Efficiency Response of Natural Gas Power Plants to Price in Various Market Structures
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Background

• Restructuring of electricity generation started in the mid 1990's as a way for competition to encourage lower electricity rates.
• Restructuring came to an abrupt halt following the electricity crisis in California.
• This left sixteen states and the District of Colombia with restructured markets
• Restructuring a third of U.S. states created a natural experiment for economists to test the effects of deregulation.

Previous Literature

• Davis and Wolfram (2012) find a 10% increase in operating performance of nuclear facilities.

Objective

For all U.S. gas-fired power plants:
1. Measure the impact of restructuring on fuel efficiency
2. Measure efficiency response to variations in natural gas price
3. Measure the differential of efficiency response to price between restructured and traditional plants

Method

A diff-in-diff model is used to identify the impact of the deregulation:

\[ HR_{it} = \beta_0 + \beta_1 \text{Dereg}_{it} + \beta_2 \text{PR}_{it} + \beta_3 \text{Dereg}_{it} \times \text{PR}_{it} + \gamma_i + \theta_t + \epsilon_{it} \]

\[ HR_{it} = \text{Logged Heat Rate} \]
\[ \text{Dereg}_{it} = \text{Regulation Dummy Variable} \]
\[ \text{PR}_{it} = \text{Logged Price Ratio of Coal to Gas} \]
\[ \gamma_i = \text{Time Variant Control Variables} \]
\[ \theta_t = \text{Plant Fixed Effects} \]
\[ \epsilon_{it} = \text{Stochastic Error Term} \]

Data

• Panel data from 1990-2012
• All U.S. gas-fired power plants defined as plants with a majority of their capacity using natural gas as the primary fuel source
• Ventyx data-EIA forms 923;860

Conclusions & Implications

• Combined cycle plants are about 5% more efficient in deregulated states, no significant difference for true peaking plants
• Combined cycle plants respond to input price (about 6%), whereas peaking plants do not
• Response to price does not differ between regulated and unregulated
• Position on the load curve matters!

Load Curve for ERCOT

Panel: Energy Information Administration

Current Status of the U.S.

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