AN ECONOMIC EVALUATION OF FARMLAND FOR TAX ASSESSMENT, TULSA COUNTY, OKLAHOMA

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INTRODUCTION

The Nature of the Problem

The general property tax is the most important source of revenue for county, city, and school district operation. For example, during the 1961 fiscal year, more than 150 million dollars were collected in general property taxes in the state of Oklahoma, of which more than 53 percent was attributed to real property.[1]

In view of the significance of real property in the tax structure of local units of government, it is of utmost importance that real property be carefully and equitably assessed. It is important for two reasons: (1) so that sufficient revenue is obtained to carry on the functions of local government, and (2) so that each property owner bears his fair burden of real property taxation.

The amount of revenue to be collected locally by means of the property tax is obtained by estimating the total expenditure for the taxing district minus the revenue available from other sources. The

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[1]This tax revenue estimate is based on estimated Mill Rate of 60, which is levied against net assessment value of real property as reported in the Fifteenth Biennial Report of the Oklahoma Tax Commission, July 1, 1960 to June 30, 1962, Oklahoma City, Oklahoma.

net amount to be collected is "spread" against the assessed value in the district and constitutes a tax levy. The total levy expressed as a percent of the assessed taxable value becomes the tax rate which is designated in terms of mills per dollar of value. Thus a 50 mill tax rate is equivalent to a five percent tax on each dollar of assessed taxable property value. The property tax is a residual type levy which produces a large and dependable source of revenue especially adapted to the needs of the local taxing district.

Since the tax on real property is based on the assessed value of that property, it is important that there be a systematic way of assessment. In the absence of standard assessment techniques, a great deal of subjectivity necessarily is introduced into assessment values which, in turn, may lead to inconsistent assessment rates. Therefore, if a systematic and objective method of assessing the value of real property could be devised, it would greatly assist tax assessors in their effort to evaluate all properties equitably.[2]

Oklahoma legislators have recognized the assessment problems which face county assessors. One of the statutory duties which has been assigned to the State Tax Commission is "...to confer with, and provide technical assistance to county assessors and County Boards of Equilization to the end that all property in Oklahoma may be uniformly

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[2]For the purpose of this study, the word equity is used in a relative sense and not in absolute terms. The task of the assessor would be one of minimizing the deviations between the assessment values of comparable properties. The achievement of equitable assessment in an absolute sense does not seem to be possible, mainly because of the high degree of subjectivity of the assessment process. While the assessor is able to measure objectively the impact of certain factors (soil productivity, location, etc.) on real property values, he has no means for estimating the impact on value of other factors (sites, community, etc.).

assessed."[3] Nevertheless, it is known that properties are not assessed uniformly in the State of Oklahoma.[4] Therefore, this study proposes to develop an analytical framework for examining problems of farmland assessment in one county of the state, Tulsa.

Tulsa County was selected for study because of the complicated problems facing assessors in assessing real property in the expanding rural-urban fringe areas around large metropolitan areas, such as the City of Tulsa.[5] For instance, a parcel of farmland which lies near an active business center may be sold for development purposes; consequently, the per acre market price may be relatively high. Next to this land there may be another tract identical in its locational characteristics, but differing in some other respects. How then will the assessor assess these two properties? Should he base his assessment on the market price of the property which is sold, knowing these properties are not exactly identical? If he bases the assessment on the apparent market value he may place a severe tax burden on one property relative to the other. Therefore, the assessor must identify factors which determine the land price before being able to assign comparable assessment values on these two properties.

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[3]The Fifteenth Biennial Report of the Oklahoma Tax Commission, p. 128.

[4]Oklahoma Tax Commission <u>Real Estate Ratio Study</u> (Oklahoma City, 1961).

[5]Personal interview of Tulsa County Assessor Glen Thompson, June, 1962.

If it be assumed that the assessor can uniformly assess properties having a known market value, then his problem is to estimate a market value for unsold tracts. Therefore, the main objectives of this study are: (1) to determine whether uniform assessment of farm real estate prevails in Tulsa County on properties which have a known market value, and (2) to examine the characteristics of rural properties in the county to see whether they have common attributes of value which can be measured in terms of dollars.

Selection of the Appraisal Technique

Several alternative appraisal methods are available to real estate assessors in assigning value to real properties. The three most widely used appraisal techniques are:

1. Replacement cost method,[6]
2. Income capitalization approach,[7] and
3. Market comparison, or so-called market data approach.

In some instances, the first method is applied to the improvements and combines with the second method in estimating the market value of a farm unit. The income capitalization approach may be used in estimating the market value of unimproved farmland. The market comparison approach is used to assign values to comparable tracts of farmland, assuming that some tracts have recently been sold.

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[6]Paul F. Wendt, Real Estate Appraisal (New York, 1956), pp. 218-229.

[7]Alfred A. Ring, The Valuation of Real Estate (Englewood Cliffs, New Jersey, 1963), pp. 109 and 229.

Of the above three alternative appraisal techniques it would appear that the market value approach is most compatible with Oklahoma state tax laws. The Oklahoma real estate tax code requires the county assessor to assess taxable real property at its fair cash market value.[8] Therefore, it is logical to select the market comparison technique as a possible means for assessing farmland in Tulsa County.

The Market Comparison Approach to Value

The market comparison approach "...permits the establishment of values of real estate by reference to actual sales of a subject property or of a comparable property."[9] However, one of the main shortcomings of this technique is the lack of sufficient number of recent bona fide sales of farm tracts to be representative of a given farming region (county, township, etc.). In this case, it is necessary to use sales of previous periods and to make adjustments for changes in land value that may have occurred through time. The sales price which a property commands is valid only for one point in time. At some other points in time this price may be quite different.

The use of actual market prices of sold farm tracts in assessing unsold tracts seems to be a realistic approach to the determination of land value, provided the assessor is able to measure the attributes of market price in a satisfactory manner. Market data can be collected

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[8] Oklahoma Tax Commission, Oklahoma Ad Valorem and Intangible Personal Property Tax Laws (Oklahoma City, 1960), p. 8.

[9] Wendt, p. 254.

fairly easily from the County Clerk's real estate transaction books. Market values may encompass some of the factors used in the income capitalization approach to value; namely, soil productivity and/or the income producing capability of the soil.

The County Assessor would be able to assess all the farmland in Tulsa County equitably given the per acre market price of each parcel of land and assuming that he applies a constant assessment rate to all the farmland within his jurisdiction.

But as not all farmland is sold annually, it is necessary to estimate the market value of those parcels of real estate which have not been sold and to do this accurately if all are to be assessed equitably. In this study, the market data approach will be used, with some modification, for estimating the probable market price of unsold farm tracts in attempting to arrive at a relatively comparable value for comparable properties. Then, the application of a constant assessment rate to all tracts will result in an equitable burden of property taxation.

It is hypothesized that the income producing capacity and the location of farmland are the two major determinants of per acre market price at any given point in time.

The income producing capacity of farmland is assumed to be a function of its physical productivity rating. Therefore, if all tracts are rated for productivity, one should be able to determine relative income producing capacity. Under the rating system used here, tracts vary from a rating of 4 to a rating of 10. The lower the number, the higher the productivity. The tract with a lower rating would be expected to sell for more than one with a higher rating, ceteris paribus.[10] Similarly, two parcels of farmland are expected to differ in price if one is more suitably located with respect to business centers, roads, etc., than another tract of land, other things equal.

Real Property as a Source of Revenue for Local Units of Government

On the average, more than 50 percent of the total general property tax may be attributed to real property (Tables I and II). This percentage has remained fairly constant over the past 15 years. The proportion of the tax base that was real property rose from 50.8 percent in 1949 to 54.4 percent in 1962, an increase of only 3.6 percent. This not only indicates that real property is a reliable tax base for local governments, but that its importance has been slowly, but steadily increasing.

Although the relative proportions of classes of property included in the tax base have not changed significantly, the increase in the total value of assessed property between 1949 and 1962 amounted to about 80 percent. This period also saw a shift in relative importance to the tax base of urban property and rural property. The assessed value of all real property rose by nearly 95 percent, but that for rural real estate increased by only 39 percent.

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[10] The ceteris paribus conditions are outlined in Chapter III of this study.

TABLE I

NET TAXABLE ASSESSED VALUES OF REAL AND PERSONAL PROPERTY FOR SELECTED YEARS IN THE STATE OF OKLAHOMA[a]

Source of Tax	1949	1950	1957	1958	1961	1962
			(Thousands of Dollars)			
All Real and Personal Property	1,472,443.9	1,543,280.8	2,081,803.3	2,147,336.2	2,575,729.9	2,676,840.6
Farm Real Property	367,361.5	378,411.8	421,699.4	429,512.5	497,619.7	509,958.0
City Real Property	380,109.4	409,899.0	697,166.4	731,245.0	894,436.2	944,830.6
Personal Property	345,777.0	361,199.0	433,692.8	441,220.3	574,959.0	595,454.0
Public Service Property	379,196.0	393,771.0	529,244.7	545,358.4	608,715.0	626,598.0
Estimated Mill Rates[b]	40	42	52	54	60	62
Estimated Local Tax Collection	58,897.8	64,817.8	108,253.8	115,956.2	154,543.8	165,964.1

[a]This table has been adapted from biennial reports of the Oklahoma Tax Commission.

[b]These mill rates have been estimated from unpublished data compiled by Dr. Raymond D. Thomas, formerly Dean of the College of Business, Oklahoma State University, Stillwater, Oklahoma, 1956.

TABLE II

SOURCE OF TAX FOR LOCAL UNITS OF GOVERNMENT: FARM, CITY, PERSONAL, AND PUBLIC SERVICE PROPERTIES AS A PERCENT OF THE TOTAL PROPERTY TAX FOR SELECTED YEARS IN OKLAHOMA STATE[a]

Source of Tax	1949	1950	1957	1958	1961	1962
			(Percent)			
Farm Property	25.0	24.5	20.2	20.0	19.3	19.1
City Property	25.8	26.6	33.6	34.1	34.7	35.3
Personal Property	23.5	23.4	20.8	20.5	22.4	22.2
Public Service Property	25.7	25.5	25.4	25.4	23.6	23.4
	100.0	100.0	100.0	100.0	100.0	100.0

[a]Adapted from Table I.

In 1949, city and farm properties were of nearly equal importance in providing revenue to local tax districts. Each source constituted around 25 percent of the total general property tax base (Table II). However, by 1962, urban real property comprised 35 percent of the property tax base, while farm property values had declined to about 19 percent of the property base. Similarly, the importance of public service property and personal property as a source of revenue have shown some change up and down, but currently they appear to be of about equal importance in providing revenue to local governments in the state as a whole. However, the general property tax structure in Tulsa County appears to differ from the state average.

During 1961 the estimated revenue from the general property tax approached 28 million dollars in Tulsa County (Table III). Of this, more than 66 percent came from real property (Table IV). It is apparent that real property is more important as a source of tax revenue in Tulsa County than in the state as a whole. Furthermore, the importance of real property as a source of tax revenue has been growing in Tulsa County at a faster rate than in the state, an average annual increase of about 0.8 percent in the county as compared to 0.6 percent in the state (Tables I and III).

In summary, it is safe to conclude that real property is one of the most essential components of tax revenue to local units of government and is especially important in Tulsa County. Therefore, utmost care must be exercised by tax authorities and county assessors to acquaint themselves with the general pattern of each component of the general property tax base in order not only to raise adequate

TABLE III

NET TAXABLE ASSESSED VALUES OF REAL AND PERSONAL PROPERTY FOR SELECTED YEARS IN TULSA COUNTY, OKLAHOMA[a]

Source of Tax	1949	1950	1957	1958	1961	1962
			(Thousands of Dollars)			
All Real and Personal Property	189,888.6	202,342.5	368,959.4	394,707.5	463,422.6	481,613.2
Farm Real Property	10,534.3	10,610.0	16,026.2	18,352.2	25,171.8	27,205.6
City Real Property	106,840.9	114,418.8	228,866.2	244,987.2	281,157.3	292,545.4
Personal Property	39,818.5	43,394.0	69,572.6	74,078.8	89,582.0	92,626.0
Public Service Property	32,694.9	33,919.7	54,494.4	57,289.3	67,511.5	69,236.2
Estimated Mill Rates[b]	40	42	52	54	60	62
Estimated Local Tax Collection	7,595.5	8,498.4	19,185.9	21,314.2	27,805.4	29,860.0

[a]This table has been adapted from biennial reports of the Oklahoma Tax Commission.

[b]These mill rates have been estimated from unpublished data compiled by Dr. Raymond D. Thomas, formerly Dean of the College of Business, Oklahoma State University, Stillwater, Oklahoma, 1956.

TABLE IV

SOURCES OF TAX FOR LOCAL UNITS OF GOVERNMENT: FARM, CITY, PERSONAL AND PUBLIC SERVICE PROPERTIES AS A PERCENT OF THE TOTAL PROPERTY TAX FOR SELECTED YEARS IN IN TULSA COUNTY, OKLAHOMA[a]

Source of Tax	1949	1950	1957	1958	1961	1962
			(Percent)			
Farm Property	5.5	5.2	4.4	4.7	5.4	5.6
City Property	56.3	56.6	62.1	62.1	60.7	60.8
Personal Property	21.0	21.4	18.7	18.8	19.3	19.2
Public Service Property	17.2	16.8	14.8	14.4	14.6	14.4
	100.0	100.0	100.0	100.0	100.0	100.0

[a]Adapted from Table III.

revenue, but also to distribute the tax burden equitably between various components and between individuals within each component.

It is hoped that this study will contribute to a solution of the problem of equitable assessments, if inequitability does exist in Tulsa County.

CHAPTER II

REVIEW OF LITERATURE

The question of property taxation has been subject to relatively intensive investigation in recent years. A number of Experiment Station projects have been investigating the whole question of farmland taxation. Many state legislative bodies have proposed or passed amendments to present laws or have enacted new legislation regarding the assessment of farmland. Much of the legislation appears to have been directed toward the idea of applying uniform assessment rates to all real properties within a given tax district.

For this reason, there is a substantial amount of information on real property assessment practices available to assessors to aid in improving their assessment knowledge and capabilities.

Presented here is a summary of selected studies which have been conducted in the field of real estate assessment since 1950. These studies have been mainly in the area of farm real estate assessment.

In 1950 the Agricultural Experiment Station, University of Nebraska,[1] published a well organized bulletin on farm real estate

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[1]Quentin W. Lindsey, The Procedure for the Equitable Assessment of Nebraska Farm Land, Agricultural Experiment Station, University of Nebraska (Lincoln, 1950), Bul. No. 400.

assessment techniques. The principal aim of this work was to provide assessors in the state of Nebraska with a guide for assessing farm tracts objectively and uniformly. A soil classification technique was developed and used as a means for achieving the goal of uniform assessments. This technique is so designed that a certain amount of annual net return is attached to each soil type (assuming that the prices received, costs of production, and the yield are known). In this way the "actual price" per acre of farmland is estimated by capitalizing the annual net return to the land at the going market rate of interest.

The income capitalization method appears to be a useful tool for the assessor who is concerned with land where the soil producing capability is the major determinant of land price. The method, however, has serious shortcomings which may hinder its usefulness since it depends upon the assessor's understanding of the major steps involved in its application. Most assessors probably lack such technical know-how, at least initially, because, being elected officers, they are not required to show competence in appraisal. As one writer puts it, "If a qualified voter is popular enough at the polls to be elected, he is legally qualified to perform the duties of the assessor."[2] Therefore, the usefulness of the income capitalization approach may be limited in a real world situation.

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[2]Walter E. Chryst and Frank Miller, Assessment of Property For Tax Purposes in Missouri, Agricultural Experiment Station, University of Missouri (Columbia, 1952), Bul. No. 490, p. 12.

Nevertheless, the soil classification technique used in the Nebraska study may be of some assistance to the assessor in assigning uniform assessment values to comparable farm tracts.

The Agricultural Experiment Station of the University of Missouri,[3] published a bulletin on real property assessment which might be regarded as a supplementary work to the University of Nebraska publication. This study provides the assessor with a short-cut method in studying the adequacy of the present assessment practices. Simple correlation and regression techniques were used in detecting the uniformity of assessment rates between various tax districts. This technique assists the assessor in checking on and in testing the nature of the existing assessment procedures before any attempt is made to change his present assessment practices.

In December, 1953, a second bulletin was published by the University of Nebraska[4] on valuation of farmland for tax assessment purposes. This study appears to have developed a more complete technique for the attainmtent of a uniform rate of farmland assessment. This method, like its predecessor, considers income capitalization as a principal guide in assigning equitable assessment values to farmlands.

A thesis on farmland assessment, written at Iowa State University[5] in 1958, studied the reassessment of farmland in Osceola County, Iowa.

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[3]Ibid.

[4]Howard W. Ottoson, Andrew R. Andahal, and L. Burback Burbank Kristjason, Valuation of Farm Land for Tax Assessment, Agricultural Experiment Station, University of Nebraska (Lincoln, 1954), Bul. No. 427.

[5]John Dean Jansma, "Reassessment of Farm Real Estate in Osceola County, Iowa" (unpub. M.S. thesis, Iowa State College, 1958).

Actual market data were used in assigning identical values to comparable real properties. Soil productivity ratings were considered as a major determinant of the market price of farmland. Jansma's study differs from most of its predecessors in that it directly correlates the productive capability of the soil with the actual farm price. However, minor attention was given to the impact of location on land market prices. Consequently, arbitrary values were attached to the locational factors.

There are two valuable sources of information which are available to assessors; namely, Assessment Study Guide,[6] and Agricultural Rents in Theory and Practice.[7] These two publications provide a bibliography of selected readings in assessment theory and practice.

A large number of publications have been written on real estate assessment-sale ratio analysis by Agricultural Experiment Stations of various states in an attempt to investigate the adequacy of the existing assessment practices. Almost all of these studies have found lack of uniformity in assessment-sale ratios within particular counties and between counties. A selected group of such studies follows:

1. Walter E. Chryst and Frank Miller, Assessment of Property For Tax Purposes in Missouri, Agricultural Experiment Station, University of Missouri College of Agriculture, Research Bulletin No. 490 (Columbia, Missouri, 1952).

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[6]National Association of Assessing Officers, Assessment Guide (Chicago, 1955).

[7]United States Department of Agriculture, ERS, Farm Economic Division, Agricultural Rents in Theory and Practice, Miscellaneous Publication No. 901 (Washington, D. C., March, 1962).

2. W. W. Armentour and Tyler F. Haywood, *Property Tax Assessment in West Virginia*, Agricultural Experiment Station, West Virginia University, Bulletin No. 358 (Morgantown, West Virginia, March, 1953).

3. William G. Murray, *Improving Property Assessment in the Midwest*, Subcommittee on Tax Assessment of the North Central Land Tenure Committee. Issued at 207 Ag. Annex (Ames, Iowa, 1954).

4. C. C. Taylor and G. Aull, *A Practical Approach to Improving Farm Real Estate Assessment in South Carolina*, Agricultural Experiment Station, Clemson Agricultural College (Clemson, South Carolina, June, 1957).

5. Illinois Department of Revenue, Property Tax Division, *Rural Land Appraisal*, reprinted from: Real Property Assessment Manual (June, 1959).

6. Clyde St. Clergy and Floyd L. Corty, *Assessment of Rural Properties in North Central Louisiana*, Agricultural Experiment Station, Louisiana State University and Agricultural and Mechanical College, Bulletin No. 538 (March, 1961).

The above studies are similar in that they deal with the same type of problem, the lack of uniform assessment-sale ratios for real estate properties and use much the same methodology in analyzing the problem. The lack of uniformity, according to the above studies, is due to the inadequacy of present assessment techniques used by assessors and leads to inequitable distribution of the real estate tax burden among real estate owners. The major steps suggested for assessing farm land as found in the studies mentioned above are:

1. Soil classification: In this step, various soil types are classified on the basis of their agricultural income producing capacity. The higher the productivity of the soil, the larger the annual net return from this soil. The annual net return from each soil type could be capitalized at a going market rate of interest. Thus, the capitalized net return of each soil type provides the assessor with a basic value for the land. These values have been transformed into index numbers which show the income producing capacity of each soil type relative to the others.

2. Adjustments made in the basic value of farmland. Two main types of adjustments are made in estimating the actual value of farmland:

   a. Adjustment for buildings: the actual value of farmland may be affected positively or negatively by the type and condition of the buildings and improvements attached to the land. The University of Nebraska publication on assessment developed a system for building classification, by which the assessor can attach certain suitability ratings to the buildings which can be translated into dollar terms.

   b. The second major adjustment to be made is related to the location of the farmland. The above studies have developed a system of classification in attaching dollar values arbitrarily to the type of road attached to the land, distance to business centers, distance to paved roads, etc.

In all these studies, assessment-sale ratios were used in analyzing the adequacy of existing assessment procedures. Sale values were obtained from the County Clerk's records, and assessed values of the corresponding properties were obtained from the County Assessor's rolls.

Most of the above studies placed minor emphasis upon the impact of location on farmland market prices. However, a large number of articles and publications have been written on this subject.

Donald L. Wood conducted a study in analyzing the impact of location on farmland prices in Jackson County, Oklahoma.[8] The per acre price of farmland was found to positively correlate with distances from business centers and hard surface roads, and with the type of road touching the farm. His conclusions appear to have been based on highly aggregative data. Therefore, locational price differential based on this study may not provide satisfactory answers to the assessor's problems; namely, the valuation of individual tracts. Nevertheless, the results of this study show that location does have an affect on farmland prices.

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[8]Donald Lee Wood, "Land Prices As Affected by Location, Jackson County, Oklahoma" (unpub. M.S. thesis, Oklahoma State University, 1950).

An investigation similar to the above work was made by Forrest during 1951.[9] He found that per acre prices of farmland positively correlated with all-weather roads, distance to rural market, distance to urban market, and distance to metropolitan areas. Techniques utilized in this study appear to be identical to those used by Woods. However, the results obtained verify the hypothesis for which it was designed; namely, the location of farm tracts with respect to various interest points (distance to all-weather roads, business centers, etc.) influences the per acre price of farmland.

One of the most recent studies on land market price has been conducted by Scharlach and Schuh at Purdue University.[10] The authors attempted to integrate the agricultural land market with the nonfarm sectors in Indiana. The per acre market price of farmland was set as a function of the following variables:

1. Population density (persons per square mile),
2. Specified farm expenditures per acre,
3. Distance from Chicago in miles,
4. Farm wage rate in dollars,
5. Property tax rate per acre,
6. Agricultural productivity index of the soil,
7. Fertilizer applications per acre in pounds, and
8. Average size of farm in acres.

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[9] E. W. Forrest, "Location Factors Affecting Land Prices in Grady County, Oklahoma" (unpub. M.S. thesis, Oklahoma State University, 1951).

[10] W. C. Scharlach and G. E. Schuh, "The Land Market as a Link Between the Rural and Urban Sectors of the Economy," Journal of Farm Economics, Vol. XLIV (December, 1962), pp. 1406-11.

It was found that all coefficients except for fertilizer application and average size of farm were significantly different from zero at 95 percent probability level.

While the study will assist real estate appraisers in assigning per acre market price to farmlands, it may have a limited usefulness to the real estate assessor, since one of the independent variables is the very thing the assessor is trying to help establish; namely, the per acre tax rate. Furthermore, it would be difficult to collect information about per acre farm expenditures, and the amount of fertilizers used by each farmer. Even so, the Purdue study appears to emphasize the point that location and agricultural productivity of farm tracts exerts substantial impact on their market prices in the state of Indiana.

Other studies which have analyzed the impact of urban centers on farmland market prices are listed in the Appendix A.

CHAPTER III

THEORY RELEVANT TO MARKET AND ASSESSMENT VALUES OF FARMLAND

It is the duty of the county assessor to assign a value to each tract of land and to each set of buildings and improvements attached to the land. The legal guide used by assessors in evaluating property for tax purposes is found in section 15.8 of Oklahoma Ad Valorem and Intangible Personal Property Tax Laws, which states that "all taxable real property shall be assessed annually, at its fair cash value estimated at the price it would bring at a fair voluntary sale..."[1] Thus, the law establishes a common denominator (fair cash value) for assessing all properties equitably, providing the fair cash value of all taxable real estate properties can be determined. The desirability of equal treatment of tax payers is revealed in the statement that "...any officer or other person authorized to assess values or subjects for taxation, who shall commit any willful error in the performance of his duty, shall be deemed guilty of malfeasance, and upon conviction thereof shall forfeit his office and be otherwise punished as may be provided by law."[2]

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[1] Oklahoma Tax Commission, p. 8.

[2] Ibid., p. 9.

It appears that knowledge of the "fair cash value" of taxable properties is of utmost importance to the county assessor. Since value is the key word in assessing properties for tax purposes, it appears useful to study, briefly, the various meanings of value.

Implication of Value

The word "value" has many interpretations. They range all the way from the ancient connotation by the philosophers and religious men as "The True, The Beautiful, and The Good"[3] to a list of fifty-four types of value presented in McMichael's Appraising Manual.[4] The existence of numerous kinds of values are due to the multiplicity in human wants. It is stated by Professor Seilingman that "...value implies capacity to satisfy wants, there are as many kinds of values as there are classes of wants."[5]

Value as defined by William G. Murray is "...a quality of worth which has the power to satisfy human want."[6] He considers value to be "...an overall general quality of worth which exists in a thing while price is the measure of this worth in terms of money..."[7] Also,

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[3]Wendt, p. 1.

[4]Stanley L. McMichael, McMichael's Appraising Manual (Englewood Cliffs, 1951), p. 11.

[5]Edwin R. A. Seilingman, Principles of Economics (New York, 1905), p. 174.

[6]William G. Murray, Farm Appraisal (Ames, 1960), p. 3.

[7]Ibid.

he emphasizes the fact that price of an article is determined by comparison, the worth of one thing in comparison with another.

Murray goes on to classify value into two major categories, subjective and objective values.[8] He defines subjective value as the worth of a thing in the mind of an individual, while the objective value is the worth of a thing in the market which is measured by the price in dollars in a transaction between a willing buyer and a willing seller.[9]

The above explanation of the meaning of value points out the fact that the market price of a thing is the only objective measure of value which materializes itself in dollars term in the market place. Therefore, if the assessor is to make objective measurements, he must rely on market values.

For the purpose of this study, the market price of real property is considered to be a satisfactory measure of value because the market value appears to have been objectively established by the multitude of factors which affect the supply and demand of farmland.[10] Therefore, it is useful to develop an analytical framework of the demand for and the supply of farmland for the determination of per acre market values.

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[8] Ibid.

[9] Ibid., p. 304.

[10] Alfred A. King, <u>The Valuation of Real Estate</u> (Englewood Cliffs, 1963), pp. 5-6.

In order to simplify the analysis, it is necessary to make certain assumptions with relation to the subject matter at hand. These assumptions are:

1. The main criterion for land allocation among its alternative uses is the profit maximization motive.
2. There are two major sources of demand for land use; namely, the demand for land for farming and the demand for land for urban development. Only two commodities are produced in the economy, one by the urban sector and the other by the farm sector of the economy. Each of these commodities may be thought of as an aggregation of a large number of other commodities.
3. A static framework is assumed:
   a. A given state of art,
   b. Pure competition--In this case, the land is not mobile and thus cannot move to the consumers. However, the consumers have perfect knowledge of the market situation and may move to land; and
   c. Given taste and preferences.
4. Total land area, at any point in time, is fixed and uniform in quality and is either under rural or urban use.
5. A typical firm is assumed with average level of management and technology.

Supply of Farmland

The market supply of any good is defined as "...the various quantities of the good which sellers will place on the market at all alternative prices, other things equal."[11] In general, a supply curve which depicts the quantity-price relationship will be upward sloping to the right, which indicates that at higher prices, more of it will be placed on the market for sale than at lower prices.

There is a great deal of controversy among economists with respect to land's supply elasticity. Many of the classical and neoclassical economists[12] (such as Eugene Von Bohm-Bawerk, Carl Menger, Leon Walras, and J. B. Clark) followed either explicitly or implicitly Ricardo's definition of land, "The original and indestructible powers of the soil." This then became the basis for much of their theory concerning the implications of diminishing returns to land. Marshall disagreed with Ricardo by saying that the land supply was fixed in an old country but was somewhat elastic in a new country.[13] Knight regards the statement about land as a fixed resource as "utterly fallacious."[14] Indeed, George Tolley, a present day land economist, uses a perfectly elastic

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[11]Richard H. Leftwich, The Price System and Resource Allocation (New York, 1961), p. 30.

[12]G. J. Stigler, Production and Distribution Theories (New York, 1941).

[13]Alfred Marshall, Principles of Economics (New York, 1948), Chapter III.

[14]Frank Knight, Risk, Uncertainty, and Profit (Boston and New York, 1921), pp. 159-60.

supply curve for agricultural land in the United States in his analysis.[15]

Professor Tolley's definition of land is mainly concerned with the economic supply of land. He considers land to be the "original and indestructible portion" of the earth plus all the man-made elements attached and fixed to it. According to his definition, the supply of land would be highly elastic because the productive capacity could be raised through increased capital investment in land. In this case, the supply of land seems to be synonymous with the number of units of output produced by one unit of land. Furthermore, Professor Tolley's definition does not distinguish between kinds of improvements which have been fixed to or erected on the bare land (the land as defined by Ricardo). Since there is some diversity of opinions of just what is meant by the term "land," this study will consider land to be the "original and indestructible" portion of the earth plus those types of permanent man-made things which have become a part of the land, e.g., terraces. Improvements will be considered as all those man-made things erected on the soil surface, such as buildings and fences. In addition, and in order to place a definite quantitative measure on the supply of land, an acre will be used as the unit of measurement. This is more relevant as a measure than is a "productivity unit" as used by Tolley. Moreover, it is common to levy taxes on the bases of acre value rather than on the value of productivity

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[15] Iowa State University Center for Agricultural and Economic Adjustments, <u>Dynamics of Land Use - Needed Adjustments</u> (Ames, 1961), p. 318.

units because the productivity of the land is one from among a host of other factors which influence market price of farmland.

Theoretically, the physical supply of land in terms of acres is restricted, since there is a limited number of acres of land within the boundaries of a given area. Therefore, the land supply in acres for farming purposes will become completely inelastic at point A_2 (Figure 1), where all the unused land has been brought under cultivation.

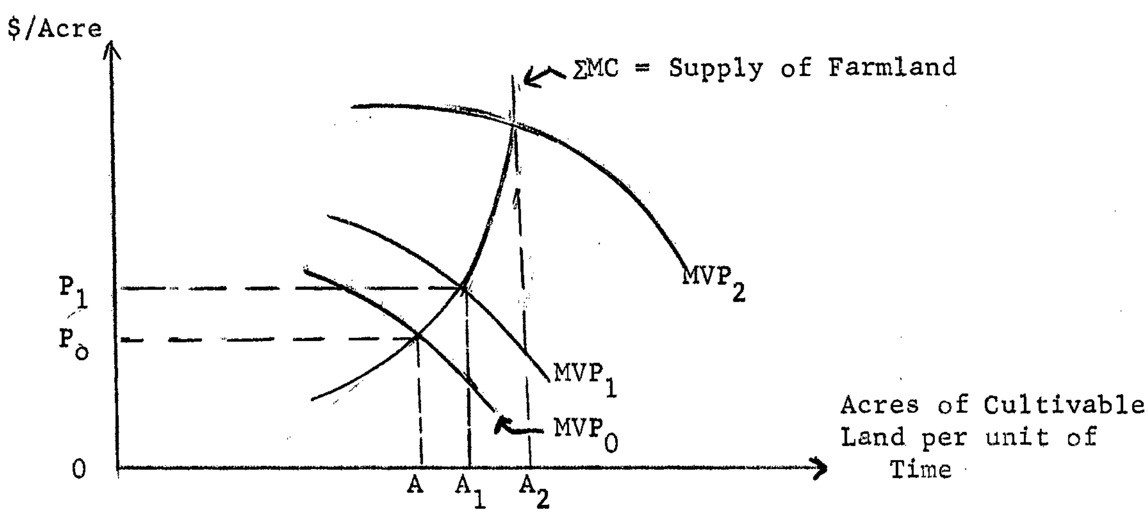

Figure 1. Hypothetical Cultivable Land Supply and Demand Curves.

It is reasonable to represent the aggregate supply schedule of usable farmland by the horizontal summation of marginal cost curves of bringing into use additional units of land (Figure 1).

An assumption that additional units of land which are brought under cultivation will cost more than the units which have been developed previously is implicit in the shape of the supply curve depicted in Figure 1. Theoretically, this assumption appears to be reasonable because land which is more suitably located and has a higher agricultural productivity is brought under cultivation prior to lower qualities of land. Similarly, the per unit cost of developing tracts of better land qualities (in terms of its agricultural productivity and locational suitability) will be lower than developing marginal or lower qualities of land. Since the marginal cost of developing additional units of undeveloped land tends to increase at an increasing rate, the supply curve is expected to take the same form.

To better understand the direction of change in the price of farmland, it is helpful to first develop the demand concept for land.

Derivation of Demand for Farmland

The demand for any good is defined as "...the various quantities of it which consumers will take off the market at all possible alternative prices, other things equal."[16] The quantities of the good which the consumers will purchase are influenced by several factors such as the price of the good, consumers' tastes and preferences, the number of consumers, etc. In addition, the demand for land will be influenced by the ability of the land to produce income and the location of the land.

It may be possible to derive a demand schedule for farmland from its production function. Theoretically, the demand schedule for land is no more than its marginal value product (MVP).[17] The marginal

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[16]Leftwich, p. 27.

[17]Ibid., pp. 284-288.

value product for land is obtained by multiplying the marginal physical product (MPP) of land times the per unit price (P_y) of the product produced (MPP x P_y = MVP), Figure 1.

The derivation of a demand schedule for farmland from its agricultural production function assumes that the total land area is utilized for agricultural production. However, there may be cases where the demand curve is not derivable from agricultural input-output relationships because some farm tracts are not used for production purposes with a view of profit maximization. Frequently farm tracts are purchased by city people with a view of enjoying what is called the quiet country life. Land speculators may bid up the price of farmland above the soil's productive capacity.

Theoretically, the demand for farmland for both agricultural and nonagricultural purposes may be established by regressing per acre price against the quantity (acres) taken off the market, per unit of time, at various price levels, ceteris paribus.

For analytical purposes, it will be assumed that all farm tracts are utilized for agricultural production in one form or another. Therefore, the horizontal summation of individual MVP curves for all farm tracts represents the aggregate demand schedule for farmland.

Interactions Between Demand For and Supply Of Farmland

The supply of land for farming purposes remains fixed as long as the MVP of land stays constant. However, when the MVP (demand curve) for land shifts from MVP_0 to MVP_1 (Figure 1), the per unit price of land tends to increase from P_0 to P_1. Consequently, the quantities (acres) of land available for farming purposes tend to increase from A to A_1 acres. Theoretically, land supply responds to price increase to the point A_2, which is the maximum limit of the land area that could be brought under cultivation. Beyond point A_2 any increase in demand for farmland can lead only to price inflation of land.

It may be useful to further explain with hypothetical examples the application of the above framework to the land market situation in Tulsa County.

Possible Explanation of the Land Market in Tulsa County

The rate of change in farmland in the United States per year does not appear to be significant,[18] however in Tulsa County, the total area in farmland has been declining since 1953.[19] The economic logic that follows will be one of per acre land price increase in Tulsa County. This is illustrated in the following graphic form (Figure 2).

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[18] Iowa State University Center for Agricultural and Economic Adjustments, p. 218.

[19] The Biennial Reports of the Oklahoma Tax Commission (1948-50, 1956-58, 1960-62).

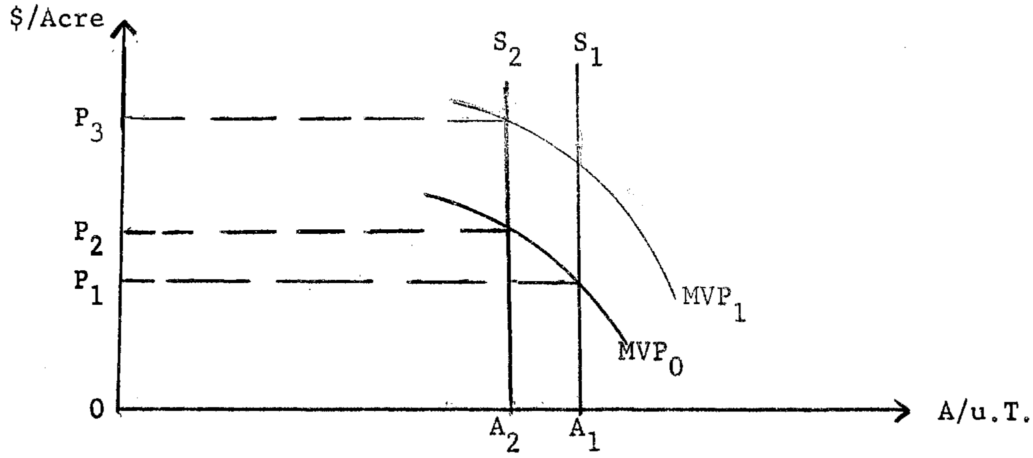

Figure 2. Hypothetical Model for Illustrating Shifts in Demand and Supply Curves for Land

The above figure suggests that through a decrease in farmland supply from A_1 acres to A_2 acres of land, the per acre price of land increases from P_1 to P_2 dollars. Under the assumption that the total land area is either in farming or in urban use, the reduction in the acreage of farmland must mean a shift from farming to urban development. The demand for farmland for urban development is a direct source of demand, while the indirect source of demand for farmland is in the increase in demand for agricultural products which may result from the population increase. A permanent increase in demand for agricultural products will shift the MVP curve of farmland upward and to the right, other things equal. When the derived demand shifts from MVP_0 to MVP_1, the per acre price tends to shift to P_3 dollars per acre (assuming S_2 is the given farmland supply). Thus, the existence of continuous increase in the population will add further upward pressure on farmland prices in addition to the pressure exerted by the direct demand for farmland. The additive pressure of these two sources of demand is much greater than either source of demand by itself.

The bidding of land away from its agricultural uses implies that the marginal value product of land must be higher in nonagricultural uses. In order to allocate land correctly between all of its alternative uses the marginal value product of land must be the same in all these uses (optimum allocation of land).

If the MVP (price) of land in urban use is originally Oq_1, which is greater than the MVP (price) of land in its farm use, then in order to achieve optimum allocation of land among its alternative uses, the MVP of land in urban use must be equated to that of its farm use (Figure 3). The MVP of land in farm use becomes equal to MVP of land in urban use at OP_2 (equilibrium point for optimum allocation of land in order to maximize profit).

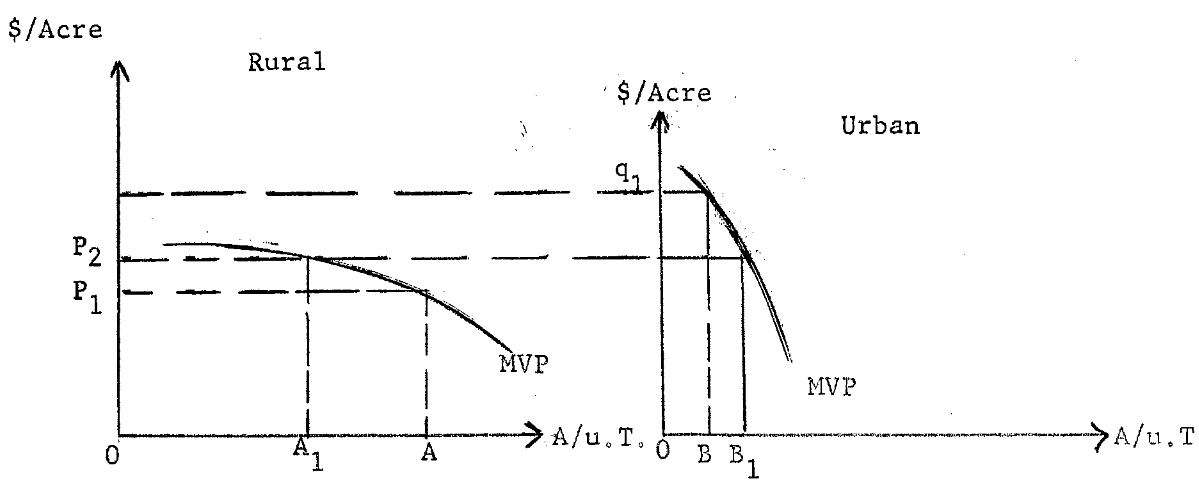

Figure 3. Hypothetical Model for Land Allocation Between Urban and Rural Uses

It appears logical to assume a somewhat elastic demand for land used in agriculture relative to the land used for urban purposes (Figure 3). This is mainly because of the nature of the way land used in agriculture as related to urban land use. Land used by the urban sector of the economy is a small portion of the total land area in Tulsa County. Any change in land value for farm uses may have little effect on demand for land by the urban sector. On the other hand, a small downward change in price per acre of farmland leads to a large increase in the quantity (acres) of land demanded for agricultural uses. The nature of land use for both farming and urban development is subject to fixity. This is more evident in urban land use than is the case in agriculture. It will be very costly, if not impossible, to convert urban land back to agricultural land after it has been adopted for urban use. Additional units of land used by the urban sector of the economy will be profitable if the marginal value product of land exceeds its acquisition price. However, when the marginal value product of land in urban use falls below its salvage price it will be economical to dispose of the land to the farm sector. In such a case, the salvage price of land may be practically zero, because of the high cost involved in converting urban land to farmland. It is possible that the cost of converting urban land to farmland would exceed the per acre price of existing farmland. In this case such land remains unused. The above case is unrealistic because if the price of land is low, the urban landowners may hold land for speculative purposes. Furthermore, the above case assumes a single use for land in either the rural or urban sector of the economy when, in reality, there are a large number of alternative uses for land within each sector. Whenever the MVP of land in one use falls to the level of salvage price or below salvage price, there will always be some other use for land where the MVP exceeds the salvage price.

The importance of the above framework is that it shows the overall picture of land utilization in two of its major uses. However, by so doing, an heroic assumption has been made. (It has been assumed that all lands in Tulsa County are uniform with respect to their quality and their locational advantages.) It is possible to overcome the problems created by making the above assumptions. This framework could be applied to a uniform soil quality which has the same locational advantages. In this case, Tulsa County can be divided into smaller areas (townships, school districts, etc.) and then apply the model for explaining land use behavior in the county.

Other Factors Affecting Land Prices

In addition to the effects of population change, there are a host of other factors which influence the land price. For instance, additional demand for farmland may arise from the existence of uneconomic sized farm units. Some farms may have more equipment than is required for the existing acreage. Consequently, the entrepreneur can see more profit if he could add additional acres to his farm. For example: Assume that a farmer operated 120 acres of land with a net revenue of \$40.00 per acre over the variable cost and has a nonland fixed cost of \$10.00 per acre. In this case, the imputed return to the land is \$30.00 per acre. Based on a five percent discount rate, he could pay $\frac{30}{.05}$ = \$600.00 per acre for the land which is already under cultivation. However, suppose this entrepreneur has sufficient fixed assets for operating an additional 30 acres of land upon which his marginal machinery and other overhead fixed costs approached zero.

In this case, the net return to the added 30 acres would be $40.00 per acre. Based on the same discount rate (.05), the farmer could pay $\frac{40}{.05}$ = $800.00 per acre for the additional land; a further upward pressure on land prices.

Furthermore, if all the other factors are held constant except the soil producing capacity, the higher the productivity of the land, the higher the per acre value of this land would be. Similarly, the closer a given tract of land is to the marketing center, the higher the per acre value this land will have, other things being equal.

The reason for paying a higher price per acre for land with a higher productivity is the fact that net revenue from farmland will be higher for the more productive land assuming the same production costs per acre. Similarly, the closer a parcel of land is to the town, the lower, theoretically, would be the transportation and marketing costs. In addition, when a parcel of land is close to a business center, land speculation for urban use tends to exert an upward pressure on land price. Consequently, the value of land which lies near business centers is not only affected by its agricultural value, but also by other demand factors. Urban demand for agricultural land will vary not only with respect to its proximity to a business center, but perhaps also its direction from the center. This may be attributed to the prevalence of better business sites and better transportation facilities in a given direction. In fact, agricultural factors as value determinants will be superseded by a new set of factors which might be completely different from those of agricultural value determinants.

It is safe to conclude that the price of farmland is not determined by one or two specific market forces, but by a host of market forces, each of which has different degrees of impact on the price of farmland. The impact of some factors may be greater than others, depending on the time and the place. It is difficult to quantify the impact of some of the market forces (variables), such as speculation in land market, on the price of farmland.

The present land use may not justify its market price. For example, suppose there is a county where most of the land is presently in farming. If this county is undergoing a rapid expansion in the urban sector, and is undergoing rapid land development, the price being paid for land very often is higher than its agricultural productivity would justify.

Classification of Farmland Market Price Determinants

We have seen that the market price of a given quality of land is determined by two major groups of factors; namely, those which affect the supply and those which affect the demand for land. The total supply of farmland in Tulsa County is assumed to be constant and known, and land changes hands in response to the prices offered for it. As mentioned earlier, however, all land in the county is not the same, and the supply of each soil type which is placed on the market will largely depend upon the market price of that soil type. It is likely that each type of soil will have different demand and supply elasticities. Therefore, each soil type will have its own equilibrium price. Thus, the assumption made previously with regard to the prevalence of one soil type in Tulsa County does not hold in the real world. Such an assumption does serve, however, to simplify the analysis of general land price determination.

Similarly, each tract has its own unique location and differences in location may cause the per acre price of a specific tract of farmland to differ from that of any other farm tract.

For the purpose of this study, therefore, the basic attributes (soil quality, locational aspects, etc.) of any group of farm tracts are considered to be the primary determinants of land-market prices. Factors such as changes in per capita income, population, technology, etc., which were discussed earlier are called secondary determinants of farmland price. The "primary" determinants of market price of farmland are of utmost interest to us because this study is concerned with the determination of price for a specific tract of farmland. The secondary determinants of farmland price are considered as demand and supply shifters, and would be of major concern in a time series analysis.

Derivation of Aggregate Assessment Schedule for Farmland

Assuming, then, that there are certain basic concepts and factors which influence the supply of and demand for land, these same factors should influence assessment values because assessed values should be directly related to market values. The task in this section is to relate the assessment value to the sale value of farmland to see if this relationship actually does hold.

Under the assumption of uniform productivity and location of all farm tracts in Tulsa County, the demand schedule for farmland could be established by regressing various levels of price against different quantities taken off the market, ceteris paribus. The aggregate assessment schedule could then be derived from it.

Since the real property assessed value in Oklahoma State is set not to exceed 35 percent of its fair cash value, the aggregate assessment schedule must be somewhere below and to the left of its demand schedule (Figure 4).

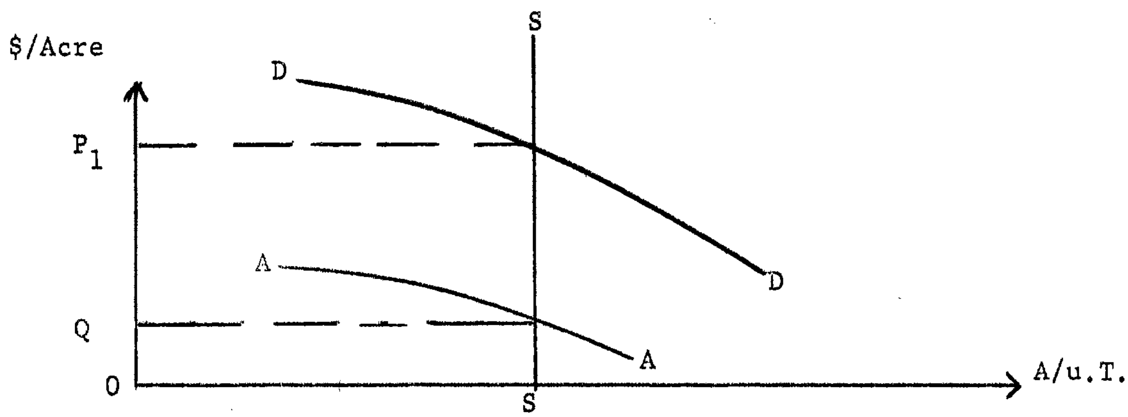

Figure 4. Hypothetical Model for Deriving Assessment Schedule from Demand Schedule for Farmland

Assuming that the demand schedule for farm real estate is DD, the derived assessment schedule would be AA. Therefore, if the aggregate supply of farmland is assumed to be SS for a given point in time, the per acre price and the per acre assessment value will be OP_1 and O_Q, respectively (Figure 4).

The land tax base may also be found by estimating the total land value in the county, which is in this case (OS x OP_1). The total tax base then is determined by multiplying the total market value of farmland by a certain rate as specified by law.

This framework provides the assessor with an overall picture of the probable tax base for a given area (county). The main weakness of the above technique lies in the assumption of a uniform quality of land in the county, and the assignment of identical values to various soil types and land locations. This practice, in fact, will result in inequitable assessment rates because each farm tract has its own unique characteristics (different soil quality and locational suitability), which will affect its market price. Therefore, in order to overcome these difficulties, a new framework must be developed to estimate the market value of each individual tract of farmland.

A Framework for Attaining Equitable Assessment Rates

In this section an attempt will be made to establish a functional relationship between price determinants and the price of farmland.

The per acre price of farmland, at any one point in time, is assumed here to be determined by its income producing capacity and its locational aspects (holding other factors constant). A soil classification technique similar to one used in bulletins cited in Chapter II of this study will be used in order to establish a productivity rating. This type of classification is identical to the establishment of a consumer index, production index, etc., which provides us with a numerical rating of each soil type relative to the other.

The locational aspects (distance to nearest business center, distance to paved road) of farm tracts can be measured in terms of miles. It is assumed that the closer a farm tract is to the business center, for example, the higher its per acre price would be, assuming other things are equal. This relationship has been shown in other studies.

The above discussion can be summarized in a functional form as follows:

$$Y = f(X_1, X_2/X_3).$$

This equation states that the price (Y) per acre of farmland is a function of its productivity (X_1) and location (X_2), holding the other factors (X_3) constant. The other factors (X_3) will include the secondary determinants of farmland prices.

It is hypothesized that the above functional relationships can be used in estimating the per acre price of each tract of farmland, and thus, accordingly, assign values to comparable tracts of farmland. Thus, by applying a constant rate of assessment-sale ratio to the properties, it will be possible to bring about equitable assessment throughout Tulsa County.

The equitable assessment rates will be achieved if, and only if, the chosen factors (land quality, locational aspects) are the relevant variables in determining market price of farmland in Tulsa County. Whether these variables do set the market price of land can be determined only by analyzing sales which have occurred.

CHAPTER IV

PROCEDURES IN COLLECTING ASSESSMENT AND SALES DATA

Criterion in Collecting Bona Fide Sales

The process of collecting land sales data, for assessment-sale ratio analysis is not as simple as it might appear. There are a large number of cases where the true values of farm tracts are not reflected in the price stated on the deed as recorded in the land transfer records.[1] Whenever transfer of a property occurs under some kind of pressure and/or "love and affection," the price, even if stated, may not be the same as it would have been in the absence of such circumstances. The determination, therefore, of what constitutes a _bona fide_ transaction which reflects land market conditions is subject to a set of qualifications before it can be regarded reliable for this type of study.

While several standards have been used in collecting _bona fide_ sales data, almost all appear to be identical with respect to their basic components. The criterion for selection of _bona fide_ sales used in this study is one which has been developed by the National

[1]This record is located in the County Clerk's office and contains facsimiles of all the deeds transferring land within the county.

Association of Tax Administrators.[2] This criterion appears to be more comprehensive than most of the others. However, it still cannot be considered as a perfect and complete guide for collecting such data. Therefore, some modification of this criterion will be made to better fit it to the present study.

Bona fide sales are defined by the association as warranty deeds or contracts for warranty deeds, which transfer property between a willing buyer and a willing seller.[3] Properties sold under the following conditions are not regarded as *bona fide* sales.[4]

1. Properties which have been transferred to or from federal, state, or county government. Even if the government apparently pays the property owner prices based on the values of identical properties which recently have transferred in the market, this price may not necessarily reflect the true value of the property.

2. Transfers which have taken place in attempt to avoid the foreclosure of a mortgage or to effect the payment of other debt to the grantee.

3. Deeds given to or by an executor, trustee of a decedent's estate, or administrator. It is believed that the price of properties which have been transferred to or by this group of transactors do not reflect the true value of the property. This belief results from the

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[2]National Association of Tax Administrators, *Guide for Assessment-Sales Ratio Studies* (Chicago, 1954).

[3]Ibid., pp. 6, 8.

[4]Ibid., pp. 6-13.

fact that this group of people may influence the market price through a direct or indirect pressure exerted by them.

4. Properties transferred between people with identical surnames, or when "love and affection" have been cited in the consideration.

5. Sales between people with different surnames, such as a transfer between father and son-in-law, if it can be determined that a fairly close relationship exists.

6. Sales between affiliated corporations.

7. Sales to nonprofit institutions. The price of the properties sold to charitable, educational, and religious institutions are subject to question. Therefore, they must be excluded from the sample.

8. Properties which have been transferred as a matter of convenience must be excluded. Frequently, this type of transaction shows only a portion of the total consideration or the revenue stamps. A husband and wife who wish to change their titleship from tenancy in common to joint tenancy, could be considered an example in this case.

9. Transfers which carry a doubtful title must be discarded, unless there is sufficient evidence to support its reliability.

10. Sales which involve reservation of essential rights must be omitted, because it is difficult to convert the reservation rights into dollars and add it to the value of the transferred rights. An example would be the sale of mineral rights or timber only.

11. Sales including personal property (Chattel). Serious difficulties may arise in translating the value of the chattels into monetary terms.

12. Exchange of properties. In this case it is difficult to estimate the total value of the property from the revenue stamps, because they show only a small portion of the total consideration.

13. Sales which convey unspecified, undivided or fractional interest in a property are excluded from the sample.

14. The transfers which involve liens and encumberances which have not been removed by the sale.

For the purpose of this study, the above criterion must be modified by adding three additional restrictions. These restrictions are as follows:

1. Improved properties are excluded from the sample. Substantial improvement might have been added to the land after it was purchased, but before assessment, consequently the assessment-sale ratio will appear to be high. Another reason for excluding improved properties is, because of the basic purpose of this study which was to develop a possible means of estimating the price of farmland based on its productivity and location.

2. The size of the transfer must not be less than ten acres. The smaller the size of the transfer, the greater the chance would be that it will be used for nonagricultural purposes.

3. Transfers which carry less than $1.65 of revenue stamps.

Neither the original nor the modified criteria can be considered as a complete or an ideal system in collecting bona fide sales data for all times and places. Fewer or additional qualifications may be needed under other circumstances.

Having formulated criteria for collecting *bona fide* sales, it was necessary to develop a procedure for collecting the data. Two principal sources of real estate transfers are available to the investigator, the record of land transfers, which is located in the County Clerk's office, and real estate brokers. The first alternative is one of the least expensive sources of data and it is available to public use. Moreover, it probably is a more complete source of data than the latter alternative. It may be convenient and useful to rely on the first alternative as a major source of data, and to use the latter in supplementing the first source.

For each *bona fide* sale, the following information is secured from deed records in the County Clerk's office:

1. The book and page number where the deed is recorded.

2. The name of the grantee and the grantor.

3. The date of the transfer. Particular attention must be focused upon distinguishing between the date of filing in the deed record and the date of the property transfer. It is necessary to remember that it is the date of transfer which must be used in analyzing the data and not the date of filing the transfers. Frequently the transferred properties are recorded at a much later date than their date of transfer. The price of a certain tract of farmland may not be the same at two different points in time.

4. The legal description. Knowledge of the legal description of a tract of land will assist an investigator in determining the number of acres transferred if it has not been cited in the deed. Furthermore, knowledge of the location of a property will assist the

researcher in estimating agricultural productivity and locational characteristics of the land.

5. If the total consideration has not been cited in the deed, it can be estimated from the revenue stamps affixed to each deed.

The law requires that 55 cents worth of revenue stamps be affixed to the deed for each transferred property which has a sale value of $100.00 to $500.00. There shall also be affixed an additional 55 cents for each additional $500.00 of value or fraction thereof. Thus, the last 55 cents of the revenue stamps may represent a range of values from one dollar to $500.00. In this case, the safest way to minimize the error in estimating the sale value would be to use the mid-point between the extremes represented by the last 55 cents worth of revenue stamps. For instance, a deed which carried $2.20 of revenue stamps will have an estimated sale value of $1,750. This value is the mid-point between the minimum value represented by the stamps, $1,501.00, and the maximum $2,000.00.

While some error may be introduced into sales data by using revenue stamps in estimating the value of the transferred properties, such errors are considered to have a minor significance. Barlowe and Limberger report that: "Three recent studies in which each sale price was verified by contact with the buyer or seller indicated that federal revenue stamps provide a reasonably accurate measure of the actual sales values of transferred properties, as long as non <u>bona fide</u>

sales are excluded and care is shown in handling of transfers that involves mortgages."[5]

Market Comparison Technique and Its Shortcomings

The market comparison approach to farmland values appears to provide a more objective way of appraising the values of farm tracts than do some other approaches. Because market values are established by a large number of economic forces in the market, utilization of techniques (income capitalization and replacement cost techniques) other than market comparison approach to value may introduce a great deal of subjectivity into the appraised values of the property. Consequently, faulty pictures of the current assessment rates may be obtained as a result of assigning inaccurate values to various farm tracts. However, the use of market data not only provides a standard for comparing the uniformity of current assessment rates, but it may also assist the appraiser in assigning comparable values to relatively identical properties.

Nevertheless, the market data approach to value appears to have at least two drawbacks. These are: (1) Lack of sufficient number of current <u>bona fide</u> sales, and (2) Whether the sold property is representative of all property. The seriousness of these pitfalls must, therefore, be analyzed with regard to their impact on the quality of the input and output data.

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[5]Raleigh Barlowe and Othmar A. Limberger, "Relationship of Tax Assessed Valuations, The Sales Value of Real Properties, Ingham County, Michigan, 1950-53" Michigan Agricultural Experiment Station, <u>Quarterly Bulletin</u>, Vol. 39 (1956), p. 150.

Lack of Bona Fide Sales

One of the major limitations of the market data approach to value is the lack of sufficient number of current *bona fide* sales. However, there seems to be but two ways of correcting for the lack of sales: Either determine the values of unsold properties through an actual detailed appraisal, or compile sales data for a period longer than one year.

The former is not only expensive, but the reliability of appraised values depends on the skill and the experience of the appraiser. The alternative method of supplementing current market data would be to use *bona fide* sales for a period longer than a year. However, the use of data for a period longer than a year may raise a new problem; namely, the year to year shifts in prices of farmland.

The latter approach was chosen for this study because it appears to be less costly and less time consuming than the former method. Not only may the shift in price be of minor importance, for short periods of time (two to three years), but it is possible to make certain adjustments to compensate for changes which do occur. Under extreme fluctuations in the farmland price, of course, the problem could become serious.

Price Adjustment Technique

The price data included in this study cover a period of three years, from January 1, 1959, to December 31, 1961. Therefore, it was necessary to adjust 1959 and 1960 farmland sales prices to the 1961 price level, before one could fairly judge the nature of assessment-sale ratios for 1962.

The Oklahoma index of farmland prices was used as a guide in adjusting past years' prices. This method was used for the lack of a better alternative when the data were collected. The price adjustment process proceeded as follows: the indices of per acre farmland prices in the state were 168, 177, and 183 (1947-49 = 100) for the years 1959, 1960, and 1961, respectively.[6] The 1961 price index was divided by the index of each of the previous two years. Thus, two new indices, 109 and 103 were obtained. All 1959 sales were adjusted upward by nine percent and 1960 sales by three percent to arrive at an estimate of what this property would have brought if it had sold one or two years later.

This technique appears to have advantages and disadvantages. The advantages of the method seem to lie in its simplicity which requires elementary mathematical knowledge, while its disadvantages lie in the fact that it reflects the per acre price change of farmland on the state and not on the county level. It is possible that the farmland price index on the county level is different from that on the state level. Further weakness of this method is that it adjusts the value equally on all tracts of farmland in the county. Consequently, it may over-adjust the price of certain types of farmland and under-adjust the others. However, the errors committed in using this technique may not be as serious as those committed by using the appraised values of farm tracts.

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[6]Economic Research Service, United States Department of Agriculture, Farm Real Estate Market Development, Bul. No. CD-61 (Washington, D. C., 1962).

Representativeness of the Sold Farm Tracts

Assuming that the price paid for farmland is based more or less on the productivity of the soil, the analysis can be strengthened by rating each tract of land for its potential agricultural productivity.

Information on soil producing capability in Tulsa County is obtainable from several sources, but for the purpose of this study, the Tulsa County soil survey manual[7] was used in establishing productivity ratings for tracts of farmland included in the sample. These ratings rank each soil according to its producing capability, as shown in Table V. The ratings range from four to ten. A soil having a grade of four rates best and one which has a grade of ten rates poorest. The table shows two types of soil classification; namely, a crop productivity index and a general productivity grade. While the general productivity grade is a broader grouping of soil types than the crop productivity index, it is believed that productivity grades will serve the purpose of this study. Although a weakness of this method seems to lie in the fact that it is too aggregative, a further breakdown in soil classes likely would have a minor impact on the quality of the data. Productivity ratings as shown in Table V were used along with a soil map for establishing the potential agricultural productivity of each tract of farmland. The hypothesis, that those tracts of farmland included in the sample are on the average representative of all tracts in Tulsa County, was verified by utilizing the general soil productivity ratings (Table V).

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[7]E. W. Knobel and O. H. Brensing, Soil Survey, Tulsa County, Oklahoma (Washington, D. C., 1942).

TABLE V

PRODUCTIVITY RATINGS OF THE SOILS OF TULSA COUNTY, OKLAHOMA[a]

Soil Names	Soil Symbols	Average Crop Productivity Index	General Productivity Grade
Brewer silty clay loam	Bs	71	4
Lonoke very fine sandy loam	Lv	70	4
Miller loam	Ml	69	4
Miller silty clay	Ms	68	4
Verdigris very fine sandy loam	Vv	67	4
Verdigris loam	Vm	65	4
Osage silty clay loam	Os	63	5
Brewer silty clay	Br	63	5
Osage silty clay	Oc	60	5
Verdigris silty clay loam	Vc	59	5
Yahola very fine sandy loam	Yv	58	5
Yahola loamy very fine sand	Yl	57	5
Stidham very fine sandy loam	Sv	57	5
Bates very fine sandy loam	Bf	56	5
Newtonia silty clay loam	Ns	53	5
Stidham fine sandy loam	Sf	53	5
Teller very fine sandy loam	Tv	53	5
Summit silty clay loam	Ss	50	5
Bates very fine sandy loam, Deep phase	Bf	56	5
Bates fine sandy loam, Deep phase	By	50	5
Bates silt loam	Ba	49	5
Fitzhugh very fine sandy loam	Fv	49	5
Newtonia fine sandy loam	Nf	45	6
Summit clay	Sc	45	6
Parson silt loam, Deep phase	Ps	43	6
Bates fine sandy loam	By	42	6
Parson silt loam	Ps	40	6
Daugherty very fine sandy loam	Dv	40	6
Cherokee very fine sandy loam	Ch	34	7
Parson silt loam, slope phase	Ps	33	7
Hanceville fine sandy loam	Hf	30	7

TABLE V (Continued)

Soil Names	Symbols	Average Crop Productivity Index	General Productivity Grade
Lightning silty clay loam	Lc	30	8
Lightning silty clay	Ls	29	8
Talihina silty clay loam	Ts	26	8
Collinsville very fine sandy loam	Cv	24	8
Stidham loamy fine sand	Sd	20	8
Collinsville stony fine sandy loam	Cs	20	9
Crawford stony loam	Cl	20	9
Denton stony clay loam	Ds	20	9
Talihina stony clay loam	Tm	20	9
Stidham fine sand	Vl	20	9
Verdigris loamy fine sand	Vl	20	9
Yahola loamy fine sand	Yf	20	9
Perry clay	Pc	20	9
Hector stony fine sandy loam	Hs	0	10
Rough stony land, Hector soil material	RsH	0	10
Rough gullied land	Rg	0	10
Riverwash	Rv	0	10
Mine dumps	X	0	10
Saline spots	S	0	10

[a]Adapted from E. W. Knobel and O. H. Brensing, Soil Survey, Tulsa County, Oklahoma (Washington, D. C., 1942).

The average productivity grade for each tract of farmland included in the sample was calculated and the weighted average of the productivity ratings for the sample was estimated. The weighted average for the sample was found to be 6.143. This average productivity grade was checked against an average productivity grade obtained in a process of random sampling.

A table of random numbers was used in drawing 10 out of approximately 17 townships of Tulsa County. Then 20 sections were selected at random from the above 10 townships. One quarter section which lies within the boundaries of Tulsa City was excluded from the sample. The weighted average of the productivity grade of these randomly drawn tracts was found to be 6.169.

In order to verify the hypothesis that there is no significant difference between the two above averages, it was assumed that the average productivity for Tulsa County obtained by random sampling was the best estimate for the county.

The chi-square test was used in verifying the above hypothesis. The calculated chi-square was found to be .001719, which is less than the tabulated chi-square, 3.84, at 95 percent probability level and one degree of freedom. On this basis, the hypothesis of no difference was not rejected.

The group comparison test was also used in verifying the same hypothesis. The calculated "t" was found to be .24055, while the tabulated "t" was 1.988 at 95 percent probability level, given degrees of freedom as 85. Thus, it was concluded that there was no basis for rejecting the hypothesis that individual observation in the selected sample were so distributed that on the average they represent all farm tracts in Tulsa County.

Procedure for Collecting Assessment Data

As mentioned in Chapter I of this study, unimproved tracts of farmland were our main concern. Accordingly, the assessed values during the year of the sale were tabulated for each bona fide sales included in the sample. An alternative approach would have been to collect the pre-transfer assessment values of the properties. The principal weakness of the first approach is the possibility that new improvements were added to the property after its transfer. The addition of a substantial amount of improvement would result in a higher assessment-sale ratio than if no improvements were added. Conversely, the weakness of the alternative approach appears to be opposite to that of the first; that is to say, the use of pre-transfer assessment values may result in a low assessment-sale ratio. The per acre price of bare land tends to rise after new improvements have been added to it. Consequently, the assessment rates will appear to be lower than if no improvements were added. In both cases, the addition or destruction of improvements to farm real estate may be detected by looking at the assessment value and its subdivision for the pre- and post-transfer years. In the case of Tulsa County, assessed values of the bare land and improvements are cited separately in the assessment rolls. Thus, by looking at the assessed values of a given property for two different periods of time, the investigator could learn of the addition or removal of improvements on the land. By acquainting oneself of this fact, such properties can be excluded from the sample. However, the main reason for using year of sale assessments was to verify the hypothesis that Tulsa County farm real estate assessors base their assessment on market prices, if such prices are available to them. This hypothesis will be examined in the next chapter.

Serious difficulties may arise in identifying transferred properties on the assessment rolls. Discrepancies may exist between the legal descriptions as found in the deed and those which are found on the assessment records. Therefore, care must be exercised in reconciling the legal description for which assessment was made to that which is found in the deed.

The total assessed value of the property includes the assessment on the bare land and that on the improvements attached to the land, such as buildings. These are shown separately in the assessment rolls. However, in this study, improved properties have been excluded, as the main concern is to analyze assessed values of bare land.

CHAPTER V

ANALYSIS OF THE ASSESSMENT DATA

Uniformity of Assessment-Sales Ratio

One of the objectives of this study was to analyze the 1962 assessment-sale ratios for Tulsa County. However, due to lack of a sufficient number of bona fide sales, it was necessary to collect assessment and sales data for each tract of farmland, which was regarded as a bona fide transfer for the period of January 1, 1959, to December 31, 1961. Only 68 transferred tracts of unimproved farmland met the sampling qualifications of this study. Accordingly, assessment-sale ratio was calculated for each parcel of farmland included in the sample. This ratio is a percentage figure which shows the relationship between assessed value and sales value.

The individual ratios were arrayed in terms of their numerical values in order to determine the median ratio of the sample.[1] The arrayed ratios began with a value of 6.26 and ended with a value of 25.5 (Table VI). The median ratio was found to be 15.10 (Table VI).

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[1]In general, the median is defined as any value which is neither greater nor less than half of the observed values. One of the features of the median is that extreme values in the distribution have no impact on the value of the median.

TABLE VI

ASSESSMENT-SALE RATIOS ARRAYED IN ASCENDING ORDER[a]

Card Number	Ratio (Percent)	Card Number	Ratio (Percent)	Card Number	Ratio (Percent)	Card Number	Ratio (Percent)	Card Number	Ratio (Percent)
66	6.26	3	13.00	17	15.00	58	15.40	24	16.40
14	6.50	5	13.00	34	15.00	36	15.60	59	16.64
64	6.94	7	13.00	47	15.00	30	15.70	57	16.90
21	7.90	2	13.10	61	15.08	54	15.70	50	17.50
11	8.00	8	13.70	37	15.10	45	15.80	39	18.20
15	9.80	62	13.80	43	15.10	56	15.80	51	18.20
38	10.50	4	13.90	48	15.10	28	15.90	1	18.30
55	10.50	19	14.00	26	15.20	29	15.90	31	22.00
20	11.00	65	14.36	35	15.20	41	16.00	40	22.20
25	11.80	32	14.40	44	15.20	42	16.00	18	24.00
6	12.00	13	14.50	49	15.20	52	16.30	60	24.84
27	12.50	33	14.60	12	15.30	53	16.30	23	25.50
9	12.60	63	14.68	22	15.30	67	16.31		
10	12.70	16	15.00	46	15.40	68	16.31	68	1009.92
								Ave.	14.85

[a]Adapted from Appendix Table D.

This suggests that unimproved farm tracts are assessed at around 15 percent of their sales value for taxation purposes. The mean ratios are summarized in a frequency distribution table in attempt to show the nature of assessment rates in the sample (Table VII). The data were divided into ten classes with equal class intervals, two, in ascending order. Class number five contains the median ratio, where about 43 percent of the observations are concentrated. Thus, based on this sample, it may be said that nearly half of the farm tracts in Tulsa County are assessed at a relatively uniform assessment rate (14 to 15.99 percent of market price). Nevertheless, more than 50 percent of the observations were assessed at rates above or below that of class number five. Even if one should consider that a range in assessment rates of 12 to 18 percent is permissable, nearly 15 percent of the properties were assessed too low and nearly 12 percent too high. This distribution can be observed more clearly in a histogram chart (Figure 5), which shows that about 26 percent of the ratios lie to the left and about 31 percent of the ratios lie to the right of class five.

Both the frequency table and the histogram show that farm tracts in Tulsa County are not assessed uniformly.

Another measure of central tendency used in this study is the mean (average) of individual ratios.[2] The average ratio was found to be

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[2]Arithmetic mean is defined as the sum of a set (n_i) of values divided by the number (n_i) in the set. One of the most important features of the mean concept is that its value is influenced by extreme values of the mean ratios in the sample.

TABLE VII

FREQUENCY DISTRIBUTION OF ASSESSMENT-SALE RATIOS[a]

Class Number	Class Intervals of Ratios	Frequency	Relative Frequency	Percent of Observations in Each Class
1	6-7.99	4	.05882	5.882
2	8-9.99	2	.02941	2.941
3	10-11.99	4	.05882	5.882
4	12-13.99	11	.16176	16.176
5	14-15.99	29	.42647	42.647
6	16-17.99	10	.14706	14.706
7	18-19.99	3	.04412	4.412
8	20-21.99	0	.00000	0.000
9	22-23.99	2	.02941	2.941
10	24-25.99	3	.04412	4.412
		68	1.00000	100.000

[a]Adapted from Table VI.

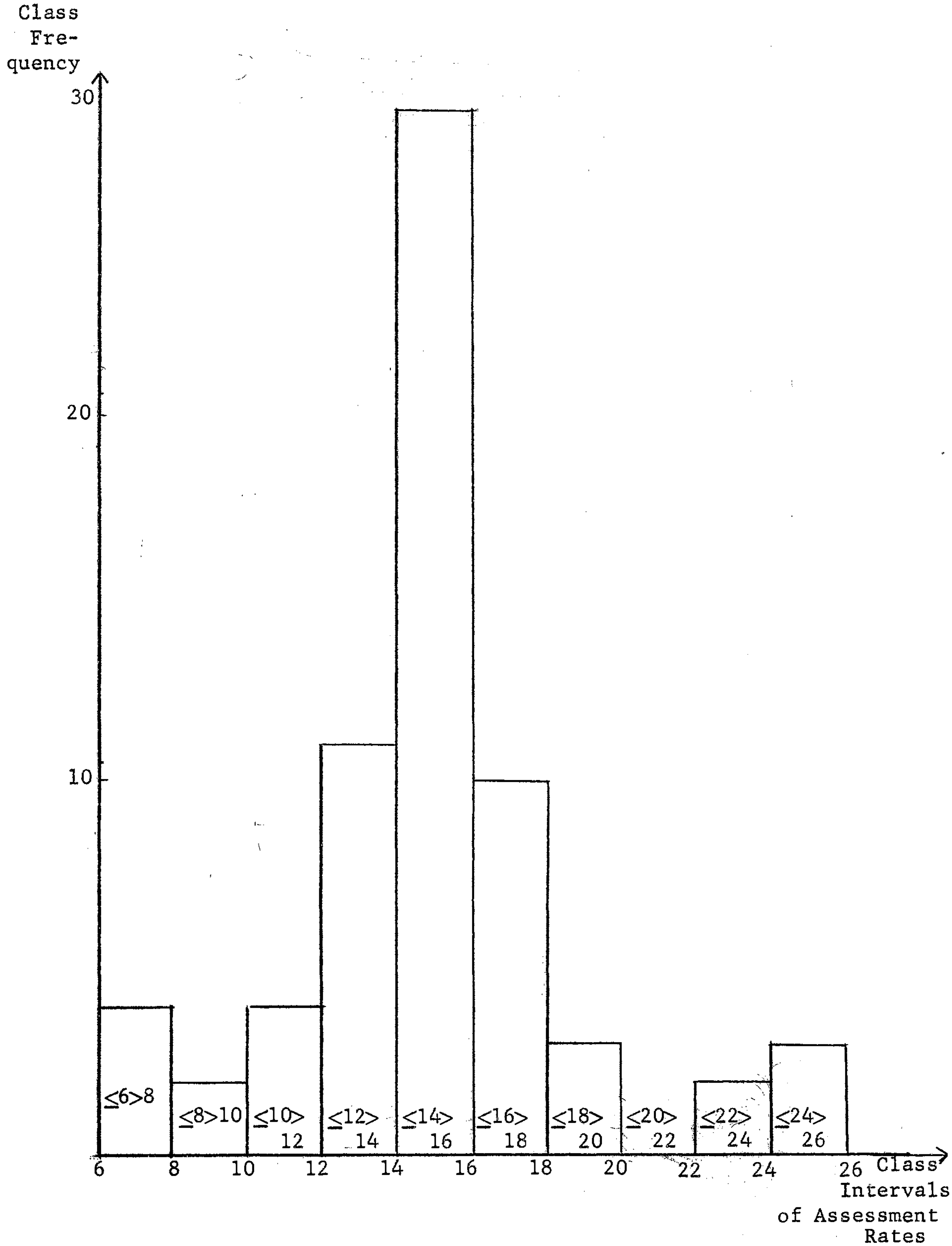

Figure 5. Frequency Distribution of Assessment Rates.

closely related to that of the median. The mean ratio is 14.85 (Table VI), as compared to 15 for the median. The difference between the median and mean ratios is small and again suggests that unimproved farm tracts in Tulsa County are assessed at a rate of about 15 percent of their market prices.

The above analysis provides an overall picture of assessment rates of farmland in Tulsa County. However, none of the above techniques explain the degree of variations between individual assessment rates. For this reason, the arrayed data of the frequency distribution table were divided into four quartiles, each of which contains an equal number of observations, 17 (Table VIII), to see if one could detect statistical significance of quartile mean ratio differences.

Each quartile was compared with every other quartile, and six quartile comparisons were made. A statistical test at 95 percent probability level was made to detect the significance of the difference between quartile means. The test showed that the mean ratio of each quartile was significantly different from every other quartile (Table IX).

The above comparisons do not provide any knowledge of the relationship between quartile mean ratio and its components. Therefore, standard deviations and coefficient of variations (coefficient of dispersion) were calculated for each quartile (Table X). It was found that quartiles 2 and 3 have very small coefficient of dispersions (about 5 and 2 percent, respectively), while quartiles 1 and 4 have relatively large coefficient of dispersion (about 23 and 18 percent, respectively). This means that individual farm tracts have been assessed more uniformly within quartiles 2 and 3 than those in quartiles 1 and 4. This suggests that corrective

TABLE VIII

CLASSIFICATION OF ASSESSMENT-SALE RATIOS BASED ON QUARTILES

Quartile 1		Quartile 2		Quartile 3		Quartile 4	
Card No.	Ratio (Percent)	Card No.	Ratio (Percent)	Card No.	Ratio (Percent)	Card No.	Ratio (Percent)
66	6.26	2	13.10	48	15.10	42	16.00
14	6.50	8	13.70	26	15.20	52	16.30
64	6.94	62	13.80	35	15.20	53	16.30
21	7.90	4	13.90	44	15.20	55	16.31
11	8.00	19	14.00	49	15.20	68	16.31
15	9.80	65	14.36	12	15.30	24	16.40
38	10.50	32	14.40	22	15.30	59	16.64
55	10.50	13	14.50	46	15.40	57	16.90
20	11.00	33	14.60	58	15.40	50	17.50
25	11.80	63	14.68	36	15.60	39	18.20
6	12.00	16	15.00	30	15.70	51	18.20
27	12.50	17	15.00	54	15.70	1	18.30
9	12.60	34	15.00	45	15.80	31	22.00
10	12.70	47	15.00	56	15.80	40	22.20
3	13.00	61	15.08	28	15.90	18	24.00
5	13.00	37	15.10	29	15.90	60	24.84
7	13.00	43	15.10	41	16.00	23	25.50
Total 17	178.00		246.32		263.70		321.90
Ave.	10.471		14.489		15.512		18.935

TABLE IX

COMPARISON OF QUARTILE MEAN RATIOS[a]

Quartiles Compared	Pooled Sum of Squares[b]	Pooled Degrees of Freedom	Calculated t value[c]	Tabulated t value at 95 Percent Probability Level	Test of Significance at 95 Percent Probability Level
Q_1-Q_2	102.322	32	6.558	2.120	Yes
Q_1-Q_3	97.953	32	8.405	2.120	Yes
Q_1-Q_4	275.831	32	8.407	2.120	Yes
Q_2-Q_3	7.285	32	21.596	2.120	Yes
Q_2-Q_4	185.163	32	5.389	2.120	Yes
Q_3-Q_4	180.794	32	4.119	2.120	Yes

[a]Adapted from Table VIII.

[b]Pooled Mean Square = $S^2 = \Sigma x^2/2\ (n-1)$

[c]$t = (\overline{R}i - \overline{R}j)/S_{\overline{x}_i - \overline{x}_j}$

where $S_{\overline{x}_i - \overline{x}_j} = \sqrt{\frac{2S^2}{n}}$; $\overline{x}_i$ is the mean of i^{th} group while $\overline{x}_j$ is the mean of the j^{th} group; n is the number of observations in the analysis.

TABLE X

QUARTILE COMPARISONS BASED ON COEFFICIENT OF VARIATION[a]

Quartile	Number of Cards	Degrees of Freedom	Corrected Sum of Squares[b]	Standard Deviation[c]	Mean Ratios ($\bar{R}$) (Percent)	Coefficient of Variation[d] (Percent)
Q_1	17	16	96.495	2.46	10.471	23.498
Q_2	17	16	5.827	0.66	14.489	4.555
Q_3	17	16	1.458	0.30	15.512	1.934
Q_4	17	16	179.336	3.35	18.935	17.692
Tulsa County ($Q_1+Q_2+Q_3+Q_4$)	68	67	902.76	3.67	14.850	24.714

[a]Adapted from Table VIII.

[b]Corrected Sum of Squares = $\Sigma x^2 = \Sigma X^2 - (X)^2/n$

[c]Standard Deviation = $\sqrt{S^2}$

where $S^2 = \Sigma x^2/n-1$.

[d]Coefficient of Variation = $\frac{S}{\bar{R}}$.

measures need to be taken by county assessors for reducing variation of assessment rates within and between quartiles.

The analysis of assessment rates based on quartile classification provides general assessment information on groups of farm tracts in Tulsa County. Quartile type analysis may assist the assessor in detecting the uniformity of assessment rates for groups and individuals within groups of farm tracts. Assessors thus will be able to locate on road and soil maps the observations of quartiles which are characterized by relatively large coefficient of dispersion, in order to study their characteristics and to bring about uniform assessment rates within and between them. It will be possible to locate individual observations on maps, if the observations are coded or numbered as in Tables VI and VIII. Each card number has been specified for individual farm tracts that have been included in the sample (Appendix Table B).

The mean standard errors were computed for each quartile mean ratio. The standard errors were found to be relatively small. They ranged from .073 to .813 (Table XI). A small value of the standard error indicates either the accuracy (representativeness) of the quartile mean ratios or it indicates a sufficient sample size or both. Confidence intervals were set about the mean of each quartile and that for the total sample data at 95 percent probability level. The confidence interval about the mean for the total sample data was found to be smallest; namely, $14.85 \pm .888$ (Table XI). This means that if repeated samples of unimproved properties were taken, on the

TABLE XI

QUARTILE MEAN STANDARD ERRORS AND CONFIDENCE INTERVALS[a]

Quartile	Quartile Mean Ratio (Percent)	Standard Error of Quartile Mean Ratio[b]	Confidence Interval About the Mean at 95 Percent Probability Level[c]
Q_1	10.471	.597	10.471 ± 1.297
Q_2	14.489	.160	14.489 ± 0.338
Q_3	15.512	.073	15.512 ± 0.154
Q_4	18.935	.813	18.935 ± 1.715
Tulsa County ($Q_1+Q_2+Q_3+Q_4$)	14.850	.445	14.850 ± 0.888

[a]Adapted from Table VIII.

[b]Standard Error of mean ratio = $S_{\overline{R}} = \frac{S}{\sqrt{n}}$

[c]Confidence Interval around the mean: $\overline{R} - t_{.05}\, S_{\overline{R}} \leq u \leq \overline{R} + t_{.05}\, S_{\overline{R}}$ where u is the true population mean.

average only five out of every 100 of them will have assessment rates which lie outside the interval $14.85 \pm .888$.

Regional Analysis of Assessment Rates

Regional analysis of assessment rates can be used as a second means of depicting variations in assessment rates within a certain county. It is possible that farm tracts within certain areas in Tulsa County have been assessed more uniformly than in others. The detection of such cases may guide the county assessor in bringing about assessment uniformity within and between regions of a given county. This technique appears to be a more useful approach than quartile analysis in comparing assessment rates within a county. Quartile analysis provides information on group observations. Observations within quartiles may be distributed throughout the county, while in regional analysis, observations lie within a specific region. Therefore, in quartile analysis, the assessor tends to study characteristics of individual observations, while in regional analysis the assessor will be able to conduct regional study to bring about uniform assessment rates. Thus, regional assessment analysis appears to be a time and capital saving technique in bringing about uniform assessment rates. For this reason, Tulsa County was divided into three regions; namely:

1. Region I. This region covers the southern sector of Tulsa County. It extends from Township 16 north through Township 17 north.

2. Region II. This region comprises the central portion of the county. It covers Townships 18 through Township 20 north.

3. Region III. This region covers the northern townships of Tulsa County; namely, Townships 21 and 22 north.

The above regional classification is based on the differences in the size of the cities which are located in the several areas and on land use. The size of the cities in the southern region ranges from 353 to 1,711 people; in the central region, from 1,734 to 261,685 people; and in the northern region, 883 to 2,526 people (based on 1961 United States Census).

The southern region appears to be characterized by truck farming, while farms in the northern region tends toward beef cattle programs. The central region, on the other hand, appears to be under a large scale urban land development program, especially the area which lies between the cities of Tulsa, Broken Arrow, and Jenks.

On the average, farm tracts are assessed at about 16, 14, and 15 percent of their sale values in southern, central, and northern regions, respectively (Table XII). It will be noted that farm tracts were assessed at the lowest rate in the central region and at the highest rate in the southern region. Thus, the simple average ratios show that the assessment rate applied to farmland differs in each region. However, when the mean ratio of each region was compared with that of other regions (Table XIII) they were not found to be significantly

TABLE XII

REGIONAL COMPARISON OF ASSESSMENT-SALE RATIOS[a]

Southern Region (I)		Central Region (II)		Northern Region (III)	
Card No.	Ratio (Percent)	Card No.	Ratio (Percent)	Card No.	Ratio (Percent)
1	18.30	4	13.90	9	12.60
2	13.10	5	13.00	10	12.70
3	13.00	6	12.00	11	8.00
12	15.30	7	13.00	15	9.80
13	14.50	8	13.70	21	7.90
16	15.00	14	6.50	23	25.50
18	24.00	17	15.00	24	16.40
19	14.00	20	11.00	27	12.50
28	15.90	22	15.30	31	22.00
30	15.70	25	11.80	32	14.40
36	15.60	26	15.20	33	14.60
38	10.50	29	15.90	41	16.00
39	18.20	34	15.00	42	16.00
40	22.20	35	15.20	44	15.20
45	15.80	37	15.10	48	15.10
55	10.50	43	15.10	49	15.20
56	15.80	46	15.40	50	17.50
57	16.90	47	15.00	51	18.20
58	15.40	54	15.70	52	16.30
59	16.64			53	16.30
60	24.84			65	14.36
61	15.08	19	262.80	66	6.26
62	13.80			67	16.31
63	14.68		13.83	68	16.31
64	6.94				
25	391.68			24	355.44
	15.67				14.79

[a]Adapted from Appendix Table D.

TABLE XIII

COMPARISON OF REGIONAL MEAN RATIOS[a]

Regions Compared	Pooled Sum of Squares	Pooled Degrees Of Freedom	Calculated t Value[b]	Tabulated t Value at 50%	Tabulated t Value at 95%	Test of Significance 50%	Test of Significance 95%
I and II	459.130	42	1.829	.681	2.016	Yes	No
I and III	774.829	47	.759	.680	2.013	Yes	No
II and III	503.901	41	.904	.681	2.023	Yes	No

[a]This table has been adapted from the data of Table XII.

[b]Calculation of t value for groups with different numbers of observations:

$$t = (\overline{R}_i - \overline{R}_j) \sqrt{\frac{n_i n_j \ (n_i + n_j - 2)}{(n_i + n_j) \ \Sigma \ x^2}}$$

where:

n_i = number of observations in group i^{th}

n_j = number of observations in group j^{th}

$\overline{R}_i$ = mean ratio of group i^{th}

$\overline{R}_j$ = mean ratio of group j^{th}

Σx^2 = corrected pool sum of squares for groups i^{th} and j^{th}.

different at 95 percent of probability level.[3] This means that, on the average, farm tracts are assessed uniformly among the three Tulsa County regions. Regional average assessment rate comparisons, however, do not show whether individual assessment rates vary within each region; therefore, it was necessary to calculate the coefficient of variation (dispersion) for each region. The coefficients of variation were found to be about 25, 17, and 29 percent of their mean ratios in the southern, central, and northern regions, respectively (Table XIV). Thus, it can be seen that farm tracts are assessed least uniformly in the northern region and most uniformly in the central region. Moreover, the coefficient of dispersion for the county was found to be about 25 percent, which suggests that farmlands have been assessed at different assessment rates throughout Tulsa County. The above conclusion can further be supported by testing the statistical significance of differences among individual assessment rates. The calculated t-value was found to be 33.371 as compared to the tabulated t-value, 1.995, at 95 percent probability level. This suggests that statistically significant difference prevails among individual assessment rates.

The above analysis revealed that although the assessment rates are not significantly different between regions, they differ significantly among individual observations.

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[3]Group comparison test was used in comparing regional mean ratios. (See: George W. Snedecor, Statistical Methods (Iowa State University, 1957), pp. 84-101.

TABLE XIV

REGIONAL COMPARISON OF ASSESSMENT-SALE RATIO BASED ON COEFFICIENT OF VARIATION[a]

Region	Number of Cards	Degrees of Freedom	Corrected Sum of Squares	Standard Deviation	Mean Ratio ($\bar{R}$) (Percent)	Coefficient of Variation (Percent)
I	25	24	365.029	3.90	15.67	24.90
II	19	18	94.101	2.29	13.83	16.56
III	24	23	409.800	4.21	14.79	28.60
Tulsa County	68	67	902.373	3.67	14.85	24.714

[a]This table has been adapted from the data of Table XII.

Procedures Used in Detecting Current Assessment Criterion In Tulsa County, Oklahoma

In order to better understand prevailing farmland assessment practices, it is helpful to know the assessment criteria which have been used by county assessors. The two most widely used criteria are the market value (market price) and the agricultural value of land. The agricultural value of a tract of farmland is reflected in its productivity ratings (soil productivity grade). Theoretically, the higher the soil productivity of a tract of land, the higher its agricultural value, ceteris paribus. Therefore, in order to attain uniform assessment rates of farmland, it is necessary to assign relatively high assessment values to tracts of higher ratings than to those of lower soil productivity ratings. It is probable that Tulsa County real estate assessors have used the agricultural value of farmland as one guide in establishing a common denominator in assessing farm tracts. For this reason, this study explored the possibility of determining relationships between assessment values of farm tracts and their agricultural productivities.

The first step was to correlate the per acre assessed values with the productivity grades for the total sample data. The correlation coefficient was found to be -.167. This coefficient appears to be logically consistent because the negative correlation shows that the higher the soil productivity, the lower would be its numerical value, and thus the higher its average assessed value.[4] This coefficient is statistically significant at 95 percent probability level. However, the numerical value of the coefficient appears to be relatively small which implies the existence of weak relationships between productivity of farmland and its average assessment value.[5]

Due to the fact that a low correlation existed between per acre assessed values of farmland and the average productivity grades on the county level, the question arose of a possible relationship between productivity grades and the average assessed values of farmland on a regional basis.[6] Accordingly, correlation coefficients were calculated and found to be -.554 for Region I; -.027 for Region II; and -.264 for Region III. The correlation coefficient of Region I is statistically significant, while those of regions II and III were not significant at 95 percent probability level. Thus, the existence of strong correlation in Region I appears to favorably affect the test of significance on a county wide basis. Therefore, it is possible that

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[4]Soil productivity grades (ratings) were designed so that tracts of highest agricultural producing capacity rates 4, while those of lowest agricultural productivity rates 10. Therefore, it is logical to attain negative correlation coefficient between per acre assessment values and the productivity grades.

[5]The existence of perfect correlation between two variables is denoted by ± 1.00, while the absence of correlation is indicated by zero (0.00). The closer the correlation coefficient is to one $|1.00|$ between two variables, the stronger is the relationship between them. However, the closer the coefficient is to zero (0.00), the weaker the relationship between them is.

[6]These regions are the same as those which were outlined in the preceding section.

the assessors have used assessment criteria other than agricultural productivity, or they may have used other guides in addition to the productivity of the soil. There remains, then, the second alternative to explore; namely, land market price. Therefore, an attempt was made to correlate per acre assessment values of each tract of farmland with their corresponding market price in Tulsa County and its three regions. The correlation coefficients were +.980 for Tulsa County; +.969 for Region I; +.970 for Region II; and +.833 for Region III. The above coefficients are logically consistent because they are preceded with positive signs. That is, the per acre assessment values of farmland are related directly to their market prices. Furthermore, the coefficients of these correlations are highly significant at 95 percent probability level. The magnitude of these coefficients are large relative to those between average assessment and the productivity ratings. One probably can conclude that the assessor has used market price as a principal guide in assessing farm tracts.

Correlation analysis may assist an investigator in detecting the existence of possible relationships between two or more variables. However, the establishment of such relationships does not provide a tool for measuring quantitatively certain characteristics of one variable from a known characteristic of the related variable. For this reason, it will be useful to establish functional relationships between the per acre assessed value of farmland and its market price.

The per acre assessment value (Y) of farmland was set as a function of its market price (X_1).[7] The functional relationship in its general form would be:

$$Y = f\ (X_1) \qquad (5.1)$$

However, a specific form of this function is set as follows:[8]

$$Y = a + b_1X_1 \qquad (5.2)$$

where:

Y = per acre assessment value of farmland

X_1 = per acre market price of farmland.

Equation (5.2) was fitted to the total sample data of Tulsa County and to its subdivisions. The results obtained are shown in Table XV.

The coefficient of determinations (R^2) of the above equations are above 90 percent level for all the equations except that for the equation (5.5), in Table XV. This means that farmland market prices, do in fact, explain a large proportion of variations in per acre assessment values. However, market price explains only about 70 percent of

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[7]In establishing functional relationships between two or more variables, it is necessary for the investigator to possess a prior knowledge of the behavior of the variables. Economic and mathematical concepts are of assistance in explaining the consistency of the established relationships. For instance, Oklahoma tax laws require county assessors to assess farm tracts based on their market values. Therefore it is logical to set assessed value as a function of market price.

[8]The symbols Y and X_1 are the same as in equation (5.1); however, "a" is called Y-intercept for it indicates the per acre assessment value when the sales price is equal to zero. Nevertheless, it is not logical to have assessment value when the land price is zero. Therefore, in order for the "a" term to have any meaning we must have price of a magnitude greater than zero. The "b" term provides a trend or a slope of a line (curve). A curve may be positively or negatively sloping, depending on the sign which precedes the "b" term.

TABLE XV

PER ACRE ASSESSMENT VALUES OF FARMLAND REGRESSED ON ITS MARKET PRICE[a]

Equation Number	Region	Equations	R^2	Degrees of Freedom (n-2)	Calculated t Value	Tabulated t Value	Test of Significance of "b" Coefficient at 95 Percent Probability Level
(5.3)	I	$\hat{Y} = 1.344+.138X_1$	.9386	23	18.900	2.069	Yes
(5.4)	II	$\hat{Y} = -12.444+.160X_1$	.9424	17	16.667	2.110	Yes
(5.5)	III	$\hat{Y} = 1.370+.1384X_1$	.6946	22	7.0612	2.074	Yes
(5.5)	I+II+III	$\hat{Y} = 1.614+.145X_1$	.9600	66	39.726	1.996	Yes

[a]Source of the data: Appendix Table D.

per acre assessment variations in the northern region (Region III) of Tulsa County. This suggests that assessors have not closely followed market price in assessing farm tracts of Region III. Considering the findings of the previous section relative to large variation in assessment rates of Region III, evidence here could suggest that one possible cause is the failure of the assessor to assess on the basis of market price. Therefore, the county assessor must reconsider the assessment methods used in this region if he achieves the goal of uniform assessment rates throughout Tulsa County. In order to comply with Oklahoma tax laws, the assessors must use land market price as a guide in assessing farmland and must apply constant assessment rates to all farm tracts for attaining relatively uniform assessment rates in the county.

The "b" coefficients of the equations in Table XV are significantly different from zero at 95 percent probability level. The slope (trend) of the lines generated by these equations appears to be relatively identical (Figure 6). However, due to the fact that each one of these equations have "a" values of different magnitude, the generated curves tend to lie one above the other. The curves generated by equations 5.3 and 5.5 overlap which means that the "a" as well as the "b" coefficients of these two equations are identical. These two curves intersect the average county curve (I+II+III) at about $280.00 per acre of market price. Thus, farm tracts with a per acre market price less than $280.00 tend to be over-assessed in regions I and III, as compared to the county average curve. However, farm tracts of higher values than $280.00 appear to be under-assessed in the same two regions (I and III) relative to the overall county average assessment level. Nevertheless, the curve

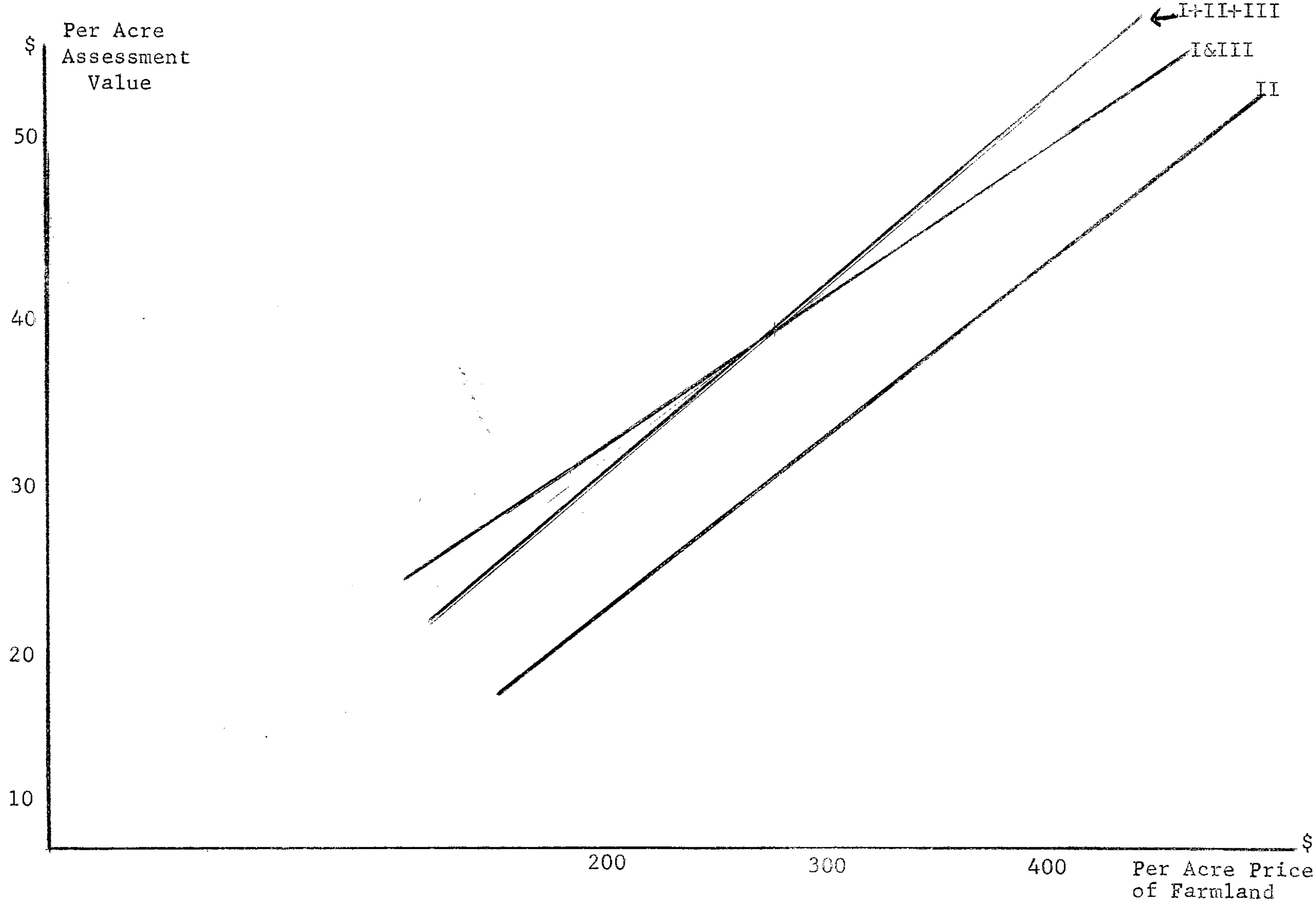

Figure 6. Comparison of Assessment and Market Price Relationships of Farmland for Tulsa County and Its Subdivisions.

generated by equation (5.4) shows that it has a relatively identical slope as that of the average curve (5.5). However, it lies a constant distance below it; consequently, a parcel of land in Region II tends to be under-assessed as compared to one located in regions I and III. This leads to the conclusion that farm tracts are not uniformly assessed in Tulsa County even though the assessor is using market price as a guide in his assessments.

A test was run to detect the statistical significance of differences between "a" and the "b" coefficients of the above equations (Table XVI). It was hypothesized that:

$$\alpha_1 = \alpha_2 = \alpha_3$$

$$B_1 = B_2 = B_3$$

Since the calculated F value was found to be less than the tabulated F value, the above equality was not rejected. Therefore, the equality among equations of Table XV cannot be rejected, based on the statistical evidence (Table XVI).

Since it was shown that the above equations are statistically not different from one another, application of each individual equation is apt to provide the same results. For this reason, it was decided to choose the equation which was fitted to the total data (5.5). The equation (5.5), (Table XV) is one which represents the overall county assessment-sales value relationship. This equation has been generated and plotted in a graphic form along with the actual observations (Figure 7). The actual observations lie very close to the generated regression line. That the regression line is of good fit

TABLE XVI

ANALYSIS OF VARIANCE FOR TESTING THE DIFFERENCES AMONG EQUATIONS (5.3), (5.4), and (5.5)[a]

Source	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	63	4459.772	
Single Equation	53	4023.860	75.922
Difference	10	435.862	43.5862

$F = \frac{43.5862}{75.922} = .574$ $F_{.05} = 2.01$, d.f.= 10,53

[a]Source of the data: Appendix Table D.

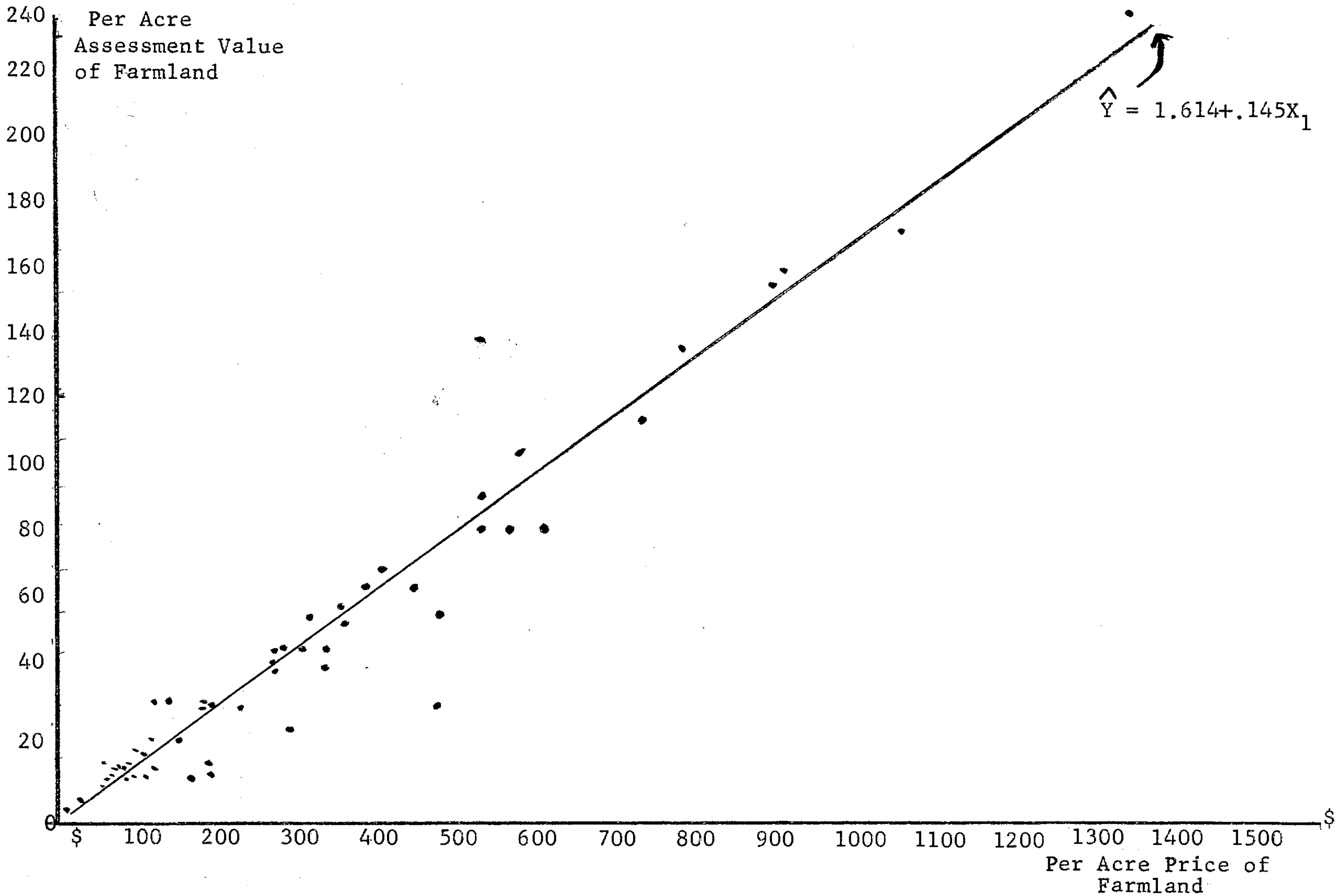

Figure 7. Relationships of Assessment and Sale Values of Currently Transferred Farm Tracts.

to the data is reflected in a high value of the equation's coefficient of determination, 96 percent. Application of this equation, given market prices, may lead to the attainment of uniform assessment rates. In other words, the burden of the total real estate tax base will be distributed among real estate owners in proportion to the value of their properties.

A much simpler functional relationship than the above can be established for assessing real properties. Such relationships can easily be established if the desired assessment rate and the market price of farmland were known. If the assessment rate of a magnitude "b" is set to prevail in the county, then all farm tracts must be assessed at a "b" rate. The equation becomes as follows:

$$Y = bX_1 \qquad (5.6)$$

where:

Y, X_1, and b have the same meaning as in the preceding equations. For instance, if the assessment rate is set at 20 percent of the sales price, then the above equation becomes:

$$Y = .20X \qquad (5.7)$$

Accordingly, a farm tract which is worth 1,000 dollars will have an assessed value of 200 dollars. Consequently, its assessment-sales ratio will be 20 percent $(\frac{200}{1000})$. Thus, the major task which remains to be explored is the establishment of a systematic way for estimating a probable sales price for unsold farm tracts in Tulsa County. Therefore, the forthcoming chapter will concern itself with the possibility of developing such a technique.

CHAPTER VI

PRICE MAKING FORCES OF FARMLAND IN TULSA COUNTY, OKLAHOMA

In the preceding chapter it was found that the per acre assessment value of farmland is positively correlated with its market price. This suggests that the county assessor has, in fact, tried to base the assessment of farm tracts on their sale price. Assessment rates appeared to be more uniform in the southern and central regions of the county than in the northern region. This indicates that the assessor has not applied exactly the same assessment rate to all unimproved farm tracts even when he had current market values of these properties available to him. Knowing market price, and assuming constant assessment-sale ratio, real estate assessors would be able to assess all farm tracts uniformly. However, since a large number of farm tracts in the county are rarely sold, the availability of systematic techniques for estimating a relative market price of the unsold tracts would be of assistance to county assessors in assessing such properties equitably. Therefore, it is the aim of this chapter to study the price making forces of different qualities of farmland in Tulsa County.[1]

The techniques to be developed must consider the factors which can easily be measured by assessors in assigning relative values to farm tracts.

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[1]In this case, the quality of farmland refers to its location (with respect to business centers, paved roads, etc.), agricultural productivity of the land, etc.

The cross-sectional analysis is used in exploring what impact the different characteristics a farm tract has on its market price. Thus, if techniques can be developed, they may assist county assessors in estimating market value for short periods of time, maybe three to five years. Over a longer period of time, not only may land price be subject to considerable fluctuations, but the relative impact of different price making forces on land price may change.

Price Making Forces

In evaluating farmland one must try to determine the relative impact various attributes of the property have on its market price. For example, if land is being purchased for farming purposes, it may be valued mainly for its agricultural productivity with less emphasis being placed on location. Land purchased for other purposes may have its value based primarily on its location with respect to business centers, highways, and the county seat with less emphasis on agricultural productivity.

For the purpose of this study, several factors were considered to affect farmland market price (X_1) in Tulsa County, Oklahoma. These factors are as follows:

X_2 = acres per transaction.

X_3 = the productivity ratings of the soil.

X_4 = distance to the principal city, in miles. Tulsa is the principal city in the case of Tulsa County.

X_5 = distance, in miles, to the nearest business center.

X_6 = distance, in miles, to a paved road.

X_7 = the percent of mineral rights transferred.

X_8 = best type of road touching the farm.

A farm tract which is bordered by a super highway is rated one, while those tracts which are not bordered by any roads are rated eight. There are several other types of roads between these two extremes.[2]

Information concerning X_1, X_2, and X_7 were secured from public records in Tulsa County land transfer books. Information on X_3 was obtained from the Tulsa County soil survey manual, and X_4, X_5, X_6, and X_8 were determined from county highway maps.[3]

Identification of Price Making Forces

The simple correlation technique was used as a guide in depicting qualitative relationships between the per acre price of farmland and the other variables (variables X_2 through X_8).

The price paid for land in Tulsa County was found to be highly correlated with distance of the transferred tracts from the city of Tulsa. However, the correlation between price and the remaining variables was relatively low. The data were then plotted on graph

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[2]Best type of road touching farm--Super or Federal highway, 1; hard surface road, 2; gravel, 3; improved dirt road, 4; graded road, 5; unimproved dirt, 6; primitive, 7; no road at all, 8.

[3]The 1961 highway map was used in order to correspond with 1961 adjusted farmland price in Tulsa County. The legal description of individual tracts were used in locating them on the maps (Appendix Table B).

paper in order to observe the graphic relationship between price and the other variables. In plotting the average price against distance in miles to the county seat, four of the observations were found to deviate significantly from the remaining 68 observations. The per acre values of these tracts were very high, ranging from $2,046.00 to about $2,453.00. These four properties were excluded from the sample after it was found that they possessed unique locational advantages over the rest of the tracts.[4] The inclusion of these observations would have had an unjustified upward impact on the estimated average price of farmland for the county.

In the process of plotting the observations on graph paper, the relationship between X_1 and X_4 was found to be highly curvelinear, while the relationships between X_1 and X_2, and X_3 and X_5 demonstrated some degree of curvelinearity. Therefore, it was decided to convert the values of X_1, X_2, X_3, X_4, and X_5 into logarithmic terms. Because of their small values, it was inconvenient to convert the value of variables X_6, X_7, and X_8 into logarithmic terms. The simple correlation coefficients among all the variables were calculated in natural as well as in their logarithmic terms and also among the natural and logarithmic terms (Table XVII). In this case, the investigator was looking for those variables which were highly correlated to land price. The correlation coefficient between price and distance from county seat

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[4]These tracts are so located that they appear to be suitable for industrial and/or other urban development. Three of these tracts were located very near the city of Tulsa, while the fourth tract was located close to the city of Broken Arrow.

TABLE XVII

SIMPLE CORRELATION MATRIX OF THE VARIABLES WHICH WERE BELIEVED TO BE IMPORTANT TO THE STUDY[a] (INCLUDES THE TOTAL DATA)

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	Log X_1	Log X_2	Log X_3	Log X_4	Log X_5
X_1	1.000	.144-	.245-	.828-	.352-	.383-	.314+	.447-	.880+	.162-	.244-	.897-	.270-
X_2		1.000	.228+	.181+	.150+	.260+	.207+	.098+	.311-	.938+	.232+	.106+	.174+
X_3			1.000	.258+	.034+	.309+	.138-	.046+	.382-	.158+	.992+	.231+	.043+
X_4				1.000	.552+	.585+	.243-	.483+	.897-	.179+	.245+	.954+	.439+
X_5					1.000	.403+	.194+	.124+	.423-	.112+	.040+	.480+	.963+
X_6						1.000	.219-	.353+	.659-	.220+	.293+	.461+	.311+
X_7							1.000	.095-	.316+	.171+	.155-	.265-	.297+
X_8								1.000	.569-	.107+	.054+	.425+	.021+
Log X_1									1.000	.311-	.377-	.845-	.306-
Log X_2										1.000	.172+	.126+	.138+
Log X_3											1.000	.225+	.056+
Log X_4												1.000	.394+
Log X_5													1.000

[a]Source of the data: Appendix Table D.

was highest in all of its forms, natural numbers, logarithmic form, and between its natural and logarithmic forms, while those between price and the other variables appear to be relatively low (Table XVII).

Intercorrelation among the independent variables (all the variables except the per acre price) were relatively low, excluding those between each variable and itself.[5]

Procedures in Estimating the Per Acre Price of Farmland

The simple correlation technique was utilized in depicting the qualitative type of relationships among the variables under study. The knowledge of intercorrelations among the independent variables may assist an investigator in eliminating one of the two highly correlated independent variables in an equation. The prevalence of high intercorrelation between two independent variables means that the inclusion of one of them in an equation may explain as much variation in the dependent variable as can be explained by both. In other words, the two independent variables are actually the same for all practical purposes. Therefore, the elimination of one of them may save a great deal of time and calculation effort. Thus, a simple correlation technique

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[5]The attainment of low intercorrelations among the independent variables is advantageous. The prevalence of low intercorrelations means that when an equation is fitted to the data, the regression coefficients tend to be stable and each of the independent variables show its impact separately on land price. For further information on this point, see: Karl A. Fox and James F. Cooney, Jr., Effects of Intercorrelations Upon Multiple Correlation and Regression Measures, United States Department of Agriculture, AMS-341, 1959.

provides valuable information in establishing functional relationships between the dependent variable (per acre price of farmland) and independent (distance to county seat, productivity ratings, etc.) variables. The functional relationships between per acre price of farmland and the other variables can be stated as follows:

$$X_1 = f\ (X_2, X_3, X_4, X_5, X_6, X_7, X_8) \qquad (6.1)$$

The above equation says that the per acre price of farmland (X_1) is a function of or dependent upon X_2, X_3, X_4, ..., X_8. However, since the use of more than four independent variables in an equation leads to the increased danger of multicollinearity relationships among them, it may be advantageous to limit the number of the independent variables included in an equation.[6] There are, of course, cases where more than four independent variables may be incorporated in an equation, especially when the relative magnitude of the intercorrelations are small and when the sample size is relatively large. The smaller the magnitude of the intercorrelation and the larger the sample size, the smaller the danger of multicollinearity.[7] High intercorrelations tend to create instability and reduced reliability for the individual regression coefficient (b- coefficients) estimates and raises their standard errors.[8]

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[6]For further information about multicollinearity problems, see: J. Johnston, Econometric Methods (New York, 1963), pp. 201-29.

[7]Ibid.

[8]Harold F. Breimyer, Demand and Prices for Meat, United States Department of Agriculture, Technical Bulletin No. 1253 (Washington, 1961).

Since intercorrelations among the independent variables in this study were relatively low, an attempt was made to include as many of the variables as possible in a series of equations in order to exhaust all the possible alternative combinations in each equation. The purpose of this process was to seek the best possible combinations of factors which may explain variation in land price in Tulsa County, Oklahoma.

The general form of the equation which is believed to fit the data best is as follows:

$$X_1 = a\ Xi^{bi}\ e^{bjXj} \qquad (6.2)$$

where:

i = 2, 3, 4, 5

j = 6, 7, 8

e = 10. Ordinarily "e" has a value of about 2.71828, while in the above equation, it has a value of 10.

In order to apply ordinary least squares regression techniques, the above equation was made linear in the parameters by taking the logarithm of both sides of the function. Accordingly, the final form of the equation becomes:

$$\text{Log } X_1 = \text{Log } a + b_i \text{ Log } X_i + b_j\ X_j \qquad (6.3)$$

The right hand side of equation 6.3 has two components; namely, the logarithmic component (Log a + b_i Log X_i), and a natural component (b_jX_j). Therefore, in order to obtain the value of X_1, it will be necessary to insert the X_i's in their logarithmic forms and the X_j's in their natural terms into the equation and then obtain the antilogarithm of X_1.

Presentation of the Results

The equations which have been fitted to the Tulsa County farmland data may assist the county assessor in estimating the relative values of individual farm tracts throughout the county. Although the usefulness of any equation is limited by the quality of the data to which it has been fitted, the farm tracts included in the sample data were fairly distributed throughout Tulsa County (Chapter IV). Therefore, the application of the fitted equations to various farm tracts in the county may be justifiable. However, this does not mean the abandonment of the assessor's good judgment in the assessment process, because there are likely to be cases where these equations will over-state or under-state the fair market price. Therefore, county assessors must be aware of such cases in making necessary adjustments of the estimated values of such tracts. One way to uncover the existence of such cases would be to keep close watch over the farmland market behavior in the county and in a specific region within the county, especially around large business centers, such as the cities of Tulsa, Broken Arrow, and Jenks. Land prices in rural-urban fringe areas may be subject to a high degree of speculation. Therefore, extreme caution must be exercised in the application of these equations to rural-urban fringe properties.[9]

An attempt was made to fit equation (6.3) to the sample data by setting farmland price as a function of all or some of the independent

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[9]It is extremely difficult to delineate the exact border line between rural and urban areas within a certain county, because the layout of farmland is such that it forms a continuous pattern within certain regions.

variables. Various equations were estimated in an effort to determine which variables can best explain farmland price variation. In this process, two major equations (6.4) and (6.5) were estimated.

To decide whether any of the estimated equations are useful, it is necessary to analyze and study their structure. It is convenient to begin this discussion by analyzing the equation which contains all of the variables considered in this study. The estimated equation appears below. The t-values are in parantheses.

$$\text{Log } \hat{X}_1 = 4.128 - \underset{(3.604)^{**}}{.231} \text{ Log } X_2 - \underset{(2.271)^{*}}{.497} \text{ Log } X_3 - \underset{(11.094)^{**}}{1.048} \text{ Log } X_4$$

$$+ \underset{(.177)}{.002} X_5 - \underset{(3.720)^{**}}{.249} X_6 + \underset{(1.627)}{.124} X_7 - \underset{(2.016)}{.018} X_8 \qquad R^2 = .836 \qquad (6.4)$$

*Statistically significant at 95 percent probability level.

**Statistically significant at 99 percent probabiilty level.

As the above equation indicates, the regression coefficient which precedes X_5 is smaller than its standard error; therefore it tends to be not significantly different from zero. Therefore, one may say that proximity to a town other than Tulsa may not have a significant affect on farmland price in Tulsa County.

The absence of relationship between land price and nearness to a town may be due to the fact that a number of sizable cities which are not too far apart are found throughout Tulsa County. Consequently, the nearest town may not affect the price of a tract of land as much as the second nearest town if it is appreciably larger.

The second thing which can be observed in the above equation is the regression coefficient which accompanies X_7. This coefficient appears to be statistically insignificant at 95 percent probability level, even though it carries relatively low standard errors. Nevertheless, the size of the regression coefficient is larger than the value of its standard error. Therefore, this regression coefficient was retained in the equation even though there is no a priori grounds to support its reliability.

The shortcomings of equation (6.4) ruled out its usefulness. Therefore, an attempt was made to improve this equation by excluding X_5 from it. A new equation containing six independent variables was fitted to the data. The estimated equation is the following:

$$\text{Log } \hat{X}_1 = 4.132 - \underset{(3.633)^{**}}{.231} \text{ Log } X_2 - \underset{(2.283)^{*}}{.495} \text{ Log } X_3 - \underset{(11.223)^{**}}{1.046} \text{ Log } X_4$$

$$- \underset{(3.826)^{**}}{.246} X_6 + \underset{(1.647)}{.125} X_7 - \underset{(2.057)^{*}}{.018} X_8 \qquad R^2 = .836 \qquad (6.5)$$

The regression coefficients of the above equation appear to be logically consistent. All but the coefficient which accompanies X_7 are statistically significant at 95 percent probability level. Nevertheless, the regression coefficient of X_7 is statistically significant at 90 percent probability level. Moreover, mineral rights have long been considered as having substantial economic importance in Tulsa County. Therefore, the variable X_7 was retained in the equation. This equation was accepted as offering one of the possible forms for estimating the relative per acre price of farmland in Tulsa County.

The coefficient of determination (R^2) of equation (6.5) shows that about 84 percent of land price variations in Tulsa County is explained by the six independent variables which have been included in the equation. Therefore, 16 percent of land price variations remains unexplained. For this reason, the county assessor must utilize his own practical experiences in making the necessary adjustments in the ultimate value for assessment purposes.

The approximate importance of the independent variables based on their calculated t values in the equation can be ordered as follows: X_4, X_6, X_2, X_3, X_8, and X_7, respectively. The variable X_4 appears to be the most important, while the variable X_7 is least important. The regression coefficient which precedes X_4 indicates that a one percent change in distance (in miles) from the city of Tulsa leads to 1.046 percent change in per acre price of farmland, ceteris paribus. However, since X_7 is in natural numbers, we can say that a change of one percent in transferred mineral rights will result in about .13 change in the price of land, ceteris paribus.

Regional Analysis of Farmland Market Prices in Tulsa County

Since a great deal of speculation in land for urban development has been occurring at the southern and southeastern edge of the city of Tulsa, it was decided to analyze the sales data of regions I and II separately from Region III. The regional study of farmland sales prices is based on the hypothesis that the impact of the price making forces (X_2 through X_8) of farmland on land prices in regions I and II is about the same, but that they affected the Region III land price differently. This hypothesis is based on the investigators' personal observation of the existing situation in Tulsa County. In substantiation of the above hypothesis, a statistical test was made to explore the existence of possible similarities among the three regions (I, II, and III). The statistical test showed that regions I and II were not significantly different from one another, but that Region III differed from both regions I and II. Therefore, it was decided to treat the data of regions I and II as one group and the data of Region III as another group (Appendix Tables C_1-C_5).

Accordingly, an equation identical to (6.5) was fitted to the combined data of regions I and II. The number and the meaning of the variables which have been included in this equation are the same as those in equation (6.5). The resulting equation appears below. The computed t-values are in parentheses.

$$\text{Log } \hat{X}_1 = 4.161 - \underset{(2.756)^{**}}{.233} \text{ Log } X_2 - \underset{(2.129)^{*}}{.561} \text{ Log } X_3 - \underset{(8.565)^{**}}{.978} \text{ Log } X_4$$

$$- \underset{(3.352)^{**}}{.255} X_6 + \underset{(1.709)}{.154} X_7 - \underset{(3.367)^{**}}{.041} X_8 \qquad R^2 = .887 \qquad (6.6)$$

*Significant at 95 percent probability level.

**Significant at 99 percent probability level.

This equation appears to provide a better fit to the combined data of regions I and II than it did when fitted to the total data. Equation (6.6) provides a coefficient of determination of about 89 percent as compared to about 84 percent for equation (6.5). As in equation (6.5), the regression coefficients of this equation are logically consistent. Also, all but the X_7's regression coefficients are statistically significant at 95 percent probability level. However, the regression coefficient of X_7 appears to be significantly different from zero at 90 percent probability level.

The intercorrelation among the variables included in the equation are relatively low (Table XVIII). Therefore, there is little danger of attaining unreliable regression coefficients or regression coefficients of a high standard error due to multicollinearity.

Based on the calculated t values, the importance of the regression coefficients in the equation (6.6) can be rated as X_4, X_8, X_6, X_2, X_3, and X_7. Thus, the variable X_4 appears to be the most important, while the variable X_7 is the least important. A one percent change in the value of X_4 leads to about the same percentage change in per acre price of farmland. However, since the values of X_7 are in natural numbers, we can say that a one percent change in the value of X_7 leads to a change of about .15 in the value of land.

Since equation (6.6) is based on the data of regions I and II, its application as a predictive tool will be limited to these two regions only. For this reason, another equation is needed for estimating land price in Region III. Thus, an equation containing the same variables and having the same form as that of the equations (6.5) and (6.6) was fitted to the observations from Region III. Generally speaking, intercorrelation among the independent variables was relatively low (Table XIX). The estimated equation appears below. The t-values are in parentheses.

TABLE XVIII

SIMPLE CORRELATION MATRIX OF THE VARIABLES WHICH WERE BELIEVED TO BE RELEVANT TO THE STUDY (INCLUDES THE DATA OF REGIONS I AND II)[a]

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	Log X_1	Log X_2	Log X_3	Log X_4	Log X_5
X_1	1.000	.144-	.245-	.828-	.352-	.383-	.314+	.447-	.880+	.162-	.244-	.897-	.270-
X_2		1.000	.228+	.181+	.150+	.260+	.207+	.098+	.311-	.938+	.232+	.106+	.174+
X_3			1.000	.258+	.034+	.309+	.138-	.046+	.382-	.158+	.992+	.231+	.043+
X_4				1.000	.552+	.585+	.243-	.483+	.897-	.179+	.245+	.954+	.439+
X_5					1.000	.403+	.194+	.124+	.423-	.112+	.040+	.480+	.963+
X_6						1.000	.219-	.353+	.659-	.220+	.293+	.461+	.311+
X_7							1.000	.095-	.316+	.171+	.155-	.265-	.297+
X_8								1.000	.569-	.107+	.054+	.425+	.021+
Log X_1									1.000	.311-	.377-	.845-	.306-
Log X_2										1.000	.172+	.126+	.138+
Log X_3											1.000	.225+	.056+
Log X_4												1.000	.394+
Log X_5													1.000

[a]Source of data: Appendix Table D.

TABLE XIX

SIMPLE CORRELATION MATRIX OF THE VARIABLES WHICH WERE BELIEVED TO BE RELEVANT TO THE STUDY (INCLUDES THE DATA OF REGION III)[a]

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	Log X_1	Log X_2	Log X_3	Log X_4	Log X_5
X_1	1.000	.533-	.306-	.695-	.121+	.107-	.540-	.499+	.981+	.701-	.288-	.687-	.217+
X_2		1.000	.254+	.404+	.199-	.211-	.268+	.311-	.534-	.870+	.245+	.422+	.166-
X_3			1.000	.155+	.035+	.198+	.081+	.094-	.409-	.133+	.994+	.177+	.087+
X_4				1.000	.081-	.137+	.302+	.249-	.729-	.517+	.139+	.988+	.122-
X_5					1.000	.115+	.192-	.036+	.142+	.246-	.054+	.072-	.935+
X_6						1.000	.279+	.336+	.206-	.161-	.167+	.079+	.145+
X_7							1.000	.067+	.499-	.413+	.034+	.279+	.190-
X_8								1.000	.408+	.387-	.109-	.261-	.095+
Log X_1									1.000	.667-	.239-	.510-	.028+
Log X_2										1.000	.126+	.529+	.282-
Log X_3											1.000	.161+	.097+
Log X_4												1.000	.002-
Log X_5													1.000

[a]Source of data: Appendix Table D.

$$\hat{\text{Log } X_1} = 3.554 - \underset{(1.746)}{.3899} \text{ Log } X_2 - \underset{(2.074)}{.4494} \text{ Log } X_3 - \underset{(3.2007)*}{.6132} \text{ Log } X_4$$

$$- \underset{(1.863)}{.4118} X_6 - \underset{(2.0254)}{.4409} X_7 + \underset{(2.741)*}{.5537} X_8 \qquad R^2 = .832 \qquad (6.7)$$

In looking at the above equation, it can be seen that the regression coefficients accompanying the variables X_7 and X_8 are inconsistent to those which were expected.

A positive sign was expected to accompany the regression coefficient of X_7 while that of X_8 was expected to be negative. A negative sign preceding X_7 implies that the higher the percentages of the mineral rights transferred with the land, the lower its price would be, other things equal. This appears to violate the accepted notion that the greater the percentage of mineral rights transferred, the higher the land price would be. Assuming that sellers are rational in their behavior, it seems logical to assume they would insist on a higher price when they transfer larger percentages than when they transfer smaller percentages of the mineral rights with the property.

On the other hand, the coefficient of X_8 should have been accompanied by a negative rather than by a positive sign. The presence of positive sign means that the lower the quality of the road touching the land, the higher its price will be. However, numerous studies have shown that the higher the quality of the road touching the farmland, the higher the land price will be (holding the other factors constant).

Nevertheless, neither the variable X_7 nor the variable X_8 can be excluded from equation (6.7) solely on the basis that the signs accompanying their coefficients are not consistent with what was expected. The presence of inconsistent signs may be due to sampling errors or due to currently unknown relationships which may prevail in Region III or they may be due to both of these factors. For instance, there may be more mineral speculations on less productive farms than on highly productive and better located farms. Consequently, the other beneficial characteristics of farmland may overshadow the mineral right transfers. Therefore, the price of the tracts which carry a larger percentage of mineral right transfers may still be below the tracts which carry a smaller percentage of the mineral rights.

Similarly, the tracts which are close to a high grade of road may possess several other poor qualities, whereby they inversely affect its market price.

The regression coefficients of the variables X_2 and X_6 are not significantly different from zero, while those of the variables X_3, X_7, and X_8 are barely significant at 95 percent probability level. The variable X_2 was excluded from the original form of the equation (6.7) and fitted it to the data from Region III with the intention of improving the estimated equation. The reason for excluding X_2 from the equation was that its regression coefficient was less significant than those of the other variables. In this new form the equation (6.7) was fitted to the data. The resulting estimated equation appears below. The t-values are in parantheses.

$$\text{Log } \hat{X}_1 = 3.5802 - \underset{(2.122)^*}{.5137} \text{ Log } X_3 - \underset{(4.125)^{**}}{.6359} \text{ Log } X_4 - \underset{(1.3632)}{.1074} X_6$$

$$- \underset{(2.975)^*}{.3216} X_7 + \underset{(3.179)^{**}}{.0262} X_8 \qquad R^2 = .802$$

(6.8)

The signs accompanying the variables X_7 and X_8 are the same as they were in equation (6.7). All the regression coefficients but the one which accompanies the variable X_6 are significantly different from zero at 95 percent probability level. Nevertheless, since the variable X_6 (distance to paved road) has a larger regression coefficient than its standard error and is economically important, its exclusion from the equation (6.8) may lead to a reduced structural validity of the equation. Therefore, it was decided to retain it in the equation, even though the reliability of its regression coefficient cannot be justified on a priori grounds. The independent variables in the equation (6.8) appear to explain about 80 percent of land price variations in Region III. Consequently, about 20 percent of farmland price variations remains to be explained by other factors. For this reason, the assessor must be aware of the shortcomings of this equation as a tool and utilize it mainly for arriving at a basic value. Then, the necessary subjective adjustments can be made to attain the final value figure.

In summary, equation (6.6) is proposed for use in estimating the relative market price of farmland in regions I and II while equation (6.8) is proposed for determining the relative price of farmland in Region III.

The operation of these equations will be explained with hypothetical examples in the following paragraphs.

Application of the Estimated Equations

It may be useful to explain the operation of one of the above equations with a numerical example. For instance, what would be the relative per acre market price (X_1) of a tract of farmland which possesses the following characteristics:

X_2 = 10 acres of farmland.

X_3 = the land has average productivity ratings of 5.3.

X_4 = it is located 10.5 miles south of the city of Tulsa.

X_6 = 0 miles away from paved road.

X_7 = 50 percent of the mineral rights have been transferred.

X_8 = grade number 1 road (paved road) touches the farm.

In estimating the price of this tract of farmland, the following steps are involved:

1. The choice of the equation. Since this tract of land is located in the southern half of Tulsa County, equation (6.6) is used.

$$\text{Log } \hat{X}_1 = 4.161 - .233 \text{ Log } X_2 - .561 \text{ Log } X_3 - .978 \text{ Log } X_4 - .255 X_6 + .154 X_7 - .041 X_8$$

2. Plug the above numbers into the equation.

$$\text{Log } \hat{X}_1 = 4.161 - .233 \text{ Log } (10) - .561 \text{ Log } (5.3) - .978 \ (10.5) - .255 \ (0.00) + .154 \ (.50) - .041 \ (1)$$

3. Convert the natural numbers into the logarithmic terms where they are so indicated.

$$\text{Log } \hat{X}_1 = 4.161-.233(1)-.561(.724)-.978(1.021)-.255(0.00)+.154(.50)-.041(1)$$

4. Accumulate the results.

Log $\hat{X}_1 = 2.5593$

By converting the logarithmic numbers into their natural forms, we find that the estimated per acre price of this tract is $362.50.

The Y-incercept of the above equation is also called the constant term of the equation, and this is equal to 4.161. However, the magnitude of the constant tends to change as the values of the independent variables change. The negative sign preceding the variable X_2 (size of tract) indicates that the larger the size of the transfer is the lower the per acre price will be, other factors constant. This seems to be consistent with the economic logic that the larger the quantity of a good placed on the market, the lower will be the per unit price of the good. On the other hand, the negative sign which precedes the variable X_3 indicates that the lower the productive capacity (the higher its numerical grade) of a given tract, the lower its per acre price will be (holding the other factors constant). The soil which has a productivity grade of 4 rates best and those with grades of 10 rate poorest. Therefore, the poorer the soil, the larger the value deducted from the constant term, and the lower the ultimate value of the land will be.

The regression coefficient of the variable X_4 (distance to county seat) is also preceded with a negative sign. This means that farm tracts which lie closer to the city of Tulsa sell for higher prices than those farther away from the city (the other factors constant). By using the same logic, as the value of X_6 or X_8 increases, the smaller the per acre price of land will be (holding other factors constant). However, the larger the percentage of the mineral rights (X_7) transferred with the land, the higher its per acre price will be (holding other factors constant).

It may be advantageous to establish basic market values of farmland for regions I + II, and III. To attain this goal, it was necessary to calculate average values of each variable from the sample data (Table XX).

TABLE XX

ARITHMATIC MEANS OF THE INDEPENDENT VARIABLES IN THE SAMPLE[a]

Regions I + II		Region III	
Items	Average Values	Items	Average Values
X_2	37.14	X_3	5.666
X_3	5.778	X_4	12.270
X_4	8.245	X_6	0.1583
X_6	0.0883	X_7	0.8958
X_7	0.8953	X_8	2.7500
X_8	1.9767		

[a]Source of data: Appendix Table D.

Based on the above averages, the basic values per acre of farmland were found to be $349.30 and $181.20 for regions I + II, and III, respectively. However, deviations from the above averages lead to deduction from or addition to the basic values.

It must be remembered that these equations are based on unimproved farm tracts. Therefore, they can be utilized only in assigning relative market price to unimproved tracts. However, they might also prove useful in assigning relative values to the bare land of improved properties. In order to use this equation in assessing just the land portion of improved properties, it must be assumed that the bare land of improved properties is valued in the market at the same price as is land in unimproved farm tracts. By using this procedure, the total assessed value of improved farm tracts is determined by adding the assessed value of land to the assessed value of the improvement attached to the land.

It is assumed that because the value of improvements can be based on reproduction cost less depreciation, the assessor is capable of assigning relative values to comparable improvements on various farm tracts. Consequently, the main emphasis was placed upon the task of assigning probable market values to unimproved tracts.

CHAPTER VII

SUMMARY AND CONCLUSIONS

Real estate property appears to be the most important source of revenue for the operation of local governments in the state of Oklahoma. About 53 percent of the total general property tax was attributed to real estate during 1961 in Oklahoma.

The amount of tax to be levied against real property within a certain tax jurisdiction can be computed by subtracting the amount of revenue available from sources other than real estate from the estimated total budget which has been outlined for a given fiscal year.

Since the tax levied on real property is based on its assessed value, it is useful to understand the nature of the factors which may affect the level of assessment rates. This appears to be important for two reasons: (1) to secure adequate revenue for financing the operation of the local governments; and (2) to distribute the real estate tax burdens uniformly among real estate owners. However, it has been found that lack of uniform real estate assessment rates prevail within and between counties in the state of Oklahoma. Therefore, an interest arose for the development of a framework for analyzing the adequacy of current assessment practices and to propose some possible measures for correcting the existing situation within a given tax district.

Tulsa County was selected for this study because of the complex farmland assessment problems which have been created as a result of rapid expansion in rural-urban fringe land development in the county.

Procedures

Since Oklahoma State tax laws require the real estate assessor to assess real property values based on their market prices, it was decided to utilize such prices as a standard for comparing assessment rates placed upon farm tracts in Tulsa County during 1962. For this reason, it was necessary to collect market price data on *bona fide* sales for 1961. Due to the fact that there were too few *bona fide* sales for 1961, it was necessary to supplement it with sales of 1959 and 1960. The price data of 1959 and 1960 were adjusted to the 1961 price level. The reason for analyzing assessment rates for a period following the transfer was to verify the hypothesis that real estate assessors, in fact, do assess recently transferred farm tracts on the basis of their market prices.

Assessment and sales data were collected for unimproved tracts of farmland, due to the lack of available data on the market price of the improvements independently from that of the bare land. Since the ultimate objective of this study was to establish functional relationships between the per acre price of farmland and the factors which may affect the price, the inclusion of the improved properties would have necessitated the use of improvement values as one of the market price determinants. Exclusion of improved properties eliminated this problem.

The assessment value of each farm tract was divided by its market price in attaining a so-called assessment-sale ratio or assessment rate.

The assessment rates were compared on a quartile and regional basis. The quartile analysis showed apparent variations in assessment rates between and within individual quartile.
Similarly, regional analysis revealed some degree of variation in the assessment rates within each region. However, the difference noted between regions was not statistically significant (Chapter IV). Even so, a lack of assessment uniformity was found to prevail among individual properties. The county assessor should apply a constant assessment rate if he intends to achieve uniform assessment rates in the county. This is difficult, however, since not all farm tracts are sold annually and he has but little basis for value. Therefore, it is necessary to develop systematic techniques for assigning comparable values to a relatively identical farm tracts.

For this reason, an attempt was made to specify the variables which were believed (based on a priori knowledge) to contribute to farmland market prices (X_1). The variables were:

X_2 = acres per transaction.

X_3 = soil productivity grade.

X_4 = distance to principal city (Tulsa City) in miles.

X_5 = distance to nearest town in miles.

X_6 = distance to paved road in miles.

X_7 = percent of the mineral rights transferred.

X_8 = best type of road touching the farm.

The data on the above variables were secured by methods which were outlined in Chapters IV and VI.

The per acre price of farmland was set as a function of X_2, X_3, X_4, ..., X_8. The general form of the functional relationship is the following:

$$X_1 = f(X_2, X_3, X_4, \ldots, X_8)$$

Attempt was made to fit a logarithmic form of a transcendental equation ($Y = a\, X_i^{bi}\, e^{bjXj}$) to the sample data by least squares regression techniques.[1]

$$\text{Log } Y = \text{Log } a + b_i \text{Log } X_i + b_j X_j$$

The above equation was fitted to the total sample data. The estimated equation provided an R^2 of a value about 84 percent (equation 6.5 in Chapter VI). However, there was reason to believe that the selected independent variables may affect land prices differently within each of the three Tulsa County regions. Therefore, the above equation was fitted to the data of each region separately. Thus, three additional equations were obtained. These three equations were compared with one another and there was no statistical evidence to indicate that the equations which were fitted to the data of regions I and II were not identical. However, the equation which was fitted to the data of Region III was shown to differ from the others. Therefore, it was decided to fit one equation to the data of regions I plus II and another equation to the data of Region III (Chapter VI). The estimated equations are the following:

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[1]Symbols in this equation are interpreted same as those in equation 6.2, Chapter VI.

1. Equation estimated for regions I + II.

$$\text{Log } \hat{X}_1 = 4.161 - .233 \text{ Log } X_2 - .561 \text{ Log } X_3 - .978 \text{ Log } X_4 - .255 X_6 + .154 X_7 - .041 X_8 \qquad R^2 = .887$$

2. Equation estimated for Region III.

$$\text{Log } \hat{X}_1 = 3.5802 - .5137 \text{ Log } X_3 - .6359 \text{ Log } X_4 - .1074 X_6 - .3216 X_7 + .0262 X_8 \qquad R^2 = .802$$

Thus, it was proposed that each of the above equations be used in estimating the per acre price of farmland for their respective regions. Since these equations cannot be considered perfect tools in estimating farmland market price, it is suggested that assessors should also utilize their own experience in arriving at the ultimate value of each property. The above equations are believed to assist the assessor in arriving at relatively accurate appraisal values of unsold farm tracts. Then, by the application of a constant assessment rate to all farm tracts, uniform assessment rates throughout Tulsa County may be achieved.

Shortcomings of the Study

A. The main shortcoming of this study appears to lie in the fact that its empirical results are applicable only to Tulsa County unless there are counties identical to Tulsa in all respects. Since the market data analysis was based on cross-sectional analysis, the predictive powers of estimated equations will be limited to a short period of time, maybe three to five years. Therefore, in order to keep up with new changes in farmland market, it will be necessary to establish new relationships between price and the independent variables, say, once in every five or more years. Over a long period of time, the impact of some of the currently important independent variables may become insignificant. Furthermore, new variables may start to affect farmland prices in the county.

B. Since the estimated equations have been computed, based on certain ranges of values which have been included in the sample, reasonable values of such variables must be plugged into the estimated equations for attaining logical answers to farmland prices. The reliability of the estimated prices are limited by the quality of the data which has been utilized in their computation. For this reason, it may be useful to point out the range within which the independent variables may be allowed to vary.

1. The variable X_2 may vary from about 10 acres to about 264 acres for the equation of Region III. However, the size of the acreages utilized in estimating the equation for regions I and II ranged from 10 acres to 160 acres. Therefore, an attempt to estimate the market prices of tracts outside these ranges may tend to be inaccurate.

2. The system of soil productivity ratings (X_3) is so designed that the best soil was rated 4, while the poorest soil was given a rating of 10. Thus, the magnitude of the productivity grades ranged from 4 to 10.

3. Distance to county seat (X_4) ranged from 2 miles to about 22 miles. The upper limit of this range represents the distance between properties which lie near southern or northern borders of Tulsa County and the City of Tulsa.

4. The magnitude of the variable X_6 (distance from pavements in miles) ranged from zero to two miles.

5. The full amount of the mineral rights transferred is denoted by one, while any amounts less than one are designated with fractions of one. The amount of the mineral rights transferred ranged from zero to one.

6. The best type of road touching the farm. The road types were classified into eight categories. The best road touching the farm was given a grade of one while no road touching the farm was rated eight.

Plugging into the equation of regions I and II, the minimum values of the variables X_2, X_3, X_4, X_6, X_8, and the maximum value of X_7 providesus with a per acre price for the best land. However, the maximum values of X_2, X_3, X_4, X_6, X_8, and the minimum value of X_7 provide the per acre price for the poorest land in regions I and II.

However, plugging minimum values of X_3, X_4, X_6, X_7, and maximum values of X_8 into the equation of Region III provides the probable per acre price of the best land in Region III. Conversely, we may obtain the per acre price of the poorest land.

Conclusions

It was found that farm tracts have not been assessed uniformly in Tulsa County, even in the presence of their market values. This leads to the conclusion that the real estate assessor deviates somewhat from farmland market prices in assessing them for taxation purposes. Therefore, it is suggested that where possible, real estate assessors should follow closely market prices of farmland in their assessment practices. Since not all farm tracts are sold annually, it was necessary to develop systematic techniques in estimating the relative market price of unsold farmland in Tulsa County. Such techniques were developed, as shown in the above section.

The statistical tools developed in this study not only assist the real estate assessors in their assessment practices, but they also aid the real estate appraisers, brokers, etc., in determining the probable market price of farmland in Tulsa County, Oklahoma.

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APPENDIX

APPENDIX A

A list of other selected studies which have explored the impact of locational differences on farmland market price is as follows:

1. Ruttan, V. W. "The Impact of Local Population Pressure on Farm Real Estate Values in California," Land Economics, Volume 37, 1961, pp. 125-31.
2. Scofield, W. H. "Prevailing Land Market Forces," Journal of Farm Economics, Volume 39, No. 5, December, 1957, p. 1500.
3. Sargent, F. O. "Land Market and Price Analysis in An Agro-Industrial Economy," The Appraisal Journal, October, 1959, pp. 359-363.
4. Scharlach, W. C. "A Cross-Sectional Analysis of Indiana Land Values, 1959," unpublished M.S. thesis, Purdue University, 1961.
5. Stewart Charles L. "Farm Land Values as Affected by Road Type and Distance," Journal of Farm Economics, Volume XVIII, No. 4, November, 1936.
6. Curtiss, W. M. "Value of Improved Roads to New York Farmers," Farm Economics No. 92, Cornell Agricultural Experiment Station, December, 1935.

APPENDIX TABLE B

LIST OF BONA FIDE TRANSFERRED FARM TRACTS DURING 1959-61, TULSA COUNTY, OKLAHOMA

Card No.	Name of The Grantee	Transaction Book: Book No.	Transaction Book: Page No.	Legal Descriptions: Specific Reference	Sec-tion	Town-ship	Range	Acres
1	C. J. McCoy	2954	257	N/2 NW/4 SW/4	17	16N	13E	20
2	G. A. Evans	2964	426	W/2 NE/4	31	17N	13E	80
3	F. E. Erin	2978	352	SE/4 SE/4	5	17N	14E	40
4	W. E. Manley	2962	686	E/2 SW/4 SE/4	6	18N	13E	20
5	E. W. Pubyl	2961	350	E/2 W/2 NE/4	14	18N	13E	40
6	P. C. Braniff	2971	362	S/2 NE/4	23	18N	13E	80
7	C. D. Greenwood	3012	304	NE/4 SE/4	10	19N	14E	40
8	J. N. Berman	2973	223	NW/4 SW/4 + N/2 S/2 SE/4 + W/2 NE/4 SE/4 + S/2 SE/4 SE/4 SE/4	14	19N	14E	105.16
9	N.C. Hoelting	2967	71	SE/4 SE/4	10	21N	13E	40
10	W.L. Caruthers	2974	274	SE/4 SE/4 SE/4 + S/2 NE/4 SW/4 SW/4	26	21N	13E	15
11	L. S. Collins	2942	124	SE/4 SE/4	25	22N	12E	40
12	E. J. Cox	3028	412	S 165' Lot 5 + S 165' SE/4 SW/4 + All of Lot 6 + NE SW	6	17N	13E	89.4
13	C. Miller	3032	107	SW/4	28	17N	13E	160
14	W. M. Phillips	3034	278	Lot 2	19	18N	14E	37.18
15	M. L. Evans	3034	154	SE/4 SW/4 less 2.01 Acres for Hwy + Co. Road	16	22N	14E	37.99
16	R. P. Roller	3041	389	SE SE less 5.4 Acres to State	34	17N	12E	34.6

APPENDIX TABLE B (Continued)

Card No.	Name of The Grantee	Transaction Book: Book No.	Transaction Book: Page No.	Legal Descriptions: Specific Reference	Section	Township	Range	Acres
17	E. L. Moore	3047	258	N/2 SE/4 NE/4 + N/2 SW/4 SE/4 NE/4	15	18N	13E	25
18	J. E. Mulkey	3049	604	S/2 NE/4 less S 330' E 660' thereof	3	16N	13E	75
19	G. L. McGraw	3063	112	E/2 SE/4	23	17N	12E	80
20	J. Joe	3070	457	E/2 E/2 NW/4 NE/4	1	18N	13E	10
21	M. Denison	3072	504	E/2 NW/4 NW/4 + SW/4 NW/4 NW/4	15	21N	13E	30
22	L. Smith	3074	49	W/2 NE/4 less 2 Acres on E. side for Road	31	18N	14E	78
23	M. Zahner	3078	425	SW/4 SE/4 less .5 Acres for Co. Road	26	22N	12E	39.5
24	M. Penner	3079	232	NE/4 SE/4 SW/4 + SW/4 SE/4 less 16.66 Ac. for State Road	10	22N	14E	33.34
25	J. L. Hurst,Jr.	3081	92	N 345' of NW/4 NW/4 SW/4 + NE/4 NW/4 SW/4 + N/2 SE/4 NW/4 SW/4	9	18N	14E	20.23
26	R.C. Dickerson	3083	175	NE/4 NW/4	8	18N	13E	40

APPENDIX TABLE B (Continued)

Card No.	Name of The Grantee	Transaction Book: Book No.	Transaction Book: Page No.	Legal Descriptions: Specific Reference	Section	Township	Range	Acres
27	A. & R. Kingery	3084	255-56	E/2 SW/4 NE/4 + E/2 SW/4 + N/2 SE/4 + SW/4 SE/4 + N/2 SE/4 SE/4 + SE 10 Ac. of Lot 4 + NW/4 SE/4 NE/4 + SW/4 SW/4 NE/4 less 4.4 Ac.R.Y. and less 1.64 Ac. Road	31	22N	14E	263.96
28	W.M.C. Phillips	3084	409	SW/4	35	17N	14E	160
29	R. & E. Curlee	3088	547	N/2 S/2 NE/4 SE/4	13	18N	13E	10
30	W. Cole	3091	170	N/2 NE/4 SE/4	5	17N	14E	20
31	M.E. & A. Tibbs	3095	275	S/2 NE/4 SE/4 NE/4 + S/2 SE/4 NE/4 + NE/4 SE/4 + N/2 SE/4 SE/4 less 2.64 Ac. for County Road	18	22N	14E	82.36
32	W.P. Tomson	3102	111	NW/4 NE/4 less .5 Ac. for Co. Rd.	19	22N	14E	39.5
33	W.L.& F.E.Young	3201	513	E/2 SW/4 NE/4 + SW/4 SW/4 NE/4	1	22N	12E	30
34	W.J. Sanditen	3037	66	E/2 W/2 SE/4 less E522' S250' + E/2 SE/4 less E 250' + less W 415' of E655' S250' thereof	36	19N	13E	101.86
35	G.S. Richards	3061	125	SW/4	36	19N	13E	160

Card No.	Name of The Grantee	Transaction Book: Book No.	Transaction Book: Page No.	Legal Descriptions: Specific Reference	Section	Township	Range	Acres
36	J.V.&W.J. Williamson	3120	494	S/2 NE/4 SE/4	22	17N	12E	20
37	I.E. Sanditen	3127	310	N/2 SW/4	20	19N	14E	80
38	H.C. Davis	3129	263	SW NW	1	16N	12E	40
39	Gusa McCaslin, Jr.	3134	18	S/2 NE/4	16	16N	14E	80
40	Gusa McCaslin, Jr.	3134	21	NW/4	16	16N	14E	160
41	B.J.& S.A. Edwards	3136	111	N/2 NE/4 NE/4 less W Cor. 1.11 Ac.	2	22N	12E	18.91
42	R.D.& J.Bennett	3140	377	W/2 NE/4 NW/4	18	21N	13E	20
43	Ethel & J.E. Hughes	3141	289	E/2 SW/4 + SW/4 NW/4 NE/4	7	20N	14E	88.19
44	W.M. & L. Phillips	3144	117	S/2 NW/4 NE/4 + SW/4 NE/4 less 1.25 Ac. for Co. Rd.	36	22N	12E	58.75
45	J.G. Stollea	3144	147	S/2 SE/4	7	16N	14E	80
46	F.D. Creekmore	3153	35	S/2 SW/4 NW/4	29	18N	14E	20
47	F.P. & G.P. Staffa	3165	357	Lot 7	6	18N	14E	37.25
48	T.S.Colpitt	3175	204	NE/4 NE/4 + S/2 NE/4 + N/2 NW/4 SE/4 less 1.00 Ac. for Co. Rd.	6	22N	14E	139.22
49	E.H. & B. Knollenberg	3181	658	W/2 NW/4 less 1.5 Ac. for Co. Rd.	2	21N	13E	79.7

APPENDIX TABLE B (Continued)

Card No.	Name of The Grantee	Transaction Book: Book No.	Transaction Book: Page No.	Legal Description: Specific Reference	Section	Township	Range	Acres
50	L.E. & B.S. Carlin	3184	203	N/2 SE/4 NW/4 + SE/4 SE/4 NW/4 + NE/4 SE/4 + NW/4 SE/4	30	22N	14E	110
51	A.T. & M.L. Ferree	3184	87	W/2 NE/4 less .5 Ac.	24	22N	12E	79.50
52	C.J. & L. Gaines	3185	435	S/2 SE/4 NE/4 SE/4 + S/2 SW/4 NE/4 SE/4	14	21N	13E	10
53	P.L. & N. Bankhead	3194	208	N/2 N/2 NE/4 SE/4	14	21N	13E	10
54	F.L. & J.M. Cummings	3201	413	N/2 NW/4 NW/4 SW/4 + NE/4 NW/4 SW/4	29	18N	14E	15
55	H.C. & F.E. Dinis	3129	263	SW/4 NW/4	1	16N	12E	40
56	R. & J.Smith	3175	140	W/2 SW/4 less In beg. 356' S NW Cor. SW/4 In NW 1345.3' So. SW/4 SW/4 then W/4 to NW Cor. SW/4 then So. to beginning	26	17N	14E	76.9
57	W.E. & S.M.Jones	3191	162	NW/4 SE/4 less S 500' W 250' & less W 130' S 210' N 810' thereof	15	17N	12E	36.63

APPENDIX TABLE B (Continued)

		Transaction Book		Legal Descriptions				
Card No.	Name of The Grantee	Book No.	Page No.	Specific Reference	Section	Township	Range	Acres
58	M.H. & G.B. Rahmer	3194	15	SW/4 SW/4 less 838' S 520' thereof	11	16N	12E	30
59	F.M. Warren	3076	65	W/2 SW/4 NE/4 + W/2 W/2 NE/4 SE/4 + NW/4 + W33' NW/4 NE/4	2	16N	12E	72
60	R. Vernon	3103	594	N/2 SE/4 NW/4	15	17N	14E	20
61	W.H. Martin	3132	543	All that part of E/2 NE/4 lying E. of and adjacent to Hwys. 69 & 75	34	17N	12E	35
62	L.P. Morris	3154	667	S/2 NE/4 less 1 Ac. + SE/4 NW/4	5	17N	14E	119
63	J.H. States	2941	278	S10 Ac. Lot 3 + N/2 N/2 Lot 4	19	17N	13E	20
64	C. Brand	2946	493	S/2 N/2 of Lot 4 & S/2 of Lot 4	19	17N	13E	30
65	P. Evans	2940	584	N/2 NW/4 SE/4	28	21N	14E	20
66	R.F.M. Denison	3072	503	NE/4 NW/4	15	21N	13E	40
67	G.W. & N.J. Rayton	3175	131	NE/4 SW/4 SE/4	26	21N	13E	10
68	E.R. & S.A. Richard	3189	479	S/2 N/2 NE/4 SE/4	14	21N	13E	10

APPENDIX C

COMPARISON OF THE PRICE MAKING FORCES AMONG REGIONS I, II, AND III

The aim of this appendix is to test whether the corresponding regression coefficients and the Y-intercept of two or more multiple regression equations all are equal.

An equation was fitted to the data of each region (regions I, II, and III) separately, and to the composite data of the three regions, whereby four equations were estimated. The general form of the fitted equation was the following.

$$\text{Log } X_1 = a+b_2 \text{ Log } X_2+b_3 \text{ Log } X_3+b_4 \text{ Log } X_4+b_6 X_6+b_7 X_7+b_8 X_8$$

The resulting equations in a symbolic term were as follows:

$$\text{Log } X_1' = a'+b_2' \text{ Log } X_2'+b_3' \text{ Log } X_3'+b_4' \text{ Log } X_4'+b_6'X_6'+b_7'X_7'+b_8'X_8' \quad \text{- - - Region I}$$

$$\text{Log } X_1'' = a''+b_2'' \text{ Log } X_2''+b_3'' \text{ Log } X_3''+b_4'' \text{ Log } X_4''+b_6''X_6''+b_7''X_7''+b_8''X_8'' \quad \text{- - -Region II}$$

$$\text{Log } X_1''' = a''' +b_2''' \text{ Log } X_2''' +b_3''' \text{ Log } X_3''' +b_4''' \text{ Log } X_4''' +b_6''' X_6''' +b_7''' X_7''' b_8''' X_8''' \quad \text{- - - - - Region III}$$

$$\text{Log } \ddot{X}_1 = \ddot{a} + \ddot{b}_2 \text{ Log } \ddot{X}_2+\ddot{b}_3 \text{ Log } \ddot{X}_3+\ddot{b}_4+\ddot{b}_6+\ddot{X}_6+\ddot{b}_7\ddot{X}_7+\ddot{b}_8\ddot{X}_8 \quad \text{. . . - Composite I+II+III}$$

The variables X_6 and X_8 were constants in the case of Region II. Consequently, they were automatically excluded from the equation of this region. For this reason an attempt was made to test the identity of the regression coefficients of the remaining variables; namely, X_2, X_3, X_4, and X_7. Accordingly, it was hypothesized that:

$$\alpha' = \alpha'' = \alpha''' = \ddot{\alpha}$$

$$B_2' = B_2'' = B_2''' = \ddot{B}_2$$

$$B_3' = B_3'' = B_3''' = \ddot{B}_3$$

$$B_4' = B_4'' = B_4''' = \ddot{B}_4$$

$$B_7' = B_7'' = B_7''' = \ddot{B}_7$$

The following steps were involved in performing the test.

1. The unexplained sum of squares were calculated for each of the regional equations. In each case the unexplained sum of squares was equal to $\Sigma(X_1 - \overline{X}_1)^2 \ (1-R^2)$. Add the results of each equation. The degrees of freedom were N-P, where N is the total number of observations in three analysis and P is the total number of coefficients in these equations. In this case, 25 observations were involved in Region I, 19 in Region II, and 24 in Region III, a total of 68 observations. The number of the coefficients in each analysis were five (four regression coefficients plus a constant term). Therefore, the total number of the coefficients (P) in the three equations were 15 (12 regression coefficients plus three constant terms). Thus, the total degrees of freedom were 68-15 = 53 (Appendix Table C_1).

2. Compute sum squares of errors (the unexplained sum of squares) for the composite equation (equation estimated by using all the data), (Appendix Table C_1).

3. Subtract the result in step one from that of step two and divide by the difference between the respective degrees of freedom, ten (63-53). This represents the mean square which is due to differences between the regression coefficients in the three regression equations.

4. Divide the unexplained sum of squares in step one by the degrees of freedom attached to it; namely, 53 (68-15). This is called the error mean square.

5. The F-value was calculated by dividing the mean square in step three by the mean square in step four.

6. Compare the calculated F-value at (10,53) degrees of freedom against tabulated F-value. The calculated F-value was found to be 4.176 as compared to the tabulated F-value, 2.02 at 95 percent probability level, given 10 and 53 degrees of freedom. Since the calculated F-value exceeded the tabulated F-value, the above hypothesis was not accepted. Thus, it was concluded that at least one of the three equations differs from the others.

For this reason, an attempt was made to compare equations of regions I and II; I and III; and II and III. The same steps which were involved in the above test were followed, but this time two regions were compared at a time. The test in comparing the two equations, one fitted to Region I while the other fitted to Region II, did not show a statistical significance, while the remaining tests showed a test of significance at 95 percent probability level. Therefore, we had no basis for accepting the hypothesis that the corresponding regression coefficients and the Y-intercepts of the equations fitted to regions I and III, and II and III were equal (Appendix Tables C_2-C_4).

The final test was to ascertain whether the corresponding regression coefficients and Y-intercepts of two of the multiple regression equations; namely, one which is fitted to the combined data of regions I and II, and the other fitted to the data of Region III were equal. The hypothesis that the corresponding regression coefficients and the Y-intercepts of these two equations were equal was not accepted (at 95 percent probability level) because the calculated F-value exceeded that of the tabulated F-value (Appendix Table C_5). Therefore, there was no grounds for accepting the hypothesis that these two equations were the same.

Thus, the above test justified the attempt of dividing the Tulsa County into two geographical regions, the southern half (townships 16 through 20), and the northern region (townships 21 through 22). Accordingly, one equation was fitted to the data of combined data of regions I plus II and another equation to the data of Region III (Chapter VI).

APPENDIX TABLE C_1

ANALYSIS OF VARIANCE FOR COMPARING EQUATIONS FITTED TO REGIONS I, II, AND III

Source of The Variations	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	63	1.736	
Single Equations	53	.971	.01832
Difference	10	.765	.0765

$F = \frac{.0765}{.01832} = 4.176$ $F_{.05} = 2.02$, d.f. (10,53)

APPENDIX TABLE C_2

ANALYSIS OF VARIANCE FOR COMPARING EQUATIONS FITTED TO REGIONS I AND II

Source of The Variations	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	39	1.075	
Single Equations	34	.818	.024
Difference	5	.267	.0534

$F = \frac{.0534}{.024} = 2.225$ $F_{.05} = 2.490$, d.f.(5,34)

APPENDIX TABLE C_3

ANALYSIS OF VARIANCE FOR COMPARING EQUATIONS FITTED TO REGIONS I AND III

Source of The Variations	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	44	1.174	
Single Equations	39	.699	.0179
Difference	5	.475	.0950

$F = \frac{.0950}{.0179} = 5.307$ $F_{.05} - 2.450$, d.f. (5,39)

APPENDIX TABLE C_4

ANALYSIS OF VARIANCE FOR COMPARING EQUATIONS FITTED TO REGIONS II AND III

Source of The Variations	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	38	.806	
Single Equations	33	.425	.0129
Difference	5	.381	.0762

$F = \frac{.0762}{.0129} = 5.907$ $F_{.05} = 2.66$, d.f. (5,33)

APPENDIX TABLE C_5

ANALYSIS OF VARIANCE FOR COMPARING EQUATIONS FITTED TO REGIONS I + II, AND III

Source of The Variations	Degrees of Freedom	Unexplained Sum of Squares	Mean Squares
Composite Equation	63	1.736	
Single Equations	58	1.228	.0212
Difference	5	.508	.1020

$F = \frac{.1020}{.0212} = 4.811$ $\qquad$ $F_{.05} = 2.37$, d.f. (5,58)

APPENDIX TABLE D

CHARACTERISTICS OF INDIVIDUAL TRACTS OF LAND INCLUDED IN THE SAMPLE

Card No.[a]	Per Acre Price of Land (Dollars)	Size of Transaction (Acres)	Productivity Grade of Tract[b]	Distance From County Seat (Miles)	Distance From Nearest Town (Miles)	Distance From Paved Road (Miles)	Mineral Rights Transferred[b]	Type of Road Touching Tract[b]	Per Acre Assessed Value (Dollars)	Assessment-Sale Ratio (Percent)
1	81.75	20.00	5.50	21.50	9.0	0.20	0.50	3	15.00	18.00
2	91.70	80.00	7.50	14.00	5.0	0.00	1.00	1	12.00	13.00
3	456.45	40.00	5.00	13.00	5.0	0.25	1.00	1	60.00	13.00
4	1076.40	20.00	4.00	2.00	2.0	0.00	1.00	1	150.00	13.90
5	347.45	40.00	7.50	4.80	5.0	0.00	1.00	1	45.00	13.00
6	623.35	80.00	5.44	6.20	5.0	0.00	1.00	1	75.00	12.00
7	579.08	40.00	6.50	6.20	6.0	0.00	1.00	1	75.00	13.00
8	546.77	105.16	6.71	7.50	4.0	0.00	1.00	1	75.03	13.70
9	238.45	40.00	5.00	9.50	3.5	0.00	1.00	1	30.00	12.60
10	236.20	15.00	5.27	7.50	2.5	0.75	1.00	3	30.00	12.70
11	300.23	40.00	4.00	11.20	1.0	0.50	1.00	8	24.00	8.00
12	204.51	89.40	5.00	8.60	2.5	0.00	0.50	1	31.21	15.00
13	101.39	160.00	9.00	16.50	5.0	0.00	0.50	1	15.63	14.50
14	486.20	37.18	5.25	7.00	4.5	0.00	1.00	1	31.47	6.50
15	128.80	37.99	5.71	19.50	1.5	0.25	1.00	3	12.63	9.80
16	141.42	34.60	7.11	12.85	4.0	0.00	0.00	1	21.10	15.00
17	962.40	25.00	9.00	4.20	4.0	0.00	1.00	1	143.60	15.00
18	65.24	75.00	5.74	16.20	3.0	0.25	1.00	8	15.60	24.00
19	154.50	80.00	6.19	11.50	2.0	0.00	0.50	1	21.88	14.00
20	489.30	10.00	7.60	3.70	4.0	0.00	0.50	1	54.00	11.00
21	197.43	30.00	5.67	9.00	5.0	0.00	0.50	1	15.67	7.90
22	366.45	78.00	5.00	9.50	6.0	0.00	1.00	1	56.03	15.30

APPENDIX TABLE D (Continued)

Card No.[a]	Per Acre Price of Land (Dollars)	Size of Transaction (Acres)	Productivity Grade of Tract[b]	Distance From County Seat (Miles)	Distance From Nearest Town (Miles)	Distance From Paved Road (Miles)	Mineral Rights Transferred[b]	Type of Road Touching Tract[b]	Per Acre Assessed Value (Dollars)	Assessment-Sale Ratio (Percent)
23	123.87	39.50	5.77	10.20	0.3	0.00	1.00	1	31.65	25.50
24	69.53	33.34	8.00	21.80	4.0	1.20	1.00	2	11.40	16.40
25	343.70	20.23	6.92	7.00	2.5	0.00	0.50	1	40.53	11.80
26	1358.33	40.00	7.00	2.50	2.0	0.00	0.50	1	206.50	15.20
27	100.48	263.96	7.73	14.50	2.0	0.00	1.00	1	12.54	12.50
28	37.02	160.00	8.88	19.00	6.0	0.65	1.00	8	5.88	15.90
29	592.30	10.00	6.70	6.60	5.0	0.00	1.00	1	94.00	15.90
30	279.65	20.00	5.00	12.50	5.0	0.00	1.00	1	44.00	15.70
31	146.95	82.36	4.23	18.20	1.0	0.00	1.00	1	32.30	22.00
32	110.84	39.50	7.75	17.80	1.0	0.00	1.00	1	15.95	14.40
33	206.00	30.00	4.70	15.50	5.0	0.25	1.00	8	30.00	14.60
34	907.55	101.86	5.73	3.50	4.0	0.00	1.00	1	137.25	15.00
35	925.39	160.00	5.74	2.50	2.5	0.00	1.00	1	140.44	15.20
36	362.50	20.00	5.25	11.20	2.0	0.75	0.50	3	56.50	15.60
37	746.88	80.00	5.00	3.20	3.5	0.00	1.00	1	112.50	15.00
38	118.75	40.00	7.38	14.50	4.5	0.25	0.50	1	12.50	10.50
39	17.20	80.00	8.00	21.00	7.0	2.00	0.00	3	3.13	18.20
40	18.88	160.00	9.81	20.00	7.0	1.50	1.00	3	4.19	22.20
41	198.31	18.91	4.65	15.00	4.0	0.00	1.00	1	31.73	16.00
42	187.50	20.00	4.00	8.20	2.0	0.00	1.00	1	30.00	16.00
43	396.87	88.19	4.97	4.50	5.0	0.00	1.00	1	59.53	15.00
44	281.70	58.75	5.51	10.20	1.0	0.00	0.50	1	42.89	15.20
45	65.63	80.00	9.19	18.50	6.0	0.75	0.50	3	10.38	15.80
46	537.50	20.00	4.00	9.30	5.0	0.00	1.00	1	82.50	15.40
47	798.66	37.25	7.08	5.00	4.0	0.00	1.00	1	120.00	15.00
48	117.37	139.22	5.76	21.50	3.1	0.00	1.00	1	17.67	15.00

APPENDIX TABLE D (Continued)

Card No.[a]	Per Acre Price of Land (Dollars)	Size of Transaction (Acres)	Productivity Grade of Tract[b]	Distance From County Seat (Miles	Distance From Nearest Town (Miles)	Distance From Paved Road (Miles)	Mineral Rights Transferred[b]	Type of Road Touching Tract[b]	Per Acre Assessed Value (Dollars)	Assessment-Sale Ratio (Percent)
49	197.62	79.70	5.75	11.80	4.0	0.00	1.00	1	30.11	15.20
50	123.96	110.00	5.14	19.00	0.5	0.00	1.00	1	21.64	17.50
51	103.77	79.50	6.88	13.50	2.0	0.25	1.00	3	18.87	18.20
52	325.00	10.00	5.30	10.50	3.0	0.00	0.50	1	53.00	16.30
53	325.00	10.00	5.50	10.20	3.0	0.00	0.50	8	53.00	16.30
54	416.67	15.00	5.00	9.50	5.0	0.00	0.50	1	65.33	15.70
55	118.75	40.00	7.33	15.00	5.0	0.00	0.50	8	12.50	10.50
56	61.77	76.90	5.73	19.00	6.5	0.00	1.00	1	9.75	15.80
57	88.73	36.63	5.00	10.00	1.0	0.08	0.00	8	15.02	16.90
58	291.67	30.00	4.67	15.00	5.5	0.00	0.50	1	45.00	15.40
59	75.11	72.00	6.56	13.20	4.5	0.25	1.00	8	12.50	16.60
60	64.40	20.00	5.00	21.20	7.5	0.75	1.00	8	16.00	24.80
61	278.57	35.00	6.00	12.00	2.5	0.00	0.50	1	42.00	15.10
62	281.93	119.00	5.34	12.20	5.0	0.00	1.00	1	38.91	13.80
63	204.40	20.00	10.00	12.00	2.2	0.00	1.00	1	30.00	14.70
64	172.94	30.00	10.00	12.00	1.8	0.00	0.50	1	12.00	6.90
65	313.40	20.00	5.40	7.00	2.2	0.40	1.00	8	45.00	14.40
66	199.58	40.00	7.25	9.50	3.5	0.00	1.00	1	12.50	6.30
67	325.00	10.00	7.80	8.80	2.0	0.20	1.00	8	53.00	16.30
68	325.00	10.00	6.00	11.20	3.0	0.00	0.50	1	53.00	16.30

[a]Each card number corresponds to individual tract of land cited in Appendix Table B.

[b]See Chapters IV and VI, for productivity rating classification, road types, and mineral rights transfers.

VITA

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Candidate for the Degree of

Doctor of Philosophy

Thesis: AN ECONOMIC EVALUATION OF FARMLAND FOR TAX ASSESSMENT, TULSA COUNTY, OKLAHOMA

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Biographical:

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