

Retail Electricity and Gas Competition

Regulatory and Market Update

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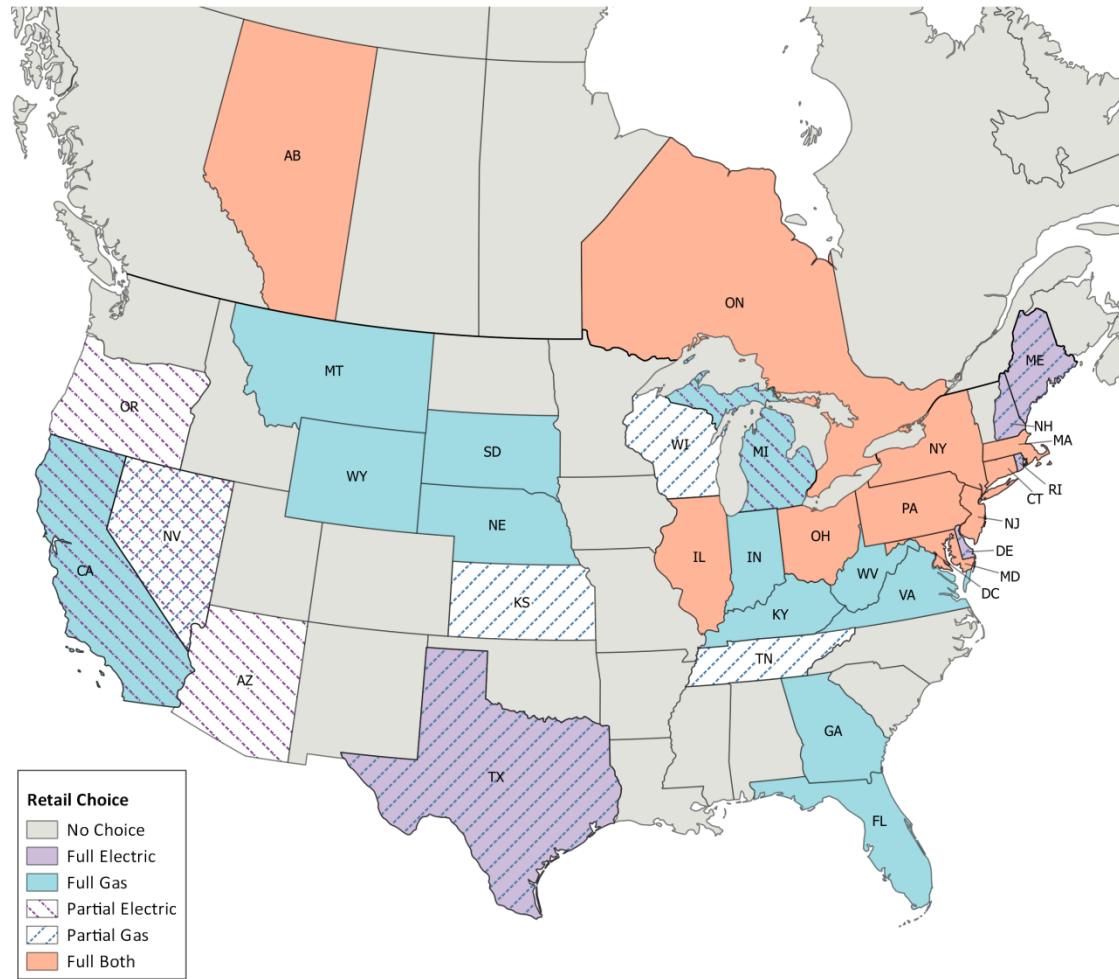
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THE **Brattle** GROUP

Status of Full & Partial Retail Energy Choice

Under full retail choice all customers (residential, commercial and industrial (C&I)) have access to the competitive market. Partial retail choice restricts access to certain customer classes or puts a cap on the percentage of load eligible for choice. As of 2017:

- 11 states/provinces have both full gas and electric choice
 - 5 additional states/provinces have full electric and partial gas choice
 - 12 additional states/provinces have full gas choice (2 of which have partial electric)
- 6 states have partial retail choice for gas, electric, or both but no full retail choice

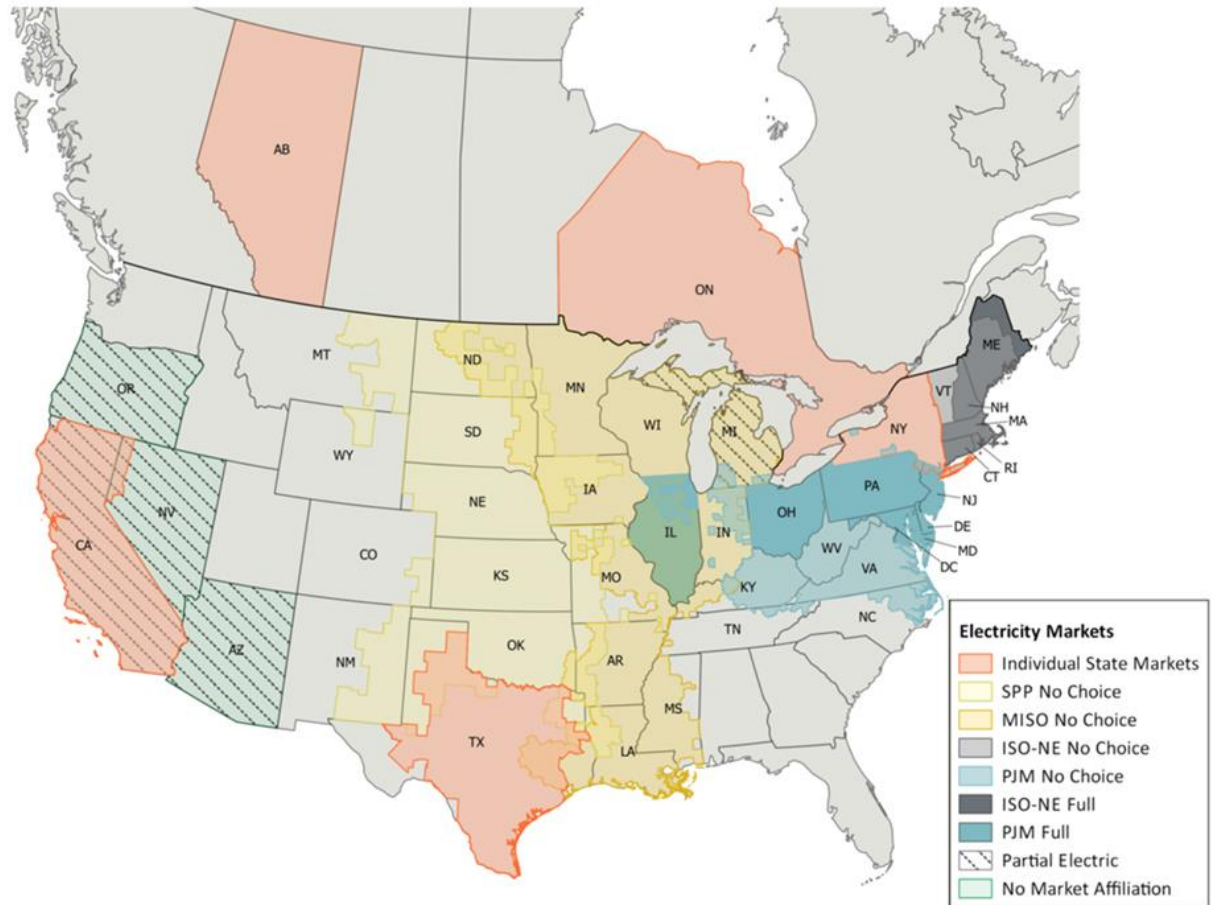


Source: Brattle Analysis

The U.S. and Canada Have Several Wholesale Electricity Markets with Retail Competition

The wholesale markets administrators are called **Independent System Operators (ISO)** or **Regional Transmission Operators (RTO)**

- **Multi-state markets***: ISO-NE, PJM
- **“Individual” state markets**: NYISO, IESO, AESO, CAISO, ERCOT
- States without any wholesale market procure electricity through vertically integrated utilities or contracts



There is no analogous wholesale market system for natural gas

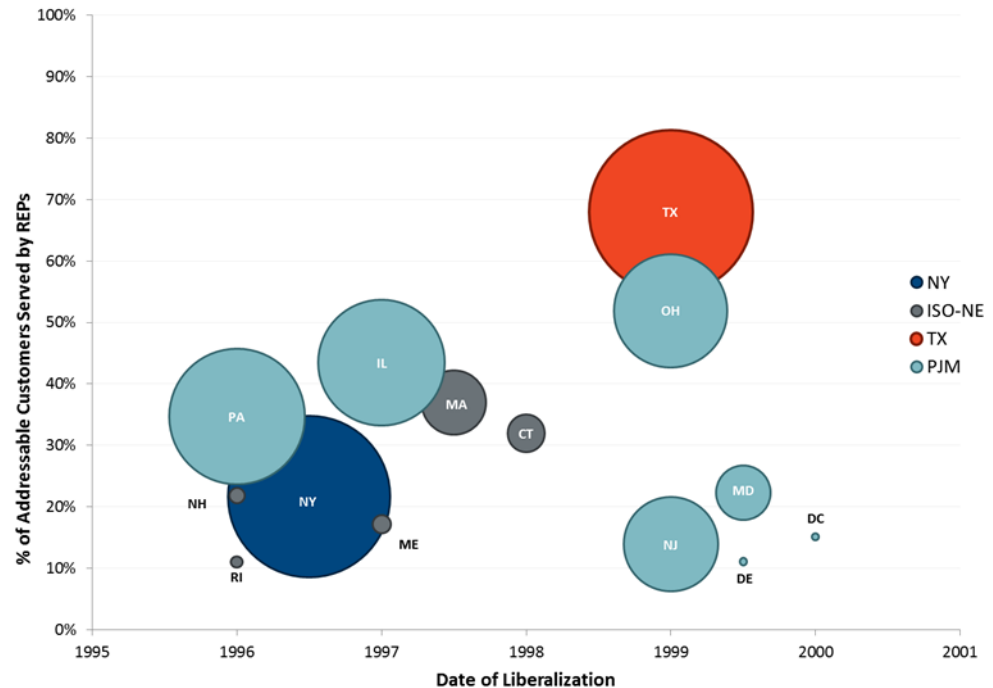
Source: Brattle Analysis

* SPP and MISO are 2 additional multi-state wholesale markets, but they do not include states with electric retail choice, and are excluded from the map

Electric Customers on REP Service

- All full electric customer choice states liberalized before 2001
 - Partial retail choice states liberalized in the early 2000s
- Except for Texas, the percentage of customers on REP service is between 10 - 50%
- The percentage of REP customers is not correlated to market size or year of liberalization

REP Share of Addressable Market (Customer Count)



Sources: The Brattle Group and US Energy Information Administration (EIA)

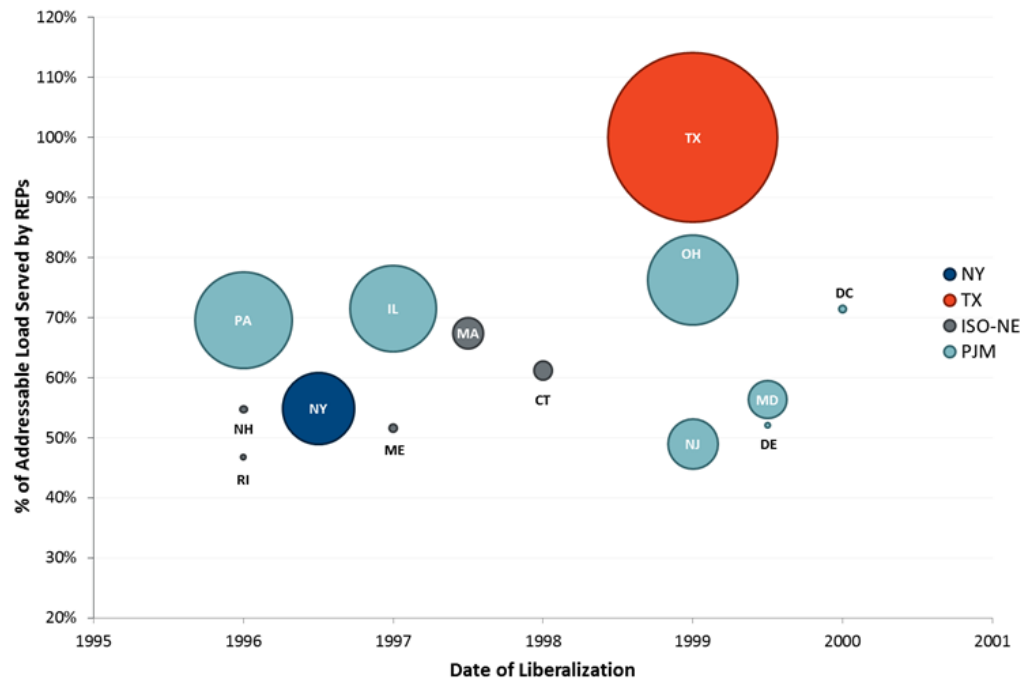
Notes:

- [1] Partial competition states are not included. These states include AZ, CA, MI, NV and OR
- [2] Centre of the circle represents the X and Y coordinates
- [3] Diameter of the circle is scaled based on the number of “addressable” customers in the state in 2016. Based on state rules addressable customers do not include customers on municipal, co-op, or state/federal agency service
- [4] Texas’ REPs serve 100% of addressable customers

Electric Load on REP Service

- Between 50 and 75% of eligible load is on REP service, apart from Texas
 - However 65%-93% of the REP load is from C&I customers
- Texas has almost double the load of any other full competition state
 - Although customer counts are similar

REP Share of Addressable Market
(Load Size)



Sources: The Brattle Group and US Energy Information Administration (EIA)

Notes:

[1] Partial competition states are not included. These states include AZ, CA, MI, NV and OR

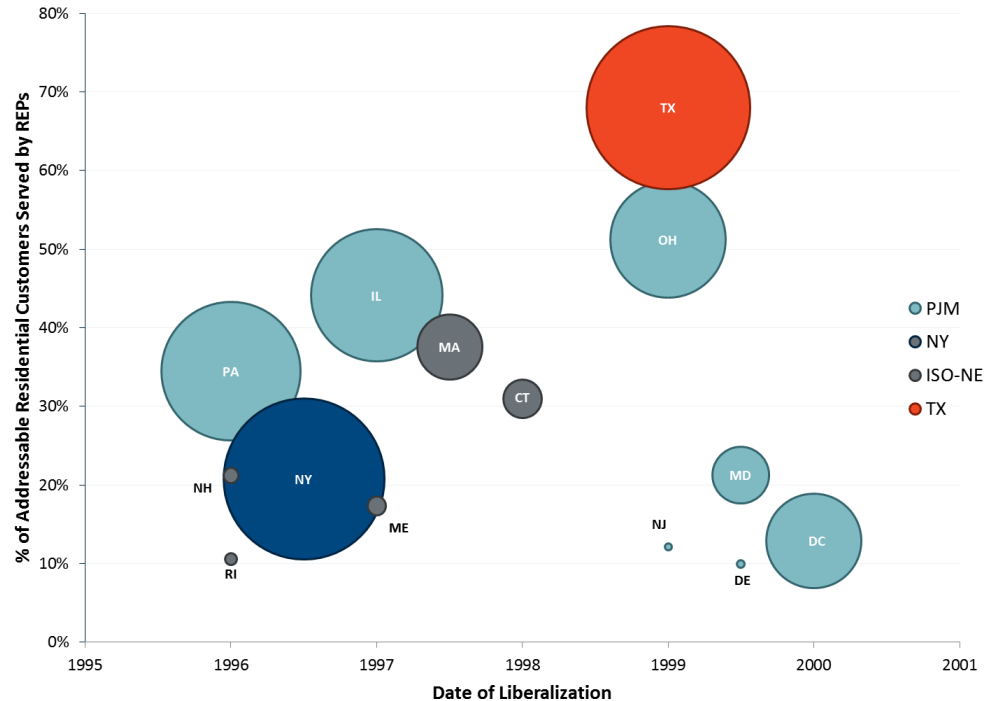
[2] Centre of the circle represents the X and Y coordinates

[3] Diameter of the circle is scaled based on “addressable” state load size (MWh) in 2016

Residential Electric Customers on REP Service

- There are significantly more residential customers than commercial and industrial
 - Causes the percentage of residential customer on REP service to be very close to the total customer percentage
- The percentage of residential customers and load served by REPs is highly correlated
 - Implies customers of all sizes are being targeted and/or opting in to REPs

REP Share of Addressable Residential Market (Customer Count)



Sources: The Brattle Group and US Energy Information Administration (EIA)

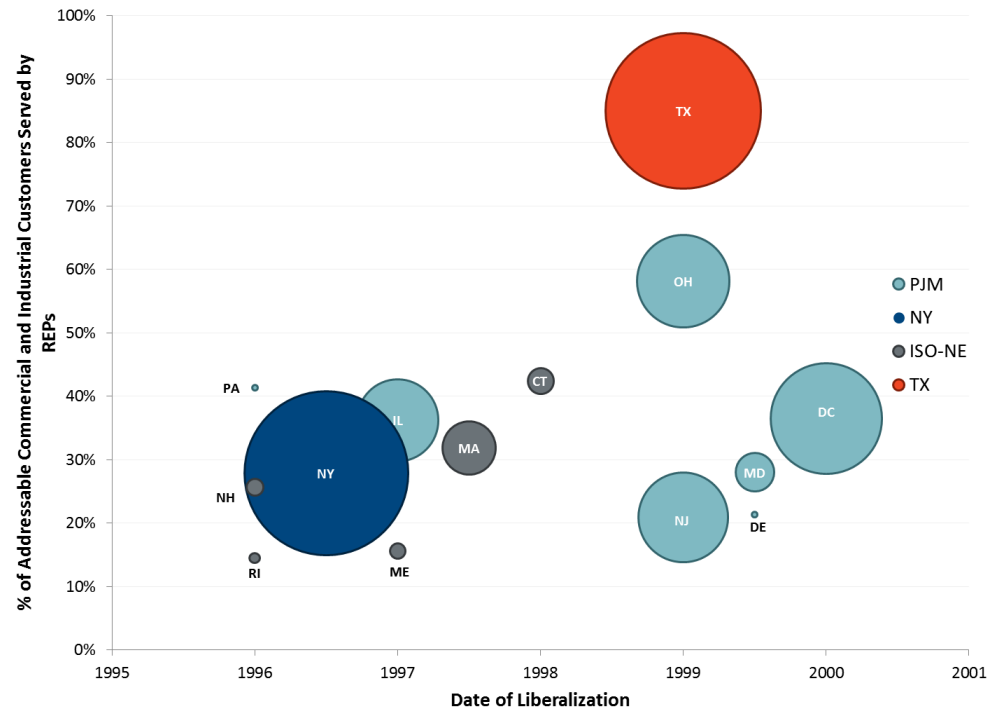
Notes:

- [1] Partial competition states are not included. These states include AZ, CA, MI, NV and OR
- [2] Centre of the circle represents the X and Y coordinates
- [3] Diameter of the circle is scaled based on the number of "addressable" customers in the state in 2016. Based on state rules addressable customers do not include customers on municipal, co-op, or state/federal agency service
- [4] Texas' REPs serve 100% of addressable residential customers

C&I Electric Customers on REP Service

- On average higher percentage of C&I customers have switched to REP service in most states. Due to C&I customers having:
 - more awareness and sensitivity to electricity bills
 - enough load to negotiate customized rates with REPs
- However these factors mean C&I customers may all be happy with their current service and be less likely to switch REPs

REP Share of Addressable Commercial and Industrial Market (Customer Count)



Sources: The Brattle Group and US Energy Information Administration (EIA)

Notes:

[1] Partial competition states are not included. These states include AZ, CA, MI, NV and OR

[2] Centre of the circle represents the X and Y coordinates

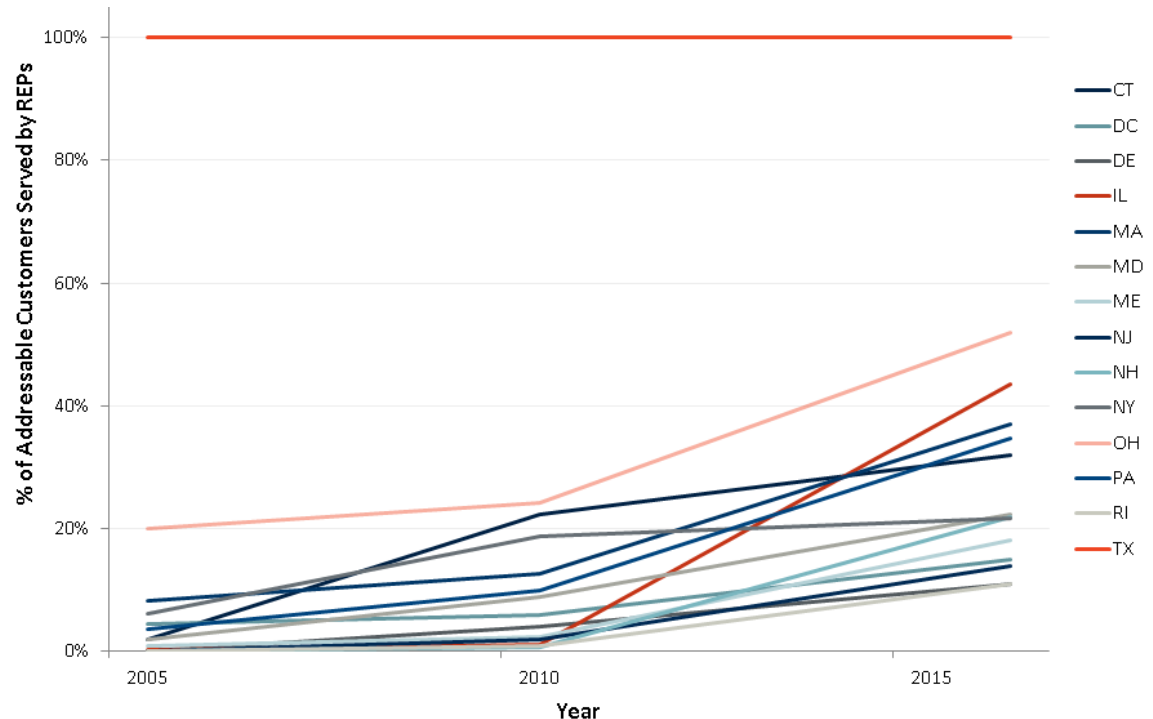
[3] Diameter of the circle is scaled based on the number of "addressable" customers in the state in 2016. Based on state rules, addressable customers do not include customers on municipal, co-op, or state/federal agency service

[4] Texas' REPs serve 100% of addressable commercial and industrial customers

REP Market Shares over Time (2005-2016)

- Market shares of REPs have increased in the last 11 years
- Initial increases were C&I
- But as this market became saturated, later increases came from residential customers
- Many of the increases in residential market share in the last 5 years attributed to CCA

REP Share of Addressable Market in 2005, 2010, and 2016



Sources: The Brattle Group, US Energy Information Administration (EIA), Maine Public Utilities Commission

Notes:

- [1] ME uses data published by the state PUC, due to anomalies in the EIA data
- [2] Partial competition states are not included. These states include AZ, CA, MI, NV, and OR
- [3] Based on state rules addressable customers do not include customers on municipal, co-op, or state/federal agency service
- [4] Excludes Canadian provinces of Ontario and Alberta

Current developments in retail electricity choice

Regulatory Focus on Residential Customers

- **In New York:**
 - REPS are currently prohibited from marketing to “low-income” customers pending further review
 - Proceeding currently underway to investigate whether REPs’ prices for residential customers should be regulated, and specifically regulated so that they offer savings compared to the Standard Offer
- **In Connecticut:**
 - REPs are prohibited from offering variable rate plans to residential consumers
- **In Alberta:**
 - Regulators capped the regulated rate option at 6.8 cents/kWh to reduce consumer exposure to market fluctuations, which makes it harder for REPs to compete

Other Market Developments

- **Community Choice Aggregation**
 - CCA consists of cities, counties and special districts aggregating the buying power of customers and securing alternative energy supply (usually with a strong renewables content) on behalf of its residents.
- **Utility of the future proceedings**
 - Under this vision where there continues to be rapid technological advances in distributed energy resources, storage, AMI, and where some consumers have a dual roles as producers and consumers—the so called prosumer role as that term is used by the New York Public Service Commission’s Reforming the Energy Vision—retail choice may become an indispensable part of the vision

Literature: retail choice and price effects

Kwoka (2008) review of studies

- Joskow (2006) – wholesale and retail choice led to lower retail prices
- Fagan (2006) – restructuring did not lead to lower industrial prices
- Taber, Chapman and Mount (2006) – deregulation not associated with lower prices
- CAEM (2003) – find consumer benefits
- Apt (2005)—no evidence of lower industrial prices

Other studies

- O'Connor (2017) – finds competitive choice jurisdictions fared better in terms of price, investment and efficiency
- Su (2014) – finds only residential class has benefitted but benefit is transitory and disappears over time
- Swadley & Yücel (2011) – retail choice makes market more efficient by lowering markup of retail prices over wholesale costs
- Studies on wholesale competition find positive effects:
 - Kleit and Terrell (2001), Fabrizio et al. (2007), Zhang (2007), Craig & Savage (2013), Tierney (2007)

Ros (2017) *The Energy Journal* Article

Approach

Data

- Panel data covering 72 electricity distribution utilities from 1972 to 2009
- Most of data are from a Total Factor Productivity Study (“TFP”) that I co-authored for an X-factor proceeding in Alberta in 2011
- TFP study provides rich data on output quantities, revenue, input quantities, and expenses and importantly on each utility’s TFP which I use as a regressor
- Average revenue per unit of output used as a proxy for price

Methodology and approach

- First part of paper I estimate static & dynamic structural electricity demand models for each customer class
 - $y_{it} = \mathbf{W}_{it}\boldsymbol{\gamma} + \mathbf{X}_{it}\boldsymbol{\beta} + v_i + \varepsilon_{it}$
- Second part I estimate reduced-form price models
 - $q_{it}^D = \beta_0 + \beta_1 P_{it} + \boldsymbol{\beta}_j \mathbf{X}_{it}$
 - $q_{it}^S = \gamma_0 + \gamma_1 P_{it} + \boldsymbol{\gamma}_j \mathbf{Z}_{it}$
 - $P_{it} = \left(\frac{\gamma_0 - \beta_0}{\beta_1 - \gamma_1} \right) + \left(\frac{\gamma_j}{\beta_1 - \gamma_1} \right) \mathbf{Z}_{it} - \left(\frac{\beta_j}{\beta_1 - \gamma_1} \right) \mathbf{X}_{it}$

Variables and estimators utilized

Variables Use

- Comp (binary)
- Comp*ng
- Comp*time
- Ratecap
- Ratecap*ng
- Time-trend
- Population
- Tfp
- HDD
- CDD
- Income
- Price natural gas
- Geographic (binary)

Estimators

- Utilized different estimators for fitting the panel-data price equations
- Static price models using fixed and random effects estimators where the standard errors are robust to intragroup correlations;
- Static price models using fixed and random effects estimators that fit the data when the disturbance term is first-order autoregressive common to all panels;
- Static price models using a generalized least square estimator that fit the data when the disturbance term is heteroskedastic and first-order autoregressive specific to each panel;
- Dynamic panel-data models using Arellano Bond GMM estimator
- Two-stage least square model using lagged values of mean electricity prices and unemployment rate

Total effect of residential retail competition by year and at mean values of *In_price natural gas*

	Model					
	FE _{AR1}	RE _{AR1}	GLS _{HAC}	AB	AB _{IV}	Mean
1998	-9.05%	-9.96%	-4.94%	-5.52%	-4.52%	-6.80%
1999	-8.29%	-8.81%	-4.13%	-5.01%	-4.08%	-6.06%
2000	-7.50%	-7.57%	-3.35%	-4.28%	-3.46%	-5.23%
2001	-6.72%	-6.38%	-2.52%	-3.75%	-3.00%	-4.47%
2002	-5.94%	-5.23%	-1.65%	-3.43%	-2.69%	-3.79%
2003	-5.15%	-4.03%	-0.79%	-3.01%	-2.30%	-3.06%
2004	-4.34%	-2.65%	-0.04%	-1.93%	-1.44%	-2.08%
2005	-3.52%	-1.36%	0.80%	-1.26%	-0.88%	-1.25%
2006	-2.69%	0.09%	1.54%	-0.03%	0.09%	-0.20%
2007	-1.86%	1.39%	2.40%	0.55%	0.59%	0.62%
2008	-1.05%	2.61%	3.34%	0.76%	0.83%	1.30%
2009	-0.17%	4.25%	4.01%	2.49%	2.15%	2.55%

Total effect of commercial retail competition by year and at mean values of *In_price natural gas*

	Model					
	FE _{AR1}	RE _{AR1}	GLS _{HAC}	AB	AB _{IV}	Mean
1998	-7.37%	-8.18%	-3.33%	-5.47%	-5.85%	-6.04%
1999	-7.59%	-8.18%	-3.50%	-5.33%	-5.62%	-6.04%
2000	-7.81%	-8.14%	-3.78%	-5.03%	-5.31%	-6.01%
2001	-8.03%	-8.14%	-3.96%	-4.88%	-5.07%	-6.02%
2002	-8.24%	-8.17%	-4.05%	-4.88%	-4.90%	-6.05%
2003	-8.45%	-8.18%	-4.19%	-4.80%	-4.69%	-6.06%
2004	-8.69%	-8.09%	-4.60%	-4.26%	-4.27%	-5.98%
2005	-8.91%	-8.06%	-4.83%	-4.02%	-3.99%	-5.96%
2006	-9.16%	-7.95%	-5.30%	-3.39%	-3.52%	-5.86%
2007	-9.38%	-7.94%	-5.49%	-3.20%	-3.27%	-5.86%
2008	-9.57%	-7.99%	-5.53%	-3.29%	-3.13%	-5.90%
2009	-9.84%	-7.80%	-6.18%	-2.32%	-2.51%	-5.73%

Total effect of industrial retail competition by year and at mean values of *ln_price natural gas*

	Model					
	FE_{AR1}	RE_{AR1}	GLS_{HAC}	AB	AB_{IV}	Mean
1998	-3.93%	-5.48%	-3.30%	-5.76%	-6.26%	-4.95%
1999	-5.30%	-6.37%	-3.44%	-6.20%	-6.69%	-5.60%
2000	-6.75%	-7.30%	-3.77%	-6.50%	-7.01%	-6.26%
2001	-8.09%	-8.17%	-3.92%	-6.93%	-7.43%	-6.91%
2002	-9.30%	-8.99%	-3.91%	-7.49%	-7.95%	-7.53%
2003	-10.55%	-9.82%	-3.99%	-7.98%	-8.41%	-8.15%
2004	-12.07%	-10.79%	-4.56%	-8.06%	-8.58%	-8.81%
2005	-13.39%	-11.66%	-4.80%	-8.41%	-8.94%	-9.44%
2006	-14.92%	-12.63%	-5.46%	-8.41%	-9.05%	-10.10%
2007	-16.15%	-13.47%	-5.64%	-8.81%	-9.45%	-10.70%
2008	-17.21%	-14.21%	-5.54%	-9.44%	-10.01%	-11.28%
2009	-18.86%	-15.25%	-6.53%	-9.16%	-9.92%	-11.95%