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The Effect of Combination Companies on Electricity Rate Structures in the United States

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THE EFFECT OF COMBINATION COMPANIES ON ELECTRICITY RATE STRUCTURES IN THE UNITED STATES

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CHAPTER I

Introduction

In general, public policy in the United States has been directed to maintaining competition. The belief has been that competitive free enterprise economy is the best means toward a higher standard of living and the preservation of personal freedom. In many industries, however, competition is imperfect. The electric power and natural gas industries are such activities.

Nature of industry

Electric power operations started on a small scale, with plants serving customers only in the immediate vicinity. Later, there was a period of short-lived competition, but the end result was city-wide and ultimately area-wide consolidation. This caused the electric power industry to evolve into large scale firms. Plants are huge and highly specialized, involving heavy investments and high fixed charges. These are built in anticipation of demand. Plants must be big enough to satisfy demand at its peak. The service they produce cannot be stored. The character of the industry probably makes monopoly the most efficient form of market organization. In general, the larger the plant, the lower the cost per kilowatt-hour, provided that there is enough business to keep it all in use. So, this industry has decreasing cost, and is said to be a natural monopoly.

Two types of firms are straight utilities and combination companies. The straight utilities engage in selling gas or electricity only. The combination companies engaged in selling both gas and electricity have operated in the United States since 1883. Richard Hellman's opinion is:

> The persistance of monopoly over competition, including gas and electricity, is illustrated by Denver. Its first two franchises were granted in 1883 and 1887, shortly after which the holders combined and they merged with the gas lighting company for a function monopoly of the utility lighting.[1]

In this study, the combination firm is defined broadly as a company which is engaged in selling both gas and electricity.

The electric utility sells electricity to different classes of buyers. Different classes were established for residential, commercial, and industrial users. Rates were differentiated from class to class; discrimination resulted. Discrimination occurs when rates are based upon differences other than cost. The elasticity of demand for residential users, commercial users, and industrial users varies from low to high in sequence. Rates will be set lower where demand is more elastic. Demand is more elastic where customers have less need for the service or less ability to pay for it, or where they can provide it for themselves or obtain it from a company's competitor at a lower rate. Rates are kept high where demand is more inelastic, that is, where the buyer's need and ability to pay are great. Thus, the electric utility has good reason to set the lowest

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[1] Richard Hellman, Government Competition in the Electric Utility Industry (New York: Praeger Publishers, Inc., 1972), p. 9.

prices for large industrial users even where there is no cost advantage. Since the larger user has the alternatives of supplying his own power or locating in another part of the country, he has a much more elastic demand for electricity than other buyers. Between the residential and commercial users, the elasticity of the commercial users' demand is higher than that of residential users. This is because large commercial users may find it possible to find some substitute source of power, as can the industrial users if the electrical rates are high. Thus, demand would be expected to be more elastic than that for residential users, but less than industrial users.

Discrimination serves the purpose of the utility. By discrimination among the customers, a company may expand its sales and enlarge its revenues. It may realize a fuller utilization of its facilities, spread its fixed cost over more units of output, and thus reduce its unit costs.

Regulation

It is the natural monopoly characteristic of the power industry which creates the need for regulation. For while a monopoly may operate as efficiently as a competitive enterprise, and may provide services of equal quality, it is under less pressure to do so. Similarly, while a monopoly may elect to sell at prices equal to those that might be secured under active competition, it is less likely to do so.

As the economies of scale of combination companies makes high entry barriers to the market, a combination company may be referred to as a more "complete" monopoly. As a monopolist, the combination company has power to control over price and output. Therefore, he is not interested to produce to the point where marginal cost equals price. He realizes that a negatively sloping demand curve will cause the marginal revenue to be less than price as long as the slope of demand curve is less than zero. The quantity supplied under monopoly depends not only on marginal cost, but also on demand elasticity. The combination company has a profit incentive opportunity at the profit-maximizing output MR = MC; at any output, $MR = P(1 + \frac{1}{\eta})$, he will set price and produce as depicted in Figure 1.

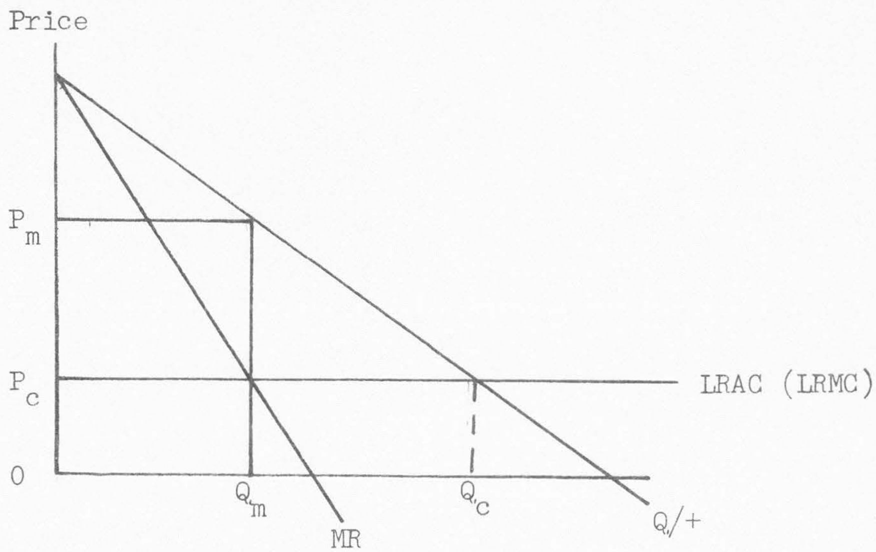

Figure 1. Price and supply under monopoly market

Compared to a competitive market, the combination company has power to set price higher, $P_m > P_c$, and produce less output $Q_m < Q_c$, as he is a monopolist.

Since combination companies have the power over price and output, government has substituted administrative regulation for competition.

Under the Sherman Antitrust Act passed in 1890, every contract, combination, or conspiracy in restraint of trade is illegal. It provides the original legal base for the enforcement of competition in the United States. The law emphasized behavior (monopolization) rather than market structure (monopoly). In 1914, Congress passed the Clayton Antitrust Act, which prohibited specific kinds of behavior, e.g., price discrimination, tied sales, and interlocking directorates. In the same year the Federal Trade Commission Act brought into being the Federal Trade Commission to investigate "unfair methods of competition" and to issue "cease and desist orders" against illegal practice, ". . . where the effect may be substantial to lessen competition or tend to create monopoly." In 1963, the Robinson-Patman Act strengthened the Clayton Act's provision against price discrimination; price differences had to be supported by cost differences, except where prices were lowered in good faith to meet competition in certain markets. In 1950, the Celler-Kefauver Act placed limitations on mergers, plugging another of the Clayton Act's loopholes.[2]

The purpose of regulation is to impose price ceilings as a substitute for the automatic control of the competitive market mechanism. It is appointed to decide what price would provide a fair return on some reasonable assessment of the value of the capital investment.

The combination company may be partially beyond the scope of regulation. It is a simple matter to issue an order forbidding new

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[2]Allan J. Braff, Microeconomic Analysis (New York: John Wiley & Sons, Inc., 1969), p. 156-7.

acquisitions of stock or assets, or to limit rate increases, but it is not so easy to break up a combination that has existed for many years. Combination companies are not within jurisdiction of anti-monopoly laws which tend to give special status to regulated industries.

Regulatory policy does permit the utility to classify its customers, thereby recognizing monopolistic class prices, but it does not permit experimentation with the quantity supplied and with the rates in order to determine the point of maximum return from the point of view of the producer alone. Public utility commissions, which are government agencies which have the statutory responsibility to control the public utilities, must exercise control of the rate structure to assure equity among customers. The legal standards are broad. "First, each specific rate must be 'just' and 'reasonable.' Second, 'undue' or 'unjust' discrimination among customers is prohibited."[3] The crux of regulation is control of rates. The general level of rate is controlled to prevent monopolists from charging prices and obtaining monopoly profit.

A commission has authorization in controlling the regulated industries. From the economist's point of view, the goals of the commissions are: "(a) to induce a more nearly equal distribution of income, and (b) to increase economic efficiency."[4]

The pursuit of an efficiency goal consistent with an income goal is bound to be demanding. Under these circumstances, what policies and procedures does the commission choose?

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[3]Charles F. Phillips, Jr., The Economics of Regulation (Illinois: Richard D. Irwin, Inc., 1965), p. 304.

[4]Stephen G. Breyer and Paul W. Maccavoy, Energy Regulation by the Federal Power Commission (Washington, D.C.: The Brooking Institution, 1974), p. 3.

First, the commission committed itself to setting prices equal to the costs of service. Elaborate procedures were established for determining investment cost-procedures for averaging past figures, collecting large amounts of accounting information, and listening to experts present their individual opinions about cost factors in great detail at numerous hearings. Somewhat simpler, more mechanical procedures were used by the commission to determine operating costs of the regulated companies, but all in all this style of regulation is laborious.

Second, the commission sought "quality" service. It employed complex methods to calculate efficient scales and adequate reserves in given instances. In the case of electric power companies especially, numerous rulings about plant layout and interconnection were laid down.[5]

Objective of paper

In this paper, multiple regression analysis was used to determine whether regulation is effective. The study was based on two related theories: first, that the electric utility is a natural monopoly, having economies of scale, and second, that the standard of performance of the commission's regulation is what would be obtained in a hypothetical competition. The criteria should be set up before the statistical test is stated:

1. If the rate structure was set by a commission, it would imply that the regulation is effective. There should be no difference between rate structure of combination companies and other utilities.

2. If the rate structure was set by a firm, it would imply that the regulation is not effective: combination company rate structure may differ from those of straight utilities.

Chapter two is a theoretical model. Chapter three takes up with the analysis of data and the final chapter is the empirical results and summary.

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[5]Ibid., p. 4.

CHAPTER II

Theoretical Model

In studying rate structure, two ratios are used. P_{ir} represents the rate of the price charged to industrial users to that of residential users, while P_{ic} is the rate of the price for industrial users to that of commercial users. The model assumes the following variables may affect rate structure:

X_1: Combination variable, it will be equal to one for the single company, and will equal to zero for the combination company. If the value approaches one, this means that there is more competition.

X_2: Population density (population per square mile).

X_3: Per capita income.

X_4: Average temperature during November-March.

X_5: Average temperature during April-October.

X_6: Value added of manufacturing.

X_7: Fuel cost.

The rate structure equation is assumed to be as follows:

1. $P_{ir} = a_1 + a_2x_1 + a_3x_2 + a_4x_3 + a_5x_4 + a_6x_5 + a_7x_6 + a_8x_7$

2. $P_{ic} = b_1 + b_2x_1 + b_3x_2 + b_4x_3 + b_5x_4 + b_6x_5 - b_7x_6 + b_8x_7$

The expected signs of the a_i and b_i are discussed in the paragraphs which follow.

Combination companies

If the regulation is effective, that means the commission sets prices. The industry would like to base its rate structure on elasticity of demand. So, differences in elasticity of demand are accompanied by changing prices and quantities. But, effective regulation does not permit the regulated industry to practice this extreme price discrimination. Hence, effective regulation should result in ratios of prices to different users which are independent of whether the firm is a straight or a combination utility. That is:

$$\frac{d\ P_{ir}}{d\ X_1} = 0$$

$$\frac{d\ P_{ic}}{d\ X_1} = 0$$

Alternatively, if regulation is not effective, then:

$$\frac{d\ P_{ir}}{d\ X_1} \neq 0$$

$$\frac{d\ P_{ic}}{d\ X_1} \neq 0$$

When the combination variable increases, that means that more competition exists in the market. The electricity demand curve of industrial, commercial, and residential users would become more elastic, from the view of the electric company. The situation is as follows:

1. For a combination company, if there is a shift between gas and electric, it still provides revenue for the firm.

2. For a single company, the shift from electricity to gas causes the firm to lose revenue.

3. When the elasticity of demand for electricity approaches zero, this implies little shift to gas if electricity prices increase. If the elasticity of demand approaches infinity, it implies a large shift if prices increase. Thus, a non-combination company attempting to practice price discrimination would increase the price to users with inelastic demand more than for users with elastic demand. A combination company would have less incentive to adjust prices in this manner because of its benefits from shifts from electricity to gas.

Because demand of residential and commercial users is relatively more inelastic than that for industrial users, a non-combination company would tend to charge residential and commercial users relatively higher prices. Thus, as X_1 increases:

$$\Delta P_i > \Delta P_r \, , \; \Delta P_c$$

Hence, it is reasonable to expect that: P_{ir} and P_{ic} would go down, when the combination variable went up, or:

$$\frac{d P_{ir}}{d X_1} < 0$$

$$\frac{d P_{ic}}{d X_1} < 0$$

<u>Population density</u>

As the market becomes more dense, unit costs decrease, but more so for residential users. Hence, price to residential users decreases, while price to other users is little affected.

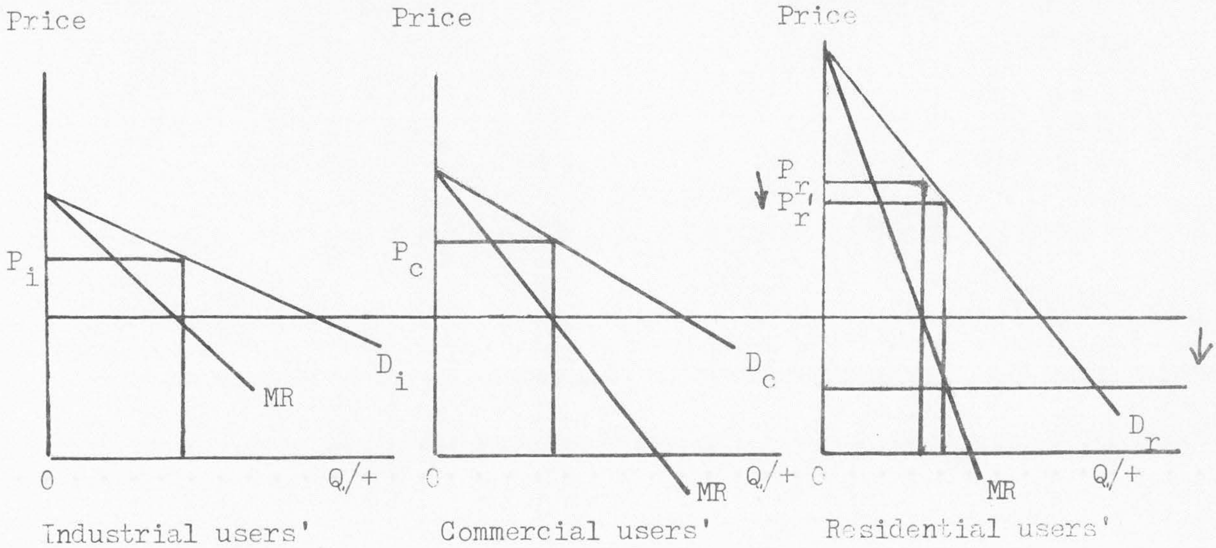

Figure 2. Population density and user prices

So, when $X_2 \uparrow \Rightarrow P_r \downarrow$; But ΔP_i and $\Delta P_c = 0$

Therefore, it can be expected that when population density went up, P_{ir} would decrease, but P_{ic} would not be changed.

$$\frac{d\,P_{ir}}{d\,X_2} > 0$$

$$\frac{d\,P_{ic}}{d\,X_2} = 0$$

Per capita income

The higher per capita income, the more elastic the residential demand curve would be expected to be. This causes the price to go down. For industrial and commercial users, there will probably be less an effect because they produce to serve nationwide.

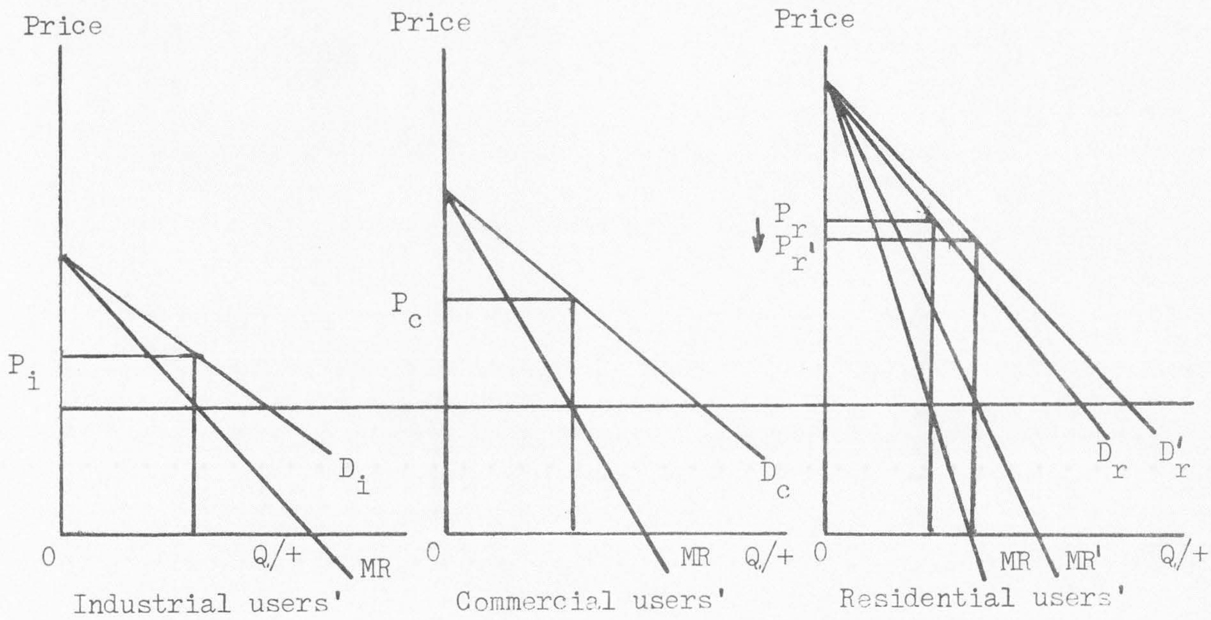

Figure 3. Per-capita income and user prices

So, the expectation is:

$$X_3 \uparrow \Rightarrow \eta_r \uparrow \Rightarrow P_r \downarrow \quad ; \quad \text{But } \Delta P_i, \Delta P_c = 0$$

$$\frac{d\, P_{ir}}{d\, X_3} > 0$$

$$\frac{d\, P_{ic}}{d\, X_3} = 0$$

Climate - winter

In especially cold areas the demand for gas and electricity for heating increases. Gas and electricity are substituted in heating. Thus, in cold areas the residential demand curve becomes more elastic because of competition from gas. However, for industrial users, price should be less affected because heating is a small part of total demand

and they consider substitute energy forms even in warm climates.

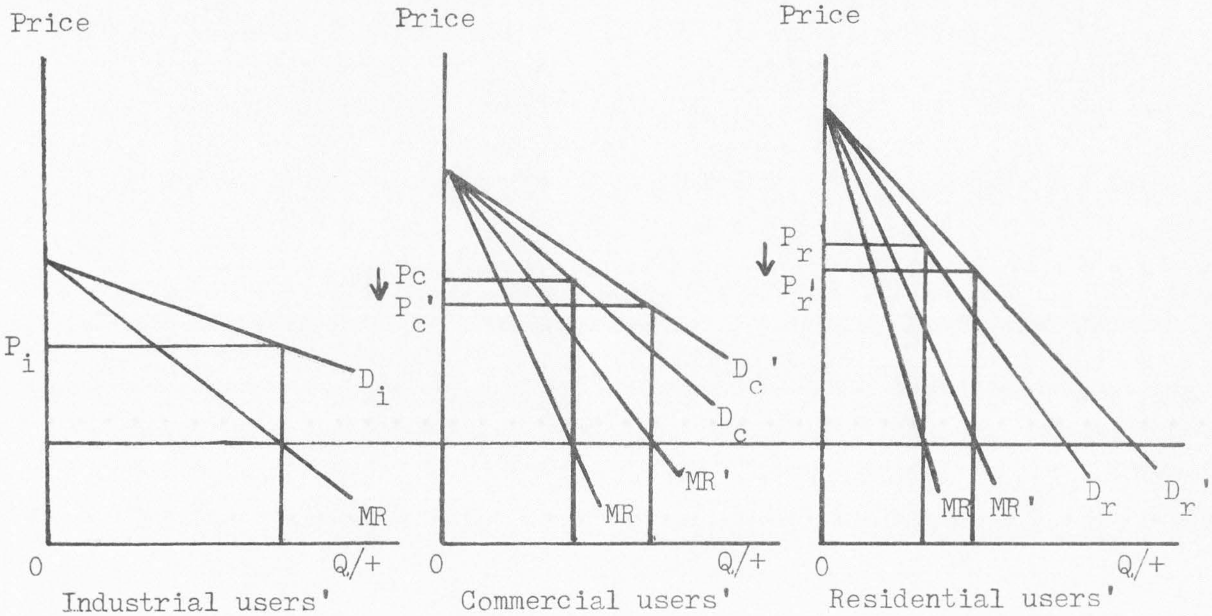

Figure 4. Climate and user prices: Winter

So, it can be expected that:

$$X_4 \uparrow \Rightarrow \eta_r \uparrow, \eta_c \uparrow \Rightarrow P_r, \quad P_c \downarrow; \quad \text{But } \Delta P_i = 0$$

Thus, P_{ir} and P_{ic} would go up.

$$\frac{d\,P_{ir}}{d\,X_4} > 0$$

$$\frac{d\,P_{ic}}{d\,X_4} > 0$$

Climate - summer

Greater air-conditioning demand implies that residential elasticity demand curve is more elastic in that both gas and electricity can be used for air-conditioning. Hence, the residential users' price and the commercial users' price would go down, but there is probably little effect to industrial users.

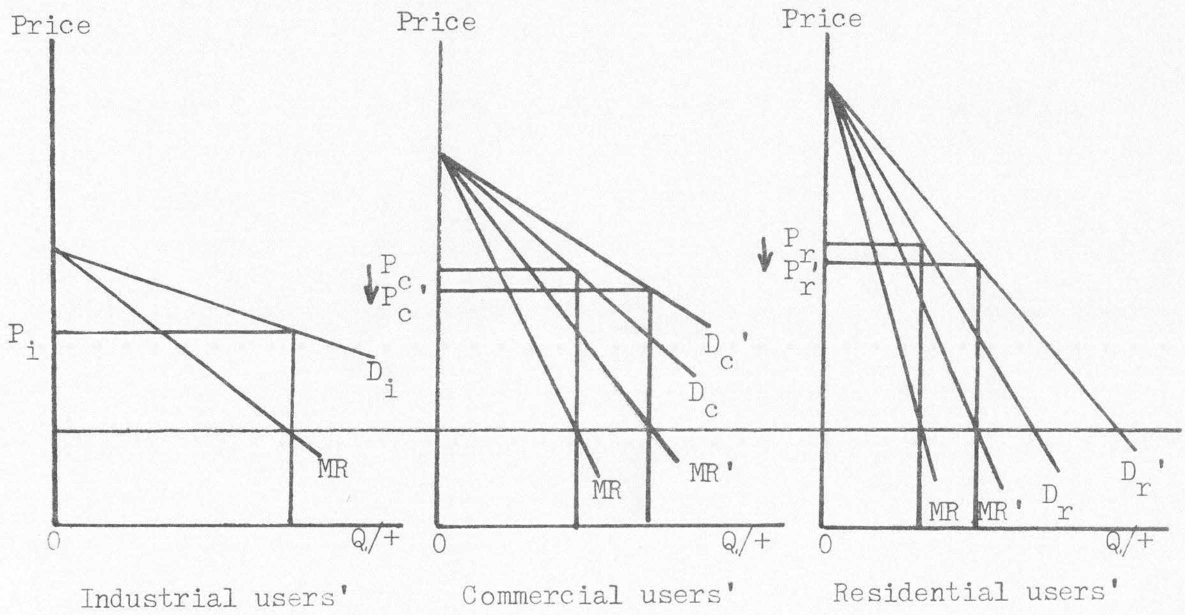

Figure 5. Climate and user prices: Summer

So, it can be expected that:

$$X_5 \uparrow \Rightarrow \eta_r, \eta_c \uparrow \Rightarrow P_r, P_c \downarrow \text{ ; But } \Delta P_i = 0$$

$$\frac{d\,P_{ir}}{d\,X_5} > 0$$

$$\frac{d\,P_{ic}}{d\,X_5} > 0$$

<u>The value added</u>

Value added involves the industrial users' price. Because, the increase in value added means an increase in industrialization. A cause of industrialization is low energy price in the past. High energy prices result in movement of industry out of the region. To hold industry, the industrial users' price must be kept low.

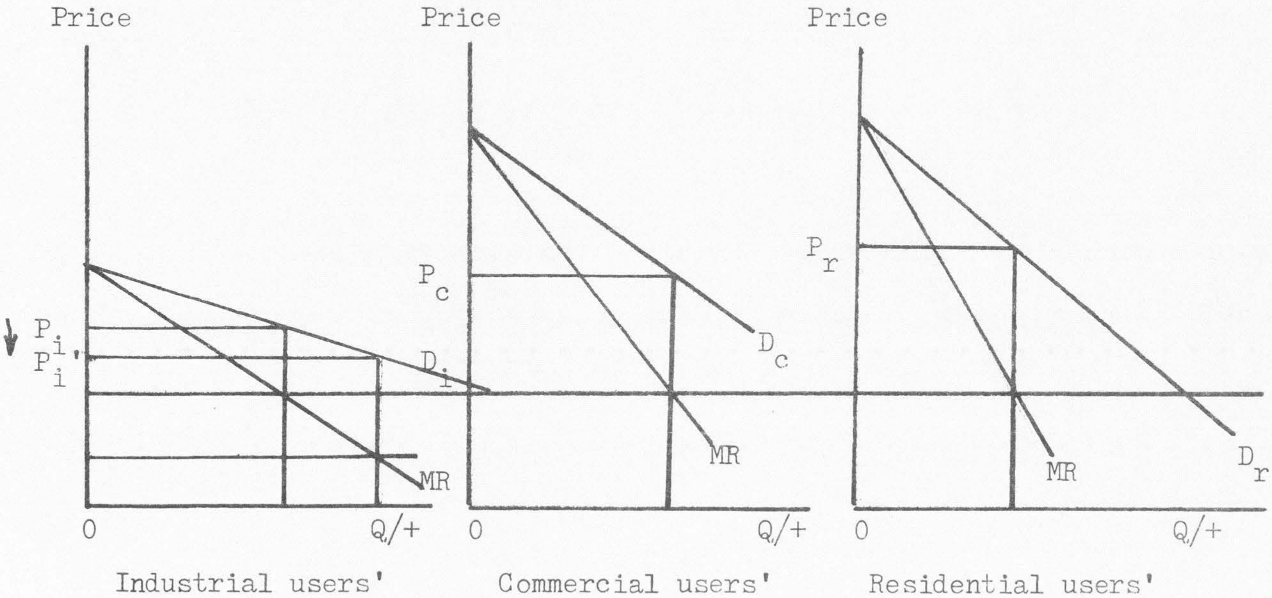

Figure 6. Value added and user prices

The expectation is as follows:

$$X_6 \uparrow \Rightarrow P_i \downarrow \text{ ; But } \Delta P_r \text{ and } \Delta P_c = 0$$

$$\frac{d P_{ir}}{d X_6} < 0$$

$$\frac{d P_{ic}}{d X_6} < 0$$

<u>Fuel cost</u>

The relationship between P_{ir} and X_7 and P_{ic} and X_7 cannot be established on a theoretical basis, but is an empirical question.

CHAPTER III

Analysis of Data

The data for this study are collected from: Performance Profiles Private Electric Utility in the United States 1963-1966, Statistics of Privately Owned Electric Utilities in the United States, 1966, and the Statistical Abstract, 1967. The data of forty-seven states were collected (Hawaii, Alaska, and Nebraska were omitted). The ratio of customers' price is defined as the ratio of total revenue to total amount of kilowatt-hour sold in each state. The independent variables for the regression equations are P_{ir} and P_{ic}: and are the industrial users' price divided by the residential users' price and the industrial users' price divided by the commercial users' price, respectively.

The combination variable, X_1, is the net electrical plant divided by the net electrical plant plus net gas plant. So, the lower in combination variable means the higher the concentration in combination in the market of that state. On the other hand, if the combination variable is equal to one in certain states, the business will be run in the single company form.

The population density variable is population in each state divided by area in square miles.

The per capita income variable is the average income of the people in each state in 1966, as reported in the Statistical Abstract, 1967.

The average temperature during the period of November to March and the average temperature during the period of April to October are normal monthly average temperatures, based on standards of a 30-year period, 1931 to 1960. The average temperature during November to March is calculated by adding the average monthly temperatures from November to March together, dividing by six; using the same method, the climate for summer is found.

Value added of manufacturing was taken from the Statistical Abstract also, but the data in 1966 are not available. So, in this study the value added in 1967 are used. This variable indicates the concentration of the industry in each state.

The fuel costs were taken from the Statistics of Privately Owned Electric Utilities in the United States. The unit of the fuel cost is BTU/CENTS in 1966 of each state.

CHAPTER IV

Empirical Results

In this chapter, the empirical results are presented to test the hypothesis of Chapter II. The result of the ordinary least square estimation equation, with P_{ir} and P_{ic} as the independent variables, is shown in Table 1 and Table 2.

Table 1. Regression result: industrial and residential prices

Variable	Regression Coefficient	t-ratio
Constant term	0.607	1.772
Combination variable	-0.003	-1.889
Population density	-0.001	-0.302
Per capita income	0.001	0.608
Climate - winter	0.003	1.07
Climate - summer	-0.001	-0.198
Value added	-0.001	-1.42
Fuel cost	-0.002	2.33

R^2 = 0.237 Number of observations = 47

Table 2. Regression result: industrial and commercial prices

Variable	Regression Coefficient	t-ratio
Constant term	0.382	1.11
Combination variable	-0.004	-2.06
Population density	-0.001	-0.487
Per capita income	0.001	1.113
Climate - winter	0.002	0.786
Climate - summer	0.003	0.666
Value added	-0.001	-0.714
Fuel cost	0.002	1.84

R^2 = 0.2127 Number of observations = 47

As expected, the regression reveals a negative sign of regression coefficience between both P_{ir}, P_{ic} and combination variables. The significance levels are 90 and 95 percent, respectively.

It was expected that the relationship between P_{ir} and population density would be positive, while we could not determine the relationship between P_{ic} and population density. The regression result indicates the negative sign of coefficient. So, it means that the price of residential users did not go down because of the increasing of population density as expected, but it went up. This should imply that with the increase in population growth, the company has to increase some cost in producing services, e.g., the fuel cost. Thus, the relationship of regression reveals negative sign. Both of them are non-significant.

The per capita income coefficient has positive sign in relation to P_{ir} as was expected, but the relationship with P_{ic} was not determined at all on a prior basis. The coefficient is not significant in the first equation, but the second one is significant at the 90 percent level.

The coefficient of the winter climate variable provides results as expected in both equations. The coefficient of the first equation is significant at the 90 percent level, but the second one is non-significant.

In the coefficient of the summer climate variable, the second equation was negative sign as viewed, but the first one was not as expected. It is probably because of the residential users' lack of an alternative to bargain the price with the company, so the residential users' price was not decreased as expected. Both coefficients are non-significant.

The value added coefficient has a negative sign as expected in both equations. The significant level of the coefficient is 90 percent in the first equation, while the second one is non-significant.

The sign of the fuel cost coefficient was not predicted. The results are negative and positive signs in the first and second equation, respectively, and the significance levels are 95 percent and 90 percent.

Summary

Both of the regression equations have a very low R^2 and there are few significant coefficients. However, the expectation of the relationship between the independent variables and the dependent variables indicated in Chapter II based on economic theory are right for most of them. Although relationships of the variables are not good, they are still consistent with theory. In this study, the variables are generated in log form also. The relationships are generally the same, but the R^2 in both equations in log form are lower than the two equations reported here.

In regard to the effectiveness of regulation, the hypothesis that regulation is effective is rejected. Combination companies have different rate structures than straight electric utilities. This should not be the case if the commissions made decisions which are independent of the nature of the company.

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