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The Origins of State Electricity Regulation: Revisiting an Unsettled Topic

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The Origins of State Electricity Regulation: Revisiting an Unsettled Topic

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Abstract

While the electricity industry is currently experiencing a regime shift from state regulation to competitive markets for generation, a number of questions regarding the change in regulatory environment in the electricity industry during the beginning of this century remain unsettled. This paper revisits some of these issues. Specifically, the paper tests the validity of the two most commonly suggested reasons for the origin of state regulation in the electricity industry. Using Census data gathered on the electricity industry during the beginning of this century, the paper models the decision to adopt state regulation as a function of the average electricity price and profit rate in the state. The results cast doubt on the commonly accepted justification, attributed to Jarrell (1978), that state regulation was passed to limit competition and increase the profits of electricity firms, but do not unambiguously support the public interest view, either. The paper then draws on trade publications to assess the industry's mindset during this period. Literature from the National Electric Light Association suggests that although some industry leaders supported state regulation in order to rid themselves of corrupt local politicians, the industry did not unilaterally support increases in regulation.

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1 Introduction

Electricity industries across the world are currently undergoing a transformation from a market organized around a single vertically integrated firm to one centered around competition as a means of disciplining price. In the United States alone, restructured electricity markets exist in Massachusetts, California, and mid-Atlantic PJM market. This regime shift comes after over 80 years of state regulation, dating back to 1907.

Despite the lengthy period of state regulation, surprisingly little is known about why the US electricity industry switched from a system of municipal regulation to that of state regulation.[1] The commonly held belief, attributed to Jarrell (1978), argues that state regulation was created by electricity firms to escape the perils of competition. However, his empirical tests of this theory may be biased given the endogenous nature of regulatory change. After implementing a test that corrects for this endogeneity, the reason for this regime shift becomes less clear, suggesting additional research is needed. In particular, I estimate a duration model that allows me to examine the factors which influence the decision to adopt state regulation. The public interest theory would predict that higher profit rates and prices would positively influence the marginal probability of adopting state regulation, while the capture theory would predict the opposite. By treating the decision to adopt state regulation in this fashion, a direct test of both theories is specified. Unfortunately, the data do not speak to either theory.

As a second means of determining the driving force behind regulation, I also looks at anecdotal evidence in order to obtain whether the mind-set of the industry was consistent with the theory that electricity utilities of the day sought protection from competition. As a whole, the evidence does not suggest that the industry was in support of more regulation, as a means of capturing regulators, but rather a regulatory framework that could more credibly commit to decisions. In this sense, the firms chose the lesser of two evils. While state regulation likely meant a more stringent constraint on profitability, state regulators were also less likely to exploit the asset specificity of firms and "hold up" the firms. Therefore, the evidence suggests that it was corruptibleness of the municipal regulators that led some industry officials to favor state regulation.

The remainder of the paper is organized as follows. In section two, I outline the evolution from municipal regulation to that of state regulation. Section three discusses the previous evidence in favor of the capture theory. Section four provides a brief theoretical justification for the two alternative explanations, namely the capture theory and the public interest theory. In section five, I estimate the decision to adopt state regulation as a function of the market characteristics. Sections six and seven discuss anecdotal evidence from the popular press and trade literature of the time period, respectively. The final section is reserved for concluding remarks and possible extensions of the work.

2 The Beginning of Regulation

Electricity regulation began with the use of franchise licenses by municipalities to control rates and right-of-way as early as 1885 (King 1912). These local regulatory authorities did little to control rates, usually

[1] See for example Rose (1995, p. 39) where he states that "the political economy of gas, electric, and trolley corporations between 1900 and 1920 is an era where findings remain incomplete and contradictory." Also see Kahn and Gilbert (1993, pg. 3) where they state that "there is considerable ambiguity about the origins of regulation."

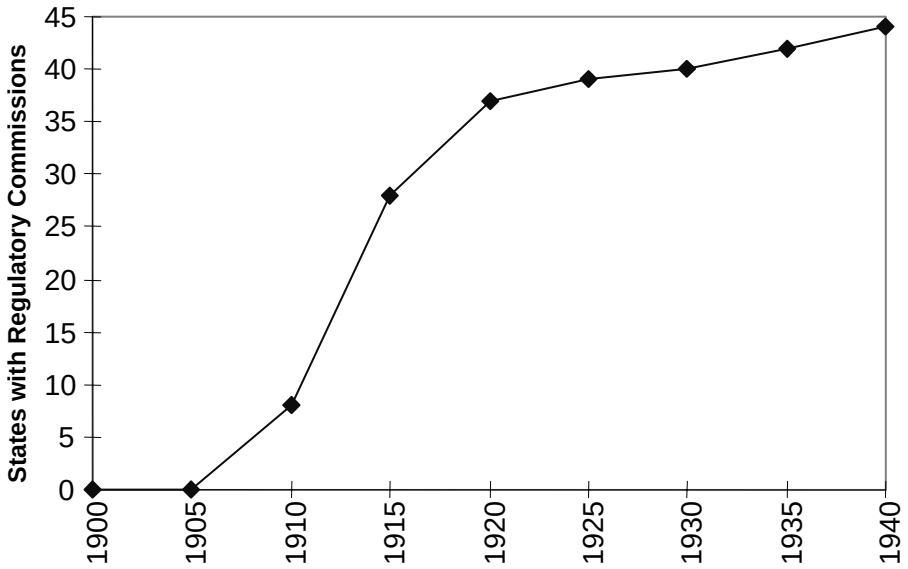

Figure 1: State Regulation Adoption

setting a maximum rate above what was already being charged (Electric Power and Government Policy 1948). Instead, municipalities focused on controlling the number of franchises offered, and thus the level of competition. Often, however, municipal regulation did little to limit entry. In Duluth for instance, five firms were allowed to provide electricity as early as 1885; New York City had six firms in operation in 1887; by 1907 there were forty-five companies allowed to provide electricity in Chicago (Phillips 1984). Given that each of these firms laid their own power lines and the likelihood of duplicate capacity, these number imply a loss of efficiency.

The migration to state regulation began in 1907, when both Wisconsin and New York passed legislation to expand the scope of their railroad commissions to include gas and electric companies. As Figure 2 illustrates more states quickly followed suit. The regulatory bodies were surprisingly similar in their scope. The commissions commonly had the power to set rates, standards, and control entry and exit. In addition, their authority superseded that of the localities. The average commission consisted of an appointed board that served terms of 3 to 7 years. Rules and procedures were usually established to deal with rate increases and investment decisions.

Because very little electricity initially flowed across state boundaries, there was little need for federal regulation. Not until 1920, with the creation of the Federal Power Commission, did the federal government enter the electricity industry. Even then, federal involvement was small, overseeing only interstate transmission, leaving the states with most of the regulatory control.

3 Competing Explanations and Their Justification

3.1 Public Interest Theory

The most obvious explanation for state intervention in the electricity market is that firms operating during this time periods enjoyed declining average costs over the relevant output ranges, and thus efficiency gains were achieved when one firm supplies the market. If these economies of scale are unable to be entirely utilized at the city level and there exists contracting costs between municipalities in the combining of regulation, then state regulation may be more efficient. It is this explanation that finds its way most often in popular literature with little or no justification. The theory behind regulating industries that are characterized by declining average costs within the relevant output ranges is well known. Industries with such cost curves are known as "natural monopolies."

There are two reasons justifying the regulation of a natural monopoly. First, given the declining average costs of firms, competition, which lowers per firm output, has the affect of pushing firms up their average cost curve leading to inefficiency. By reducing the number of firms serving the market, each firm travels further down its average cost curve. Regulation can therefore be used to eliminate competition and increase efficiency by allowing only one firm to serve the market. However, left alone, the monopolist would charge the profit maximizing price, while the regulatory commission would like the firm to price at marginal cost. Therefore, the second justification to regulate natural monopolist is to assure price is set more socially efficiently.

In support of the public interest theory, Emmons (1997) finds that regulation and public ownership reduced prices during the years of 1930 to 1942. However, he also finds that competition acts to reduce prices. Therefore, his analysis is broadly consistent with both theories.

3.2 The Capture Theory

Among economists, the commonly accepted justification for state regulation has been that the electricity firms themselves sought to be regulated to ward off fierce competition, and that the government was subsequently "captured" by the industry.[2] The capture theory of regulation contends that firms are consumers of regulation; that firms value the ability provided by regulation to coordinate output reductions, or limiting competition. A rich body of literature exists on the "capture theory" of regulation.[3] In the case of electricity, proponents of the capture theory hold that the industry valued regulation for its ability to limit competition, thus increasing profits.

4 Previous Evidence in Favor of the Capture Theory

The belief that the onset of state regulation in the electricity industry was a result of the industry "capturing" state regulators can be traced back to a study performed by Stigler and Friedland (1962). In this paper,

[2]This explanation may even be more popular than the natural monopoly explanation. See Anderson (1981) and the Edison Electric Institute literature for an example.

[3]The theory began with Stigler (1971) and Noll (1971).

the authors investigated whether or not regulation had an impact on the pricing behavior of electricity firms during the period of 1907 to 1922. Towards this end, Stigler and Friedland regressed the average revenue of electricity in each state, taken at five year intervals, on control variables and a dummy variable equal to one if the state was regulated. Their results, reported below, suggest that although lower rates were associated with regulation, this effect is not statistically significant. For this reason, the authors conclude that "no effect of regulation can be found in the average level of rates."

$$\begin{array}{lccccccccc} Avgrev = .0918 - & .0592 Pop & + & .0604 Cost & + & .230 Inc & - & .498 \%hydro & - & .0109 D_{reg} \\ & (.0248) & & (.1665) & & (.204) & & (.083) & & (.0068) \end{array}$$

where $Avgrev$ is the average revenue per kilowatt hour by state and by year, Pop is the urban population of the state, $Cost$ the cost of fuel, Inc is the average annual income in the states, $\%hydro$ the proportion of capacity available from hydroelectric plants, and D_{reg} a dummy variable equal to one if the state was regulated. The standard errors are in parentheses.

Despite the insignificance of D_{reg}, their conclusion may not follow. The authors ignore the fact that this variable is potentially endogenous, biasing the coefficient. For example, if regulation was passed in a state as a result of high prices, then high prices being correlated with regulation even if state regulators sought to lower prices upon taking control. Without controlling for this potential endogeneity, we may erroneously conclude that regulation causes high prices, even though the reverse is true. Therefore, it is possible that the coefficient on D_{reg} is insignificant as a result of this potential bias.[4]

Jarrell (1978) builds on the work of Stigler and Friedland by making the stronger claim that it was the industry itself that sought regulation, to escape the competitive environment. To test this claim, Jarrell estimates the effect of regulation on price, profit, and output. To test this claim Jarrell estimates a system of equations for demand, average costs, and price and includes a dummy variable for the time period "prior"to regulation (the quotation marks will become clear in a moment). By focusing on the period right before regulation Jarrell is able to nicely side-step the issue of endogeneity of regulatory change and ask the question of how the industry looked before regulation was passed.

His results for the price specification are reported in Table 1. His main conclusions follow from observing that the 1912 prices (and profit rates) of states that became regulated between 1912 and 1917, were lower than those that did not become regulated, implying that low prices and profit rates in 1912 are correlated with regulation being passed between 1912 and 1917.

Unfortunately, the manner in which the "prior" to regulation variable was defined casts doubt on the results. Jarrell's indicator variable for whether a state is regulated, is defined to be whether the state adopted regulation up to three years prior. This implies that the variable defined as "regulated between 1912 to 1917" should actually be read as becoming regulated between 1909 to 1914. Taking this into account weakens his results, since we can no longer conclude that low prices in 1912 are correlated with regulation in the time period after 1912. This coefficient may be negative because the firms that underwent regulation in 1909 to 1912 were forced to lower their rates as a result of regulation. In fact, 12 of the 25 states that became regulated between 1909 and 1914 were already regulated by 1912. Therefore, this coefficient could

[4]Caution might also be taken from the fact that only one of the coefficients on the covariates (excluding the constant term) is significant, implying the specification may be wrong. For example, these results suggest that changes in costs have a statistically insignificant effect on price, which is unlikely in both the capture and public interest theories.

Table 1: Jarrell's Results

Dependent Variable – Average Revenue per KWh					
Regression Number	Year of Data	Regulated in 1912	Regulated between 1912 and 1917	Regulated in 1917	Regulated between 1917 and 1922
1	1912	–.226	–.463	—	—
		(1.463)	(4.423)		
2	1917	–.011	–.203	—	—
		(.050)	(1.325)		
3	1917	—	—	–.225	–.299
				(1.389)	(.852)
4	1922	–.180	–.321	—	.120
		(.987)	(2.548)		(.479)

Source: Jarrell (1978). Reported t-statistics in parentheses.

be negative because state regulators in these 12 states reduced rates and this effect outweighs the impact of municipal regulation in the remaining 13 states. Alternatively, the coefficients could be negative because the 13 states that passed legislation after 1912 had, on average, lower prices and profit rates, supporting the capture theory. However, given Jarrell's specification it is impossible to distinguish between these two effects.

Defining "regulated between 1912 and 1917" in this way also represents the wrong test. Jarrell's premise is that low profit and prices today cause regulation tomorrow. To test this he should look at whether low prices in 1912 caused regulation after 1912, not whether low prices in 1912 are correlated with regulation in 1909 to 1914, as his results indicate. It is implausible to believe that low prices in 1912 would cause regulation in 1909.

A final reason cautiously interpret these results is that he only finds this effect in his "1912 to 1917" variable, finding no statistically significant effect for his "1917 to 1922" variable.[5] This variable might be insignificant because of the two competing effects described above. It may be that the states that were regulated during 1914 and 1917 had low rates in 1917 because regulators forced firms to lower their rates, and states that became regulated between 1918 and 1919 had high rates, leading to the regulatory activity. Again, we cannot determine the true cause from the tests undertaken. With these qualifications in mind, some may conclude that the issue of why the adoption of state regulation took place is still open for debate.

[5]Jarrell does not report the coefficient for the "1917 to 1922" variable (should be read as passing legislation between 1914 and 1919) when specifying profit as the dependent variable.

5 The Evidence, Can we Decide?

5.1 Modelling the Decision to Regulate

As noted in section 2, past researchers have taken advantage of the rich data the Census Bureau collected during this time period. However, as argued, their conclusion that regulation was the result of industry pressure, is not fully justified. In this section, I directly model the decision to move from municipal regulation to state regulation using duration analysis techniques that were unavailable to the previous authors. By doing so I can focus on the issues at hand, namely: why did state regulation come into existence? Was it due to low price/low profits, as Jarrell has argued, or high prices/high profits, in an attempt to benefit consumers?

The most natural way to test this is by estimating the decision to regulate, and the variables that lead to this regulation. Again, however, we must be careful. If we simply were to look at the probability that a firm was regulated as a function of current variables, our coefficients would again be biased. For example, suppose we model the probability that a state is regulated at time t as follows:

$$\Pr(Regulated_t) = f(X_t, Y_t, Z_t) \tag{1}$$

where X is a vector representing firm behavior, Y a vector representing market conditions, and Z a vector representing state characteristics at time t.

Such a specification would lead to biased results. For example, suppose that Jarrell is correct in that states became regulated as a result of low prices and low profits. In this case we would expect to find that lower prices and profits led to a higher likelihood of regulation. However, regulatory activity increases both price and profits since, under our assumptions, firms capture the state politicians and, in turn, regulators increase price and profits. Therefore, this causes states with regulation at time t to have higher prices at time t, a positive relationship, even though regulation was passed as a result of lower prices and profits.

To get around this problem, I model the *decision to regulate*, rather than the *probability a state is already regulated*. That is, I model the likelihood that a state becomes regulated at time $t+1$ as a function of variables at time t. Specifically:

$$\Pr(Pass\,Regulation_{t+1}) = f(X_t, Y_t, Z_t) \tag{2}$$

Modelling regulation in this way solves the endogeneity problem, since regulation at time period $t+1$ cannot have an impact on the price at time period t.[6] Once estimated, the signs of the coefficients signs associated with the above variables will aide us in determining why state regulation was passed.

[6] It could be argued that the firms worried about regulation in time period t+1 and thus reduced their price in time period t. However there are two reasons why this effect would be small or non-existent. First, there would seem to be a credibility issue with simply threatening regulation. If merely threatening regulation reduced rates and profit levels, then all states would have an incentive to threaten regulation, and the threat would thereby be incredible. Secondly, because this is a time period where many firms coexisted, it could therefore be argued that each firm believed its impact on average price and average profit was negligible and would choose not to reduce its price given a threat of regulation.

5.2 Empirical Framework

To model the decision of a state to adopt state regulation, I estimate a two-state semi-Markov duration model that allows for right censoring. The semi-Markov model, as opposed to the Markov model, weakens the assumption that the probability a state adopts state regulation is time invariant.[7] Weakening this assumption allows the impact of the exogenous variables to change over time, and better controls for any unmodelled state characteristics such as a state's aversion to increases in regulation that may exist.

Let $\gamma^i_{k,j}(t, x\beta)$ be the probability that state i moves to regime j at time $t+1$ given that the state was in regime k at time t, which is a function of the industry characteristics x and their associated parameters β. In our context (dropping the $x\beta$), $k, j \in \{$state regulated, municipally regulated$\}$. Therefore:

$$\gamma^i_{U,R}(t) = \Pr\left(\text{state } i \text{ is state regulated at time } t+1 \,|\text{municipally regulated at time } t\right) \tag{3}$$

The probability that a state was under municipal regulation for the interval $(0, T)$ and then became state regulated during the period of $(T, T+t)$ can be expressed as:

$$P = \left\{ \prod_{l=0}^{T-1} \left[1 - \gamma^i_{U,R}\left(\frac{lt}{z}\right)\frac{t}{z} \right] \right\} \gamma^i_{U,R}(T)\frac{t}{z} \tag{4}$$

where $z = t/\Delta t$. The term in curly brackets is the probability that municipal regulation was the regulatory structure in the state from time 0 to time $T-1$. The second term denotes the probability that the state passed state regulation at time T. For sufficiently small $1 - \gamma^i_{U,R}$ the above is well approximated by:

$$P \approx \left\{ \exp\left[-\int_0^{T-1} \gamma^i_{U,R}(z)dz \right] \right\} \gamma^i_{U,R}(T)\frac{t}{z} \tag{5}$$

Since the expression t/z is independent of time t, the likelihood function for an individual state j is equation 5 dropping t/z . Letting the density function for state j be:

$$f^i(t_i) = \left\{ \exp\left[-\int_0^{t_i} \gamma^i_{U,R}(z)dz \right] \right\} \gamma^i_{U,R}(t_i) \tag{6}$$

The likelihood function for all states that underwent a regime change in the sample period is the product of equation 6 over states, where t_i represents the year state i passed state regulation.

Some states, however, remained municipality regulated throughout the sample time period. In the literature such states are referred to as right censored. Letting the distribution function for state i be:

$$F^i(T) = 1 - \left\{ \exp\left[-\int_0^{T} \gamma^i_{U,R}(z)dz \right] \right\} \tag{7}$$

where T is the terminal year of the sample, the likelihood function for right censored states is given by $1 - F^i(T)$. Denoting the states that adopted state regulation before 1921 (the terminal date for this study

[7] See Amemiya (1985) for a lengthy discussion on Markov and semi-Markov models.

due to limitations on data) by $1, ..., n$, and those who did not by $n+1, ..., N$, the combined likelihood function is represented by:

$$\mathcal{L} = \prod_{i=1}^{n} f^i(t_i) \prod_{i=n+1}^{N} \left[1 - F^i(T)\right] \tag{8}$$

Although the general form of the likelihood function is well described by theory, theory does not predict a particular functional form for $\gamma^i_{U,R}(t)$. Many specifications have been used in the literature.[8] With a limited number of observations (93) and 11 dependent variables, degrees of freedom quickly become an issue when elaborate specifications are employed.[9] To estimate the model, I adopt two functional forms. The first allows for both the intercept and the impact of the covariates to change monotonically in each year, the second allows for the intercept to change nonmonotonically. Model one is as follows:

$$\int_0^t \gamma^i_{U,R}(t, x\beta) = \alpha_1 t + \alpha_2 t^2 + \beta x_{it} t + \varepsilon_{it} \tag{9}$$

where ε_i is a mean zero logistic distributed error term.

Model two specifies $\gamma^i_{U,R}(t)$ as follows:

$$\int_0^t \gamma^i_{U,R}(t, x\beta) = \alpha_1 1912 + \alpha_2 1917 + \beta x_{it} + \varepsilon_{it} \tag{10}$$

where 1912 and 1917 are an indicator variables for the years 1912 and 1917 respectively, and ε_i is a mean zero logistic distributed error term. The inclusion of year dependent dummy variables, the intercept is allowed to differ by year.

Model two has a natural interpretation if we view the decision to adopt state regulation as a latent variable. In particular let $y^*_i = \beta x_i + \varepsilon_i$ be the utility gained from adopting state regulation for state i. Then state i will undergo a regime change if:

$$\begin{aligned} y^*_{it} &= \alpha_1 1912 + \alpha_2 1917 + \beta x_{it} + \varepsilon_{it} > 0 \\ &\Rightarrow \quad -\varepsilon_{it} < \alpha_1 1912 + \alpha_2 1917 + \beta x_{it} \end{aligned}$$

In practice, we observe only if $y^*_{it} < 0$, implying a continuation of municipal regulation, or $y^*_{it} > 0$ implying a regime shift. By including year dummies, we can view the threshold level for whether a state shifts regimes as changing over time. For example, if the estimate of $\alpha_1$is negative, this implies that states were less likely, *ceteris paribus*, to adopt state regulation in 1912.

5.3 Discussion of Variables

5.3.1 Dependent Variable

The dependent variable used in this analysis is whether or not state regulation was passed within a four year window. For example for 1907 data, the independent variable is whether or not a state passed legislation

[8] See Kiefer (1988) for a discussion of duration models.

[9] Because no state ever reverted back to municipal regulation, once a state passed such legislation they are dropped out of the sample, thus the low sample size. This is the standard practice in duration studies, such as those on unemployment. Once an individual becomes employed, he or she is no longer part of the likelihood function.

during the years 1908 to 1912.[10]

5.3.2 Independent Variables

Profit Rate: The *profit rate* is the average accounting rate of profit in a given state over all firms. Under the public interest theory of regulation, we would expect to see high profit rates leading to regulation, as politicians act to curb the market power of firms by reducing price and increasing output. On the other hand, the capture theory would predict the opposite. Firms in states with low profit rates would have a greater incentive to lobby for regulation to increase future profit margins.

Price: The *price* is the average revenue per KWh for the state over all firms. As with the *profit rate*, higher prices should lead to regulation if regulation is passed in the interest of the public, while the opposite would be true if firms are capturing the states.

Capacity Level: The *capacity level* is the amount of dynamo generation capacity in each state. Both theories of regulation would predict a positive coefficient on this variable. Higher capacity levels, *ceteris paribus*, represents inefficiency, and thus would lead to regulation under the public interest theory. In addition, under the capture theory, higher capacity levels may also represent greater competition, and thus reason for firms to seek regulation. Therefore, both theories would predict a positive influence of this variable on the likelihood a state becomes regulated.

Number of Plants: The *number of plants* is the number of central power stations in a given state. As with the capacity level both theories would predict a positive coefficient on this variable. the greater the number of plants, the greater the inefficiency. In addition, the more plants in a state, the larger the incentive for firms to lobby for regulation, since this variable may be a proxy for competitive activity.

Percentage of Population Served: This variable is the percentage of the population in a given state that had home access to electricity. Under the public interest theory, higher penetration rates may represent a lower need for regulation as this signals that firm behavior is more aligned with the social goals.

Municipal Output: This variable is the percentage of output in a given year attributed to municipally owned companies. If we assume that municipally owned firms act more in the interest of consumers than do private firms, then for higher levels of municipal output there is less need to discipline the actions of firms in the state, and thus a lower incentive to pass state regulation.

Hydroelectric Output: This is the amount of hydro capacity per population in the state. This variable controls for cost differences due to the availability of inexpensive hydroelectric generation.

Total Output: Total output is the total electricity consumed per person in a given state. Under the public interest theory, higher output levels curb the need for regulation since firm production is closer to the socially optimal output level. Alternatively, because profit maximization leads to a reduction in output, higher output levels represent lost profits, thus creating an incentive for firms to capture state politicians by supporting state regulation.

Table 3 lists the expected signs of the variables in the two competing hypotheses.

[10] Admittedly four years is a bit arbitrary, but it is likely that legislation takes some time to be initiated, passed, and then implemented. The analysis was also performed for three year intervals, and the results are qualitatively similar.

Table 2: Expected Signs Under Alternative Explanations

	Capture Theory	Public Interest Theory
Variable	E(Sign)	E(Sign)
Profit Rate	–	+
Price	–	+
Capacity	+	+
Number of Plants	+	+
% of Population Served	?	–
% of Output by Municipality-owned firms	+	–
Hydro Capacity	?	?
Output	+	–

Table 3: Summary Statistics

Variable	**Mean**	**Min**	**Max**	**Std Dev**
Became Regulated	.2688	0	1	—
Price ($/Kwh)	3.469	.48	9.01	1.602
Profit Rate	.2366	–.0478	.4417	.0856
Capacity (Kw)	68685	3208	478933	91347
Number of Plants	101.8	7	383	82.41
Output per person(1000s Kw)	150445	4614	1150900	220791
Percent Served	48.39	13.75	99.1	22.40
% of Output by Municipality-owned firms	.1109	0	.6295	.1215
% of Capacity due to Hydro Capacity	25313	0	211533	39459
Population (1000s)	1823	103	8293	1568

5.4 The Data

To estimate the decision to regulate, data was collected from all unregulated states during the years of 1907, 1912, and 1917. The price was collected from the appendix of Stigler and Friedlander (1962). All remaining variables were collected from the Census Bureaus' Central Electric Light and Power Stations. Table 3 lists the summary statistics for these variables.

5.5 Results

I first estimate the two parametric duration models described above. Namely:

$$\int_o^t \gamma^i_{U,R}(t, x\beta) = \alpha_1 t + \alpha_2 t^2 + \beta x_{it} t + \varepsilon_{it} \tag{11}$$

where ε_i is a mean zero logistic distributed error term. Model two specifies $\gamma^i_{U,R}(t)$ as follows:

Table 4: Duration Model Estimates of the Decision to Regulate

	Model 1		Model 2	
Variable	**Coefficient**	**p-value**	**Coefficient**	**p-value**
Intercept	–.7040	.0962	–.4150	.0897
	(.4232)		(.2432)	
T	.0858	.9277	—	—
	(.9213)			
T^2	–.2475	.0856	—	—
	(.1440)			
D1912	—	—	.4750	.0002
			(.1291)	
D1917	—	—	.6200	.0042
			(.2166)	
Profit Rate	.1792	.4562	.1744	.2774
	(.2428)		(.1428)	
Price	–.0568	.4878	–.1749	.1908
	(.0818)		(.1337)	
Capacity	.0779	.4807	.1012	.5481
	(.1105)		(.1685)	
Output	.0106	.9051	–.0059	.9660
	(.0893)		(.1380)	
% Population Served	–.1017	.2697	.0199	.9052
	(.0921)		(.1674)	
% Output by Munis	–.0247	.2671	–.0247	.2671
	(.0222)		(.0222)	
Log Hydro Capacity	–.0142	.0941	–.0222	.1059
	(.0085)		(.0138)	
$-2\log(\mathcal{L})$	83.45		83.26	
– N –	93		93	

$$\int_o^t \gamma^i_{U,R}(t, x\beta) = \alpha_1 1912 + \alpha_2 1917 + \beta x_{it} + \varepsilon_{it} \tag{12}$$

The maximum likelihood estimation results for the base case are presented in Table 4. The results do not bode well for either theory. The results provide weak evidence that states with higher levels of profit are more likely to adopt state regulation. Thus, providing weak evidence in favor of the public interest theory. However, this coefficient is not statistically significant at conventional levels. The coefficient estimates on the price level suggest that states with lower prices are more likely to adopt state regulation, evidence in favor of the capture theory.

The results are suggestive that higher levels of capacity are correlated with the passing of state regulation, consistent with both theories. The level of output does not appear to have any measurable impact on the likelihood of a regime change. Higher levels of municipal production seems to reduce the chances of state

regulation being adopted, consistent with the public interest theory. In addition, higher levels of hydro production reduces the probability of adopting state regulation.

Unfortunately, the insignificance of the coefficient estimates can arise as a result of a variety of causes, and do not *necessarily* imply that both theories are incorrect. For example, if the modelled functional form is not the true data generating process, then the estimated coefficients will be noisy, causing them to be statistically insignificant.[11] However, it is also possible that after controlling for the bias present in previous studies, the conclusions of previous studies no longer follow. Therefore, at the very least, these results cast doubt on the conventional wisdom, and suggest the need for further research in this topic.

6 Anecdotal Evidence from Individual States

Although the empirics provide little direction in determining the cause of the regime shift in the electricity industry during the beginning of this century, anecdotal evidence from a number of states may provide some direction. Casual observation of the state of Illinois suggests that state politicians were interested in the cost savings of regulation, rather than the profit motives of industry leaders. The most vocal proponent of regulation in the industry was Samuel Insull, a leading industry figure and controller of Chicago Edison of Illinois. If states were being captured by the industry we might, therefore, expect Illinois to be one of the earliest to regulate. Yet, Illinois was one of the later states to pass such regulation.[12] In fact, Illinois passed regulatory legislation in 1913, a mere year after Insull provided data from his experiment that illustrated the high degree of with economies of scale that existed in the electricity industry at the time.[13] This suggests that Illinois was, if anything, skeptical of Insull's plea for regulation to curb competition, but rather interested in the cost savings regulation would bring, and did not act upon Insull's suggestions until they were provided with evidence that costs would be reduced.

On the other end of the time spectrum were Wisconsin and New York, the first two states to adopt regulation. Evidence from both Wisconsin and New York suggests that state regulation was adopted to curb firm behavior. At the turn of the century the Progressive political movement was in full force in Wisconsin (see e.g., Johnson 1964). Progressive political leaders took a harsh stance against corporate power, and one in support of governmental oversight of this power. One such leader was Governor Robert La Follette, who was in office during the adoption of state regulation. La Follette viewed local regulators of utilities as being corrupt, and believed state regulation would provide a more thorough supervision of the industry (Anderson 1981, pg. 54). In fact in his autobiography, La Follette boasts that the actions of the state utility commission reduced rates within three years by $375,000 (La Follette 1960).

The beginning of state regulation in New York seems to be traced back to a spat between political leaders and the industry in 1903, when state legislatures instituted a committee to investigate the rates of gas and electricity companies. The committee chose Charles Hughes, then a New York lawyer, to be their chief council. Hughes later showed that (1) Consolidated Gas Company charged the city $80,000 for electricity that would have cost a private customer only $25,000, (2) charged the city 4.86 cents per kilowatt hour

[11] A number of alternative specifications were estimated, however, the results were similar.

[12] This does not seem to be due to an aversion to regulation per se, since Illinois was one of the earliest states to regulate the railroad industry.

[13] For a discussion of his results see Kahn (1991).

for electricity that cost 2.42 cents to produce, (3) New York Gas and Electric Light Company charged an average of 8.042 cents per kilowatt hour when it only cost 3.664 to produce, and (4) Consolidated Gas had reported only 75 percent of the valuation of its taxable property in order to escape taxes (Anderson 1981, pg. 50). In 1905, Hughes made the following observations:[14]

> The gross abuse of legal privilege in overcapitalization and in the manipulation of securities for the purpose of unifying control and eliminating all possible competition shows clearly that there can be no effective remedy by general legislation or through ordinary legal proceedings, and that for the protection of the public there should be created a commission with inquisitorial authority, competent to make summary investigations of complaints, to supervise issues of securities and investment in the stocks or bonds of other companies, to regulate rates and to secure adequate inspection, or otherwise enforce the provisions of the law.

Following his investigation, Hughes was elected governor of New York in 1906, and in the following year, the state passed legislation to regulate the electricity industry.

These examples support the idea that, for at least these three states, state regulation was passed to curb the behavior of firms, rather than support their profitability.

7 Evidence from Industry Literature

In this section, I draw on trade literature written during this time period in an attempt to gather the motives of industry leaders in their support of state regulation. There is no denying that certain high profile figures in the electricity industry pushed for state regulation as early as 1898. In a 1898 speech delivered to the National Electric Light Association (NELA), Samuel Insull, controller of Chicago Edison, first advocated the establishment of state agency control over rates and service.[15] He argued that the existence of competition did not lower rates, but instead increased the riskiness of investment thereby increasing costs. Regulation, he stated, would allow the electricity industry to acquire investment capital at a lower interest rate, reducing the costs of production.

Insull was aware that the industry as a whole did not share his support for state regulation. To gain support for the notion, Insull established a committee on public policy in 1899. However, even after six years the committee could not agree on the necessity of regulation. In 1905 Edgar Davis, a committee member, stated "the one great and constant menace to the industry is unwise, burdensome and restrictive legislation... the power to regulate contains the germ of the danger of confiscation, in whole or in part" (NELA 1905, pg. 6).

The industry did seem to stand united in the fight against corrupt municipal regulation and municipal ownership. There is much evidence to suggest that local control of electric utilities was riddled with corruption. The most glaring example was a group of Chicago city council members known as the Gray Wolves who repeatedly extracted money from utility companies. The motives of the Gray Wolves are well documented.[16]

[14] As quoted in Anderson, pg. 51.

[15] The NELA was the electricity industry's trade association. Insull was president at the time of the address.

[16] See Anderson (1981).

They began their extortionary activities with the transportation sector, forcing firms to buy their votes in order to renew their franchise contracts. Insull had his first contact with the Gray Wolves when the Wolves opened their own electricity franchise in Chicago and threatened to compete at a loss against Insull if he refused to buy their franchise.[17] Other evidence suggests that municipal regulation was also corrupt in Wisconsin. McDonald (1957) argues that local politicians recognized that voters in Milwaukee responded favorably to attacks on utilities, "irrespective of whether the attacks were justified."

Evidence from NELA also suggests that the electricity industry ceded the idea of regulation, prompting some NELA members to seek state regulation as the lesser of four evils (municipal regulation, municipal ownership, state regulation, and federal regulation). In 1907, the NELA Subcommittee on Public Regulation and Control as a response to the impending state regulation in New York and Wisconsin, reached three major conclusions:

> 1. That the NELA should favor properly constituted general supervision and regulation of the electric light industry.
> 2. That if state commissions be constituted, they should be appointed in that manner which will give them the greatest freedom from local and political influences, to the end that their rulings shall be without bias.
> 3. That state commissions be clothed with ample powers to control the granting franchises, to protect users of service against unreasonable charges or improper discriminations, to enforce a uniform system of accounting, and to provide for publicity. If the state provides for publicity on the one hand, on the other hand it should safeguard investments. Regulation and publicity would be a grievous wrong unless accompanied by protection.
>
> In the conferring of these powers, great care should be taken. Regulation in and of itself necessarily introduces a factor of resistance to the adoption of new methods and to progress generally. Hence in the interest of lower costs, and consequently lower charges to users of service, the functions of the commissions should be confined within strictly regulative lines (NELA 1907).

It appears clear from conclusions two and three that the industry was fearful of the influence of local politicians and their extortionary use of franchises. Conclusion two illustrates that the industry was fearful of local influence and the political nature of local regulation, whereas three suggests that the industry supported franchise agreements to be taken out of the hands of local politicians.

Even stronger evidence that the industry viewed regulation as inevitable with or without their consent is the following statement from a report by the NELA Committee on Public Policy:

> That which is uppermost in the public mind is public supervision and control. In the judgment of your committee some form of such supervision and control is inevitable in many if not all of the states of the union... The practical question is not whether there is to be such regulation and control as it is what the nature and form of them are to be. (NELA, 1907)

[17] This was most likely the reason Insull was so intent on procuring state regulation, further evidence that it wasn't regulation per se that the industry wanted, but rather the elimination of municipalities as the regulatory agents.

This statement clearly speaks to the effect that the industry did not necessarily push for regulation, but rather pushed to have some control over what that regulation was to be.

The actions of the industry support the idea that if regulation was going to be expanded, the industry favored of state regulation rather than federal or municipal. Because state regulation relieved them of the evident local corruption, while still giving them ample opportunity to influence regulators in the future, it seemed to be the natural choice. The actions of the industry, however, do not suggest that state regulation was used as a means of increasing profits as the electricity industry captured the state politicians.

8 Conclusion

This paper revisits the issues behind the emergence of state regulation during the beginning of this century. The paper does not purport to have solved the matter, but rather offers econometric and anecdotal evidence against the commonly held belief that state regulation was passed as a means of making the industry more profitable. Although, the results cast doubt on the capture theory, they do not overwhelmingly support the rivaling public interest theory.

The paper also examines the actions of industry leaders in their attempts to push for state regulation, rather than the alternatives of the day. Analyzing trade organization proceedings, it seems clear that the industry was in no way fully supportive of state regulation. Instead, once the realization of some sort of expansion of regulation became evident, it was more in their interest to support state regulation rather than corrupt local regulation, and the more centralized federal regulation.

The mind set of the nation during this time was for the expansion of regulation, especially in industries important to the growth of the economy. Regulation of the railways began in Illinois in 1870, and soon became wide spread. The electricity industry must have presented itself as the next natural candidate for state regulation. The electricity industry may have simply ceded the idea of regulation and sought the most favorable type. State regulation gave the industry relief from the corruptive nature of municipal regulation while keeping regulation decentralized enough to provide ample opportunity for the influencing of its decisions in the future.

The results support the need for further fact gathering on this question. For one, actions of the agents involved may have to be expanded. It may indeed be that regulation was initially passed to benefit consumers, but in fact later harmed them as utilities gained influence over the regulatory agencies. As noted, state regulation provided the industry with the greatest opportunity for influencing decisions. In this "life cycle" theory of regulation, we must look not at the decision to regulate, but rather at the actions of regulators later on in the cycle. To look into this, we must look at how the actions of regulators changed over time, instead of only at the beginning of regulation as in this paper.

Another interesting topic would be to see if outside pressure for regulation existed. Electricity use was becoming more and more important in manufacturing processes. Given the stochastic nature of price in a competitive regime, the manufacturing industry may have been inclined to support electricity regulation. Regulation of the electricity industry would have provided the manufacturing industry with a greater ability to forecast production costs allowing for less risky investments. The manufacturing industry therefore had an incentive to push for regulation.

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