Price Salience and Social Comparisons as Policy Instruments: Evidence from a Field Experiment in Energy Usage

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Motivation 1. Information Interventions

Many settings have non-linear price incentive schemes, such as utility tariffs in electricity, gas, and water, Social Security benefit rules, the Earned Income Tax Credit, and the understanding of non-linearity leading to behavior in energy consumption (Kahn & Wolak, 2013), Social Security (Liebman & Luttmer, 2011), and the Earned Income Tax Credit (Chetty & Saez, 2013). Social comparisons can also influence behavior in energy consumption (Schultz et al., 2007; Allcott, 2011) and retirement savings (Duflo & Saez, 2003; Beshears et al., forthcoming).

In a common setting, we evaluate the relative strength of two types of information interventions.
Motivation 1. Information Interventions

- Many settings have non-linear price incentive schemes
  - Utility tariffs in electricity, gas, water
  - Social Security benefit rules
  - Earned income tax credit
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- Salience/understanding of non-linearity → behavior
  - Energy consumption (Kahn & Wolak, 2013)
  - Social Security (Liebman & Luttmer, 2011)
  - EITC (Chetty & Saez, 2013)
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Motivation 2. Subsidized Energy in Developing Countries

Electricity (and other fuels) are highly subsidized. In Ecuador, the cost of electricity subsidies is $438 million (2% of public sector expenditures). Politics makes increasing prices difficult. If subsidies were removed, the cost to electricity consumers would increase by 27%. Can consumption be reduced by non-price means? This reduces emissions and frees up funds allocated to subsidies.
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  - In Ecuador, cost of electricity subsidies is $438 million (2% of public sector expenditures)

- Politics makes increasing prices difficult
  - Cost to electricity consumers would increase 27% if subsidies removed

- Can consumption be reduced by non-price means?
  - Reduces emissions
  - Reduces funds allocated to subsidies
Residential Electricity in Quito

- We partner with the Electric Utility in Quito, Ecuador (EEQ)
- EEQ’s tariff has Notches
Example of Typical Non-linear Tariff in U.S.

The graph shows the relationship between total bill ($, on the y-axis) and monthly consumption (kWh, on the x-axis). The total bill increases non-linearly with consumption.

- Marginal Price at 200 kWh: $5.01 per kWh
- Marginal Price at 600 kWh: $9.78 per kWh
- Marginal Price at 1600 kWh: $6.96 per kWh

The graph illustrates how the marginal price varies with increased consumption.
Example of Total Tariff Function in Quito
Residential Electricity in Quito

- We partner with the Electric Utility in Quito, Ecuador (EEQ)
- EEQ’s tariff has Notches
- Biggest notch (at 111 kwh) does not appear to induce consumption reduction around the notch
Pre-treatment evidence #1: effect of notch

Discontinuity Estimate (log difference in height)

−0.017 (t=−1.42)

Approach: “McCrary Test”
Pre-treatment evidence #2: effect of notch

Excess mass around notch

Approach: “Excess bunching?”
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- One of our information interventions seeks to make notch salient & measure effect
Social Comparisons

Non-price incentives are used to influence behavior in various areas, including alcohol and drug use, retirement savings, eating disorders, gambling, voting, tax compliance, recycling, energy consumption, among others. Social comparisons are used to encourage conservation by making salient the average consumption level for the target population.
Social Comparisons

- Non-price incentives are used to influence behavior
  - Alcohol and drug use, retirement savings, eating disorders, gambling, voting, tax compliance, recycling, energy consumption, among others

- Social comparisons are used to encourage conservation
  - Information on private optimum level of consumption
    - Becker (1965)
  - Moral payoff of consuming above the social norm
    - Levitt & List (2007)
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- We make salient the average consumption level for our target population
Experimental Design

Information intervention to HHs with historical average consumption between 100 and 125 kWh

Letters attached to the monthly electric bills in March 2014

Random assignment of 3 treatments (16k each)

1. Make the 111 kWh price notch salient
2. Make a social comparison (same level as in the notch)
3. Do both

Control (16k)
Experimental Design

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INFORMACIÓN IMPORTANTE

Ahorre Electricidad y Ahorre Dinero

Estimado Cliente:

La siguiente información con respecto a su consumo mensual de electricidad durante el año pasado puede ser de su interés.

Su consumo promedio mensual fue aproximadamente: 115 kWh

Un hogar similar al suyo consume en promedio: 110 kWh

Esto significa que durante el año pasado usted consumió aproximadamente 4.5 % más que otros hogares similares. Le exhortamos que haga un uso eficiente de la energía para ahorrar dinero.

Por favor lea con atención los consejos para ahorrar energía que le damos a continuación para que empiece a ahorrar dinero ya! Comparta esta información con los demás miembros del hogar.

- No deje la puerta del refrigerador abierta por mucho tiempo y asegúrese que la puerta cierre herméticamente.
- No deje el televisor encendido si nadie lo mira.
- No olvide apagar las luces al salir de una habitación.

¡AHORRE ELECTRICIDAD, AHORRE DINERO!
Dear Customer:

Electricity in Quito is billed using a progressive pricing system. What this means for you is that there is a large increase in your monthly bill should you consume more than 110 kWh.

We thought that you might be interested in the following information regarding your monthly electricity use over the past year.
Dear Customer:

Electricity in Quito is billed using a progressive pricing system. What this means for you is that there is a large increase in your monthly bill should you consume more than 110 kWh.

We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average consumption was: 

115 kWh
This means that you have paid around $12 a month for the electricity you use ($144 per year). If you were to reduce your electricity use by 5 kWh per month (around 4% of your average consumption), your bill would be reduced by nearly 47% and would save approximately $64 per year. We encourage you to use energy wisely to save money.
This means that you have paid around $12 a month for the electricity you use ($144 per year). If you were to reduce your electricity use by 5 kWh per month (around 4% of your average consumption), your bill would be reduced by nearly 47% and would save approximately $64 per year. We encourage you to use energy wisely to save money.

Please read carefully the following savings tips so you can start saving electricity now. Share this information with all the other members of the household.

- Don’t leave the refrigerator door open for too long and make sure it closes tightly
- Turn off the television if nobody is watching it
- Don’t forget to turn off the lights when leaving a room
Social Comparison Letter

Same Intro...
We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average consumption was: 115 kWh

The average household like you consumes: 110 kWh

This means that you have consumed approximately 5% more electricity per month than others like you. We encourage you to use energy wisely to save money.
Social Comparison Letter

Same Intro...

We thought that you might be interested in the following information regarding your monthly electricity use over the past year.

Your average consumption was: \(115 \text{ kWh}\)

The average household like you consumes: \(110 \text{ kWh}\)

This means that you have consumed approximately 5% more electricity per month than others like you. We encourage you to use energy wisely to save money.

Same Ending...
Sample balanced across treatments

<table>
<thead>
<tr>
<th>Group</th>
<th>Count</th>
<th>Average</th>
<th>Median</th>
<th>Standard Deviation</th>
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<tbody>
<tr>
<td>Control</td>
<td>15,875</td>
<td>112.39</td>
<td>112</td>
<td>7.23</td>
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<tr>
<td>Social Comparison</td>
<td>15,854</td>
<td>112.34</td>
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<td>Price Notch Salience</td>
<td>15,860</td>
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<td>112</td>
<td>7.23</td>
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<tr>
<td>Both</td>
<td>15,853</td>
<td>112.36</td>
<td>112</td>
<td>7.19</td>
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</table>
Results

- We study 3 post-treatment months (April-June 2014)
  - Data: household-level monthly consumption
  - Split results by whether historically “Above” or “Below” 110
- One time treatment so decay likely
- We interpret as the effect of a one-time (low-cost) information intervention
### ATE Estimates - Above 110 Pre-Treatment

**Dependent Variable:** Monthly Consumption (kWh)

<table>
<thead>
<tr>
<th></th>
<th>Cross Section (April-June 2014)</th>
<th>Panel (January 2013-June 2014)</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
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<tr>
<td>Social Comparison</td>
<td>-1.362**</td>
<td>-1.317**</td>
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<tr>
<td></td>
<td>(0.599)</td>
<td>(0.597)</td>
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<tr>
<td>Price Notch Salience</td>
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<td>-0.375</td>
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<tr>
<td></td>
<td>(0.612)</td>
<td>(0.609)</td>
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<td>Both</td>
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<td></td>
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<td>(0.604)</td>
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<td>Month-by-year FE</td>
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<td>Yes</td>
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<tr>
<td>Avg Q 2013</td>
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<td>Yes</td>
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<tr>
<td>Q 1-2/2014 4-6/2013</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Route FE</td>
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<td>No</td>
</tr>
<tr>
<td>Household FE</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>

Robust standard errors clustered at the household level. *** p<0.01, ** p<0.05, * p<0.1
ATE Estimates - Above 110

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kWh)

-3 -2 -1 0 1 2

Social Comparison

Price Notch Salience

Both

Cross Section with Controls
Diff–in–Diff
Household Fixed Effects

Pellerano, Price, Puller, and Sánchez
USAEE 2015
ATE Estimates - 111-115

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kwh)

Social Comparison
Price Notch Salience
Both

Cross Section with Controls
Diff–in–Diff
Household Fixed Effects
ATE Estimates - 116-125

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kwh)

Social Comparison
Price Notch Salience
Both

Cross Section with Controls
Diff−in−Diff
Household Fixed Effects
ATE Estimates - Below 110

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kWh)

Social Comparison
Price Notch Salience
Both

Cross Section with Controls
Diff-in-Diff
Household Fixed Effects

Pellerano, Price, Puller, and Sánchez
USAEE 2015
ATE Estimates - Above & Below

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kwh)

Social Comparison
Price Notch Salience
Both

Cross Section with Controls
Diff-in-Diff
Household Fixed Effects

Pellerano, Price, Puller, and Sánchez
USAEE 2015
ATE Estimates - Above 110, Low Var HHs

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kWh)

Social Comparison | Price Notch Salience | Both

-3 -2 -1 0 1 2

Cross Section with Controls
Diff-in-Diff
Household Fixed Effects

Pellerano, Price, Puller, and Sánchez
USAEE 2015
ATE Estimates - Above 110, High Var HHs

95% Confidence Interval of Treatment Effect

Change in Monthly Consumption (kwh)

Social Comparison
Price Notch Salience
Both

Cross Section with Controls
Diff–in–Diff
Household Fixed Effects

Pellerano, Price, Puller, and Sánchez
USAEE 2015
Results

- **Social comparison** treatment reduces consumption:
  - 1.0% reduction in 3 months after treatment
  - Compare to 2% effects of (longer-term) OPOWER Home Energy Reports
  - Equivalent to turning off 60 Watt bulb for $\approx$ half hour per day
  - Effect similar for those “just above” and “far above” the benchmark comparison (with precision caveats)
  - Social comparisons may have “wider range”

- **Price notch saliency** may have effect for those “just above” but overall effect for those above 100 is zero/small

- Suggests that incentive to conserve is “linear in distance to comparison” for **Social Comparison**, but “non-linear” for **Price Notch**

- No boomerang for households below 110
Thanks
Mode in Consumption around 110 existed prior to notch’s creation in 2007
Electricity Distribution in Ecuador