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Estimate of the Price Effects of Competition: The Case of Electricity

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ABSTRACT

ESTIMATE OF THE PRICE EFFECTS OF COMPETITION:
THE CASE OF ELECTRICITY

This study estimates the effects of direct electric utility competition on consumer prices. The data are from cities where two electric firms compete for the same customers. In these situations, if prices charged by one firm are too high, or services are inferior, a customer has the opportunity to change to the other firm serving his city.

Multiple regression analysis shows that substantially lower prices evolve in competitive situations. The marginal price between 500 and 750 KWH blocks is lower by 16 percent, the marginal price between 750 and 1000 KWH blocks is lower by 19 percent, and the average price (average revenue) is lower by 33 percent because of competition. These results provide a measure of the effects of monopoly on the prices consumers pay and an assessment of the effects of competition as a regulator of utility rates of municipal utility firms.

ESTIMATE OF THE PRICE EFFECTS OF COMPETITION: THE CASE OF ELECTRICITY

by Walter J. Primeaux, Jr.*

INTRODUCTION

Economists have long been interested in assessing the effects of monopoly in the business world. Many sectors of the economy have been previously examined to determine the impact of market structure differences on prices charged for goods and services produced under different competitive conditions. See: Hay and Morris (1979). In spite of the wide scope of the previous studies, one important segment of the economy has been neglected and an important question remains unanswered. The neglected business is municipal electric utility firms and the question is, what are the pricing effects of monopoly in that business. Given the rapidly increasing price of electric energy, better public policy decisions could be made if there was a better understanding of utility pricing under competitive and monopoly conditions.

Direct competition between two electric utility firms within a given city has been generally overlooked by public utility researchers. Although not common, these kind of competitive situations do exist and they have been discussed in some detail in Primeaux (1975, 1977, 1974)

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and in Awh and Primeaux (in press). This competition is briefly discussed later but for our purposes it is important to explain here that where direct electric utility competition exists, two electric utility firms serve a given city and consumers have a choice of being served by one firm or the other.[1] Consumers choose between the two utility firms in their city in much the same way as they choose between firms supplying other goods and services; both quality of service and price are important considerations. From a given customer's point of view, however, day to day changes from one company to the other are not practical, because of the inconvenience of having services disconnected from one company and then reconnected by the other. Yet, consumers actually do have the option of changing from one company to the other. Moreover, competition has tended to eliminate the service charges imposed for disconnecting service from one company and then connecting service by the other (Primeaux, 1975); consequently, the economic constraints to switching companies is significantly weakened.[2] As discussed later, this direct competition imposes significant pressure on firms to be efficient while monopoly electric utility firms are free from such competitive forces.

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[1]Although competition may not exist throughout every city, the previous studies have shown that the competition is vigorous and provides significant restraining influences upon the rivals, for example see: Primeaux (1975, 1977).

[2]Utility poles are shared in some cities with direct competition and in other cities two sets of electric poles exist. In all cases, two sets of electric lines exist. The reader who is interested in learning more about other aspects of these competitive situations is directed to Primeaux (1975).

This is an empirical study of prices charged to residential subscribers by municipal electric firms and the findings are that prices are significantly lower if firms face competition than if they do not.

PREVIOUS STUDIES

Several studies have assessed the impact of competition between natural gas and electricity by examining differences in economic performance between monopoly electric firms competing with monopoly gas firms. These results were then compared with combination firms, that is, those which sell both gas and electricity. These studies are useful and interesting; however, they only focus upon the substitutability of these two types of energy for some uses as the source of competition among firms, and they are not concerned with the effects of competition between firms selling the same service. For examples see: Wilson (1971) and Brandon (1971).

Primeaux (1975) explained that the effects of direct competition existing between two electric utility firms in the same city is a neglected area of research. According to Primeaux (1975), this past deficiency was caused largely by the general lack of knowledge by economists that competition does actually exist in the electric utility business and data are available to test the effects of rivalry in a "natural monopoly" environment.

Behling (1938) presents an interesting history of competition in the electric utility business and some insight into natural monopoly theory. However, his work is void of data or rigorous statistical analysis.

Hellman (1972) examined government competition with privately owned electric firms. He also presents case studies of a number of cities where direct competition has existed between two electric utility firms. While Hellman's is an interesting study and does present price comparisons, it does not use statistical analysis to make comparisons. Therefore, his conclusions regarding price effects of monopoly vs. competition should be examined more fully.

Primeaux (1977) assessed X-efficiency gained through competition and Primeaux (1974) examined price rigidity in this type duopoly, but neither study examined price effects of competition in this business.

While other previous works have examined competition in a "natural monopoly" environment, they are all concerned with matters which are different from the central purpose of this investigation.

THE THEORY

Electric utility firms are generally regulated by rate-of-return regulation but, for reasons discussed below, it is unnecessary that rate-of-return regulation be modelled to derive an equation that would be capable of testing the primary hypothesis of this study. The main reason for this statement is that firms in the sample are municipally owned, as mentioned earlier in the text; as such, they are free of commission regulation and their rates are _not_ set by rate-of-return procedures.

Firms in the sample are regulated by _local regulation_ which may be imposed through a locally constituted body such as a public utility board or a city council. The important point is that these types of regulators do not use rate-of-return regulation to establish prices and they are unconcerned with rate bases. The pricing procedure is more like that followed by unregulated business firms where a meeting of some pricing committee is held to discuss a price (rate) change without the elaborate procedure involved in state commission regulation. Price changes for utility firms in this type of setting are virtually assured, without state control or scrutiny. Under this type of regulation, it is not unusual at all for price increases to be approved in one meeting lasting only a few hours while rate-of-return regulation of privately owned firms at the state level involves extensive documentation and calculations by both the firm and the regulatory commission.

As Primeaux (1977) points out, rate-of-return regulation is based on cost-plus pricing. In the price setting behavior of interest to this study, cost considerations are not unimportant; yet, demand considerations are of much more significance than under rate-of-return regulation.

Rate-of-return regulation commonly requires many months of work based on financial and economic justification for making the price change; an essential ingredient in these proceedings is a rate-of-return and a rate base.

From the above discussion, we may conclude that firms in this sample are not regulated by either state level or rate-of-return regulation. So the outcome reported in the text of the paper was not influenced by rate-of-return regulation.

Primeaux (1974) and Awh and Primeaux (in press) have established that the electric utility firms in the sample are profit seekers and do, indeed, want profits.[3] Even though firms in the sample are profit motivated, Primeaux (1977) has shown that there are significant differences between levels of efficiency of electric utility firms facing competition and those operating in a monopoly market structure. Primeaux (1977) explains that the source of inefficiency within monopoly electric utility firms originate in the X-inefficiency concept, developed by Leibenstein (1966). The X-efficiency concept is multifaceted and deals with a number of conditions within a firm which can affect the level of its efficiency. Among those conditions is the degree of competition a firm faces; that is the condition of primary interest to this study. Leibenstein would attribute the X-inefficiency of monopoly firms to the fact that competitive rivalry cannot force them to become efficient; consequently, there is a different level of effort caused by market structure differences.

Primeaux (1975 and 1977) found electric utility inefficiency to be manifested in higher operating cost levels for the monopoly firms.

Although many of the same operating conditions exist whether an electric utility firm operates as a monopoly or whether it competes for the same customers within a given city, two conditions tend to cause lower consumer prices to emerge in competitive situations. First, since the nonmonopoly firms are forced to be more X-efficient because of the competitive rivalry, lower operating costs would result, as shown in Primeaux (1975). These lower costs would tend to permit

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[3] Firms in this study are a subset of samples used in some previous studies. The earlier studies examined questions of efficiency, cost levels and price flexibility but they were not concerned with price levels, which is the central concern of this study.

the firm to set lower prices, even if it maintained accounting profit near the monopoly levels. The second condition which would tend to cause lower consumer prices to emerge with rivalry is the competitive pressure which is exerted on price levels. Since consumers served by competitive firms have the opportunity of being served by one electric firm or the other, firm prices cannot be set at levels which exist in monopoly situations. If a firm sets prices which are too high, consumers will switch their service to the firm with lower prices, as they do when they purchase other goods and services. Firms in these kind of competitive situations must consider demand conditions as they set prices.[4]

Residential prices of electricity are affected by a number of variables which can be broadly categorized as demand and cost factors.

The income of the buyer is an important demand determinate of consumption and thus affects price levels. With higher customer incomes, the utility firm is able to exact higher customer prices for its services.

The price of natural gas should also affect prices charged for electric services. For many uses, natural gas can be substituted for electricity; this substitutability should put downward pressure on electricity prices.

The price of electricity should be affected by consumer density in the service area. Since the number of customers per square mile

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[4]Primeaux (1974 and 1975) has shown that there is no evidence of price fixing behavior between firms in this type of competitive situation.

affects distribution costs, a higher density should be reflected in a lower consumer price and vice versa.

Production costs of the electric utility also affect electricity prices. Costs of fuel and other production expenses (including purchased power) would be included in the costing formula used by those responsible for making the pricing decisions and rate schedules. Higher costs per kilowatt would obviously result in higher residential prices.

In addition to the production expenses, mentioned above, other operating expenses would also affect price levels because higher expense levels would cause firms to charge higher prices. These costs would also be included in the pricing formula used to construct rate schedules.

The composition of customer types should also affect rate schedules. There is a different cost mix in serving residential consumers compared with commercial and industrial consumers. This is an important consideration because those establishing rate schedules must consider the common costs associated with producing electricity for residential, commercial, and industrial uses. One would expect the residential price to be lower as the proportion of residential consumers increases. These results are supported by previous research by the author.[5]

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[5] Primeaux (1975) found in a study of average costs of firms of the same type in a very similar sample that the variable for consumption per residential consumer possessed a larger negative coefficient than the coefficient for commercial and industrial consumption per customer.

Climatic factors also affect the demand and price of electricity because seasonal variations cause differences in cooling and heating requirements of customers served by electric firms. These variations affect capacity costs for the supplying firms and affect the price schedules.

Competition should also affect electric rates. If the rivalry is vigorous and if costs are not higher with competition, lower consumer prices should result.

Linear ordinary least squares regression analysis was used to develop the price equations used in this analysis.[6]

METHODOLOGY

As mentioned earlier, there is very little discussion of electric utility duopolies in the literature even though there actually are cities with competing electric utility firms.[7]

Data from the existing duopoly markets provided the information for assessing the impact of competition upon price levels charged by electric utility firms. In the duopolistically competitive cities, there was actual duplication of distribution facilities and in some cases generation capacity.[8] The usual arrangement was that a privately

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[6]The justification for this approach is discussed in some detail in footnote 13.

[7]F. Steward Brown, then Chief, Bureau of Power of the Federal Power Commission, revealed in correspondence to the author dated July 29, 1969, that direct competition between two electric utility firms existed in forty-nine cities. The data are as of January 1, 1966, for cities with a population of 2,500 or larger.

[8]Although this condition may seem to indicate inefficiency, Primeaux (1975) reported beneficial effects from competition because average costs were actually lowered when it existed.

owned electric firm competed with a municipally owned firm. Supply conditions were such that the consumer had a choice of being served by one firm or the other. In the Texas and Missouri cities, for example, a customer could switch from one firm to the other at will. In Portland, Oregon, on the other hand, new customers could take service from either company. However, once they had selected a firm they could not switch from one electric supplier to the other. Cities where terrorists are allocated and duplication of facilities does not exist were not included in the study. Primeaux (1974b) presents a detailed case study of a city served by two competing electric utility firms.

It was not possible to obtain data for the individual cities served by privately owned firms. This difficulty was caused because privately owned electric utilities do not allocate or report sales and revenue data according to the individual cities in which they operate; therefore, the data necessary for an adequate examination of privately owned firms are not available. Since privately owned firms usually serve several cities and face competition in some communities and not in others, published data for privately owned firms are not useful for this study.[9]

[9] Price data for block rates of privately owned firms are presented in Typical Electric Bills (Washington: Federal Power Commission). However, operating data published by the Federal Power Commission, which could be useful for an examination of privately owned firms, are not allocated to the individual cities in which the firms operate. Thus, they are not useful in this study.

For the above reasons, and because privately owned firms are generally regulated by state regulatory commission,[10] it was decided to focus attention on cross section data for two subsets of municipally owned firms, each firm operating in a different city. As mentioned earlier, firms in the duopoly subset established prices in the face of rivalry, the other group set prices in a monopoly environment and competition did not affect price levels. Data from these two subsets of firms would indicate relative price levels of firms in monopoly and duopolistically competitive markets.

Generally, a "matched" firm without competition was selected for every firm with competition. The criteria used to select the matched firms were as follows: First, to the extent possible, the matched firm should be from the same state as the firm with which it would be paired. Second, the matched firm should be approximately the same size (in terms of KWH sales) as the firm with which it would be paired; if no such firm existed in the relevant state, a larger firm was accepted; competitive firms were never matched with smaller firms. Third, to the extent possible, types of power sources should be identical for both matched firm and the competitive firm.

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[10]This analysis does not attempt to answer any questions concerning the effectiveness of utility regulation. As mentioned earlier, since municipally owned utility prices are controlled by some local commission, regulatory effects on the results are minimized by following this procedure. It is true that prices set for privately owned utilities by a state regulatory commission effectively puts a ceiling on prices which may be charged by a supplier that faces competition. Our interests, however, center on the question of whether rate levels are lowered by competition.

The matching procedure was used to select a noncompetitive subset to be compared with the duopolistically competitive subset. The matching was undertaken because, first, it was thought that it would reduce heteroscedasticity and the variance in the error term in regressions. Second, if the matched firm was selected from the same state as the firm with competition, some interstate price differences not picked up by the estimating equations might be eliminated. Third, if the matched firms were at least as large as the competitive firms, any price differences due to scale effects not picked up by the estimating equations would tend to bias the results of the analysis in favor of those cities without competition. Hence the results of the study are more conservative.[11] Fourth, if the types of power sources for the competing and noncompeting firms were matched, price differences due to supply characteristics which may not have been picked up by the estimating equations would tend to be eliminated.

It was not possible to adhere to the guidelines for matching firms in all cases. Municipally owned firms from the cities listed in column one of Table I filed F.P.C. reports and operating data are published in Statistics of Publicly Owned Electric Utilities in the United States. These firms constitute the subset of competing electric enterprises. Other competing publicly owned firms were eliminated

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[11]In some cases the bases of the matching were more important in Primeaux (1975) than in this paper. The sample in this investigation is not identical to that in that study; however, a subset of firms from the same basic sample was used in this study. It was also necessary to eliminate some firms contained in that study, because data were not available for the variables used in this analysis. The unmatched data in Table I resulted from the elimination of some firms for reasons mentioned above but retaining the matched city.

because data were not available.[12] Data from 1967 were used because Mann and Mikesell (1971) indicated that this was a stable year for making comparisons; moreover, it was feared that more recent data may have been affected by inflation.

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Column two of Table I presents the cities from which the matched municipally owned monopoly firms were selected. As indicated, it was not always possible to select matched firms from the same state for all competing electric companies. Table I also presents the relative size of the firms in terms of kilowatt-hour sales. The crucial matching test with respect to size involved the sales volume (annual KWH) of the competitive and noncompetitive firms.

THE REGRESSION MODELS

As mentioned earlier, linear ordinary least squares regression analysis was used to examine the effects of competition and monopoly

[12]Lincoln, Nebraska, and Hagerstown, Maryland are included in the sample even though competition did not exist in those cities in 1967. This was justified because it was believed that any competitive effects would have continued to that year. Hagerstown prevented customers from switching to the competitive firm as of September, 1967. Competition terminated in Lincoln, Nebraska in 1965. The inclusion of all competitive firms would have required the use of unpublished data which the F.P.C. considered too incomplete to justify publication.

on residential prices of firms included in the sample.[13] Price functions were specified for residential prices and these equations made possible the assessment of the effect of market structure differences on prices of electricity.

As mentioned earlier, the price schedules for firms selling to residential customers are determined by demand variables, as well as cost conditions, faced by the selling firms. This is a recursive model[14] and the specification of the residential price function is:

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[13] Linear specifications were used because the statistical relationships in all of the previous studies were found to be linear. That is, whenever the specified models were run in nonlinear form, the fit to the data was adversely affected. For example see: Primeaux (1975).

Moreover, the equations discussed later in Table II were slightly modified to nonlinear form and, in the alternative specification, the squared output term was statistically insignificant. These regression results are available from the author upon request.

A simultaneous equation model was not used for two reasons. First, as footnote 14 indicates, the model is recursive and involves a "causal chain" case; consequently, this is not a simultaneous equation issue at all. Moreover, even if a simultaneous equation model were appropriate, the sample size makes the selection of this approach over OLS unnecessary. Zellner (1979, p. 634) explains that for small samples, simultaneous equation results are very close to or exactly equal to OLS estimates.

[14] This is not a simultaneous equation issue but is, instead, an example of what Professor Herman Wold referred to as the "causal chain" case and a recursive model. In this case, EXKWH and PRcost (discussed below) can be taken as having occurred in an exogenous fashion. The direction of effect is one way only. While EXKWH and PRcost are cost variables which affect prices through the pricing formula, prices do not affect costs. In a recursive model, ordinary least squares produces consistent and unbiased estimates. The necessary assumption of independence among the error terms is most reasonable because the recursiveness is a natural product of the model due to the economic character of the system modeled. For discussions see: Elliott (1973 and Kmenta (1971).

$$P = A + B_1 INCOME + B_2 \%RES + B_3 EXKWH + B_4 PRCOST + B_5 CLIMI + B_6 CLIMII + B_7 CLIMIII + B_8 DCOM + B_9 GAS + B_{10} DENSITY \quad (1)$$

Where all variables are in linear form and P, the dependent variable, is a price variable which consists of several different definitions, depending upon the equation specified.

Price Variables (Dependent Variables)

MP_1 = Marginal price between the 250 KWH typical electric bills rate and the 500 KWH typical electric bills rate.

MP_2 = Marginal price between the 500 KWH typical electric bills rate and the 750 KWH typical electric bills rate.

MP_3 = Marginal price between the 750 KWH typical electric bills rate and the 1000 KWH typical electric bills rate.

Y_1 = Average residential price; sales revenue/KWH sold.

Cost and Demand Variables (Independent Variables)

INCOME = Mean county estimated buying income per household.

GAS = Average gas price-state.

DENSITY = Number of customers per square mile.

%RES = Ratio of total residential sales to total commercial and industrial sales.

EXKWH = Operating and maintenance expense per KWH.

PRCOST = Cost per KWH generated and purchased.

CLIMI = A regional climatic dummy variable for the corn belt area.[15]

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[15] A more detailed description of the climatic variables is presented in the Appendix.

CLIMII = A regional climatic dummy variable for the Dakota-New England area.

CLIMIII = A regional climatic dummy variable for the humid Northwest area.

DCOM = The dummy variable, 1 if duopoly, 0 if monopoly.

Data sources and a more extensive discussion of all variables are presented in the Appendix. As developed in the theory section, the coefficient on the %RES variable and the DENSITY variable should be negative and the coefficient on all other variables except DCOM should be positive. The appropriate sign for the climatic dummy variables is not obvious. The omitted dummy variable is for the cotton belt, so the signs on these dummy variables would reflect relative price levels with those in the cotton belt climatic region.

The appropriate sign on the competition dummy variable is also not obvious. If competition causes lower electricity prices the sign should be negative; however, if competition results in higher electricity prices, the sign should be positive.

RESULTS

The residential equations were estimated by using cross section data as outlined in the earlier section on methodology.

Table II shows the best specification of the equations using either the average price or marginal prices as the dependent variables.[16] T statistics appear in parentheses below the coefficients in Table II; the signs for all variables included in the four equations in Table II conform to expectations.

INSERT TABLE ABOUT HERE

Interestingly, the signs of the coefficients of the competition dummy variable for the equations in Table II are all negative indicating that competition caused the price of residential electricity to be lower with competition, regardless of whether a marginal or average price variable is used as the dependent variable.

Since the Federal Power Commission used standard rate blocks for all firms in Typical Electric Bills, rate blocks for all firms are comparable. The difference between the price paid by a customer if he consumed in one block and the price he would pay in the next highest block represents a marginal price. The coefficient on the competition dummy variable for the MP_1 price is negative but not statistically significant at the 12 percent level. However, the coefficients on the other price variables are all negative and MP_3 significant at the 5 percent level, Y_1 significant at the 10 percent level, and MP_2 significant at the 12 percent level. The low $\overline{R}^2$ and the insignificant t statistics on the competition dummy variable in the MP_1 and MP_2

[16]The GAS variable and DENSITY variable were not statistically significant and did not increase the explained variance when they were included in the equation.

The gas price data were state average prices. Since the sample included a larger number of relatively small cities, it was impossible to obtain gas price data for those individual cities. Perhaps this explains why the gas variable was unimportant and frequently had the wrong sign on the coefficient.

equations in Table II probably reveal that for smaller blocks of consumption demand and cost variables are less important than social considerations in establishing electricity prices.

The four equations in Table II reflect that the impact of competition on residential electricity prices is quite significant. As mentioned earlier, the marginal price of moving from the 250 KWH block to the 500 KWH block (MP_1) is statistically insignificant. However, the marginal price of moving from the 500 KWH block to the 750 KWH block (MP_2) is lowered by $1.34 because of competition and the marginal price of moving from the 750 KWH block to the 1000 KWH block (MP_3) is lowered by $2.25.[17] The average price (average revenue) is lowered by $6.3133 per 1000 KWH because of competition.[18] At mean

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[17]The following interpretation of the greater effect of rivalry for large than for small usage-price discrimination is reasonable: Households with low usage--thus low expenditures--will tend <u>not</u> to switch from one seller to another when offered a lower price because of the fixed costs of switching; since connect and disconnect charges are frequently not imposed, these <u>costs</u> would also involve the disutility of having to make a change when relative small cost savings are realized. But for large users the costs of switching are dominated by the gains to switching. An electric utility firm faced with a rival should respond to these differential elasticities by making larger downward price adjustments to large users than to small users, relative to the price schedule of a firm without competition.

[18]To ensure that the results were not caused by the inclusion of very large firms not facing competition, the equations were reestimated excluding the four monopoly cities considerably above mean size. No important differences appeared. The signs on all variables were consistent with those in equations including the whole sample. The effects of the elimination of these observations on the competition dummy variable were very slight. The MP_2 price was lowered by $1.59 instead of $1.34; the MP_3 price was lowered by $2.36 instead of $2.25; and the Y_1 price was lowered by $7.17 instead of $6.31. Consequently, inclusion of the four largest cities did not bias the results in favor of competition; indeed, the effect was the other way around.

prices for the sample, these decreases amount to 16 percent and 19 percent respectively for the marginal price. The average price (Y_1) was lowered by 33 percent.

Interaction variables were used to determine whether the effect of competition had influenced the slope coefficients of the economic variables. These variables were constructed by multiplying the competition dummy variable by the economic variables in the equation.

Only the interaction variable (%RES*D) constructed by multiplying the competition dummy variable by the %RES variable was statistically significant, indicating that only the slope coefficient of that variable was affected by competition. Table III presents the statistics necessary to test the hypothesis that all coefficients of the interaction variables were zero, except the variable for %RES. The results show that the hypothesis cannot be rejected (that is, the calculated F value of .18797 is less than the F-table value for 27 degrees of freedom in the denominator and 3 degrees of freedom in the numerator). Thus it was necessary to modify the basic equation only by adding the %RES*D interaction variable to reflect the effects on price of competition. As mentioned earlier, the competition dummy variable was not affected by competition for the MP_1 equation; all interaction variables in the equation for this price variable were similarly unaffected by competition.

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The change in slope coefficients for all but equation (1) in Table II indicates that price is affected by market structure differences because of some characteristic which is different in the competitive subset of firms compared with monopoly subset. This change is probably caused by the increased distribution costs of residential consumer sales with competition. This effect is due to the lower customer density with competition which causes upward pressure on costs and prices as utility firms must provide distribution facilities through a given area to serve fewer customers than if monopoly existed.[19]

The change in the slope coefficient of the %RES variable reveals that for the duopoly firms, price tends to be higher as the ratio of total residential sales to total commercial and industrial sales increases. Computations show that the duopoly MP_2 price is lower than the monopoly price as long as the ratio is $\leq .43$. The duopoly MP_3 price will also be lower than the monopoly price as long as the ratio of total residential sales to total commercial and industrial sales is $\leq .42$. The average price, Y_1, will be lower under duopoly than under monopoly as long as the ratio is $\leq .45$.

CONCLUSIONS

Prices of electricity are lower with competition than in a monopoly market structure and the price differences are substantial. The marginal price between the 500 and 750 KWH blocks is lower by 16 percent, the marginal price between the 750 and 1000 KWH blocks is lower by 19 percent, and the average price (average revenue) is lower by 33 percent because of competition. These results provide a measure of the

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[19] As mentioned in footnote 16, the DENSITY variable, reflecting the number of customers served per square mile, was used in the equation to pick up the effects on price of density differences. However, this variable did not add to the explained variance.

effect of monopoly on the prices consumers pay and an assessment of the effect of competition as a regulator of utility rates of municipal utility firms.

Substantial benefit seems to accrue to customers whenever electric utility competition exists. In addition to the lower prices, consumers have a choice whenever competition exists. The existence of an alternative supply, in contrast to the usual monopoly conditions, obviously provides consumers with a more favorable buying situation (Primeaux (1974)). Consumer satisfaction with electric utility competition is reflected in the fact that they have been reluctant to vote it out in cities where it exists (Primeaux (1974b)). Previous studies have indicated that the present regulatory environment is hostile to electric utility competition (Primeaux (1979) and Primeaux et. al. (1984); however, consumer welfare may be enhanced if policy makers would carefully reevaluate policies which tend to discourage this type of rivalry.

APPENDIX

Sources of Data

Price Variables

Data for marginal prices were obtained from Typical Electric Bills. Marginal prices were computed by taking the difference between one rate block and the next largest rate block. The marginal price, therefore, is the price of moving into the next rate category.

The average price or average revenue data were taken from Statistics of Publicly Owned Electric Utilities. The average price data were computed by dividing total residential dollar sales by the number of KWH sold to residential consumers.

Cost and Demand Variables

Data for the INCOME variable are the estimated mean buying income per household--county average. These data are from 1968 Survey of Buying Power.

The GAS price variable data were taken from Gas Facts. The variable was constructed by dividing state total gas sales by MCF sales to obtain an average price per MCF. Data for individual cities included in the sample were unavailable.

The DENSITY variable was constructed by dividing the number of square miles in each city into the number of residential customers served by each firm. Land area in square miles was taken from the U.S. Department of Commerce, Area Measurement Reports. Numbers of customers were taken from Statistics of Publicly Owned Utilities in the U.S.

The %RES variable is the ratio of total KWH sales made to residential consumers. Data are from Statistics of Publicly Owned Electric Utilities in the U.S.

The EXKWH variable is operating and maintenance expense per KWH. Data are from Statistics of Publicly Owned Electric Utilities in the U.S.

The PRCOST variable represents production expense per KWH. This cost includes purchased power costs, in addition to production expense. Data are from Statistics of Publicly Owned Electric Utilities in the U.S.

The climatic dummy variables group firms in the sample from similar climatic areas. The Dakota-New England Area: Winters - very cold and snowy, summer mild and rainy. The Corn Belt Area: Winters - moderately cold and snowly, summers hot and rainy. The Cotton Belt: Winters - cool and rainy, summers hot and rainy. The Humid Northwest: Winters - cool and rainy, summers mild and rainy. These classifications are taken from World Book Encyclopedia. A map delineates the various climatic areas of the U.S.; for this study, only the above areas are relevant.

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TABLE I

CITIES FROM WHICH MUNICIPALLY OWNED ELECTRIC UTILITIES WERE SELECTED FOR THE STUDY (SIZE IN TERMS OF THOUSANDS OF KWH SOLD-1967)[a]

CITIES WITH COMPETITION	KWH SALES	MATCHED CITIES - WITHOUT COMPETITION	KWH SALES
Bessemer, Alabama	96,897	Florence, Alabama	408,069
Tarrant City, Alabama	57,014	Scottsboro, Alabama	81,784
Fort Wayne, Indiana	301,026	Richmond, Indiana	357,959
Maquoketa, Iowa	16,531	Algona, Iowa	25,940
Hagerstown, Maryland	102,330	Bristol, Virginia	196,344
Allegan, Michigan	15,775	Niles, Michigan	59,974
Bay City, Michigan	92,518	Wyandotte, Michigan	108,391
Dowagiac, Michigan	20,964	Hillsdale, Michigan	63,027
Ferrysburg, Michigan[b]	130,620	Lansing, Michigan	1,179,935
Traverse City, Michigan	64,094	Sturgis, Michigan	66,935
		Petoskey, Michigan	28,463
Kennett, Missouri	34,281	Rolla, Missouri	45,201
Poplar Bluff, Missouri	58,362		
Trenton, Missouri	24,699		
Lincoln, Nebraska	124,026[c]	Omaha, Nebraska	2,343,826[c]
Cleveland, Ohio	521,191		
Columbus, Ohio	166,771	Springfield, Illinois	501,079
Piqua, Ohio	121,818	Logansport, Indiana	119,687
Springfield, Oregon	166,103	Eugene, Oregon	1,123,796
Greer, South Carolina	42,931	Greenwood, South Carolina	67,829
		Watertown, South Dakota	53,944
Garland, Texas	303,914	San Antonio, Texas	2,913,818
		Springfield, Missouri	583,488

[a]Statistics of Publicly Owned Electric Utilities in the United States. Data for municipally owned firms in each city were for the year 1967, unless other years are indicated.

[b]This city is served by Grand Haven Board of Light and Power and Consumers Power Company.

[c]Competition terminated in 1965, therefore, 1965 sales were used for matching cities.

TABLE II

RESIDENTIAL PRICE FUNCTION
AVERAGE AND MARGINAL PRICES

Equation	Dependent Variable	DCOM	INCOME	%RES	EXKWH	PRCOST	CLIMI	CLIMII	CLIMIII	%RES*D	DF	CONSTANT	$\bar{R}^2$
(1)	MP1	-.1560	.0001	-2.0517	.1969	.0679	.2272	-.3353	-.0956		31	2.2961	.0258
		(-.5537)	(.1723)	(-1.7418)[c]	(1.5738)[d]	(1.0399)	(.2581)	(-.4488)	(-.1150)				
(2)	MP2	-1.3388	.0012	-2.7061	.0754	.0938	1.2842	.7966	1.0967	3.1146	30	-1.3253	.4679
		(-1.5787)[d]	(2.4147)[b]	(-1.8676)[c]	(.6729)	(1.6030)[d]	(1.6266)[d]	(1.1856)	(1.4727)	(1.6191)[d]			
(3)	MP3	-2.2528	.0015	-3.4404	.0258	.1491	1.6516	.9679	1.0101	5.5529	30	-2.1011	.5147
		(-2.3593)[b]	(2.6258)[b]	(-2.1088)[b]	(.2051)	(2.2638)[b]	(1.8580)[c]	(1.2793)	(1.2048)	(2.5637)[b]			
(4)	Y_1	-6.3133	.0037	-22.0517	1.0415	.7971	7.4618	3.8107	3.6599	13.8819	30	3.1938	.6377
		(-1.6893)[c]	(1.6431)[d]	(-3.4534)[a]	(2.1075)[b]	(3.0913)[a]	(2.1446)[b]	(1.2869)	(1.1152)	(1.6375)[d]			

N = 40
t statistics in parentheses (TWO TAILED t TEST)
a significant at .01 level
b significant at .05 level
c significant at .10 level
d significant at .12 level

TABLE III

F-TEST STATISTICS OF CROSS SECTION DATA
WITH INTERACTION VARIABLES IN THE EQUATION

Regression	Standard Error	Degrees of Freedom	Mean Square Error	Sum of Squared Residuals
Equation 2 in Table II, including all interaction variables	.73700	27	.54317	14.6657
Equation 2 in Table II, including only %RES*D interaction	.70644	30	.49906	14.9720
Difference		3		.3063

$$F_c = \frac{\frac{.3063}{3}}{.54317} = \frac{.1021}{.54317} = .18797 < F_{27}^{3}\ (.01) \approx 4.60$$