

Electricity restructuring and plant production costs: evidence from the United States

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Electricity restructuring

- In the mid 1990s, most electricity customers in the U.S. were served by investor-owned, vertically integrated utilities under cost-of-service regulation
- Between 1995 and 2002 most states considered major regulatory reforms aimed at introducing competition in the production and sale of electricity and incentive regulation in distribution
- Restructuring was intended to improve efficiency, enhance coordination of grid operations and lower consumer costs as a result of more competition in the production of electricity

Literature

- Many studies have examined the impact of restructuring on plant performance and operations (Bushnell and Wolfram, 2005; Chan et al., 2017; Cicala, 2015; Craig and Savage, 2013; Davis and Wolfram, 2012; Fabrizio et al., 2007; Goto and Tsutsui, 2008; Kleit and Terrell, 2001; Knittel, 2002; Zhang, 2007)
- Bushnell et al. (2008), Hortaçsu and Puller (2008), Joskow (2006) and Mansur and White (2012) consider efficiency improvements from better coordination of operations and lowering of transaction costs within ISOs/RTOs
- A more recent strand of the literature focuses on the effects of restructuring on retail prices (Borenstein and Bushnell, 2015; Hortaçsu et al., 2015; Joskow, 2006; Kwoka, 2008)

Contribution

- 1 We construct a 17 year (1995-2011) panel data set including many years of post restructuring observations
- 2 Using a difference-in-differences approach, we examine the impact of restructuring on production costs reported by investor-owned fossil fuel power plants

Data

- Our primary data source is FERC (Federal Energy Regulatory Commission) Form 1
 - ▶ Plant characteristics (technology type, construction year, installed capacity, average number of employees)
 - ▶ Plant operations (net generation, net peak demand on plant)
 - ▶ Variable costs (including fuel, labour and material costs)
 - ▶ Costs are in 2010 dollars
- Dates of restructuring are from the EIA (US Energy Information Administration) and earlier studies (Fabrizio et al., 2007; Craig and Savage, 2013; Chan et al., 2017)

Definition of restructuring

- Restructuring: Access to wholesale electricity markets
 - ▶ Treatment is equal to 1 from the year in which utilities in the state were allowed to trade in a wholesale electricity market

Identification strategy

- We rely on variations in timing of restructuring across states
- We use a difference-in-differences approach
- Restructuring is our binary treatment
- Production costs at the plant level represent our outcome variable
- Treated plants are located in states that have pursued restructuring
- Control plants are located in states that have not pursued restructuring

Identification assumptions

1 Parallel trends

- ▶ Violation means that we cannot attribute the effect on production costs solely to restructuring

2 Exogeneity of treatment

- ▶ May be violated if plants select into treatment based on unobservable characteristics or if restructuring activity is affected by production costs

Empirical specification

$$\log(\text{Production costs}_{it}) = \beta_0 + \beta_1 \text{Restructuring}_{st} + X\gamma + \mu_j + \delta_t + \varepsilon_{it}$$

- $\text{Restructuring}_{st} = 1$ from the year, t , in which utilities in the state, s , were allowed to trade in a wholesale electricity market (= 0, otherwise)
- β_1 is our coefficient of interest
- X includes covariates affecting production costs of electricity generation
 - ▶ Net generation, load factor, capacity factor, fuel price
- μ_j captures within-plant unobserved heterogeneity
- δ_t captures annual shocks common to all plants that may affect production costs
- ε_{it} is an i.i.d. error term

Preliminary results and conclusion

Table: Results for (log) production costs

	(1)	(2)
Restructuring	-0.076* (0.028)	-0.094* (0.026)
Plant fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
Observations	11,083	11,084
Adjusted R^2	0.940	0.944

Clustered, by plant, standard errors in parentheses.

*: Significant at the 5% level.

(1): Cobb-Douglas production function

(2): Translog production function

- Results indicate that restructuring lead to reductions in variable costs of around 8 – 9%
- Future work will refine model specification (through inclusion of additional covariates, e.g. input prices) and consider difference-in-differences estimation with matched plants

Questions?

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