	9	756	50	7.1
24	8	636	-120	-15.9
25	14	819	183	28.8
26	8	920	101	12.3
27	9	652	-268	-29.1
28	10	647	-5	-0.8
29	14	752	105	16.2
30	14	635	-117	-15.6
31	18	571	-64	-10.1
32	20	600	29	5 1
33	15	517	-83	-13 8
34	15	541	24	4.6
35	17	493	-48	-8.9
36	25	481	-12	-2 4
37	27	498	17	3.5
38	17	503	5	1.0
39	17	557	54	10 7
40	14	467	-90	-16.2
41	27	411	-56	-12 0
42	25	508	97	23.6
43	28	419	-89	-17.5
44	13	516	97	23 2
45	22	481	-35	-6 8
46	21	431	-50	-10.4
47	13	408	-23	-5 3
48	15	412	4	1 0
49	22	345	-67	-16 3
50	23	335	-10	-2 9

Linear and square root regression functions were fitted to the average values for each distance to determine if a suitable prediction equation could be established. The above prediction equations have coefficients of determination (R square) values of 0.74 and 0.755. This means that about seventy-five percent of the variability in the average prices could be explained by the distance to city variable.

The negative sign in the equations shows that a inverse relationship exists between the per acre prices paid for land and the distance to the metropolitan area. Also, the t-values show that both X coefficients are significant at the 0.001 level of probability.

The linear prediction equation shows that for every mile increase in distance, the per acre price would fall by $25.20. The square root prediction equation shows price changes of a diminishing nature as distance increases. The first mile increase in distance reduces the per acre price by $41.70, while the 49 mile to 50 mile increase reduces the per acre price by $19.20. Table XIV shows the changes in dollars and in percentages for the predicted prices created by the linear and square root equations.

Because of the high R square values and the significance of the t-values, these prediction equations can be used as a tool to help determine the price differences between tracts of land that are different distances from the Oklahoma City and Tulsa metropolitan areas. However, due to the influence of many other factors, these equations should not be used exclusively in predicting the actual prices of land in Oklahoma.

TABLE XIV

PREDICTED PRICES AND PRICE CHANGES FOR CITY 1

Distance to City	Linear Prediction (dollars)	Change (dollars)	Percent	Square Root Prediction (dollars)	Change (dollars)	Percent
10	1243.6	-	-	1334.2	-	-
11	1218.4	-25.2	-2.0	1292.5	-41.7	-3.1
12	1193.2	-25.2	-2.1	1252.7	-39.8	-3.1
13	1168.0	-25.2	-2.1	1214.5	-38.2	-3.1
14	1142.8	-25.2	-2.2	1177.7	-36.7	-3.0
15	1117.6	-25.2	-2.2	1142.3	-35.5	-3.0
16	1092.4	-25.2	-2.3	1108.0	-34.3	-3.0
17	1067.2	-25.2	-2.3	1074.8	-33.2	-3.0
18	1042.0	-25.2	-2.4	1042.5	-32.3	-3.0
19	1016.8	-25.2	-2.4	1011.1	-31.4	-3.0
20	991.6	-25.2	-2.5	980.5	-30.6	-3.0
21	966 4	-25.2	-2.5	950.7	-29 8	-3 0
22	941.2	-25.2	-2.6	921.6	-29.1	-3.1
23	916.0	-25.2	-2.7	893.1	-28 5	-3.1
24	890.8	-25.2	-2.8	865.3	-27.9	-3.1
25	865.6	-25.2	-2.8	838.0	-27.3	-3.2
26	840.4	-25.2	-2.9	811.3	-26.7	-3.2
27	815.2	-25.2	-3.0	785.1	-26.2	-3.2
28	790.0	-25.2	-3 1	759 3	-25 8	-3.3
29	764.8	-25.2	-3.2	734.0	-25.3	-3.3
30	739.6	-25.2	-3.3	709.2	-24.8	-3.4
31	714.4	-25.2	-3.4	684.7	-24.5	-3 4
32	689.2	-25.2	-3.5	660.6	-24.1	-3.5
33	664.0	-25.2	-3.7	637.0	-23.7	-3 6
34	638.8	-25.2	-3.8	613 6	-23.3	-3.7
35	613.6	-25.2	-3 9	590.7	-23.0	-3.7
36	588.4	-25.2	-4.1	568.0	-22.7	-3.8
37	563.2	-25.2	-4.3	545.6	-22 4	-3.9
38	538.0	-25.2	-4.5	523 6	-22.0	-4.0
39	512.8	-25.2	-4.7	501.9	-21.8	-4.2
40	487.6	-25.2	-4.9	480 4	-21.5	-4.3
41	462.4	-25.2	-5 2	459.2	-21.2	-4 4
42	437.2	-25.2	-5 4	438 2	-21.0	-4 6
43	412 0	-25.2	-5.8	417 5	-20.7	-4.7
44	386.8	-25.2	-6.1	397.0	-20.5	-4 9
45	361.6	-25.2	-6 5	376.8	-20 2	-5 1
46	336.4	-25.2	-7.0	356.8	-20 0	-5 3
47	311.2	-25.2	-7.5	337.0	-19.8	-5 6
48	286.0	-25.2	-8.1	317.4	-19 6	-5 8
49	260.8	-25.2	-8.8	298.0	-19 4	-6.1
50	235.6	-25.2	-9 7	278 8	-19.2	-6 4

City 2

The City 2 category includes 602 land sales falling within twenty-five miles of the towns of Bartlesville, Enid, Lawton, Muskogee, Ponca City, Shawnee, and Stillwater. Sales that were within twenty-five miles of these towns but also within thirty miles of Oklahoma City or Tulsa were excluded. The actual average prices and price changes for land sales corresponding to the distance to the center of the City 2 cities can be seen in Table XV. The closest land sales to these cities were three miles away and had a per acre price of 683 dollars. Moving one mile further away increased the value to 712 dollars per acre which was the highest value paid. The land sales twenty-five miles away had the lowest per acre prices at 375 dollars.

Estimated Equations

Linear		Square Root	
$Y = 707.9 - 14.3X$		$Y = 873.4 - 101.2\sqrt{X}$	
R square	= 0.824	R Square	= 0.849
Std. Error of X	= 1.44	Std. Error of X	= 9.32
t - value	= 9.92	t - value	= 10.86

Linear and square root regression functions were fitted to the average values for each distance to determine if a suitable prediction equation could be established. The above prediction equations have coefficients of determination (R square) values of 0.824 and 0.849. This means that about eighty-two and eighty-five percent of the variability in the average prices could be explained by the distance to city variable.

The negative sign in the equations show that an inverse relationship exists between the per acre prices paid for land and the distance to the cities. In

TABLE XV

ACTUAL PRICES AND PRICE CHANGES FOR CITY 2

Distance (miles)	Number of Sales	Price (dollars)	Change (dollars)	Percent
3	2	683	-	-
4	4	712	29	4.2
5	5	659	-53	-7.4
6	11	653	-6	-0.9
7	11	526	-127	-19.4
8	21	650	124	23.6
9	11	587	-63	-9.7
10	18	468	-119	-20.3
11	21	543	75	16.0
12	16	470	-73	-13.4
13	32	490	20	4.3
14	27	583	93	19.0
15	28	462	-121	-20.8
16	49	489	27	5.8
17	37	489	0	0.0
18	29	420	-69	-14.1
19	35	380	-40	-9.5
20	34	446	66	17.4
21	32	404	-42	-9.4
22	40	395	-9	-2.2
23	46	385	-10	-2.5
24	44	400	15	3.9
25	49	375	-25	-6.3

other words, when distance increases, prices fall. The t-values of the regressions show that both X coefficients are significant at the 0.001 level of probability.

The linear prediction equation shows that for every mile increase in distance, the per acre price would fall by $14.30. The square root prediction equation shows price changes of a diminishing nature as distance increases. The first mile increase in distance reduced the per acre price by $27.10, while the 24 mile to 25 mile increase reduced the per acre price by $10.20. Table XVI shows the changes in dollars and in percentages for the predicted prices created by the linear and square root equations.

Because of the high R square values and the significance of the t-values, these prediction equations can be used as a tool to help determine the price differences between tracts of land that are different distances to the City 2 cities. These equations, however, should not be used exclusively in predicting the actual prices of land in Oklahoma.

City 3

The City 3 category includes 294 land sales falling within fifteen miles of the towns of Ada, Altus, Ardmore, Chickasha, Duncan, Durant, Guthrie, McAlester, Miami, Okmulgee, Sapulpa, and Woodward. Sales that were within fifteen miles of these towns but also falling within thirty miles of the City 1 cities and fifteen miles from the City 2 cities were not included. This was to negate any price increases caused by the larger cities. The actual average prices and price changes for land sales corresponding to the distance to the City 3 cities can be seen in Table XVII. The closest land sale to these cities was two miles away and had a per acre price of 1042 dollars. Moving one mile further away

TABLE XVI

PREDICTED PRICES AND PRICE CHANGES FOR CITY 2

Distance (miles)	Linear Prediction (dollars)	Change (dollars)	Percent	Square Root Prediction (dollars)	Change (dollars)	Percent
3	665.0	-	-	698.1	-	-
4	650.7	-14.3	-2.2	671.0	-27.1	-3.9
5	636.4	-14.3	-2.2	647.1	-23.9	-3.6
6	622.1	-14.3	-2.2	625.5	-21.6	-3.3
7	607.8	-14.3	-2.3	605.6	-19.9	-3.2
8	593.5	-14.3	-2.4	587.2	-18.5	-3.1
9	579.2	-14.3	-2.4	569.8	-17.4	-3.0
10	564.9	-14.3	-2.5	553.4	-16.4	-2.9
11	550.6	-14.3	-2.5	537.8	-15.6	-2.8
12	536.3	-14.3	-2.6	522.8	-14.9	-2.8
13	522.0	-14.3	-2.7	508.5	-14.3	-2.7
14	507.7	-14.3	-2.7	494.7	-13.8	-2.7
15	493.4	-14.3	-2.8	481.5	-13.3	-2.7
16	479.1	-14.3	-2.9	468.6	-12.9	-2.7
17	464.8	-14.3	-3.0	456.1	-12.5	-2.7
18	450.5	-14.3	-3.1	444.0	-12.1	-2.7
19	436.2	-14.3	-3.2	432.3	-11.8	-2.6
20	421.9	-14.3	-3.3	420.8	-11.5	-2.7
21	407.6	-14.3	-3.4	409.6	-11.2	-2.7
22	393.3	-14.3	-3.5	398.7	-10.9	-2.7
23	379.0	-14.3	-3.6	388.1	-10.7	-2.7
24	364.7	-14.3	-3.8	377.6	-10.4	-2.7
25	350.4	-14.3	-3.9	367.4	-10.2	-2.7

TABLE XVII

ACTUAL PRICES AND PRICE CHANGES FOR CITY 3

Distance (miles)	Number of Sales	Price (dollars)	Change (dollars)	Percent
2	1	1042	-	-
3	7	450	-592	-56.8
4	5	615	165	36.7
5	11	411	-204	-33.2
6	15	476	65	15.8
7	37	474	-2	-0.4
8	21	448	-26	-5.5
9	23	424	-24	-5.4
10	23	433	9	2.1
11	27	397	-36	-8.3
12	36	497	100	25.2
13	30	413	-84	-16.9
14	25	397	-16	-3.9
15	33	386	-11	-2.8

lowered the price to 450 dollars per acre. This was a decrease of over 56 percent. The next mile increase in distance raised the average price to 615 dollars per acre. The lowest average per acre price was 386 dollars, which was the price corresponding to the fifteen mile distance.

Estimated Equations

Linear		Square Root	
$Y = 693.3 - 23.9X$		$Y = 895.2 - 143.6\sqrt{X}$	
R square	= 0.349	R Square	= 0.429
Std. Error of X	= 9.42	Std. Error of X	= 47.9
t - value	= 2.54	t - value	= 3.00

Linear and square root regression functions were fitted for the data to determine if a suitable prediction equation could be established. The above prediction equations have R square values of 0.349 and 0.429. This means that only about thirty-five and forty-three percent of the variability in the average prices could be explained by the distance to city variable.

The negative sign in the equations show that an inverse relationship exists between the per acre prices paid for land and the distance to the cities. The t-values of the regressions show that the X coefficients for the linear equation is significant at the 0.05 level of probability while the X coefficient for the square root equation is significant at least at the 0.02 level of probability.

The linear prediction equation shows that for every mile increase in distance, the per acre price would fall by 24 dollars. The square root prediction equation shows price changes of a diminishing nature as distance increases. The first mile increase in distance reduces the per acre price by 46 dollars, while the 14 mile to 15 mile increase reduces the per acre price by 19 dollars.

TABLE XVIII

PREDICTED PRICES AND PRICE CHANGES FOR CITY 3

Distance (miles)	Linear Prediction (dollars)	Change (dollars)	Percent	Square Root Prediction (dollars)	Change (dollars)	Percent
2	645.5	-	-	692.1	-	-
3	621.6	-24	-3.7	646.5	-46	-6.6
4	597.7	-24	-3.8	608.0	-38	-6.0
5	573.8	-24	-4.0	574.1	-34	-5.6
6	549.9	-24	-4.2	543.5	-31	-5.3
7	526.0	-24	-4.3	515.3	-28	-5.2
8	502.1	-24	-4.5	489.0	-26	-5.1
9	478.2	-24	-4.8	464.4	-25	-5.0
10	454.3	-24	-5.0	441.1	-23	-5.0
11	430.4	-24	-5.3	418.9	-22	-5.0
12	406.5	-24	-5.6	397.8	-21	-5.1
13	382.6	-24	-5.9	377.4	-20	-5.1
14	358.7	-24	-6.2	357.9	-20	-5.2
15	334.8	-24	-6.7	339.0	-19	-5.3

Table XVIII shows the changes in dollars and in percentages for the predicted prices created by the linear and square root equations.

The equations show that there is an inverse relationship between the price of a tract of land and the distance to the City 3 cities. But because the R square values and t-values were not very large, caution should be used when using these equations to help determine the price differences of these tracts. The low R square value also shows that there are other unexplained factors influencing the price.

City 4

The City 4 category includes 245 land sales falling within ten miles of the towns of Alva, Anadarko, Blackwell, Clinton, Cushing, Elk City, Frederick, Guymon, Henryetta, Hugo, Idabel, Poteau, Pryor, Sallisaw, Seminole, Tahlequah, Vinita, Wagoner, and Weatherford. Sales that were within ten miles of these towns but also within thirty miles of the City 1 cities, fifteen miles from the City 2 cities, and ten miles from the City 3 cities were not included. This exclusion was to negate any price increases caused by the larger cities. The actual average prices and price changes for land sales corresponding to its distance to the City 4 cities can be seen in Table XIX. The closest land sales to these cities were two miles away and had a per acre price of 643 dollars. Moving one mile further away reduced the price to 606 dollars per acre. The lowest average per acre price was 469 dollars which was the price corresponding to the eight mile distance.

TABLE XIX

ACTUAL PRICES AND PRICE CHANGES FOR CITY 4

Distance (miles)	Number of Sales	Price (dollars)	Change (dollars)	Percent
2	11.0	643	-	-
3	8.0	606	-37.0	-5.8
4	19.0	538	-68.0	-11.2
5	26.0	525	-13.0	-2.4
6	28.0	481	-44.0	-8.4
7	30.0	494	13.0	2.7
8	30.0	469	-25.0	-5.1
9	49.0	480	11.0	2.3
10	44.0	484	4.0	0.8

Estimated Equations

Linear		Square Root	
$Y = 642.7 - 19.7X$		$Y = 753.3 - 96\sqrt{X}$	
R square	= 0.768	R Square	= 0.845
Std. Error of X	= 4.10	Std. Error of X	= 15.5
t - value	= 4.81	t - value	= 6.19

Linear and square root regression functions were fitted for the data to determine if a suitable prediction equation could be established. The above prediction equations have R square values of 0.768 and 0.845. This means that about seventy-seven and eighty-five percent of the variability in the average prices could be explained by the distance to city variable.

The negative sign in the equations show that an inverse relationship exists between the per acre prices paid for land and the distance to the cities. The t-values for the regressions show that the X coefficients for the linear equation is significant at the 0.002 level of probability, while the X coefficient for the square root equation is significant at the 0.001 level of probability.

The linear prediction equation shows that for every mile increase in distance, the per acre price would fall by 20 dollars. The square root prediction equation shows price changes of a diminishing nature as distance increases. The first mile increase in distance reduces the per acre price by 31 dollars, while the nine mile to ten mile increase reduces the per acre price by 16 dollars. Table XX shows the changes in dollars and in percentages for the predicted prices created by the linear and square root equations.

Because of the high R square values and the significance of the t-values, these prediction equations can be used as a tool to help determine the price

TABLE XX

PREDICTED PRICES AND PRICE CHANGES FOR CITY 4

Distance (miles)	Linear Prediction (dollars)	Change (dollars)	Percent	Square Root Prediction (dollars)	Change (dollars)	Percent
2	603.3	-	-	617.5	-	-
3	583.6	-20	-3.3	587.0	-31	-4.9
4	563.9	-20	-3.4	561.3	-26	-4.4
5	544.2	-20	-3.5	538.6	-23	-4.0
6	524.5	-20	-3.6	518.1	-20	-3.8
7	504.8	-20	-3.8	499.3	-19	-3.6
8	485.1	-20	-3.9	481.8	-18	-3.5
9	465.4	-20	-4.1	465.3	-16	-3.4
10	445.7	-20	-4.2	449.7	-16	-3.3

differences between tracts of land that are different distances from the City 4 cities. These equations, however, should not be used exclusively in predicting the actual prices of land in Oklahoma.

City 5

The City 5 category includes 141 land sales falling within six miles of 40 rural Oklahoma towns with populations between 3000 and 6000 people. To negate larger city influences on land values, the sales within thirty, fifteen, ten, and five miles of the City 1, 2, 3, and 4 cities were excluded. The actual average prices and price changes for land sales corresponding to the distance to the City 5 cities can be seen in Table XXI. Land sales within one mile of these cities had average prices of 499 dollars per acre. Moving one mile away lowered the price by 53 dollars to 446 dollars per acre. The next two mile increases showed price increases of 16 and 26 dollars to up the average per acre price to 488 dollars. The next two mile increases saw the price drop to 446 dollars per acre.

<u>Estimated Equation</u>

Linear		Square Root	
$Y = 484.7 - 4.4X$		$Y = 498.7 - 16.3\sqrt{X}$	
R square	= 0.14	R Square	= 0.16
Std. Error of X	= 5.41	Std. Error of X	= 18.6
t - value	= 0.82	t - value	= 0.88

Linear and square root regression functions were fitted for the data to determine if a suitable prediction equation could be established. The prediction equations had R square values of 0.14 and 0.16. This means that only about

TABLE XXI

ACTUAL PRICES AND PRICE CHANGES FOR CITY 5

Distance	Number of Sales	Price (dollars)	Change (dollars)	Percent
1	4	499	-	-
2	5	446	-53	-10.6
3	20	462	16	3.6
4	36	488	26	5.6
5	36	474	-14	-2.9
6	40	446	-28	-5.9

fifteen percent of the variability in the average prices could be explained by the distance to City 5 variable.

The negative sign in the equation shows that an inverse relationship exists between the per acre prices paid for tracts of land and the distance to the cities. The t-values for the regressions show that the X coefficients for the two equations were significant at least at the 0.5 level of probability.

Because of the lack of variation explained by the regression and the random nature of the price changes presented in Table XXI, it can be argued that the distance to the City 5 cities has very little effect or influence on the per acre price of land.

City 6

The City 6 category includes 217 land sales falling within three miles of towns having populations between 500 and 3000 people. Like the other city categories, the sales falling nearer to the larger cities were not included. The average per acre price of land falling within one mile of the City 6 cities was 463 dollars. Moving one mile further away increased the per acre price by 18 dollars to 481 dollars. The next mile increase lowered the price by 43 dollars to 438 dollars per acre.

Regression equations were not fitted for this data due to only three data points. Because of the initial increase and the following decrease in price as distance increased, the per acre prices were determined to not be significantly related to distance.

Summary

The cities in Oklahoma were divided into six different categories according to population. Simple regression was used to determine if the distances to cities had a predictable or significant effect on the price of land.

The City 1 category included 501 sales falling within fifty miles of the Oklahoma City and Tulsa metropolitan areas. Linear and square root regression functions were fitted to the data and had R square values of 0.74 and 0.77. Both equations had negative signs meaning that an inverse relationship existed between the per acre prices and the distance to the metropolitan area.

The City 2 category included 602 land sales falling within twenty-five miles of the towns of Bartlesville, Enid, Lawton, Muskogee, Ponca City, Shawnee, and Stillwater. Linear and square root regression functions were fitted to the data and had R square values of 0.82 and 0.85. An inverse relationship existed between the per acre prices and the distance to the City 2 cities.

The City 3 category included thirteen cities with populations between 10,000 and 25,000 people. There were 294 land sales falling within fifteen miles of these cities. Linear and square root regression functions were fitted for the data and had R square values of 0.35 and 0.43. An inverse relationship existed between the per acre prices and the distance to the City 3 cities.

The City 4 category included nineteen cities with populations between 6,000 and 10,00 people. There were 245 land sales falling within ten miles of these cities. Linear and square root regression functions were fitted for the data and had R square values of 0.77 and 0.85. An inverse relationship existed between the per acre prices and the distance to the City 4 cities.

The City 5 category included cities with populations between 3000 and 6000 people. There were 141 land sales falling within six miles of these cities. Linear and square root regression functions were fitted for the data and had R square values of 0.14 and 0.16. An inverse relationship existed, but the R square was not large enough to imply that the distance variable had a significant impact on the per acre prices.

The City 6 category includes cities with populations between 500 and 3000 people. There were 217 land sales falling within three miles of these cities. Because land values initially increased and then decreased, it was argued that there was not a significant relationship between per acre prices and distance.

CHAPTER V

SUMMARY AND CONCLUSIONS

Summary

The general objective of this study was to examine the effect of distance to hard surface roads and distance to urban areas on the agricultural land market in Oklahoma. More specifically, the objective included identifying and measuring amounts and values of Oklahoma agricultural land sales for the period 1986 to 1989 and quantifying the relationships existing between the distance to hard surface roads and urban areas on the per acre price of agricultural land. In addition, equations were estimated for use in projecting the effects of hard surface roads and cities on the per acre price of agricultural land.

The data employed in this study came from information provided by the Federal Land Bank in Wichita, Kansas. The data was for land sales during the period, January 1986 to December 1989.

Agricultural Land Market Activity and Average Prices Paid in Oklahoma

For the period January 1986 through December 1989, information was obtained on 5486 land sales in Oklahoma. The average size of tracts sold was 210 acres and these sales represented approximately 1,152,370 acres, or four percent of the total acres of land in Oklahoma that are in farm related uses.

For the four-year period, 1986 to 1989, there was a 6.9 percent increase in the price of land in Oklahoma. However, the average prices of land were lower in 1987 and 1988 than they were in 1986. The average price of land in Oklahoma in 1986 was 436 dollars per acre. In 1987 the average price fell to 424 dollars per acre. It increased in 1988 to a level of 425 dollars per acre and then increased by almost ten percent to a price of 466 dollars per acre in 1989. The average price of land for the four-year period was 434 dollars per acre. It was also found that as tract size increased land prices decreased. Tract sizes falling into the 40 to 100, 100 to 200, and 280 to 1000 acres size categories had average prices of 476, 400, and 304 dollars per acre, respectively.

The state was divided into eight regions based on similarity of soil types and crops grown. The Panhandle region had the lowest four-year average price at 275 dollars per acre while the East-Northeast region had the highest four-year average price at 518 dollars per acre. The other six regions had four-year average per acre prices ranging from 379 dollars to 501 dollars.

The average price of cropland sales in Oklahoma for the years 1986 through 1989 was 536 dollars per acre. There was a steady upward trend in cropland prices during the four-year period. The average per acre price for cropland in 1986 was 481 dollars, this increased to 500 dollars in 1987, increased again to 519 dollars in 1988, and increased again in 1989 to 675 dollars per acre. These figures were derived by analyzing only those sales which were at least 90 percent cropland. Sales of cropland were found to account for approximately 16 percent of the total sales in the state.

Pastureland sales, sales of land containing at least 90 percent pastureland, accounted for approximately 52 percent of the total sales in the state for the four-year period. The average price paid for pastureland in Oklahoma for the years 1986 through 1989 was 419 dollars per acre. Unlike cropland, which increased in value each time period, pastureland decreased in value each year. The average per acre price of pastureland in 1986 was 448 dollars, this decreased to 423 dollars in 1987, decreased again in 1988 to 411 dollars, and decreased again in 1989 to 406 dollars per acre.

Impact of Distance to Hard Surface Roads

The distance data for the whole state of Oklahoma consists of 3489 sales which occurred between 1986 and 1988 and are all nine miles or less from the nearest hard surface road. Land within one mile of a hard surface road had an average per acre price of 466 dollars. Moving one mile away lowered the average price by 46 dollars to 420 dollars per acre. The subsequent prices, as distance increased, continued to fall and the nine mile distance had an average per acre price of 313 dollars. It was also determined that approximately 78 percent of the land sales in Oklahoma were three miles or less from the nearest hard surface road while 93 percent of the sales were within five miles.

Linear and square root regression functions fitted to the state data showed an inverse relationship between per acre price paid for land and the distance to the nearest hard surface road. The square root equation provided the best fit and had a R square value of 0.98.

The distance data for the Western part of Oklahoma, less the Panhandle, consists of 1888 sales which are nine miles or less from the nearest hard surface road. Land adjacent to or within one mile of a hard surface road had an average per acre price of 476 dollars. The subsequent prices, as distance increased, continued to fall until the nine mile distance. The nine mile distance saw an increase of seven dollars per acre from the eight mile distance.

The linear and square root regression equations for Western Oklahoma showed an inverse relationship between the price of land and the distance to the nearest hard surface road. The square root equation showed the best fit with a 0.955 R square value.

The distance data for the Eastern part of Oklahoma consists of 1426 sales which were seven miles or less from the nearest hard surface road. Land adjacent to or within one mile of a hard surface road had an average per acre price of 472 dollars. The subsequent prices, as distance increased, decreased for the two, four, five, and seven mile distances, but increased for the three and six mile distances.

The regression equations fitted for the Eastern Oklahoma data showed an inverse relationship between the per acre prices and the distance to the nearest hard surface road, but the best R square value was only 0.743.

The distance data for the Panhandle part of Oklahoma consists of 175 land sales which were nine miles or less from the nearest hard surface road. The per acre price of land in the Panhandle that is adjacent to or less than one mile away from a hard surface road was 267 dollars. As the distance from hard surface roads increases, the per acre prices range from 346 dollars at the seven mile distance to 200 dollars at the nine mile distance.

Due to the very low R square values it was determined that the distance to hard surface roads had an uncertain effect on the per acre price of land in the Panhandle area of Oklahoma.

Impact of Distance to Cities

The cities in Oklahoma were divided into six different categories according to population. Simple regression was used to determine if the distances to cities had a predictable or significant effect on the price of land.

The City 1 category included 501 sales falling within fifty miles of the Oklahoma City and Tulsa metropolitan areas. Regression functions were fitted to the data and the square root function had the best fit with a R square value of 0.77. An inverse relationship existed between the per acre prices and the distance to the metropolitan area.

The City 2 category included 602 land sales falling within twenty-five miles of the towns of Bartlesville, Enid, Lawton, Muskogee, Ponca City, Shawnee, and Stillwater. An inverse relationship existed between the per acre prices and the distance to the City 2 cities. The best regression equation fitted to this data had a R square value of 0.85.

The City 3 category included thirteen cities with populations between 10,000 and 25,000 people. There were 294 land sales falling within fifteen miles of these cities. The best fitting regression function had a R square value of 0.43. An inverse relationship existed between the per acre price and the distance to the City 3 cities.

The City 4 category included nineteen cities with populations between 6,000 and 10,000 people. There were 245 land sales falling within ten miles of these cities. The square root regression function had the best R square value of 0.85. An inverse relationship existed between the per acre prices and the distance to the City 4 cities.

The City 5 category included cities with populations between 3000 and 6000 people. There were 141 land sales falling within six miles of these cities. An inverse relationship existed, but the R square was not large enough to imply that the distance variable had a significant impact on the per acre prices.

The City 6 category included cities with populations between 500 and 3000 people. There were 217 land sales falling within three miles of these cities. Because land values initially increased and then decreased, it was argued that there was not a significant relationship between per acre prices and distance.

Conclusions

For the period 1986 through 1989, land prices, as a whole, increased slightly in value. Based on the average yearly prices indicated in this study, this increase can be attributed to the increase of cropland values. This attribution is made evident by the information in Chapter II that shows an increase in the prices of cropland sales for the four-year period but a decrease in the prices of pastureland sales.

Based on previous research, it was hypothesized that as the distance from a hard surface road increased the price of land would decrease. The whole state data, presented in Chapter III, supported the hypothesis. All areas in the state of Oklahoma, with the exception of the Panhandle area, showed decreasing prices as distance increased. It was thereby concluded that distance to hard surface roads was an important factor in determining land values for the entire state of Oklahoma except for the three counties in the Panhandle.

The effects of urban expansion and distance to cities was gauged in Chapter IV. Based on the actual land values observed and the regression fitted into those values, it was shown the cities with populations over 6,000 people did show an inverse relationship between distance to cities and the price of land. However, cities with under 6,000 people did not show a significant relationship between the distance and the price.

Limitations and the Need for Further Research

Before the regression equations estimated in this study can be asserted to be a tool in helping determine the value of a tract of land, some limitations should be noted. (1) Regression analysis is a useful method of analyzing historical data, but before equations estimated in this manner are applied in actual use they should be tested on new land values in the area that they are to be used in. (2) The estimated equations only take into consideration one factor. It needs to be kept in mind that there are many factors influencing land values. (3) The estimated equations were based on averages for the particular area, so the estimated values may not be appropriate for use in estimating values in other areas. The judgement of the individual should be used when using these equations as a tool and allowances should be made for unique characteristics of individual tracts.

Further research into the influences of distance to hard surface roads and cities on rural Oklahoma land values is needed. It would be useful to add a few other factors into the equation to help determine the exact effect of the distance variables. A regional factor and a tract size factor would be two areas that could be looked at using the existing data.

Increasing the length of the time period studied could provide another way to help identify the exact effect of the distance variables. By lengthening the time period you would increase the number of observations and this would be helpful in removing any effects of uniquely high or low land values.

Finally, it would be interesting to determine which tracts had been sold with the purpose of converting it from an agricultural use to some other alternative use and finding out how the prices of these sales compared to the other sales in that area and the whole state.

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