Shades of Integration: The Restructuring of the U.S. Electricity Markets

Alexander MacKay[1] Ignacia Mercadal[2]

[1]Harvard University

[2]Columbia University

May 29, 2019

NBER Electricity Markets and Regulation Workshop

A Bit of History: Electricity Restructuring

In the 1990s, several (state-level) initiatives were begun to restructure electricity markets in the United States

A Bit of History: Electricity Restructuring

In the 1990s, several (state-level) initiatives were begun to restructure electricity markets in the United States

The objective was to bring down electricity prices through the introduction of markets and competition

- By replacing regulated vertically integrated utilities with markets
- Following deregulation of airlines, trucking, and telecom

A Bit of History: Electricity Restructuring

In the 1990s, several (state-level) initiatives were begun to restructure electricity markets in the United States

The objective was to bring down electricity prices through the introduction of markets and competition

- By replacing regulated vertically integrated utilities with markets
- Following deregulation of airlines, trucking, and telecom

Economic reasoning:

- More efficient operation of plants
- More efficient long-term investment decisions

What Happened After Restructuring?

Increased productive efficiency (lower costs)

- Fabrizio, Rose and Wolfram (2007), Davis and Wolfram (2012), Cicala (2017)

Evidence on prices is inconclusive or finds small effects

- Borenstein and Bushnell (2015), Bushnell, Mansur, and Novan (2017 WP)

What Happened After Restructuring?

Increased productive efficiency (lower costs)

- Fabrizio, Rose and Wolfram (2007), Davis and Wolfram (2012), Cicala (2017)

Evidence on prices is inconclusive or finds small effects

- Borenstein and Bushnell (2015), Bushnell, Mansur, and Novan (2017 WP)

This paper: We revisit this question, using a detailed dataset on electricity transactions

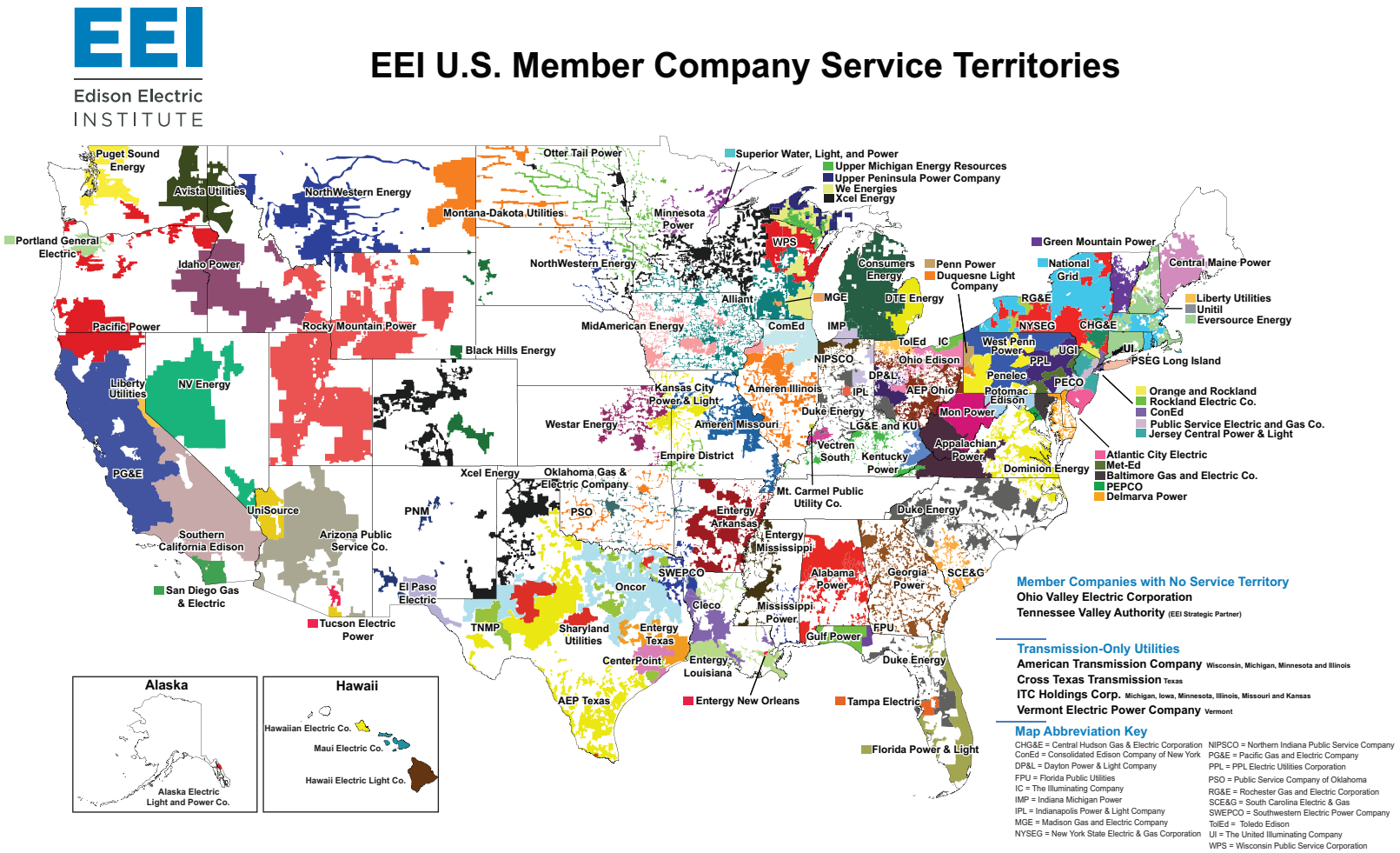
We account for intermediate forms of vertical integration

- Whether buyers and sellers are affiliated (same parent company)
- Long-term contracts

Data

1. FERC Form 1: detailed information on investor owned utilities (IOUs)
   - Financial information
   - Purchases: from whom, price, quantity, affiliation
   - Generation costs
   - Sales: retail by type of customer, wholesale, competitive retailers
2. FERC Electric Quarterly Reports (EQRs):
   - Wholesale electricity sales
   - Contractual details: parties, price, quantity, terms, length
   - Does not include purchases from an ISO (only transactions in which the ISO is the buyer).
3. S&P Global energy dataset:
   - Corporate structure

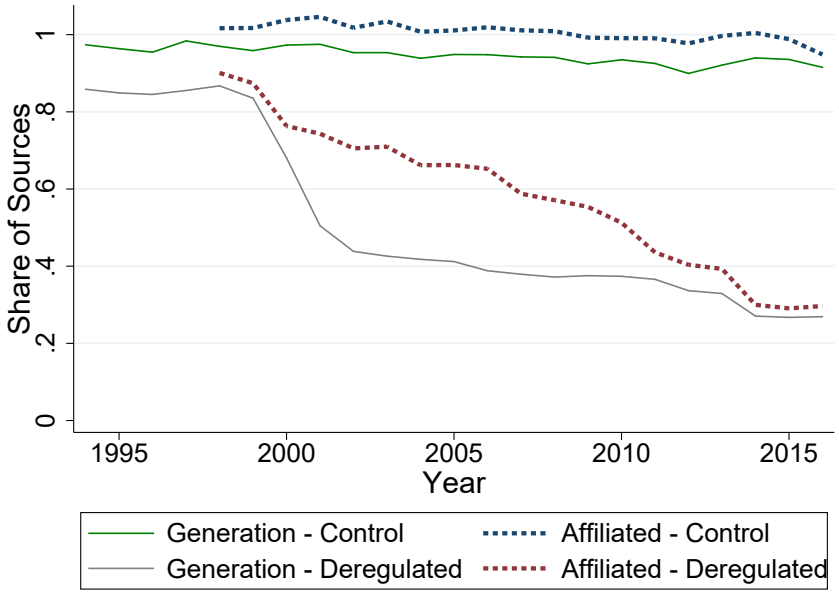
Empirical analysis: Investor-owned utilities (70% of sales)



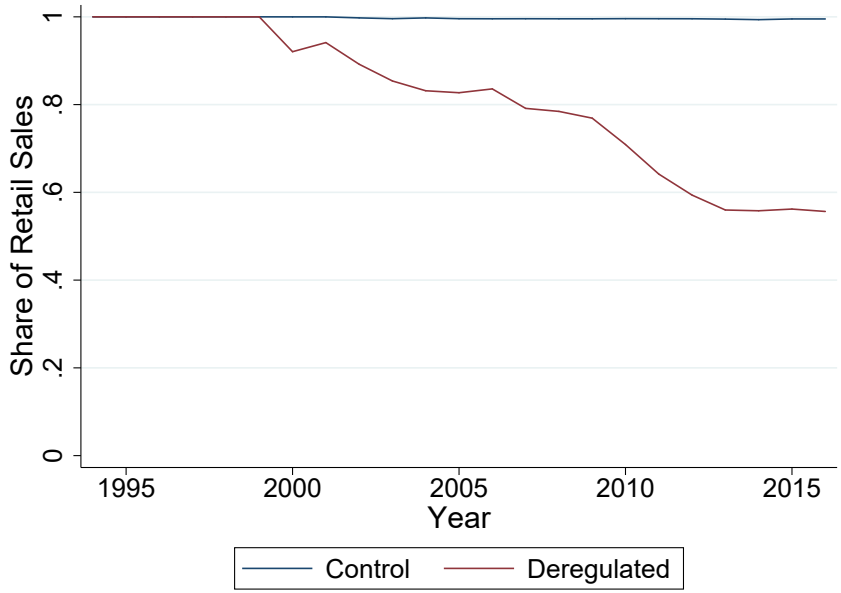
Produced by Edison Electric Institute. Data Source: ABB, Velocity Suite. October 2018

Share of the market supplied by IOUs

Wholesale market (Upstream)

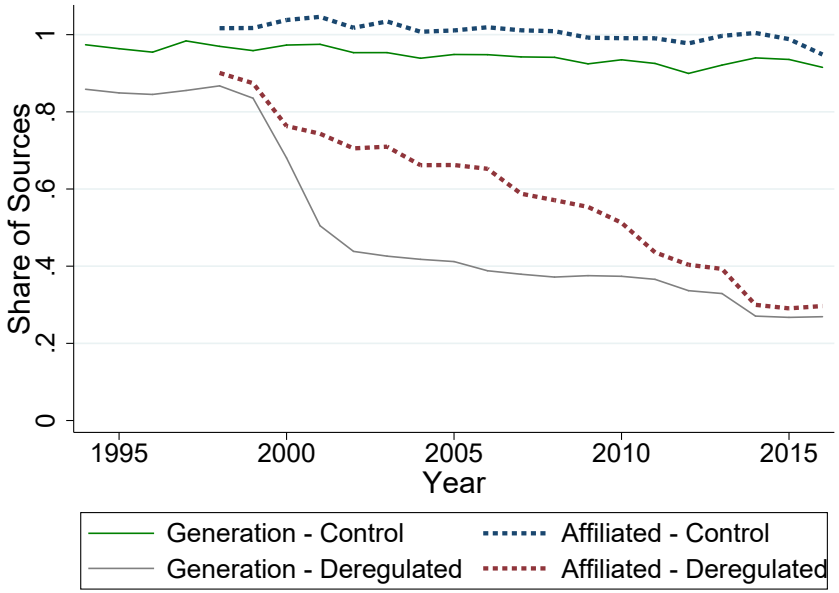


Retail market (Downstream)

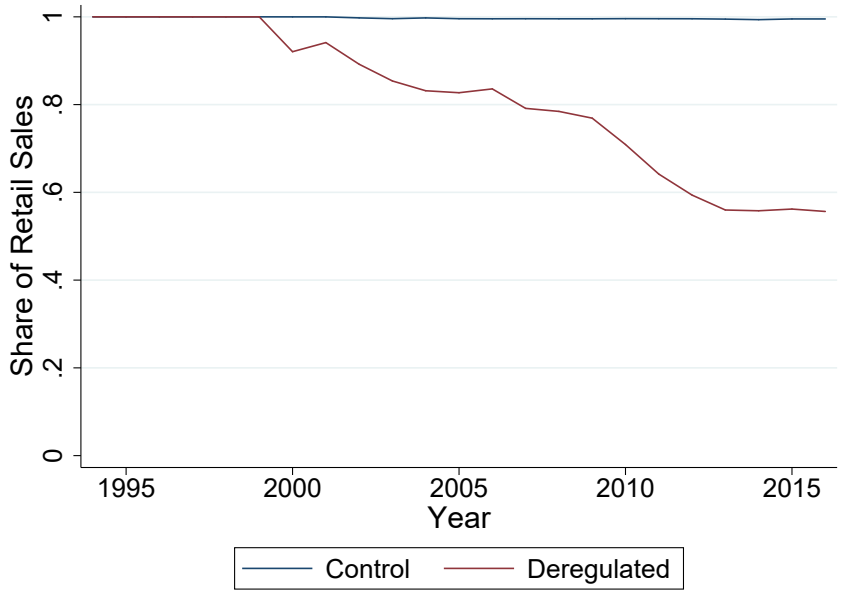


Share of the market supplied by IOUs

Wholesale market (Upstream)



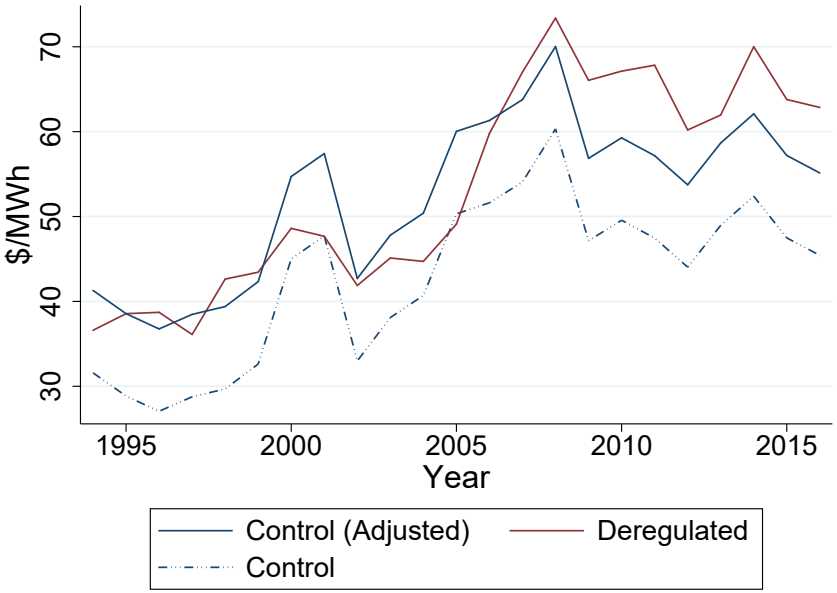
Retail market (Downstream)



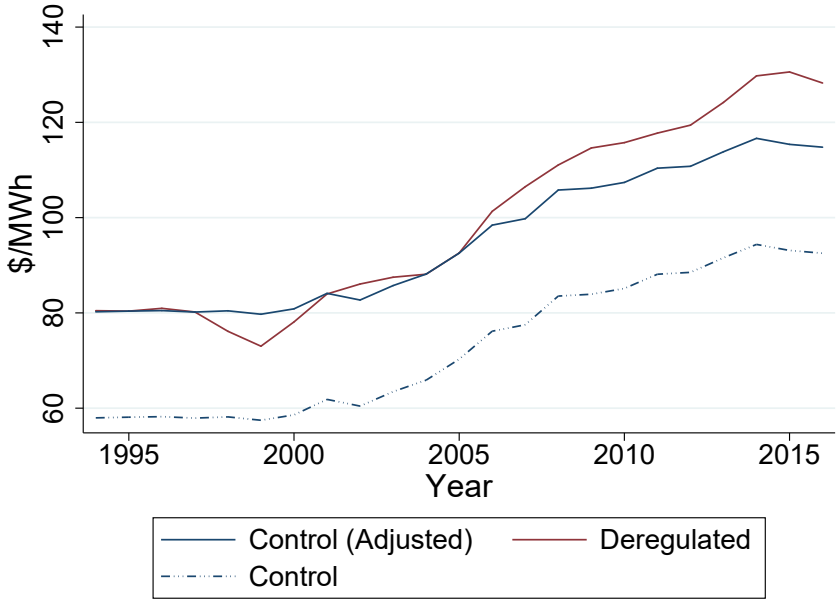
Effective restructuring: Share of sales from independent sellers.

Prices

Wholesale market (Upstream)



Retail market (Downstream)



Markets after restructuring

1. Delayed restructuring
   - Quick divestment process, but generation stayed within the same parent company for many years.
   - Retail competition was very weak in the first decade
2. Higher prices following **effective** restructuring
   - Wholesale and retail prices are higher for restructured utilities

Consequences of effective restructuring

$$price_{it} = \beta^U E_{it}^U + \beta^D E_{it}^D + \gamma X_{it} + \xi_i + \phi_t + \varepsilon_{it} \quad (1)$$

- E_{it}^U: share of purchases from independent sellers
- E_{it}^D: share of sales from independent retailers
- ξ_i: utility fixed-effects
- ϕ_t: year fixed-effects
- β^U, β^D: net effect of effective restructuring on prices.

Potential identification concerns

- Rate freezes
  - Many states had rate freezes in the early years after restructuring
  - Could have been removed at the same time as changes in market structure
  - For most states, rate caps were removed before effective restructuring took off (before 2004)

Potential identification concerns

- Rate freezes
  - Many states had rate freezes in the early years after restructuring
  - Could have been removed at the same time as changes in market structure
  - For most states, rate caps were removed before effective restructuring took off (before 2004)
- Stranded costs
  - Regulators allowed formerly regulated utilities to recover "stranded costs" by increasing rates
  - For most states, this had stopped by 2005

Potential identification concerns

- Renewable portfolio standards
  - Require utilities to purchase a fixed share of electricity from renewable sources
  - Implemented in 29 states (all restructured)
  - Control by share of renewable generation

Potential identification concerns

- Renewable portfolio standards
  - Require utilities to purchase a fixed share of electricity from renewable sources
  - Implemented in 29 states (all restructured)
  - Control by share of renewable generation
- Clean Air Act 2005
  - Higher costs for coal plants from environmental compliance
  - Control by carbon emissions in 2005 interacted with years after 2005

Potential identification concerns

- Renewable portfolio standards
  - Require utilities to purchase a fixed share of electricity from renewable sources
  - Implemented in 29 states (all restructured)
  - Control by share of renewable generation
- Clean Air Act 2005
  - Higher costs for coal plants from environmental compliance
  - Control by carbon emissions in 2005 interacted with years after 2005
- Reverse causality:
  - Markets with higher retail prices attract more / better competitive retailers
  - IV: Share of commercial and industrial customers

Wholesale prices (upstream)

	(1)	(2)	(3)	(4)	(5)	(6)
Upstream Deregulation	8.586**		−3.885	−4.859	−5.042	−10.062**
	(3.903)		(4.099)	(3.958)	(3.922)	(4.148)
Downstream Deregulation		34.620***	39.381***	38.517***	38.757***	55.042***
		(6.501)	(7.242)	(7.092)	(7.111)	(9.662)
Fuel Cost				0.755***		0.737***
				(0.260)		(0.253)
Fuel Cost × Treatment					0.876***	
					(0.258)	
Fuel Cost × Control					0.497*	
					(0.282)	
Year FEs	X	X	X	X	X	X
Utility FEs	X	X	X	X	X	X
IV						X
Observations	2,610	3,212	2,610	2,610	2,610	2,610
R^2	0.58	0.59	0.61	0.62	0.62	0.62

Regressions are weighted by MWh purchased.

Cluster-robust standard errors are calculated at the utility level and displayed in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Retail prices (downstream)

	(1)	(2)	(3)	(4)	(5)	(6)
Upstream Deregulation	16.478***		3.049	1.702	2.128	−5.111
	(2.940)		(3.866)	(3.511)	(3.477)	(3.974)
Downstream Deregulation		40.290***	40.598***	41.808***	41.337***	43.501***
		(8.544)	(8.674)	(8.661)	(8.700)	(10.344)
Fuel Cost				0.896***		0.986***
				(0.193)		(0.294)
Fuel Cost × Treatment					0.721***	
					(0.233)	
Fuel Cost × Control					1.039***	
					(0.154)	
Year FEs	X	X	X	X	X	X
Utility FEs	X	X	X	X	X	X
IV						X
Observations	2,640	3,249	2,640	2,640	2,640	2,640
R^2	0.89	0.90	0.90	0.91	0.91	0.87

Regressions are weighted by retail MWh.

Cluster-robust standard errors are calculated at the utility level and displayed in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Contract prices

	OLS				*IV*	
	(1)	(2)	(3)	(4)	(5)	(6)
Downstream dereg	0.823***	0.807***	0.738***	0.799***	1.200***	1.200
	(0.158)	(0.167)	(0.160)	(0.149)	(0.164)	(0.941)
Upstream dereg	0.067	0.054	0.053	0.087	0.049**	0.049
	(0.099)	(0.104)	(0.101)	(0.090)	(0.024)	(0.183)
Share ISO	0.051	−0.044	−0.041			
	(0.143)	(0.129)	(0.133)			
log(quantity)	−0.021***	−0.020***	−0.020***	−0.016***	−0.015***	−0.015***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.001)	(0.005)
CO_2 05 CAA			−0.013	0.001	0.013**	0.013
			(0.019)	(0.019)	(0.006)	(0.034)
Share wind/solar			−0.653***	−0.733***	−0.472***	−0.472
			(0.191)	(0.256)	(0.131)	(0.686)
Constant	2.924***	2.141***	2.179***	2.951***	2.632***	2.632***
	(0.194)	(0.223)	(0.230)	(0.163)	(0.141)	(0.697)
Utility FE	Y	Y	Y	Y	Y	Y
Year FE	Y	Y	Y	Y	Y	Y
BA FE	N	Y	Y	N	N	N
Contract chars	Y	Y	Y	N	N	N
Observations	72,718	71,921	71,921	72,763	72,763	72,763
R^2	0.519	0.547	0.548	0.512	0.511	0.511
Clustered SE	Y	Y	Y	Y	N	Y

Note: *p<0.1; **p<0.05; ***p<0.01

Electricity restructuring

1. Effective restructuring was delayed for 10 years
   - Incumbent's market share decreased slowly in both the wholesale and the retail markets
2. Negative or zero correlation between effective wholesale competition and prices
3. High and positive correlation between effective retail competition and prices

Why did prices increase?

Competition and loss of monopsony power (AC $\Rightarrow$ MC)

- As retailers compete to buy power from generators, the incumbent utility losses market power
- Typical regulation reimburses incumbent at AC, not MC.

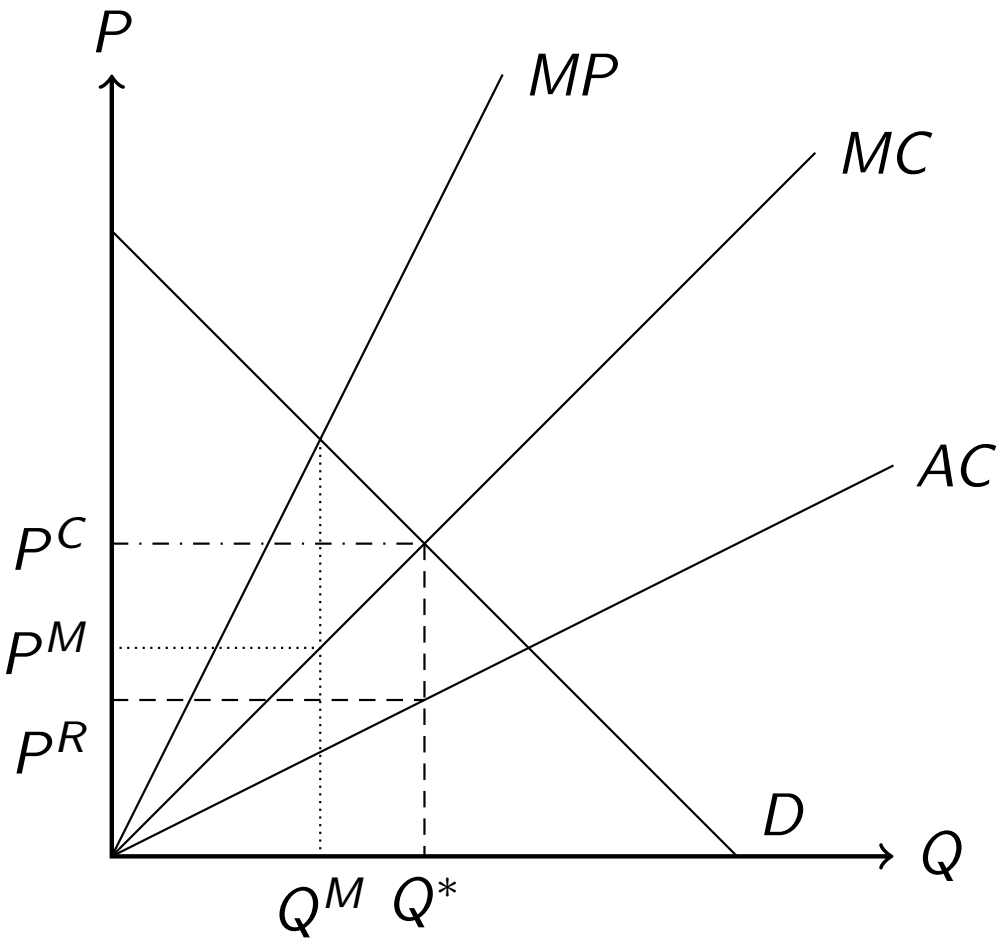
Double marginalization (MC + markup)

- Introducing intermediaries increases prices

Market power (MC ++ markup)

- Markets are not (yet?) very competitive.

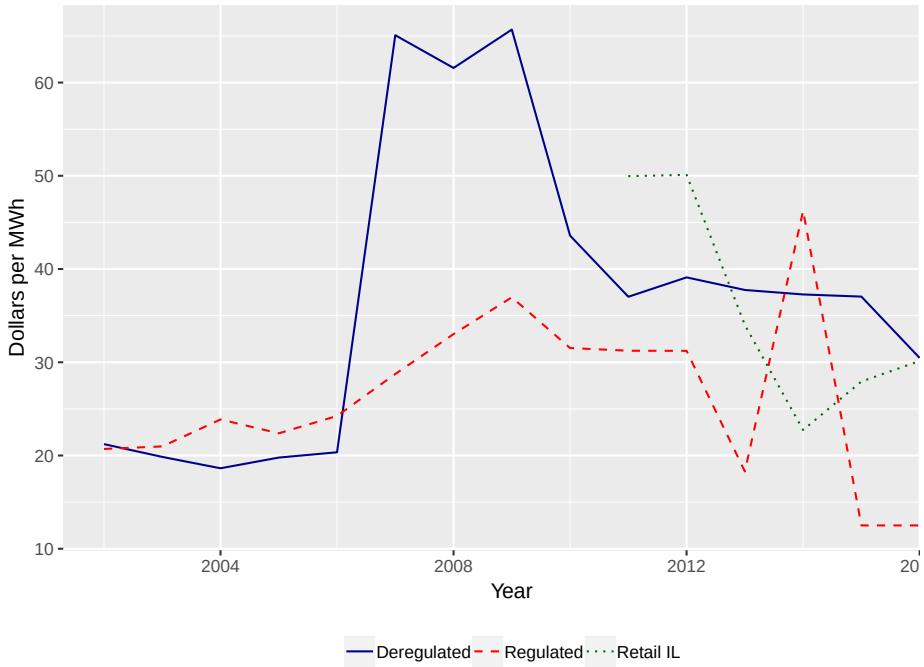
Why did prices increase?



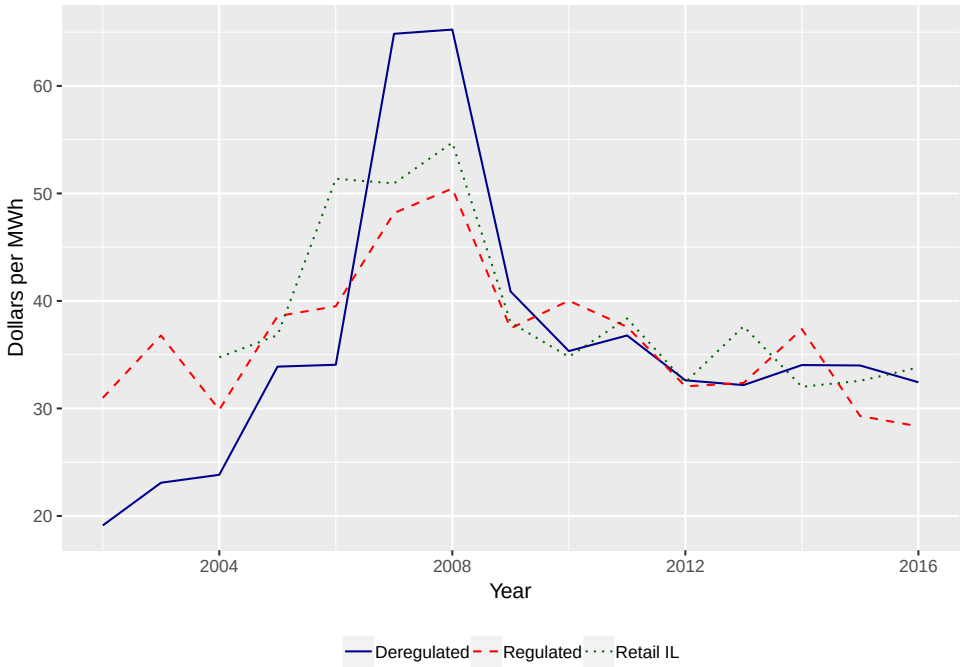
- Regulated: P^R
- Monopsony: P^M
- Competition: P^C

Wholesale purchase prices in Illinois by affiliation

Affiliated



Non-affiliated



Conclusion

- Vertical integration is an important dimension in the analysis of the consequences of electricity restructuring
  - Firms may be able to delay changes in market structure using intermediate degrees of vertical integration
- New empirical fact: Prices increased after effective restructuring

Conclusion

- Vertical integration is an important dimension in the analysis of the consequences of electricity restructuring
  - Firms may be able to delay changes in market structure using intermediate degrees of vertical integration
- New empirical fact: Prices increased after effective restructuring

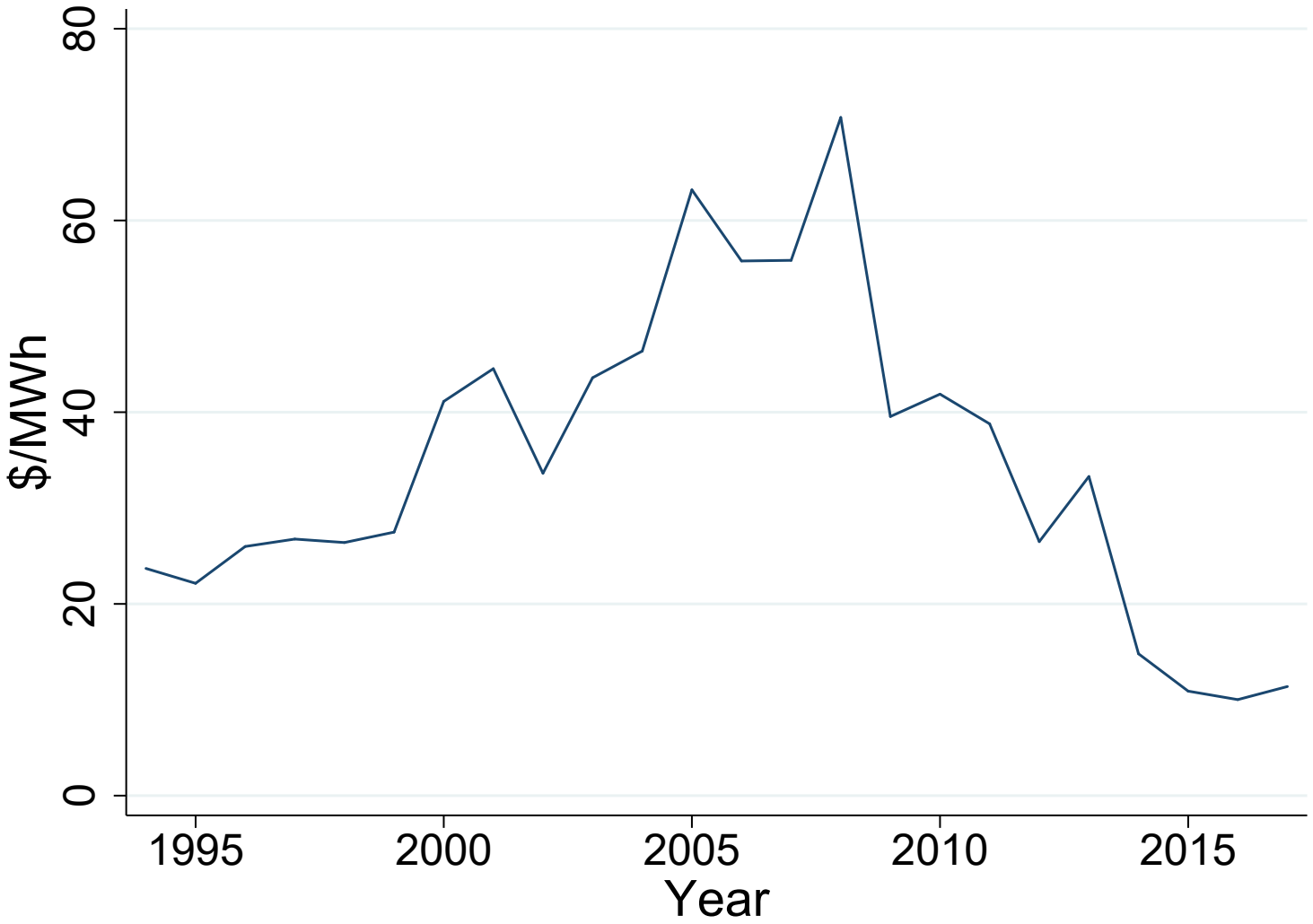
Next steps

- Better understanding of the mechanism behind price increases at the time of effective restructuring

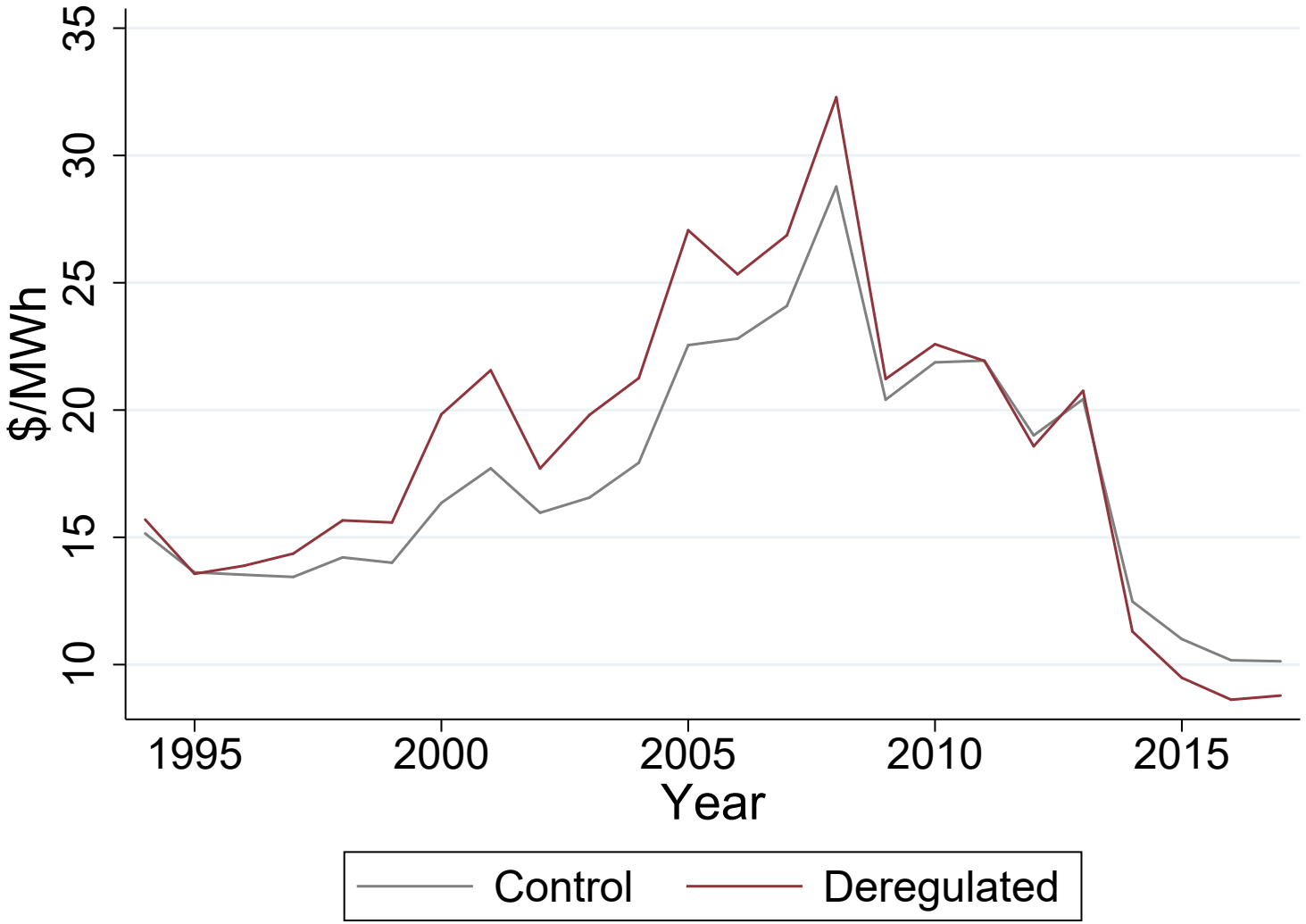
Thank you

ignacia.mercadal@columbia.edu

What about natural gas prices?



Generation costs



Back