The Political Economy of (De)Regulation: Theory and Evidence from the U.S. Electricity Market.

Carmine Guerriero
Website: http://sites.google.com/site/carmineguerrieroshomepage/

ACLE and Department of Economics, University of Amsterdam

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The Question: Competition Versus Regulation.

Economists have long maintained that not only competition assures allocative efficiency but that it also delivers dynamic advantages (Raith, 2003; Baggs and de Bettignies, 2007): thus, regulation should be enhanced in very specific cases—i.e.:

- market failure (Stiglitz, 1989) or specific technology (Baumol and Klevorick, 1970);
- the industry designs institutions in order to extract rents (Stigler, 1971);
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Yet, deregulation seems to have delivered very modest efficiency gains and a few works have proposed the idea that regulation could be superior from a dynamic efficiency point of view (Averch and Johnson, 1962; Aghion et al., 2005; Vives, 2008).

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3. Given that the new generating capacity entered service in the last decade was built mainly for firms in non restructured markets (Joskow, 2008), my evidence provides a rational for the re-regulation wave.

An Example: Deregulation in the U.S. Electricity Market.

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Public officials' incentives:

- The details of reforms are decided during hearings which are usually initiated by the state government (EIA, 2003) and presided by commissioners, who are either elected or appointed (Gormley, 1983; Friedman, 1991).

Set Up.

The strictly decreasing demand is $q(p) > 0$ for $p \in [0, \bar{p})$, $q(p) = 0$ for $p \geq \bar{p}$; the social surplus at p is $S(p) = \int_p^{\bar{p}} q(x)\, dx$; production is assured by either one firm under regulation or two under competition. The technology is CRS and the cost c:

- equals c_L w. p. $1/2$ and c_H w. p. $1/2$; let $\Delta \equiv c_H - c_L > 0$;
- is statistically uncorrelated across firms.

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A firm maximizes the rent U which is the sum of the profits $\pi(p, c) \equiv q(p)(p - c)$ and a transfer $t \geq 0$, given only under regulation and bringing social costs $1 + \lambda$. Society attaches a weight $\alpha \in [0, 1)$ to the firm's rent and the social welfare is: $S(p) + \alpha U - (1 + \lambda) t = S(p) + \alpha\pi(p, c) - (1 + \lambda - \alpha) t$.

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Assumption A1: *The demand is such that* $q''(p)(\bar{p} - c_L) + q'(p) < 0$ *and its elasticity* $\varepsilon_{p,q} = -q'(p)\,p/q(p)$ *is strictly lower than 1.*

Timing.

$t = 1$.—Society chooses between the two market conducts on the basis of the expected welfare and a mean-zero preference shock $\delta \in [-\infty, \infty]$ (Aghion et al., 2009). Next, under regulation, a menu of (t, p) pairs are offered to the monopoly; the contract is conditional on the firm's report of c but not on the level of investment.

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$t = 4$.—Under regulation the firm executes the contract if she finds it acceptable. Under competition each firm announces a price. A firm serves all the market at the price announced by the opponent if able to undercut it and half if the bids are equal. Thus, the equilibrium is the same as under symmetric information.

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Cost Reducing Investments: Regulation Vs. Competition.

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Under assumption A1: $2q(\hat{c}_H) > q(c_H)$ and, in turn, $I^R > I^C$.

The Static Versus Dynamic Efficiency Trade Off.

For $\delta = 0$ competition prevails if: $\frac{\left(1+\hat{I}^C\right)^2}{4} S\left(c_L\right) +$
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▸ Static Efficiency.

Information and Politics.

A signal ϕ on c whose precision increases with the regulator's effort:
Proposition 2: If $\varepsilon_{p,q} < \bar{\varepsilon}_{p,q}$, the probability of adopting competition rises with the precision of the signal and, in particular, when the regulator is elected.

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Should several key assumptions be relaxed, the message of the model would stand.

▸ Robustness.

Testable Predictions.

Prediction 1: The likelihood of a reform toward more competition will fall:

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2. with society's concerns for cost-reducing investments;
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Prediction 2: Expected production costs could be either greater or lower under competition.

Why? Because competition will assure a lower expected average cost whenever:

$$\left[2\frac{1-\left(\hat{I}^C\right)^2}{4}+\frac{\left(1+\hat{I}^C\right)^2}{4}\right]c_L+\frac{\left(1-\hat{I}^C\right)^2}{4}c_H<\frac{1+\hat{I}^R}{2}c_L+\frac{1-\hat{I}^R}{2}c_H$$

$$\leftrightarrow \frac{1-2\left(\hat{I}^R-\hat{I}^C\right)-\left(\hat{I}^C\right)^2}{4}\left(c_L-c_H\right)<0$$

Dataset and Dependent Variables.

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Data-set.—All the large fossil-fuel steam and combined cycle gas turbine generating plants for which data were reported to the FERC between 1981 and 1999 and enough observations on the quality of information gathering and political competition are available: 8,059 observations on 503 plant-epochs—i.e. years when the plant capacity was "stable"—in 43 states (Fabrizio, Rose and Wolfram, 2007).

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Institutions.—*Deregulation* equals one for states—or plants in states—that restructured beginning in the year of the first hearing and zero otherwise.

Table 1: Deregulation — Logit.

	The dependent variable is the likelihood of: *Deregulation*			
Elec_Reg	- 0.001	0.011	0.009	0.008
	(0.017)	(0.026)	(0.024)	(0.023)
Mc_Fuel(-3)	- 0.082			
	(0.013)***			
Heat_Rate(-3)		- 0.013		
		(0.004)***		
Ratio_Mfc(-3)			- 0.105	
			(0.034)***	
Ratio_Hr(-3)				- 0.130
				(0.031)***
Republican	0.018	0.030	0.027	0.024
	(0.020)	(0.028)	(0.027)	(0.025)
Majority	- 0.038	- 0.065	- 0.069	- 0.066
	(0.027)	(0.037)*	(0.035)**	(0.033)**
Der_Nei	0.256	0.401	0.392	0.372
	(0.047)***	(0.052)***	(0.051)***	(0.053)***
Pseudo R^2	0.48	0.46	0.46	0.47
Log Pseudo-Likelihood	- 159.60	- 165.56	- 165.58	- 163.42
Number of Observations	688	688	688	688

Notes: 1. Robust standard errors—z distribution—in parentheses;
2. The entries are marginal effects and *** denotes significant at the 1% confidence level; **, 5%; *, 10%.

▶ Further Details.

Methodology.

Examine whether deregulation pushes the firm to use a better mix of inputs given prices, estimating by OLS and GMM the equations (Fabrizio, Rose and Wolfram, 2007):

$$\ln\left(N_{p,t}\right) = \beta_1^N \ln\left(Q_{p,t}^N\right) + \beta_2^N \ln\left(P_{p,t}^N\right) + \mathbf{j}'\mathbf{x}_{p,t}^N + \gamma_{p,t}^N + \alpha_p^N + \delta_t^N + \varepsilon_{p,t}^N$$

$N_{p,t}$: *Ln_Emp*, *Ln_Btu* or *Ln_Hr*;
$Q_{p,t}^N$: annual net MWh generation for plant p in year t;
$P_{p,t}^N$: price of the $N_{p,t}$ if the latter is an input—i.e., the BLS annual wage bill in dollars divided by total employment for *Ln_Emp* and none for *Ln_Btu*;
$\mathbf{x}_{p,t}^N$ gathers the determinants of deregulation which cannot be excluded by the input use equation and a dummy for the presence of a FGD scrubber;
$\gamma_{p,t}^N$ is the dummy *Deregulation*; α_p^N are plant fixed effects; δ_t^N are time effects.

Table 2: Input Use — OLS Versus Difference GMM.

	The dependent variable is:					
	Ln_Emp	*Ln_Emp*	*Ln_Btu*	*Ln_Btu*	*Ln_Hr*	*Ln_Hr*
Deregulation	- 0.069 (0.010)***	- 0.127 (0.032)***	- 0.021 (0.007)***	- 0.153 (0.081)*	0.005 (0.008)	- 0.122 (0.080)
Estimation	OLS	GMM	OLS	GMM	OLS	GMM
Instr. count		25		24		23
Hansen test		0.51		0.34		0.25
Test for AR(3) in first differences		0.36		0.10		0.25
Number of observations	8059	7429	8059	7429	8059	7429

Notes: 1. All specifications consider also *Elec_Reg*, *Republican*, *Majority*, *Ln_Mwhs* and *Scrubber* and fixed plant and time effects; those in columns (1) to (3) include also *Wage*;
2. Robust standard errors in parentheses; Windmeijer correction in col. (2), (3), (5), (6);
2. In the GMM model the endogenous variable is *Deregulation* and the excluded instruments are *Mc_Fuel*(-3) (*Ratio_Mfc*(-3)) and *Der_Nei* in columns 2 and 4 (3 and 6).

Standing on the Shoulders of the Giants.

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Avenues for further research:

- What about service quality (see Ajodhia and Hakvoort, [2005])?
- Endogenous deregulation in pharmaceutical and commercial banking markets.

Institutional Choice With No Investments.

Competition is chosen when $W^C > W^R + \delta$ that, for $\delta = 0$, rewrites as:
$\frac{1}{2}\left[\frac{S(c_L)+S(c_H)}{2} - \frac{S(c_L)+S(\hat{c}_H)}{2}\right] > \frac{1}{2}\left\{\frac{S(c_L)+S(\hat{c}_H)}{2} - [S(c_H) + \alpha\Delta q(c_H)]\right\} \leftrightarrow$
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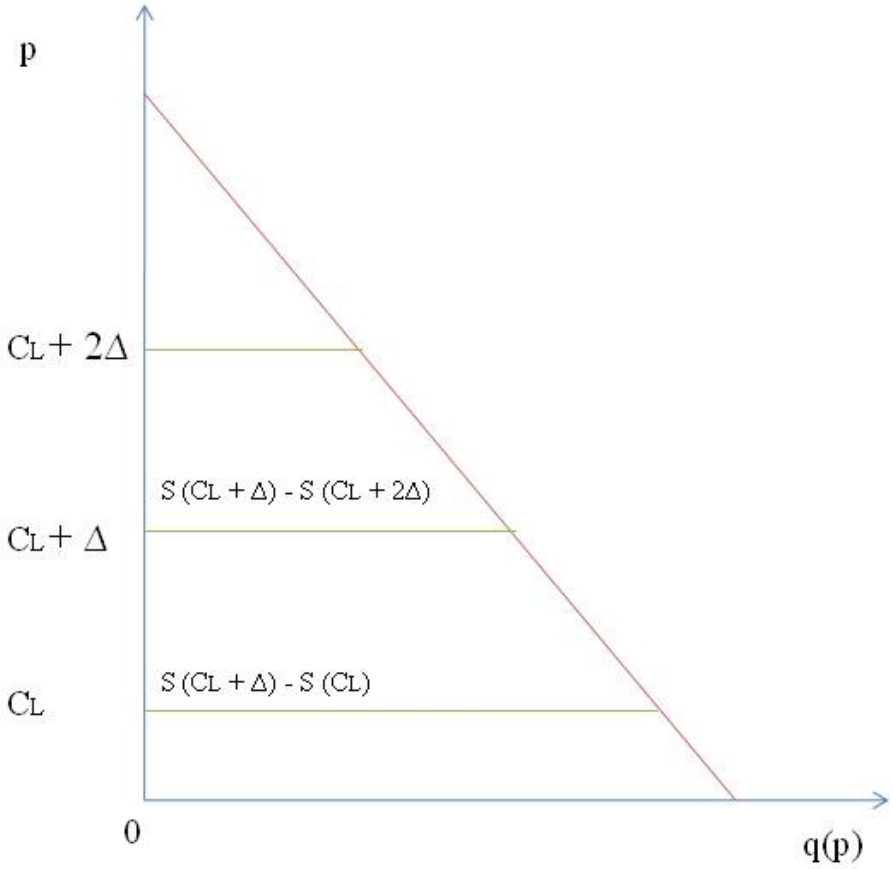
$2[S(c_H) - S(\hat{c}_H)] + 2\alpha\Delta q(c_H) > [S(c_L) - S(c_H)].$

Lemma 1: For $\delta = 0$, competition always outperforms regulation when $2[S(c_L + \Delta) - S(c_L + 2\Delta)] > S(c_L) - S(c_L + \Delta)$. Also, the probability of adopting competition rises with society's investment concerns α.

Inelastic Demand.



The Information Gathering Technology.

In $t = 2$ the Constitutional table directly offers the firm (t, p) pairs conditional also on a signal on c observed by the regulator between $t = 3$ and $t = 4$. If $c = c_L$ w. p. $\phi \in [0, 1]$ the Constitutional table sees c_L and w. p. $1 - \phi$ she remains uninformed. If $c = c_H$, she always remains uninformed. This time:

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$W^{R,S} = \frac{1+\hat{I}^{R,S}}{2} S(c_L) + \frac{1-\hat{I}^{R,S}}{2} S(\hat{c}_H^S)$
where $\hat{c}_H^S \equiv c_H + \left(1 + \hat{I}^{R,S}\right)\left(1 - \hat{I}^{R,S}\right)^{-1}(1-\phi)(1-\alpha)\Delta$. The monopoly invests $\hat{I}^{R,S} = \arg\max_{I \geq 0} (1/2)(1+I)(1-\phi)\Delta q\left(\hat{c}_H^S\left(\hat{I}^{R,S}\right)\right) - \psi(I)$.

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$\phi_s = \theta e_s$ where $\theta \in [0, 1]$ is the random ability, $e_s \in [0, 1]$ is the effort, and $s = \{A, E\}$ indexes implicit incentives. θ has mean $\bar{\theta}$ and is drawn from a density g.

Regulator's Implicit and Firm's Explicit Incentives.

The regulator maximizes: $P + \tau \left[B\left(e_s\right) - C\left(e_s\right) \right]$ where $C' > 0$, $C'' > 0$, $B^E\left(e_E\right) = \Pr\left\{ e_E \geq \bar{\theta} e^{\exp} \right\}$, $B^A\left(e_A\right) = \mathrm{E}_\theta \left[E_\theta \left(\theta \left| \phi_A, {e_A}^{\exp} \right. \right) \right]$.

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If $g\left(\bar{\theta}\right) > 1$, elected regulators exert more effort than appointed ones do.

Strategic Deregulation.

The reformer is an incumbent party $\tilde{m}$: either the pro-shareholder *Re* or the pro-consumer *De*. After period 4, $\tilde{m}$ faces an election with exogenous winning probabilities $x_{\tilde{m}}$ and the winner m implements an aid $\rho_m > 0$ proportional to the firm's rent and paid out to the firm if it invests. Next, the firm decise whether spend $\bar{I} > 0$ given the expected return $\pi\bar{I}$ with $\pi \equiv \bar{\pi}\delta + \underline{\pi}(1-\delta) > 0$ and $\bar{\pi} > 0 > \underline{\pi}$.

Thus, only c_L invests if $(1+\rho_m)\hat{U}^j + \underline{\pi}\bar{I} \geq 0$.

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Robustness: Competition.

A generic number of Bertrand competitors under symmetric information.—As the number of competitors N rises, the firm's incentive to invest will fall. Regulation will have an even higher dynamic advantag and the model's message continues to stand.

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Cournout Competition.—With symmetric information on c, free entry at $\kappa \geq 0$ and downward sloping best replies or $P' + P''q\left(c, i, N-i\right)$, where $q\left(c, i, N-i\right)$ is the choice of a c firm when, among the N entrants, i have type c_L and $N-i$ a type c_H:

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- if the elasticity of the demand is not too low, a price respecting the usual Cournout conditions and strictly greater than the mean marginal cost exists;
- for a sufficiently low entry cost and sufficiently efficient investment technology, the firm's incentive to invest are lower under competition.

Robustness: Regulation.

A positive shadow cost of public funds.—The equilibrium Ramsey pricing rule is implicitly defined by $p + \lambda (1 + \lambda)^{-1} q(p) [q'(p)]^{-1} = c$ so that $\partial p / \partial c > 0$:

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- the level of investment continues to be higher under regulation;
- the effect of a change in α and γ on the welfare under regulation is multiplied by $\partial p / \partial c$; provided that a condition similar to A2 holds and the elasticity of the demand is sufficiently low, the model conveys the same message.

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Regulatory commitment.—When an ex post participation constraint is imposed:

- the level of investment under regulation, when contractible, would still be inefficient but higher than the one under competition. The rule giving p as a function of c would be unaffected;
- when investments are not contractible, $\hat{c}_H$ would be distorted even more in order to take into account the moral hazard in investment constraint. Regulation retains its dynamic advantage and, under a condition similar to A2 and with sufficiently inelastic demand, the model's message survives.

Return 3

Choice of Proxies and Methodology.

Proxies:
Society's investment concerns.—Average marginal fuel cost in cents of dollar per Kwh—*MC_Fuel*—and average heat rate in BTUs necessary to produce 1 MWh—*Heat_Rate*. Ratio of the average marginal fuel cost (heat rate) in a state over those of bordering states—*Ratio_Mfc* (*Ratio_Hr*).
Political competition.—Share of seats held by the majority party averaged across both houses *Majority* and dummy equal to one if both houses were *Republican*.
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Methodology:
Logit with dependent *Deregulation*. Look at the marginal effects—the percentage variation in the likelihood of deregulation when the control rises by 1% holding other controls constant. Remark: Similar results when the dependent is *Law* or switching to the ordered logit with dependent *Der_Ord*, which equals three for states that restructured beginning in the year that legislation was enacted, two for states that restructured beginning in the year of the first formal hearing, one otherwise.

Return 4