The Price Effects of Independent Transmission System Operators in the U.S. Electricity Market

Presented at:
9th Annual International Industrial Organization Conference

Boston, MA
April 10, 2011

Ted Kury
Director of Energy Studies
Public Utility Research Center
University of Florida

"Today the Commission issues three final, interrelated rules designed to remove impediments to competition in the wholesale bulk power marketplace and to bring more efficient, lower cost power to the Nation's electricity consumers."

– FERC Order 888 4/24/96

Outline

- The Evolution of the U.S. Electric Industry
- Previous Literature
- 2SLS Estimation of Pricing
- Results and Implications

Electricity Market Structure

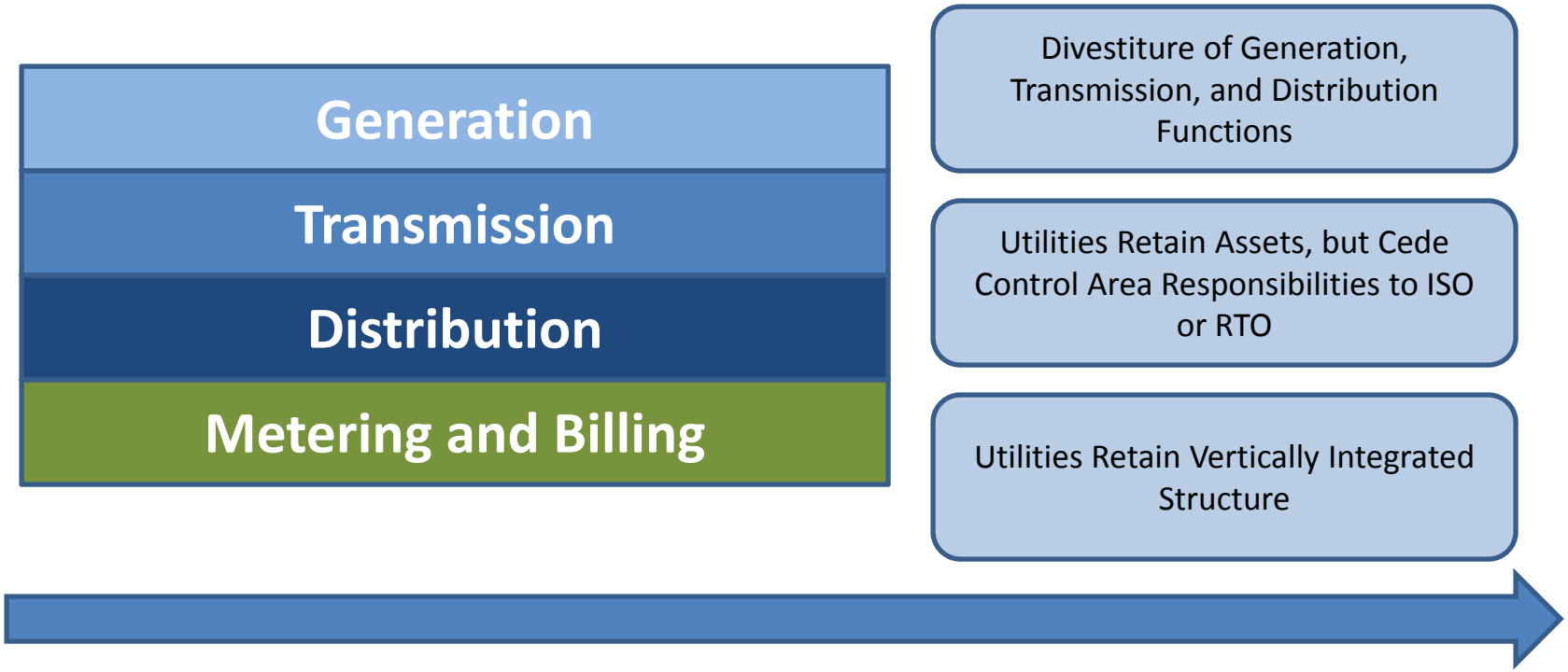
Generation

Transmission

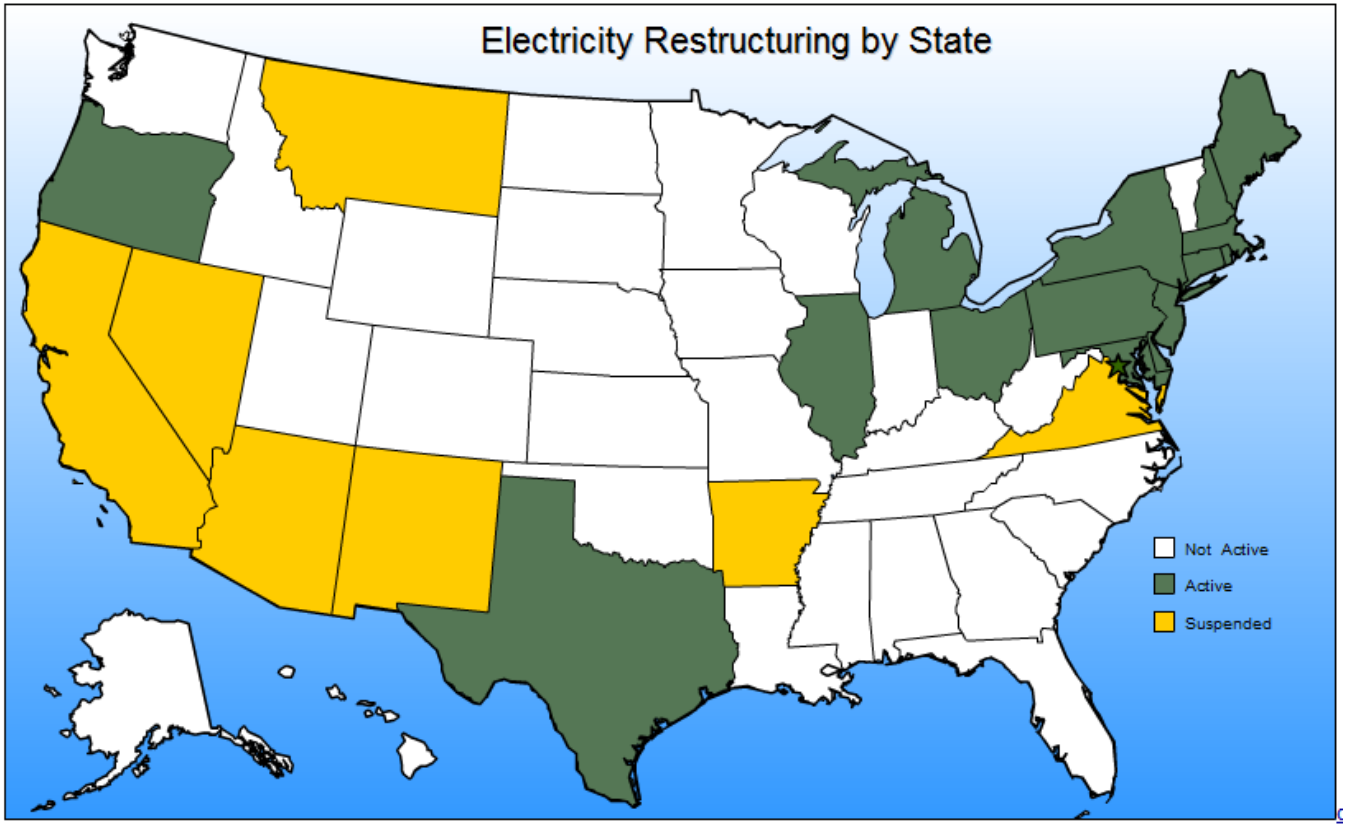
Distribution

Metering and Billing

U.S. Electric Industry Market Structure

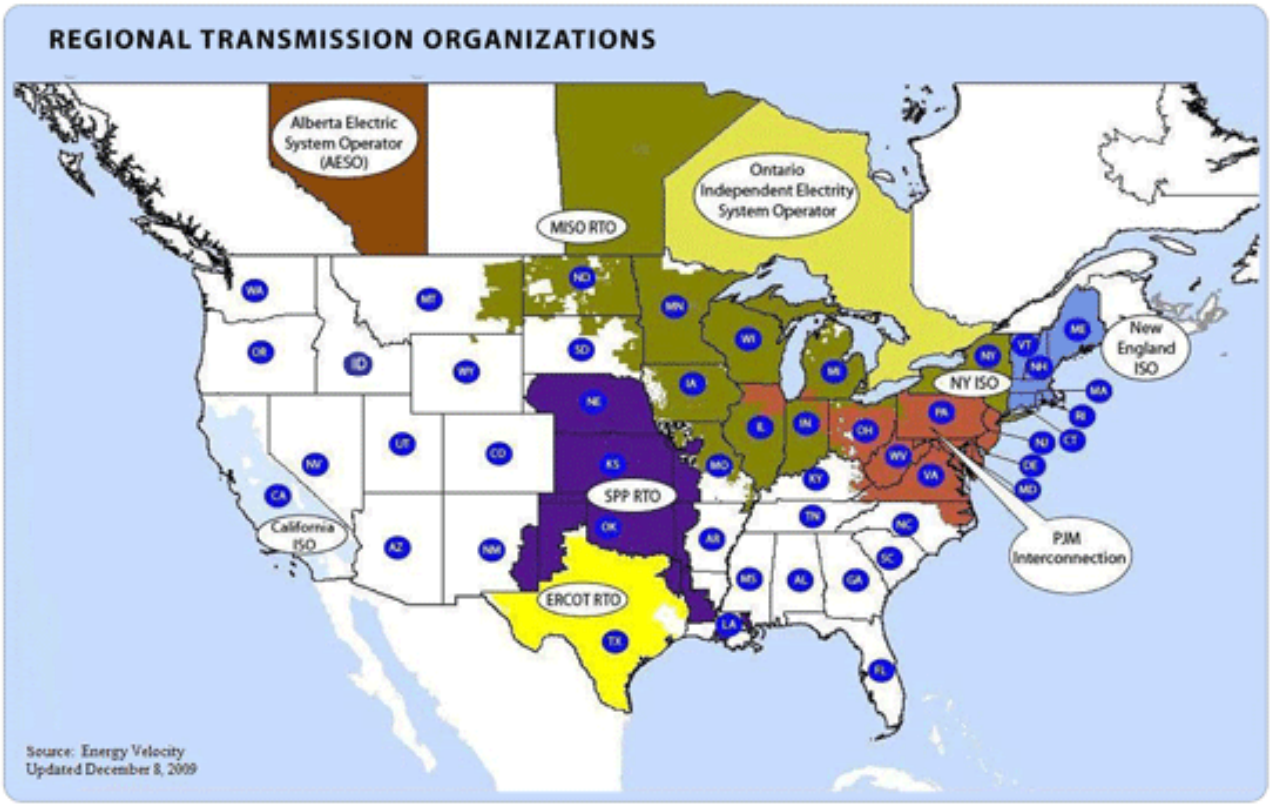


Restructured States



Source: Energy Information Administration

Independent System Operators



Existing Literature

- Existing literature focuses on the effects of restructuring (e.g. Joskow 2006)
- But two things have changed in restructured markets (Kwoka 2006)
  - Structural change in the industry
  - Rate agreements to facilitate restructuring
- Very difficult to separate effects
- FERC has started to collect data from ISOs and now has one year of data

RTOs and Price

- RTOs provide opportunities to lower cost to consumers
  - Optimize least-cost system dispatch
  - Allow non-discriminatory access to the transmission grid
- RTOs cause costs to be incurred
  - Costs associated with operating RTO (Greenfield and Kwoka 2010)
  - Compliance costs for utilities

Data

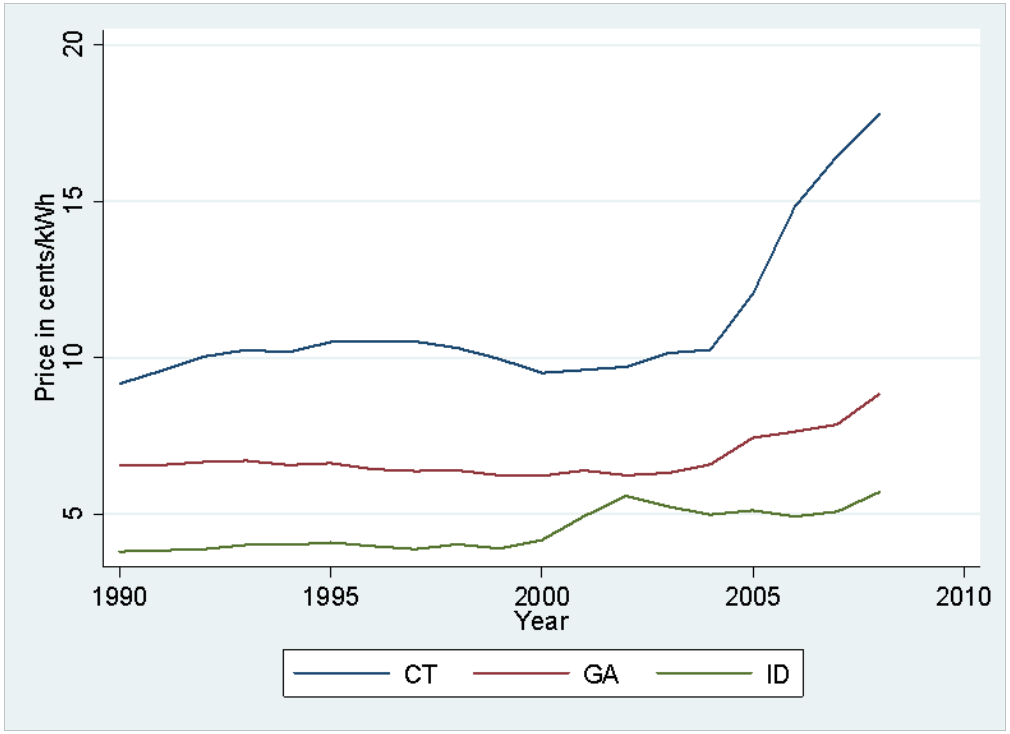
- Annual data for 48 states from 1990-2008
- State Energy Data System (SEDS) from Department of Energy
  - Prices
  - Consumption
  - Electricity generation by source
- National Climatic Data Center
  - State heating and cooling degree days
- Department of the Census
  - State population

Panel Equation of Electricity Price

$$Price_{it} = \alpha_i + \beta_0 Sales_{it} + \beta_1 Coal_{it} + \beta_2 Gas_{it} + \beta_3 \%Hydro_{it} + \beta_4 \%Nuc_{it} + \beta_5 RTO_{it} + u_{it}$$

Price	Nominal state price of electricity
Sales	Electricity sales
Coal	Nominal state price of coal
Gas	Nominal state price of natural gas
%Hydro	Percent of electric generation from hydroelectric sources
%Nuc	Percent of electric generation from nuclear sources
RTO	Whether the majority of the electric customers in the state are served by a utility that belongs to an RTO

State Level Fixed Effects



2SLS Estimation of Price Change

$$\Delta Price_{it} = \beta_0 \Delta Sales_{it} + \beta_1 \Delta Coal_t + \beta_2 \Delta Gas_t + \beta_3 \Delta\%Hydro_{it} + \beta_4 \Delta\%Nuc_{it} + \beta_5 \Delta RTO_{it} + u_{it}$$

- Variables in logs, so all variables are now annual percent changes
- If the price elasticity of electric demand is anything but zero, then we have an endogeneity problem
- Use (log changes in) state population, heating degree days, and cooling degree days to instrument for *Sales*
  - F-statistic for first stage regression is 15.74

2SLS Estimation of Entire Sample

Table 1: 2SLS Estimates with Entire Sample	
Variable	**Coefficient**
Constant	0.0192***
	(0.0030)
Sales	-0.1058
	(0.0979)
Coal	0.1622***
	(0.0271)
Gas	0.0206***
	(0.0076)
%Hydro	-0.1714***
	(0.0548)
%Nuc	-0.0147
	(0.0182)
RTO	-0.0202**
	(0.0089)
RTO_{t-1}	-0.0286***
	(0.0093)
RTO_{t-2}	-0.0043
	(0.0126)
(Robust standard errors clustered by state in parentheses) * Statistically significant at the 90% level ** Statistically significant at the 95% level *** Statistically significant at the 99% level	

2SLS Estimation of Restricted Sample

Table 3: 2SLS Estimates By Customer Class Excluding States that have Restructured their Electric Industry			
Variable	**Residential**	**Commercial**	**Industrial**
Constant	0.0170***	0.0245***	0.0051
	(0.0023)	(0.0068)	(0.0060)
Sales	-0.1017	-0.3477**	0.1565
	(0.0627)	(0.1485)	(0.3184)
Coal	0.1357***	0.1290***	0.2850***
	(0.0326)	(0.0384)	(0.0936)
Gas	0.0073	0.0199**	0.0656***
	(0.0069)	(0.0093)	(0.0211)
%Hydro	-0.0317	-0.0266	-0.6413**
	(0.0547)	(0.0586)	(0.3200)
%Nuc	0.0600	0.0738	0.0104
	(0.0424)	(0.0553)	(0.0972)
RTO	-0.0139**	-0.0176	-0.0017
	(0.0070)	(0.0122)	(0.0159)
RTO_{t-1}	-0.0074	-0.0081	-0.0261*
	(0.0096)	(0.0147)	(0.0150)
RTO_{t-2}	0.0087	0.0072	-0.0003
	(0.0071)	(0.0137)	(0.0192)
(Robust standard errors clustered by state in parentheses) * Statistically significant at the 90% level ** Statistically significant at the 95% level *** Statistically significant at the 99% level			

2SLS Estimation by Customer Class

Table 3: 2SLS Estimates By Customer Class Excluding States that have Restructured their Electric Industry			
Variable	**Residential**	**Commercial**	**Industrial**
Constant	0.0170***	0.0245***	0.0051
	(0.0023)	(0.0068)	(0.0060)
Sales	-0.1017	-0.3477**	0.1565
	(0.0627)	(0.1485)	(0.3184)
Coal	0.1357***	0.1290***	0.2850***
	(0.0326)	(0.0384)	(0.0936)
Gas	0.0073	0.0199**	0.0656***
	(0.0069)	(0.0093)	(0.0211)
%Hydro	-0.0317	-0.0266	-0.6413**
	(0.0547)	(0.0586)	(0.3200)
%Nuc	0.0600	0.0738	0.0104
	(0.0424)	(0.0553)	(0.0972)
RTO	-0.0139**	-0.0176	-0.0017
	(0.0070)	(0.0122)	(0.0159)
RTO_{t-1}	-0.0074	-0.0081	-0.0261*
	(0.0096)	(0.0147)	(0.0150)
RTO_{t-2}	0.0087	0.0072	-0.0003
	(0.0071)	(0.0137)	(0.0192)
(Robust standard errors clustered by state in parentheses) * Statistically significant at the 90% level ** Statistically significant at the 95% level *** Statistically significant at the 99% level			

Conclusions

- Statistically significant price benefits from the establishment of RTOs only exist when restructured states are included in the data set
- This suggests that restructuring, and its attendant rate agreements, are the source of the benefit
- RTOs may have benefits for certain classes of customer, but these benefits range from 1½ - 2½%

Contact Information

- Ted Kury

  ted.kury@warrington.ufl.edu