AN ANALYSIS OF SCHOOL LAND SALES IN THE OKLAHOMA PANHANDLE

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Stillwater, Oklahoma

1961

Submitted to the Faculty of the
Graduate College of the
Oklahoma State University
in partial fulfillment of
the requirements for
the Degree of
MASTER OF SCIENCE
May, 1968

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PREFACE

Appreciation is expressed to the Agricultural Economics Department of Oklahoma State University for assistance while preparing this thesis.

The author is indebted to many people for their assistance throughout the course of this study. Deepest appreciation is extended to Dr. Loris A. Parcher, Graduate Committee Chairman, for his supervision and criticism during this study and for his encouragement throughout the graduate program. Thanks are also due Dr. Charles H. Little and Professor Geoffery P. Collins, other committee members, for their helpful suggestions.

The writer wishes to thank the personnel of the Land Office Branch, Oklahoma School Land Commission, Oklahoma City, and the Agriculture Stabilization and Conservation offices at Boise City and Guymon, for their assistance in preparing and making available the data used in the study.

Other people who have contributed significantly to this study are: Henry Magalit, Statistical Department; Pat Cundiff, Agricultural Economics Department, Statistical Laboratory, who aided me in the programming; Judy Eley, who typed the preliminary drafts; and Mrs. Carl Estes, who typed the final manuscript.

Finally, I would like to acknowledge the many sacrifices made by my family and express special appreciation to my wife, Avis, and to my children, Leah Jean and Jo Jewel, for their encouragement and devotion.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

A large proportion of farmers, or persons contemplating farming, will at some time be confronted with the problem of buying a farm or additional land. When this problem arises the person involved must in some way be able to evaluate the land resources in order to make a decision as to the wisdom of such a purchase.

No one knows the true value of a tract of land or a whole farm. Value depends upon the flow of benefits in the future, which is always open to question. Value is measured in terms of price in a free enterprise economy and the valuation process is accomplished by consumers themselves as they spend their incomes.[1]

How does one place a value on land? Loans, taxes, rentals, and sales of farm land and even efficiency of production often depend on the changing, indefinite thing called "value". Here we are trying to explore the basis for value, such as commodity prices, expected income, amenity factors, and the land market. Knowledge or awareness of these factors is highly important to those who every

[1]Richard H. Leftwich, The Price System and Resource Allocation. Reinhard and Company, New York, 1966, p. 13.

year must put a value on a tract of land or on a farm.[2]

Land in a strict economic sense is a natural resource that consists not only of soil, but topographic, climatic and location features associated with it. A more comprehensive view of land shows it to be one of the factors which is combined with varying amounts of capital and labor to produce goods. These factors of production are incorporated with practically all land used for agricultural production. Land therefore seldom is valued apart from the structures, man-made fertility, and other improvements, that have been made on it. Furthermore, land is multi-purpose. It contributes not only to the production of products, but yields intangible services and satisfactions as well. Its value cannot be separated from its use nor from the capital and labor that must be combined with it to make it productive.

The land market, therefore, is concerned with the valuation of a bundle of productive resources that together constitute farm real estate. The term "land", farm land", and "rural property" will here be used interchangeably to mean farm property as it is bought, sold, and valued in the market.

The words "value" and "price" have many meanings. Value is the inherent worth of any good or services which has the power to satisfy a human want. Price is simply a

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[2]William H. Scofield, "How do you put a value on land"?, Land, The Yearbook of Agriculture, Washington, D. C., 1958, p. 14.

measure of the value any good or service has for satisfying human wants.

A price is established whenever one sells farm real estate. The value of a particular farm or farms in an area can be estimated on the basis of the price at which a relatively few properties have been transferred or in terms of the income that is expected to be received in the future.

There is a difference in "value" depending on who is doing the measuring. Value can be either subjective or objective. Subjective valuation is the worth of a thing in the mind of an individual. Objective, or market, value is the worth of a property measured by the price arrived at through negotiations between a well-informed seller, and a well-informed buyer, who are under no compulsion to buy or sell the property in question.

The idea of a market and that of competition are interrelated. A perfect market can exist only under conditions of perfect competition which is characterized by five conditions.

1. All sellers of a particular kind of product sell homogeneous units of the product.
2. Each buyer and each seller of the product involved must be so small in relationship to the entire market for the product that his activity cannot influence the supply and output price.
3. No artificial restrictions are placed on demand

for, supplies of, and price of goods and resources.

4. Mobility of goods and services and resources exist in the economy.

5. All economic units possess complete knowledge of the economy.[3]

Special Characteristics of Land

It is apparent from the foregoing that the farm real estate market cannot be considered a perfectly competitive market. Buyers and sellers do not have perfect knowledge. Each tract of land has characteristics which are unique. Immobility of the product is a distinct attribute; therefore, land markets are highly dispersed and poorly organized and price is largely a product of local supply and demand conditions.

The characteristics of land as a factor of production influences the manner in which it is priced because these characteristic influences the extent to which land can be substituted for other factors.

1. The fixed location of the products around which they center.

2. The non-standardized and frequently heterogenous nature of the product.

3. Dependence on local supply and demand conditions.

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[3]Ibid, p. 22.

4. The large considerations involved in most transactions.
5. Because of the impediments of dividing it into small units, the proportions in which it may be combined with other resources is relatively fixed.
6. Land performs many services which have only a subjective value-prestige of ownership, site value, et cetera.[4]

How the Land Market Functions

The land market is not a "market" in the usual sense of the term as it is applied to most of the other commodities. Each tract of land is unique and there is no central market where supply and demand can be equated in terms of price. Each seller has only limited knowledge of potential buyers and is limited by time and geographic area to relatively few buyers. In addition, both parties have limited knowledge of the bases for value and the consequence of alternative decisions. Despite these limitations, land prices within local areas tend to respond to change in price and income expectation which reflect general economic conditions. Several billion dollars worth of property changes hands each year which affects the economic welfare of many regions, areas, communities and individuals.

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[4]Raleigh Barlowe, Land Resource Economics, Prentice-Hall, Inc., New York, 1963, p. 202.

The Objectives

Information on the land market situation in Oklahoma is constantly being sought by prospective buyers, sellers, commercial lenders and other agricultural organizations. The objectives of this study are: (1) ascertain the major factors influencing the price paid for land, (2) determine the factors which have the most influence on price paid for land, (3) develop an estimating equation that could be used in determining the value of a tract or farm, and (4) test the accuracy of the derived coefficients in an estimating equation.

The major factors which influence the price paid for farm land become important in varying degrees depending upon the type of farming, location, extent of improvements, and prevalence of acreage allotments.

Many studies have been made concerning the evaluation of farm real estate, some of which have probed for the factors and practices used by buyers and sellers in arriving at an equilibrium price that results when land is transferred. An evaluation of this nature can be accomplished only by an analysis of factors relevant in land transactions. However, the weight buyers and sellers attach to a specific factor may be difficult to determine from data obtained from sales and personal interview.

Agricultural production or output is a result of the application of various inputs. The amount of output not only is dependent upon the quantity and quality of inputs

but upon the quality of the land itself. But as stated earlier, price may be based on factors other than output. A price determining function is a means which may be used for describing these price-making forces for a given factor or product. A generalized price function of interest to farm land purchasers may be written as

$$Y = f(X_1, X_2, X_3, X_4, \cdots, X_n)$$

where

Y = price of land per acre

X_1 = per cent wheat allotment of cropland

X_2 = productivity rating of land

X_3 = distance to paved road

X_4 = other variables such as distance to state highway, distance to nearest trade center, etc.

This equation states that the value of Y depends upon the values of $X_1, X_2, X_3, X_4, \cdots, X_n$. A change in any one or any combination of the independent variables (X_i) will result in a change in the price of land (Y).

Investigations of other areas have shown high correlation between certain factors and land price. For example, in a Garfield County study, 47 per cent of the variation of land prices was explained by three factors: (1) acreage allotments per 100 acres, (2) yields per acre, and (3) per cent mineral rights conveyed.[5] This and other studies

[5]Billy H. Stewart, "Analysis of the Farm Real Estate Market in Beckham and Garfield Counties" (unpub. M. S. thesis, Oklahoma State University, 1958), p. 62.

indicate that usually one can account for only a part of the variation in land price and also indicate that the relative importance of price influencing factors may vary from area to area.

The purpose of this research project is to determine, by analytical and statistical measurements, the relative importance different individuals placed on the various value determining factors in the Oklahoma Panhandle. An attempt was made to select all factors which might influence land prices at a given point in time.

An attempt also was made to find an estimating equation which, when fitted to the sample data, gives a functional relationship which best fits the data. Such an estimating equation could be used by real estate assessors, professional appraisers, and prospective buyers as a tool in evaluating the farm land market with greater objectivity.

CHAPTER II

THEORETICAL CONSIDERATION

The Data

The data studied for this report are the land sales made by the Oklahoma School Land Commission in the two western counties of the Oklahoma Panhandle in December, 1965. These sales occurred in Cimarron and Texas counties, a high plains area, highly productive for wheat and grain sorghum. Some unusual features of the data are that all of the sales were made by one seller; all were sold by public auction; all sales occurred during a two-day period; the same credit terms were available to all buyers, twenty-five per cent down and the balance financed by the Oklahoma School Land Commission at 4.5 per cent interest rate; all were unimproved; and most tracts were about 160 acres in size. These conditions removed a number of variables which usually are expected to have a pronounced influence on price per acre of farm land. The area studied is shown in Figure 1.

The Oklahoma School Land Commission sold fifty-eight tracts, comprising 9,513 acres in Cimarron county and ten tracts containing 1,390 acres in Texas county. These tracts were sold at an average price of $140 and $196 per acre, respectively.

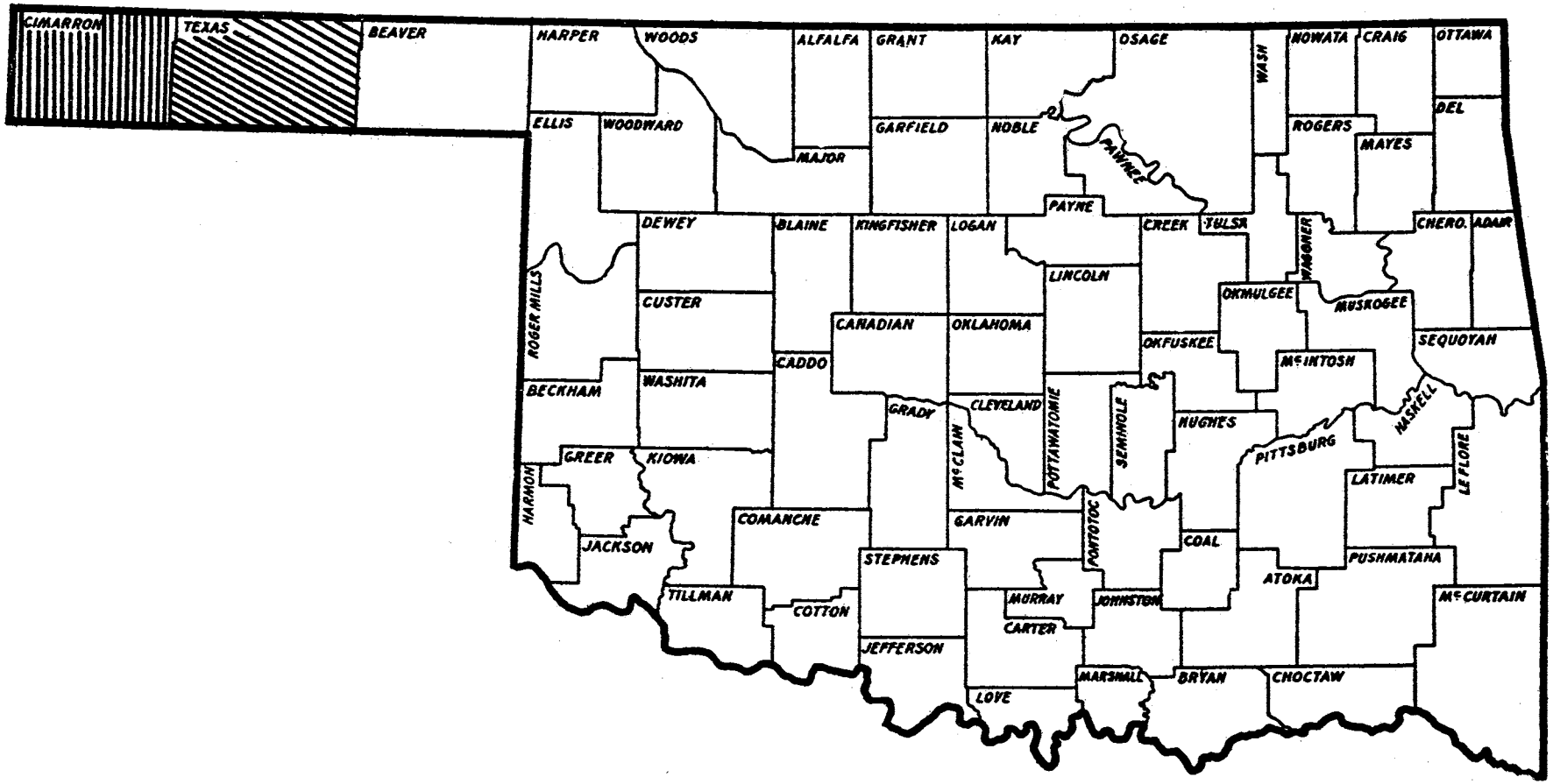

Figure 1. A Map of Oklahoma Showing the Study Area of Land Sold by the Oklahoma School Land Commission, December, 1965

The amount sold in the area studied was 1.4 per cent of the 780,948 acres administered by the Oklahoma School Land Commission in the State and 3.78 and 3.11 per cent of all land administered by the Commission in Cimarron and Texas counties, respectively (Figures 2, 3, and 4).

The Hypothesized Factors Which Affect Farm Land Price

There is little doubt that many factors influence the price which people pay for farm land. When a buyer and seller enter the land market, each one's subjective price and consequently his action, is affected by his response to those factors. The same factors are not likely to affect all buyers and sellers equally, nor is it likely that all factors enter into the decisions of each party to a transaction. However, it is probable that at least some of the differences in price paid for different tracts of land can be explained by certain factors which observations indicate are important. Previous studies, and empirical observations have indicated that certain factors perhaps are more relevant in the land price setting mechanism. On the basis of these studies and observations it was hypothesized that among the more relevant factors in the study area were: (1) size of tract, (2) acres of cropland, (3) acres of wheat allotment, (4) acres of feedgrain base, and (5) productive quality of the land. It was felt that these factors probably would be of primary importance and

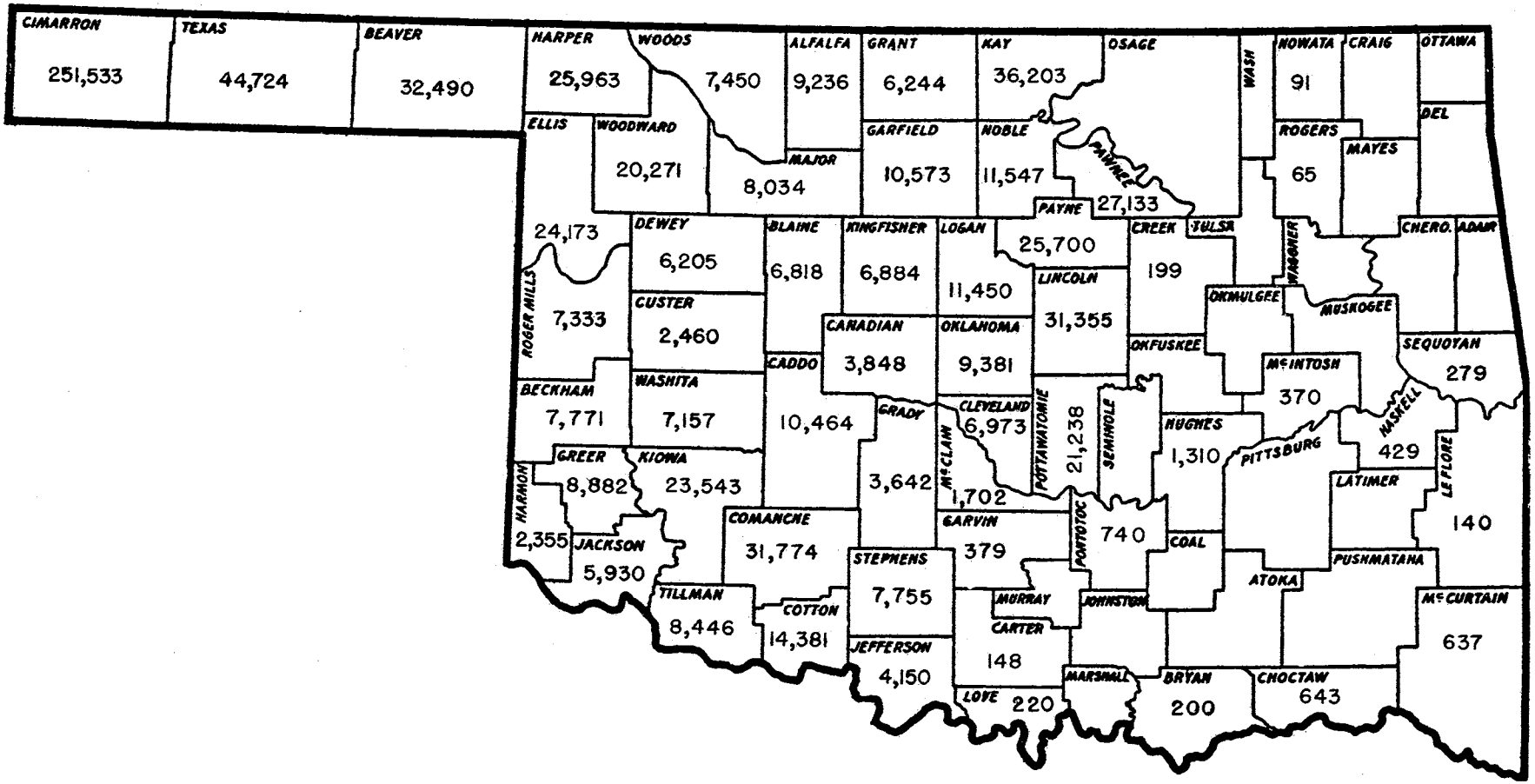

Figure 2. County Map of Oklahoma Showing Acres of Land Administered by the Oklahoma School Land Commission, December, 1965

Source: Land Office Branch, Oklahoma School Land Commission, Oklahoma City, Oklahoma, December, 1965.

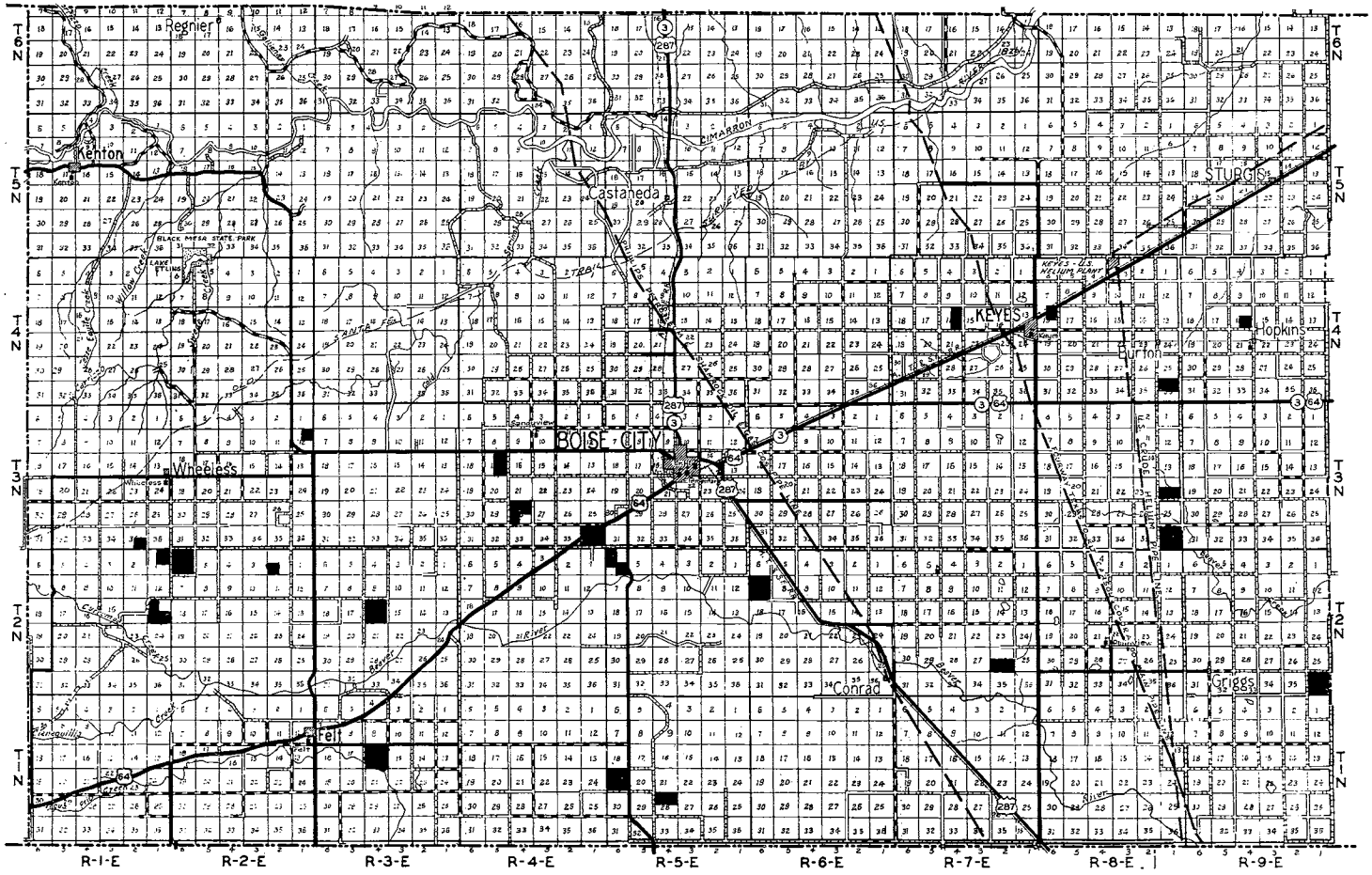

Figure 3. Map of Cimarron County Showing the Location of Land Sold by the Oklahoma School Land Commission, December, 1965

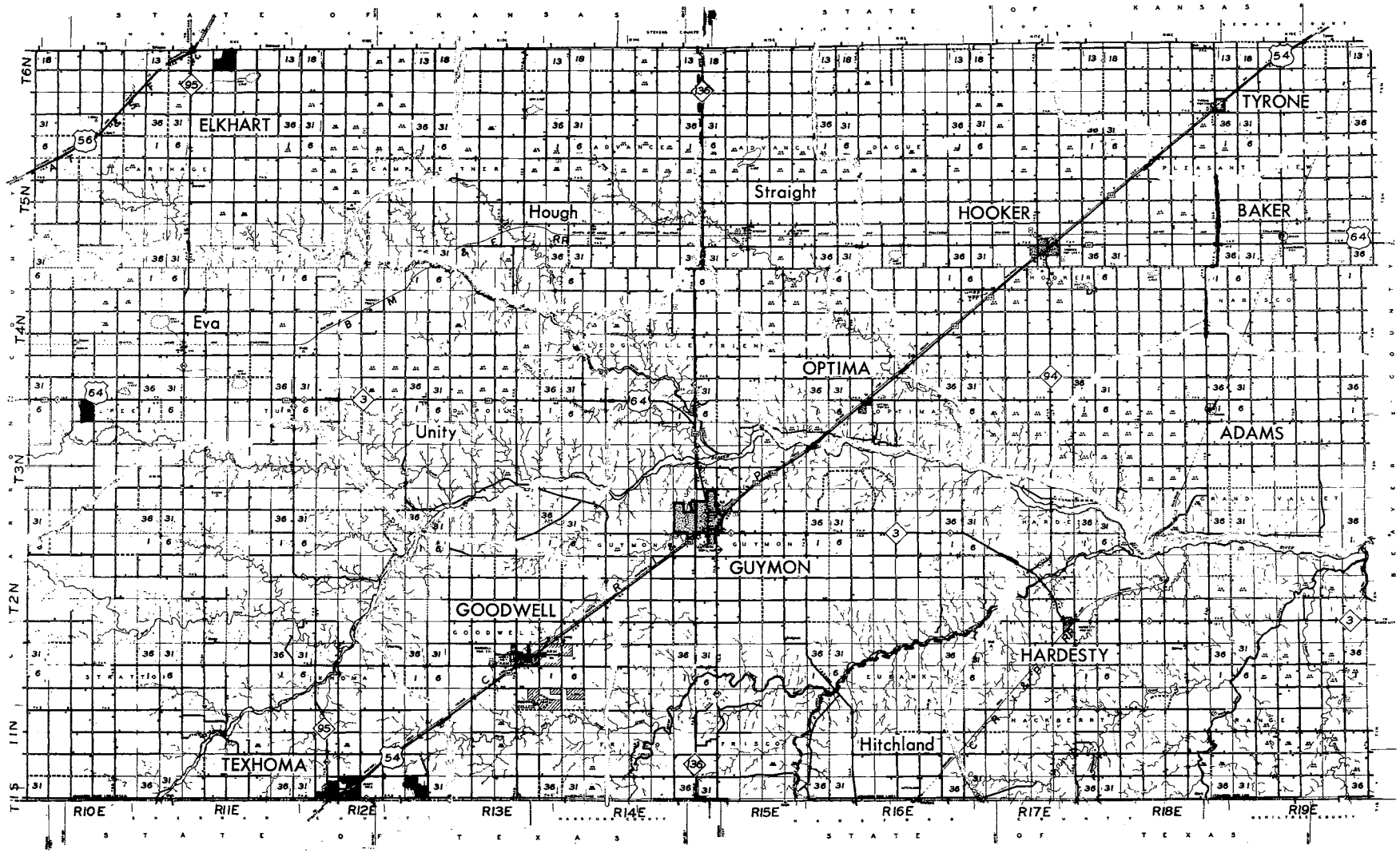

Figure 4. Map of Texas County Showing the Location of Land Sold by the Oklahoma School Land Commission, December, 1965

would do much to explain the variation in price per acre of land. It is believed that the above factors plus other pertinent factors can be useful in predicting the price per acre of farm land with some degree of accuracy.

The General Procedure

Each sale was classified in terms of its characteristics with respect to the following items obtained from the Agricultural Stabilization and Conservation Offices at Boise City and Guymon, Oklahoma, and from the Land Office Branch of the Oklahoma School Land Commission, Oklahoma City, Oklahoma:

1. The total acres in tract
2. The total acres in cropland
3. Acres of wheat allotment
4. Acres of feedgrain base.

In addition to the above information, each tract of land sold was further classified as to:

1. Price per acre of tract
2. Percentage of cropland in tract
3. Wheat allotment as per cent of all land
4. Wheat allotment as per cent of cropland
5. Feedgrain base as per cent of all land
6. Feedgrain base as per cent of all cropland
7. Acres of all allotments
8. Allotments as per cent of all land
9. Allotments as per cent of cropland

10. Acres of range land
11. Per cent range land
12. Productivity index
13. Distance to all-weather road (miles)
14. Distance to paved road (miles)
15. Distance to state highway (miles)
16. Distance to nearest market (miles)
17. Distance to small trade center (miles)
18. Distance to large trade center (miles)
19. Distance from present operation (miles).

Analytical Procedure

The data for the 68 tracts sold were assembled into tabular form and examined for any obvious relationship in the selected 21 independent variables with the price per acre of farm land.

After the tabular analysis was made then a Forward-Selection Step-Wise Multiple Regression Analysis was made using 21 selected independent variables, to analyze the impact and relationship of these independent variables on the dependent variable, price per acre of farm land. Also a Forward-Selection Step-Wise Miltiple Regression Analysis was made using 15 independent variables selected from the 21 that were directly related to size, the productivity of the land, or acreage allotments.

The reason for selecting those variables directly related to acreage allotments was because persons who own

farm land with allotments may be expected to obtain for themselves an important part of the price-raising benefits of the allotment program. The allotments for a particular farm are "owned" and their use is controlled by the persons who own the land.

Over a period of time, however, a shifting of program benefits between sellers and buyers of land is possible. Landowners who bought their land after a program began, probably do not get so large a share of the price-raising benefits of a program as persons who, when the program was first set up, happened to own land that received acreage allotments.

When a program is expected to continue into the future, the right to receive future benefits is a valuable asset in the form of acreage allotments that are transferred from one individual to another with the sale of farm land. When such farm land is sold, its selling price will be somewhat higher than it would otherwise have been, so as to include at least some part of the expected future benefits.

The person who owned farm land when the land was first assigned an acreage allotment, therefore, will receive windfall gain when he sells the land with its allotments. He will profit in this way to the extent that expected later benefits of the program are capitalized into the prices of such land. Probably only a part of the price-raising benefits of the program will be reflected in higher selling prices for land having an allotment, because the

future of the program is not certain.

Persons who buy such land after some of the future price-raising benefits of the program have been capitalized into farm land prices must therefore pay higher prices than would prevail without the program. These later purchasers are paying in advance for part of the future benefits of the program. To this extent a program that raises the long-run average level of crop prices increases the amount of capital that owners must put into their farms.

One final aspect should be mentioned. People come to expect the continuance of a program that has existed for a number of years. The sudden end of a program would disrupt the economic life of many agricultural areas, and would mean sudden capital losses for persons who had purchased farm lands with acreage allotments at prices that reflect the expected future benefits of the program. Therefore, it is logical to use those variables directly connected with allotment programs as a tool when one is predicting the price per acre of farm land.

The correlation and multiple regression approaches analyze the functional relationship of the dependent variables to several independent variables in the form of a mathematical equation. When information is available on more than one variable, a form may be found of expressing this relationship if a relationship exists. It is also possible to measure the strength of this relationship.

CHAPTER III

TABULAR ANALYSIS

Land Characteristics and Price

High productivity of a soil, a farm, or an area is one of the more substantial factors influencing income and is a highly regarded value factor in the minds of many farmers and prospective farm land buyers. However, there may be combinations of other factors that play an equally important role in land values. These factors should receive special consideration before placing an estimate on price per acre that a tract of farm land might command.

When examining the combination of factors which influence the price per acre of farm land there are several techniques that can be employed to aid in the investigation. The use of cross classification tables is one method which may be used to examine the various value contributing factors to see whether there is evidence of their influence on the value per acre of farm land.

In Table I the sales were divided into three price range categories and the characteristics listed as an average of the tracts falling into a particular price range. There is evidence that certain characteristics are associated with each of the three price range groups. The first thing

TABLE I

CHARACTERISTICS OF TRACTS SOLD ACCORDING TO PRICE PER ACRE, FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Sales Price Per Acre		
	Less than $150	$150 to $200	More than $200
Number of transactions	32	23	13
Average price per acre	$95.50*	$163.50*	$254.00*
Average acres per tract	168	159	142
Average acres of wheat allotments	34	34	36
Average acres of feedgrain base	38	64	71
Average acres of allotments	72	98	107
Wheat allotments as a per cent of all land	20	21	27
Feedgrain base as a per cent of all land	22	41	50
All allotments as a per cent of all land	42	62	77
Average acres of cropland	73	113	96
Cropland as per cent of all land	46	71	89
Average productivity rating	70	89	91

*Price per acre was rounded to nearest $\frac{1}{4}$ of a dollar.

which is noticeable is that the larger average size is associated with lower sales price per acre, although the difference in size probably is not great enough to be significant.

The next factor worthy of note is that higher per acre prices are associated with higher acreage allotments. We also note that there is a greater proportion of the land in cropland at the higher price level. Finally, this method of analysis shows that higher prices are associated with the higher productivity ratings. These factors will be further examined in Tables II, III and IV.

It would appear on the basis of the figures in Table I, that size, allotments, proportion of cropland, and productivity are factors which are considered in the market for farm land in this area.

As hypothesized earlier in the study, the acreage of alloted crops appears to have a pronounced influence on purchase price per acre. Studies in other areas of the State have indicated a significant effect from this factor and it could be a very helpful measure in explaining the variations in price per acre of farm land.[1]

Investigation of wheat allotments and feedgrain base as a percentage of all land indicates that individually they help to explain the variation in price per acre (see Appendix Tables III and IV). Even though these two factors

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[1] Stewart, p. 23.

are important individually, neither shows the influence on price per acre as sharply as when they are assimilated into total allotments as a per cent of all land.

Table II holds allotments constant within certain ranges as a percentage of all land and further examines their relationship to price and other factors. It will be noted that again there is a positive relationship between allotments as a percentage of all land in the tract and price per acre. Tracts that had an average of 23 per cent in allotted crops, commanded an average price of $109.50 per acre, while tracts with an average of 92 per cent in allotted crops sold for an average of $173.00 per acre. An increase of 69 percentage points in allotments, brought about a 58 per cent increase in average price per acre.

Considering the relationship between percentage of allotments and the average price per acre, it appears that an additional increase in the percentage of allotments above the 60 to 79 per cent range was more important in the eyes of buyers than an increase from below 50 per cent to 60 to 79 per cent range. An average increase between the first two categories from 23 per cent of land in allotted crops to 69 per cent was accompanied by an increase in price of only $6.50 per acre. The change from 69 per cent average, however, to 92 per cent was accompanied by an increase of $37.00 per acre.

One must note, however, that the change in price from one category to the next may also have been influenced by

TABLE II

RELATIONSHIP OF PERCENTAGE ALLOTMENTS TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Allotments as a Percentage of all Land		
	0-59	60-79	80-100
Number of transactions	32	19	17
All allotments as per cent of all land	23	69	92
Average price per acre	$109.50	$136.00	$173.00
Average acres per tract	159	158	166
Average acres wheat allotments	26	46	34
Average acres feedgrain base	10	64	118
Average acres of allotments	36	110	152
Wheat allotments as per cent of all land	16	28	21
Feedgrain base as per cent of all land	7	41	71
Average acres of cropland	47	113	153
Cropland as per cent of all land	30	72	92
Average productivity rating	71	81	91

the percentage of cropland in the tract and the productivity level of the tract. A rise in these two factors also accompanied the price increase.

However, the relationship between allotments and price was not always direct. One 160 acre tract which sold for $32,600 had 100 per cent allotted acres, while another 160 acre tract which sold for over $40,000 had no allotted acres. Such instances indicate purchasers were also considering other factors. For example, "How well does the tract fit present operation?", or "How many more acres is required to make an economic size unit in this area?"

Beginning farm purchasers indicated that acreage allotments were important factors in their minds. Out of the 68 purchasers only six did not already own other land in the area. Each of the six purchased tracts contained high acreage allotments.

None of the tracts sold in the area was large enough to be considered an economic size farm unit. This may have deterred potential beginning farm purchasers from entering the market in this area. Size of tract as a factor in the demand by purchasers may be somewhat less important to farmers interested in expansion of their present units than it would to prospective farmers who would be wholly dependent on just the acres purchases at the sale.

As mentioned earlier, percentage cropland of a tract which often is associated with acreage allotments apparently had an influence on the purchase price per acre (Table III).

TABLE III

RELATIONSHIP OF PERCENTAGE CROPLAND TO PRICE AND SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Percentage of cropland		
	0-74	75-89	90-100
Number of transactions	35	17	16
Average percentage of cropland	33	81	98
Average price per acre	$124.00	$164.00	$170.00
Average acres per tract	165	156	158
Average acres of wheat allotments	27	31	40
Average acres of feedgrain base	23	62	89
Average acres of allotments	50	93	129
Wheat allotments as per cent of all land	17	20	26
Feedgrain base as per cent of all land	14	40	57
All allotments as per cent of all land	31	60	83
Average acres of cropland	50	126	155
Average productivity rating	74	87	90

Those tracts containing less than 75 per cent with an average of 33 per cent cropland commanded an average purchase price of $124.00 per acre. Such tracts were about two-thirds range land. On the other hand those tracts which were almost all cropland brought a price of $170.00 per acre. Tracts in the 90 to 100 per cent cropland category averaged 98 per cent cropland. Tracts which averaged about 80 per cent cropland brought $164.00 per acre.

The relationship of acres of cropland to price shown in Table III, indicates that when the average acres of cropland increased from 126 to 155 (a 23 per cent increase in cropland acres), the average price increased less than four per cent. This is an increase of about one per cent in average price for each six per cent increase in cropland acres. When average acres of cropland increased from 50 to 126 (a 152 per cent increase in cropland acres), the average price increased about 32 per cent. One per cent increase in price for each 4.75 per cent increase in cropland acres.

The law of diminishing utility apparently applies here. Tracts that contain higher average acres of cropland seem to be subject to a smaller increase in price with a further increase in cropland acres than those tracts containing lower acreage of cropland. It must be noted however that increased acreage of cropland was accompanied by an increase in average acres of allotments and average productivity rating.

The value per acre of land is expected to be directly related to the quality of the land. A buyer usually will pay a higher price per acre for land of higher quality than for land with a lower income producing ability.

The productivity rating was calculated so that soils with the highest physical productive capacity in this area is given a rating of 100. The lowest rated in the area had a numerical rating of 28. The method employed to estimate the productivity rating of the soil is shown in Appendix Tables I and II.

The relationship of productivity of the soils to price in these two counties is reflected in the data shown in Table IV. There were 18 tracts that rated less than 80, while 50 of the tracts sold rated 80 or greater. The table shows a relationship of productivity to the price paid. With an increase in the average productivity rating from 55 to 86 the average price increased from about $92.00 to $153.00 per acre. In other words, an increase of 31 points in productivity within this range was accompanied by 65 per cent increase in the average price per acre. A ten point increase in the productivity rating, from 86 to 96, was accompanied by about a 12 per cent increase in average price per acre. It appears that the price response to changes in productivity becomes less elastic as quality increases.

The relationship between price per acre and distance from present operation was contrary to expectations (Table V).

TABLE IV

RELATIONSHIP OF PRODUCTIVITY RATING TO PRICE AND SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Productivity Rating		
	0-79	80-89	90-100
Number of transactions	18	23	27
Average productivity rating	55	86	96
Average price per acre	$ 92.50	$153.00	$171.00
Average acres per tract	159	157	165
Average acres wheat allotments	15	42	30
Average acres of feedgrain base	11	59	79
Average acres of allotments	25	101	109
Wheat allotments as per cent of all land	9	27	18
Feedgrain base as per cent of all land	7	37	48
All allotments as per cent of all land	16	64	66
Average acres of cropland	30	116	115
Cropland as per cent of all land	19	74	70

TABLE V

RELATIONSHIP OF DISTANCE FROM PRESENT OPERATION TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Distance From Present Operation		
	0.0-0.5	1.0-4.0	Greater than 4.0
Number of transactions	30	22	16
Average distance present operation (miles)	.1	2.5	11.0
Average price per acre	$118.25	$175.00	$183.00
Average acres per tract	158	167	157
Average acres wheat allotments	24	30	47
Average acres feedgrain base	54	64	45
Average acres of allotments	78	94	92
Wheat allotments as per cent of all land	15	19	30
Feedgrain base as per cent of all land	34	38	29
All allotments as per cent of all land	49	57	59
Average acres of cropland	78	99	114
Cropland as per cent of all land	50	58	73
Average productivity rating	77	85	89

Purchasers paid more for farm land a greater distant from present operation, than for farm land tracts adjacent to their present operation. An average price of $118.25 per acre was paid for adjacent tracts, compared with an average price of $183.00 per acre for land over four miles from their present operation.

Persons interviewed, however, felt that present equipment is mobile enough that a few miles of travel from one part of their operations to another means little when compared to the great economic efficiency attained by increasing their scale of operation. It is worthy of note, however, that in the tabular analysis in Table V, increased distance to present operations was accompanied by an increase in three important value factors: per cent of land in allotted crops, per cent of cropland, and productivity rating.

The size of the buyer's operation before purchase was examined for possible relationship with price per acre paid and size of present operations. There appears to be a relationship. The price per acre paid for additional land was directly associated with size before purchase. Small operators (999 acres or smaller) paid an average of $155.00 per acre for the land they purchased, while larger operators (over 3,000 acres) paid an average of $173.00 per acre. There was a fairly uniform increase in price per acre between the two extreme categories.

It would appear from the data in Table VI that other

TABLE VI

RELATIONSHIP OF SIZE OF PRESENT OPERATION TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Size of Operation Before Purchase			
	0-999	1000-1999	2000-3000	Greater than 3000
Number of transactions	34	13	9	12
Average size of prior operation	312	1,438	2,418	4,650
Average price per acre	$155	$158	$160	$173
Average acres per tract	140	163	126	122
Average acres wheat allotments	30	27	35	41
Average acres feedgrain base	51	67	67	40
Average acres of allotments	80	94	102	81
Wheat allotments as per cent of all land	19	17	22	24
Feedgrain base as per cent of all land	32	43	42	23
All allotments as per cent of all land	41	61	64	47
Average acres of cropland	86	110	102	85
Cropland as per cent of all land	54	70	64	49
Average productivity rating	79	84	80	86

important value influencing factors other than allotments, percentage of cropland, and productivity rating were the cause of differences in price. The average value of these factors did not increase as price per acre rose. It would appear that size of current operations was positively associated with price.

One can understand, perhaps, why the large operators paid more. Their resources presumably were great enough that they could bid high enough to acquire any tract they wanted. On the other hand, one wonders whether the willingness to bid should not be more closely associated with apparent need to expand scale of operations.

These are only a few of the factors which contribute to the average price per acre of farm land. Other factors which could be considered when one is wanting to determine the worth of a tract of farm land may be found in Appendix Tables III, IV, V, VI, VII.

The use of cross-classification tables is one method used to help determine the impact certain selected factors have on the variation in value per acre of farm land. Even though this method is used to look at the different factors relating to value per acre of farm land caution should be observed in their use. Certain factors that would not show up in the cross classification tables could be extremely important in the minds of certain individuals.

The use of Forward-Selection Step-Wise Multiple Regression procedure is another method which one could use

to look at the different factors which help to explain the value of farm land. The Forward-Selection Step-Wise Multiple Regression analysis is also much faster and easier to use once the estimating equation has been determined.

CHAPTER IV

STATISTICAL ANALYSIS

This chapter outlines the more commonly used method of analyzing the relationship of land prices to selected independent variables. There is no unique statistical procedure for doing this, and personal judgment will be a necessary supplement to the statistical methods discussed.

When we possess information on two or more related variables, a form may be found to express this functional relationship. That is, not only do we seek a mathematical function which tells us how the variables are interrelated, but also how precisely the value of one variable can be predicted if values of the associated variables are known.[1]

The techniques used to accomplish these two objectives are known as correlation methods, Forward Selection Step-Wise Multiple Regression Procedure. Correlation methods are used to measure the degree to which the different variables are associated, while regression methods are used to determine the "best" functional relation among the variables. The Forward-Selection Step-Wise Multiple Regression Procedure will determine the "best" functional

[1]Bernard Ostel, Statistics in Research, Iowa State University Press, Ames, Iowa, 1963, p. 420.

relationship, but at the same time will let one look at the regression equation at each step in the procedure. In addition it eliminates those variables that are not statistically significant at a given probability level.

Correlation Analysis

Correlation analysis is a method of measuring the degree of association between variables. The name itself reflects the universal practices of speaking about measurement of correlation rather than about the degree of association. A correlation coefficient is a definite measure of the closeness of relation between two variables. The measurement of correlation is referred to as a coefficient of correlation.

If the correlation coefficient is to perform satisfactorily as a measure of relationship, it should exhibit two characteristics.

1. It should be large when the degree of association is high and small when the degree of association is low.
2. It should be independent of the unit in which the variables are measured.

Since the correlation coefficient is a measure of the association among independent variables, if the correlation coefficient is positive and equal to one, this means the independent variables are perfectly and positively correlated with a dependent variable. If it is negative, we say they

are negatively correlated. The closer the correlation coefficient approaches zero, regardless of the sign, the lower the correlation or association of the dependent variable with the independent variables.

Regression Analysis

The objectives of the regression analysis are first, to show the relationship between the value of the dependent variable (Y_i) and unit changes in various selected independent variables (X_i) and second, to provide a basis for making predictions of (Y_i) for certain (X_i).[2]

The statistical criteria used to determine goodness of fit of the regression equations were the R^2 and t_{b_i} values. The t_{b_i} is the symbol for Student t-statistic of the estimated coefficients. It is used to test whether the b_i values are significantly different from zero at a given probability level. The b_i values are the regression coefficients that measure the effects on (Y_i) per unit change in (X_i).

The symbol R^2 refers to the coefficient of determination which indicates the proportion of the squared variability in (Y_i) explained by the factors (X_i). The coefficient of non-determination ($1-R^2$) is the proportion of the squared variability not explained. The multiple correlation

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[2]George W. Snedecor, Statistical Methods, Iowa State College Press, Ames, Iowa.

coefficient R^2 indicates the degree of association between (Y_i) and a set of (X_i).[3]

How well the equation fits the data is indicated by the size of the R^2. Once the size of the b_i value is determined, the statistical test is based primarily on the size of R^2.

The "goodness" of fit is improved as the R^2 value approaches 1.0 if the $R^2 = 1.0$, then the fitted equation would pass through every observed point and would characterize the data perfectly.

The primary objective of the regression analysis in this paper was to determine the relationship between selected price influencing factors and price per acre paid for farm land. That is, the degree to which the independent variables are associated with the dependent variable purchase price per acre of land.

Analysis of Data

Previous studies, as well as empirical observations have indicated that certain factors affect the per acre price of farm land. The independent variables listed below were chosen on the basis of their hypothesized effect on the dependent variable, (Y), price per acre of farm land. It will be noted that size of prior operations is not

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[3]Frank A. Pearson and Kenneth R. Bunt, Statistical Methods Applied to Agricultural Economics, John Wiley and Sons, Inc. (New York, 1942), p. 176.

included as an independent variable although this variable was shown to be associated with price in the previous chapter, it is not a variable which can be readily determined from public records.

X_1 = Size of tract. This refers to the number of acres in tract.

X_2 = Acres of cropland. This refers to number of acres in the tract that can be cultivated.

X_3 = Percentage of cropland. The percentage of acres in the entire tract that can be cultivated.

X_4 = Acres of wheat allotment. This refers to number of acres of wheat that could be planted and still be eligible for price support loans.

X_5 = Acres of feedgrain base. Acreages of feedgrain that could be planted and still be eligible for government support.

X_6 = Percentage wheat allotment of total acres. Refers to percentage of wheat allotment based on total acres in tract.

X_7 = Percentage wheat allotment of cropland. This is the percentage wheat allotment of total cultivable acres.

X_8 = Percentage feedgrain of all land in tract. This refers to percentage feedgrain base in relation to total acres in tract.

X_9 = Percentage feedgrain of cropland. This is the percentage feedgrain acreage is of all land

under cultivation.

X_{10} = Total allotment acres. This refers to acres of all allotted crops in the tract.

X_{11} = Percentage allotments of all land. Relationship of total acres in allotment to total acres in tract.

X_{12} = Percentage allotments of cropland. This is the relationship of all allotments to total cropland acres in the tract.

X_{13} = Acres of rangeland. This is acres of land that are best adapted for livestock grazing.

X_{14} = Percentage rangeland. Per cent rangeland is of total acres in the tract.

X_{15} = Productivity index. This refers to the tract's ability to produce, based on fertility of soil as designated by various soil surveys.

X_{16} = Distance to all weather road. Miles from tract to an improved road that is passable most of the time.

X_{17} = Distance to paved road. Miles from tract to nearest hard-surfaced road.

X_{18} = Distance to state highway. Miles from tract to nearest state highway.

X_{19} = Distance to nearest market. Miles from tract to nearest point where the relevant agricultural products can be marketed.

X_{20} = Distance to small trade center. Miles from tracts to nearest town with population less than 1,000.

X_{21} = Distance to large trade center. Miles from

tract to nearest town with population greater than 1,000.

A correlation analysis was made to measure the interrelationship of various factors thought to have an influence on price per acre of farm land. First, all 21 independent variables were analyzed separately. Included in the second set were size of tract and those variables which reflect the influence of government programs and productivity on purchase price per acre (Tables VII and VIII). In the group of 21 selected independent variables (Table VII) four factors were statistically significant at the five per cent level as having positive correlation with price per acre of farm land were: acres of cropland, per cent cropland, acres of wheat allotment, and productivity index of the tract. Two negative correlations were statistically significant at the five per cent level. One was distance to all weather road and the other wheat allotment as per cent of cropland. This negative correlation would indicate that for each mile the tract was from an improved road the value would decrease. It would also indicate that as wheat allotment as per cent of cropland increased the value per acre of farm land would decrease. The data does not explain this inconsistency, but it is conceivable that this factor may be so interrelated with other factors that it has a negative relationship with price per acre of farm land.

TABLE VII

MATRIX OF SIMPLE CORRELATIONS ANALYSIS OF TWENTY-ONE FACTORS SELECTED FOR THIS STUDY

	Price Per Acre Y	Size of Tract X_1	Acres of Cropland X_2	Per Cent of Cropland X_3	Acres of Wheat Allotment X_4	Acres of Feedgrain X_5	Per Cent Wheat Allotment All Land X_6	Per Cent Wheat Allotment Cropland X_7	Per Cent Feedgrain All Land X_8	Per Cent Feedgrain Cropland X_9	Acres of Total Allotment X_{10}
Y	+1.00	- .3474	+ .2520*	+ .4132*	+ .0052*	+ .2834	+ .1593	- .0045*	+ .3071	+ .2668	+ .2639
X_1		+1.00	+ .2661	- .0923	+ .3013	+ .1477	- .0589	+ .0285	+ .0435	+ .1153	+ .3003
X_2			+1.00	+ .9258	+ .5027	+ .7162	+ .4008	+ .1521	+ .6856	+ .6218	+ .9338
X_3				+1.00	+ .3980	+ .6793	+ .4486	+ .1606	+ .6829	+ .5999	+ .8427
X_4					+1.00	- .1449	+ .9193	+ .8033	- .1933	- .1981	+ .4115
X_5						+1.00	- .2283	- .3534	+ .9910	+ .9454	+ .8420
X_6							+1.00	+ .8514	- .2438	- .2636	+ .2908
X_7								+1.00	- .3706	- .2937	+ .1123
X_8									+1.00	+ .9482	+ .8074
X_9										+1.00	+ .7628
X_{10}											+1.00
X_{11}											
X_{12}											
X_{13}											
X_{14}											
X_{15}											
X_{16}											
X_{17}											
X_{18}											
X_{19}											
X_{20}											
X_{21}											

	Per Cent Allotment All Land X_{11}	Per Cent Allotment Cropland X_{12}	Acres of Range Land X_{13}	Per Cent Range Land X_{14}	Productivity Index X_{15}	Distance to All Weather Road X_{16}	Distance to Paved Road X_{17}	Distance to State Highway X_{18}	Distance to Nearest Market X_{19}	Distance to Small Trade Center X_{20}	Distance to Large Trade Center X_{21}
Y	+ .3897	+ .2435	- .4668	- .4600	+ .5664*	- .1084*	- .0198	- .0610	- .0621	- .0927	- .3898
X_1	+ .0130	+ .1277	+ .1474	+ .0619	+ .0481	+ .0648	+ .0466	+ .0331	+ .1212	+ .1378	+ .2479
X_2	+ .8913	+ .6892	- .7194	- .7393	+ .5547	- .1171	- .0923	+ .0512	+ .0815	- .0832	- .0168
X_3	+ .9143	+ .6751	- .7905	- .7948	+ .5662	- .1411	- .1145	+ .0328	+ .0523	- .1242	- .1162
X_4	+ .3140	+ .3997	- .4637	- .4818	+ .3234	- .1081	- .2560	- .3082	- .2833	- .2945	- .0664
X_5	+ .8475	+ .6222	- .4478	- .4602	+ .4154	+ .0047	+ .1120	+ .3541	+ .3476	+ .1964	+ .0666
X_6	+ .3081	+ .3739	- .5191	- .5246	+ .3254	- .1339	- .2875	- .3471	- .3228	- .3380	- .1670
X_7	+ .1040	+ .4545	- .3448	- .3590	+ .2571	- .1672	- .3651	- .3281	- .1469	- .1315	- .1222
X_8	+ .8473	+ .6123	- .4595	- .4612	+ .4036	+ .0083	+ .1213	+ .3655	+ .3497	+ .1952	+ .0484
X_9	+ .7865	+ .7176	- .4458	- .4614	+ .4084	+ .0441	+ .0972	+ .3653	+ .4126	+ .2570	+ .0748
X_{10}	+ .9518	+ .7910	- .6653	- .6865	+ .5590	- .0545	- .0362	+ .1581	+ .1657	+ .0203	+ .0251
X_{11}	+1.00	+ .8072	- .7354	- .7406	+ .5743	- .0655	- .0403	+ .1715	+ .1694	+ .0091	- .0414
X_{12}		+1.00	- .6664	- .6913	+ .5658	- .0825	- .1802	+ .1079	+ .2783	+ .1450	- .0176
X_{13}			+1.00	+ .9903	- .7159	+ .0784	+ .1655	+ .1190	- .0174	+ .1448	+ .3095
X_{14}				+1.00	- .7355	+ .0675	+ .1620	+ .1226	- .0390	+ .1233	+ .2969
X_{15}					+1.00	+ .0927	- .1816	- .2997	- .0753	- .0920	- .3859
X_{16}						+1.00	+ .3348	- .0192	- .1006	+ .1313	+ .0526
X_{17}							+1.00	+ .4385	+ .3528	+ .3389	+ .2913
X_{18}								+1.00	+ .5922	+ .4909	+ .6181
X_{19}									+1.00	+ .8601	+ .4531
X_{20}										+1.00	+ .3663
X_{21}											+1.00

* Statistically significant at 5% probability level.

In the 15 independent factors that are related to size of tract, productivity of tract and government programs (Table VIII), two factors were statistically significant at the five per cent level as having positive correlation with price per acre of farm land. However, two other factors were shown to be significant at the ten per cent level. Those factors positively correlated at the five per cent level were per cent feedgrain of all land, and productivity index of the tract. Those factors significant at the ten per cent level were allotments as per cent of all land, and wheat allotments as per cent of cropland. Allotments as per cent of all land was positively correlated and wheat allotments as per cent of cropland was negatively correlated with price per acre of farm land.

When the Forward-Selection Multiple Regression analysis was used on the 21 selected independent factors thought to have an effect on farm land values, it was found that 17 variables explained 63 per cent of the variations in per acre price of farm land. Also, with the 15 selected variables it was found that ten variables explained 53 per cent of the variation in price per acre of farm land.

The Multiple Regression Procedure is one of the more commonly used methods to derive an estimating equation which can be used to predict the value of farm land. One of its weaknesses is that it makes no effort to explore the effect that the introduction of a new variable may have on the role played by a variable which entered at an earlier

TABLE VIII

MATRIX OF SIMPLE CORRELATIONS ANALYSIS OF FIFTEEN FACTORS SELECTED FOR THIS STUDY

	Price Per Acre Y	Size of Tract X_1	Acres of Cropland X_2	Per Cent of Cropland X_3	Acres of Wheat Allotment X_4	Acres of Feedgrain X_5	Per Cent Wheat Allotment All Land X_6	Per Cent Wheat Allotment Cropland X_7
Y	+1.00	- .3474	+.2520	+ .4132	+ .0052	+ .2834	+ .1593	- .0045**
X_1		+1.00	+ .2661	- .0923	+ .3013	+ .1477	- .0589	+ .0285
X_2			+1.00	+ .9258	+ .5027	+ .7162	+ .4008	+ .1521
X_3				+1.00	+ .3980	+ .6793	+ .4486	+ .1606
X_4					+1.00	- .1449	+ .9193	+ .8033
X_5						+1.00	- .2283	- .3534
X_6							+1.00	+ .8514
X_7								+1.00
X_8								
X_9								
X_{10}								
X_{11}								
X_{12}								
X_{13}								
X_{14}								
X_{15}								

	Per Cent Feedgrain All Land X_8	Per Cent Feedgrain Cropland X_9	Acres of Total Allotment X_{10}	Per Cent Allotment All Land X_{11}	Per Cent Allotment Cropland X_{12}	Acres of Range Land X_{13}	Per Cent Range Land X_{14}	Productivity Index X_{15}
Y	+ .3071*	+ .2668	+ .2639	+ .3897**	+ .2435	- .4668	- .4600	+ .5664*
X_1	+ .0435	+ .1153	+ .3003	+ .0130	+ .1277	+ .1474	+ .0619	+ .0481
X_2	+ .6856	+ .6218	+ .9338	+ .8913	+ .6892	- .7194	- .7393	+ .5547
X_3	+ .6829	+ .5999	+ .8427	+ .9143	+ .6751	- .7905	- .7948	+ .5662
X_4	- .1933	- .1981	+ .4115	+ .3140	+ .3997	- .4637	- .4818	+ .3234
X_5	+ .9910	+ .9454	+ .8420	+ .8475	+ .6222	- .4478	- .4602	+ .4154
X_6	- .2438	- .2636	+ .2908	+ .3081	+ .3739	- .5191	- .5246	+ .3254
X_7	- .3706	- .2937	+ .1123	+ .1040	+ .4545	- .3448	- .3590	+ .2571
X_8	+1.00	+ .9482	+ .8074	+ .8473	+ .6123	- .4595	- .4612	+ .4036
X_9		+1.00	+ .7628	+ .7865	+ .7176	- .4458	- .4614	+ .4084
X_{10}			+1.00	+ .9518	+ .7910	- .6653	- .6865	+ .5590
X_{11}				+1.00	+ .8072	- .7354	- .7406	+ .5743
X_{12}					+1.00	- .6664	- .6913	+ .5658
X_{13}						+1.00	+ .9903	- .7159
X_{14}							+1.00	- .7355
X_{15}								+1.00

* Statistically significant at the 5% probability level.

** Statistically significant at the 10% probability level.

stage. This deficiency in the analysis is overcome by the Forward-Selection Step-Wise Multiple Regression Procedure; and improvement on the Forward-Selection Multiple Regression Procedure.

Forward-Selection Step-Wise Regression Procedure

In spite of its entirely different name, this procedure is, in fact, an improved version of the Forward-Selection Procedure. The improvements involve the re-examination at every stage of the regression, the variables incorporated into the model in the previous stage. In the Step-Wise[4] Procedure, intermediate results are used to give valuable statistical information at each step in calculation.

These intermediate answers are also used to control the method of calculation. A number of intermediate regression equations are obtained by adding one variable at a time thus giving the following intermediate equations.

a. $Y = B_0 + B_1 X_1$

b. $Y = B_0 + B_1 X_1 + B_2 X_2$, etc.

The coefficients for each of the intermediate equations and the certainty of each coefficient are obtained by the Forward-Selection Step-Wise Procedure. The values and certainty may vary with each subsequent equation. The coefficients represent the best values when the equation is

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[4]For more information about Step-Wise Regression Procedure see: N. R. Daper and H. Smith, Applied Regression Analysis (John Wiley and Sons, Inc., 1966), pp. 171-172.

fitted to the specific variables included in the equation. The variable is added that makes the greatest improvement in "goodness of fit" or, stated another way, gives the greatest reduction in variance of the dependent variable.

A variable may be indicated as significant at an early stage and enter the regression equation. After several other variables are added to the regression equation, a variable in the equation may be indicated to be insignificant. Under this situation the Forward-Selection Step-Wise Regression Procedure will remove the insignificant variable before adding an additional variable. Thus, at the various steps in the regression procedure, only those variables which are significant will be included in the regression equation. The last step in the Step-Wise Procedure predicts the value of the dependent variable for each set of observations based on the final regression equation. The deviation between the actual and predicted values is also calculated.

Forward-Selection Step-Wise Analysis of the Data

The independent variables of the analysis were chosen on the basis of their hypothesized effect on the dependent variable (Y) price per acre of farm land. The first step in the analysis was to determine the relationship of the selected 21 factors X_i's on price per acre of farm land (Y_i). This statement can be summarized in a functional form as follows:

$$Y = f(X_1, X_2, X_3, X_4, \ldots, X_{21}).$$

This equation states that price per acre (Y) of farm land depends upon, or is determined by, $X_1, X_2, X_3, X_4, \ldots, X_{21}$.

The coefficients of determination (R^2) and the t-statistic for the regression coefficients were utilized in choosing the most useful equation estimated.

Due to a relatively high intercorrelation among some of the independent variables and lack of a strong relationship between the dependent and independent variables (Table VII), some of the less important variables were eliminated. The Forward-Selection Step-Wise Multiple Regression Procedure eliminated seven variables leaving 14 to be used in the estimating equation. The following estimating equation is based upon the 14 most significant variables, that were derived from the sample data.

$$\begin{aligned} Y_1 = &- 80.88 + 0.2577\ X_1 + 2.4504\ X_2 + 3.1270\ X_3 \\ &- 1.8650\ X_4 - 1.5405\ X_7 + 0.5175\ X_9 + 0.0820\ X_{13} \\ &+ 2.5655\ X_{15} - 20.4745\ X_{16} + 2.6635\ X_{17} + 3.3057\ X_{18} \\ &- 1.5231\ X_{19} + 2.0184\ X_{20} - 1.9121\ X_{21} \end{aligned}$$

$R^2 = .63$

The coefficients of determination (R^2) was .62621 which shows that these factors account for almost 63 per cent of the variation in price per acre of farm land. The standard error and computed t-values for each of the

coefficients used in the estimating equation are shown in Table IX. Out of the 14 variables used in the first estimating equation, only four had significant b values and were positively correlated at the five per cent probability level. These were: acres of cropland X_2, per cent cropland X_3, acres of wheat allotment X_4, and productivity index of tract X_{15}. Two other factors were negatively correlated and statistically significant at the same probability level. One was distance to all weather road X_{16} and the other was wheat allotment as a per cent of cropland X_7.

A Forward-Selection Step-Wise Multiple Regression Analysis was computed. In this equation 15 selected independent variables were used to determine what influence these factors have on price per acre of farm land. The variables were selected to see what effect size of tract, government programs, and productivity of the tract had on price per acre of farm land with the other variables removed. In this equation the Step-Wise Procedure eliminated six of the variables that were highly intercorrelated or were less important than some of the nine remaining variables. The second estimating equation which appears below uses size of tract, those variables which reflect government programs, and the productive quality of the tract.

$$Y_2 = 22.08 - 0.2599\ X_1 + 0.3558\ X_2 - 2.3482\ X_4 + 1.1398\ X_7 - 5.4483\ X_8 + 0.2172\ X_9 + 1.0027\ X_{10} + 4.1860\ X_{11} + 2.1554\ X_{15}\ .$$

TABLE IX

THE VARIABLES, REGRESSION COEFFICIENTS, STANDARD ERROR OF COEFFICIENTS AND THE t-VALUES: FOR 14 SELECTED INDEPENDENT VARIABLES, USED TO PREDICT THE PRICE PER ACRE OF FARM LAND

Independent Variables	Regression Coefficients	Standard Error of Coefficients	t Values
X_1	0.2577	0.5722	0.4504
X_2	-2.4504	0.9215	-2.6589*
X_3	3.1270	1.2771	2.4485*
X_4	1.8605	0.8800	2.1140*
X_7	-1.5405	0.6313	-2.4398*
X_9	0.5175	0.3974	1.3020**
X_{13}	0.0820	0.2051	0.3999
X_{15}	2.5655	0.5727	4.4795*
X_{16}	-20.4745	8.8652	-2.3095*
X_{17}	2.6635	4.4460	0.5591
X_{18}	3.3057	2.2184	1.4901**
X_{19}	-1.5231	3.8221	-0.3985
X_{20}	2.0184	3.2624	0.6187
X_{21}	-1.9121	1.2507	-1.5288**

*Statistically significant at 5% probability level.

**Statistically significant at 25% probability level.

The (R^2) value was .5429 which indicates that the nine factors explained 54 per cent of the variation in per acre price of farm land.

Only two factors, in the estimating equation, feedgrain allotment as per cent of all land X_8 and productivity index of the tract X_{15} were significant at the five per cent level. The standard error and computed t-values for each of the coefficients of the latter estimating equation appear in Table X.

Even though the use of such selected factors as size of tract, factors associated with government programs, and productivity of the soil explains only 54 per cent of the variation as compared with 63 per cent when 21 selected variables are used, it would sometimes be more feasible to use a shorter estimating equation. The smaller the number of coefficients used in the estimating equation the smaller the burden of computation and the less the possibility of arithmetic errors. Also, Table XI suggests that factors connected with government programs, and productive quality of a tract might contribute more to the price per acre than is reflected by the estimating equation. The average price per acre paid for tracts with allotments as compared to those without allotments (Table XI) was higher. Those tracts which had allotments averaged $48.25 more per acre than tracts without allotments. Allotments were not the only factor in price difference, however. It will be noted that tracts with allotments had an average index of

TABLE X

THE VARIABLES, REGRESSION COEFFICIENTS, STANDARD ERROR OF COEFFICIENTS AND t-VALUES: FOR NINE SELECTED VARIABLES, USED TO PREDICT THE PRICE PER ACRE OF FARM LAND

Independent Variables	Regression Coefficient	Standard Error of Coefficients	t Values
X_1	-0.2599	0.6355	-0.4090
X_2	-0.3558	0.3709	-0.9592***
X_4	-2.3482	1.7885	-1.3129***
X_7	-1.1398	0.5855	-1.9464**
X_8	-5.4483	2.8404	-1.9181*
X_9	0.2172	0.6743	0.3221
X_{10}	1.0072	1.5836	0.6331***
X_{11}	4.1860	2.2324	1.8750**
X_{15}	2.1554	0.4461	4.6240*

*Statistically significant at 5% probability level.

**Statistically significant at 10% probability level.

***Statistically significant at 25% probability level.

TABLE XI

PRICE PER ACRE PAID FOR TRACTS WITH AND WITHOUT ALLOTMENTS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	With Acreage Allotments	Without Acreage Allotments
Number of transactions	55	13
Average price per acre	$158.00	$109.75
Average acres wheat allotments	43	0
Average acres feedgrain base	81	0
Average acres of allotments	107	0
Average acres of cropland	115	0
Average acres of rangeland	0	143
Average productivity index	86	60

productivity 26 points higher than tracts without allotments. Also tracts without allotments did not have any cropland.

Step-Wise Multiple Regression provides a tool to use in estimating land values in the study area. It was shown that this method could explain 63 per cent of the difference in price when using 14 of the selected independent variables and 54 per cent of the variation could be explained by using only nine selected independent variables when those variables were related to size, productivity, and government programs.

Even though this method explains only part of the variation in price per acre of farm land, it is superior to the method which is used by the School Land Commission for appraising land values. Figures 5, 6, and 7 show graphically the deviations of the calculated and appraised value per acre from the actual selling price as shown in Tables XII and XIII. The data show that the estimating equations tend to over-value the price per acre of low-valued farm land and under-value high priced farm land.

When one is using the estimating equation to arrive at values, it may be useful to adjust downward the per acre price of low-valued tracts and adjust upward the per acre price of high-valued tracts. This means the appraiser who is using the estimating equation must use his judgement and experience in making the necessary price adjustment.

TABLE XII

DEVIATIONS OF PREDICTED PRICE PER ACRE AND APPRAISED PRICE PER ACRE FROM ACTUAL PRICE PER ACRE, USING 14 SELECTED FACTORS, FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

Sale Number	Predicted Dollars* Per Acre	Deviation From Actual Dollars* Per Acre	Actual Dollars* Per Acre	Appraised Dollars* Per Acre	Deviation From Actual Dollars* Per Acre
1	173	+ 33	140	73	- 67
2	118	+ 52	66	40	- 26
3	107	+ 22	85	40	- 45
4	112	+ 31	81	40	- 41
5	71	+ 25	45	40	- 5
6	130	- 35	165	73	- 92
7	157	+ 21	138	80	- 58
8	149	+ 16	133	80	- 53
9	166	- 4	171	75	- 96
10	170	- 9	180	75	-105
11	123	- 41	165	63	-102
12	152	- 71	244	97	-127
13	125	- 74	200	85	-115
14	104	+ 11	93	75	- 18
15	193	- 58	252	88	-164
16	154	- 7	162	88	- 74
17	158	- 4	163	88	- 75
18	162	- 13	176	88	- 88
19	151	- 9	161	88	- 73
20	185	+ 35	150	100	- 50
21	151	+ 78	73	48	- 25
22	175	- 76	252	90	-162
23	178	- 61	240	95	-145
24	193	-152	346	98	-248
25	166	+ 30	136	100	- 36
26	160	+ 9	151	100	- 51
27	131	- 11	143	90	- 53
28	151	- 4	155	90	- 65
29	196	- 44	240	105	-135
30	202	- 3	205	93	-112
31	204	- 12	216	98	-118
32	195	- 18	213	105	-108
33	215	+ 64	151	88	- 63
34	181	+ 20	161	90	- 71
35	97	+ 33	64	45	- 19
36	95	+ 37	58	40	- 18

TABLE XII (Continued)

Sale Number	Predicted Dollars* Per Acre	Deviation From Actual Dollars* Per Acre	Actual Dollars* Per Acre	Appraised Dollars* Per Acre	Deviation From Actual Dollars* Per Acre
37	71	+ 21	50	40	- 10
38	175	+ 9	166	88	- 78
39	200	+ 11	189	82	-107
40	163	+ 62	101	83	- 18
41	173	+ 23	150	88	- 62
42	158	+ 68	90	55	- 35
43	89	- 28	117	55	- 62
44	169	+ 19	150	85	- 65
45	181	+ 36	145	89	- 56
46	90	+ 7	83	73	- 10
47	88	+ 23	65	43	- 22
48	100	+ 27	73	65	- 8
49	94	+ 17	77	75	- 2
50	37	- 27	65	55	- 10
51	77	- 14	91	90	- 1
52	160	+ 38	122	95	- 27
53	123	+ 17	106	85	- 21
54	52	- 38	91	65	- 26
55	179	+ 45	134	90	- 44
56	108	+ 33	75	73	- 2
57	52	+ 54	106	65	- 41
58	181	+ 36	145	85	- 60
59	101	- 11	112	75	- 37
60	95	+ 13	82	75	- 7
61	170	- 3	173	151	- 22
62	181	+ 8	173	150	- 23
63	191	+ 33	158	150	- 8
64	165	- 12	177	71	-106
65	320	- 6	326	205	-121
66	235	- 20	255	166	- 89
67	212	- 64	276	150	-126
68	212	- 23	235	150	- 85

*Dollars per acre rounded to nearest dollar.

TABLE XIII

DEVIATIONS OF PREDICTED PRICE PER ACRE AND APPRAISED PRICE PER ACRE FROM ACTUAL PRICE PER ACRE, USING 9 SELECTED FACTORS, FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

Sale Number	Predicted Dollars* Per Acre	Deviation From Actual Dollars* Per Acre	Actual Dollars* Per Acre	Appraised Dollars* Per Acre	Deviation From Actual Dollars* Per Acre
1	160	+ 20	140	73	- 67
2	86	+ 20	66	40	- 26
3	84	- 1	85	40	- 45
4	88	+ 7	81	40	- 41
5	34	- 11	45	40	- 5
6	144	- 21	165	73	- 92
7	171	+ 33	138	80	- 58
8	155	+ 22	133	80	- 53
9	168	- 3	171	75	- 96
10	182	+ 2	180	75	-105
11	159	- 6	165	63	-102
12	146	- 78	224	97	-127
13	123	+ 77	200	85	-115
14	116	+ 23	93	75	- 18
15	187	- 65	252	88	-164
16	187	+ 25	162	88	- 74
17	182	+ 19	163	88	- 75
18	193	+ 17	176	88	- 88
19	187	+ 26	161	88	- 73
20	179	+ 29	150	100	- 50
21	156	+ 83	73	48	- 25
22	157	- 95	252	90	-162
23	172	- 68	240	95	-145
24	174	-172	346	98	-248
25	153	+ 17	136	100	- 36
26	149	- 2	151	100	- 51
27	125	- 18	143	90	- 53
28	140	- 15	155	90	- 65
29	185	- 55	240	105	-135
30	188	- 17	205	93	-112
31	186	- 30	216	98	-118
32	183	- 30	213	105	-108
33	199	+ 48	151	88	- 63
34	177	+ 16	161	90	- 71
35	90	+ 26	64	45	- 19
36	86	+ 28	58	40	- 18

TABLE XIII (Continued)

Sale Number	Predicted Dollars* Per Acre	Deviation From Actual Dollars* Per Acre	Actual Dollars* Per Acre	Appraised Dollars* Per Acre	Deviation From Actual Dollars* Per Acre
37	62	+ 12	50	40	- 10
38	181	+ 15	166	88	- 78
39	191	+ 2	189	82	-107
40	161	+ 60	101	83	- 18
41	179	+ 29	150	88	- 62
42	157	+ 67	90	55	- 35
43	162	+ 45	117	55	- 62
44	178	+ 28	150	85	- 65
45	176	+ 31	145	89	- 56
46	92	+ 9	83	73	- 10
47	91	+ 26	65	43	- 22
48	98	+ 25	73	65	- 8
49	102	+ 25	77	75	- 2
50	48	- 17	65	55	- 10
51	88	- 3	91	90	- 1
52	183	+ 61	122	95	- 27
53	150	+ 44	106	85	- 21
54	53	+ 38	91	65	- 26
55	170	+ 36	134	90	- 44
56	118	+ 43	75	73	- 2
57	60	- 46	106	65	- 41
58	183	+ 38	145	85	- 60
59	132	+ 20	112	75	- 37
60	125	+ 43	82	75	- 7
61	144	- 29	173	151	- 22
62	161	- 12	173	150	- 23
63	165	+ 7	158	150	- 8
64	152	- 25	177	71	-106
65	341	+ 15	326	205	-121
66	211	- 44	255	166	- 89
67	172	- 63	235	150	- 85
68	172	- 63	235	150	- 85

*Dollars per acre rounded to nearest dollar.

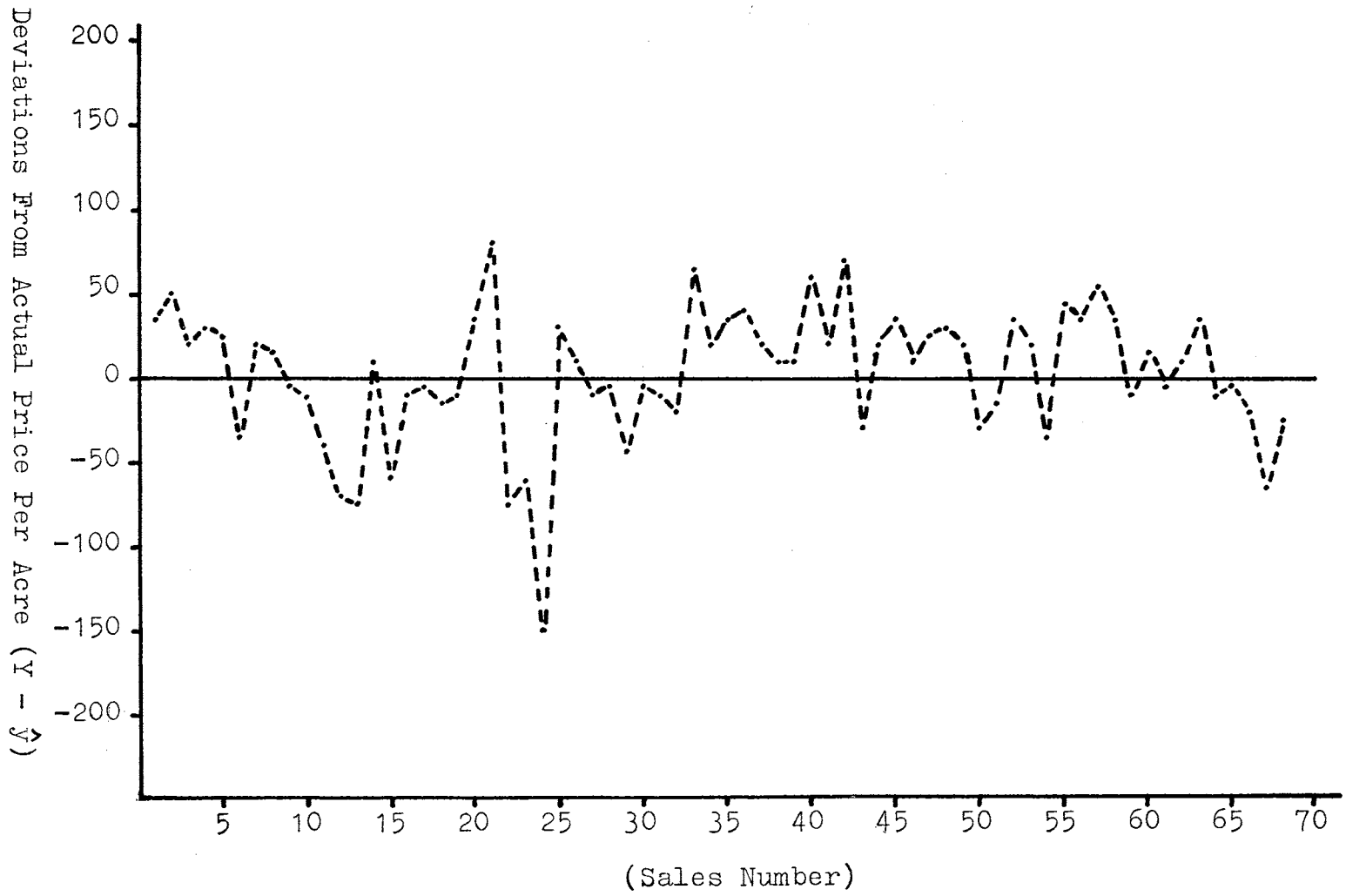

Figure 5. Deviations of Estimated Price From Actual Price Per Acre of Farm Land, Using the Estimating Equation and 14 Selected Independent Variables, Cimarron and Texas Counties, Oklahoma

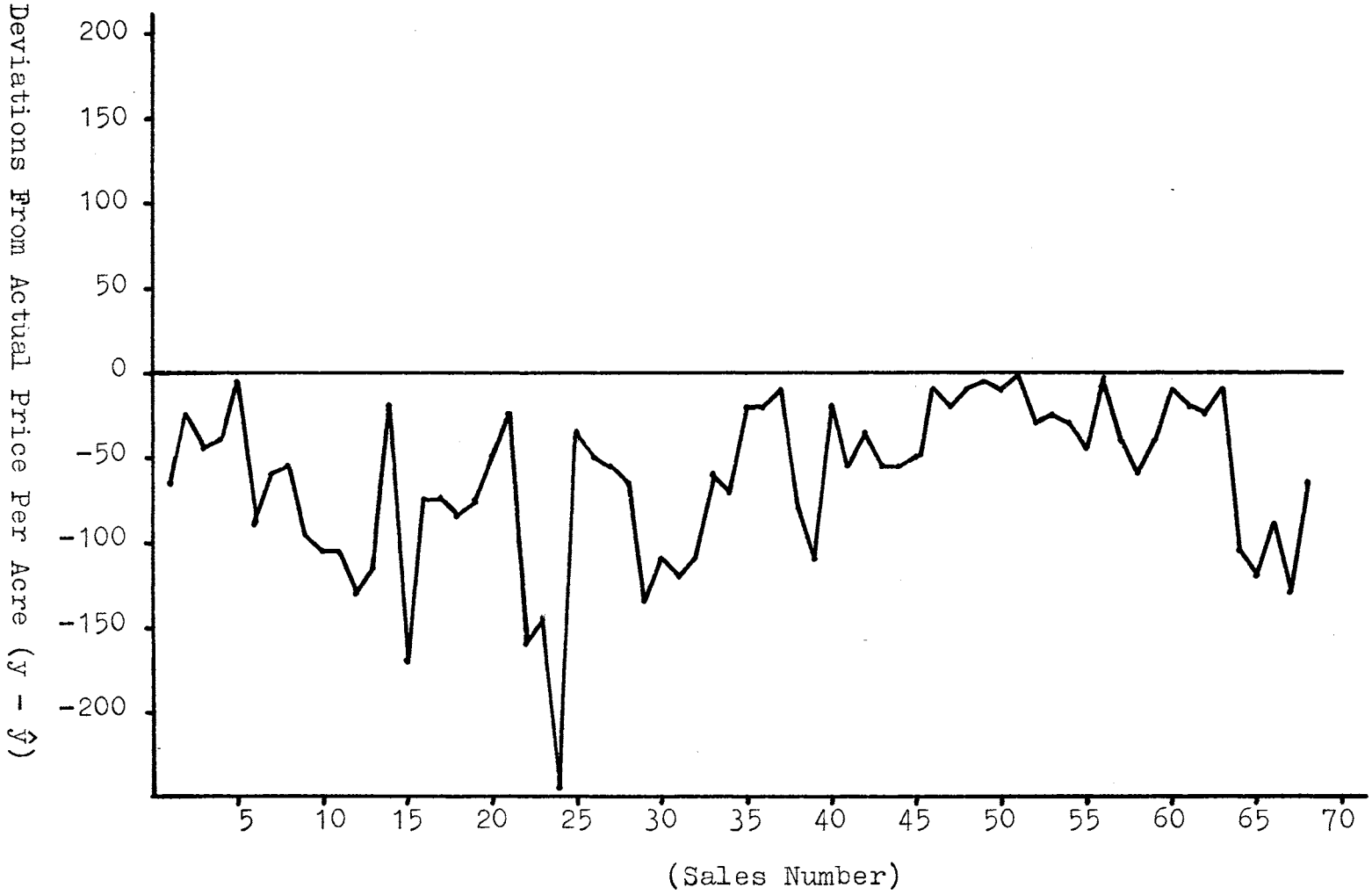

Figure 6. Deviations of the Appraised Price, From Actual Price Per Acre of Farm Land, Using Oklahoma School Land Commissions Method of Appraisal, Cimarron and Texas Counties, Oklahoma

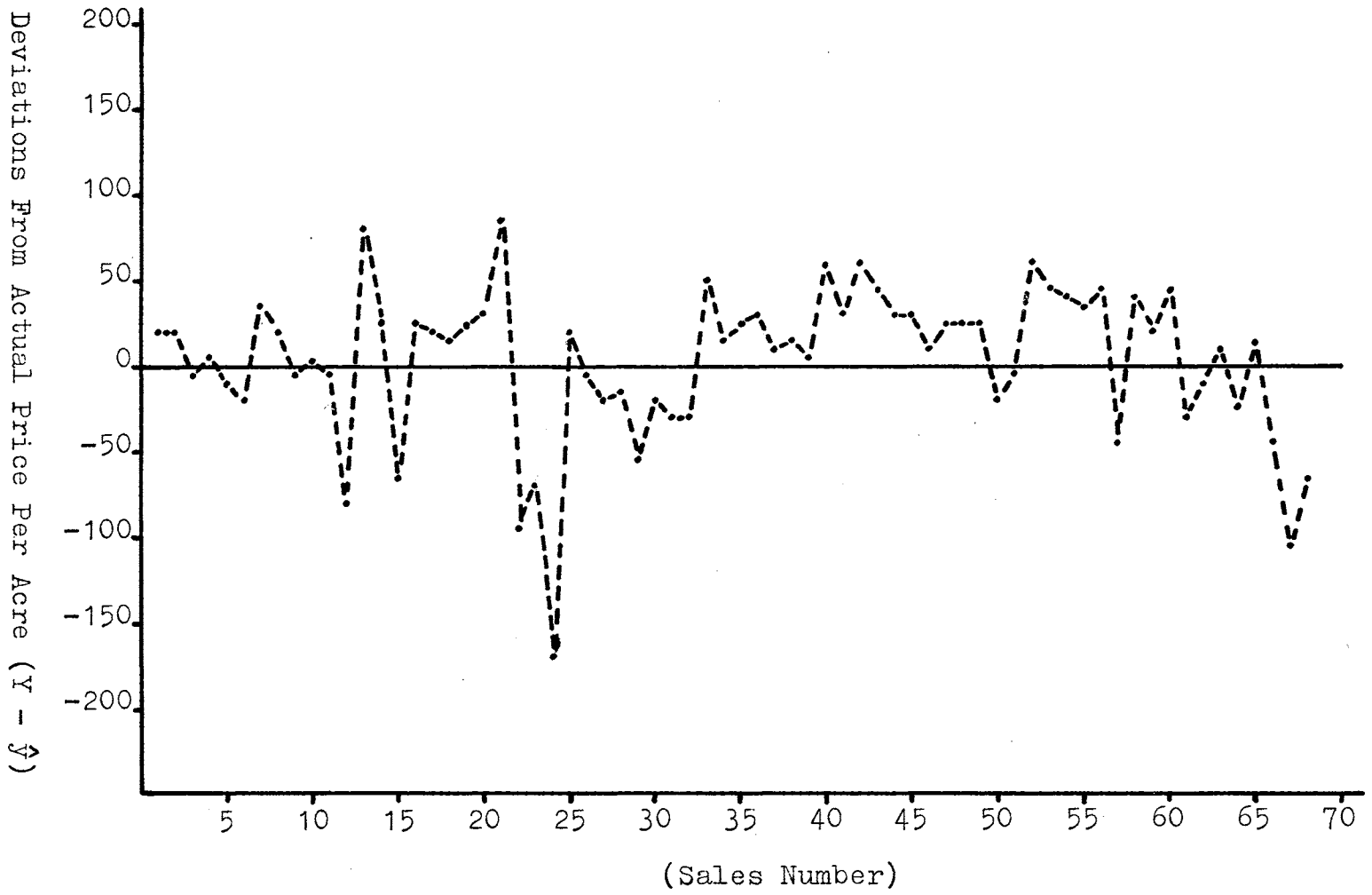

Figure 7. Deviations of Estimated Price From Actual Price Per Acre of Farm Land, Using the Estimating Equation and Nine Selected Independent Variables, Cimarron and Texas Counties, Oklahoma

Application of the Equation

The application of the "Forward-Selections Step-Wise Multiple Regression equation on page 48" can be illustrated with an example using an actual tract. This tract of land has the following characteristics:

X_1 = 160 (number of acres in tract)
X_2 = 0 (acres of cropland in tract)
X_3 = 0 (per cent cropland in tract)
X_4 = 0 (acres of wheat allotment in tract)
X_7 = 0 (per cent wheat allotment in tract)
X_9 = 0 (feedgrain as a per cent of cropland)
X_{13} = 160 (acres of rangeland in the tract)
X_{15} = 54 (productivity index of the tract)
X_{16} = 1 (distance to all weather road in miles)
X_{17} = 1 (distance to paved road in miles)
X_{18} = 1 (distance to state highway in miles)
X_{19} = 8 (distance to nearest market in miles)
X_{20} = 8 (distance to small trade center in miles)
X_{21} = 20 (distance to large trade center in miles).

After the values of the independent variables have been determined, the following steps are involved in estimating the per acre price of the tract used for illustration. First, the values are inserted into equation number one thus:

$$\hat{Y}_1 = -80.88 + 0.2577\ (160) + 2.4504\ (0) + 3.1270\ (0) + 1.8650\ (0) - 1.5405\ (0) + 0.5175\ (0) + 0.0820\ (160) + 2.5655\ (54) - 20.4745\ (1) + 2.6635\ (1) + 3.3058\ (1) - 1.5231\ (8) + 2.0184\ (8) - 1.9120\ (20) .$$

After completing the calculation for estimating the value of $\hat{Y}_1$, the above tract of farm land is estimated to have a market price per acre of $63.21. Its actual price per acre was $65.62.

If one wished to eliminate some of the arithmetic calculations the variables containing zeros could be eliminated from the estimating equation and use only those variables having a numerical value. Also, if all the variables had a numerical value, estimating equation number two could be used to shorten the number of calculations involved.

The application of equation number two on page 50 involves nine selected independent variables that were related to size, government programs, and productivity of the tract. The use of this estimating equation can be used in the same manner as number one.

For instance, what is the calculated per acre price (Y_2) of an actual tract having the following characteristics?

X_1 = 160 (number of acres in the tract)
X_2 = 95 (number of acres of cropland in the tract)
X_4 = 55 (number of acres of wheat allotment)
X_7 = 58 (per cent wheat allotment of cropland acres)
X_8 = 0 (per cent feedgrain base of all land)
X_9 = 0 (per cent feedgrain base of cropland)
X_{10} = 55 (acres of total allotment)
X_{11} = 34 (per cent allotment of all land)
X_{15} = 71 (productivity index of tract).

After values for each of the independent variables have been determined, they are inserted into the estimating equation.

$$\hat{Y}_2 = 22.08 - 0.2599\ (160) - 0.3558\ (95) - 2.3482\ (55) - 1.1398\ (58) - 5.1443\ (0) + 0.2172\ (0) + 1.0027\ (55) + 4.1860\ (34) + 2.1554\ (71).$$

After completing the calculations for estimating the values of $\hat{Y}_2$, the tract of land has an estimated market value of \$101.94 per acre compared to its actual price of \$97.50 per acre.

As another test, the two estimating equations were used on ten farm land tracts taken from the deed records in Texas county, Oklahoma, not sold by the School Land Commission. Selling price per acre of these tracts was estimated from the value of the revenue stamps shown on the warranty deed. Out of the ten tracts, the estimating equation gave a price per acre which averaged \$12.50 deviation per acre from the actual price. The range was from \$2.41 per acre too low to \$25.50 per acre too high.

When one is using an equation to estimate the value of farm land, it should be kept in mind how the equation tends to over estimate low value tracts and to under estimate high value tracts. Also, because the price affecting factors may change markedly over time, the value of the estimating equation may be limited to short periods of time.

It may be useful to supplement the equation with the land price index which reflects the relative year-to-year

land price changes. Since the estimated equation is based on 1965 sales data, the estimated per acre land price for succeeding years could be adjusted by use of the index.

CHAPTER V

SUMMARY AND CONCLUSION

It is well known that differences in market value exist among various tracts of land. Such differences are expected since each tract of land and the conditions surrounding each sale has unique characteristics. It was hypothesized that this uniqueness is based upon certain variables which can be measured and that these variables will help to explain differences in market value.

Many factors appear to influence the price per acre which people are willing to pay for farm land. When a buyer and seller enter the land market, each one's subjective prices, and consequently his actions, are affected by his response to certain value influencing factors. The same factors are not likely to affect all buyers and sellers equally, nor is it likely that all of the same factors even enter into decisions of each party to a transaction. However, it is reasonable to believe that at least some of the differences in price paid for different tracts of farm land can be explained by certain factors which observations seem to indicate are important.

To analyze sales and to study the factors affecting the variation in land values in the study area, an attempt

was made to select all factors which might cause one tract of land to sell for more or less than another.

One of the basic purposes of research in land pricing is to see if procedures might be devised that can be used buy buyers, sellers, lenders, and others who need to evaluate land. Land pricing by people in the market usually is based on a "feel" of the market. There is little in the way of precise measurement of value.

The over-all objective of this study was to investigate the impact of selected price influencing forces on the per acre price of farm land. The specific objectives were (1) to determine whether hypothesized relationships exist between price per acre and selected independent variables, (2) to determine the factors which have the most influence on price paid for farm land, (3) to develop an estimating equation that could be used for predicting the value of a tract or farm, and (4) to test the accuracy of the derived coefficients in an estimating equation.

In the analysis, the independent factors were selected which were thought most likely to influence the price of an individual tract of land. The measurable variables which were assumed to be related to per acre price of farm land were those which reflected the quality of tract, crop acreage allotments, size and location of the tract. The location and crop acreage allotments have been shown in other studies to be important in the per acre price of farm land.

The data used in the analysis were unusual in that such factors as time of sale, method of sale, seller pecularities, and access to credit were the same for all tracts. One seller, the Oklahoma School Land Commission, sold at public auction during a period of two days all the tracts used in the analysis. The same credit terms were offered to each buyer by the Commission. Therefore, when examining the combination of different factors which influence the per acre price of farm land, the factors of time, the method and condition of sale, and credit terms can be eliminated.

There are several techniques which can be employed to aid in the investigation. Cross classification tables may be used to examine the various value contributing factors to see whether there is evidence of their influence on per acre price of farm land.

When the cross classification tables were used it appeared that size of tract, allotments, proportion of cropland, productivity, and size of prior operations of buyers are factors which influenced the market for farm land in this particular area. Out of the five factors mentioned, size probably is not important enough to have a significant influence on per acre price. Even though size of tract is not particularly important in the study area, it must be kept in mind that in other areas size of tract might be one of the more important factors in determining price per acre.

The Forward-Selection Multiple Regression and

Correlation Analyses were performed on the 21 selected independent variables and then on 15 selected independent variables that were related only to size of tract, government allotment programs, and quality of the tract. In the first case, it was found that 17 of the 21 variables explained 63 per cent of the variation in per acre price of farm land. In the second case with 15 selected variables, it was found that ten of them explained 53 per cent of the variation in price per acre of farm land.

A correlation analysis was made to measure the interrelationship of various factors thought to have an influence on price per acre of farm land. In the group of 21 selected independent variables, four factors, acres of cropland, per cent cropland, acres of wheat allotment, and the productivity index of the tract, were significant and positively correlated with price per acre at the five per cent level. Two factors, wheat allotment as per cent of all cropland and distance from the tract to an all weather road were negatively correlated with price per acre at the five per cent level.

A correlation analysis was made of the 15 independent variables related to size of tract and those variables which reflected the influence of government programs and productivity of the tract on purchase price per acre.

Two factors, the per cent feedgrain acres of all land, and the productivity index of the tract were significant at the five per cent level and had a positive correlation

with price per acre. However, two other factors were shown to be significant at the ten per cent level. One factor, allotments as per cent of cropland, was negatively correlated, while allotments as a per cent of all land was positively correlated with price per acre at the ten per cent level.

The Multiple Regression Procedure is one of the most common methods used to derive an equation for estimating the price per acre of farm land.

Another drawback to the Multiple Regression Procedure is that it makes no effort to explore the effects that the introduction of a new variable may have on another variable which entered at an early stage. The deficiency in the analysis is overcome by the Forward-Selection Step-Wise Multiple Regression Procedure.

When the Forward-Selection Step-Wise Multiple Regression Procedure was applied to determine the relationship of 21 selected independent factors on price per acre, the coefficient of determination (R^2) was .62621 which, after seven factors were eliminated, indicated that 14 variables in the regression equation explained almost 63 per cent of the variation in price per acre. Out of the 14 variables used in the first estimate only four of the factors were positively correlated and had significant b values at the five per cent probability level. These were acres of cropland X_2, per cent cropland X_3, acres of wheat allotment X_4, and productivity index X_{15}. Two other factors were

negatively correlated and had significant b values at the five per cent probability level. These were wheat allotment as per cent of cropland X_7, and distance from tract to all weather road X_{16}.

Another Forward-Selection Step-Wise Multiple Regression Analysis was performed to determine the relationship of only 15 selected independent factors to price per acre of farm land. In the second analysis the 15 selected independent factors were those directly related to size of tract, government programs, and productivity index of the tract. In this equation the Step-Wise Procedure eliminated six of the variables that were highly intercorrelated or were less important than some of the nine remaining variables. The (R^2) value was .5429 which indicates that these nine factors explained 54 per cent of the variation in total price per acre of farm land. Only two of the factors, feedgrain allotment as a per cent of all land and the productive quality of the tract, had significant b values at the five per cent probability level.

When the two estimating equations were used on land sales by sellers other than the Oklahoma School Land Commission, the estimating equation gave a price per acre with an average deviation of $12.50 per acre from the actual price. The range was from $2.41 per acre below the actual value to $25.50 per acre above. The estimating equation may be a useful tool for real estate appraisers, assessors, investors, and others in evaluating land. The

usefulness of this approach to the estimation of value lies in the fact that all information needed for the equation can be obtained from county highway maps and the County Agricultural Stabilization and Conservation Office.

Limitations of Equations

One must keep in mind that because certain price affecting factors may change markedly over time, the value of the estimating equation may be limited to short periods. Also, the equation only covers the area from which the sample data were drawn. It is necessary to calculate the value for each of the independent variables used in the estimating equation.

It appears that the equations tend to over value the price per acre of low valued land and under value high priced farm land. Therefore, to arrive at a relatively accurate estimate of values, it would be necessary to adjust downward the per acre price of low valued land and adjust upward the per acre price of high valued farm land. This means the one who is using the estimating equation must utilize his judgement in making the necessary price per acre adjustments.

The estimating equation which could be derived for any area, will be no better than the information that is available on the independent variables used in deriving the estimating equation.

The final decision with respect to value based upon

an estimating equation cannot be exact nor can it be expressed easily. But it can be said that an estimate is the best clue to value, since it is based on observations of basic economic forces which influence value.

Needs For Further Research

As one looks at the estimating equation method as a mathematical or statistical tool to use in predicting the per acre value of farm land, there are many unanswered questions which need to be examined. The exploration of these factors might increase or decrease the degree of accuracy of the estimating equation.

Other factors which possibly could affect the estimating equation would be: (1) the average price per acre of allotments, (2) revenue received from different farm programs, and (3) size of prior operation of buyers. It would seem particularly useful if it were possible to incorporate these three factors statistically where they could be used with coefficients in the estimating equation, or use other variables to get the equation into a more manageable form. The need for application of these and other statistical techniques is evident.

All the methods we used to analyze the short of sale were later critized by pointing out some factors that could affect them and decrease them of showing accuracy. They should be thoroughly examined before the acceptance of general use of the methods on the sch. sales of land.

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APPENDIX

APPENDIX

METHODS AND SOURCES USED FOR CONSTRUCTION OF THE PRODUCTIVITY INDEX

The productivity ratings in the study area are based on the estimated yeilds and income for a given soil that is suitable for dryland farming. Under this type of farming, yields obtained on the same soil vary greatly from year to year, depending upon the amount of moisture received before planting and during the growing season. The estimates are based on yields that can be expected over a number of years under improved management. Improved management consists, not only of common management, but in addition, using soil and moisture conserving practices.

Each tract in the study area was classified into land capability units and range sites as shown in Appendix Tables I and II. The best income producing soil in the area was given a numerical rating of 100. Then each soil that had a lower income producing ability would be a certain per cent of the best soil in the area. The numerical rating of each tract is based on the income producing ability of each soil within an individual tract of land. Each soil in the area is figured on its highest and best use. Each individual range site in the area was treated in the same

manner. If one wanted to arrive at a productivity rating for land in the area that is suitable for irrigation it could be approached by the same method that was used to figure the productivity rating for dryland farming.

APPENDIX TABLE I

HIGH PLAINS LAND RESOURCE AREAS LAND CAPABILITY CLASSIFICATION, RANGE SITES, AND PRODUCTIVITY RATINGS

Cimarron County, Oklahoma

Map Symbol	Soil Name	Capability Unit Dryland	Capability Unit Irrigated	Productivity Rating C	Productivity Rating R	Range Site
Sa	Spur soils	III c	I	100		Loamy bottomland
Rb	Richfield clayloam, 0-1%	III c	I	100		Hardland
Rd	Richfield fine sandy loam, 0-1%	III e	I	100		Hardland
Da	Dalhart fine sandy loam, 0-1%	III e	II e	100		Sandy plains
Db	Dalhart fine sandy loam, 1-3%	IV e	II e	95		Sandy plains
Dd	Dalhart loamy fine sand, 0-3%	IV e	III e	90		Deep sand
Re	Richfield loam, 0-1%	III c	I	88		Hardlands
Pa	Portales clay loam, 0-1%	III c	I	88		Hardlands
Bb	Berthoud loam, 0-3%	IV e	II e	88		Hardlands
Dc	Dalhart fine sandy loam, 0-3%	IV e	III e	83		Sandy plains
Rc	Richfield clay loam, 1-2%	III e	II e	73		Hardlands
Md	Mansker-Dalhart loams, 1-3%	IV e	II e	71		Hardlands
Pb	Portales clay loam, 1-2%	IV e	II e	65		Hardlands
Sb	Sweetwater fine sandy loam	VW*			100	Subirrigated
La	Lincoln soils	VI e			65	Deep sand
Ba	Berthoud fine sandy loam, 2-5%	VI e			54	Sandy plains
De	Dalhart loamy fine sand, 0-3%	VI e			52	Deep sand
Vb	Vona-Tivoli loamy fine sands	VI e			52	Deep sand and dune
Ra	Randall clay	VW*			48	Hardlands
Bc	Berthoud loam, 3-5%	IV e			48	Hardlands
Mb	Mansker loam, 0-3%	IV e	III e		48	Hardlands
Me	Mansker loam, 3-5%	VI e			48	Hardlands
Me	Mansker-Potter complex, 3-12%	VI e			48	Hardlands and shallow
Ma	Mansker fine sandy loam, 2-5%	VI e			43	Limy sandy plains
Oa	Otero loamy fine sand	VI e			43	Limy sandy plains
Ca	Carnero loam	VI e			37	Hardlands
Pc	Potter-Mansker loams, 1-3%	VVI s			37	Hardlands
Va	Vernon clay loam	VI s			37	Hardlands
Aa	Apache stony clay loam	VI s			26	Stony loam
Ta	Travessilla stony loam	VI s			26	Stony loam
Rf	Rough stony land	VIII s			28	Breaks

*Parts of these areas are wet only about 6 out of 20 years. On site determination will be needed in each case.

C = productivity rating for cropland.

R = productivity rating for rangeland.

Source: United States Department of Agriculture Soil Survey, Cimarron County, Oklahoma, Washington D. C., June, 1960.

APPENDIX TABLE II

HIGH PLAINS LAND RESOURCE AREAS LAND CAPABILITY CLASSIFICATION, RANGE SITES, AND PRODUCTIVITY RATING

Texas County, Oklahoma

Map Symbol	Soil Name	Capability Unit Dryland	Capability Unit Irrigated	Productivity Rating C	Productivity Rating R	Range Site
Rf	Richfield fine sandy loam	III e	II e	100		Sandy plains
Rt	Richfield loam thick surface	III c	I	100		Hardlands
DaA	Dalhart fine sandy loam, 0-1%	III e	II e	97		Sandy plains
Rc	Richfield clay loam	III c	I	87		Hardlands
DaB	Dalhart fine sandy loam, 1-3%	III e	II e	87		Sandy plains
Sp	Spur soils	III c	I	87		Loamy bottomland
DuA	Dalhart-Ulysses loams, 0-1%	III e	I	86		Hardlands
Bp	Bippus clay loam	III e	II e	73		Hardlands
Pm	Pullman clay loam	III e	II e	73		Hardlands
UcA	Ulysses clay loam, 0-1%	III a	I	73		Hardlands
DuB	Dalhart-Ulysses loams, 1-3%	III e	II e	68		Hardlands
UcB	Ulysses clay loam, 1-3%	III e	II e	68		Hardlands
WwB	Woodward loam, 1-3%	III e	III e	68		Hardlands
Lo	Lofton clay loam - low areas	III w	III w	68		Hardlands
DsB	Dalhart loamy fine sand, 0-3%	IV e	III e	65		Deep sand
DuC	Dalhart-Ulysses loams, 3-5%	IV e	III e	65		Hardlands
BeB	Berthoud loam, 1-3%	III e	II e	61		Hardlands
BcC	Berthoud loam, 3-5%	IV e	III e	61		Hardlands
Ba	Bayard fine sandy loam	III e	II e	55		Loamy bottomland
MaB	Mansker clay loam, 0-3%	IV c	III e	55		Hardlands
Ot	Otero fine sandy loam	IV e	III e	53		Limy sandy plains
Sw	Sweetwater soils	VW*			100	Subirrigated
Ln	Lincoln soils	VI s			76	Sandy bottomland
Ov	Otero - vona fine sandy loam	VI e			52	Limy sandy plains
VoB	Vona-loamy fine sand, 0-3%	VI e			52	Deep sand
Voe	Vona-loamy fine sand, 3-8%	VI e			52	Deep sand
Vp	Vona-Otero-Potter soils	VI e			52	Deep sand and shallow
Mp	Mansker-Potter (complex)	VI e			48	Hardland and shallow
Ra	Randall clay	VIII			48	Hardlands
MaC	Mansker clay loam, 3-5%	VI e			48	Hardlands
Tv	Tivoli fine sand	VIII e			40	Dunes
MaC4	Mansker soils, severely eroded	VI e			30	Shallow
Pt	Potter soils	VI s			30	Shallow
Ve	Vernon loams	VI s			30	Shallow

*Parts of these areas are wet only 6 out of 20 years. On site determination will be needed in each case.

C = productivity rating for cropland.

R = productivity rating for rangeland.

Source: United States Department of Agriculture Soil Survey, Texas County, Oklahoma, Washington D. C. July, 1961.

APPENDIX TABLE III

RELATIONSHIP OF PERCENTAGE WHEAT ALLOTMENTS TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Percentage Wheat Allotments			
	0-20	21-30	31-40	41-50
Number of transactions	39	11	6	12
Average price per acre	$138.75	$139.75	$143.25	$176.00
Average acres per tract	165	160	157	154
Average per cent wheat allotments	6	29	37	96
Average acres wheat allotments	10	46	59	147
Average acres of feedgrain base	61	76	26	27
Average acres of allotments	71	122	85	174
Feedgrain base as per cent of all land	37	48	17	17
All allotments as per cent of all land	43	77	54	113
Average acres of cropland	71	122	142	112
Cropland as per cent of all land	43	76	90	73
Average productivity rating	78	80	84	91

APPENDIX TABLE IV

RELATIONSHIP OF PERCENTAGE FEEDGRAIN ALLOTMENTS TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Percentage Feedgrain Allotments		
	0-69	70-89	90-100
Number of transactions	52	10	6
Average price per acre	$137.00	$152.25	$196.50
Average acres per tract	161	157	160
Feedgrain base as per cent of all land	19	58	96
Average acres wheat allotments	38	32	5
Average acres of feedgrain base	31	91	154
Average acres of allotments	69	123	159
Wheat allotments as per cent of all land	24	21	3
Allotments as per cent of all land	43	79	99
Average acres of cropland	78	130	159
Cropland as per cent of all land	49	83	99
Average productivity rating	79	89	92

APPENDIX TABLE V

RELATIONSHIP OF DISTANCE FROM STATE HIGHWAY TO SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Distance to State Highway			
	0.0-2.0	2.5-5.0	5.5-10	Greater than 10.0
Number of transactions	31	12	12	13
Average price per acre	$139.25	$178.75	$156.50	$126.00
Average distance from operations	0.8	3.6	8.2	11.5
Average acres per tract	156	159	159	160
Average acres wheat allotments	39	38	23	16
Average acres feedgrain base	31	63	90	65
Average acres of allotments	70	101	113	81
Wheat allotments as per cent of all land	25	24	14	10
Feedgrain base as per cent of all land	21	40	57	41
All allotments as per cent of all land	46	64	71	51
Average acres of cropland	73	100	113	84
Cropland as per cent of all land	47	63	71	53
Average productivity rating	83	90	81	68

APPENDIX TABLE VI

RELATIONSHIP OF DISTANCE TO MARKET AND SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Miles to Market			
	0.0-3.0	3.5-5.0	5.5-7.0	Greater than 7.0
Number of transactions	14	17	4	33
Average price per acre	$140.75	$138.25	$149.00	$150.00
Average distance to market	2.14	4.20	6.87	11.93
Average acres per tract	154	158	160	164
Average acres wheat allotments	37	34	21	26
Average acres feedgrain base	25	49	47	74
Average acres of allotments	62	83	69	101
Wheat allotments as per cent of all land	25	22	14	16
Feedgrain base as per cent of all land	16	31	29	45
All allotments as per cent of all land	41	53	43	61
Average acres of cropland	76	87	115	101
Cropland as per cent of all land	49	55	72	61
Average productivity rating	80	80	86	82

APPENDIX TABLE VII

RELATIONSHIP OF DISTANCE TO PAVEMENT AND SELECTED FACTORS FOR 68 TRACTS, SCHOOL LAND SALES, CIMARRON AND TEXAS COUNTIES, OKLAHOMA, DECEMBER, 1965

	Miles to Pavement			
	0.0	0.5–1.5	2.0–3.5	Greater than 3.5
Number of transactions	20	23	17	8
Average price per acre	$141.00	$131.25	$163.75	$147.50
Average distance to pavement	0	.69	2.44	5.18
Average acres per tract	156	159	167	160
Average acres wheat allotments	38	31	33	18
Average acres feedgrain base	39	46	90	45
Average acres allotments	77	77	123	63
Wheat allotments as per cent of all land	24	19	19	11
Feedgrain base as per cent of all land	25	29	54	28
All allotments as per cent of all land	49	48	73	39
Average acres of cropland	86	86	125	63
Cropland as per cent of all land	55	54	74	39
Average productivity rating	80	81	89	65

VITA

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