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Determinants of Regulatory Policies Toward Competition in the Electric Utility Industry

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Abstract

Direct competition in the electric industry does actually exist in some cities; its impact on firm performance has been analayzed in a number of previous studies. Control of entry into a market is an important method regulatory commissions use to protect the monopoly status of an existing firm, yet there have been no previous attempts to investigate and identify the factors which ultimately influence regulatory policy toward permitting direct competition in this industry. That is one of the main objectives of this study.

The model specified is a logit transformation with multiple explanatory variables. The statistical results are generally consistent with the Stigler-Peltzman theory of regulation. The data also tend to refute the notion that regulatory policy is an exogeneous variable which results from ad hoc political and administrative factors. The findings suggest, instead, that regulatory policy is a direct result of economic factors.

DETERMINANTS OF REGULATORY POLICIES TOWARD COMPETITION IN THE ELECTRIC UTILITY INDUSTRY

INTRODUCTION

Control of entry into markets is an important method regulators use to ensure monopoly in the electric utility industry. Though unusual, direct competition in the electric industry does actually exist in some cities and its impact on performance has been analyzed in a number of different studies by Primeaux (1974, 1975b, 1977, 1978). However, no previous studies have attempted to investigate and identify the factors which ultimately influence regulatory policy toward permitting direct competition in this industry.

George Stigler (1971) presented a revisionist theory of regulation which challenges the notion that regulation is designed to serve the public interest. Stigler's model was formalized and extended by Sam Peltzman (1976). Peltzman concluded that special interest groups incur costs and realize benefits from regulation; total realized net benefits, however, are not as great as they would be in the absence of regulation. Benefits accrue in the form of transfers of wealth and arise through control of entry, establishment of rate structure (price fixing), control over price and production of substitutes, and cash payments.

This study is concerned with the use of entry control as a manifestation of use of regulation to transfer wealth. Using Peltzman's theory of regulation, an attempt is made to identify factors which indicate hostility toward competition on the part of regulators. The statistical results are generally consistent with the Stigler-Peltzman theory of regulation. The data also tend to refute the notion that regulatory policy is an exogeneous variable which results from ad hoc political and administrative factors. The findings suggest, instead, that regulatory policy is a direct result of economic factors.

Regulatory Objectives

Following Peltzman's generalization (1976) of a Stiglerian model of political wealth transfers, we assume the regulator wants to maximize a majority M, of voters, generated by

(1) $$M = n \cdot f - (N-n) \cdot h$$

where n = number of potential voters in the beneficiary group,

f = (net) probability that a beneficiary will grant support

N = total number of potential voters

h = (net) probability that he who is taxed (every non-n) opposes.

Although beneficiaries pay with both votes and dollars, the productivity of the dollars to a regulator lies in mitigation of opposition. Hence the regulator has an objective function of the form

(2) $M = M(W_1, W_2, \ldots, W_n)$

where W_i = wealth of group i, and where $M_i > 0$.[1]

This objective function is maximized subject to a constraint on total wealth (V):

(3) $V = W_1 + W_2 + \ldots + W_n = V(W_1, W_2, \ldots W_n)$

where $V_i > 0$, but where $V_{12} < 0$, i.e., the total wealth to be distributed is limited.

Among the groups vying to achieve benefits or mitigate losses from the regulatory process are consumers of the regulated good, producers (both of the regulated good, and producers of substitutes), and the regulators themselves. In the case of electric utility regulation by PSC's, we can specialize the majority generating function, (2) as

(4) $M = M(P, \pi_E, \pi_S)$

where P = price of electricity, π_E = wealth of electricity producers, and π_S = wealth of producers of substitutes (who may be regualted by the same commission).

We assume the regulators have powers to affect the market which result in $M_{\pi_E} > 0$, $M_{\pi_S} > 0$, (i.e., greater wealth generates support) and $M_P < 0$ (i.e., higher electricity rates generate opposition from residential customers, commercial and industrial customers, and "consumer action: groups[2]). If we introduce cost and demand conditions, summarized by a profit function

(5) $\Pi = f(P,c)$

where $c = c(Q)$ = production costs as function of quantity, the formal problem for a successful utility regulator is to maximize the Lagrangian

(6) $L = M(P, \Pi_E, \Pi_S) + \lambda[\Pi - f(P,c)]$

with respect to P, Π_E, Π_S and λ which yields

(7) $-\frac{M_P}{f_P} = M_{\Pi_E} = M_{\Pi_S} = -\lambda$

This is the Stigler-Peltzman conclusion that the marginal political product of a dollar of profits ($M\Pi_E$, $M\Pi_S$) must equal the marginal political product of a rate cut ($-M_P$) that also costs a dollar of profits (f_P is the dollar profit loss per dollar of rate reduction.) Or, in terms of the present study of electric utility regulation, we generate a testable hypothesis that, through regulation of electricity rates and entry, PSC's attempt to maximize M by balancing marginal gains to interested groups.

Winners and Losers from Entry Control

Regulated electric utilities tend to utilize discriminatory rate structures (Primeaux and Nelson, 1980; Hollas and Friedland, 1980). Entry control is a necessary means of perpetuating this discrimination because duopoly, or increased competition through entry, would reduce the extent of the discrimination. Increased competition reduces the ability of a firm to price discriminate profitably. Residential customers are probably the biggest losers in a discriminatory rate structure, due to their relatively inelastic demand, consequently they should benefit the most from competition. An important constraint upon residential customers, in particular, is that it may be costly to organize into a coalition in order to exert political pressures.

However, if competition is active and the natural monopoly theory does not hold, as reported in Primeaux (1974), all customer groups will receive lower average rates due to the competition. The discriminating utility will be the only clear loser due to reduced profit potential from discrimination.

Of course, profit reduction may also originate from other sources. Consumers of substitute fuels such as natural gas benefit from competition for two reasons. First, competition in the electric industry lowers electric rates and increases competition between electric and gas utilities;[3] this will directly benefit gas customers.

Second, since some gas users will then switch to electricity because of its lower price, this will tend to reduce gas prices for those who continue to use natural gas.

Natural gas producers would, in general, oppose a policy of direct competition in electricity.[4] Natural gas and electricity are direct substitutes for many residential and commercial markets (e.g. electric home heating versus natural gas heating). Because all electricity is not produced by using natural gas as a fuel, one would expect the increase in natural gas used by electric producers from increased competition in the electric industry to be less than the decrease in natural gas used by households and commercial users from lower electric rates.

Retail natural gas utilities should also be adversely affected by direct electric utility competition because this would reduce the price of electricity, which is a substitute for the natural gas which they sell. Thus commissions in states with relatively more powerful natural gas distributors will be less likely to encourage competition.

A MODEL OF REGULATORY POLICY TOWARD COMPETITION IN THE ELECTRIC UTILITY INDUSTRY

The general factors which may explain the tendency of Public Service Commissions (PSC) to be hostile toward competing electric utilities have been outlined in the previous section. This section develops and tests a model of regulatory policy toward comptition in the electric utility industry.

The dependent variable in the model is unobserved. It consists of an assessed probability of hostile policies toward competing utilities which lies between zero and unity. What is actually observed is whether the particular state PSC is hostile toward competition or not; and the sample results in a qualitative, dichotomous dependent variable, taking a value of zero or one.

The policy of the commisssion in each individual state is classified as hostile or non-hostile toward direct competition. The information used to classify policies was obtained through questionnaires sent to commissioners in May 1971. The policy was classified as hostile if either direct competition was not permitted legally or if the commission stated that it would not allow competition. On the other hand, the commission was classified as non-hostile either if the commission does not have jurisdiction (it can not prevent competition) or if it contends that direct competition would be allowed. States without commissions were classified as non-hostile toward competition. Table 1 presents a summary of the

the classifications of regulatory policy.[5]

The major hypothesis of this paper is that economic variables explain costs and benefits (potential) of regulation to the interest groups which support or oppose entry control. A group derives power either from their numbers or their (potential) wealth. We now turn to a discussion of the explanatory variables of the model.

Consumers of Electricity

The mean income of residential consumers should be inversely related to their desire for direct competition between electric utilities. For example, the price elasticity of demand for electricity of a given customer would be lower, the smaller the fraction his utility bills are of his total budget. Lower income consumers would probably be more concerned than high income consumers about paying marginally higher fuel bills, because they buy from a monopolist not facing direct competition.

Another factor which could indicate the strength or power of consumers is whether utility regulators are elected or appointed. Peltzman (1976, p. 215) argues that the method of regulator selection does not make any difference. Jack Hirshleifer (1976, p. 242) however, maintains that it does make a difference. Whereas the governor or state legislators which appoint a commissioner may campaign on several issues in a given platform, an elected commissioner will campaign on a very narrow platform. Thus, voters elect a governor or legislator for reasons in addition to the performance of their commission appointees. However, elected commissioners are selected based upon only their regulatory platform. In addition to the other questions examined, this study also tests the hypothesis that elected officials respond more readily to constituency pressures than appointed officials.[6]

Value added by manufacturing fimrs ia a proxy for wealth of industrial customers. As this measure of wealth increases, one would expect a more favorable PSC policy toward competition.

Gas Producers

Because electricity and gas are substitutes, natural gas producers would not benefit from increased competition in the electric industry (see discussion above). Therefore, as the importance of natural gas production rises relative to that of electric utilities, we would expect PSCs to become more hostile toward competing electric utilities. This outcome would be expected because producers of substitute products for electricity prefer higher electric prices to reduce competition with their products.

Electric Utilities

The more monopoly power an electric utility has, the more wealth it can lose if competition takes place. Therefore, in states where utilities currently exercise substantial monopoly power, PSC's should be more hostile toward competition; there is, however, a problem of simultaneous cause and effect. Policy is certainly affected by the power or influence of electric producers, however, the PSC policy and attitude toward direct competition should also affect the power and wealth of the electric utilities. This problem is discussed in more detail below.

Empirical Results

The model specified is a logit transformation with multiple explanatory variables of the type introduced by M. Nerlove and S. J. Press (1973) and takes the form:

(8) $$P = \frac{e^{\beta_i X_i + u_i}}{1+e^{\beta_i X_i + u_i}}$$.

which when transformed, gives

(9) $$\ln\left(\frac{P}{1-P}\right) = \beta_i X_i + u_i$$

where P is the probability that the relevart PSC is "hostile" toward competition, ($\ln(\frac{P}{1-P})$ is the "log of the odds" of a PSC being hostile), the X_i are vectors of explanatory variable values, and u_i is an error term. As u_i is either $(1-\beta_i X_i)$ or $(-\beta_i X_i)$, u_i is heteroscedastic, and maximum likelihood estimation of the β_i must be used.

Specifically, the model to be tested is:

$$\ln(\frac{P}{1-P}) = \beta_1 \text{(ELECTRICITY)} + \beta_2\text{(ELECTED)} + \beta_3 \text{(INCOME)} + \beta_4\text{(VALUE ADDED)} + \beta_5\text{(NATGAS)} + u \quad (10)$$

where ELECTRICITY measures the influence of electric utilities, ELECTED, INCOME, and VALUE ADDED represent consumer interest variables, and NATGAS represents a substitute producer's interest variable. The nature of the variables and data is presented in Table 2, however, a few additional comments on the ELECTRICITY variable may be in order. If the ratio equals unity, then the utility is charging the monopoly price. Consequently, a larger ratio indicates less realized monopoly power.

Two complications arise with measurement of the ELECTRICITY variable. First, the 1969 estimates of this variable for residential consumers presented in a recent article by Robert Meyer and Leland Hayne (1980) were used in the analysis. Second, simultaneous equation bias exists because the power and strength of the utility affects policy but the effect is not one way only; policy also affects the power and strength of the utility. Since data processed by equation (3) showed a (expected) high correlation between ELECTRICITY and the error term, an instrumental variable (IV) technique was utilized in which estimates of ELECTRICITY were obtained by regressing ELECTRICITY on a subset of exogenous variables.

The following analysis should clarify the technique:

(11) $$Y_1 = \beta_1 Y_2 + \beta_2 Z_1 + \beta_3 Z_2 + \beta_4 Z_3 + u_1$$

and

(12) $$Y_2 = \alpha_1 Y_1 + \alpha_2 Z_4 + \alpha_3 Z_5 + v_2$$

where Y_1 = policy (1,0)

Y_2 = influence (power) of electric producers

Z_1 = influence of natural gas producers

Z_2 = influence of residential consumer interest

Z_3 = influence of industrial consumer interest

etc.

and u_1 and v_2 are error terms.

A small increase in u_1 would result in a small increase in Y_1. However, equation (12) shows that a change in Y_1 results in a change in Y_2. Therefore, a change in u_1 results in a change in Y_2; that is, one of the explanatory variables and the error term are correlated (highly correlated in this specific case). An instrumental variable was created to remove correlation by regressing Y_2 on a subset of the exogenous variables.

Specifically, the power of an electric utility Y_2 measured by the ratio of residential monopoly price to actual price, was regressed on the following exogenous variables: number of retail establishments in 1972, 1971 state per capita income, number of municipal electric utilities in 1971, 1971 total revenue of municipal utilities, 1971 percent of population in SMSA areas, 1971 state bituminous coal production per capita, and retail sales per establishment.[7] From this equation a predicted value of the ratio of the residential monopoly price to actual price, $\dot{Y}_2$, was obtained. These estimates of Y_2 were then substituted into equation (11) for the logit estimation procedure.

Table 3 presents the results of the logit analysis. The coefficients are defined as the marginal impact on the dependent variable of a one unit change in the explanatory variable, holding other variables constant at mean values. Care must be taken in interpreting the coefficients; in this case the depedent variable is $\ln(\frac{P}{1-P})$. To assess the effect on the <u>probability</u>

of hostile policy, P, the effect on $\ln(\frac{P}{1-P})$ must be solved for P. (The relationship between a unit change in an independent variable and the value of P is, hence nonlinear, and depends on the <u>level</u> of P. (See Footnote 9.) Column 1 presents the estimated coefficients and column 2 reports the t-ratios.

All coefficients have the correct sign and all coefficients are statistically significant at the .05 level or better except for the NATGAS variable, which is significant at about the .07 level. The Stigler-Peltzman hypothesis that numerous groups will benefit from regulation is generally supported, however, it appears that elected commissioners are more likely to favor a competitive policy. This result is at odds with Peltzman's argument that the method of regulator selection should be unimportant.

The estimates of the coefficients of the logit model can be used to assess the relative influence of the interested groups vying for political favor from the commissions. Table 4 below gives the effect on the assessed probability of a given PSC being "hostile" toward competition, given a change in the circumstances of interested groups. The probability is calculated for both elected and appointed commissions. The mean value of each explanatory variable, $\overline{X}_i$, was inserted in the regression equation and a predicted value of $\ln(\frac{P}{1-P})$, and hence P, was obtained. We then changed each explanatory variable from $\overline{X}_i$ to $(\overline{X}_i + s_i)$ where s_i is the sample standard deviation of the explanatory variable, X_i, and solved for P, holding the remaining explanatory variables constant at their means.[8] The third and fourth columns give the percentage change in the probability of observing an anti-competitive commission, given a one- standard-deviation change in the value of the explanatory variable.[9] From this we note a number of conclusions, most of which reinforce the Stigler-Peltzman theory. The regulated industry itself has the greatest influence on commission policies, regardless of whether the commission is elected or appointed. If the variable measuring the relative strength of natural gas interests is increased, there is a significant impact on policy in the predicted direction, and elected commissions are significantly more sensitive than appointed.[10]

Large industrial users of electricity have the third highest level of influence on commission policies after the utilites themselves and producers of substitutes, while the more diffuse residential consumer interest has the least impact. The only result inconsistent with Peltzman's predictions is the different impact on elected versus appointed commission, as noted above.

Summary

Statistical results from this study generally support the Stigler-Peltzman theory of regulation. The only finding not consistent with Peltzman's formulation of the theory is that elected officials are more likely to favor pro-competitive policies than appointed officials. Peltzman has argued this should be an unimportant factor. For public policy purposes, however, it seems that any movement toward elected regulatory commissions would tend to foster pro-competitive policies, at least in the short run.

Data reveal that an increase in realized monopoly power of the utility increases the probability of hostile PSC policies toward competition. An increase in average value added in manufacturing and a decrease in the state's per capita income increased the probability of favorable PSC policies toward competition. Also, the more powerful are natural gas interests, the more hostile are commission policies toward competition.

These empirical findings refute the hypothesis that regulatory policy is somehow an exogenous variable which results from ad hoc political and administrative factors. Instead, it appears that regulatory policy is a direct result of economic factors.

Table 1

Public Service Commission Policies
Toward Competition in 1971

State	Commission Policy Toward Direct Competition	Categorization of Policy
Alabama	no policy	non-hostile
Alaska	seeks to eliminate	hostile
Arizona	not permitted	hostile
Arkansas	not permitted	hostile
California	probably not permit	hostile
Colorado	no policy	non-hostile
Connecticut	actively discourages	hostile
Delaware	no jurisdiction	non-hostile
Florida	not permitted	hostile
Georgia	no policy	non-hostile
Idaho	not permitted	hostile
Illinois	not permitted	hostile
Indiana	not permitted	hostile
Iowa	no jurisdiction	non-hostile
Kansas	not permitted	hostile
Kentucky	allowed in some cases	non-hostile
Louisiana	not permitted	hostile
Maine	no established policy	non-hostile
Maryland	no response	hostile[a]
Massachusetts	not permitted	hostile
Michigan	opposed to extension of competition	non-hostile
Missouri	no jurisdiction over existing competition between private and municipal utilities	non-hostile
Montana	no jurisdiction	non-hostile
Nevada	not permitted	hostile
New Mexico	not permitted	hostile
New York	would allow competition if considered useful	non-hostile
North Carolina	North Carolina courts have held that municipally owned electric systems are free to compete	non-hostile
North Dakota	not allowed	hostile
Ohio	not sanctioned	non-hostile
Oregon	no response	hostile[b]
Pennsylvania	not encouraged or advocated	non-hostile
Rhode Island	legislature would not permit	hostile
South Carolina	not permitted between private utilities	non-hostile
South Dakota	no regulation	non-hostile[c]
Tenenssee	not permitted	hostile
Texas	no regulation	non-hostile[c]
Utah	not permitted	hostile
Vermont	not permitted	hostile
Virginia	not permitted	hostile
West Virginia	permitted if existing service is inadequate	non-hostile
Wisconsin	permitted if existing service is inadequate	non-hostile
Wyoming	not permitted	hostile

[a]This commission was categorized as hostile due to corr-spondence with utility official in Hagerstown, Maryland.

[b]This commission was categorized as hostile due to studies by Primeaux (1975a) and Galat (1971).

[c]These states were categorized as non-hostile toward competition as 1) they had no state regulatory commission in 1971 and 2) we observed the existence of cities with competing electric utilities.

Table 2

Variables Included in the Analysis

Y_1 = 1971 PSC policy toward competition in the state; 1 = hostile toward competition, 0 = favors competition.

ELECTRICITY = 1969 ratio of the monopoly price to actul price for residential customers.

ELECTED = method of selecting commissioners; 1 = elected, 0 = appointed.

INCOME = natural log of 1971 state per capita income

VALUE ADDED = 1972 state value-added per firm in manufacturing (in millions)

NATGAS = 1971 ratio of cubic feet of natural gas produced (in millions) to KWH (in millions) of electricity sold in the state.

Sources: Y_1 was obtained through questionnaires mailed by Primeaux to utility commissions; ELECTRICITY was taken from Table 2 of Meyer and Hayne (1980, p. 560); INCOME and VALUE ADDED are from Statistical Abstract; NATGAS is from Gas Facts and Statistical Yearbook.

Table 3

Results of Logit Analysis

	Coefficient[a]	t-ratio
ELECTED	-0.933 (0.533)	-1.75[c]
VALUE ADDED	-2.721 (1.213)	-2.24[c]
NATGAS	0.022 (0.014)	1.52[d]
ELECTRICITY	-0.112 (0.042)	-2.64[b]
INCOME	1.431 (0.520)	2.75[b]

[a]Standard errors in parentheses
[b]Significant at the .01 level
[c]Significant at the .05 level
[d]Significant at the .10 level

Table 4

Relative Influence of Interested Groups on Commission Policies[a]

	P (Elected Commission)[c]	%ΔP	P (Appointed Commission)[c]	%ΔP
Mean Predicted Probability[b]	.259	---	.471	---
Commercial/Industrial Electricity Consumers (VALUE ADDED)	.094	-64%	.209	-56%
Natural Gas Interests (NATGAS)	.540	108%	.749	59%
Residential Consumers/ Consumer Action Groups (INCOME)	.300	16%	.521	11%
Electric Utility Interests (ELECTRICITY)	.062	-76%	.143	-70%

[a] Effect of a one-standard deviation increase in explanatory variable value on P, holding other variables constant at their means.

[b] Mean values of continuous explanatory variables inserted in estimated equation.

[c] Value of 1 inserted (if commission elected), and 0 inserted (if commission appointed) in estimated equation.

Footnotes

1. Our function differs from Peltzman's in two respects: 1) we explicitly incorporate Hirshleifer's suggestion (1976) that "the regulators themselves constitute an interest group"; and 2) we implicitly relax Peltzman's assumption that $M_{ij}=0$, $i \neq j$, or, "there are no intergroup dependencies." An example of such an interdependency would be the PSC regulation of both natural gas prices and electricity rates, when natural gas and electricity are substitutes (in residential usage, say) and natural gas is used as fuel for electricity generation.

2. The interests of consumers and "consumer action" groups will not be, in general, identical.

3. This analysis assumes that the electric and gas companies are competing firms and not combination utilities providing both energy services.

4. There may also be a second order effect: producers of fuels used by the utilities may gain or lose depending upon output effects. That is, second degree price discrimination probably increases output, creating additional demand for fuels such as coal, oil, and natural gas. Output effects of third degree price discrimination are not as clear and depend upon the shape of the demand curve (Robinson, 1933). On the other hand, increase competition will also increase output due to lower prices of electricity. This also creates increased consumption by utilities for fuels to generate electricity.

5. This information was obtained through questionnaires sent to commissioners in May 1971 (Primeaux, book manuscript in progress). The states not included were those which Primeaux had no responses, or all utilities were publicly owned, or which did not have commissions and competing utilities.

6. It is our intuitive feeling that Peltzman is correct in long-run equilibrium. The observed difference in the policies of elected versus appointed regulators reported later in this paper may be analagous to the (seemingly) contradictory theories of the consumption function reconciled by Friedman's "permanent income hypothesis."

7. As is standard with an IV technique, the regressors for this equation are uncorrelated with u_1 and highly correlated with Y_2, and chosen to minimize the standard error of the estimate and the covariance matrix. For a discussion of this technique, see Maddala, Econometrics, pp. 476-477. The following works provided the data. Statistical Abstract, 1976 provided the number of retail establishments and retail sales (in millions of dollars). Edison Electric's Statistical Yearbook was the source for the number of municipal electric utilities and total revenue of municipal utilities. Mineral Yearbook, 1971 supplied number of short tons of bituminous coal and lignite.

8. We are indebted to Sam Peltzman for this method of assessing "relative contribution."

9. Due to the nature of the $\ln(\frac{P}{1-P})$ function,

$$\left(\frac{\partial P}{\partial[\ln(\frac{P}{1-P})]} = \frac{1}{P(1-P)}\right.$$ and is not independent of

the level of P), one cannot take any single mean effect of a varaible on $\ln(\frac{P}{1-P})$ by itself and solve for the mean effect of the explanatory variable on P, the probability of a commission being hostile toward competition. Values for allother explanatory variables must be included before $\Delta\ln(\frac{P}{1-P})$ can be solved for ΔP.

10. While the distributions of the other explanatory variables are well behaved, with no skewness, the natural gas variable is highly right skewed. (Some states are large producers, others have no natural gas.) The standard deviation of this distribution is larger than the mean, and this is what leads to the inordinantly large effect on the commission of a "one-standard-deviation" increase in the explanatory variable.

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