A RESTRICTED ANALYSIS OF THE RELATIONSHIP

BETWEEN PROPERTY TAX ASSESSMENTS

AND ELECTRIC UTILITY EARNINGS

IN DENTON

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AND ELECTRIC UTILITY EARNINGS
IN DENTON

THESIS

Presented to the Graduate Council of the
North Texas State University in Partial
Fulfillment of the Requirements

For the Degree of

MASTER OF SCIENCE

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Denton, Texas

May, 1964

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CHAPTER I

INTRODUCTION

Electric power was originally supplied to Denton, Texas, by the Denton Water, Light and Power Company owned by one W. J. Williams. The city council granted the franchise to Denton Water, Light and Power Company on January 28, 1892.[1]

The contract between the city and the newly formed power plant provided that the public schools would receive water and electricity free of charge, as would the city hall.

The contract also gave the city of Denton the option to purchase the system at the end of a ten year period, if they so desired, at a price that would be determined by the machinery set forth in the contract.

In return, the system was to be exempt from any taxation that fell within the jurisdiction of the city. Also, the city council was to pass an ordinance giving the company the power to set rates that would not exceed the maximum annual rates of those charged to consumers in the cities of Dallas, Fort Worth, and Temple, Texas.[2]

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[1]William Collins, The Denton Muncipal Power Plant (Denton, 1938), p. 11.

[2]*Ibid*., p. 10.

As was stated above, this all came to pass on the 28th day of January, in the year 1892. At that time Denton Water, Light and Power Company, capitalized at $50,000, began furnishing private utility service to the city of Denton, Texas. The relationship between the newly established power system and the city it served was a harmonious one during the first ten years of tenure. The symmetry of the relationship began to deteriorate somewhat in 1901.[3] It was in July of that year that the City Council voted to consider exercising their contractual option to purchase the power facilities of Denton Water, Light and Power Company, thus initiating the steps which would culminate with the advent of municipal enterprise in Denton, Texas.

As could be expected, the method put forth in the contract for determining a just and fair price for the Company failed to function to the satisfaction of both parties. The Denton Water, Light and Power Company submitted a price of $50,000, a figure which the City Council readily rejected. The initial rejection of the Company's considered fair market value was followed by a period of complete discord, in which the divergence between officials of the Denton Water, Light and Power Company and the City Council took the form of parallel

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[3] _Ibid_., p. 18.

lines; both progressing in the same direction, but never meeting.

It was during this period that the City of Denton refused to pay a bill submitted by the Denton Water, Light and Power Company for services rendered, a charge which amounted to $3,200.[4] The Company brought suit against the City when they refused to pay the bill submitted them. The court decision was announced on August 31, 1904.[5] The results were highly unfavorable to the City of Denton. The most objectionable result being that the franchise of Denton Water, Light and Power Company was to be extended for a period of thirty years, and the City's option to purchase the plant, as stated in the original contract, was forfeited.

The displeasure that was evident among the City Offials was put in the form of a bond election for the purpose of securing funds to erect a municipally-owned water and power facilities.

On December 7, 1904,[6] the citizens of Denton approved a $25,000 bond issue for the purposes stated above, by a majority vote. The bond issue was to mature on February 27, 1947. The indenture gave the City Council the right to redeem a part, or the total issue at which time

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[4] <u>Ibid.</u>, p. 17. [5] <u>Ibid.</u>, p. 17. [6] <u>Ibid.</u>, p. 20.

they so desired. The bonds were sold to the City Loan & Trust Company of Gainesville, Texas, on February 27, 1905.[7]

The managers of Denton Water, Light and Power Company were quick to recognize the impossible situation which was developing. Not wishing to enter into competition with the City of Denton, they agreed to sell their system for a sum of $65,000 of which $50,000 would be the original bond issue of the private company,[8] and was to be paid off out of the profits of the new owners.[9] The complete transaction required a cash outlay of only $1,500. The City's water works bond issue of $25,000 was put into a special expansion fund to be used in the future for expansion purposes.[10]

So it was on the first day of July, 1905, that the City of Denton officially entered the controversial realm of public ownership, thus, becoming the sole heirs of all the problems that are inherent within this realm. The most significant was the application of earnings derived from the operation of the Utility System to the

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[7]Ibid., p. 21.

[8]This is the original capitalization of the private company. Only the interest payments had been met, and no part of the issue had been retired.

[9]Collins, op. cit., p. 23.

[10]Collins, op. cit., p. 24.

functions of the City Government, a role in the past left primarily to ad valorem taxes. This study will concern itself with this problem.

Statement of the Problem

The relationship between property, both real and personal, and the tax levied upon it, is somewhat less complex than the relationship this study aspires to discern.

All property has a market value which is determined by the interaction of the forces of supply and demand. The fact that a piece of property is not put into the market place for purposes of an actual transaction is of little consequence. Tax departments and courts have long recognized that sale prices are not the sole determinants of market value.[11] Sales prices are a major factor in property value, but appraisals based on a number of criteria, including reported sale prices, will render a just market value for a tax basis. It is necessary to give proper weights to the many factors which influence the balance between supply and demand in order to arrive at a full market value which reflects the "true" value of property. In this manner it is possible to attach a value to each property unit which will be closely aligned with

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[11] Clara Penniman, "Property Tax Equalization in Wisconsin," <u>National Tax Journal</u>, XIV (June, 1961), p. 185.

the definition of full market value. Clara Penniman defines this value as "an owner willing but not obliged to sell and a willing buyer not obliged to buy."[12] Having arrived at fair market values for all units of property, be it personal or real, city tax departments are left only with the task of applying uniform assessment ratios and uniform tax rates in order to fulfill all the prerequisites which go into the makeup of a proportional tax relationship.

Denton recently reappraised all property in order to eliminate the presence of widely divergent assessment ratios. Prior to the reappraisal program assessment ratios ranged from a low of 8 per cent to a high of 68 per cent.[13]

Property in Denton is assessed at 40 per cent of 90 per cent of market value, or 36 per cent of the market value.[14] Since 1956, the tax rate per $100 of assessed value has been 1.5 per cent.[15]

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[12] Ibid., p. 185.

[13] An interview with Tax Collector-Assessor of Denton, Mr. Buttrill, August 3, 1961.

[14] An individual whose property has a market value of $10,000 will be assessed at 90 per cent, or $9,000. This amount is assessed for tax purposes at 40 per cent, or $3,600 which is 36 per cent of $10,000.

[15] Price Waterhouse, Financial Statements and Supplementary Financial Information (Denton, 1960), p. 53.

A joint study by several private enterprises with large vested interests, with the exception of Texas Power and Light Company, in Denton revealed the actual Denton City assessment ratio to be 34.2 per cent.[16] This is slightly below the aimed for assessment ratio of 36 per cent. Sampling procedures, however, could easily account for the disparity between the two figures.

All property in Denton, irrespective of the status of the owner, has the same assessment ratio and tax rate applied. This has been the case since the reappraisal program.[17]

Given the above data about the property tax as it exists in Denton, the average citizens could discern the relationship of the property tax. The members of the City Council can intelligently consider any property tax rate change for added revenue, because they are aware of the tax relationship. This relationship in Denton is proportional.

Over the past decade the ad valorem tax has accounted for an average of 46 per cent of Denton's total yearly revenue.[18]

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[16]These include Southwestern Bell Telephone, Texas & Pacific Railway company, Santa Fe Railway Company, KATY Railway Company, and Texas Power & Light, Denton County Ratio Study (Denton, 1960), p. 2.

[17]An interview with City Tax-Assessor, Mr. Buttrill, August 3, 1961.

[18]Calculated from selected data derived from the City Audit Reports for the years 1950 through 1960.

Table I displays the significant role that electric utility profits have played in the revenue structure of Denton. Since 1950 electric utility transfers[19] have accounted for an average of 26 per cent of Denton's total yearly revenue.[20] The application of electric utility

TABLE I

ELECTRIC UTILITY PROFITS TRANSFERRED TO GENERAL FUND FOR SELECTED YEARS

Year	Electric Transfer	Total Revenue	Per Cent
1950	$120,000	$ 630,000	16.2
1954	169,350	472,334	35.9
1955	192,694	618,972	32.2
1956	184,000	689,257	26.7
1957	126,500	741,483	24.0
1958	150,000	802,201	25.3
1960	114,424	1,088,568	17.1

Source: Auditors Report for selected years given above.

[19]As defined by Section 12.03 of the City Charter: "After all requirements of the various funds have been met, there shall be computed a return on the net investment in the utility system. The "Net Investment" figure used in these computations shall be taken from the independent audit of the utility system for the last fiscal period. The City shall be entitled to receive annually on the net investment from excess revenue, if any, not more than six per cent of the net investment.

[20]Calculated from selected data derived from the City Audit Reports for the years 1950 through 1960.

earnings to the functions of municipal government makes it unnecessary for the City of Denton to levy a direct tax equal to the amount of the transfer.

In the strictest sense utility earnings cannot be considered a tax, direct or indirect. However, they have accounted for a substantial portion of Denton's revenue, and while not being a direct tax, utility earnings have most certainly served as a substitute for such.

It seems only proper that any sizeable source of Denton's revenue should be based on the equitableness of the burden imposed when such source is compared with an alternate method of raising an equal amount of revenue. This view is supported by the International City Managers' Association when they state:

> Whether a municipality decides to raise a sizeable portion of its nonproprietary revenues from municipal enterprise or not should be made to depend on the equitableness of the burden thus imposed compared with alternative methods for raising a like sum of money.[21]

The problem of this study will be to compare the equitableness of electric utility earnings as a source of city revenue with the equitableness of revenue derived from the property tax.

Scope of the Study

Persons included in this study were those listed on the 1960 tax rolls of Denton, who payed monthly electric

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[21] The International City Managers' Association, Municipal Finance Administration (Austin, 1955), p. 49.

utility bills for the same period of time and further that the same electric utility bills fell within the limits prescribed by the residential A-1 rate classification.[22]

The above definition of individuals included in the study excludes two types of electric power consumers. First, it was necessary to exclude any consumer who did not pay property taxes. This exclusion was necessary because the basis for comparing the equitableness of utility profits with that of property tax payments is the property tax assessment. Second, those individuals who failed to pay electric utility bills for a complete year. The frequency of this occurrence renders this exclusion almost insignificant.

Purpose and Significance

When the Denton Municipal Power Plant charges rates which more than cover the cost of production, distribution, expansion, and subsequently apply the excess charges to the functions of City Government, if only in part, they are in effect reducing the amount of direct taxes necessary to meet municipal expenditures. In doing so they create a new source of revenue which, like a direct tax, has a definite relationship to its source. In this instance, the

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[22]See Appendix A.

assumption is that the shift is from a proportional property tax[23] to an unknown relationship between utility profits and electric power consumers.

The primary purpose of this study will be to compare the equitableness of utility earnings as a source of municipal revenue when compared to that of property taxes. Put another way, are utility earnings regressive, progressive, or proportional in nature when compared to property tax assessments? The social and economic desireability of the results, whatever they might be, will be the secondary objective of this study.

The role that utility earnings will play in the future revenue structure of Denton is revealed by a study conducted in 1958 by Black & Veatch, a consulting engineering firm operating out of Kansas City, Kansas. They found that the peak load of the Denton Muncipal Power Plant increased at an average rate of 13.9 per cent over the last eighteen years.[24] By the fiscal year 1969

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[23]To illustrate this relationship two extreme cases taken from the files of the 1960 tax roll will be used. An individual whose property was assessed at a value of $1,030 paid a property tax bill of $15.45. An individual whose property was assessed at $13,390 paid a tax bill of $350.85. In both instances the relationship of property tax payments to assessments is identical, thus the relationship is proportional.

[24]Black & Veatch, <u>Report on Cost of Service and Rates for Municipal Utility Services</u> (Kansas City, 1958), p. 1.

the system load is forecast to be approximately 74,000 kilowatts.[25] The present productive capacity is 59,935 kilowatts.[26]

In a world where technology has taken a foremost seat in determining the standard of living for the household, it is reasonable to expect a continuing increase in the already wide usability of electric power, particularly in the household unit.

A source of revenue which comprises one fourth of total city revenue should be subjected to an intensive, empirical analysis. Armed with an analysis of this type it will be possible to determine whether or not the municipally owned electric utility plant is justified in charging rates above cost, and substituting earnings for direct property taxes.

A study by Black & Veatch recommended rate increases of 6.4 per cent for the Electric Department, 7.9 per cent for the Water Department, and 29 per cent for the Sewer Department.[27] In their study considerable time and research was devoted to a comparison of Denton's rates,

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[25] Ibid., p. 1.

[26] As of January, 1963, this was the installed generating capacity.

[27] Black & Veatch, op. cit., p. 1.

including the recommended rate increases, and those of surrounding areas. Their concern with the comparability of Denton's residential power rates is illustrated by the following passage.

> . . . . these recommended rates are designed to be fair and equitable between all consumer classifications for each of utility services.[28]

This study proposes to carry their conclusion further and determine whether these rates are designed to be fair and equitable as a method of collecting City revenue.

Survey of Literature

William Wheat Collins wrote his master's thesis on The Denton Municipal Power Plant in 1938.[29] His was more or less a historical account of the acquisition of the power plant, and the transition period that followed.

Collins was somewhat preoccupied with the flow of capital from the small utility companies into the hands of large eastern money men by a method prevelant in that period known as the holding company, and with the many blessings derived from the newly acquired municipal enterprise.

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[28] Black & Veatch, op. cit., p. 1.

[29] Collins, op. cit., pp. 1-92.

This is not to imply that Collins reached conclusions which were unfounded, only, that in like studies before and after his, absolutely no consideration is given to the ramifications that municipal ownership and operation above cost of distribution embraces.

A brief study entitled "Municipal Utility Profits or Taxes" was conducted by Howard K. Hyde in 1936.[30] Using the small town of Winnetka, Wisconsin, Hyde made a direct comparison of individual yearly property tax payments with the electric utility payment for the month of June. After computing the ratio of June electric bill to the annual tax bill he was able to discern the relationship between the two. Hyde concluded that this relationship was regressive.

It is important to note, however, that studies of this nature are completely dependent upon the utility and property tax rates when considering the application of the results to cities other than the one Hyde studied. Consequently, the conclusions reached by Hyde will only be valid in cities which have identical property tax and utility rates to those of Winnetka, Wisconsin.

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[30]Howard K. Hyde, "Municipal Utility Profits or Taxes," <u>The Journal of Land & Public Utility Economic</u>, XII (March, 1936), 212-215.

Any variance in one or the other, or both of the rates necessarily creates a unique relationship.

One might reasonably object to the use of an electric utility payment for only one month serving as the basis for comparison with the property tax payment contention that the month of June is "almost"[31] an average month in Winnetka, Wisconsin would not be valid in the city of Denton. As displayed in Table II, there is a significant increase in the peak load during the months of May through October. The peak load during this period is almost twice that of the remaining months.

TABLE II

MONTHLY PEAK LOADS FOR DENTON'S
ELECTRIC POWER SYSTEM
FISCAL YEAR 1961

Month	KW Peak Load	Month	KW Peak Load
October	18,200	April	12,400
November	13,600	May	18,400
December	13,300	June	23,400
January	12,700	July	25,200
February	12,000	August	27,000
March	12,300	September	24,400

Source: Production Records, Denton Municipal Power Plant, 1960-1961.

[31] Ibid., p. 213.

This study will use the yearly electric utility payments as a basis of comparison, thereby removing any bias that might occur with the use of only one month.

CHAPTER II

BASIS OF THE STUDY

This chapter is designed to establish a basis for the study. Certain elements must be considered on which the methodology and conclusions will rest.

First, characteristics that are unique to public utilities need to be considered, particularly those of price discrimination, decreasing costs and their relationship to residential electric power rates.

Second, methods used in this study are designed to measure the equitableness of electric utility bills when compared to property tax assessments. It is worthwhile then to give general consideration to individuals who have no property tax assessments, but pay electric bills. This requires a theoretical examination of the shifting and incidence of property taxes on residential rental property in Denton.

Third, this study will examine the possibility that the value of an individual's household is indicative of his level of income. Since the property tax assessment is directly related to that value, then it too would reflect the income bracket of the property tax payer. If this is so, then one might hypothetize that the relationship between electric bills and property tax assessments is similar to the relationship between electric bills and incomes.

The elements outlined above deserve general consideration and serve as the framework of this chapter.

Characteristics of Electric Utilities

A distinguishing characteristic of electric utility enterprises is that they must maintain productive capacity in excess of total consumption. The productive capacity of the Denton Power Plant must stand ready to generate and distribute power in an amount equal to the highest point on the system's aggregate demand curve. In addition, excess capacity must be available to provide for a failure of one or more generating units and to meet future increases in peak demand.

As shown in Table II, the peak demand in 1961 was 27,000 kilowatts in the month of August. This was approximately 25 per cent[1] below the 1961 generating capacity of 35,700[2] kilowatts.[3]

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[1]An excess productive capacity of 25 per cent is recommended by Black & Veatch.

[2]Black & Veatch, op. cit., p. 3.

[3]This figure has increased to 59,935 kilowatts as of January, 1963.

The increase in the peak demand started in May, and remained relatively high throughout the summer months. The increase can be attributed to the increased use of air-conditioning units. The peak demand in the months November, 1960, through April, 1961, is relatively low; consequently the need for a generating capacity of 35,700 kilowatts seems, at first glance, to be remote.

However, the electric power system had to possess the generating capacity to supply the peak demand for the twelve-month period of 27,000 kilowatts in August, 1961. This was necessary despite the fact that between the months of November, 1960, and April, 1961, the peak demand ranged rather narrowly between a low of 12,000 to a high of 13,600 kilowatts.

The load factor is the governing statistic that indicates the relationship of the average load to the peak load for a particular time period. "The load factor is an average load expressed as a percentage of the peak load."[4]

The Denton Power Plant, for most purposes, is interested only in the load factor for each month. The peak load, which may be for a time period of only fifteen minutes during the month, determines the amount of generating capacity that the system must maintain.

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[4]Eli Winston Clemens, Economics and Public Utilities (New York, 1950), p. 282.

As the load factor increases the cost per unit of electric power (kilowatt hour) decreases, because the fixed costs[5] which are relatively large in amount for electric utilities, are spread over more productive units.

Chart 1 exhibits the projected electric power demands through the fiscal year 1970. The projected demand calls for an installed generating capability of 90,700 kilowatts by 1970. This will require an additional 33,000 kilowatts to the 1963 capacity of 57,700.

The plan, as presented by Black & Veatch, calls for this addition to the system in the calendar year 1966.[6]

Another distinguishing characteristic of electric utility enterprises is decreasing costs.

With the reserve capacity that is provided for in the production of electric power, and a load factor below 100 per cent, the Denton Power Plant may be said to be operating under conditions of decreasing costs that is to say, as more units of power are produced and marketed the cost per unit decreases. Fixed cost will remain constant

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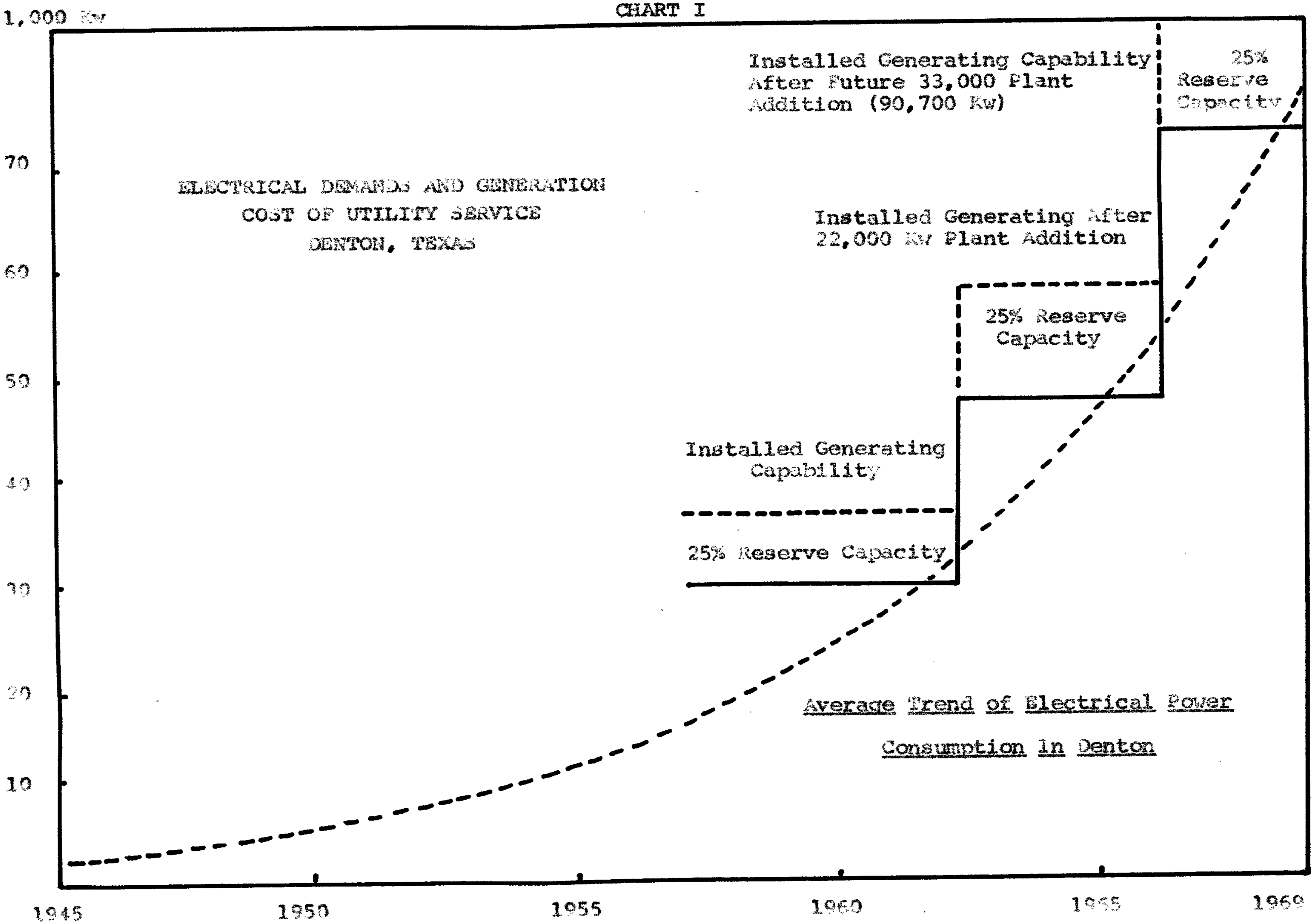
[5]Costs are classified as fixed if their total amount remains constant irrespective of changes in output. Examples of fixed expenses are debt interest and management salaries.

[6]Black & Veatch, _op. cit._, p. 3.

CHART I



Source: Black & Veatch, <u>Report on Cost of Service and Rates for Municipal Utility Services</u> (Kansas City, 1958), p. 3.

regardless of any change in output. The other component of total cost, variable, may decrease, increase, or remain constant, as output changes.[7]

Clemens contends that under these conditions:

> A utility will increase its output as long as the price which it can get for additional output is greater than the additional cost if it can retain all the revenue derived from the existing output.[8]

This theoretical model is familiar to economists as producing at a point where marginal cost equals marginal revenue. Clemens does not draw a distinction between privately and publicly owned utilities; however, he is obviously referring to any utility that operates at a pro.

In actual practice Clemen's conclusion is not always applicable. Given the ability to discriminate between the elasticities of customer demands, some customers are served at a price below marginal cost.[9]

Thus, the electric utility system discovers itself to be in what could be termed perpetual decreasing cost conditions. A continual increase in the load factor will be a signal that additional generating capacity is needed. The addition of generating capacity increases the fixed cost, thereby increasing the cost per unit of power. The

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[7]Clemens, op. cit., p. 248.

[8]Ibid., p. 254.

[9]Ibid.

system then comes under pressure to reduce its cost per unit which, if successful, will culminate with the addition of more generating capacity. This process is exemplified in Chart I for Denton's power system.

Methods used by electric utilities to influence the load factor fall into two classifications: price differences based on cost per unit of output and price discrimation based on demand for power.

The least accepted cost argument concerns the utilization of total generating capacity. Because of erratic demand schedules, electric utility companies always have some unused generating capacity. At times during a given period the load factor may be as low as 50 per cent. Given these conditions, electric utility companies will offer lower rates to off-peak buyers. As long as off-peak sales do not necessitate further plant investment they can well afford to. This assumes, of course, that marginal increases in revenue exceed the marginal increases in cost. The rationale behind this type of price discrimation is that revenues from off-peak sales are used to reduce the cost of on-peak production, thus, reducing the selling price per unit of power to all classes of power consumers. There is some question as to whether these off-peak earnings are actually used to lower the selling price of power to regular consumers, or whether in fact, the only purpose they serve is to increase the profit margin.[10]

Joint cost allocation is another method employed by rate experts to justify selling power at varying price levels. Rate managers explain that the differences in selling prices are not greater than the differences in the average cost of delivering one unit of power to the separate groups.

While the various methods of joint cost allocation range from simple to complex, the most widely used basis of allocation is maximum class demands for service.[11] Employment of this method requires that the maximum demand for each consumer class be measured separately.

The largest amount of consumption during a period of time, usually thirty minutes, represents the maximum class demand for power. The maximum demand for each class of consumer is totaled to arrive at the aggregate maximum demand for the system. The maximum demand of each class is converted into a ratio of that aggregate maximum demand of which is used to prorate plant overhead or joint cost. The class of consumer receiving the largest proportion of joint cost will pay the highest price per kilowatt hour.

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[10] Emery Troxel, _Economics of Public Utilities_ (New York, 1947), p. 574.

[11] _Ibid._, p. 575.

Accountants and cost engineers will attest to the fact that any allocation of joint costs or, if you prefer, overhead expenses to the productive unit is basically arbitrary.[12] Consequently, students of electric utility rates are somewhat skeptical of elaborate cost studies which are presented as an explanation of price discrimination. Troxel is of the opinion that:

> Company studies of cost differentials clearly do not prove that class prices of service are nondiscriminatory. The firms simply cannot present convincing evidence that the price differentials are not larger than the cost differentials for the several kinds of service. So there is still a basis of belief that companies, guided by demand conditions, have a discriminatory pattern of class pricing. In several ways the conduct of company managers suggest a noncost basis of price differentiation.[13]

Most electric utilities attempt to differentiate between the elasticities of various customer demands as stated above. Those customers having an inelastic demand curve will be charged a higher rate per kilowatt hour than customers who possess elastic demand curves. The higher rate is based on the premise that their consumption will not fall off significantly due to their need for a certain amount of electric power. The latter group, whose demand is elastic, will be charged lower prices

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[12]Rufus Wixon, editor, Accountants Handbook (New York, 1962), Chapter 6, p. 5.

[13]Troxel, op. cit., p. 578.

because their consumption "will increase more than proportionally to the decline in price."[14]

Among the various customer classifications in Denton, residential rates are higher because this group requires a relatively fixed amount of electric power, consequently they are willing to pay a higher average price per kilowatt hour than commercial and industrial consumers.

The management of Denton's Municipal Power Plant is assuming an inelastic demand curve for residential consumers, which in fact, may not be the case. It is quite possible that a reduction in residential rates would increase demand to an extent that profits would equal, if not exceed, their level at the higher rates. The increased demand comes from at least two sources. First, those people who considered electrical rates beyond their financial capacity would, at lower rates, install additional electrical household devices. Second, individuals who already possess the maximum number of electrical devices would be encouraged to increase their use of these.

The national averages show that reduced residential power rates have been followed by an increase in consumption and revenue. Table III exhibits this relationships for the United States between the years 1926 and 1947.

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[14]Clemens, _op_. _cit_., p. 254.

While the average price for residential service paid per kilowatt hour declined from 7.00 cents in 1926, to 3.09 cents in 1947, the average consumption jumped from 430 to 1,438 kilowatt hours. During the same period of time the

TABLE III

CHANGES IN THE COST AND CONSUMPTION
OF RESIDENTIAL ELECTRICITY
1926-1947

Year	Average Consumption Per Customer In Kw-hr.	Average Annual Bill	Average Cost Per Kw-hr.
1926	430	$30.10	7.00¢
1947	1438	44.43	3.09¢

Source: Eli Clemens, <u>Economic and Public Utilities</u>, (New York, 1950), 279.

average annual electric bill increased from $30.10 to $44.43. It would seem, in the long-run at least, that the demand curve for residential power consumers is elastic.

Clemens is of the opinion that "if rates had been reduced even more sharply a still greater increase in the consumption would have yielded the industry the same profits."[15]

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[15]*Ibid.*, p. 279.

Clemens was not referring to Denton's Power System; however, it is conceivable that the residential power rates in Denton are unnecessarily restricting consumption. That is to say, with lower average power rates the same earnings level could be maintained because of a favorable consumption response.

This possibility will be examined at length in Chapter IV of this study.

Shifting and Incidence of Property Taxes

A study conducted by the Texas University Bureau of Business Research showed home ownership in Denton to be 59 per cent.[16] Put another way, 59 per cent of residential homes in Denton are occupied by legal owners. The remaining 41 per cent are occupied by someone other than the legal owner. The majority of this 41 per cent rent their place of residence, thus do not pay a property tax. As explained earlier, these individuals were excluded from this study. Since they comprise a high (41 per cent) proportion of electric power consumers, it is worthwhile to examine the shifting and incidence of property taxes in Denton. Conceivably the entire property tax could be incorporated in the price of rent.

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[16] Texas University Bureau of Business Research, An Economic Survey of Denton County (Austin, 1957), p. 14.

Most students of the shifting and incidence of property taxation make several varying, but essentially similar, assumptions when attempting to explain the amount of property tax shifted, and the approximate time factor necessary to effect the shifting of the tax.[17] This study will consolidate these similar assumptions into a consideration of the economic environment of the community. This is based on the premise that all factors influencing the shifting of property taxes into the rent payments permeate from the economic environment, with the exception of the age of the rental property and the length of time the property tax has been in existence.

There is little need to discuss the period of time the property taxes have been present in Denton, because a thirty-year period is more than enough time for the shifting of the tax from the owner to tenant.[18] The property tax in Denton is considerably older than thirty years.

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[17]See for example, William J. Shultz and C. Lowell Harris, American Public Finance (Englewood Cliffs, 1959), p. 169; or Otto von Mering, The Shifting and Incidence of Taxation (Philadelphia, 1952), Chapter X; or Richard A. Musgrave and Carl S. Shoup, Readings in the Economics of Taxation (Homewood, 1959), p. 234; or E. H. Plank, Public Finance, (Homewood, 1953), p. 214.

[18]Shultz and Harris, op. cit.

The age of the rental property in Denton has both extremes--those that have survived a change in the fashion of households, and those of the most modern and recent patterns.

It would seem that the market for rental property could most properly be deemed a sellers market, that is to say the demand for rental property is at the moment off balance with the supply.

This can be attributed to the rapid growth of North Texas State University, and to the lack of adequate housing facilities of the University. Certainly, other factors have influenced and helped to create the market demand for rental property in Denton; however, few would disagree that increasing college enrollment is the primary factor.

Given a flexible flow of capital between industries, an inelastic market demand, and the presence of competition in the building industry, the capitalist will maximize the return on his investment by incorporating the amount of the property tax payment into the rent payment, thereby shifting the tax burden to the tenant.

As long as the demand for rental property is increasing, and investment capital is supplying rent property, then it is reasonable to assume that the amount of property tax on rental property due each year is embodied in the price of rents in Denton. Property taxes on property which does not produce an income to the owner cannot in any way be shifted, consequently individuals who occupy and hold the legal title to their place of residency have to pay the property tax out of another form of income.

If the above be true, and it surely must be to an extent, then all consumers of electrical power within the tax jurisdiction of Denton are property tax payers. Those that rent, pay indirect property taxes through higher rents, and those that own legal title and reside in their households pay direct property taxes.

Property Tax Payments and Income

That the value of an individual's household, and therefore his property tax assessment is a measure of that individual's income, is a view shared by the Brookings Institution.[19] In their study, America's Capacity to Consume, they found that expenditures on the home were fairly constant throughout the income groups of non-farm families. Household expenditures as a percentage of income tended to decrease as incomes increased.

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[19]Levin, Moulton, and Warburton, America's Capacity to Consume (Washington, 1934), p. 257, as cited by H. K. Hyde, "Municipal Utility Profits or Taxes," The Journal of Land Public Utility Economics, XII (March, 1936), 214.

H. K. Hyde, in his study, states that:

> The item of expenditure on home includes more than that reflected in the property tax but it probably can be assumed that the various types of expenditures on the home are roughly proportional. We may then conclude that a tax which is regressive when compared with the property tax is at least as regressive when compared with income and is probably somewhat more so.[20]

More recent studies in this area were conducted by Theodore Beckman and Harold Maynard. The results of this study and one conducted by the University of Pennsylvania[21] appear in Table IV. An examination of the table leads one

TABLE IV

EXPENDITURES OF DISPOSABLE INCOME RELATED TO THE OPERATION OF HOUSEHOLDS FOR 1950

Income Level	Percent of Disposable Income			
	Housing	Fuel, Light, and Refrig-eration	Household Operation	Furnish-ing and Equipment
Under 1,000	38.9	15.6	10.3	9.0
$1,000-1,999	18.1	7.0	5.4	5.7
2,000-2,999	13.7	5.2	4.5	6.9
3,000-3,999	11.8	4.4	4.2	6.8
4,000-4,999	10.9	3.9	4.2	7.4
5,000-5,999	9.9	3.6	4.3	7.0
6,000-7,499	9.4	3.2	4.2	6.5
7,500-9,999	8.3	2.8	4.6	5.4
10,000 & Over	7.2	1.9	5.4	5.7

Source: Theodore N. Beckman and Harold H. Maynard, _Principles of Marketing_ (New York, 1957), pp. 96-97.

[20] H. K. Hyde, _op. cit._, p. 214.

[21] University of Pennsylvania, _Study of Consumer Expenditures, Incomes and Savings_ (Philadelphia, 1956), XVIII.

to conclude, as did Hyde, that there is a tendency for expenditures, as a percentage of disposable income, to decrease as the income increases. This inverse relationship between income and disposable income related to the occupancy and operation of households substantiates the conclusion that a tax which is regressive when compared to property assessments is also regressive when compared with the incomes of individual property owners.

Thus, if electric bills in Denton are regressive when compared to property tax assessments, it might be concluded that electric bills (utility earnings) are also regressive when compared with incomes.

CHAPTER III

STATISTICAL PRESENTATION

This chapter will be devoted to the presentation and examination of sample data taken from the files of Denton's municipal utility records.

This study is a direct comparison of utility bills and property tax assessment in Denton, Texas. Property in Denton is assessed at 36 per cent of market value. A property tax rate of 1.5 per cent is applied to the assessment to arrive at the tax liability of individual property owners.

The 1.5 per cent is a ratio of the tax liability to property tax assessments. The relationship between these two sets of data may be measured by means of the correlation technique. They could be plotted graphically with property tax assessments placed on the horizontal axis and the ratio values on the vertical axis. For any value of the property tax assessments the ratio value will be the same--1.5 per cent. Thus, the line representing the association between the two variables will be horizontal.

The variables in this study are 1960 electric utility bills and property tax assessments. The problem is to determine the association or relationship between 220 randomly-selected electric power consumers and their property tax assessments.

There are two ways in which the variables might be graphed. The electric bills could be plotted on the vertical and the property tax assessments on the horizontal axis. If this were the case the average line of relationship would be a rising one because as property tax assessments in Denton increase the amount of the electric bill also increases. Whether or not electric bills are more or less an equitable method of raising revenue when compared to property tax assessments would not be shown. The same would be true in the case of property taxes, if instead of plotting the property tax rate on the vertical axis, the amount of the property tax payments were substituted for the tax rate.

The second method would be to convert the electric bill into a rate, that is, the annual electric bill as a percentage of the property tax assessment. The ratio values, or rate might be plotted on the vertical and property tax assessments on the horizontal axis. The line expressing the average relationship using this method is much more descriptive, consequently will be employed in this study.

For example, suppose a customer who had a property tax assessment in 1960 of $2,000 paid an annual property tax of $30 and an annual electric bill of $30. The ratio of the property tax to the property tax assessment is .015; likewise, the ratio of the electric bill to the property tax assessment is .015. If another customer had a property tax assessment of $4,000 and his annual electric bill was $60, his ratio of annual electric bill to his property tax assessment is .015. In both instances, the customer would be paying electric bills in the same proportion as he paid property taxes. Suppose, however, that the second customer paid an annual electric bill of $40, the ratio would be .01. A line expressing the relationship between the two customers would be a falling one; thus, when compared to property tax assessment, electric bills would be regressive. The customer owning the lesser amount of property is contributing a proportionately larger amount to utility profits, at least, this would be the case in Denton.

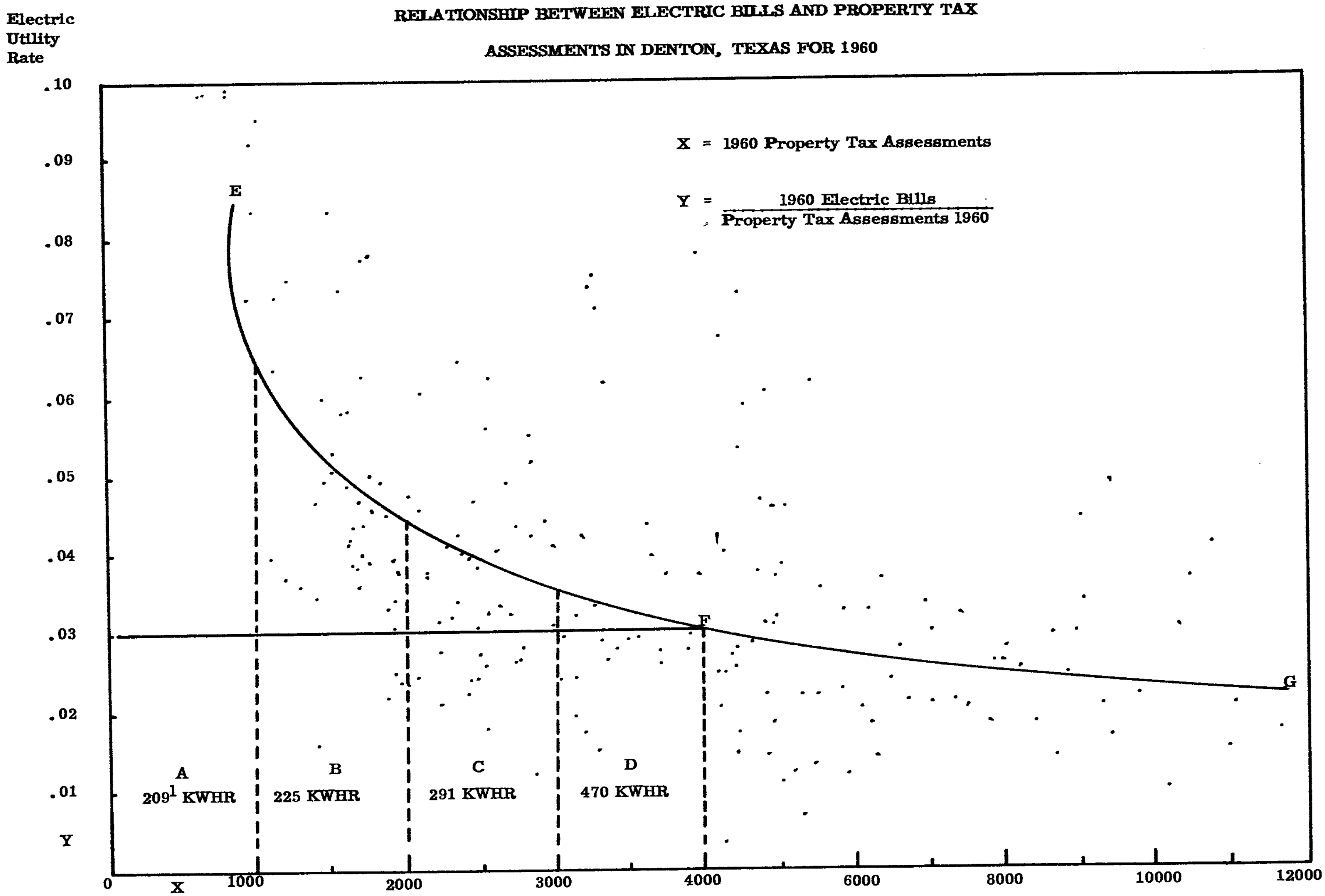
The 1960 electric power bill was divided by the 1960 property tax assessment for each consumer in this study. This will serve as a mathematical test to determine the desireability of using electric utility profits in lieu of property taxes as a source of city revenue.

Chart 2 displays a second-degree parabola curve correlation between the two variables. The formula for

CHART - 2

RELATIONSHIP BETWEEN ELECTRIC BILLS AND PROPERTY TAX

ASSESSMENTS IN DENTON, TEXAS FOR 1960



[1]The kilowatt hour figure in A, B, C, and D is the average kilowatt hours consumed for those individuals with property tax assessments of $1,000, $2,000, $3,000.

the curve is $Y = 2.026 + 1579.59e^{-x/100} + 52.28^{1/x/100}$.[2] The relationship between electric bills as a percentage of property tax assessments[3] is not so complex as to warrant an elaboration of this correlation technique. This particular type of curve is desirable only when the more simple straight-line correlation technique does not satisfactorily show the relationship between two variables. This is not the case in this instance.

The primary function of the curve EG in Chart 2 is to give significance to separating the sample into two groups. A close examination of the curve leads one to conclude that two relationships exist. The segment of the curve EF shows the relationship to be extremely regressive, while the segment FG indicates the relationship, for practical purposes, to be proportional. In terms of kilowatt hour consumption, persons having an average kilowatt hour consumption over 470 will pay a proportional electric utility rate between two and three per cent, but persons having an average monthly kilowatt hour consumption below 470 will pay an increasingly higher electric utility rate which ranges from three to ten per cent.

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[2]This formula was fitted to the original sample data used in the study by Mr. Gene Milner, then supervisor of the North Texas University Computer Center, using the IBM 1620 computer.

[3]Henceforth in this study this ratio will be referred to as the electric utility rate.

A perpendicular line drawn from point F on the curve shows the property tax assessment to be $4,000. At this point the sample will be separated into two groups. Group I will include individuals whose property tax assessment is less than $4,000 and average monthly kilowatt hour consumption is below 470. In Chart 2 this includes consumption block's A, B, C, and D, or segment EF on the curve.

Group II includes individuals with property tax assessments of $4,000 or more, and whose monthly kilowatt hour consumption is above 470. This is the proportional segment (FG) of the curve in Chart 2.

Least-Squares Fit of Straight Line

It is worthwhile at this point to discuss the method of correlation technique to be used in the analysis of Group I and II.

"The simplest type of curve is the straight line, which is described by an equation of the type $Y = a + bX$."[4] In this study X represents property tax assessments and Y the electric utility rate.

The method of least squares supplies a handy device for deriving an objective fit of a straight-line relationship between two variables. This relationship is shown in Chart 3.

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[4]Fredric E. Croxton and Dudley J. Cowden, Applied General Statistics (Englewood Cliffs, 1955), p. 263.

If a vertical line were to be drawn, in Chart 3, from each Y value to the straight-line relationship, the vertical lines extending upward would exactly balance those extending downward. This is true because "the sum of the vertical deviations of the observed values from the fitted straight line equals zero."[5] The method of least squares gets its name from the fact that "the sum of the squares of all these deviations is less than the sum of the squared vertical deviations from any other straight line."[6] In other words, no other straight-line could be constructed that would express the average relationship between the variables more precisely.

Correlation involves at least three types of measurements. The line of regression, standard error of estimate, and the coefficient of correlation.

The least squares curve is known as the line of regression which describes the functional relationship between the electric utility rate and property tax assessments. As mentioned before the line of regression equation is $Y = a + bX$. Since the values of a and b must be computed for the data to be analyzed, they are called unknowns. They are also called constants, since, once

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[5] *Ibid.*, p. 265.

[6] *Ibid.*, p. 265.

their values are computed, they do not vary.[7] Once determined, it is possible to estimate the value of Y for any value of X. For example, an estimate of the electric utility rate for a property tax assessment of $3,500 could be determined by substituting $3,500 for X in the equation.

The standard error of estimate measures the divergence of actual values from their computed values. If the relationship were a perfect one this statistic would equal zero. Since the relationship between variables is seldom perfect, computation of the standard error of estimate gives an insight into the dependability or reliability of estimates of Y. This statistic is identical to the standard deviation of a frequency distribution. One standard deviation measured off plus and minus from the arithmetic mean includes 68 per cent of the observations; and one standard error of estimate will also encompass 68 per cent of the cases when measured off plus and minus from the line of regression. Two standard errors of estimate plus and minus from the line of regression will include 95 per cent of the observations, and in a like manner, three standard error of estimates will include 99.7 per cent of the observations.[8]

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[7]The values of a and b are obtained from the normal equations:

$$\text{I} \quad \Sigma (Y) = Na + b\,(X).$$
$$\text{II} \quad \Sigma (XY) = a\,(X) + b\,(X^2).$$

[8]Herbert Arkin and Raymond R. Colton, Statistical Methods (New York, 1956), p. 77.

The larger the values of the standard error of estimate the greater the scatter about the line of regression and the poorer the relationship.

The standard error, however, has no relative significance, since it is expressed in terms of the original unit of the Y variables. It would be possible to compare the degree of relationship between property tax assessments and the electric utility rate with the degree of relationship between property tax assessments and taxable income of the owners, because the original unit of the Y variables is in the first instance, a percentage, and in the second instance, dollars.

A coefficient of correlation can be determined by dividing the standard error of estimate by the standard deviation of the Y values. The resulting value will be in a percentage form. This value can be subtracted from 1.00 and used as the comparative measure of association.[9]

Analysis of Group I

The relationship between property tax assessments and electric utility rates for Group I is displayed by

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[9]The formula for the coefficient of correlation is:

$$r = \sqrt{1 - \frac{Sy^2}{y^2}}$$

Sy^2 is the standard error of estimate and Y^2 is the standard deviation of Y values.

the scatter diagram in Chart 3. The straight-line is fitted by the method of least squares ($Y = a + bX$). The formula for this line of regression was found to be $Y = .73310 + -.114497X$.

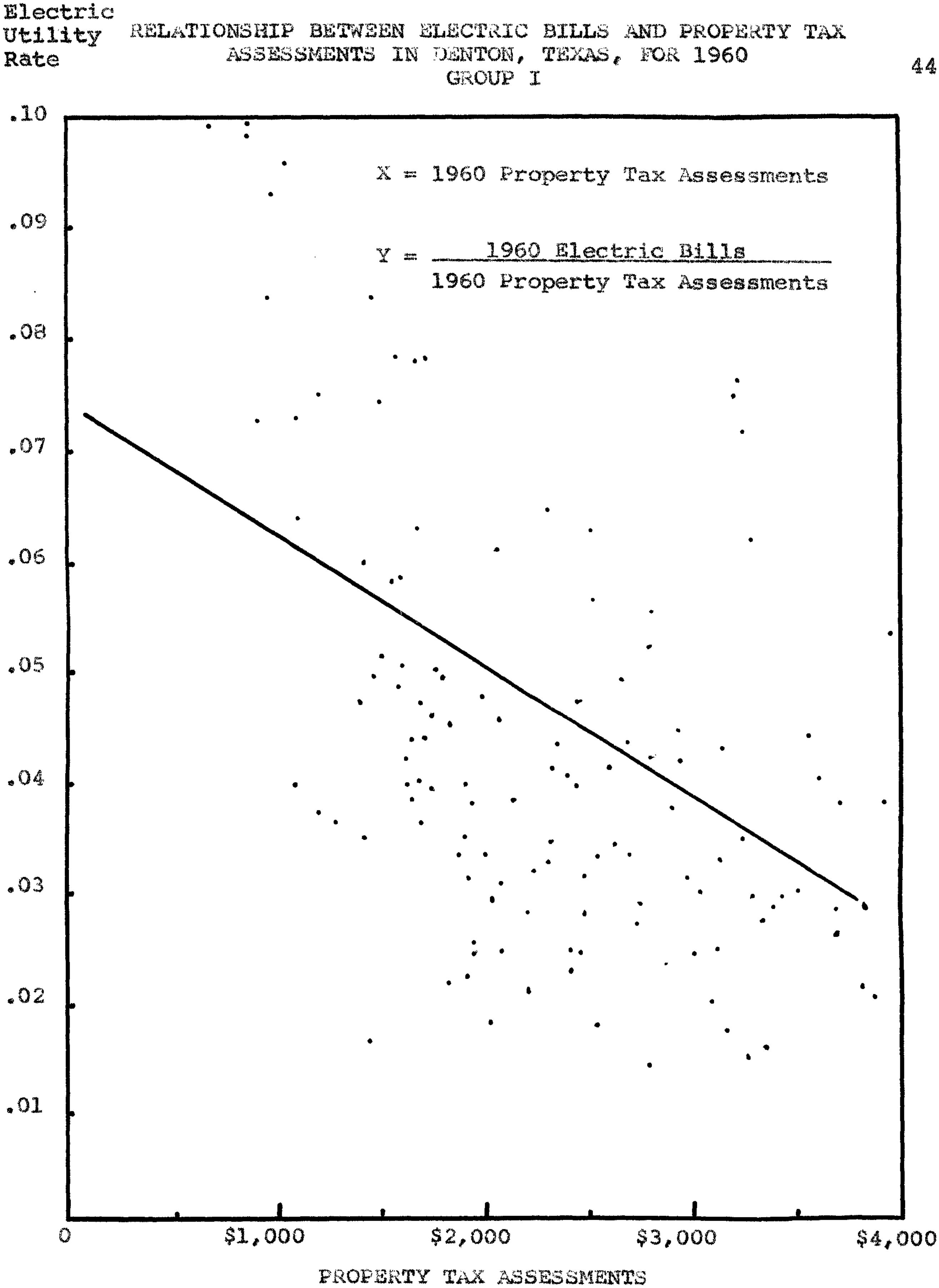
The standard error of estimate for the observations is .017 or 1.7 per cent. Thus, 2(.017), or 3.4 per cent (in terms of electric utility rates) measured plus and minus from the line of regression will include 95 per cent of the 131 observations in the sample.

The coefficient of correlation is -.6495 which is a relatively strong regressive correlation. The minus sign preceding the coefficient of correlation indicates a negative correlation. For a detailed examination of the computations of the statistics reviewed above see Appendix B.

The decline of the line of regression from 7.375 per cent to 2.625 per cent as property tax assessments progress to $4,000 illustrates the extremely regressive relationship that exists for Group I. Thus, individuals with a property tax assessment of $1,000 paid an average electric utility rate of 6.125 per cent, while individuals whose property tax assessment is $3,500 paid an average electric utility rate of 3.25 per cent. Clearly, as property tax assessments increase the electric utility rate decreases.

CHART 3

RELATIONSHIP BETWEEN ELECTRIC BILLS AND PROPERTY TAX ASSESSMENTS IN DENTON, TEXAS, FOR 1960
GROUP I



As the curve approaches that point where property tax assessments are $4,000 or more, the curve becomes proportional, that is, flatter. This transition in the nature of the relationship is clearly illustrated by the second-degree parabola curve in Chart 2.

Analysis of Group II

The relationship between property tax assessments and electric utility rates for Group II is depicted by the scatter diagram in Chart 4. The straight-line is fitted by the method of least squares. The formula for the line of regression is $Y = .3910 + -.1559X$.

The standard error of estimate for the observations is .039, or 3.9 per cent. This indicates the wide divergence of actual values from their estimated values, as represented by the line of regression. This divergence is thrice the standard error of estimate of 1.7 per cent for Group I. Consequently, as the coefficient of correlation will bear out, the relationship for Group II is much poorer than that of Group I.

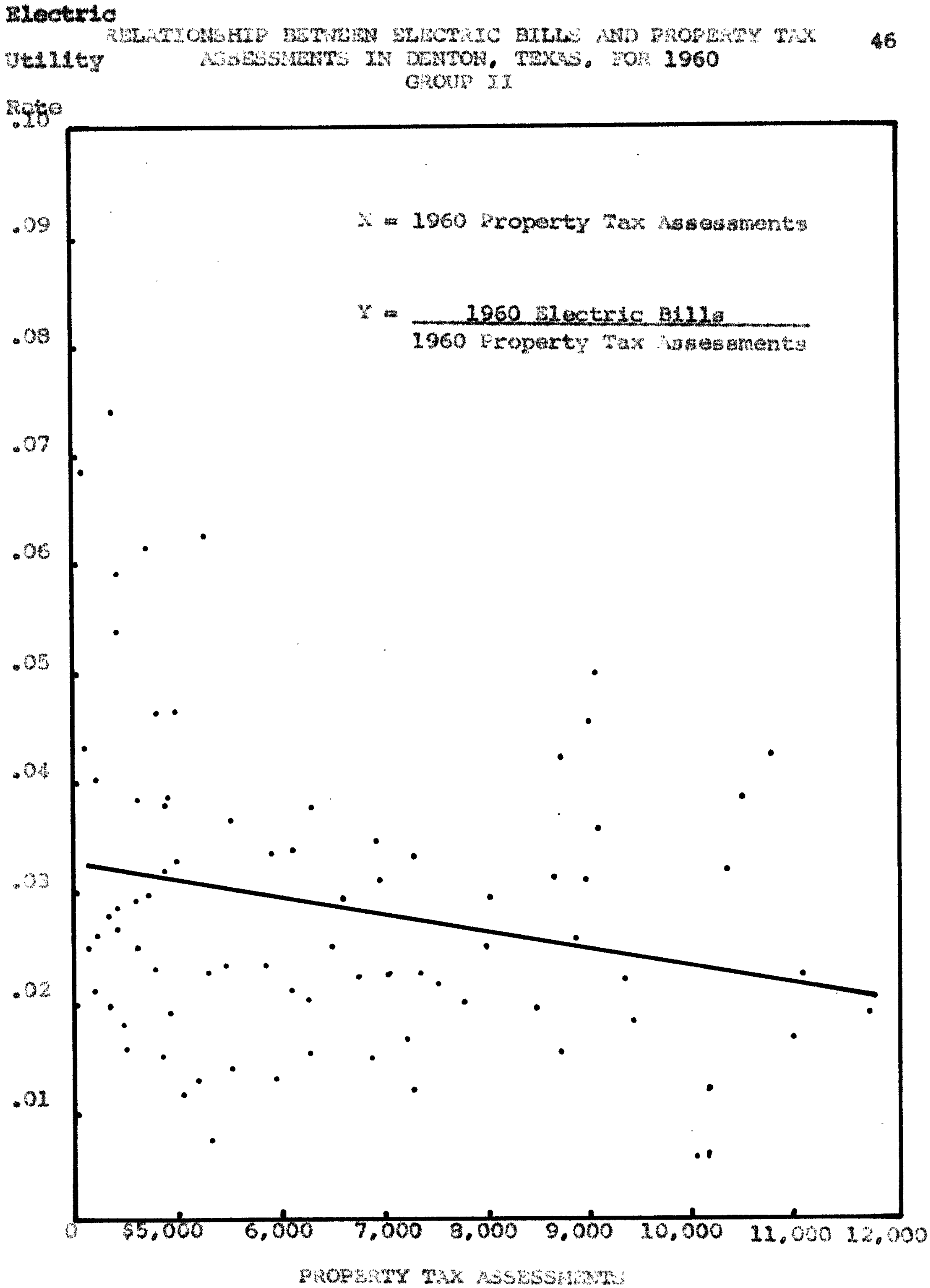
The coefficient of correlation for Group II is -.2111 which is a weak regressive correlation. (See Appendix C for a close examination of the formulas used to compute the sample statistics for Group II.)

The angle of slope for the line of regression is very slight, since the drop from a property tax assessment of

CHART 4

RELATIONSHIP BETWEEN ELECTRIC BILLS AND PROPERTY TAX ASSESSMENTS IN DENTON, TEXAS, FOR 1960

GROUP II



$4,000 to one of $12,000 is only approximately one percentage point in the electric utility rate. This compares with a drop of approximately 4.75 percentage points for Group I. This leads one to conclude that the relationship for those individuals whose property tax assessments is above $4,000 is more or less proportional.

It is worthwhile to note that individuals whose property tax assessment is $5,500 will pay an average electric utility rate of approximately 3 per cent, while individuals whose property tax assessment is $11,000 will pay an average electric utility rate of approximately 2.2 per cent. Thus, while the property tax assessment declined by $5,500 the electric utility rate only declined eight tenths of one per cent. Group I showed that a decline in property tax assessments from $3,500 to $1,000 brought a decline in the electric utility rate from approximately 6.1 per cent to 3.2 per cent.

The fact that the relationship for Group II is proportional is significant. If this were true for both Group I and Group II, then one could justifiably conclude that raising city revenue by operating the electric utility at a profit is as equitable a method as raising city revenue by property taxation. But only Group II has such a relationship, consequently the conclusion drawn above is only valid for those individuals whose property tax assessment is $4,000 or above.

This is not the case for Group I, however, where the relationship is distinctly regressive. Group I includes property tax assessments of $4,000 and below of which covers some 60 per cent of the electric power consumers in Denton for 1960 (see Table V). It is in this area

TABLE V

AVERAGE MONTHLY KWHR CONSUMPTION, AVERAGE MONTHLY ELECTRIC BILLS AND FREQUENCY FOR DENTON IN 1960

Class Interval	Average Monthly KWHR Consumption	Average Monthly Bill	Sample Frequency	Cumulative Percentage Frequency
Under $ 999	209	$ 6.65	6	2.73%
$1,000-1,999	225	6.90	47	24.09
2,000-2,999	291	8.28	48	45.91
3,000-3,999	470	11.25	30	59.55
4,000-4,999	619	12.71	29	72.73
5,000-5,999	528	12.23	13	78.64
6,000-6,999	605	13.46	11	83.64
7,000-7,999	654	14.49	10	88.18
8,000-8,999	960	19.43	9	92.27
9,000-9,999	1294	24.11	8	95.91
10,000-10,999	780	16.30	6	98.64
11,000 & Over	848	18.83	3	100.00

<u>Source</u>: Statistics were computed from sample data taken from the files of Denton's municipal records.

that a manipulation of the rate structure is necessary in order to eliminate the regressive relationship that is evident.

The isolation of the area that is in need of evaluation has been effected, consequently, the remainder of the study will explore the feasibility and implications of remedial measures.

CHAPTER IV

THE EFFECT OF RESIDENTIAL POWER RATES ON THE LEVEL OF CONSUMPTION

The objective of this chapter is to examine the relationship between residential power rates and the level of consumption or demand for electrical power. Unfortunately, precise mathematical measurements of demand elasticities for residential consumers are not available, however historical comparisons of price differentials will be employed to reveal significant characteristics of the demand for residential power.

Certain demands of the small buyer are in fact inelastic. Power rates would have to increase to fantastic proportions before residents would switch to kerosene lamps as a substitute for electric lighting. And it is doubtful that the demand for electric lighting would change significantly if power rates were reduced by one half. But the domestic lighting by electricity is only a component part of total demand and by no means dictates the slope of the aggregate demand curve.

Electric cooking, refrigeration, and water heating, to mention only a few, will most probably react to a manipulation of residential power rates. These are the component parts of the residential demand curve that are most likely to increase with a decrease in power rates. The demand for such uses of electricity is most probably elastic.

If this is the case, then the effect of high rates is low consumption, conversely the effect of low rates would be high consumption.

Bauer collected financial and operating data from all municipally operated electric systems in towns having more than 50,000 population.[1] The average monthly consumption for residential buyers was compared with the average rates per kilowatt hour. These comparative figures showed an "almost direct correlation between rates and consumption; the higher the rates the lower the consumption."[2]

Tacoma, Washington, had the highest consumption, 134 kilowatt hours per month per consumer. Tacoma also had the lowest average rate per kilowatt hour of 1.7 cents. At the other extreme was an average of 4.4 cents per kilowatt hour with an average monthly consumption per customer of only 39 kilowatt hours. It is interesting

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[1]John Bauer, "Municipal Utilities: Profit vs. Taxes," National Municipal Review, XXVIII (September, 1939), 630.

[2]*Ibid.*, p. 630.

to note that the plants having the next highest average monthly consumption--97 kilowatt hours--also have the next lowest average rates.[3]

Kuhlman surveyed all municipally-owned electric utilities in North Carolina, and found a close relationship between rates and consumption. That is to say, high rates are accompanied by low consumption and low rates tend to encourage higher consumption levels.[4]

In 1933, Congress created the Tennessee Valley Authority with the explicit purpose of charging the lowest possible rates consistent with making the power program self-liquidating.[5] It is worthwhile to analyze the success of this program, which in 1961, included 102 municipalities, 51 cooperatives, and 2 privately-owned systems.[6] The financial and operating data appearing in Table VI gives an insight into the success of the program. While total revenue was increasing from $58 million in 1949, to $238 million in 1959, for a gain of 310 per cent, the average residential rate per

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[3] _Ibid._, p. 631.

[4] Clarence E. Kuhlman, _Survey of Municipal Utilities in North Carolina_, cited in John Bauer, _op. cit._

[5] Tennessee Valley Authority, _Facts about TVA Operation_ (Knoxville, 1960), p. 7.

[6] _Annual Report of Tennessee Valley Authority_ (Washington, D. C., 1961), p. 48.

kilowatt hour declined from 1.54 cents to 1.03 cents. During the same period of time the average yearly

TABLE VI

SELECTED FINANCIAL AND OPERATING DATA
FOR TENNESSEE VALLEY AUTHORITY
1949 AND 1959

Description	1949	1959
Total Revenue	$ 58,030,515	$ 237,540,179
Net Power Income	20,944,415	50,829,938
Net Power Investment, Plant in Service	431,432,417	1,546,507,832
Number of Retail Customers	987,387	1,380,598
Average Residential Use (KWH)	2,765	7,863
Average Residential Rate Per Kilowatt Hour	1.54¢	1.03¢

Source: Tennessee Valley Authority, TVA in the Nineteen Fifties (Knoxville, 1960), p. 3.

residential use increased from 2,765 to 7,863 kilowatt hours. A selected statistical comparison of Denton's Municipal Electric Utility with the TVA is illustrated below.

	Denton	TVA	TVA Advantage
Average Residential Consumption (Kw-hr.)	5,237	9,135	74%
Average Price Paid Per Kilowatt Hour	2.93¢	1.00¢	66%

In 1961, the home use of TVA electricity increased to 9,135[7] kilowatt hours which was some two and one half the national average of 3,930, and some 74 per cent higher than Denton's average residential consumption in 1963 of 5,237.[8] The average cost for TVA residential use of power dipped below 1 cent per kilowatt hour in 1961, which compares with Denton's average of 2.93 cents[9] in 1962. Thus, TVA residential power is approximately 66 per cent cheaper than residential power is in Denton. The national average was 2.46 cents in 1961.[10]

Present rates available to all customer classes in the Valley Region are some 25 per cent below the basic rates established in 1933.[11] There is little doubt but what the steady decline in power rates have brought about tremendous increases in the consumption of electric power and standards of living for the citizens. But more important to this study is the fact that net revenue has also increased in the face of declining power rates. Thus, the decline in average rate per kilowatt hour from 1.54 cents in 1949, to 1.03 cents in 1959, was accompanied by an increase in net power income from $20.9 million to

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[7]Ibid., p. 50.

[8]Calculated from data taken from Denton Utility System's Monthly Operating Reports for 1963.

[9]Ibid., p. 12.

[10]Annual Report of TVA

[11]Annual Report of TVA

$50.8 million for the same period of time. A 33 per cent decrease in average price brought about an increase in net income of 150 per cent. It is quite evident that the demand for residential power in the Valley Region is elastic. Can the basic residential rate[12] charged by Tennessee Valley Authority be used effectively as a yardstick for other geographical locations? With the exception of their low-cost hydroelectric power, it seems that other electric utilities could apply TVA residential rates with a degree of success. The element of cheap water power, however, loses much of its significance when you consider that of the 64.5 billion kilowatt hours generated by the TVA System in 1961, only 16.9 billion (approximately one quarter) came from hydroelectric plants.[13] The steam-electric plants produced the remaining 47.6 billion kilowatt hours. Put another way, 75 per cent of the TVA power is generated in the same manner as the power in Denton is produced.

Table VII displays the advantages of low rates and high consumption. Operating expenses of TVA distributors are 50 per cent lower than privately-owned electric power

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[12] See Appendix D for the TVA basic residential power rates.

[13] <u>Annual Report of TVA</u>, p. 43.

TABLE VII

COST OF PRODUCING AND MARKETING ELECTRIC POWER IN MILLS PER KILOWATT HOUR OF ENERGY SOLD

Operating Expenses	TVA Area Fiscal Year 1958	Private Utilities in U.S. 1957	TVA Costs As Per Cent of Private
Operating Expenses:			
Production	1.66	4.67	40
Transmission and Distribution	.96	1.69	60
Customer Accounting and Collection	.25	.55	50
Sales Promotion and Research	.09	.29	30
Administration	.51	1.13	50
Depreciation	1.74	1.76	100

Source: Tennessee Valley Authority, *Facts about TVA Operations* (Knoxville, 1960), p. 3.

systems. Operating expenses, in which TVA distributors also outstrip the national averages, are "achieved by giving primary concern and constant attention to keeping rates as low as possible to encourage the widest and most abundant use of electricity."[14] The Tennessee Valley

[14] *Ibid.*, p. 7.

Authority has subordinated the profit motive to the social objective of supplying power to the public at cheap rates, and in doing so, have succeeded in increasing profits as well as the use of power.

Residential power rates in Fort Worth, Texas, were recently reduced by 7.1 per cent.[15] This was the first decrease in power rates for this city since 1946, and comes after rate increases in 1951, and 1961.[16] Net savings to Fort Worth residents are estimated to be $1,287,000 per year.

After successive residential rate increases in 1951, and 1961, the decision of Texas Electric Service Company to grant a reduction has a precise significance. While the engineering studies preceding the rate reduction are not available,[17] their rate manager, Al Newton, readily agreed that the company expected an increase in kilowatt hour consumption to accompany the reduction and that a much better utilization of plant equipment was expected.[18]

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[15] The Fort Worth Star-Telegram, February 20, 1963, Sec. 1, p. 1.

[16] Ibid., p. 4

[17] Texas Electric Service Company considers these data to be classified and respectfully declined its use in this study.

[18] Statement by Al Newton, rate manager, Fort Worth, Texas, April 25, 1963.

One can assume then, that in the opinion of management, the demand for residential power in Fort Worth is elastic, and given the lower power rate structure consumption will increase sufficiently to make up for the $1,287,000 in lost revenue, if not exceed it.

It is most probable that under no other circumstances would the management of Texas Electric Service Company have reduced residential rates, for the primary measure of their effectiveness is ability to produce profits. It would be naive to assume the company expects to absorb the loss of revenue. Unfortunately it is much too early to analyze the success of the rate reduction; however, the implications of the decision suffice, in this instance, to further strengthen the contention of this study--that the demand for residential power is elastic.

Viewing the historical relationship between price per kilowatt hour, average annual consumption, and average annual electric bills one is led to the same conclusion--that the demand for residential power is elastic. Table VIII shows this relationship. Average annual kilowatt hour consumption has increased from 430 in 1926, to 2,549 in 1954 which is a 500 per cent gain. During the same period of time the average price per kilowatt hour declined 61 per cent. This figure was 7.00 cents in 1926, and 2.69 cents in 1954. The most significant element of this relationship is the average annual electric bill. While average rates were declining to 2.69 cents, the annual bill climbed from $30.10 in 1926, to $68.57 in 1956.

A decline in the average cost of electric power of 61 per cent motivated residential consumers to increase

TABLE VIII

TRENDS IN SALES, CONSUMPTION, AND PRICE PER KILOWATT HOUR FOR RESIDENTIAL CUSTOMERS-SELECTED YEARS FOR UNITED STATES

Year	Average Annual KWHR Consumption	Average Annual Electric Bill	Average Price Per Kilowatt Hour
1926	430	$30.10	7.00¢
1930	547	32.98	6.03
1935	677	33.93	5.01
1940	952	36.56	3.84
1945	1,229	41.97	3.41
1950	1,830	52.70	2.88
1954	2,549	68.57	2.69

Source: Russell E. Caywood, Electric Utilities Rate Economics (New York, 1956), p. 20.

their average annual consumption by 500 per cent which in turn propelled the average annual revenue to electric utilities up some 121 per cent.

This historical relationship shows the residential demand for electric power to be definitely elastic. One could hardly want for more conclusive evidence. The elasticity of demand express the relationship between a change in quantity demanded and the corresponding change in price per unit. If a change in unit price results in no change whatever in quantity demanded, the demand is perfectly inelastic for this particular price range. If the percentage drop in price per unit is equal to the percentage increase in quantity demanded, the elasticity of demand is called unit elasticity, or one. If a 61 per cent drop in unit price is associated with a 500 per cent increase in quantity demanded, the elasticity of demand for residential power is greater than one, consequently is said to be relatively elastic.

Earnings Objective

In many ways the management of municipal utility systems have devoted greater attention to service and less to earnings than have private utility management. As a result the pricing patterns of municipal systems tend to be social instead of profit.[19]

Many towns switched to municipally-owned systems because private investors were not willing to put their funds into utility plants. In the beginning, the objective

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[19]Emery Troxel, op cit., p. 671.

of these utility systems was to serve its citizens at much cheaper prices; that is to say, take the profits out of producing and distributing electric power. If total revenues failed to cover total costs, the deficit could be covered by tax revenue. In most cases the property tax rate was increased in order to cover any accounting deficit of the utility system.[20]

In this manner the public welfare was better served because individuals were served irrespective of whether marginal revenue covered marginal cost.[21] The important fact being that power in greater quantities at lower prices was available. This had not been true, nor is it today, under privately-owned utility systems. While a private utility system is required to serve everyone who desires service within the geographical area of its franchise, this is by no means an absolute rule. Private companies are not always required to extend service if there is a reasonable doubt that marginal revenue will not cover marginal cost.[22]

Generally speaking, municipally-owned utility systems can be put into three classifications as to earnings objectives. First, there are those systems whose

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[20]Ibid., p. 671 [21]Ibid. [22]Ibid.

management seeks to equate costs and revenues, thereby creating a self-supporting system. Secondly, some managers set prices slightly above cost so as to provide a small accumulation of earned surplus. The surplus earnings serve as a cushion against contingencies.

Lastly, there are those municipal systems whose managements deliberately establish rates that produce excess earnings:[23] excess earnings that will eventually find their way into the coffers of the City Treasury, and once there will be applied to the general expense of government. City officials, the Chamber of Commerce, and a portion of the citizenry point out, with a certain degree of pride, that these utility earnings reduce property taxes. The implication being that the substitution of utility earnings for property taxes is advantageous to the general public. Denton's Municipal Electric Utility would fall into this third classification.

The substitution of electric utility earnings is not to the advantage of at least 60 per cent of the residential power consumers in Denton. As shown in Chapter III, individuals whose property tax assessment is below $4,000 pays a decisively higher electric utility rate than do the remaining 40 per cent of residential consumers.

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[23]Very few real world examples will be found for the first and second classification, particularly electric utility systems. The majority of them fall into the third classification.

CHAPTER V

RESIDENTIAL RATE STRUCTURE MODIFICATIONS

There is no simple approach to electric utility rates and it is outside the scope of this study to enter into a detailed evaluation of Denton's residential rate structure. However, in light of the findings of the statistical study presented in Chapter III, there is a definite responsibility to discuss the possibility of alternate residential rate structures. Rate structures that would eliminate the regressive relationship between property tax assessments and electric bills.

The mathematical measurement of the equitability of utility profits as a substitute for property taxation showed this particular source of revenue is a poor substitute for property taxes. This study further concluded that an individual's property tax assessment is a reflection of his income; therefore, the lower the income the higher the electric utility rate.

The electric utility rate, as defined in this study, is dependent upon two factors: the amount of electricity consumed, and the value of individual homes, or more precisely, the amount of the property tax assessment. This compounds the already complex problem of establishing residential power rates which at all levels of consumption will produce a proportional relationship.

It is a simple task to establish proportional electric rates by charging a straight line meter rate. At all levels of monthly kilowatt hour consumption the average price per kilowatt hour would be the same. However, when the annual electric bill is divided by the property tax assessment, the relationship might still be regressive. Table IX displays such a relationahip between selected residential consumers

TABLE IX

RELATIONSHIP BETWEEN PROPERTY TAX ASSESSMENTS AND STRAIGHT LINE POWER RATES DENTON, TEXAS

Consumer	Monthly KWH Consump.	Price	Annual Bill	Property Tax Assessment	Electric Utility Rate
A	200	2¢	$ 48.00	$ 1,000	4.8%
B	600	2¢	144.00	8,000	1.8
C	1,000	2¢	240.00	14,000	1.7

Source: Computed from sample data using a hypothetical straight line power rate.

in Denton.[1] A hypothetical straight line rate was substituted for the actual residential rate and the electric

[1]This relationship is based on the assumption that residential electric power consumption is a function of both income (income in this instance is represented by property value) and price per kilowatt hour.

utility rate was computed in the same manner as defined in Chapter III. Clearly the relationship is regressive irrespective of the fact that the electric utility rate is perfectly proportional. The obvious advantage of this type of residential rate structure is its simplicity, but it does not serve this study's purpose, that being the elimination of the regressive relationship between property tax assessments and electric bills.

It would be possible to lower the price per kilowatt hour in the first two blocks and increase the rate charged in the third block above the preceding block. This would give an additional charge for the larger loads (demand) and decrease the cost for smaller demands. Table X exemplifies this type of rate structure. To display the effect on the

TABLE X

COMPARISON OF PRESENT AND PROPOSED
RESIDENTIAL RATE STRUCTURE

Block Size	Present Rates	Proposed Rates
First 30 kwhr at	7.4¢	6.4¢
Next 50 kwhr at	4.8¢	4.0¢
Next 120 kwhr at	2.4¢	2.4¢
Over 200 kwhr at	1.9¢	3.0¢

relationship between property tax assessments and electric bills five consumers were selected from the original sample data. The results of the comparison appear in Table XI.

TABLE XI

COMPARISON OF PRESENT RESIDENTIAL RATES AND PROPOSED RATE STRUCTURE AND THE ELECTRIC UTILITY RATE

Consumer	Average Monthly KWH Consump.	Annual Bill Present Rates	Annual Bill Proposed Rates	Property Tax Assessments	Present Electric Utility Rate	Proposed Electric Utility Rate
A	209	$ 82	$ 76	$1,000	8.20%	7.60%
B	225	86	82	2,000	4.30	4.10
C	291	100	103	3,000	3.33	3.43
D	470	136	161	4,000	3.40	4.03

Note: The annual electric bills were rounded to the nearest whole number and include the standard 10 per cent deduction which is allowed if the bill is paid within a specific time period.

Despite the reduction in rates for the first two blocks, and a significant increase in the final block, the relationship is distinctly regressive. Under the alternate rates, consumer D's electric bill increased from $136 to $161 and the electric utility rate from 3.40 per cent to only 4.03 per cent. Obviously the increase in the electric utility rate for consumers whose average monthly consumption is above 400 kilowatt hours combined with the decrease in this statistic for consumption below 400 kilowatt hours does very little to eliminate the regressive relationship.

The most logical solution to the problem would be to invert the present residential rate structure. Table XII displays this type of rate structure. The rate per kilowatt

TABLE XII

PROPOSED RESIDENTIAL RATE STRUCTURE

Block Size	Residential Rates
First 200 kwhr at	1.9¢
Next 120 kwhr at	2.4¢
Next 50 kwhr at	4.8¢
Next 30 kwhr at	7.4¢
Over 400 kwhr at	3.0¢

hour moves progressively higher throughout the first four blocks. Conversely, the block size decreases through the four blocks. The fifth and final block begins at the 400 kilowatt hour consumption level. The rate per kilowatt hour is 3.0 cents which is a reduction of more than one half from the preceding block.

Table XIII displays the effect of this residential rate structure on the electric rate. The revenue from rate structure (Table XII) is some 2.9 per cent higher than that of the present rates. Consumer A's annual electric bill

TABLE XIII

COMPARISON OF PRESENT RESIDENTIAL RATES AND PROPOSED RATE STRUCTURE AND THE ELECTRIC UTILITY RATE

Con-sum-er	Average Monthly KWH Consump.	Annual Bill Present Rates	Annual Bill Proposed Rates	Property Tax Assessments	Present Electric Utility Rate	Proposed Electric Utility Rate
A	209	$ 82	$ 43	$ 1,000	8.20%	4.30%
B	225	79	48	2,000	4.30	2.40
C	291	0	67	3,000	3.33	2.17
D	470	136	14	4,000	3.40	3.63

<u>Note</u>: The annual electric bills were rounded to the nearest whole number and include the standard 10 per cent reduction which is allowed if the bill is paid within a specified time period.

declined from $82 to $43, or 46 per cent. This compares with a 3 per cent increase in annual electric bill of consumer C, and a 7 per cent increase for consumer D.

The significance of this alternate residential rate structure is that the electric utility rate for all consumption levels is more or less equal, thereby eliminating the regressive relationship between property tax assessments and electric bills.

The effect of this type of residential rate structure, assuming the demand for residential power is elastic, would be a reduction in total kilowatt hours purchased.

While the average decrease in the rate per kilowatt hour is only approximately 3 per cent, the varying per cent change at different levels of consumption ranges from a 70 per cent decrease in the annual bill at 100 kilowatt hours to a 25 per cent increase where the average kilowatt hour consumption is 859.

The advantage of this rate structure is the low charge in the first two blocks. As displayed in Table XIV, the annual electric bill decreases at all levels of consumption

TABLE XIV

PERCENTAGE RELATIONSHIP OF PROPOSED RATES TO PRESENT RATES

Average Monthly Consumption	Annual Electric Bill Present Rates	Annual Electric Bill Proposed Rates	Percentage Increase (or Decrease)
100	$ 55	$ 21	(68.9)%
200	81	41	(49.4)
300	102	67	(34.4)
400	122	122	----
425	127	130	2.3
450	132	138	4.5
500	143	154	8.4
616	171	199	15.6
859	216	270	25.0

<u>Note</u>: The annual electric bills were rounded to the nearest whole number and the 10 per cent deduction was allowed.

below 400 kilowatt hours. If this residential rate structure were established, the relationship between property tax assessments and electric bills would be, for all practical purposes, proportional. The variance is very slight. As such, the use of electric utility profits as a substitute for property taxes would be justified. This is so because when compared to the property tax assessment both have a proportional relationship; therefore, one method is just as equitable as the other.

A rate structure of this design would be a break with conventional residential rate structures. There is little doubt but what these power rates would be equitable; however, without the promotional aspect very little could be accomplished toward expanding consumption. The promotional rates (pricing forms which give lower charges as a consumer's use increases) are the most desirable design and have been a contributing factor toward increased consumption.

It is the conclusion of this study that any electric utility rate which would effect a proportional relationship would be so impractical as to eliminate any possibility of establishment in Denton. This being true, only one course of action is left--take the profit out of residential power in Denton. Pass the savings on to consumers in the form of reduced rates. This possibility will be examined at length in the next chapter.

CHAPTER VI

SUMMARY, RECOMMENDATIONS, AND CONCLUSIONS

There is little doubt that the managers of Denton's Municipal Electric Utility have done an excellent job and that the system is an asset to the community. They are proud of the fact that their rates compare favorably with surrounding cities at all levels of consumption. Table XV shows that Denton has the lowest, or second lowest, monthly electric bill for the various levels of consumption.

TABLE XV

COMPARISON OF ELECTRIC COST FOR RESIDENTIAL SERVICE KILOWATT HOURS PER MONTH IN DENTON

Town or Company	250	500	1,000	2,000	4,000
Denton	$7.61	$11.88	$20.43	$37.53	$71.73
Texas Electric Service	7.83	12.58	20.08	41.08	79.08
Texas Power & Light	8.18	12.79	22.09	40.69	77.89
Greenville	7.20	12.20	21.20	37.70	67.70
Dallas Power & Light	7.53	11.98	20.88	38.68	74.28
Garland	7.68	12.18	21.18	39.18	75.18

Source: Computed from rate schedules published by indicated towns and companies and allows for any discount for paying the bill within a prescribed time period.

That the management of Denton's Municipal Electric Utility consider "comparable rates" as a worthy objective is indicated in a brochure published by the Chamber of Commerce. The city points out that "Denton's utilities are rated tops among cities of comparable size in the southwest" and invite interested parties to "compare the rates of Denton with other cities, and you will find that your electric bill is lower than the same power usuage in most area towns."[1]

A second objective of Denton's Municipal Electric Utility is implied in a quote from the same publication. "Not only is your Utility system self sustaining, but, it helps keep your tax bill low. Revenues from the electric system help pay the cost of many city services."[2]

Obviously, the system operates under the assumption that as long as they treat electric consumers as well as they are treated in comparable situations in other cities where private ownership prevails, they are justified in applying excess earnings from operation to expenses of general government.

This study considers this assumption to be invalid when applied to the Municipal Electric System of Denton. The

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[1]Denton Chamber of Commerce, "Welcome to Dynamic Denton" (Denton, 1963), p. 3.

[2]*Ibid.*, p. 3.

transfer of electric utility profits to the general fund to keep property taxes low is not a satisfactory policy.

As shown in Chapter III, the residential consumption of electric power is an unsatisfactory index of tax-paying ability when compared to property taxation.

This study finds two principal objections to operating the Denton Municipal Electric System at a profit. First, the electric utility rate (which includes the excess earnings that will be substituted for property taxes) is regressive, particularly for those residential consumers of power whose property tax assessments are below $4,000. This group comprises 60 per cent of the power consumers in Denton. Thus, electric utility earnings as a source of city revenue fail to meet the primary prerequisite put forth by the International City Managers' Association:

> Whether a municipality decides to raise a sizeable portion of its nonproprietory revenues from municipal enterprises or not should be made to depend on the equitableness of the burden thus imposed compared with alternative methods for raising a like sum of money.[3]

This study has shown that electric utility earnings are not as equitable a method of raising city revenue as property taxes, and as such requires individuals of lesser wealth to pay a higher tax.

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[3]The International City Managers' Association, Municipal Finance Administration (Austin, 1955), p. 49.

The second objection to using utility earnings in place of property taxes is that they restrict the consumption of electricity. This is especially true for residential consumption as pointed out in Chapter IV. Troxel divides promotional price schedules into two dimensions; the demand dimension and the earnings dimension. Speaking of private utilities, he states that "companies originally developed block schedules because they were interested primarily in earning increments rather than output increments. For companies the earnings dimension of promotional pricing is paramount; the output dimension is secondary."[4] The promotional residential rate structure in Denton was designed along these same guide lines. The rates embody a profit which is unnecessarily restricting consumption.

Private electric utility systems exploit consumers and pass the fruits of exploitation (excess earnings) on to investors in the form of dividend payments. Denton's Municipal Electric System exploits its residential consumers and pay a dividend in the form of a relatively low property tax rate. The economic and social welfare of the community would be better served if the earnings of the electric system were passed on to the residential consumers in the form of reduced power rates, and the

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[4]Emery Troxel, op. cit., p. 602.

property tax rate were increased to compensate for any lost revenue. All social and economic advances which depend on low-cost electric power could be achieved, thus the community welfare would be better served.

Where the Revenue Will Come From

Property taxation would be the most satisfactory source of additional revenue. If residential rates were reduced by an amount that would eliminate earnings there would be a reduction in city revenue by an amount equal to the earnings transferred to the General Fund which could be attributed to earnings from gross receipts of residential power sales. Unfortunately, earnings from sales to residential consumers are not available because the accounting department does not break down net income as to source.

Gross sales, however, are listed by source. The gross sales for the fiscal year ending September 30, 1963,[5] are shown below along with a percentage composition. Assuming

	Sales	Per Cent of Total
Commercial	$1,213,797	50.7%
Residential	1,051,841	43.9
Intergovernmental	73,373	3.1
Other	55,735	2.3
Total sales	$2,394,746	100.0

[5]Price Waterhouse, Audit Report for Denton, Texas (Denton, 1963), p. 19.

that earnings are transferred to the General Fund in proportion to sales, then 43.9 per cent of the 1963 transfer of $180.153[6] would be the amount of revenue lost, were residential power rates reduced to cost. This amounts to $80,153 ($180,303 X .439). It should be pointed out that this figure does not represent a precise measurement but rather a rough approximation and is employed to emphasize that only a portion of the electric utility transfer will be eliminated. It is quite improbable that the portion thus eliminated would impair the over-all financial position of the electric system.

"The power to tax property is conferred by law upon all cities, towns, and villages in Texas."[7] The extent to which this power may be employed varies among different cities. The rate to be used depends on the size of the population and the laws under which the municipalities are incorporated.

Cities and towns of more than five thousand population, including both home rule and general law cities, are limited to a maximum property tax rate of 2.5 per cent of the assessed value of property.[8] Assessed value may be as

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[6]Ibid., p. 21.

[7]Lynn F. Anderson, Texas Property Taxes (Austin, 1949), p. 15.

[8]The Constitution of the State of Texas, Article XI, section 5 (VACS, article 1028).

much as 100 per cent of the market value although in reality 100 per cent assessment is rare.

The assessed value of taxable property in Denton for 1962, was $39,946,870.[9] An increase in the property tax rate on one tenth of one per cent would bring additional tax revenue of $39,947. Thus, an increase of two tenths of one per cent would offset the loss of revenue caused by a loss of earnings from residential power consumers.

More precisely, if the property tax rate were increased from .015 to .017 an additional tax revenue of $79,894 (.002 X $39,946,870) would be forthcoming. An increase in the property tax rate of 1 per cent, which would bring Denton's property tax rate up to the maximum of 2.5 per cent, would increase city revenue by $399,947. This would exceed the amount of electric utility transfers identified with residential power sales for several years to come without a change in the assessment ratio.[10]

An increase in the property tax rate of .002, however, would be adequate in the beginning. This would increase the property tax rate in Denton from .015 to .017, or considerably below 2 per cent.

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[9]Waterhouse, op. cit., p. 3.

[10]Using the 1962 assessed value of property of $39,946,870 as a basis, the theoretical limit on property tax revenue in Denton is $7,774,088. If 36 per cent equals $39,946,870 then 100 per cent equals $110,963,527. The maxi- tax rate of 2.5 per cent applied to this figure gives $7,774,008.

Income Tax Advantage

An obvious advantage accruing to the individual is that property tax payments are a deductible item in arriving at taxable income, whereas electric bills are not.[11] Assume an individual had a property tax payment of $150 before the increase in the property tax rate. After the property tax rate increase his property tax payment is $170. The influence of an increase in the property tax rate on the federal income tax liability is illustrated below. The cash savings after the increase

	Before Rate Increase	After Rate Increase
Adjusted Gross Income	$5,000	$5,000
Less: Property Tax Payment	150	170
	$4,850	$4,830
Less: Other Exemptions	1,800	1,800
Taxable Income	$3,050	$3,030
Income Tax Ability Assuming a .25 Rate	762.50	757.50

in the property tax rate amounts to $5.00. Assuming the $20 increase in the property tax payment is equal to the amount of the contribution to electric utility profits, individuals will gain in two respects. First, they will be paying a proportional property tax instead

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[11] Commerce Clearing House, Federal Income Taxes (New York, 1962), p. 515.

of the regressive electric utility rate. Secondly, they will realize a cash saving through a reduction of their federal income tax liability.

Recommended Residential Rates

As a practical matter Denton's Municipal Electric System might do well to adopt a policy of gradual rate reductions. The pursuance of this policy would allow for a "feeling out" of the point at which earnings cover costs. There is little doubt but what the reduced rates would bring a significant increase in the average annual consumption of electricity.

The recommended residential power rates displayed in Chart XVI are designed to fulfill three major objectives.

TABLE XVI

RECOMMENDED RESIDENTIAL RATE STRUCTURE FOR DENTON

Block Size	Price
First 100 kwhr each month	3.0¢ a kwhr
Next 300 kwhr each month	1.5¢ a kwhr
Over 400 kwhr each month	0.5¢ a kwhr

Source: Adapted from the standard residential rate of the TVA and those recommended by Gold and Bauer.

First, the rates are highly promotional. The price per kilowatt hour for the first 100 kilowatt hours consumed was taken from the standard residential rate of the Tennessee Valley Authority.[12] The block size is somewhat larger than traditional initial consumption blocks, however, in light of the fact that very few people in Denton consume less than 100 kilowatt hours in a month, the block size seems justified. The remaining two consumption blocks are those recommended by Gold and Bauer as being highly promotional and readily attainable in most electric systems.[13]

This residential rate structure should bring about a significant, if not tremendous, increase in residential power consumption in Denton. That grand results can be expected from rate reductions is expressed by David Lilienthal when he comments on the experiments in demand elasticities by the Tennessee Valley Authority:

> What had proved to be a good business principle for Henry Ford in the pricing of his first automobiles, what was good business in the mass production field generally, would be good business in electricity supply. It would, moreover, add to the strength and the richness of living of the people of the valley. The particular rates the locally owned distributors of TVA power were to charge their customers, as embodied in those early TVA schedules, were not designed, nor were they advanced, as an absolute standard of precisely what should be charged for

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[12]See Appendix D.

[13]Emery Troxel, op. cit., p. 602, citing Gold and Bauer, The Electric Power Industry, p. 96.

> electricity anywhere and everywhere in the country, with the implication that any company charging more than the TVA rate was therefore proved an extortionist ....The example this valley has supplied is a yardstick in a much more important sense. It has been demonstrated here, to the hilt, to the benefit both of consumers and utilities, that drastic reductions in electric rates result in hitherto undreamed of demands for more and more electricity in homes and on farms. That the yardstick, in this vital sense, has established its value and validity is no longer challenged.[14]

Equating cost and revenue is the second objective of the recommended power rates. It is highly improbable that these rates precisely measure the cost of producing residential power. As mentioned before, a period of experimentation would probably be necessary to determine the rates that reflect cost. However, they should not vary a great deal from those proposed.

While there is an inherent regressiveness in any residential rate structure that is essentially promotional, the power rates recommended in this chapter minimizes this phenomenon. Table XVII exhibits the electric utility rate and the annual electric bill for varying levels of average monthly consumption for the present and recommended rate structure.

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[14] Martin G. Glaeser, Public Utilities in American Capitalism (New York, 1957), p. 564 citing David Lilienthal, "TVA--Democracy on the March."

TABLE XVII

COMPARISON OF PRESENT RESIDENTIAL RATES AND PROPOSED RATE STRUCTURE AND THE ELECTRIC UTILITY RATE

Con-sumer	Average Monthly KWH Consump.	Annual Bill Present Rates	Annual Bill Proposed Rates	Property Tax Assess-ments	Present Electric Utility Rate	Proposed Electric Utility Rate
A	209	$ 82	$ 51	$1,000	8.20%	5.10%
B	225	86	52	2,000	4.30	2.60
C	291	100	63	3,000	3.33	2.10
D	470	136	85	4,000	3.40	2.13

Source: Computed from the rate structure appearing in Appendix A and Table XVI.

Table XVIII compares the electric utility rates for the several rate structures examined in Chapter V with that of the recommended residential rate structure appearing in Table XVI. The electric utility rate for the recommended power rates is distinctly less regressive than the same figure for the present power rates. The increase in the electric utility rate for the existing rate structure is (8.20-3.40) 4.8 percentage points compared to (5.10-2.13) 2.97 for the recommended power rates.

The electric utility rate in column four (Table XI rates) will produce almost identical results when compared to that of the recommended power rates.

TABLE XVIII

COMPARISON OF ELECTRIC
UTILITY RATES

Average Monthly KWH Consump.	Property Tax Assess-ments	Present Electric Utility Rate	Electric Utility Rate (Table XI)	Electric Utility Rate (Table XII)	Recommended Utility Rate
209	$1,000	8.20%	7.60%	5.20%	5.10%
225	2,000	4.30	4.10	2.40	2.60
291	3,000	3.33	3.43	2.17	2.10
470	4,000	3.40	4.03	3.63	2.13

Source: Data taken from statistics presented in Chapters V and VI.

The electric utility rate in column five (Table XII rates) is less regressive than that for the recommended rate structure. As property tax assessments decrease from $4,000 to $1,000, the electric utility rate increases only 1.57 percentage points. This compares with an increase of 2.97 percentage points for the recommended electric utility rate. This comparison leads one to conclude that the residential rate structure that produced the electric utility rate in column five would be the most desirable selection. Other things being equal, this would be a valid conclusion. However, this electric utility rate was produced by inverting the existing residential rate structure, consequently, would have to be rejected because of its adverse effect on residential power consumption in Denton. This fact was pointed out in Chapter V.

There is little doubt but what the recommended residential rate structure displayed in column six of Table XVIII is the most desirable choice, particularly when you consider the three objectives to be fulfilled:

(1) residential rates that are highly promotional,

(2) residential rates that will reflect the cost of production,

(3) residential rates that will minimize the regressiveness of the electric utility rate.

On the matter of rate reduction this study is in agreement with Troxel, who is of the opinion that

> Municipal ownership of utility plants offers an opportunity for experimental pricing. The managers need not follow the conservative pricing practices of private utility companies, holding back price reductions until the earnings are excessive, until the buyers earn the price reductions. They can offer lower prices to buyers and wait for their reactions. If the buyers do not have an elestic demand for service and the total revenue declines, the old rates can be restored. Unlike the private companies, municipal systems usually do not go through regulatory investigations every time the rates are increased. On the other hand the demand may be elestic. If the total revenue increases enough to cover the cost increment of the new sales, the price experimentation is justified. Taking chances on price reductions, a municipal can expand consumption and increase the use of its capacity. Yet the municipal systems seldom experiment with prices. Except in areas where municipal electric plants are in contact with federal power projects like the Tennessee Valley Authority, the public

> managers apparently have no more interest in experimental price reductions than the managers of private firms.[15]

This study has shown utility profits to be a poor substitute for property taxes in Denton, and that a residential rate structure which would render utility earnings a satisfactory substitute for property taxes would not only be impractical, but in all probability would cause a decrease in the purchase of total residential power.

The function of Denton's Municipal Electric System should be to furnish electric power for economic and social purposes at as low power rates as are attainable and still be consistent with efficient operations. The system should not be used as a tax collecting agency for as Bauer concludes "its public justification depends fundamentally upon its promotion of community advancement, rather than a means of taxation."[16] To have residential rates that compare favorably with surrounding privately owned electric utilities is not enough.

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[15] Ibid., p. 630.

[16] John Bauer, "Municipal Utilities: Profits vs. Taxes," National Municipal Review, XXVIII (September, 1939), 630.

APPENDIX A

RESIDENTIAL RATES IN DENTON

Residential Rate

(1) Rate:

First 30 kwhr @	7.4¢ per kwhr
Next 50 kwhr @	4.8¢ per kwhr
Next 120 kwhr @	2.4¢ per kwhr
All over 200 kwhr @	1.9¢ per kwhr

Usage during the months of November through May which is in excess of 800 kwhr will be supplied at 1.35¢ per kwhr if the entire home is heated electrically--heat pump or resistance.

(2) Minimum Charge: $1.10

(3) Availability:

Applicable for single family residential use. Where multiple dwelling units are served through the same meter, the number of kwhr in each block of the rate and the minimum charge will be multiplied by the number of family or housekeeping units.

(4) Service:

Single phase service at utilization voltage will be supplied hereunder. No charge will be made for the installation of three phase service when such service is required by the user.

(5) Discount:

A ten per cent (10%) discount will be allowed on the monthly billing if paid on or before the discount date as shown on the bill. Failure to receive bill does not establish claim for discount.

APPENDIX B

STATISTICAL DATA FOR GROUP I

(1) Coefficient of Correlation:

$$r = \frac{N \sum fd' \, . \, dy' - (\sum fx\, d'x)(\sum fy\, d'y)}{\sqrt{N \sum fx(d'x)^2 - (\sum fx\, d'x)^2 \quad N \sum fy(d'y)^2 - (\sum fy d'y)^2}}$$

$$r = \frac{(131)(-231) - (102)(-136)}{\sqrt{(131)(174) - (102)^2 \quad (131)(534) - (-136)^2}}$$

$$r = \frac{(-30,261) - (-13,872)}{\sqrt{636,564,620}}$$

$$r = -.6495$$

(2) Standard Error of Estimate:

$$SY.X = Sy' \sqrt{1-r^2}$$

$$SY.X = .022 \sqrt{1-.6495^2}$$

$$SY.X = .022 \cdot .7599$$

$$SY.X = .017$$

(3) Other Sample Statistics:

Arithmetic Mean	$1,778
Median	2,261
Mode	2,052
Standard Deviation	850

APPENDIX C

STATISTICAL DATA FOR GROUP II

(1) Coefficient of Correlation:

$$r = \frac{N \textstyle\sum fd' \cdot dy' - (fx\ d'x)(fy\ d'y)}{\sqrt{N \textstyle\sum fx(d'x)^2 - (fx\ d'x)^2 \quad N\ fy(d'y)^2 - (fyd'y)^2}}$$

$$r = \frac{(89)(360) - (-158)(-236)}{\sqrt{(89)(649) - (-158)^2 \quad (89)(806) - (-236)^2}}$$

$$r = \frac{(32,040) - (37,288)}{\sqrt{24,330}}$$

$$r = -.21113$$

(2) Standard Error of Estimate:

$$SY.X = Sy' \sqrt{1-r^2}$$

$$SY.X = .01385 \sqrt{1-2113^2}$$

$$SY.X = .01385 \cdot .978$$

$$SY.X = .0135$$

(3) Other Sample Statistics:

Arithmetic Mean

Median

Mode

Standard Deviation

APPENDIX D

STANDARD RESIDENTIAL RATE OF

TENNESSEE VALLEY AUTHORITY

Residential Rate

(1) Rate:

First 50 kwhr @	3.0¢ per kwhr
Next 150 kwhr @	2.0¢ per kwhr
Next 200 kwhr @	1.0¢ per kwhr
Next 1000 kwhr @	0.4¢ per kwhr
Excess over 1,400 kwhr	0.75¢ per kwhr

(2) Minimum Charge: $0.75

(3) Availability:

Available for domestic use to all residential customers served from local alternating current distribution systems. Service under the Standard Residential Rate shall apply only to electric service in a single private dwelling and its appurtenances, the major use of which is for lighting and household appliances, for the personal comfort and convenience of those residing therein. Private dwellings in which space is occasionally used for the conduct of business by a person residing therein will be served under the Standard Residential Rate. Where a portion of a dwelling is used regularly for the conduct of business, the electricity consumed in that portion so used will be separately metered and billed under the appropriate Basic Lighting and Power Rate. If separate circuits are not provided by the customer, the entire premises shall be classified as nonresidential and billed accordingly. The Standard Residential Rate shall not apply to service to institutions such as clubs, fraternities, orphanages or homes; recognized rooming or boarding houses; the space in an apartment or other residential building primarily devoted to use as an office or studio for professional or other gainful purposes.

(4) Character of Service:

Alternating-current service at approximately 60 cycles, 120 or 240 volts, either single-phase, two-wire or three-wire or four-wire, as may be required by Distributor.

(5) Payment:

Above rates are net, the gross rates being 10 per cent higher. In the event that the current monthly bill is not paid within 10 days from the date of bill, the gross rates shall apply.

(6) Single-Point Delivery:

The above rates are based upon the supply of service to the entire premises through a single delivery and metering point, and at a single voltage. Separate supply for the same customer at other points of consumption, or at a different voltage, shall be separately metered and billed. Service under this classification is subject to Rules and Regulations of Distributor.

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