Faculty Working Papers

WHAT CAN REGULATORS REGULATE: THE CASE OF ELECTRIC UTILITY RATES OF RETURN

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College of Commerce and Business Administration
University of Illinois at Urbana-Champaign

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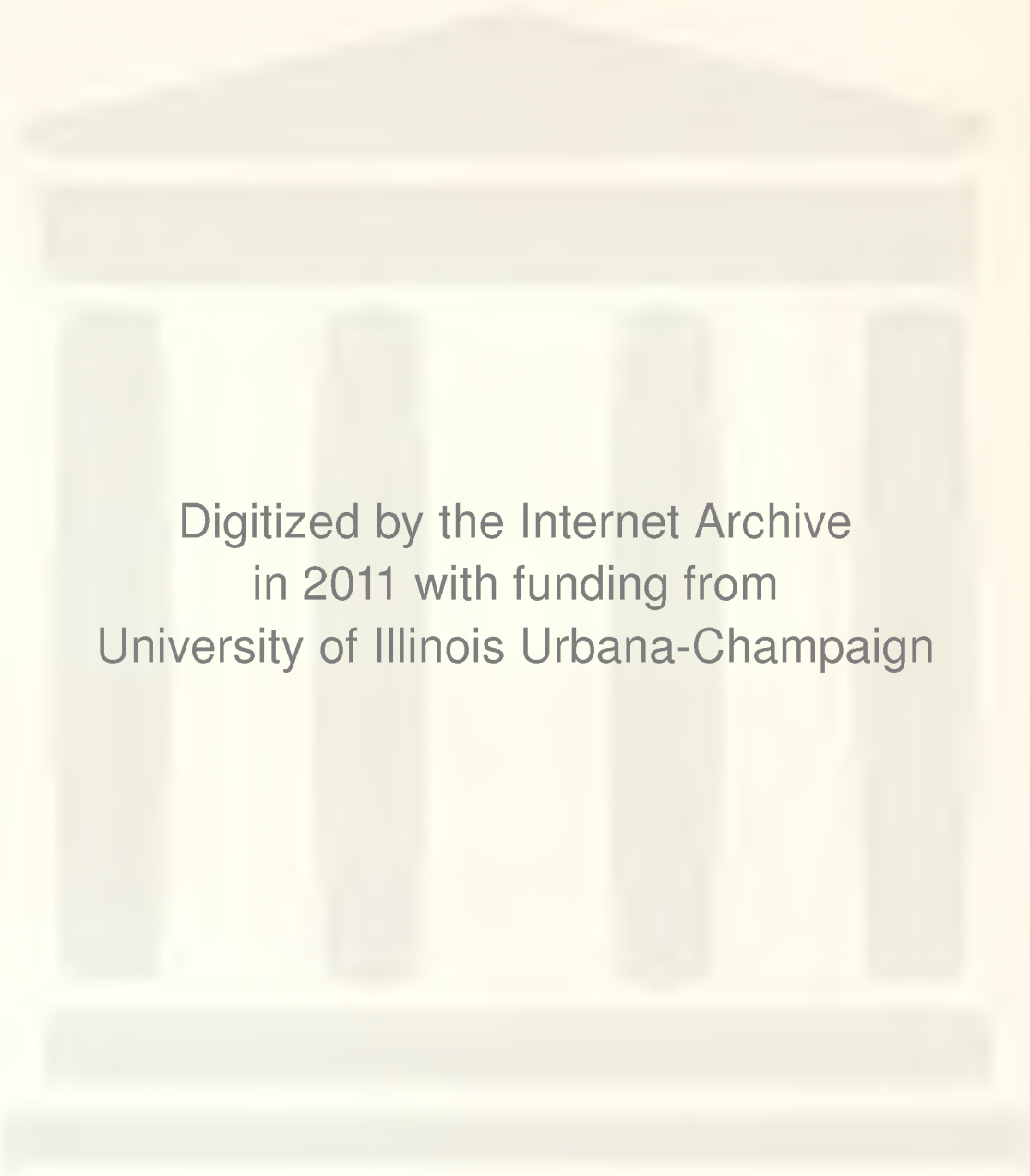
Summary

The efficacy of electric utility regulation has not been finally determined. The purpose of this study is to assess the impact of Commission regulation on the level of earnings realized by electric power utility firms. Previous studies have relied upon price data which were generated during the very early days of utility regulation; moreover, cross section analyses, aggregating firms controlled by diverse regulatory regimes, were employed for assessing the effects of regulation.

Time series data for the individual electric firms operating in Florida, Iowa, and Mississippi were used in the analysis. These are the only three states regulated since World War II and it was possible to compare profit rates for the individual firms before and after Commission regulation was instituted and to make an assessment of the effect of the charge in each case -- the data for each firm are for the period 1948 through 1976.

The results show that firms in the sample were earnings economic profits prior to regulation and that regulation is responsible for substantial reductions or total elimination of those profits.

Public policy recommendations and the significance of the results for the various theories of regulation are also presented.



WHAT CAN REGULATORS REGULATE: THE CASE OF ELECTRIC UTILITY RATES OF RETURN

By Walter J. Primeaux, Jr.

INTRODUCTION

Criticism of utility regulation may now be at a peak; however, the efficacy of the process has been the subject of considerable skepticism through the years. The criticism, in general, rests on the alleged grounds that regulation accomplishes very little or nothing at all.[1]

Electric utility regulation has existed in the U.S. since the early 1900's, but there is little convincing evidence that the performance of regulated industries differs significantly from what it would be in the absence of regulation.[2]

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[1]See, for example, George J. Stigler and Claire Friedland, "What Can Regulators Regulate? The Case of Electricity," The Journal of Law and Economics, Vol. 5, 1962, pp. 1-16; T. G. Moore, "The Effectiveness of Regulation of Electric Utility Prices," Southern Economic Journal, April, 1970, pp. 365-375; C. G. Moore, "Has Electricity Regulation Resulted in Higher Prices? An Econometric Evaluation Using a Calibrated Regulatory Input Variable," Economic Inquiry, Vol. XIII, No. 2, June 1975; Walter J. Primeaux, Jr. "Some Problems with Natural Monopoly" The Antitrust Bulletin vol. XXIV, No. 1, Spring 1979; and Walter J. Primeaux, Jr. "A Reexamination of the Monopoly Market Structure for Electric Utilities," in Promoting Competition in Regulated Markets Almarin Phillips (ed.), Washington: the Brookings Institution, 1975, pp. 175-176.

[2]This statement concerning regulated industries was made by Alfred E. Kahn, The Economics of Regulation (New York: John Wiley and Sons, Inc., 1971), p. 108. A discussion of regulatory reform is presented in Electric Utility Rate Reform (Washington, D.C. American Enterprise Institute, 1977).

The growing concern with regulatory processes, and the emerging climate calling for deregulation of business, generates a need for additional knowledge concerning the performance of firms in the electric utility industry. If regulation, in fact, generates little or no positive social benefit, abolition or reform of the institution would probably be a policy prescription; therefore, assessment of utility regulation is an important undertaking and that is the main objective of this study.

Previous studies concerning regulation have generated mixed results; some have found it to be a relatively unimportant institution. Econometric studies may be challenged on several grounds, so it is important to continue to generate research which will eventually permit an overall assessment of commission regulation. The purpose of this study is to assess the impact of commission regulation on earnings realized by electric utility firms. Although the efficacy of the regulation process cannot be determined by the absence of economic profits alone, control of earnings is clearly an important objective of the institution. Indeed, Kahn explains that regulated profits are the most obvious and comforting evidence that regulation can be "effective."[3]

The results of this investigation show that firms in the sample were earning economic profits prior to regulation and that regulation is responsible for substantial reductions or total elimination of those excessive profits.

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[3]Alfred E. Kahn, The Economics of Regulation vol. 1 (New York: John Wiley and Sons, Inc., 1970), p. 31.

PREVIOUS STUDIES

In a landmark study, G. Stigler and C. Friedland examined the impact of electric utility regulation on rates charged and rates of return earned. They found that regulation of electric utility firms, as indicated by the presence of a state regulatory Commission, added nothing to the explanation of interstate rate differences.[4] The study explains that the ineffectiveness of regulation stems from two sources. (1) Individual utility systems do not have any significant long-run monopoly power, and (2) the regulators cannot force the utility to operate at a specified combination of output, price, and cost. The authors make some inferences from their price examinations and conclude that pure monopoly profits would not occur in the absence of regulation.[5]

T. G. Moore measured the effectiveness of the regulatory process in reducing prices to residential customers of electric utilities. The study concludes that regulation has not reduced prices more than 5 percent and probably less than that.[6] Moore explains that, ". . . without regulation the firm would face competition from neighboring firms which might encroach on its territory. To the extent that this type of competition is possible, any removal of regulation would increase the elasticity of demand faced by a single firm above the elasticity for the market and so lead to lower prices."[7] Moore concludes that the current

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[4] Stigler and Friedland, op. cit., pp. 200-203.

[5] Ibid.

[6] T. G. Moore, op. cit.

[7] Ibid., p. 374.

form of regulation is not performing one of its main functions and that some major changes in procedures are due.[8]

Charles Guy Moore found that regulation had a perverse effect because it actually caused higher prices. He found that the higher prices were caused, in part, by Commission policy which attempts to discriminate in favor of the more numerous small users of electricity whose demand is relatively less elastic than the demand of larger users. This policy would result in a loss of economies of scale and higher prices. Moore points out that regulators are capable of other errors and any Commission practice which increases total cost of producing and distributing electricity will also necessitate raising prices, reducing output, and foregoing economies of scale. This study, however, does not assess the magnitude of the higher prices and does not examine rates of return.[9]

Jackson found that regulation did not succeed in reducing residential rates in 1940 and 1950 but was significant in 1960.[10]

Although these four are important empirical studies by competent economists, they have not determined once and for all the impact of regulation on the economic performance of electric utility firms. Also, the previous studies were restricted to examining the price effects of regulation and, except for the indirect examination by Stigler and Friedland, the effects of regulation on rates of return were not examined. Moreover, as mentioned earlier, it has been said that there is

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[8] Ibid.

[9] C. G. Moore, op. cit.

[10] Raymond Jackson, "Regulation and Electric Utility Rate Levels," Land Economics, Vol. XLV, August 1969, pp. 372-376.

little convincing evidence that the performance of regulated industries differs significantly from what it would be in the absence of regulation;[11] therefore, further study of regulation is very important.

THE THEORY

Unregulated monopolies, according to theory, would charge a price above average cost and earn an economic profit. The notion is that in the absence of the market mechanism, where price competition would drive prices down to lower levels, the unregulated monopolist would exact a higher price and earn higher profits than if it faced competition or if it were regulated.[12] Kahn explains that the regulatory process has focused primarily on profits as the control target because

> ...these are politically the most visible--excessive profits the most obvious danger and sign of consumer exploitation, in the absence of effective competition, regulated profits the most obvious and comforting evidence that regulation can be "effective."[13]

Kahn's argument is a good one. Even though regulators may scrutinize prices very closely as suggested by Joskow, there is an ultimate effect on profits.

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[11] Kahn, op. cit.

[12] This situation is discussed in Walter J. Primeaux, Jr., Rate Base Methods and Realized Rates of Return," Economic Inquiry, Vol. XVI, No. 1, January 1978.

[13] Kahn op. cit. Although Kahn explains that excessive profits are the main concern of regulators, these bodies also review utility operations for the following possible abuses: (1) inclusion of improper operating expenses in the cost of service used for rate making; (2) price discrimination among customers (3) poor customer service. An assessment of price discrimination among customer classes is presented in Walter J. Primeaux, Jr. and Randy A. Nelson, "An Examination of Price Discrimination and Internal Subsidization by Electric Utilities," Southern Economic Journal (in press, July 1980).

> As profits increase for these firms, there may be an increasing tendency for the staff of the regulatory authority to "suggest" price reductions or improvements in service, often in response to external pressures from citizens' groups or politicians. Thus, although there is a constraint tending to limit continual growth of profits, it appears to be a much looser kind of constraint than much of the theoretical literature might lead one to believe. Regulated firms do appear to respond to this moral suasion from time to time, because the regulatory authority has the power to force a formal regulatory review and firms feel that they will do better in the long run if they keep the Commission happy by filing a rate reduction from time to time rather than by waiting for the Commission to come after them.[14]

The above discussions indicate that effective regulation would be expected to reduce the profit levels of electric utility monopolists.

The residential natural gas price faced by an electric utility monopolist would also affect its profit level. Since gas is a substitute for some important electric utility applications, such as heating and clothes drying, one would expect a direct relationship between profit rates and natural gas prices. As residential prices of a competitive gas company increase, profitability of the electric monopoly would increase as customers convert to using electricity where feasible.[15]

Profitability of an electric utility monopolist would be affected by the general regulatory climate and economic trends throughout the

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[14]Paul L. Joskow "Pricing Decisions of Regulated Firms: A Behavioral Approach" Bell Journal of Economics, Spring, 1973, p. 123.

[15]This relationship would not necessarily hold in a gas-electric combination company. In this situation, the firm is a monopolist both for gas and electricity and sells both services in a given city. Consequently, a consumer facing a higher price for natural gas may change to electricity but the same firm would continue to earn profit from selling the substitute energy to him. The net effect on profitability, in this case, depends upon both how the regulatory commission discriminates between gas and electric prices and the extent of consumer responses to price changes.

country. Utility Commissions do not operate in a vacuum. They observe what is happening in other jurisdictions and react accordingly. This is not to say that they all react in the same way, but that they are all influenced to some extent by the overall economic and social environment in which regulated utility firms exist. This tendency is enhanced by the National Association of Regulatory Utility Commissioners which publishes statistics and engages in other matters of interest to regulators and students of regulation.[16] Because of these influences, one would expect profitability of individual firms in this business to parallel that of the industry as a whole. Consequently, as profitability in the electric utility industry increases, regulators are more likely to allow increased profitability of firms in their jurisdiction.

Sales growth is another important influence on profitability of the firm; however, the net effect cannot be determined unambiguously. The fact is, sales growth would probably cause a firm's total profit to increase but profitability per unit sold may rise or decline, depending on operating conditions of the particular firm involved. Profitability per unit sold would increase as sales increase if the firm is operating with excess capacity. Even if excess capacity does not exist, if

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[16]Charles F. Phillips The Economics of Regulation (Homewood: Richard D. Irwin, Inc., 1969), p. 96 explains that this body has also established for its members an annual regulatory development course which covers regulatory principles and their applications. This reflects their influence on Commission thinking and attitudes. The importance of the regulatory climate is discussed in Richard N. Benjamin's "Economic and Regulatory Problems of Electric Utilities" in The Economics of Regulation of Public Utilities Evanston: Northwestern University, 1966., p. 19.

regulatory lag is minimized, and higher consumer prices are quickly approved as costs rise when new customer load is added, profits per unit may increase. On the other hand, sales growth could cause lower per unit profitability, if the firm's average costs are rising and if the firm faces long regulatory lags before higher rates are approved to offset the rising costs incurred as new customers are added. So two effects are reflected by sales growth; these are capacity utilization and regulatory lag.

Electric utility regulation is based on "cost-plus-profit" procedure.[17] Under this form of regulation, the utility firm is permitted to recover all costs of operation. Earnings are generated by the firm being allowed to earn a fair return on its investment. Consequently, all taxes, operating expenses, and depreciation are recoverable by the utility firm, then a fair return on investment is added as compensation to investors.[18] To the extent that consumer rates are established on a previous test year basis, future expected costs are the costs involved in the rate determination procedures, not costs actually incurred by the firm during the relevant operating year.

The regulatory Commission has the responsibility of attempting to protect the investors of the utility firm. At the same time, it must

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[17]This point is made in William G. Shepherd's "Utility Growth and Profits Under Regulation" in Utility Regulation New Directions in Theory and Policy, ed. William G. Shepherd and Thomas G. Gies (New York: Random House, 1967) p. 30: and Dudley F. Pegrum Public Utility Regulation of Business (Homewood: Richard D. Irwin, 1965), pp. 664-682.

[18]The rate making procedure is quite complex and it will not be discussed here. A case study of rate making and a discussion of costs of service is presented in Paul J. Garfield and Wallace F. Lovejoy Public Utility Economics (Englewood Cliffs: Prentice-Hall, 1964), pp. 249-259.

avoid exploitation of consumers as would occur if rates became excessive and the firm earned an economic profit. Commissions must consider inflationary pressure to protect both the utility and the consumer. One authority in public utility regulation has stated:

> Some Commissions add a percentage allowance in the rate of return to offset the shift in price level or attrition due to rapid growth in a period of inflation.[19]

Joskow has also indicated the need for regulatory adjustments and presents an "inflation premium" hypothesis.

> In an effort to make up losses that result from regulatory lag in an inflationary world the Commission may allow a higher proportion of "corrected" firm requests during periods of rapid inflation than it would in a period of relatively stable prices.[20]

Joskow presents regression results which give some support to his "inflation premium" hypothesis.[21]

Given the rate making procedure of utility companies, one would expect per unit profitability to be unaffected by production expenses. If the regulated price is just compensating the utility firm for its production costs, one would expect rising or falling production costs to have a neutral effect on per unit profitability. If the regulators because of inflation allow a higher rate of return to compensate for the

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[19] John P. Bauer Updating Public Utility Regulation: Assuring Fair Rates and Fair Returns (Chicago: Public Administration Service, 1966), p. 65.

[20] Paul L. Joskow "The Determination of the Allowed Rate of Return in a Formal Regulatory Hearing," The Bell Journal of Economics, Autumn 1972, p. 641.

[21] Ibid., p. 643.

higher costs, as suggested by Bauer and Jaskow,[22] the higher production costs will cause higher per unit profit. Essentially, in this case, the utility firm is allowed to recover, through higher prices, more than its increase in costs.

METHODOLOGY

Following the above statement by Kahn, this study examines rates of return (profits) as evidence of the efficacy of electric utility regulation. If regulators do consider profits as their primary control target, as he suggests, this is indeed the appropriate variable to examine.[23]

Previous studies have largely relied upon price data which were generated during the very early days of utility regulation and some have depended on cross section analyses, aggregating firms controlled by diverse state regulatory regimes.

The method employed here was designed to avoid some of the problems previously mentioned. If, indeed, utility regulation across the country is applied in a very "uneven" manner, as suggested in a previous study,[24] cross section comparisons may be infected with problems which are very difficult to isolate. Moreover, regulators are expected to accomplish

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[22]Bauer, op. cit. and Jaskow, op. cit.

[23]The important problem of how to manipulate rates of return to induce efficiency is not addressed here. For discussions of this problem see: Kahn, op. cit., p. 53 and William Iulo, Electric Utilities--Costs and Performance: A Study of Inter Utility Differences in the Unit Electric Costs of Privately Owned Electric Utilities (Pullman: Washington State University, 1961).

[24]Primeaux, op. cit., p. 105.

efficient outcomes because automatic markets are not permitted to operate. Their task is very difficult and there is no certainty that the effects of regulation will fall upon firms in a consistent manner. Indeed, it is entirely reasonable to expect one firm to fare better than another in the same state, under the same regulators.[25] In a cross section study, aggregation of data makes it very difficult to assess the impact of commission regulation on an individual firm.

Time series data for the individual electric firms operating in Florida, Iowa and Mississippi were used in the statistical analyses. These states were used because they are the only ones in which Commission regulation was implemented since 1948;[26] and it was possible to compare profit rates for individual firms before and after Commission regulation was installed and make an assessment of the effect of the change in each case. The earliest data are from 1948 because of concern that the World War II or depression periods would affect the validity of the results.

Each firm was examined individually by ordinary least squares regressions, employing time series data from 1948 through 1976.[27] This procedure made it possible to isolate the specific impact of Commission regulation on each firm's rate of return.

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[25] This is not explicitly stated but is implied in Primeaux, op. cit.

[26] Actually, Minnesota and Texas have also implemented Commission regulation since WWII but it was not possible to include them in this study. Commission regulation has jurisdiction in Texas only where it has been requested by the public, and data are insufficient in Minnesota's case because it was only recently regulated.

[27] Data are from Statistics of Privately Owned Electric Utilities in the United States (Washington, D.C., Federal Power Commission, various years).

Commission regulation was implemented in Florida in 1951, in Iowa in 1963, and in Mississippi in 1956. Figure 1 lists all of the class A & B privately owned electric utility firms in the three states being examined; there are thirteen firms involved. Publicly owned (municipally owned) firms were not included in the sample, because they are not regulated by the state regulatory Commissions.[28]

This study assumes that the time of establishment of the state regulatory commission is the time when effective regulation was implemented in the state. It must be assumed that the State Regulatory Commission was designed to be effective by the legislation setting up the agency. If the Commission proves to be ineffective, that merely reflects unfavorably upon regulation as an effective institution.[29]

One might assert that the firms were not entirely free from some sort of regulation prior to the date that the State commission was established, therefore, a comparison of before and after performance would not really reveal how effective regulation is. However, the central issue in all of the previous studies, as well as this examination, is, in fact, how effective is State commission regulation in affecting eco-

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[28]Profitability of publicly owned electric firms is discussed in Patrick Mann "Publicly-Owned Electric Utility Profits and Resource Allocation" Land Economies, November, 1970, pp. 478-484.

[29]The question examined is how effective is regulation; not, how effective is effective regulation.

Figure 1

ALL CLASS A & B ELECTRIC UTILITIES
IN FLORIDA, IOWA, AND MISSISSIPPI
(Firms constituting the sample of the study)

Florida	Iowa	Mississippi
Florida Power Corp.	Iowa Illinois Gas & Electric Co.[a]	Mississippi Power Co.
Florida Power & Light Co.	Iowa Southern Utilities Co.	Mississippi Power & Light
Tampa Electric Co.	Iowa Public Service Co.[b]	
Gulf Power Co.	Iowa Power & Light Co.	
Florida Public Utilities Co.	Interstate Power Co.[c]	
	Iowa Electric Light & Power Co.	

[a]Serves both Iowa and Illinois. Iowa sales were 64.64 percent of total KWH sales in 1979.

[b]Serves Iowa and South Dakota. Iowa sales were 99.1 percent of total KWH sales in 1979.

[c]Serves Illinois, Iowa, and Minnesota. Iowa sales were 79.6 percent of total sales in 1979.

Proportions of sales in Iowa were provided through Mr. Robert Latham of the Iowa Commerce Commission in a telephone conversation May 23, 1980.

nomic performance. This is really the important question, since this form of regulation dominates all others.[30]

THE REGRESSION MODEL

As mentioned earlier, ordinary Least Squares linear regression analysis was used to determine the effects of Commission regulation on the rates of return of firms in the sample.

The specification of the rate of return function is:

$$\Pi/S = A + B_1 REG + B_2 RGAS + B_3 NI/OR + B_4 SGRO + B_5 PE/S + U$$

where:

U = random distrubance term.

Π/S = is realized net income in dollars per 1000 kwh sold. (Dependent variable).

REG = is a regulatory dummy variable, taking a value of 1 for years when the firm was regulated by a state Commission, a zero for years before.

RGAS = residential average natural gas price, in thousands of dollars per trillion BTU's.

NI/OR = net income as a percent of operating revenue for all class A and B utilities in the U.S. (an index or trend variable indicating national movements in profitability or rates of return).

SGRO = a demand growth variable, in percent change of KWH sold. A proxy for capacity utilization and regulatory lag.

PE/S = Production expense in dollars per 1000 kwh.

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[30] The usual arrangement was that firms were regulated at the local level by some sort of city commission prior to state commission regulation.

One study found local regulation even less effective than state commission regulation. See: R. J. Sampson, "Comparative Performance of Electric Utilities Under State and Under Local Rate Regulation," Land Economics, Vol. XXXIV, No. 2, May, 1958, p. 178.

Some additional details and an elaboration of the data and the nature of the variables are presented in the appendix.

All financial data were deflated by the GNP implicit price deflator and separate time series equations were run for each firm. These data reflect firm performance for the years 1948-1976. The regulation variable (REG) was lagged to conform to the Stigler and Friedland study where regulation was said to have taken place three years after the State Commission was established.[31] The purpose of this procedure was to allow a sufficiently long period of time for regulation to be effective after it was actually installed.

The Π/S variable (net income in dollars per 1000 KWH sold) is a proxy for the rate of return earned by the electric utility firm. This specification was used as the dependent variable because of the desire to assess the effect of Commission regulation on firms profits. Plant or assets were not considered to be the appropriate units to use to standardize earnings for comparison purposes. Utility firms add plant capacity in discrete units and there was concern that plant additions always create excess capacity. This condition would cause large increases in the denominator, without comparable increases in the numerator. Moreover, all plant is not necessarily of the same vintage. Consequently, questions are raised concerning the appropriate real value of the assets. The decision was made to use sales units (KWH) as the denominator because this measure is clearly and consistently defined throughout the whole time series period. Moreover, since time series

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[31] Stigler and Friedland, op. cit.

data are used, the necessary distinction between per unit profitability and total profitability does not create serious problems.

The RGAS variable was included to consider the effect of the price of residential natural gas as a substitute for electricity. Since natural gas is a substitute for electricity for several important uses, a positive sign would be expected on this variable.

The NI/OR variable was included to consider the regulatory environment and the overall electric utility profit trends in the equation. To the extent that regulators in a given state behave in the same way as regulators across the whole country, one would expect a positive sign on this variable.

The SGRO variable would have a negative sign because as more units of electricity are sold, less efficient generating units are brought into use and this causes per unit cost to rise, causing profit per unit to fall. This relationship would hold unless the firm has excess capacity of high efficiency quality for use in providing the additional service.

If regulators just allow cost recovery by the utility firm, the PE/S variable would be expected to be insignificant and unrelated to profit per KWH sold. Since this variable is a proxy for total costs of the firm, one would not expect that it would affect profitability, unless regulatory commissions allow excessive or insufficient estimates of costs in the procedure of rate determination. If the regulatory commissions tend to project excessive cost estimates, this variable would have a positive sign and if they underestimate cost levels this variable would have a negative sign. Of course, allowed rates of return and recoverable

expenses are translated into realized rates of return and recovered expenses by the prices established for consumer services.[32]

REGRESSION RESULTS

This section presents the regression equations for each of the thirteen firms included in the sample. Both OLS and seemingly unrelated regression equations were run but the results were quite similar so only the OLS results are presented. Only linear equations are presented; log specifications were also run but they did not increase the level of explained variance.

In addition to the variables mentioned above, an OPEC dummy variable was included to attempt to isolate the effect of the energy shortage on rates of return earned by electric utility firms included in the sample. This variable was not statistically significant and it showed a high degree of multicollinearity with other independent variables. Consequently, it was omitted. Interaction variables were statistically significant and regression coefficients were unaffected when they were removed.

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[32] As mentioned earlier, the electric utility regulatory procedure allows a recovery of all expenses and costs only, plus a rate of return on investment. See: William G. Shepherd, op. cit. A discussion of how consumer prices must be compatible with the allowed rate of return is presented in Harold Somers "Rate of Return and Misallocation of Resources" in Joseph E. Haring and Joseph F. Humphrey (eds.) Utility Regulation During Inflation Los Angeles: Occidental College Economics Research Center, 1971), p. 44. Consumer prices, of course, translate the regulated or allowed return into the amount which companies will realize from sales of services and ultimately net profit. The regulated and allowed rates of return are discussed in R. Blaine Roberts, G. S. Maddala and Gregory Enholm "Determinants of the Requested Rate of Return and the Rate of Return Granted in a Formal Regulatory Process" Bell Journal of Economics, Autumn 1978, pp. 611-621.

The Cochrane-Orcutt interative technique[33] was employed to develop a model which would be free of significant autocorrelation. The equations adjusted by this procedure are indicated on the tables which present the final regressions.

The overall results show rather strong support for the notion that commission regulation has probably reduced economic profits in the electric utility industry.

Florida

Table 1 presents equations for the five firms in the sample from the State of Florida. The RGAS variable reveals that some consumers did react to higher gas prices by switching to electricity for some purposes. The table shows positive signs on the RGAS variable in four of the five equations. Only in the equations for Florida Public Utilities Company and Gulf Power Company is the RGAS variable significant at the ten percent level or better, showing that higher natural gas prices actually caused higher per unit profits for these firms.

The NI/OR variable is positive in all equations and statistically significant at the five percent level or better in four of the five cases. The positive sign indicates that the Florida firms were all allowed to increase their profitability, as the profitability of electric utility firms across the country increased. This is probably an indication that the Florida public utility commission is responsive to the needs of the regulated firms and is sensitive to the economic and social environment existing across the country.

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[33] D. Cochrane and G. H. Orcutt, "Application of Least Squares Regression to Relationships Containing Autocorrelated Error Terms," Journal of American Statistical Association, March 1949, pp. 749-809.

TABLE 1

OLS ESTIMATES OF PROFIT FUNCTIONS--Florida Companies

Florida Company	Constant	REG	RGAS	NI/OR	SGRO	PE/S	DF	R^2	Dw
Tampa Electric Co.	-4.41174	-.59838[c] (-1.78752)	.00009 (1.44796)	.52123[a] (3.16918)	.89976 (.5648)	.20908[b] (2.37430)	21	.642	1.692[z]
Florida Power Corp.	-.12579	-1.57940 (-1.20767)	.00012 (1.02904)	.83056[a] (3.03493)	-1.77620 (-1.26293)	.10026 (1.17550)	20	.347	1.744[z]
Florida Public Utilities Co.*	-2.57334	-3.56660[a] (-5.57107)	.00031[b] (2.33873)	.75306[b] (2.76553)	-3.62349 (-1.61043)	-.00114 (-.01148)	20	.778	2.192[z]
Gulf Power Co.	-7.3127	-4.72870[a] (-9.99847)	.00022[c] (1.71849)	.86956[a] (4.33614)	-3.11441 (-1.44155)	.36669[a] (3.86421)	22	.888	1.908
Florida Power & Light Co.	-.48954	.8864 (.5809)	-.00003 (-.2898)	.3777 (1.0490)	.6183 (.2841)	.0630 (.3851)	18	.191	1.65[z]

a significant at 1 percent level (two tailed test)
b significant at 5 percent level (two tailed test)
c significant at 10 percent level (two tailed test)
t values appear in parentheses beneath the corresponding coefficients
* combination company - sells both gas and electricity
z adjusted for autocorrelation

The SGRO variable is statistically insignificant in all cases; so profits per unit for the Florida firms did not change as sales growth occurred. This result can be explained in terms of production capability which allowed these firms to sell additional units of electricity without relying on less efficient generating facilities.

The PE/S variable is significant at the five percent level or better in two of the five regressions in Table 1, and the coefficient is consistently positive. This set of coefficients shows that profits increased as costs increased, reflecting a tendency for the Florida Commission to overcompensate firms for the cost incurred in operating the business.

The coefficient on the REG variable indicates that regulation has caused lower profits in three of the five Florida firms in this sample. Florida Power Corporation has experienced a tendency toward higher profits since regulation and Florida Power and Light Company has experienced a tendency toward lower profits since regulation, but both effects are statistically insignificant. The coefficients on the REG variable for Tampa Electric Company, Florida Public Utilities Co., and Gulf Power Company reflect significantly lower profits after State regulation was established.

After State Commission regulation, Tampa Electric Co. profits were lower by $.598 per 1000 KWH sold; Florida Public Utilities Co. profits were lower by $3.566 per 1000 KWH sold; and Gulf Power Co. profits were lower by $4.728 per 1000 KWH sold.

Iowa

Table 2 presents the equations for the six firms in the sample from the state of Iowa. As indicated in the table, every firm from the state of Iowa is a combination firm, selling both natural gas and electricity. The table also shows that the coefficient on the RGAS variable is negative in every case and statistically significant at the five percent level or better in five of the six equations. These results mean that consumers do react to higher natural gas prices and do generally switch to electricity for some uses as the price of natural gas rises. The results also show that this substitution caused lower profits for the six public electric utility monopolists who also sell natural gas. These results seem to indicate that the regulatory Commission in Iowa has allowed combination firms to earn higher profits from natural gas than from equivalent electric services.

The NI/OR variable is positive in all cases and statistically significant in five of the six equations at the five percent level or better. As with the Florida firms, this indicates that the Iowa Commission allowed firms to increase their profitability as the profitability of firms across the country increased. This is an indicator of the responsiveness of the Iowa Commission to the needs of regulated firms in that state.

The SGRO variable is negative in five of the six equations for the Iowa firms. However, the variable is statistically significant in only one equation. The significant coefficient indicates that Iowa Public Service Co. incurred decreases in profits per unit sold as it's sales increased. These results probably reflect that as sales growth

TABLE 2

OLS ESTIMATES OF PROFIT FUNCTIONS - Iowa Companies

Iowa Company	Constant	REG	RGAS	NI/OR	SGRO	PE/S	DF	R^2	Dw
Iowa Illinois Gas Electric Co.*	-1.44904	-1.71169[b] (-2.62874)	-.00000 (-.61245)	.48061[b] (2.21322)	1.52631 (.50887)	.40767[b] (2.55049)	19	.68	1.720[z]
Interstate Power Co.*	-9.81659	-1.18522[b] (-2.28945)	-.00002[a] (-4.77232)	.95723[a] (5.54275)	-1.82396 (-1.23434)	.71873[a] (7.34623)	19	.889	1.958[z]
Iowa Public Service Co.*	-2.30377	-1.54372[a] (-3.65634)	-.00001[a] (-2.67048)	.56910[a] (4.06307)	-7.19481[a] (-2.91498)	.26934[a] (4.47373)	20	.890	1.966
Iowa Southern Utilities Co.*	-3.01474	.59078 (1.66241)	-.00000[b] (-2.29551)	.53269[a] (5.44760)	-.15969 (-.09492)	.22267[a] (5.25954)	19	.789	1.69[z]
Iowa Electric Light & Power Co.*	-7.46769	-.93935[a] (-2.90121)	-.00001[a] (-4.41385)	.83597[a] (8.04852)	-.82313 (-.60161)	.54953[a] (9.52610)	19	.939	1.893[z]
Iowa Power & Light Co.*	-.60528	-.03450 (-.09510)	.00440[b] (2.02921)	.17439 (1.12843)	-2.06567 (-1.44625)	-.02699 (-.51561)	17	.442	1.713[z]

a significant at 1 percent level (two tailed test)
b significant at 5 percent level (two tailed test)
c significant at 10 percent level (two tailed test)
t values appear in parentheses beneath the corresponding coefficients
* combination company sells both gas and electricity
z adjusted for autocorrelation

took place this firm used less efficient plants to produce the additional output, reducing profit per unit. They may also reflect that this firm was not as aggressive and successful in seeking rate adjustments when sales were growing and costs were increasing, consequently, profits were adversely affected by regulatory lag. Of course, both of these explanations are likely and they may apply concurrently.

The PE/S variable is positive and significant at the five percent level or better in five of the six equations in table 2. These results reflect a strong tendency of the Iowa Commission to overcompensate firms for the projected cost component in their electric rate computation. The results mean that profits are higher for these firms as costs increase.

The coefficient of the REG variable reveals that Commission regulation has caused lower profits for four of the six Iowa firms included in the sample. Table 2 reveals that the coefficient on the REG variable is significant at the five percent level or better for all Iowa firms, except Iowa Southern Utilities Co. and Iowa Power & Light Co.

The equations in table 2 reveal that the profit reductions from Commission regulation ranged from a low of $.939 per 1000 KWH sold for Iowa Electric Light and Power Co. to a high of $1.711 per 1000 KWH sold for Iowa Illinois Gas Electric Co. Intermediate reductions per 1000 KWH sold were: Interstate Power Co. ($1.185), and Iowa Public Service Co. ($1.543).

Mississippi

Table 3 presents the equations for the two firms in the sample from the state of Mississippi. The sign on the RGAS variable is in the expected

TABLE 3

OLS ESTIMATES OF PROFIT FUNCTIONS - Mississippi Companies

Mississippi Company	Constant	REG	RGAS	NI/OR	SGRO	PE/S	DF	R^2	Dw
Mississippi Power Co.	.35908	-.58550[b] (-1.86285)	.00742[a] (5.31785)	-.24847[b] (-2.18973)	-2.36444[b] (-2.44406)	-.19733[a] (-4.01406)	21	.677	1.680[z]
Mississippi Power & Light	.24682	-.24682 (-.6943)	.00329[b] (2.31943)	.09202 (.74598)	-2.13357 (-1.64900)	1.34864 (.43424)	20	.384	1.819[z]

a significant at 1 percent level (two tailed test)
b significant at 5 percent level (two tailed test)
c significant at 10 percent level (two tailed test)
t values appear in parentheses beneath the corresponding coefficients
z adjusted for autocorrelation

direction, indicating that higher natural gas prices cause profits of the electric utilities to increase. These firms are electric monopolies but they do not sell natural gas, as in the case of the firms from Iowa. Consumers substituting electricity for natural gas when gas prices rise would increase the profitability of electric firms. The RGAS coefficients in the equations were significant at the five percent level or better.

The NI/OR for Mississippi Power and Light Company is positive but insignificant at the ten percent level but the coefficient on this variable in the Mississippi Power Co. equation is negative and statistically significant. These results show that the Mississippi regulatory Commission, in contrast to both the Florida and Iowa Commissions, does not seem to be so responsive to the overall regulatory environment in permitting firms in that state to increase profits. This may also indicate a lack of responsiveness of the Mississippi Public Service Commission to the needs of the regulated firms in that state.

The SGRO variable is negative for both firms but only significant for Mississippi Power Co. Mississippi Power Co. has possibly faced extensive regulatory lag in obtaining rate increases in the face of rising costs per KWH sold. Profits per unit sold are unaffected as sales growth takes place for Mississippi Power and Light Co.

The PE/S variable is significant in the equation at the five percent level for Mississippi Power Co. but not for Mississippi Power & Light Co. These results indicate that the Mississippi Commission is just allowing Mississippi Power & Light Co. to recover costs as they increase, so profit per unit is unaffected. In Mississippi Power Co's.

situation, however, the Commission undercompensates the firm and profits per unit fall as production expenses increase.

The negative coefficients on the REG variable reveals that Commission regulation has tended to lower profit per kwh sold for both firms in Mississippi. Only in Mississippi Power Co's case, however, is the reduction statistically significant. Mississippi Power Company profits have been lowered by $.585 per 1000 kwh sold.

CONCLUSIONS

Commission regulation has lowered rates of return earned by electric utility firms included in this study. Table 4 presents the mean value of the dependent variable for each firm in the sample and the regulatory effect for comparison purposes. Eleven of the thirteen firms included experienced pressure toward lower rates of return after commission regulation.

Of the five firms operating in Florida, three experienced statistically significant lower rates of return after regulation. The lower profits developed from this analysis ranged from $.598 per 1000 KWH sold to $4.728 per 1000 KWH sold.

Only two of the six firms operating in the state of Iowa did not experience statistically significant lower rates of return after Commission regulation. The reductions experienced by the four firms which were affected ranged from a low of $.939 to a high of $1.711 per 1000 KWH sold.

One of the two firms operating in Mississippi experienced lower profits after regulation. The reduction amounted to $.585 per 1000 KWH sold.

TABLE 4

SUMMARY OF MEAN VALUES FOR DEPENDENT VARIABLE
COMPARED WITH VALUES FOR DUMMY VARIABLE
(Firms in the Sample)

	Regulatory Effect Dummy Variable[a]	Mean Value Dependent Variable[a]
Florida		
Florida Power Corp.	-$1.579*	$1.249
Florida Power & Light Co.	+ .8864*	$ .906
Tampa Electric Co.	-$ .598	$2.891
Gulf Power Co.	-$4.728	$5.066
Florida Public Utilities Co.	-$3.566	$4.630
Mean of Florida Firms[b]	-$2.964	$2.948
Iowa		
Iowa Illinois Gas & Electric Co.	-$1.711	$4.067
Iowa Southern Utilities Co.	+$ .590*	$4.252
Iowa Public Service Co.	-$1.543	$7.244
Iowa Power and Light Co.	- .034*	$ .991
Interstate Power Co.	-$1.185	$4.512
Iowa Electric Light and Power	-$ .939	$3.648
Mean of Iowa Firms[b]	-$1.344	$4.119
Mississippi		
Mississippi Power Co.	-$ .585	$1.244
Mississippi Power and Light	-$ .246*	$ .796
Mean of Mississippi Firms[b]	-$ .585	$1.020

* statistically insignificant
a measured in terms of dollars per 1000 KWH sold
b mean of statistically significant effects only (ten percent level or better)

Table 4 reveals that the Iowa firms showed the highest average profitability at $4.119 per 1000 KWH sold, the Florida firms averaged $2.948 and the Mississippi firms averaged $1.020 per 1000 KWH sold.

Table 4 also shows that the regulatory Commission of Florida has reduced economic profits by the greatest average magnitude, $2.964 per 1000 KWH sold. The Mississippi Commission reduced economic profits by the smallest amount, $.585 per 1000 KWH sold and the Iowa Commission reduced economic profits by $1.344 per 1000 KWH sold. These data give some indication of the relative impact of Commission regulation in these three states.

One conclusion is that some firms fared better under regulation than others. These kinds of differences are obscured in aggregated studies and they do show the merit of time series approaches to assessing the impact of regulation.

The results of this study add support to the "inflation premium" hypothesis, presented by Joskow. Indications are that commissions tend to overcompensate the firms in the sample for rising production expenses.[34]

The above results, however, are at odds with those presented in the Stigler-Friedland study.[35] Stigler and Friedland concluded that pure monopoly profit would not accrue to electric utility firms in the absence of regulation. The evidence cited above clearly reflects lower

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[34] Joskow, op. cit.

[35] Stigler and Friedland, op. cit.

profit rates after state regulation was installed. Consequently, it is reasonable to conclude that most firms in the sample were indeed earning economic profits prior to regulation.

The findings are inconsistent with the "Capture" theory of regulation advocated by Stigler, Posner and Peltzman.[36] There does not seem to be any indication or evidence that the utility firms experiencing lower profits have control over the commissions regulating them.[37] If these utility firms were actually in control of the Commissions, one would expect them to maintain the profit levels experienced before regulation was implemented. One possible policy conclusion is that proponents of deregulation should move cautiously in this industry. Consumer welfare is indeed benefiting to some extent from Commission regulation in the three states examined here, to the extent that monopoly profits have been reduced or eliminated. It is not possible to determine if monopoly profits have been totally eliminated by commission regulation. The dummy variables show a reduction in profitability of a significant degree. Since the firms have remained in business, it seems possible to conclude that they are earning a fair return on investment and that their profits prior to regulation were excessive.

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[36]George Stigler, "The Theory of Economic Regulation," Bell Journal of Economics and Management Science Spring 1971, pp. 3-21; Richard A. Posner, "Theories of Economic Regulation," Bell Journal of Economics and Management Science Autumn 1974, pp. 335-58; Sam Peltzman, "Toward A More General Theory of Regulation," Journal of Law and Economics August 1976, pp. 211-40.

[37]Arizona Corporation Commission, Fifty-eighth Annual Report, 1970, p. 9 reports that the Commission of Iowa is appointed by the Governor while the Commissions of Florida and Mississippi are elected by voters.

Finally, although regulation has reduced rates of return in most cases examined here, from a public policy point of view it is still not clear that regulation is cost effective. Moreover, regulation is also charged with responsibilities other than financial control and we are unable to determine whether performance in those areas is effective. These are all important matters which require rigorous research.

APPENDIX

Data Sources

All data are from Statistics of Privately Owned Electric Utilities in the U.S. except the gas price data. Gas price information was obtained from Gas Facts.

The state average prices for residential natural gas was obtained by taking state residential gas sales revenue (in thousands of dollars) and dividing that number by state residential gas quantity sold (in trillions of BTU's).

The GNP implicit price deflator was taken from the Economic Report of the President.