Do Markets Reduce Costs? Assessing the Impact of Regulatory Restructuring on Generation Efficiency

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Electricity markets in historical perspective

- **Early industry evolution/economics led to monopoly concerns**
  - Government ownership/regulation intended to limit firms’ exercise of pricing power
- **“Traditional” cost-of-service regulation of investor-owned utilities (IOUs) dominated in US**
  - Works well to keep average prices close to average costs over time: Low “rents”
    - Prices may be too high or too low compared to economic cost
    - Distorts consumption decisions
  - But provides few incentives to keep costs low
    - Higher costs generally flowed through to ratepayers
    - Insulation from competition reduces feedback and cost pressure
  - And distorts investment incentives

Trade off: Imperfect markets v. imperfect regulation

Restructuring has replaced traditional cost-of-service regulation with increased reliance on competition in many jurisdictions (globally)

- **Does restructuring improve efficiency?** This is the "billion dollar" question

- Theory: Changes in incentives change behavior

- Empirical evidence: What has happened?

Focus on electricity generation

How does restructuring change generation?

- US: 1,000+ interconnected generating plants built and operated mainly by investor-owned utilities (IOUs)
- What changes in restructured regimes?
  - **New information (price signals)**
  - **New incentives for operation** by existing owners (anticipatory, short- to medium-run)
  - **Divestitures/new owners** of existing plants (short- to medium-run)
  - **Investment in new plants** (long-run)
  - [And substantially larger potential gains if we expose a significant fraction of customers to real time prices]

What might change: plant level

- **Technical efficiency**
  - e.g. improve heatrates
- **Input mix**
  - e.g. change labor/technology/fuel mix
- **Cost of inputs**
  - e.g. changes in fuel procurement practices, employment
- **Re-balance expense of preventive maintenance v. cost of forced outages**

What might change: dispatch level

- Mix of plants included in the dispatch may improve due to expanded coordination areas (+)
  - Market prices signal trade opportunities
  - Regional trading organizations may improve inter-regional trade and congestion management
- Mix of plants included in the dispatch may worsen due to dispatch on price (bids) not costs(-)
  - If some firms withhold capacity from the market to exercise market power, it will be replaced by power from plants that otherwise would have been too expensive to run.
- Mix of plants brought online improves (+)

Empirical assessment: Measuring the effects of restructuring

- We can't simply compare prices, costs or efficiency measures across restructured v. traditional regulatory environments
  - Restructured states tended to have higher electricity prices before restructuring
  - Plant mix is different in states that have restructured
  - Input shocks, especially fuel prices, change costs over time even without restructuring

- We need a counterfactual: What would have happened *without* restructuring?

Empirical assessment: The importance of the counterfactual

- To measure empirical effects of restructuring, consider a set of efficiency measures, *X*
  - *X* $\in$ {investment, fuel use, staffing levels, etc.}
- Some candidate counterfactuals:
  - *X* before restructuring
  - *X* in other parts of the world.
  - *X* in states/utilities that aren't restructuring (as quickly?)

Restructuring Effect:

difference: $X_{2000} - X_{1990}$

"difference in differences"

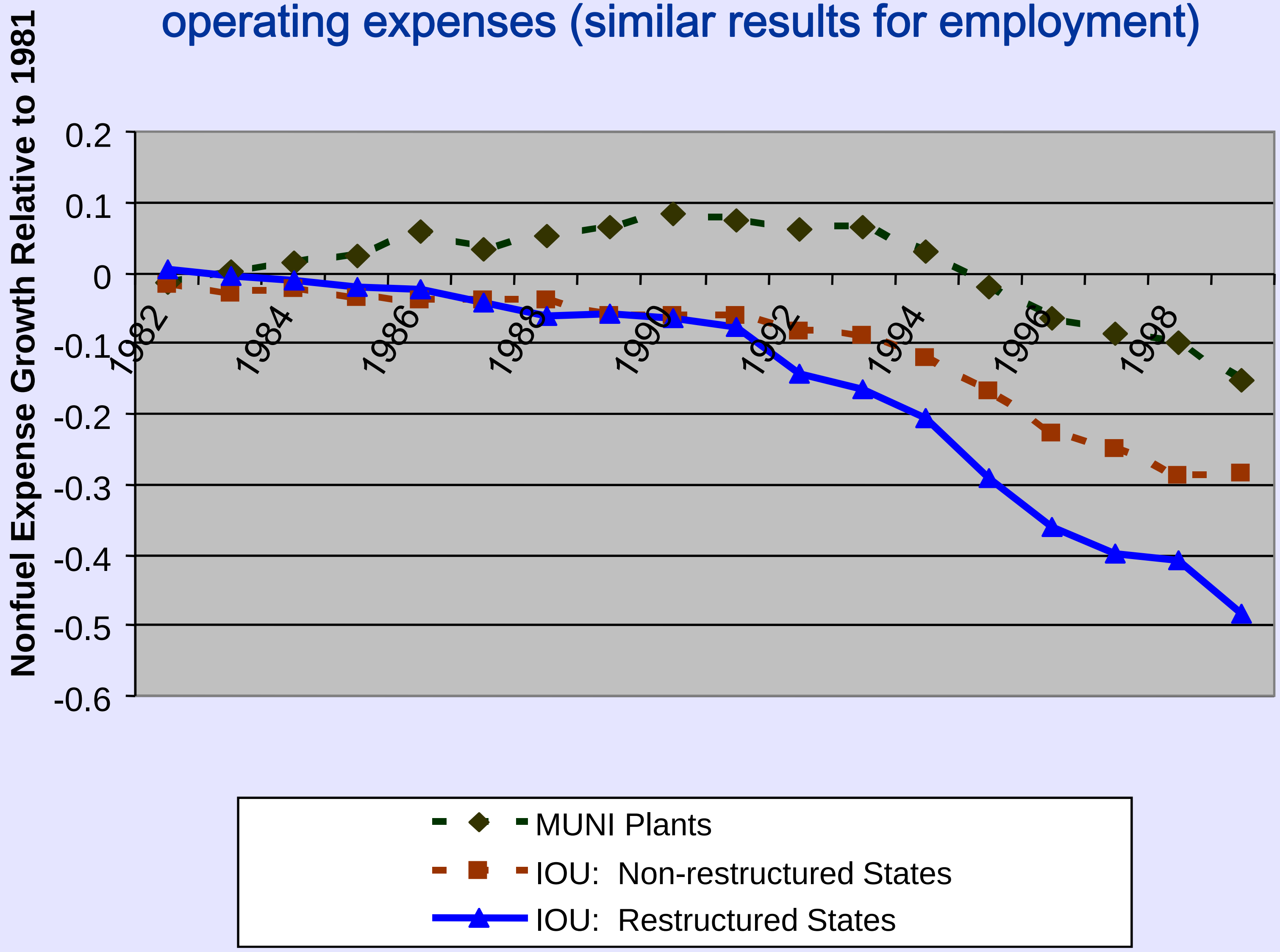
$(X_{2000, CA} - X_{1990,CA})$ -

$(X_{2000,KY} - X_{1990,KY})$

Restructuring effects on operating efficiency

- Fabrizio, Rose and Wolfram (AER, 2007): Operation of existing fossil plants/existing owners (IOUs)
  - Difference-in-difference analysis
  - Significant improvement in input use at large fossil IOU plants in restructuring states over 1980-1999 relative to two “control groups”
    - Similar IOU plants in non-restructuring states
    - Cooperatively- and publicly-owned plants
- Restructuring improved nuclear plant capacity factors Zhang (JIE, 2007)

Plants operated by IOUs in restructuring states experienced the greatest improvement in nonfuel operating expenses (similar results for employment)



Capacity factors increased for nuclear plants facing restructuring activity (Zhang, 2007)

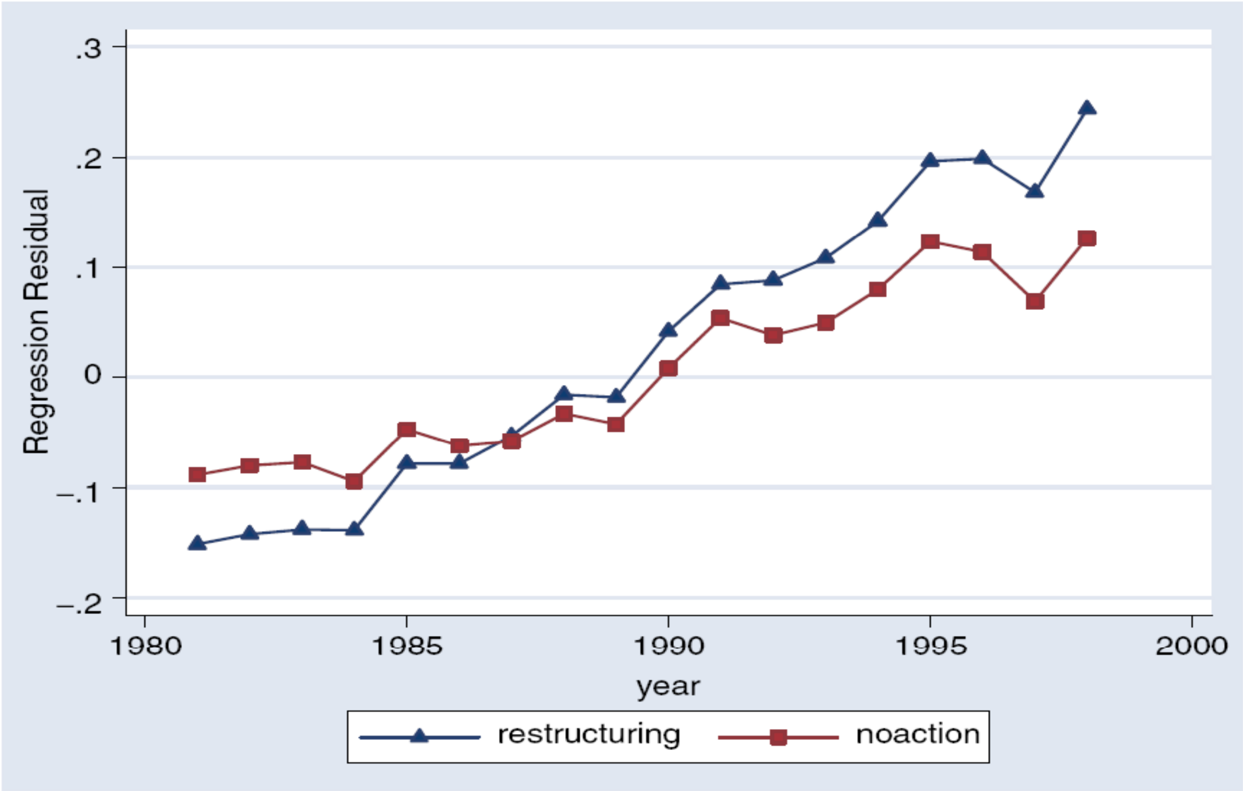


Figure 1
Yearly Capacity Factor (%) Change by Regulatory Status in 1998

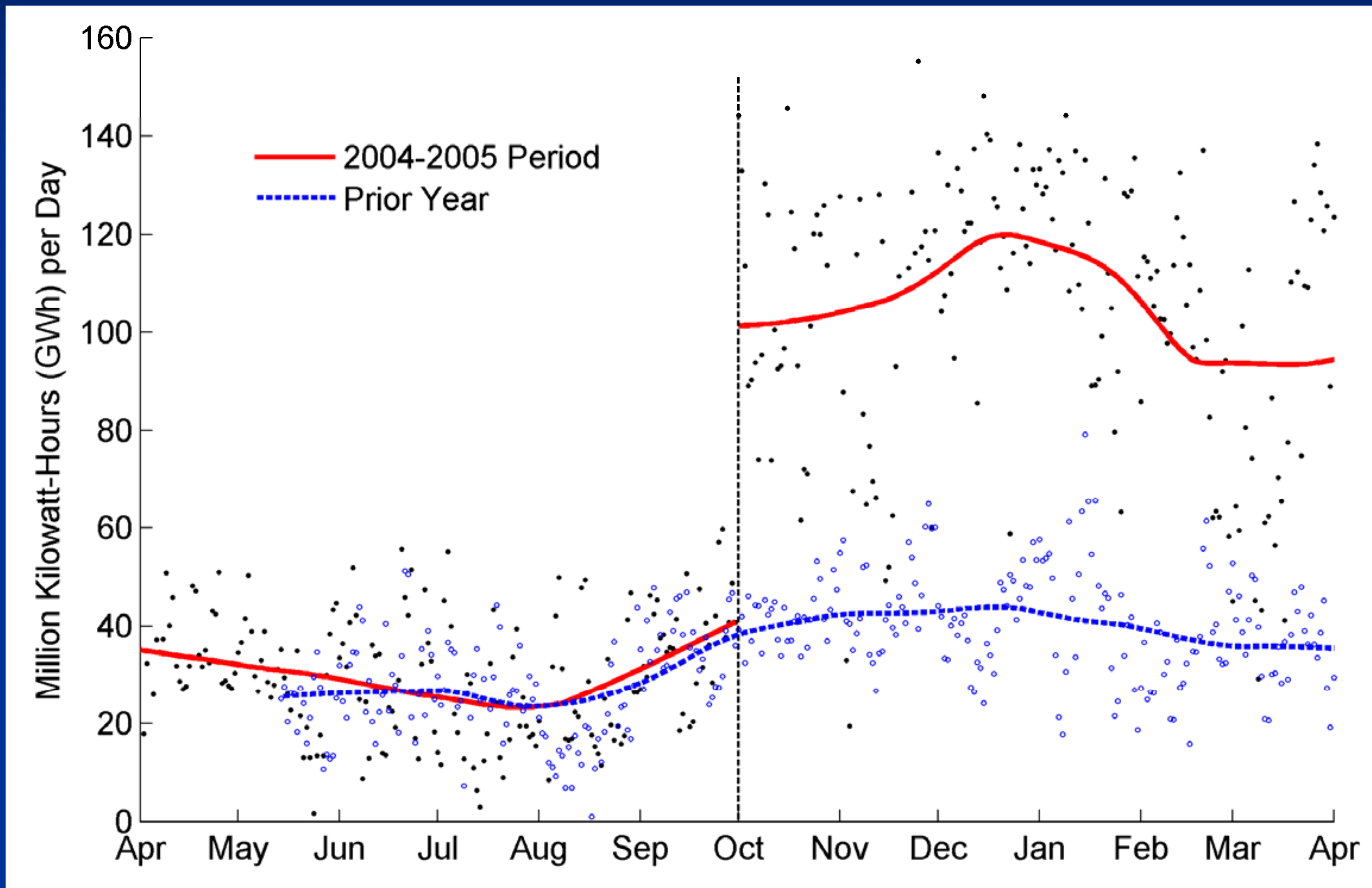
Efficiency Increases in Divested Plants

- **Bushnell and Wolfram (2006) estimate that fossil plants have ~2% lower heat rates after divestitures**
  - At current fuel prices, this amounts to $1.50/MWh or more
  - At the plants that were divested, this adds up to savings of more than $1 billion per year
- **Barmack, Kahn, & Tierney (2007) estimate nuclear plant capacity factors increase about 10% post-divestiture**

Markets improve the mix of plants in dispatch

- Mansur and White (2008) examine effects of PJM market expansion
- Centralized market replaced bilateral trading between PJM East and the Midwest
- Dramatic increase in volumes that flowed from inexpensive coal plants in the Midwest to Pennsylvania, New Jersey and Maryland
- Reduced prices spreads across markets
- Estimated savings on the order of $180m/year

Quantities traded: Day-ahead net exports, Midwest → East



What's the bottom line on restructuring?

- Remind ourselves about the source of potential gains from restructured electricity markets:
  - It's <u>not</u> about simple short-term price level movement
    - That may be due to temporal shifts (such as differences in plant age, regulatory rate base accounting, treatment of "stranded costs,") or to changing input prices, especially fuel
  - Real benefits arise from
    - Lower costs due to increased operational efficiency (short- to medium-run)
    - Better investment decisions (long-run)
    - Better consumption decisions (using retail prices to signal true costs of consumption)

Initial Evidence is Encouraging

- **Evidence on operating efficiency at existing generating plants is positive.**
- **Effective market design can help mitigate market power**
- **Additional efficiency gains** possible through:
  - **More efficient long-term (capital) investment**
  - **Incentive regulation for transmission and distribution**
  - **Allowing retail prices to better signal the true costs of consumers' energy usage decisions** (e.g., real time pricing)
    - Improving consumption decisions
    - Decreasing investment needed in peak capacity

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