

# Journal Presentation

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約有 562,000 項結果 (搜尋時間：0.31 秒)



## 5月底全台恐限電

中時電子報 - 9 小時前

經濟部評估5月底備轉容量率只剩3%左右，限電風險大增。... 台電與達電廠機組故障，加上先前核電機組失火，裝置容量驟減7%，台電董事長黃重球 ...

## 備轉容量率又亮紅燈5月限電風險高

中央通訊社 - 2015年5月6日

## 黃重球：5月底限電風險將逐漸升高

聯合財經網 - 21 小時前

## 經長：民生若限電該負責一定會負責

聯合新聞網 - 22 小時前

## 限電危機台電提前祭出需量競價

yam天空新聞 - 18 小時前



聯合財經網



聯合新聞網



ETtoday



三立新聞網

[深入瞭解](#) (還有 38 篇報導)





<http://eliq.se/en/products/eliq-energy-display/>

**REAL-TIME USAGE**

**ELECTRICITY PRICE**

**BILL-TO-DATE**

**ESTIMATED MONTHLY USAGE**

# Finding

- ◆ Households in the price-only group reduce their usage by between 0 and 7 percent on average during pricing events, relative to control. In contrast, those exposed to the same price changes but who also have **IHDs, exhibit much larger usage reductions** of 8 to 22 percent.
- ◆ Empirical evidence suggests that experience with IHDs **facilitates consumer learning**, improving households' decision making when confronted with high prices.
- ◆ In the long run, an evaluation of trends in usage over the days of the summer reveals that households in both the price and price-plus-information groups are **forming conservation habits** even when events are not occurring.



**Knowledge is (Less) Power:  
Experimental Evidence from Residential Energy Use**  
K. Jessoe and D. Rapson (AER, Avril 2014)

However, basic information may often be unclear.

- Whether agents perfectly know and comprehend the price of a good (i.e., price “salience”). In many settings they do not.
- There is uncertainty about non-price attributes

“Electricity customers traditionally exhibit low price elasticity”

*But it may be the features of setting that full information is not accessible*



- **Infrequent billing** make it difficult to know both electricity usage at any moment in time and the input requirements of each appliance.
- Electricity comprises only a **modest share of household budgets**, it may be rational for households not to invest the time and effort to resolve this uncertainty.

# An alphabet soup of dynamic pricing structures

- **RTP**, Real Time Pricing, the first-best
- **TOU**, Time of Use: different prices for different periods (e.g., on-peak vs. off-peak)
- **CPP**, Critical Peak Pricing: the supplier announces a **CPP** event for the next day. **CPP** events are much less frequent than on-peak hours, but prices in a **CPP** event are much higher than on-peak prices in **TOU**

# Experiment Design

## Randomized Control Trial (RCT) (1)

### WHERE?

- Connecticut (Bridgeport and New Haven)

### WHEN?

- During summer 2011 (July and August): 6 Events
- All events occurred during peak hours, but there was variation in the length and exact timing of events

### HOW?

- Partnership with local utility (United Illuminating, UI)

# Experiment Design

## Randomized Control Trial (RCT) (2)

- ◆ Users are split in three groups
  1. No action (control group)
  2. Receive information on price increase (price only group)
  3. Receive information on price increase and have an IHD of their electricity consumption (price + IHD group)
- ◆ Usage data for each group is collected (15-minute intervals) and analyzed

# Participants compensation

- ◆ \$40 participation incentive: \$20 upon completion of a pre survey prior to assignment, and \$20 upon completion of a survey once the pilot ended

Survey: Demographic and housing unit characteristics, appliance ownership, conservation-related actions, tendency to be home during the day, and the **frequency with which households checked their IHDs.**

- ◆ Off-bill account initially credited with \$100.

Customers keep the balance at the end of the study=

$\$100 - [(Value\ of\ energy\ consumed\ during\ the\ price\ event) - (its\ value\ at\ the\ regulated\ rate)]$

Table 2: Summary Statistics by Control and Treatment Group

Panel A: Initial Group								
	Control		Price			Price+IHD		
	Mean	Obs	Mean	Obs	Difference	Mean	Obs	Difference
Off-peak usage (kWh/h)	1.159 (0.687)	207	1.279 (0.737)	130	0.121 (1.524)	1.203 (0.646)	100	0.044 (0.542)
Peak usage (kWh/h)	1.422 (1.107)	207	1.529 (1.034)	130	0.107 (0.887)	1.383 (0.954)	100	-0.038 (-0.298)
TOU Rate (1=yes)	0.184 (0.388)	207	0.200 (0.402)	130	0.016 (0.373)	0.240 (0.429)	100	0.056 (1.153)
Home ownership (1=yes)	0.768 (0.423)	203	0.798 (0.403)	129	0.030 (0.641)	0.773 (0.42)	97	0.005 (0.091)
Annual income (\$1000)	72.00 (29.00)	203	74.00 (29.00)	129	2.000 (0.690)	71.00 (31.00)	97	-0.001 (-0.181)
Home size (1000 square feet)	1.529 (1.11)	189	1.880 (1.83)	119	0.351 ** (2.100)	1.451 (1.14)	91	-0.078 (-0.550)
Age of home (years)	52.423 (30.29)	156	57.619 (31.34)	97	5.195 (1.309)	52.239 (26.94)	71	-0.184 (-0.044)
<b>Integrity of randomization</b>								
Panel B: Final Group								
	Control		Price			Price+IHD		
	Mean	Obs	Mean	Obs	Difference	Mean	Obs	Difference
Off-peak usage (kWh/h)	1.161 (0.69)	203	1.294 (0.73)	124	0.121 * (1.52)	1.202 (0.62)	72	0.044 (0.542)
Peak usage (kWh/h)	1.432 (1.11)	203	1.551 (1.03)	124	0.107 (0.89)	1.432 (0.96)	72	-0.038 (-0.298)
TOU Rate (1=yes)	0.182 (0.39)	203	0.202 (0.40)	124	0.016 (0.37)	0.181 (0.39)	72	0.056 (1.153)
Home ownership (1=yes)	0.774 (0.42)	199	0.821 (0.39)	123	0.030 (0.64)	0.855 (0.36)	69	0.005 (0.091)
Annual income (\$1000)	72.00 (29.00)	199	75.00 (28.00)	123	0.002 (0.69)	76.00 (28.00)	69	-0.001 (-0.181)
Home size (1000 square feet)	1.541 (1.10)	185	1.908 (1.84)	114	0.351 ** (2.10)	1.611 (1.16)	66	-0.078 (-0.550)
Age of home (years)	52.221 (30.43)	154	56.574 (31.02)	94	5.195 (1.31)	53.375 (28.59)	56	-0.184 (-0.044)

Notes: Means are reported by treatment group, with standard deviations in parentheses below. "Difference" displays the difference in means between each treatment group and control, with t-stats reported in parentheses below. \*, \*\*, \*\*\* denote significant at the 0.10, 0.05, and 0.01 level.

# Asymmetric Attrition

Use intent-to-treat (ITT) and treatment-on-the-treated (ToT) estimators to account for asymmetries in non-compliance.  
Compliers

TABLE 3—GROUP ASSIGNMENT BALANCE ON OBSERVABLES, INITIAL, AND COMPLIERS

	Initial group		Compliers	
	Price	Price + IHD	Price	Price + IHD
Mean off peak kWh	0.021 (0.040)	-0.019 (0.040)	0.030 (0.029)	0.060 (0.071)
TOU rate (1=yes)	0.010 (0.074)	0.088 (0.071)	-0.018 (0.053)	-0.263** (0.109)
<i>F</i> -statistic	0.206	0.775	0.579	2.915
<i>p</i> -value	0.814	0.462	0.562	0.059
Observations	337	307	130	100

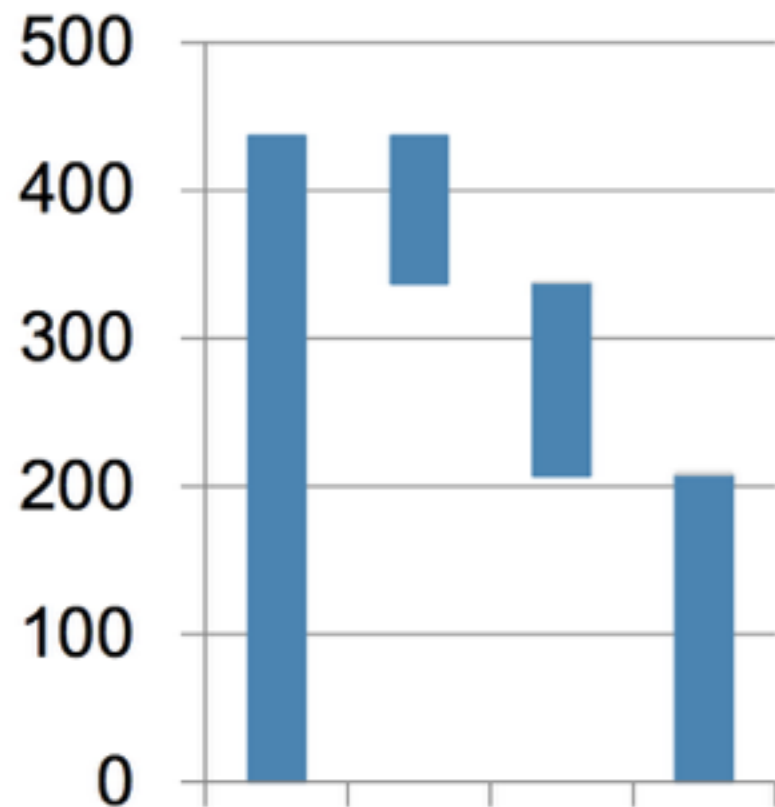
*Notes:* Results denoted “Initial group” are from a linear probability model regressing observables on the treatment group indicator. Results denoted “Compliers” are from a LPM regressing observables on a compliance indicator. *p*-value corresponds to probability that coefficients are jointly equal to zero. Control group used as control in each specification. Standard errors in parentheses.

\*\*\* Significant at the 1 percent level.

\*\* Significant at the 5 percent level.

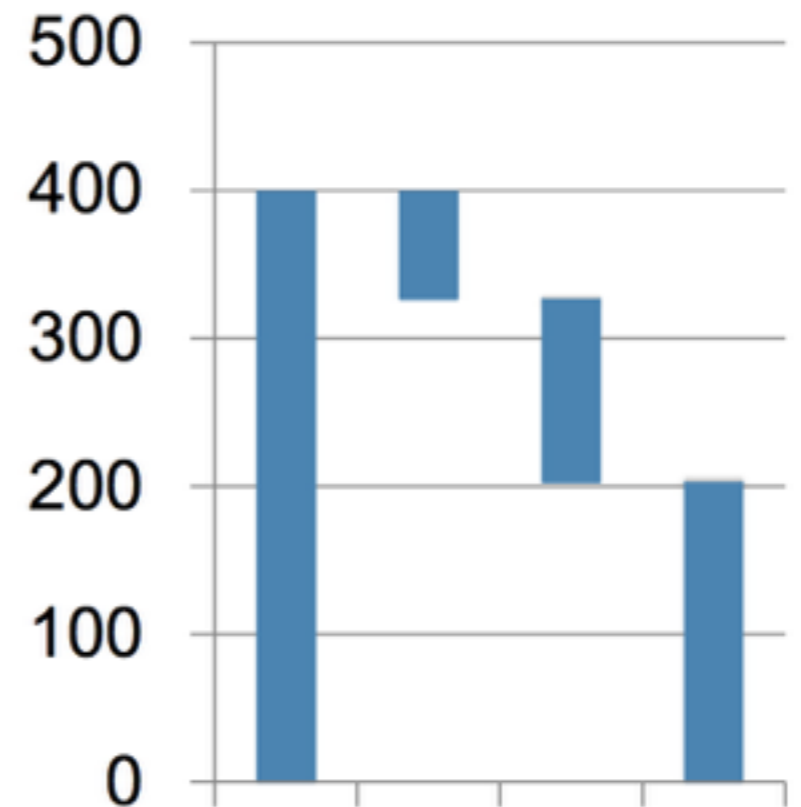
# Sample Structure

## Intent to Treat group (ITT)



Non compliance:  
38  
households

## Treatment on Treated (ToT)





# Price Events Description

- Day Ahead (DA) : 3 times

Notification that the price of electricity would increase for a few hours the next day by 0.50 \$/kWh (500 \$/MWh), roughly 250% increase over the standard rate

- Thirty Minute (TM): 3 times

Notification that the price of electricity would increase for a few hours starting in 30 minutes by 1.25 \$/kWh (1 250 \$/MWh)

- Households receive notification of these events by email, phone call and / or text message depending on their stated preference

## Response to a TM price event

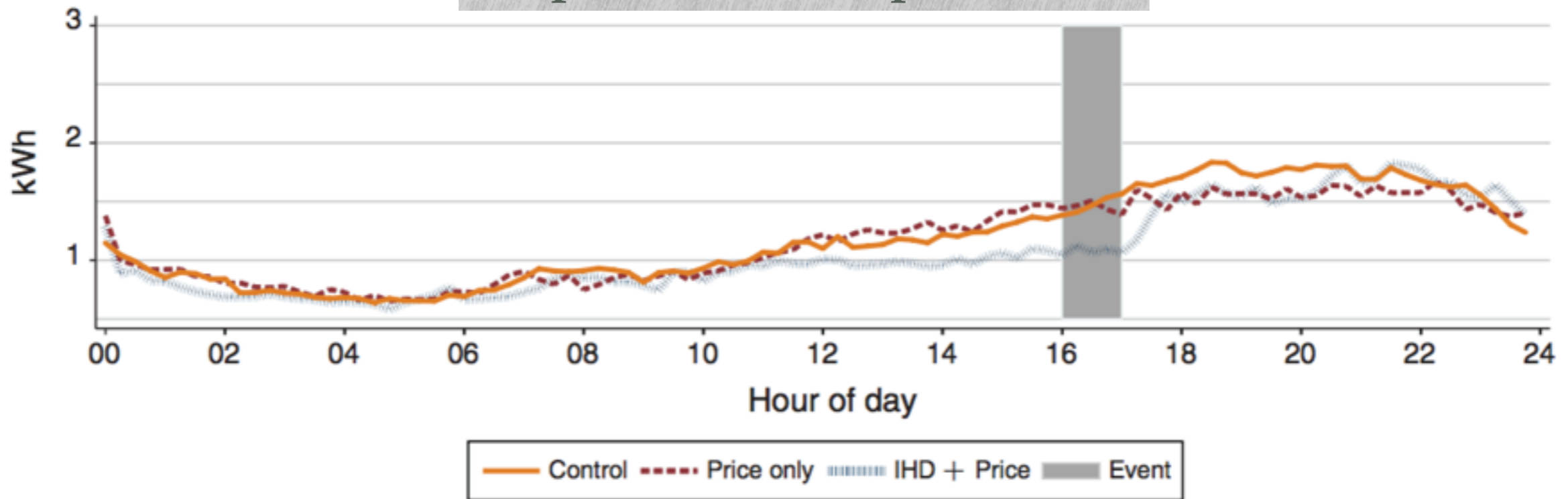


FIGURE 5. AUGUST 17, 2011: 2HR \$1.25 INCREASE, 30-MIN NOTICE

## Response to a DM price event

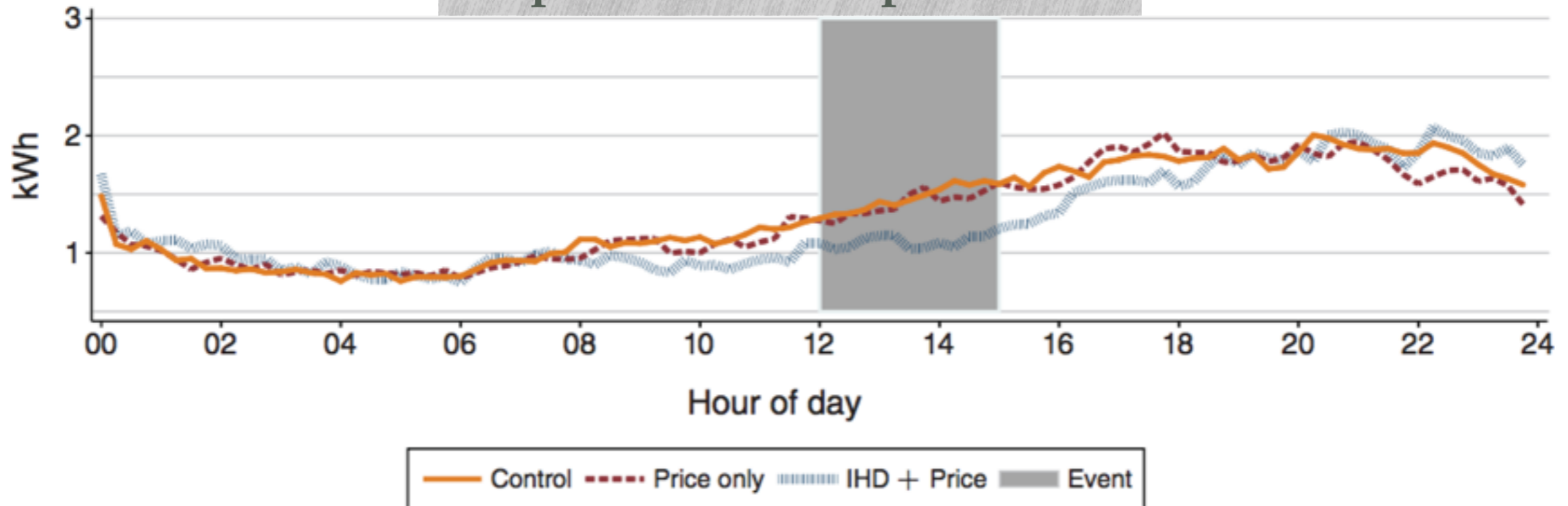


FIGURE 6. AUGUST 26, 2011: 4HR \$0.50 INCREASE, DAY-AHEAD NOTICE

# Econometric analysis

$$q_{it} = \beta_0 + \sum_{g \in \{P, P+I\}} \beta_g D_{it}^g + \gamma_g + \delta_e + \mu_{it}$$

- Households are indexed by  $i$ , periods are indexed by  $t$
- $q_{it}$  is the logarithm of consumption (in kWh) by household  $i$  in period  $t$
- $D_{it}^g = 1$  if household  $i$  is in group  $g$  and if a pricing event occurs for household  $i$  in period  $t$
- $\gamma_g = 1$  if household  $i$  is in group  $g$ , and  $\delta_e = 1$  if pricing event occurs during period  $t$
- $\beta_P$  and  $\beta_{P+I}$  are consistent estimates of the average percentage change in electricity usage from assignment to treatment during pricing events

# Econometric results: Treatment Effects

Event Type: Column:	All (1)	All (2)	All (3)	All (4)	Day Ahead (DA) (5)	30min (TM) (6)
<b>Panel A: ITT Unbalanced Panel</b>						
Price Only	-0.031 (0.036)	-0.054 (0.036)	-0.027 (0.036)	-0.038 (0.036)	-0.071* (0.042)	0.006 (0.044)
Price + IHD	-0.116** (0.048)	-0.137*** (0.048)	-0.123*** (0.047)	-0.137*** (0.046)	-0.171*** (0.051)	-0.084 (0.057)
Prob(P = P+I)	0.096*	0.098*	0.051*	0.044**	0.066*	0.130
R-Square	0.00	0.05	0.54	0.58	0.58	0.58
Hour-by-day FEs	N	Y	N	Y	Y	Y
HH FEs	N	N	Y	Y	Y	Y
Number of Events	6	6	6	6	3	3
Number of HHs	437	437	437	437	437	401

- The inclusion of household and time controls does not meaningfully alter the magnitude of treatment effects provides further evidence for the integrity of the randomization.
- Provide strong evidence that the cumulative effect of real-time information feedback in this setting is to increase the price elasticity of demand.

# Econometric results: ToT

Event Type: Column:	All (1)	All (2)	All (3)	All (4)	Day Ahead (DA) (5)	30min (TM) (6)
Price Only	-0.032 -0.037	-0.056 -0.037	-0.028 -0.037	-0.040 -0.037	-0.074* -0.044	0.007 -0.046
Price + IHD	-0.143** -0.058	-0.170*** -0.058	-0.153*** -0.057	-0.170*** -0.057	-0.217*** -0.064	-0.100 -0.067
Prob(P = P+I)	0.061*	0.052*	0.030**	0.023**	0.025**	0.115
R-Square	0.00	0.05	0.54	0.58	0.58	0.58
Hour-by-day FEs	N	Y	N	Y	Y	Y
HH FEs	N	N	Y	Y	Y	Y
Number of Events	6	6	6	6	3	3
Number of HHs	437	437	437	437	437	401

- The treatment effect on treated households (ToT) is the causal effect of the price and price + IHD treatments on compliers.
- The ToT specification uses initial treatment assignment as an instrument for receipt of treatment, and is estimated using two-stage least squares.

Empirical evidence suggests that experience with IHDs **facilitates consumer learning**, improving households' decision making when confronted with high prices.

## Hypothesis:

Consumers learn through experience with the IHDs, and that this plays an important role in the reagents differential.

*Were the differential response to exist because IHDs increase awareness of price events?*

# Notification and Awareness of Price Events: Making electricity price changes salient.

- By having the utility send all customers in the price and price + IHD groups notification in the form of a combination of a text message, e-mail and / or phone call in advance of each event.
- Conditional on confirmation of event notification, **reject the null** that the coefficient estimates are equal with 95 percent confidence overall, and with 90 and 85 percent confidence when estimating DA and TM events separately—> **IHDs do not appear to be either informing households of events or enabling unaware households to respond.**



# Notification and Awareness of Price Events

## **How to conquer?**

By making electricity price changes salient.

## **Control:**

Having the utility send all customers in the price and price + IHD groups notification in the form of a combination of a text message, e-mail and/or phone call in advance of each event.

## Hypothesis:

Consumers learn through experience with the IHDs, and that this plays an important role in the reagents differential.

*Did IHDs facilitate learning about the electricity usage associated with the portfolio of household production alternatives?*

TABLE 7—FREQUENCY OF IHD INTERACTION

	Percent of HHs	All events	DA events	TM events
Price + IHD × 1[0/None]	4	−0.453** (0.196)	−0.690*** (0.181)	−0.161 (0.338)
Price + IHD × 1[1–2 times]	10	−0.013 (0.139)	−0.028 (0.137)	0.007 (0.160)
Price + IHD × 1[3–5 times]	8	0.02 (0.083)	−0.02 (0.083)	0.06 (0.091)
Price + IHD × 1[More than 5 times]	40	−0.248*** (0.077)	−0.279*** (0.085)	−0.204** (0.086)
Price + IHD × 1[Missing]	38	−0.023 (0.096)	−0.065 (0.095)	0.037 (0.119)
<i>p</i> -value (PIHD × >5 = PIHD × 1–2)		0.123	0.102	0.225
<i>p</i> -value (PIHD × >5 = PIHD × 3–5)		0.011**	0.017**	0.020**
HH FEs		Yes	Yes	Yes
Hour-by-day FEs		Yes	Yes	Yes
Number of HHs		307	307	273

This evidence suggests that more frequent experience with the IHDs facilitates learning about the quantity of electricity consumed by energy consuming durables

$R^2$  0.526 0.526 0.526

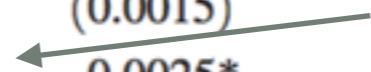
Note: Treatment effect and survey reported initial weekly frequency of IHD interaction

In the long run, an evaluation of trends in usage over the days of the summer reveals that households in both the price and price-plus-information groups are **forming conservation habits** even when events are not occurring.

TABLE 9—HABIT FORMATION

	Price	Price + IHD
12–1 PM Calendar day trend	–0.0023 (0.0016)	–0.0030** (0.0015)
1–2 PM Calendar day trend	–0.0024 (0.0015)	–0.0027* (0.0014)
2–3 PM Calendar day trend	–0.0025* (0.0014)	–0.0032** (0.0013)
3–4 PM Calendar day trend	–0.0027* (0.0014)	–0.0031** (0.0013)
4–5 PM Calendar day trend	–0.0033** (0.0014)	–0.0034*** (0.0013)
5–6 PM Calendar day trend	–0.0032** (0.0014)	–0.0033** (0.0013)
6–7 PM Calendar day trend	–0.0038** (0.0015)	–0.0032** (0.0014)
7–8 PM Calendar day trend	–0.0037** (0.0017)	–0.0029** (0.0015)
HH FEs		Yes
Hour-by-day FEs		Yes
Number of HHs		339
$R^2$		0.556

Early hours:  
Change Larger



12-1PM:  
Daily decrease  
(gradient) in usage  
of 0.23 percent for  
price-only  
households during  
this noontime hour

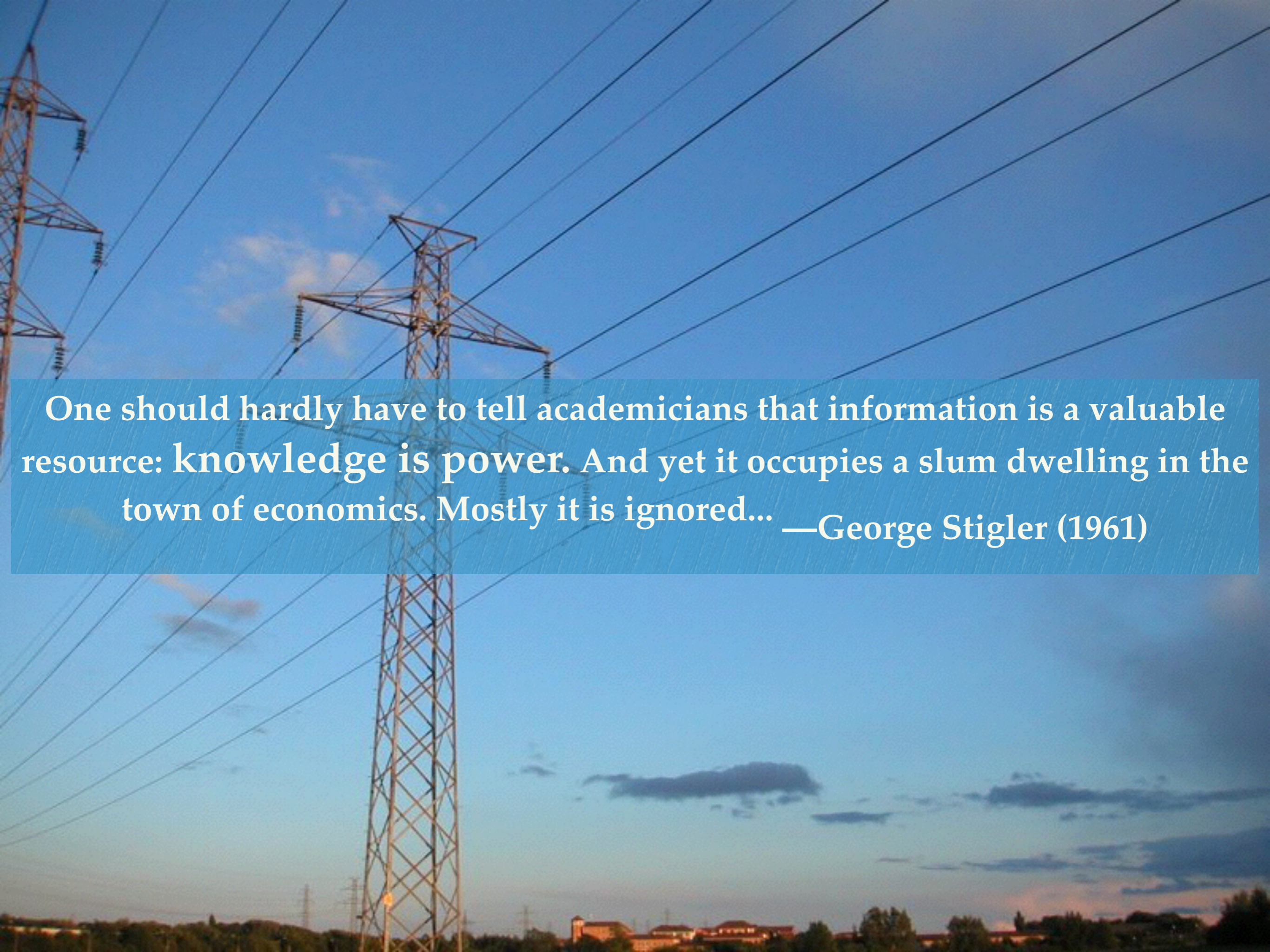


14 % decrease in  
usage on August  
relatively to July 1.

Peak hours Period:  
Change Larger

Notes: Results from a single regression specification which interacts a calendar day time trend for each peak hour with initial treatment assignment. The sample is restricted to all non-pricing event weekdays in July and August, and includes only households that were present for all treatment events (what we are calling the balanced panel). Standard errors clustered by household in parentheses.

- \*\*\* Significant at the 1 percent level.
- \*\* Significant at the 5 percent level.
- \* Significant at the 10 percent level.



One should hardly have to tell academicians that information is a valuable resource: **knowledge is power**. And yet it occupies a slum dwelling in the town of economics. Mostly it is ignored... —George Stigler (1961)