Retail Choice Impact on Consumer Behavior [1]

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Abstract

Our empirical findings indicate that the introduction of retail choice in Pennsylvania led to an overall increase in the magnitude of the elasticity of demand across customer classes, which indicates a move towards more competitive markets. We also examine switching patterns from utility to retail providers and find significant differences in pace and pattern of switching by customer class. We propose an extension of the classic Bass diffusion model to explain switching patterns from utility to retail providers.

JEL Classification: Q410, Q470

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[1] *The opinions expressed are the author's and do not reflect the views of FirstEnergy, Charles River Associates or any of its respective affiliates. Results are based on the data used in this paper and other regional data might result in different conclusions.*
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1 Introduction

Retail choice for electricity became available in Pennsylvania after passage of the Electricity Generation Customer Choice and Competition Act of 1996. However, more than a decade elapsed before customers widely switched to a retail provider. In December of 2008, the Pennsylvania Public Utility Commission ("PA PUC" or "Commission") approved a final rulemaking order which "adopted reporting requirements regarding electric generation market activity to prevent anticompetitive or discriminatory conduct and the unlawful exercise of market power.[4]" Since then, all retail choice suppliers are required to file an annual activity sales report with the PA PUC. The first annual "Retail Electricity Choice Activity Report" was issued by the Commission in 2010. 2010 marks a boom in switching activity from utilities to retail choice providers in all customer classes. However, some customers have since switched back to the local utility from their retail provider. For example, extreme cold weather in January of 2014 led to a spike in energy prices and triggered a noticeable switch back to traditional utilities in multiple states,[5] and switching has been seen in Pennsylvania as well.

This study examines the impact of the introduction of retail choice, which enabled energy customers to choose their retail supplier over the local incumbent utility, on consumer behavior, namely the elasticity of demand. Overall, we find that the introduction of retail choice led to an

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[4] PA Public Utility Commission (PUC). Retail Choice Activity Reports accessed from: http://www.puc.state.pa.us/utility_industry/electricity/retail_choice_activity_reports.aspx

[5] The polar vortex of January 2014 led FirstEnergy Solutions, a major retail power marketer in both Illinois and Ohio, to announce plans for a one-time polar vortex surcharge of $5 to $15 for Residential customers in both states. The company ultimately changed course, but "the announcement was unpopular and resulted in retail choice customers switching back to their full-service providers in Ohio and Illinois. https://www.eia.gov/todayinenergy/detail.php?id=37452

increase in the magnitude of the elasticity of demand, which indicates a move towards more competitive markets.

Our study also investigates aggregate customer switching from utility to retail providers. We observe patterns that are consistent with the classic Bass (1969) diffusion model, once we allow for switching back from retail providers to utility. We evaluate switching patterns for each customer segment (i.e., Residential, Commercial and Industrial) separately and observe differences in pace of the switching to retail providers for different customer classes.

Our dataset includes Residential, Commercial and Industrial aggregate load for two Pennsylvania utilities: Metropolitan Edison Company ("Meted") and Pennsylvania Electric Company ("Penelec") from 2008 until the first half of 2019. The load is aggregated into two groups – "served by utility" and "served by a retail choice provider."

This paper is organized as follows: this section follows with review of the existing literature on electricity demand models; Section 2 provides an analysis of market saturation of retail choice programs in the Meted and Penelec service territories; Section 3 describes our empirical methodology for demand estimation; Section 4 describes the data we gathered for our analysis; and Section 5 concludes with further research questions.

1.1 Literature Review

End-use electricity demand has been studied by many economists for various customer segments including Residential, Commercial and Industrial customers, and multiple studies employed reduced-form demand equations to estimate price elasticity of electricity demand.

Houthakker et al. (1974), Taylor (1984), Bohi and Zimmerman (1984) and Dubin and MacFadden (1984) estimated Residential and Commercial electricity demand using dynamic adjustment approaches. Their estimated price elasticity of demand ranges from 0.2 to 0.7, which suggests inelastic demand. Later studies by Bernstein and Griffin (2005) and Paul et al. (2009) also found that Residential customers are price inelastic.

More recently, Alberini and Flippini (2011) employed a least squares dummy variable estimator to correct for the measurement error introduced by highly averaged price data. They found that the measurement error correction produced higher price elasticity. Their estimate ranges between 0.45 and 0.75. A recent study by Ros (2017) found that price elasticity of demand varies between 0.40 and 0.61 for Residential, between 0.33 and 0.77 for Commercial and approximately 0.60 for Industrial customers. All of these studies mentioned above employed either monthly or annual customer bill data to estimate price elasticity of demand.

Few notable studies estimated price elasticity of demand using hourly or sub-hourly data. Patrick and Wolak (2001), Fan and Hyndman (2011) and Lijesen (2007) estimated real-time price elasticity of demand in the wholesale electricity market to be in the range from 0.04 to 0.43. Schwarz (2002) found that price responsiveness substantially varies by customer segment and time of day throughout the year. Eryilmaz et al. (2017) estimated price elasticity of electricity demand for Industrial customers in the Midwest in both retail and wholesale markets. Their estimated price elasticity ranges between 0.09 and 0.21, which accounts for different dynamics during peak hours only and all hours in a day.

Joskow (2006) is one of the first studies that looked at the impact of competition on retail prices for Residential and Industrial customers. Although Joskow’s study provides an indication of price reduction in retail rates, the results are based on a limited dataset. Swadley and Yucel (2011) study the impact of retail competition and transitional pricing on Residential electric rates using Texas as a baseline. Their study showed that retail choice programs had no impact on retail electricity prices in the long run and conclude that customers did not have an incentive to switch to a retail supplier.

Su (2014) empirically investigates the impact of retail competition on consumer energy prices using Difference-in-Differences approach and find that retail competition benefited only Residential customers. Specifically, the estimated price reduction for Residential customers ranges between 0.87 to 1.02 cents/kWh. They also find that impact of retail competition on prices diminishes over time.

Finally, Ros (2017) employed an econometric analysis of electricity demand in the United States and estimated the impact of competition on customer price responsiveness. Ros' study updates the study done by Joskow (2006) with more comprehensive and recent data, and concludes that retail competition overall benefited electric customers, particularly large Industrial customers.

Our research extends the existing literature in several ways. First, this study presents a theoretical framework to explain customer switching between the incumbent utilities and retail choice providers. Our modeling framework can be useful in explaining consumer adoption of any innovative energy product, which is the subject of our forthcoming research. Second, this is one of the first studies to estimate price elasticity of electric demand of utility customers and customers switched to a retail choice program separately. As expected, we find different consumption dynamics between the two groups.

2 Data

The dataset for this analysis includes hourly load data for utilities and retail provider customers as well as quarterly switching statistics on both Meted and Penelec territories. This data is publicly available at https://www.fepaauction.com/Documents/LoadandOtherData.aspx.

2.1 Customer Class

In Meted and Penelec territories, as in most of the US, energy load is divided into three customer classes: Residential, Commercial and Industrial. The customer class for each consumer or business entity is determined largely by the size of their load.[6] The rates offered to Residential and Commercial class customers by the utilities and retail choice providers are mostly Fixed Cost (FC) rates[7], and Industrial customers are offered Hourly Pricing (HP) Service.[8].

The Fixed Price customers (Residential and Commercial) are offered a Fixed (unvarying by hour, flat) rate for each kWh. For the incumbent utility customers, this rate is set for an entire PJM year (June 1st to May 31st). The retail choice providers offer a Fixed (Flat) rate, Time of Use (TOU) rate, Hourly, Seasonal and Hybrid pricing options. According to the Retail Electricity Choice Activity Report (2018) issued by PA PUC[9] over 80% of the retail choice customers chose the Fixed Rate option.

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[6] For detailed information about customer class and pricing offered by the utility please see https://www.firstenergycorp.com/content/dam/customer/Customer%20Choice/Files/PA/tariffs/Met-Ed-Tariff-52-Supp-72.pdf

[7] Residential and Commercial customers that meet the metering requirements can elect to have Hourly Pricing Service.

[8] S. Littlechild (2018) detailed report on regulation and retail completion in US for detailed description of market dynamic. https://www.eprg.group.cam.ac.uk/report-the-regulation-of-retail-competition-in-us-residential-electricity-markets-by-s-littlechild/

[9]The Retail Electricity Choice Activity Reports can be found at the Commission website, the report we site above is found here: http://www.puc.state.pa.us/Electric/pdf/Electric_Choice_Report-2018.pdf

Hourly Pricing service means that the consumer pays a relatively small administrative fee and fixed fee of capacity, ancillary services and other relevant charges per each kWh hour of energy consumed. In addition, the consumer pays the *"Real Time PJM load-weighted average Locational Marginal Price ("LMP") for the ME Transmission Zone"* for each kWh in the billing period. The exact terms of the contract depend on the energy provider.

Note that the customers with the Hourly Pricing option are directly affected by real-time LMP fluctuations, while the customers with the Fixed Price option are protected from fluctuations in PJM markets. If there is an unexpected drop in the energy prices, then the Hourly Priced (mostly Industrial) customers will see a lower bill, and the Fixed Price – Residential and Commercial customers will not. On the other hand, when the market prices go up, the Industrial consumers will have a higher bill than anticipated, and the rates charged to Residential and Commercial consumers will not change.

Appendix A summarizes the variables used in our analysis.

3 Switching between utility and retail choice providers

In this section of the paper, we examine the total number of customers that switched from the utility to a retail provider by Company and customer class. The two variables in our dataset[10] that we use in this section are: (1) total number of customers served by a retail provider and (2) the percentage of customers served by a retail provider out of total customers in the class. This data is available quarterly by Company and customer class from the second quarter of 2008 to the second quarter of 2019.

[10] See Appendix A for variable lists by Company

3.1 Switching patterns observed in data

We first plot the switching patterns and then propose a theoretical explanation for our results. Due to data limitations, we do not perform a more rigorous econometric analysis at this time. Figure 1 shows switching patterns by Company and customer class. Note that "Percent of customers switched in a quarter" is plotted on the second y-axis and can be negative, indicating switch back from retail providers to utility.

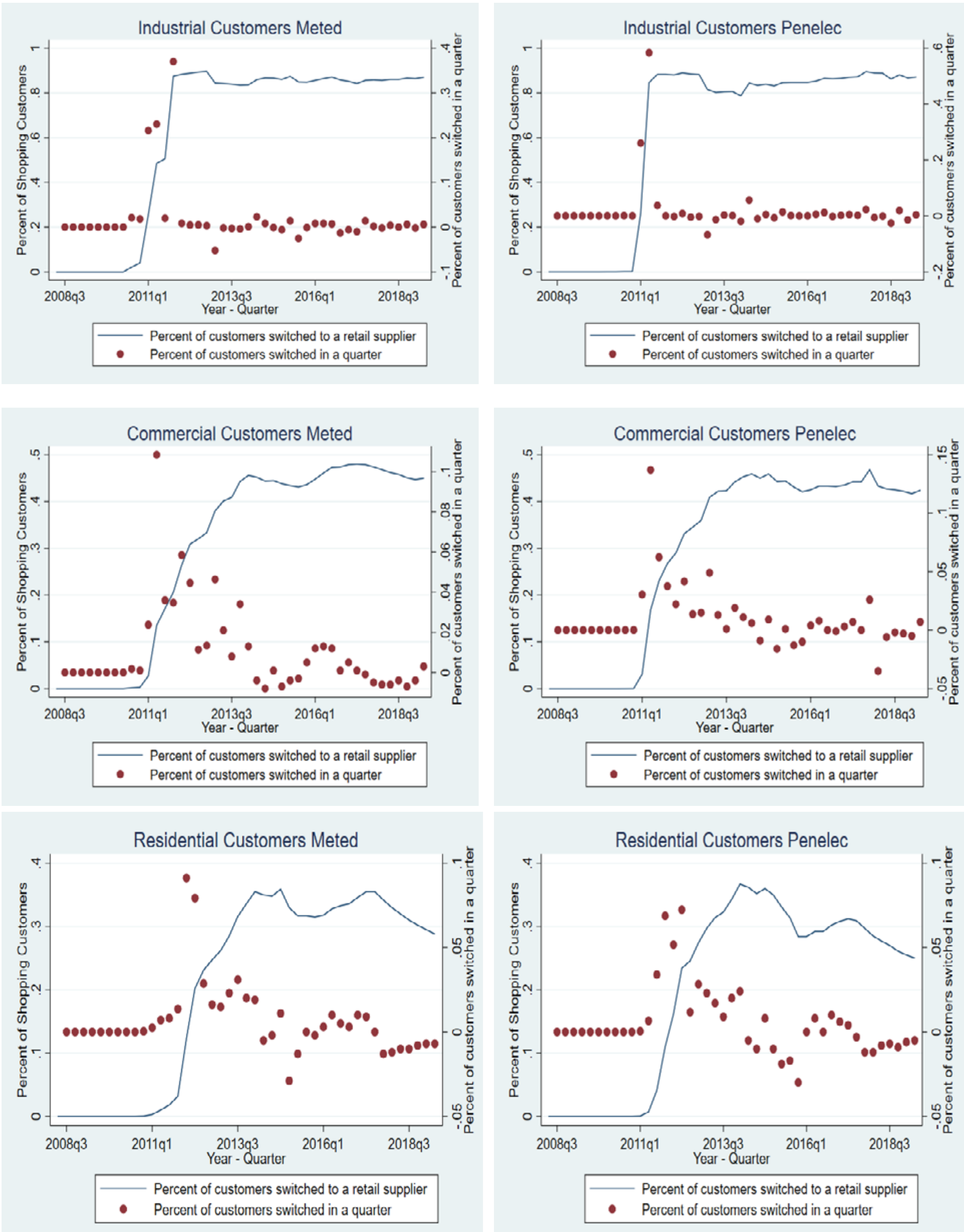
The graphs show that active switching to retail providers in Pennsylvania happened between the first quarter of 2010 and the end of 2012. The switching patterns vary by customer class. Industrial consumers switched to retail providers at the highest pace compared to the Residential and Commercial classes. There are two potential explanations. (1) Industrial customers are most familiar with energy markets. This customer class often has the ability to observe the real-time price of electricity (e.g., participation in the wholesale market.) (2) Industrial customers are likely able to negotiate contract terms with retail suppliers. (3) Industrial customers are much fewer in number, but consume relatively more energy than customers in Commercial or Residential groups.[11] Thus, it is easier for a retail provider to reach all customers in the Industrial group and create tailored offers for them.

Figure 1 shows three data regimes in each chart. First is the pre-retail choice, with no instances of switching to retail providers. Second is the period of active switching, where consumers self-select into two groups – utility customers and retail provider customers. This switching process is most clearly seen in the Industrial customer segment. The third period is a

[11] There are approximately 1,700 Industrial customers, over 150,000 Commercial and close to one million Residential accounts across Meted and Penelec,

steady state, again mostly clearly seen in the Industrial customer segment. See Table 1 in the next section for proposed timing for switching by company and customer class.

Figure 1. Switching Patterns by Company and Customer Class



3.2 Extension of classic Bass Model

Retail choice programs are a market innovation and, to explain their impact on consumer behavior, we turn to existing models describing diffusion of new technologies. Classic Bass (1969) diffusion model is expressed as the following:

$$n(t) = \frac{dN(t)}{dt} = l[M - N(t)] + \frac{q}{M}N(t)[M - N(t)] + \qquad [1]$$

Where

n(t) : the rate of adopters at time *t*

N(t) : the cumulative number of adopters

M : ultimate number of adopters

l : adoptive influence that is independent of prior adoptions (innovator rate)

q : adoptive influence that depends on imitation (imitator rate)

The term $l[M - N(t)]$ in (1) represents the number of consumers that adopted new technology and who are not influenced by others. These are “innovators,” and the term $\frac{q}{M}N(t)[M - N(t)]$ represents the number of consumers that are influenced by previous buyers. The terms *p* and *l* are referred to as the coefficient of innovation and coefficient of imitation, respectively. These terms are typically assumed to be constants.

Figure 2 below shows a graphic representation of Bass model (1). It is based on a simulation in which we assume that *l = 0.003* and *q = 0.15*. That the resultant coefficient of innovation was significantly smaller in magnitude is consistent with prior findings in the literature[12].

Note that data presented in Figure 1 shows a much less “orderly” pattern than seen in Figure 2. The differences between the classic Bass model (Figure 2) and what we observe in the energy provider marketplace (Figure 1) may be attributed to the fact that retail choice providers are not the most cost-effective option for consumers. Consumers that are aware of the ability to switch providers will only switch from utilities if retail providers offer a more competitive price. Consumers have an option to switch back to utilities, if utilities’ prices are lower.

For example, extreme cold weather in January of 2014 led to a spike in energy prices and triggered a noticeable switch back to traditional utilities in multiple states.[13] This switch back is seen in Figure 1 for Commercial and Residential customer classes.

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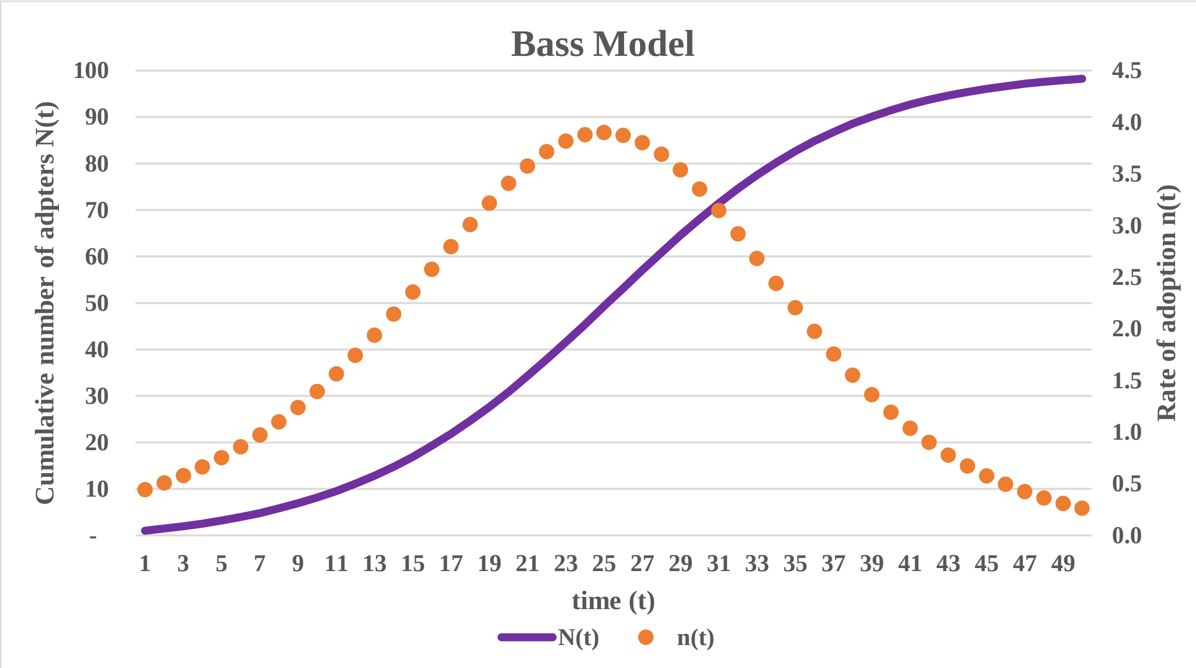
[12] For example, see Mahajan, Muller and Bass (1995). doi:10.1287/mksc.14.3.G79
[13] The polar vortex of January 2014 led FirstEnergy Solutions, a major retail power marketer in both Illinois and Ohio, to announce plans for a one-time polar vortex surcharge of $5 to $15 for residential customers in both states. The company ultimately changed course, but "the announcement was unpopular and resulted in retail choice customers switching back to their full-service providers in Ohio and Illinois. https://www.eia.gov/todayinenergy/detail.php?id=37452

Figure 2. Classic Bass Model



Note: This simulation assumes l = 0.003, q = 0.15

With this in mind, we propose an extension of the Bass model where pace of switching depends on relative prices offered by retail providers and utilities. We also introduce the switch back option:

$$n(t) = \begin{cases} if\, p_u(t) > p_r(t) \;\; l(p_u(t), p_r(t))[M - N(t)] + \frac{q(p_u(t), p_r(t))}{M} N(t)[M - N(t)] \\ if\, p_u(t) < p_r(t) \;\; l(p_u(t), p_r(t))N(t) \\ 0 \; otherwise \end{cases} \qquad [2]$$

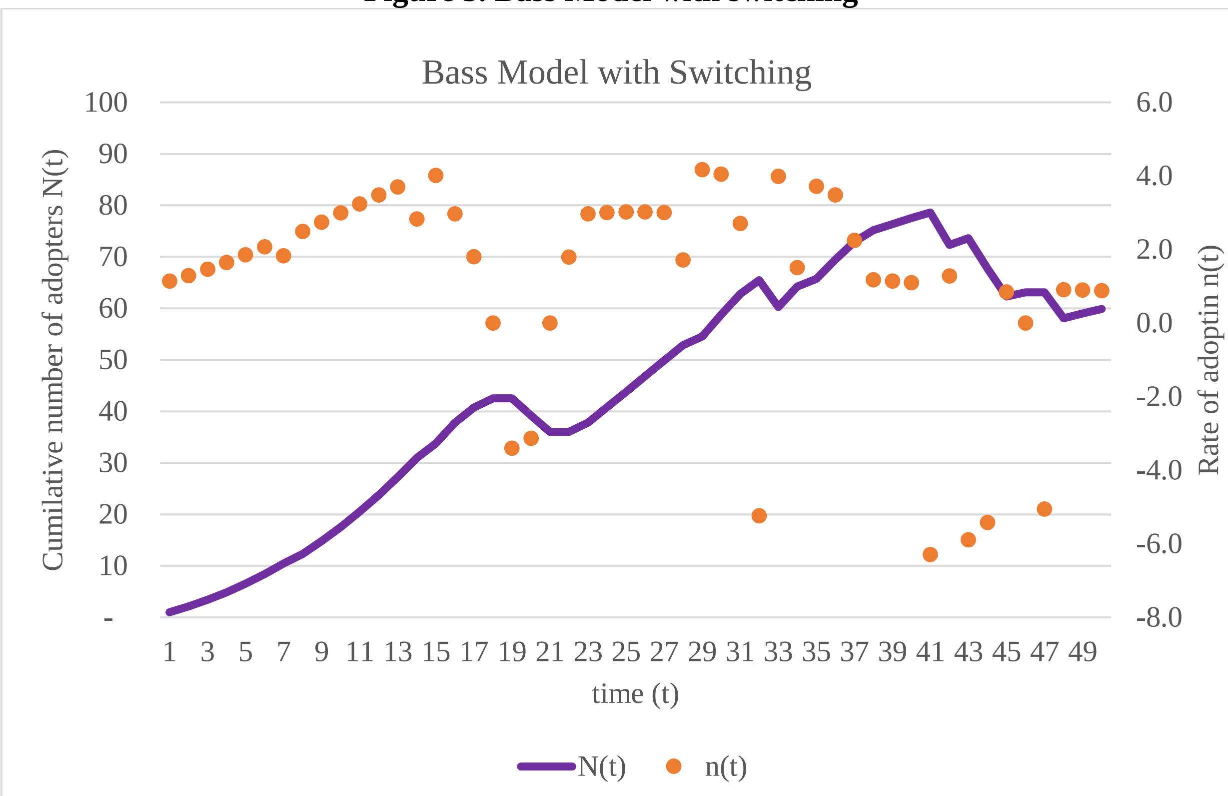
Where the new variables are:

$p_u(t)$: price offered by utility at time *t*

$p_r(t)$: price offered by a retail choice provider at time *t* (assume, without loss of generality that there is only one retail choice provider)

In this specification, consumers who learn about the retail choice program and switch *only if* the prices offered by the retail choice providers are less then what is offered by utility are represented by the equation - $if\, p_u(t) > p_r(t)$.

Figure 3. Bass Model with switching



Note: Simulation of model described in Equation (2), for illustrative purposes only

If, on the other hand, utilities offer better prices, some of the retail provider customers will switch back to their default utility provider. For example, simulations of the model specified in Equation (2) are illustrated in Figure 3. We assume that at any time *(t)*, 8% of the retail provider's customers compare prices they are offered to the utility prices, and switch back if utilities offer a better price.

The rates of switching $l(p_u(t), p_r(t))$ and $q\big(p_u(t), p_r(t)\big)$ are not constant and vary depending on the relative prices in the marketplace. The rates of switching are higher when retail providers offer a higher percentage of price savings over utilities and vice versa.

We performed several simulations of equation (2), one of which is presented in Figure 3.[14] Our goal was to see which parameter combination(s) may explain patterns that we observe in Figure 1. Based on the model specified in Equation (2) and our simulations, we can make some conjectures regarding data presented in Figure 1:

1. Retail providers likely offered attractive introductory rates initially, leading to high switching rates around 2010 – 2012.
2. Utilities likely offered better rates during and immediately after the polar vortex and energy price spikes of 2014. This explains the switch back to utilities beginning around that time. Retail providers are more likely to be impacted by power price fluctuations in the market than utilities.
3. From 2014 – 2015 on, we observe something close to a market equilibrium, where both utilities and retail providers offer comparable prices. There are some differences between the prices offered by various providers, but the magnitude of the differences very likely isn't large. Utilities are likely offering slightly better prices to residential customers than retail providers are.

The three points above are conjectures, and our further research aims to evaluate and prove each of the statements. The dataset we use for this study does not distinguish between

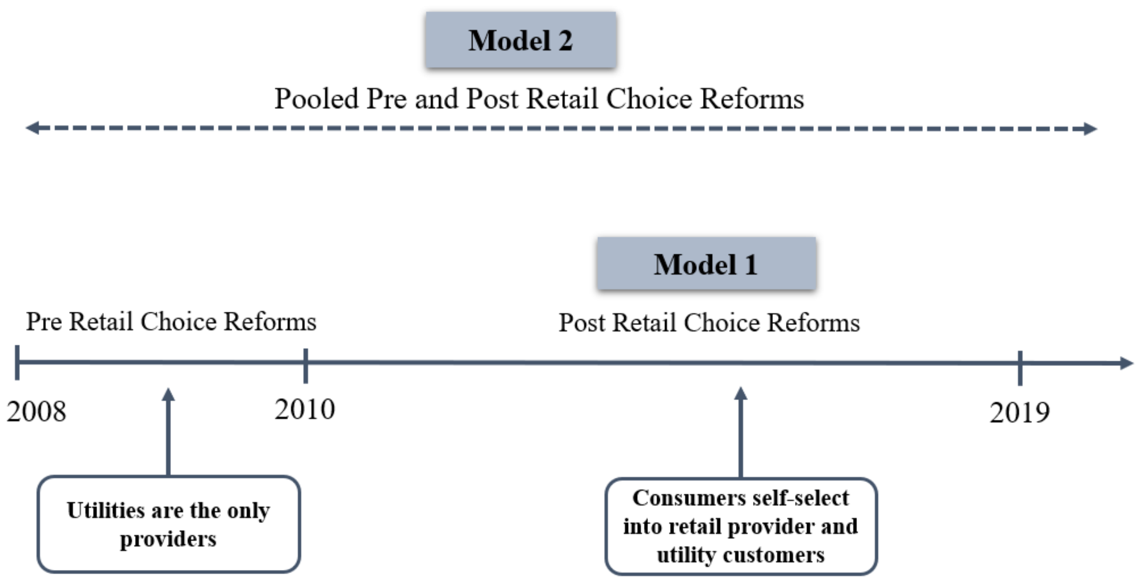
[14] See Appendix B of this paper for simulated data behind Figure 3

utility and retail provider prices offered to consumers. We are researching ways to obtain this data.

4 Empirical Methodology

In this section, we discuss our empirical approach for estimating price elasticity of demand for each customer segment. Our empirical framework is twofold, as illustrated in Figure 4.

Figure 4. Illustration of Empirical Methodology



First, we specify a dynamic linear demand equation similar to Houthakker (1974), Bohi and Zimmerman (1984), Gately and Huntington (2002), Bernstein and Griffin (2006), Erdogdu (2010), and Alberini and Filippini (2011) for Residential, Commercial and Industrial customer segments separately and estimate price elasticity of demand for utility and retail provider customers after the adoption of retail choice programs ("Post Adoption Period"). Post adoption period is defined separately for each customer class, as the pace of customer switching to the retail choice programs were different for each customer segment, as discussed in the previous section.

Unlike Residential and Commercial customers, Industrial customers bills are directly impacted by real-time prices of electricity. Note, that most Residential and Commercial customers often do not have the technology to track real-time prices of electricity. Thus, the estimated demand equation for Industrial customers is specified as hourly model, while the estimated demand equation for Residential and Commercial customer classes are specified as monthly models. Estimated price elasticity for each customer class provides an understanding of customers' responsiveness to price changes for customers who switched to retail programs versus the customers who stayed with the utilities (or switched back to the utilities). We define the "Post Retail Reform Period" as the time when customers begin switching to retail providers. The timing for each customer class is summarized in Table 1.

Table 1. Post Retail Reform Period

Customer Class	Penelec	Meted
Residential	>2012q2	>2012q2
Commercial	>2012q2	>2012q1
Industrial	>2012q2	>2011q4

Second, we estimate demand on "pooled" data by combining energy consumption of utility and retail customers from 2008 to 2019. This data includes energy consumption data prior to retail choice reforms in Pennsylvania ("Pre-Retail Reform Period") and the energy consumption data from the Post Retail Reform Period. We estimate the price elasticity of demand for each market after the adoption of retail choice programs.

4.1 Model 1: Demand Estimation for Post Adoption Period

We estimate electricity demand for utility and retail customers separately using historical electricity consumption data for each customer class in Meted and Penelec service territories. We assume that these customers face the same market prices, weather conditions, and other economic factors in the region. We also assume that consumers are not able to adjust to the real-time price fluctuations instantly (i.e. their response to price fluctuations is delayed). For example, it may take customers time to adopt a new technology (e.g. smart meters) to track real-time electricity prices, or some customer classes may be constrained by their production or operational processes, or there may be regulatory constraints that render customers unable to observe the hourly or daily fluctuations in price. Residential and commercial customers observe electricity prices on monthly bases via monthly utility bills and are unlikely to change their demand patterns right away. Our empirical model controls for this delay in response.

We define the following variables:

t. – time variable, and defined as hour {1 … 24} or month {1 … 12}

i - customer class {Residential, Commercial, Industrial}

$U_{i,t}$ – aggregate electricity demanded by utility[15] customers in customer class *i* at time *t*

$RP_{i,t}$- aggregate electricity demanded by retail provider customers in customer class *i* at time *t*

[15] The utilities are Meted and Penelec. We run a separate econometric analysis for each utility.

Key factors that determine the amount of electricity consumption are:

$P^{e}_{i,t}$: hourly (or monthly) price of electricity (*e*). The hourly prices are real time LMPs for the Meted and Penelec Zones, and the monthly prices are from the Energy Information Administration (EIA), which are average prices for across utility and retail provider customers. We assume that utility and retail provider loads face the same average monthly prices.

$W_{i,t}$: hourly (or monthly) weather indicators (temperature and dew point[16])

$\vartheta_{i,t}$: time-dummy variables to control for seasonality (e.g., time trend or month-specific binary variables that take the value 1 during the associated month and 0 otherwise).

$\varepsilon_{i,t}$ random error term assumed to be identically and independently distributed with zero mean and constant variance ($\varepsilon_{i,s,t} \in \mathrm{IID}(0, \delta^2)$).

We emulate Eryimaz et al (2017) in our modeling below, where demand for electricity is determined by equation below. The derivation for the retail provider customers are identical. Suppose there is an optimal demand $NS^{*}_{i,t}$ for electricity that is unobservable to researchers:

$$lnNS^{*}_{i,t} = \theta_0 + \theta_1 lnP^{e}_{i,t} + \theta_2 lnW_{i,t} + \vartheta_{i,t} + \pi_{i,t} \qquad [3]$$

The actual demand $NS_{i,t}$ is observed, and the dynamic relationship between optimal and actual electricity demand can be expressed as

$$lnNS_{i,t} - lnNS_{i,t-1} = \sigma\left(lnNS^{*}_{i,t} - lnNS_{i,t-1}\right) \qquad [4]$$

[16] Dew point is a measure of humidity

Where σ is the coefficient of adjustment of the actual demand to the optimal demand.

Estimated regression equations for Model 1 for utility (5) and retail customers (6) thus become:

As mentioned, we use the same specification for utility and retail supplier customers in order to compare the price elasticity of demand between the two groups.

Hourly demand is priced in the real-time market, where generators are dispatched in the reverse order of the marginal costs they bid (the lowest price dispatched first, etc.). The hourly price is determined by the last dispatched generator's marginal cost, and thus, as the demand for electricity increases, so does the price. To address this, we estimate the Equations [5] and [6] above as a two-stage regression estimation, where the first stage regression is defined below:[17]

$$lnP_{i,t}^{e} = \quad \alpha_0 + \alpha_1 lnW_{i,t} + \tau_{i,t} \qquad [7]$$

An appropriate instrumental variable is highly correlated with an endogenous variable (real-time price in this case) and is not correlated with the error term. Our instruments are hourly temperature and hourly humidity (dew point). Specifically, we interact temperature with winter months (December, January, February) and shoulder months (i.e., months outside of summer and winter months) dummies and humidity for summer month (June, July, August) dummies. Further, we conducted statistical analyses to validate the instrumental variables.

[17] In a two-stage regression analysis, the predicted values of the endogenous variables (i.e., hourly price of electricity in this case) are obtained in the first-stage of the regression and the predicted values of the endogenous variable are used to estimate demand in the second-stage equation. We used Stata to estimate two-stage regression estimation using its "ivregress2" package.

In the hourly demand equations, for industrial customers, we estimate price elasticity for peak and off-peak hours separately.[18]

4.2 Model 2: Demand Estimation for Pre and Post Adoption Period

In this section, we set up a modeling approach to evaluate electricity demand for utility and retail customers jointly. We then estimate the effect of the retail choice reform on the overall demand elasticity. The demand equation has the following functional form:

$$lnD_{i,t} = \beta_0 + \beta_1 lnD_{i,t-1} + \beta_2 lnP^e_{i,t} + \beta_3 lnP^e_{i,t} * Post_{i,t} + \beta_4 lnW_{i,t} + \vartheta_{i,t} + \varepsilon_{j,i,t} \qquad [8]$$

Where:[19]

$D_{i,t} = U_{i,t} + PR_{i,t}$ is total hourly (or monthly) energy consumption of Utility and Retail Provider customers in customer class *i* at time *t*.

$Post_{i,t}$: is a binary {0.1} variable to identify the time period after the retail choice reform took place for each customer class. See Table 2 for dates by area and customer class.

We use Model 2 [8] to estimate the average price elasticity of demand after the adoption of retail choice programs. The estimated coefficient β_2 in [8] is the average price elasticity of demand for a given customer segment (i.e. the average of utility and retail provider customers)

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[18] Following PJM manuals, the peak hours are defined as the hours between 8 a.m. and 10 p.m. during weekdays. Weekends, hours outside of 8 a.m. and 10 p.m. and US Holidays are defined as off-peak, including New Year's Day, Christmas Day, July 4th, Thanksgiving, the 1st Monday of September, and the last Monday in May.

[19] Variables not defined here are defined in section 4.1. Note that the complete regression results are provided in Appendix C.

and $(\beta_2 + \beta_3)$ is the price elasticity of demand for a given customer segment during the Post Adoption Period.

5 Findings

In Table 3 we present the findings of our empirical analyses using Model 1 (described in the previous section), namely the estimated price elasticity of demand obtained from each regression for all customer classes. Note that price elasticities for Residential and Commercial customer class are estimated using monthly data, while Industrial class on-peak and off-peak price elasticities are estimated using hourly data.

Table 3. Price Elasticity of Demand by Customer class (Model 1).

	Residential	Commercial	Industrial	
			Peak	Off-peak
Retail Provider Customers				
Penelec	-1.440*** (8.21)	-0.444*** (-3.86)	-0.011* (2.28)	-0.012*** (6.66)
Meted	-2.485** (3.50)	-0.346 (0.50)	-0.003* (2.56)	-0.007*** (6.58)
Utility Customers				
Penelec	-0.112 (-0.72)	0.517* (2.26)	-0.036** (2.68)	-0.023*** (3.30)
Meted	-1.823*** (2.77)	-0.223 (0.29)	-0.011* (2.35)	0.005* (1.88)

*t-statistics in parenthesis *** p<0.01, ** p<0.05, * p<0.1*

We observe first that the price elasticities differ between retail provider and utility customers, which shows that the retail choice program allowed customers in all classes to self-separate into two groups, and that these groups have different characteristics.

In Penelec and Meted, we find that both Residential and Commercial retail provider customers have higher price elasticities compared to utility customers. Commercial utility customers in Penelec demonstrate positive elasticity. One possible explanation is that these customers are almost perfectly price inelastic, at least in the price range observed in our data, and the coefficient on price is showing correlation between Penelec Commercial utility customer load and total aggregate load, which is one of the price determinants.

In Penelec, estimated elasticity for residential retail provider customers is -1.440 (i.e., a percent increase in electricity price is associated with ~1.442 percent decrease in the amount of electricity demanded, all else equal) and utility customers is -0.112 and it is statistically insignificant. Estimated elasticity for Commercial retail provider customers is -0.444 and is positive 0.517 for utility customers. One possible explanation for this positive coefficient is that Commercial utility customers in Penelec are almost perfectly price inelastic, at least in the price range observed in our data, and the coefficient on price is showing correlation between Penelec Commercial utility customer load and total aggregate load, which is one of the price determinants. As for Meted, estimated elasticity for Residential retail provider customers is -2.485 and for utility customers is -1.823, which suggests that Meted Residential customers are price elastic. Estimated elasticity for Commercial retail provider customers in Meted is -0.346 and utility customers is -0.223 and is statistically insignificant.

We find that price elasticity estimates for Industrial utilities customers are greater than those of retail provider customers, except for off-peak estimates in Meted. Close to 90% of all Industrial load in both Meted and Penelec is served by retail choice providers. In Penelec, hourly price elasticity for industrial retail provider customers is -0.011 and -0.012 for on-peak and off-peak hours respectively, while hourly price elasticity for industrial utility customers is -0.036 and -0.023 for on-peak and off-peak hours respectively. In Meted, hourly price elasticity for industrial retail choice customers is -0.003 and -0.007 for on-peak and off-peak hours respectively, while hourly price elasticity for industrial utility customers is -0.011 and 0.005 for on-peak and off-peak hours respectively.

Estimated coefficients on lagged demand (i.e. the adjustment factor to optimal demand) is positive as expected and statistically significant for all three customer classes in both Meted and Penelec, except for retail provider Commercial class in Penelec. One possible explanation for this is that the changes in aggregate retail provider load due to customer switching make the lagged demand a less reliable predictor. This coefficient is higher for industrial customers (ranges between 0.97-1.00) compared to residential (ranges between 0.10-0.56) and commercial (ranges between 0.39-0.79) customers.

Next, we evaluate the Model 2 equation [8] by customer class for both Meted and Penelec. In this analysis, we both estimated the price elasticity (β_2 in Equation [8]) as well as the price elasticity after the retail choice reforms ($\beta_2 + \beta_3$) from Equation [8]) by customer class.

Table 2. Pooled Utility and Retail Provider Customers Regression Estimates

	Penelec			**Meted**		
	Residential	**Commercial**	**Industrial**	**Residential**	**Commercial**	**Industrial**
Electricity Price (β_2)	-0.286* (2.38)	0.1428* (1.72)	-0.0031** (3.06)	-0.816** (2.11)	-0.142 (0.37)	-0.002*** (3.90)
Price * Post Retail Reform (β_3)	-0.007 (0.64)	-0.006 (1.11)	-0.0001 (1.09)	-0.074** (2.62)	-0.037 (1.51)	-0.003*** (19.10)
$\beta_2 + \beta_3$	-0.2935** (2.47)	0.1372 (1.63)	-0.0032** (2.99)	-0.8903** (2.53)	-0.1790 (0.46)	-.0054*** (7.92)

*t-statistics in parenthesis *** p<0.01, ** p<0.05, * p<0.1*

In this analysis, we both estimated the price elasticity (β_2 in Equation [8]) as well as the price elasticity after the retail choice reforms ($\beta_2 + \beta_3$) from Equation [8]) by customer class.

Variable “Price * Post Retail Reform (β_3)” is the estimated effect of the retail reforms on price elasticity. We find it to be negative in all cases. That is, all customer classes became more price elastic, although not always statistically significantly.

For the Residential sector, Meted’s customers’ price responsiveness increases significantly after the retail choice reforms (-0.8903 = -0.816 + -0.074), while an increase in Penelec customers’ price responsiveness is not statistically significant (- 0.2935 = -0.286+ -0.007). Commercial customers’ price responsiveness is higher after the retail choice programs in both Meted and Penelec, although statistically insignificantly. Finally, Penelec Industrial customers’ price responsiveness is higher (-0.0032 = -0.0031 + -0.0001) and the increase is statistically significant, while Meted Industrial customers’ price responsiveness increases significantly (-0.0054 = -0.002 +-0.003) after retail choice reforms.

6 Policy Implications and Conclusions

We find that the introduction of retail choice in Pennsylvania led to an overall increase in the magnitude of the elasticity of demand across all customer classes, which indicates a shift towards more competitive markets. We also observe that retail choice programs allowed consumers to self-separate into two distinct power purchasing groups with different characteristics.

The patterns of switching between utility and retail providers show significant differences in pace and pattern by customer class. Our theoretical model indicates that the switch back to utilities from retail choice providers that we observe starting in 2014 is a manifestation of the competitive market forces in action. The switch should be attributed to a more attractive price offered by utilities in some time periods.

Our study demonstrates that the retail choice program benefited consumers in Pennsylvania by raising awareness of prices, and we believe that presence of incumbent utilities provides all consumers with a reliable and competitively priced option.

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8 Appendix A. Data description.

Meted Variables

Variable	# Unique Observations	Frequency	Mean	Std. Dev.	Min	Max	Start Date	End Date
Residential Utility customers hourly load	96,338	Hourly	792,630.20	292,232.70	214,201.30	2,329,860.00	1-Jun-08	31-May-19
Commercial Utility customers hourly load	96,338	Hourly	241,516.80	112,239.00	55,393.07	947,192.50	1-Jun-08	31-May-19
Industrial Utility customers hourly load	96,338	Hourly	159,318.50	238,694.10	-	883,262.60	1-Jun-08	31-May-19
Residential Retail Providers customers hourly load	96,338	Hourly	275,413.30	229,805.00	-	1,132,227.00	1-Jun-08	31-May-19
Commercial Retail Providers customers hourly load	96,338	Hourly	352,556.40	246,233.40	-	1,138,957.00	1-Jun-08	31-May-19
Industrial Retail Providers customers hourly load	44	Quarterly	840,852.70	547,319.30	-	1,804,447.00	1-Jun-08	31-May-19
Residential: Number of Retail Provider customers	44	Quarterly	103,443.80	73,548.75	-	177,018.00	1-Jun-08	31-May-19
Commercial: Number of Retail provider customers	44	Quarterly	19,939.17	12,813.20	-	31,978.00	1-Jun-08	31-May-19
Industrial : Number of Retail Provider customers	44	Quarterly	565.71	318.46	-	785.00	1-Jun-08	31-May-19
Residential: Percent of Retail Provider customers	44	Quarterly	21%	15%	0%	36%	1-Jun-08	31-May-19
Commercial: Percent of Retail provider customers	44	Quarterly	30%	19%	0%	48%	1-Jun-08	31-May-19
Industrial : Percent of Retail Provider customers	44	Quarterly	63%	36%	0%	90%	1-Jun-08	31-May-19
Real Time LMP	96,338	Hourly	39.09	38.08	(227.03)	1,817.52	1-Jun-08	31-May-19
Day Ahead LMP	96,338	Hourly	39.58	32.51	(2.49)	997.61	1-Jun-08	31-May-19
Wind Speed	96,338	Hourly	6.04	3.58	0.12	26.00	1-Jun-08	31-May-19
Temperature	96,338	Hourly	51.79	18.44	(5.11)	98.41	1-Jun-08	31-May-19
Dew Point	96,338	Hourly	41.56	18.70	(19.09)	76.00	1-Jun-08	31-May-19

Penelec Variables

Variable	# Unique Observations	Frequency	Mean	Std. Dev.	Min	Max	Start Date	End Date
Residential Utility customers hourly load	96,338	Hourly	433,692.80	163,699.70	121,619.90	1,352,693.00	1-Jun-08	31-May-19
Commercial Utility customers hourly load	96,338	Hourly	224,198.20	149,738.00	69,405.38	881,548.70	1-Jun-08	31-May-19
Industrial Utility customers hourly load	96,338	Hourly	168,254.30	266,431.00	-	900,123.30	1-Jun-08	31-May-19
Residential Retail Providers customers hourly load	96,338	Hourly	121,615.10	93,029.94	-	631,179.50	1-Jun-08	31-May-19
Commercial Retail Providers customers hourly load	96,338	Hourly	235,066.00	149,458.00	-	628,678.40	1-Jun-08	31-May-19
Industrial Retail Providers customers hourly load	96,338	Quarterly	528,844.80	277,673.40	1,406.64	1,043,666.00	1-Jun-08	31-May-19
Residential: Number of Retail Provider customers	44	Quarterly	102,634.70	70,288.76	-	184,912.00	1-Jun-08	31-May-19
Commercial: Number of Retail provider customers	44	Quarterly	25,290.13	15,649.38	-	39,660.00	1-Jun-08	31-May-19
Industrial : Number of Retail Provider customers	44	Quarterly	545.08	310.06	3.00	748.00	1-Jun-08	31-May-19
Residential: Percent of Retail Provider customers	44	Quarterly	20%	14%	0%	37%	1-Jun-08	31-May-19
Commercial: Percent of Retail provider customers	44	Quarterly	30%	19%	0%	47%	1-Jun-08	31-May-19
Industrial : Percent of Retail Provider customers	44	Quarterly	64%	37%	0%	90%	1-Jun-08	31-May-19
Real Time LMP	96,338	Hourly	37.57	30.06	(227.56)	1,742.91	1-Jun-08	31-May-19
Day Ahead LMP	96,338	Hourly	38.01	24.16	0.66	925.00	1-Jun-08	31-May-19
Wind Speed	96,338	Hourly	6.04	3.58	0.12	26.00	1-Jun-08	31-May-19
Temperature	96,338	Hourly	51.79	18.44	(5.11)	98.41	1-Jun-08	31-May-19
Dew Point	96,338	Hourly	41.56	18.70	(19.09)	76.00	1-Jun-08	31-May-19

9 Appendix B Simulated Data

Appendix Figure 1. Simulated Data

t	n(t)	N(t)	M	l(p_u (t),p_r (t))	q(p_u (t),p_r (t))	p_u (t)	p_r (t)
1	1.1	1	100	0.01	0.15	1	0.85
2	1.3	2	100	0.01	0.15	1	0.85
3	1.5	3	100	0.01	0.15	1	0.85
4	1.6	5	100	0.01	0.15	1	0.85
5	1.9	7	100	0.01	0.15	1	0.85
6	2.1	8	100	0.01	0.15	1	0.85
7	1.8	10	100	0.01	0.1	1	0.9
8	2.5	12	100	0.01	0.15	1	0.85
9	2.7	15	100	0.01	0.15	1	0.85
10	3.0	18	100	0.01	0.15	1	0.85
11	3.2	21	100	0.01	0.15	1	0.85
12	3.5	24	100	0.01	0.15	1	0.85
13	3.7	27	100	0.01	0.15	1	0.85
14	2.8	31	100	0.01	0.1	1	0.9
15	4.0	34	100	0.01	0.15	1	0.85
16	3.0	38	100	0.01	0.1	1	0.9
17	1.8	41	100	0.01	0.05	1	0.95
18	0.0	43	100	-0.08	0	1	1
19	-3.4	43	100	-0.08	-0.05	1	1.05
20	-3.1	39	100	-0.08	-0.2	1	1.2
21	0.0	36	100	-0.08	0	1	1
22	1.8	36	100	0.01	0.05	1	0.95
23	3.0	38	100	0.01	0.1	1	0.9
24	3.0	41	100	0.01	0.1	1	0.9
25	3.0	44	100	0.01	0.1	1	0.9
26	3.0	47	100	0.01	0.1	1	0.9
27	3.0	50	100	0.01	0.1	1	0.9
28	1.7	53	100	0.01	0.05	1	0.95
29	4.2	55	100	0.01	0.15	1	0.85
30	4.0	59	100	0.01	0.15	1	0.85
31	2.7	63	100	0.01	0.1	1	0.9
32	-5.2	65	100	-0.08	-0.05	1	1.05
33	4.0	60	100	0.01	0.15	1	0.85
34	1.5	64	100	0.01	0.05	1	0.95
35	3.7	66	100	0.01	0.15	1	0.85
36	3.5	69	100	0.01	0.15	1	0.85
37	2.2	73	100	0.01	0.1	1	0.9
38	1.2	75	100	0.01	0.05	1	0.95
39	1.1	76	100	0.01	0.05	1	0.95
40	1.1	78	100	0.01	0.05	1	0.95
41	-6.3	79	100	-0.08	-0.05	1	1.05
42	1.3	72	100	0.01	0.05	1	0.95
43	-5.9	74	100	-0.08	-0.02	1	1.02
44	-5.4	68	100	-0.08	-0.01	1	1.01
45	0.8	62	100	0.01	0.02	1	0.98
46	0.0	63	100	-0.08	0	1	1
47	-5.1	63	100	-0.08	-0.01	1	1.01
48	0.9	58	100	0.01	0.02	1	0.98
49	0.9	59	100	0.01	0.02	1	0.98
50	0.9	60	100	0.01	0.02	1	0.98

10 Appendix C Regression Results

Table 1A. Penelec Residential Regression Results

	Retail Provider Customers	Utility Customer	Diff-n-Diff Pooled Data
L1. Residential Load (log)	0.096	0.133	0.122
	(1.20)	(1.51)	(1.73)
Electricity Price (log)	-1.440***	-0.112	-0.286*
	(-8.21)	(-0.72)	(-2.38)
Post*Electricity Price (log)			-0.007
			(-0.64)
NG Price (log)	-0.183**	-0.118	-0.123*
	(-2.65)	(-1.60)	(-2.37)
Temperature (log)	-0.235***	-0.341***	-0.365***
	(-4.28)	(-5.62)	(-8.22)
% of Retail Choice Customers	2.933***	-1.476***	-0.014
	-8.87	(-5.84)	(-0.13)
1.qtr	0	0	0
	(.)	(.)	(.)
2.qtr	-0.062*	-0.055	-0.039
	(-2.02)	(-1.66)	(-1.56)
3.qtr	0.080*	0.062	0.079*
	(2.07)	(1.50)	(2.54)
4.qtr	0.033	0.015	0.036
	(1.33)	(0.55)	(1.67)
Summer	0.183***	0.187***	0.199***
	(8.78)	(8.37)	(11.56)
Constant	14.818***	13.155***	13.757***
	(11.94)	(9.88)	(12.75)

Table 1B. Penelec Commercial Regression Results

	Retail Provider Customers	**Utility Customer**	**Diff-n-Diff Pooled Data**
L1. Commercial Load (log)	-0.15	0.391***	-0.276***
	(-1.56)	(3.74)	(-3.57)
Electricity Price (log)	-0.444***	0.517*	0.143
	(-3.86)	(2.26)	(1.72)
Post*Electricity Price (log)			-0.006
			(-1.11)
NG Price (log)	-0.121*	0.336***	0.081**
	(-2.24)	(3.52)	(2.81)
Temperature (log)	-0.067*	-0.199***	-0.156***
	(-2.30)	(-3.95)	(-7.38)
% of Retail Choice Customers	0.745***	-0.915**	0.064*
	(4.21)	(-2.87)	(2.02)
1.qtr	0	0	0
	(.)	(.)	(.)
2.qtr	-0.04	-0.043	-0.032*
	(-1.91)	(-1.31)	(-2.15)
3.qtr	0.032	-0.031	0.049**
	(1.22)	(-0.77)	(2.65)
4.qtr	-0.047**	0.03	-0.029**
	(-3.09)	(1.30)	(-2.63)
Summer	0.090***	0.133***	0.098***
	(6.53)	(6.10)	(9.91)
Constant	15.412***	6.233***	16.294***
	(12.04)	(5.97)	(16.67)

Table 1C. Penelec Industrial Regression Results

	Retail Provider Customers (OnPeak)	**Retail Provider Customers (OffPeak)**	**Utility Customers (OnPeak)**	**Utility Customers (OffPeak)**	**Diff-n-Diff Pooled Data**
L1. Industrial Load (log)	0.988***	1.001***	0.986***	0.977***	1.009***
	(220.69)	(423.56)	(479.66)	(713.51)	(840.06)
PENELEC Real Time Price (log)	-0.011*	-0.012***	-0.036**	-0.023***	-0.003**
	(-2.28)	(-6.66)	(-2.68)	(-3.30)	(-3.06)
Post*Electricity Price (log)					0
					(-1.09)
weekend	0	-0.013***	0	-0.022***	
	(.)	(-24.22)	(.)	(-13.37)	
h_1	0	-0.001	0	-0.016***	0
	(.)	(-1.13)	(.)	(-6.73)	(.)
h_2	0	-0.001	0	-0.004	0
	(.)	(-1.40)	(.)	(-1.71)	(0.27)
h_3	0	0.004***	0	-0.001	0.004***
	(.)	(6.10)	(.)	(-0.33)	(6.88)
h_4	0	0.018***	0	0.013***	0.016***
	(.)	(22.60)	(.)	(5.05)	(27.21)
h_5	0.00	0.035***	0	0.035***	0.032***
	(.)	(39.78)	(.)	(11.56)	(49.41)
h_6	0	0.051***	0	0.056***	0.047***
	(.)	(56.05)	(.)	(17.70)	(71.00)
h_7	0	0.049***	0	0.061***	0.048***
	(.)	(53.58)	(.)	(18.18)	(71.37)
h_8	0.050***	0	0.071***	0	0.038***
	(30.74)	(.)	(12.40)	(.)	(49.29)
h_9	0.030***	0	0.042***	0	0.021***
	(18.87)	(.)	(7.19)	(.)	(27.35)
h_10	0.032***	0	0.044***	0	0.023***
	(19.77)	(.)	(7.47)	(.)	(29.52)
h_11	0.022***	0	0.038***	0	0.015***
	(13.93)	(.)	(6.36)	(.)	(20.01)
h_12	0.019***	0	0.022***	0	0.010***
	(12.07)	(.)	(3.90)	(.)	(13.22)
h_13	0.025***	0	0.033***	0	0.016***
	(16.29)	(.)	(5.77)	(.)	(21.28)
h_14	0.007***	0	0.022***	0	0.003***
	(4.44)	(.)	(3.67)	(.)	(4.00)
h_15	-0.010***	0	0.008	0	-0.009***
	(-5.87)	(.)	(1.37)	(.)	(-11.19)
h_16	-0.008***	0	-0.015*	0	-0.006***
	(-3.81)	(.)	(-2.29)	(.)	(-7.65)
h_17	0.001	0	-0.013*	0	0
	(0.49)	(.)	(-2.13)	(.)	(0.31)
h_18	0.016***	0	0.009	0	0.011***
	(7.71)	(.)	(1.45)	(.)	(12.71)
h_19	0.022***	0	0.025***	0	0.015***
	(12.18)	(.)	(4.60)	(.)	(18.98)

h_20	0.032***	0	0.025***	0	0.027***
	(28.30)	(.)	(6.51)	(.)	(38.24)
h_21	0.019***	0	0.020***	0	0.018***
	(24.56)	(.)	(6.49)	(.)	(27.90)
h_22	0.001	0	-0.003	0	0.004***
	(1.49)	(.)	(-1.20)	(.)	(6.73)
h_23	0	0	0	0	0.004***
	(.)	(.)	(.)	(.)	(6.47)
h_24	0	0	0	0	0
	(.)	(.)	(.)	(.)	(0.82)
% of Retail Choice Customers	-0.007	-0.043***	0.216***	0.102***	-0.001
	(-0.51)	(-5.53)	(7.33)	(4.24)	(-1.77)
Peak Hours					-0.010***
					(-30.85)
Year 2018					0
					(-0.30)
Shoulder					0
					(-1.66)
Constant	0.102***	0.067***	0.111**	0.126***	-0.053***
	(9.59)	(5.53)	(3.12)	(6.67)	(-9.70)

Table 1A. Meted Residential Regression Results

	Retail Provider Customers	Utility Customer	Diff-n-Diff Pooled Data
L1. Residential Load (log)	0.567***	0.518***	0.513***
	(6.39)	(6.54)	(7.18)
Electricity Price (log)	-2.485***	-1.823**	-0.816*
	(-3.50)	(-2.77)	(-2.11)
Post*Electricity Price (log)			-0.074*
			(-2.62)
NG Price (log)	-0.423	-0.264	-0.294
	(-1.77)	(-1.45)	(-1.94)
Temperature (log)	0.004	-0.194	-0.240*
	(0.02)	(-1.42)	(-2.00)
% of Retail Choice Customers	4.048**	2.473*	1.542***
	(3.01)	(2.22)	(4.99)
1.qtr	0		0
	(.)		(.)
2.qtr	-0.083		-0.021
	(-0.77)		(-0.30)
3.qtr	0.008		0.051
	(0.06)		(0.59)
4.qtr	0.074		0.073
	(0.92)		(1.38)
Summer	0.377***	0.353***	0.374***
	-5.2	-4.96	-7.78
Constant	11.604***	11.688***	10.060***
	(5.19)	(5.63)	(6.54)

Table 1B. Meted Commercial Regression Results

	Retail Provider Customers	Utility Customer	Diff-n-Diff Pooled Data
L1. Commercial Load (log)	0.799***	0.793***	0.780***
	(8.31)	(8.04)	(12.86)
Electricity Price (log)	-0.346	-0.223	-0.142
	(-0.50)	(-0.29)	(-0.37)
Post*Electricity Price (log)			-0.037
			(-1.51)
NG Price (log)	-0.071	-0.026	-0.013
	(-0.27)	(-0.10)	(-0.11)
Temperature (log)	-0.123	-0.214	-0.113
	(-0.88)	(-1.48)	(-1.31)
% of Retail Choice Customers	-0.893	-1.269	0.413*
	(-0.77)	(-1.07)	(2.16)
1.qtr	0	0	0
	(.)	(.)	(.)
2.qtr	-0.019	-0.013	-0.012
	(-0.18)	(-0.12)	(-0.19)
3.qtr	-0.015	-0.007	-0.032
	(-0.12)	(-0.05)	(-0.42)
4.qtr	0.003	0.029	-0.011
	(0.05)	(0.38)	(-0.24)
Summer	0.171*	0.217**	0.156***
	(2.55)	(3.13)	(3.66)
Constant	4.347*	4.337*	3.525**
	(2.42)	(2.35)	(3.23)

Table 1C. Meted Industrial Regression Results

	Retail Provider Customers (OnPeak)	Retail Provider Customers (OffPeak)	Utility Customers (OnPeak)	Utility Customers (OffPeak)	Diff-n-Diff Pooled Data
L1. Industrial Load (log)	1.000***	1.004***	0.994***	0.987***	1.016***
	(1370.69)	(1003.24)	(1090.64)	(861.40)	(1795.06)
METED Real Time Price (log)	-0.003*	-0.007***	-0.011*	0.005	-0.002***
	(-2.56)	(-6.58)	(-2.35)	(1.88)	(-3.90)
Post*Electricity Price (log)					-0.003***
					(-19.10)
weekend	0	-0.017***	0	-0.018***	
	(.)	(-42.85)	(.)	(-22.20)	
h_1	0	0.002**	0	-0.002	0.009***
	(.)	(3.04)	(.)	(-1.14)	(17.12)
h_2	0	0.004***	0	0.006***	0.012***
	(.)	(7.27)	(.)	(4.89)	(21.91)
h_3	0	0.009***	0	0.011***	0.017***
	(.)	(15.85)	(.)	(8.40)	(32.72)
h_4	0	0.021***	0	0.023***	0.029***
	(.)	(35.49)	(.)	(16.30)	(61.63)
h_5	0	0.040***	0	0.042***	0.048***
	(.)	(62.68)	(.)	(27.51)	(111.47)
h_6	0	0.060***	0	0.065***	0.068***
	(.)	(91.68)	(.)	(41.61)	(157.64)
h_7	0	0.059***	0	0.067***	0.067***
	(.)	(88.17)	(.)	(41.53)	(155.38)
h_8	0.057***	0	0.077***	0	0.057***
	(97.20)	(.)	(35.68)	(.)	(144.09)
h_9	0.033***	0	0.051***	0	0.039***
	(57.77)	(.)	(23.97)	(.)	(99.31)
h_10	0.030***	0	0.047***	0	0.036***
	(51.24)	(.)	(21.64)	(.)	(90.49)
h_11	0.023***	0	0.039***	0	0.029***
	(39.18)	(.)	(17.85)	(.)	(72.21)
h_12	0.016***	0	0.034***	0	0.022***
	(28.02)	(.)	(16.25)	(.)	(55.20)
h_13	0.020***	0	0.035***	0	0.025***
	(36.19)	(.)	(16.78)	(.)	(61.97)
h_14	0.007***	0	0.035***	0	0.016***
	(12.50)	(.)	(16.18)	(.)	(40.33)
h_15	-0.010***	0	0.022***	0	0.004***

	(-16.75)	(.)	(10.00)	(.)	(9.15)
h_16	-0.017***	0	0.017***	0	0
	(-26.63)	(.)	(7.08)	(.)	(.)
h_17	-0.010***	0	0.018***	0	0.005***
	(-15.27)	(.)	(7.45)	(.)	(12.94)
h_18	0.008***	0	0.031***	0	0.020***
	(11.68)	(.)	(12.91)	(.)	(50.10)
h_19	0.017***	0	0.036***	0	0.026***
	(27.45)	(.)	(16.97)	(.)	(67.11)
h_20	0.016***	0	0.028***	0	0.025***
	(35.33)	(.)	(17.90)	(.)	(60.49)
h_21	0.010***	0	0.013***	0	0.020***
	(23.17)	(.)	(9.15)	(.)	(44.56)
h_22	0.002***	0	0.007***	0	0.015***
	(4.39)	(.)	(4.72)	(.)	(31.77)
h_23	0	0	0	0	0.015***
	(.)	(.)	(.)	(.)	(31.11)
h_24	0	0	0	0	0.007***
	(.)	(.)	(.)	(.)	(12.36)
% of Retail Choice Customers	-0.015**	0.009	0.028	-0.047*	-0.002***
	(-3.13)	(0.94)	(1.72)	(-2.17)	(-5.44)
Year 2018	0.001*	0.001	0	-0.009***	0.009***
	(1.98)	(1.65)	(0.27)	(-8.38)	(23.12)
Shoulder	-0.002***	0.002***	-0.004***	0.003***	0
	(-13.71)	(8.44)	(-7.03)	(4.93)	(1.70)
Peak Hours					-0.014***
					(-65.21)
Constant	0.003	-0.021	0.019	0.020**	-0.110***
	(0.50)	(-1.91)	(1.46)	(2.80)	(-43.59)