

Helping Mexican Households Benefit from Electricity Industry Restructuring: Using Information to Encourage Energy Efficiency

Gordon Leslie

w/ Ognen Stojanovski, Mark Thurber, Frank Wolak and Juan Enrique
Heurta Wong

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Energy market restructuring in transitioning economies

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- Transform their state-owned monopolist utility, CFE into a productive enterprise with the clear objective of creating economic value.
- Restructure electricity generation industry to competitive wholesale markets
- Increase renewable generation share.
- Improve energy efficiency

These objectives have the potential to improve the efficiency of Mexico's energy industry and the welfare of their citizens if well designed.

Challenges to effective energy market restructuring in transitioning economies

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 - Presents a need for a more active demand side of the market.
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Passage from Deloitte's summary of the proposed Mexican Utility Reform:

Politicians, under pressure to show competition is reducing prices for all customers, are likely to extend subsidies. Over time, these can be reduced as the market matures. As subsidies decline, competitive offerings to utility-provided power may become viable depending on the delivered price of electricity.

Question: How can actionable information be provided to consumers to help unlock the benefits of energy market reform and ease the transition?

Key Findings

- Puebla RCT: Actionable information can be effective in promoting energy efficiency.
 - Customers on the highest marginal kWh tariff respond to actionable information.
 - Average response to being offered the workshop was a reduction in consumption of 2.4%.
 - Local average response of those that completed the workshop was a reduction of 5.5%.

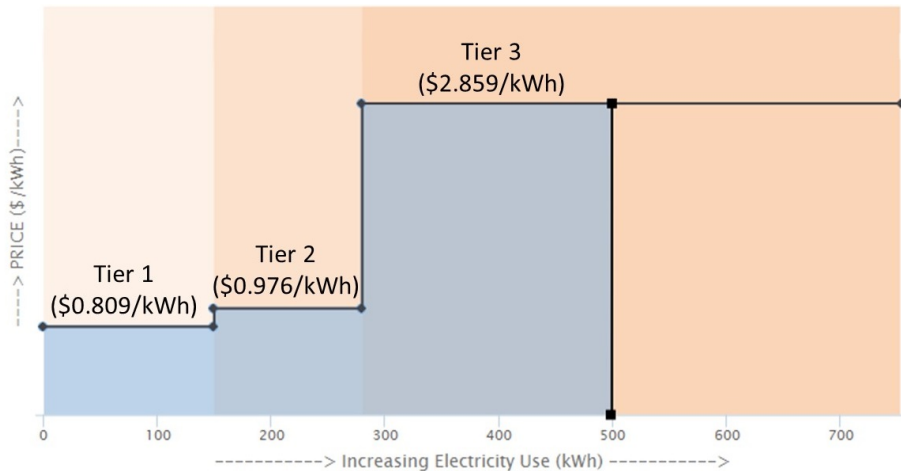
Key Findings

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 - Average response to being offered the workshop was a reduction in consumption of 2.4%.
 - Local average response of those that completed the workshop was a reduction of 5.5%.
- Method of communication extremely important to engage customers
 - Response rate of 43% for unsolicited, in-person and on-the-spot workshop invitation
 - Response rate of 0.8% for postcard invitation to online workshop
 - Response rate of 6.5% for hand-delivered and explained postcard invitation

Setting

- CFE is a state-owned monopolist electric utility
- Puebla, Mexico is a temperate region billed under Tarifa 1 of CFE's electricity rate schedule.
- Increasing block pricing: Three segments to its tariff regime
 - 1 Básico: First 150kWh per bimonth charged at MXN\$0.809 per kWh
 - 2 Intermedio: Next 130kWh per bimonth charged at MXN\$0.976 per kWh
 - 3 Excedente: All extra kWh per bimonth charged at MXN**\$2.859** per kWh
- Therefore, the marginal electricity price a household faces is a non-linear function of its bimonthly consumption

Tarifa A



Intervention

Offer, medium and reward:

- Houses were approached by 3 students and offered to participate in an electricity pricing workshop.
- Interviewers were identified as university students.
- Workshop performed on a computer tablet at the household's doorstep.
- Participants were given a \$100 MXN (\approx \$5 USD) Walmart gift card upon completion of the workshop.

An interview



Intervention

Workshop details - four modules:

- 1** What is a kWh?
- 2** How does your electricity bill work (personalized, appliance usage converted to \$)
- 3** Demographic and appliance usage questions
- 4** Personalized tips for reducing electricity use and estimated \$ savings

Median completion time 20 minutes.

Workshop



Anterior

Siguiente

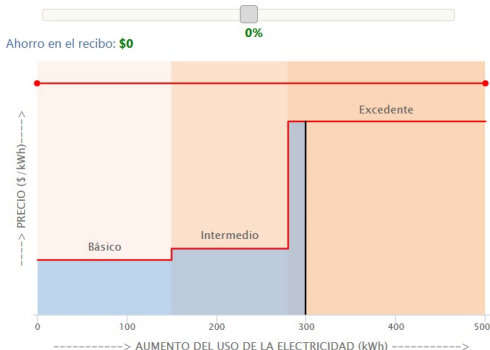
El gráfico de la derecha muestra su recibo de luz. El área azul es la cantidad que CFE le cobra. Cuanto más grande el área azul, mayor será el costo. Por favor, mueva el cuadro en la parte superior del gráfico para ver cómo sus costos cambiarían si aumentar o disminuir su consumo de energía.

Su recibo típico: 334

Recibo nuevo: --

Ahorro en el recibo: \$0

Porcentaje de descuento en el recibo: 0%



Workshop



Anterior

Siguiente

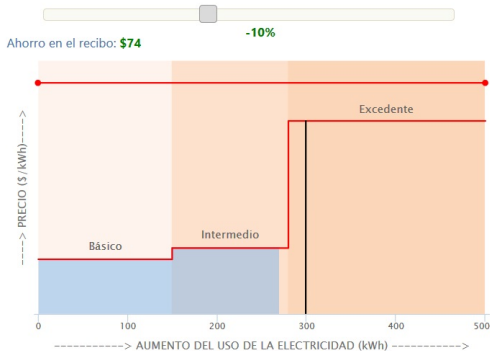
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Su recibo típico: 334

Recibo nuevo: **\$260**

Ahorro en el recibo: **\$74**

Porcentaje de descuento en el recibo: **22.2%**



Sample selection and data description

Logistics: Had to select sample without seeing consumption history.
Consequently randomization occurred in multiple stages:

- 1 Baseline population: Census blocks in top 40% of mean income
- 2 Randomly select census blocks (14 selected)
- 3 Randomly select street blocks in census block (1/4 probability of selection)
- 4 Randomly select properties on block with 1/4 probability
 - If property is an apartment block, individual apartments sampled with 1/4 probability
 - Consequence: Apartments undersampled
 - But fail to reject null of no difference in pre-intervention trend of group assigned treatment.

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In total, workshop offered to 719 households. 265 accepted the intervention, 239 were not home.

Balanced panel matches to CFE data: 472 households. 208 accepted the intervention, 132 were not home. 32,230 in control group

Average bimonthly consumption by group Not interviewed

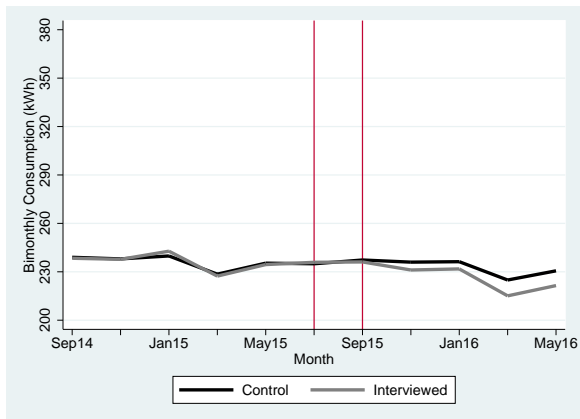


Figure: Interviewed and control group consumption means, full sample

Interviewed group series has subtracted the mean difference in pre-intervention consumption between itself and the control group for comparison purposes.

Average bimonthly consumption by group, Excedente customers

Not interviewed

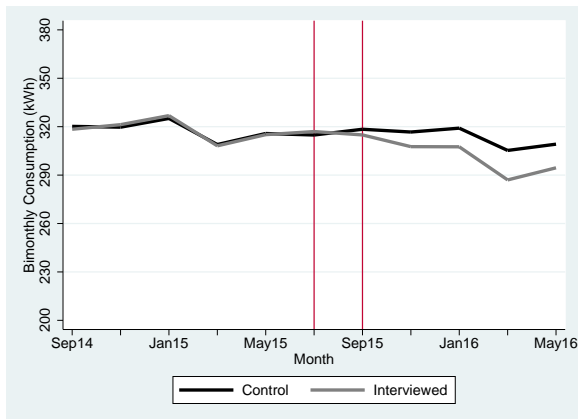


Figure: Interviewed and control group consumption means, pre-intervention max kwh >280

Interviewed group series has subtracted the mean difference in pre-intervention consumption between itself and the control group for comparison purposes.

Results - ITT estimate, levels

Estimate of the expected impact from assignment to treatment:

$$\text{kWh}_{i,t} = \alpha_i + \gamma_t + ITT * Z_{i,t} + \epsilon_{i,t}, \text{ assuming } E[\epsilon_{i,t}|Z_{i,t}] = 0$$

Group	All	Básico Max < 150	Intermedio 150 < Max < 280	Excedente Max > 280
\hat{ITT}	-3.76 (1.94)	2.69 (2.90)	0.63 (2.03)	-8.49 (3.44)
Obs.	359,722	34,551	165,880	159,291
Num HH assigned	472	27	215	230
Num HH interviewed	208	10	97	101
Num HH control	32,230	3,114	14,865	14,251

Standard errors clustered at the household level reported in parentheses. There are 11, 2-month time periods - sample is restricted to households with 11 observations.

Results - ITT estimate, logs

Estimate of the expected impact from assignment to treatment:

$$\log(\text{kWh})_{i,t} = \alpha_i + \gamma_t + ITT * Z_{i,t} + \epsilon_{i,t}, \text{ assuming } E[\epsilon_{i,t}|Z_{i,t}] = 0$$

Group	All	Básico Max < 150	Intermedio 150 < Max < 280	Excedente Max > 280
\hat{ITT}	-0.009 (0.009)	0.027 (0.029)	0.002 (0.012)	-0.024 (0.014)
Obs.	359,722	34,551	165,880	159,291
Num HH assigned	472	27	215	230
Num HH interviewed	208	10	97	101
Num HH control	32,230	3,114	14,865	14,251

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Results - LATE estimate, levels

Estimate of the impact from the intervention for those whom $D_{i,t}(Z_{i,t} = 1) = 1$:

$$\text{kWh}_{i,t} = \alpha_i + \gamma_t + \text{LATE} * D_{i,t} + \epsilon_{i,t}$$

$$D_{i,t} = \beta Z_{i,t} + \mu_{i,t}$$

assuming $E[\mu_{i,t}, \epsilon_{i,t} | Z_{i,t}] = 0$

Group	All	Básico Max < 150	Intermedio 150 < Max < 280	Excedente Max > 280
<i>LATE</i>	-8.47 (4.35)	7.27 (8.09)	1.38 (4.43)	-19.32 (7.82)
Obs.	359,722	34,551	165,880	159,291
Num HH assigned	472	27	215	230
Num HH interviewed	208	10	97	101
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Group	All	Básico Max < 150	Intermedio 150 < Max < 280	Excedente Max > 280
$\widehat{\text{LATE}}$	-0.021 (0.020)	0.074 (0.080)	0.003 (0.026)	-0.055 (0.031)
Obs.	359,722	34,551	165,880	159,291
Num HH assigned	472	27	215	230
Num HH interviewed	208	10	97	101
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Results - Targeting demographics

- Conditional on taking the survey, no detectable differences in consumption responses by Gender, Age, Education or Income.
- Marginal price is the only observable household characteristic that we detect differential consumption changes.
 - Targeting the 14,251 excedente customers in our neighbourhoods - estimated 121MWh reduction per bimonth or 725MWh reduction per year
 - Can be effective in meeting Government's energy efficiency goals
 - Might not be desirable if CFE were a private company
 - Saves approximately MX\$2 per kWh, but these customers pay \$2.8 per kWh
 - Welfare impact?

Discussion - Policy relevance

- Possible for utilities in Mexico to effectively communicate with their clients about their tariffs
 - Information and tariff design policy could encourage a more active demand side
 - More active demand side will be enabling for efficiency gains from energy reforms
- Marginal prices for consumers must align with efficiency goals
 - Evidence that targeting higher users of electricity will be most effective in reducing electricity use

Discussion - Next steps

This study

- Continue matching process with CFE administrative data

Data collection in process on a self-administered workshop in Puebla

- Attempted to target the excedente customers with an online, self-administered intervention.
- Less than 1% response rate if invitation was dropped in mailbox.
- 6% response rate if invitation was handed over with a brief explanation about the workshop.

Separate utility has offered to allow us to attach invitations to customer bills.

- Method should help with credibility and be more practical if scaled up.

Average bimonthly consumption by group [Back](#)

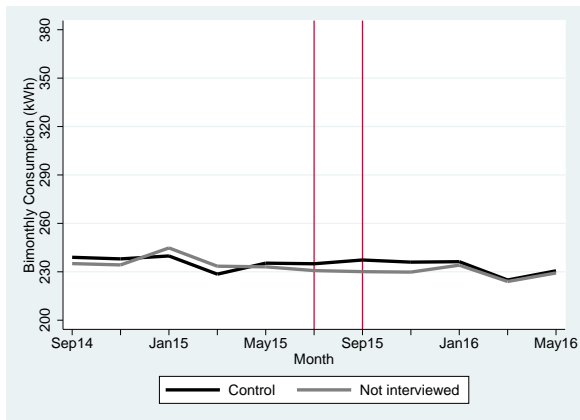


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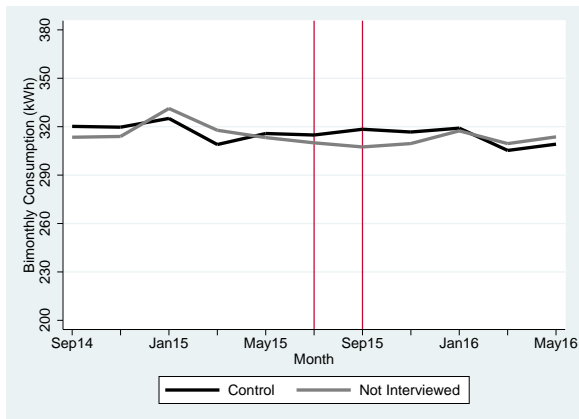


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