Environmental Externalities
and Intrahousehold Inefficiencies

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This paper = Chiappori + Pigou

- Intrahousehold decision making
- Environmental externalities & corrective pricing
Intrahousehold decision-making

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  Environmental externalities from consumption, specifically water use.
- Specific context: HHs in urban Zambia with piped water connections.
Intrahousehold inefficiency

- Household achieves Pareto efficient outcomes in collective model
- But households might have limited information or limited enforcement, leading to inefficiency
- Our work fits into this part of literature
- Household cannot achieve optimal outcome even for themselves, and this exacerbates negative externality on the environment
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- Implication: More inefficient households are less price sensitive
  - Inefficient = internalizes less of externality due to (a) less observability
    (b) weaker enforcement (c) less altruism
Environmental externalities

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- Standard policy prescription: Corrective pricing
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- Standard policy prescription: Corrective pricing
- For home water and electricity use, the price is applied to household consumption
- Pigouvian tax needs to correct for 2 externalities: (1) intrahh problem causes household to consume more than its first best (2) household’s first best exceeds societally optimal consumption
Husbands and wives

- Intrahousehold inefficiency arises even if men and women are “symmetric”
  - Equal bargaining power (income net of water bill is shared equally)
  - Consume same amount of water

In fact, women consume most of the water (cooking, cleaning, bathing children, etc.)

Plus, men – at least in our context in Zambia – are the residual claimant when water bills increase or decrease.

Thus, the person who consumes most of the water has very weak incentives to conserve.
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- How do we change water prices?

How do we change residual claimant?
- Vary whether we tell and give prize to (a) just wife (b) just husband (c) wife and husband together

How do we measure household efficiency?
- Lab-in-the-field game that measures combo of altruism and enforcement between spouses

Two other interventions

▶ Information about price of water
▶ Information on how water utility measures quantity and sets bills
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Preview of results

- Consumption responds to price incentives: average short run price elasticity is -0.3
- Consumption response is larger among more efficient households:
  - Elasticity is 3 times as large for HHs with above-median efficiency compared to below median
- Price incentives are more effective if they target spouse that is not usually the residual claimant
Outline of rest of talk

- Model of household decision making about water
- Setting, study design, and data
- Empirical specification and results
- Next steps and conclusions
Model setup

- Non-cooperative decision: Nash equilibrium
- Individual $i$ chooses own water use $w_i$, taking spouse’s water use $w_{-i}$ as given
- $w_{-i}$ is not observable
- Water utility observes and bills for household consumption, $W = w_A + w_B$, and charges the household $pW$
Individual decision problem

- Bargaining weight $\lambda_i$
- Division of after-bill income: $\lambda_i(Y - pW)$
- Individual utility from water use and income for other consumption
  \[ v_i = f(w_i) + c = f(w_i) + \lambda_i(Y - pW) \]
- Altruism toward spouse $\alpha_i < 1$ determines how much $i$ internalizes $-i$’s utility:
  \[ u_i = v_i + \alpha_i v_{-i} \]
- $\alpha_i$ could also reflect contract enforcement (which we do not model)
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- $\alpha_i$ could also reflect contract enforcement (which we do not model)
- First order condition: $f'(w_i^*) = p(\lambda_i + \alpha_i \lambda_{-i})$
- Consume less water if
  - Larger residual claim on after-water income
  - More altruistic toward spouse
Effects of a price change

- Response to a change in $p$ depends on $\alpha_i$ and $\lambda_i$

- **Result 1:** $\left| \frac{\partial w_i^*}{\partial p} \right|$ is increasing in $\alpha_i$
  - More efficient households are more price sensitive
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    - When bill is to the household, individual who is larger residual claimant is more price sensitive
- Meanwhile, when we target prices to specific people, person who is not residual claimant in status quo is more price sensitive
- There are also predictions on interactive effects (e.g., HH is more price sensitive if large water user is primary residual claimant)
What’s special about water?

Who stole the cookies from the cookie jar?

___ stole the cookies from the cookie jar.

Who me?
Yes you!
It couldn’t be!
Then WHO?

Who stole the cookies?
Spouse’s water consumption is difficult to observe

- mTurk survey of US couples (we are replicating it in Zambia)
- “Suppose you were trying to estimate your spouse/partner’s consumption. Among the following categories, which 3 would you be LEAST confident in your estimate of the $ value for his or her consumption in a typical week?”
Own water consumption is also difficult to observe.
Outline

- Model of household decision making about water
- **Setting, study design, and data**
- Empirical specification and results
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Study setting

- Study location: Livingstone, Zambia
- Collaborated with regional water utility, Southern Water and Sewerage Company (SWSC)
- Use their account data for sampling and outcome measure (water use)
- Water bill \( \sim 5\% \) monthly household expenditure for our sample, about 10 USD
  - US EPA’s affordability threshold is 2\% and UNDP’s is 3\%
- Water shortages during dry season
Sampling

- Used data as of April 2015
- Obtained monthly billing and payment records for all metered residential customers in Livingstone since 2012 (N=9800)
- Excluded households with suggestive evidence of meter tampering, very low or high users, those with large debts (N=7425)
- Screening visits to restrict sample to: (a) married couples, (b) tenancy > 6 months, (c) non-shared meter (N=2051)
- Return visit to survey household; surveyed 1282 households
  - Include all screened households in analysis to improve precision → 6594 hh in analysis
Household survey

- Sample: 1,282 married couples
- Surveyed households on a rolling basis from May-December 2015
  - Treatment delivered with survey so turns on at different times for different households
- Simultaneous but separate survey of husband and wife (two-surveyor teams)
- Collect data on perceived price water use, decision-making, household characteristics
- Measure of intrahousehold altruism/efficiency: Dictator game with sharing multiplier between spouses
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Measuring intrahousehold efficiency

Modified dictator game between spouses

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- Amount sent is doubled; sending everything maximizes total household income

Opportunity to conceal income

Randomize size of endowment

Two decisions: Transfer to spouse and transfer to water NGO; randomize which decision is paid out

Spouse only learns payoff to him/her

Will send more money to spouse if you value spouse having income (altruism) or expect to recoup money from spouse (enforcement)

Interpret share of endowment sent to spouse as a measure of $\alpha_i$
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\[
\alpha_i = \frac{2}{45}
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Considerable variation in how much is sent
Husbands send more on average than wives
Increasing the effective price of water
Prize for reducing water use

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- Individual treatment: \( v_i = f(w_i) + \lambda_i(Y - pW) + R \times 1(W < \bar{W}) \)
  - not multiplied by \( \lambda_i \)
Other intervention: Price information

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- Brought couple together at end and gave them this information
WANT TO SAVE MONEY ON YOUR MONTHLY WATER BILL?
NANGA MUFUNA KUCHEPESA NDALAMA ZIMENE MUMA LIPILA BILL YANU YA MANZI YAPA MWEZI?

TURN OFF THE TAP!
VALANI POPI YANU!

Save 10 Kwacha per month with 10 minutes less tap use per day.
Sungani K10 pamwezi paku chepesako 10 minetisi yosebenzesa tap yamanzi pa siku imodzi.

Save 20 Kwacha per month with 20 minutes less tap use per day.
Sungani K20 pamwezi paku chepesako 20 minetisi yosebenzesa tap yamanzi pa siku imodzi.

These reductions are for your entire household, not any particular individual. These are typical savings. Depending on your water pressure, your situation may be slightly different.
Other intervention: SWSC credibility on billing

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- Interesting hypothesis but intervention had no effect (cheap talk?)
Summary of study design

Eligible for screening (N = 7,425)

Screened (N = 6,594)

Surveyed (N = 1,282)

Control (1/4 sample)

Price info (1/4 sample)

Price info + Price incentive (1/2 sample)

Incentive: Husband (1/3 treatment)

Incentive: Wife (1/3 treatment)

Incentive: Both (1/3 treatment)

Cross-cutting Provider credibility treatment (1/2 each treatment arm)
Outcome data

- Monthly water consumption in cubic meters from SWSC bills
- Household average usage is 20 cubic meters/month
- Based on physical water meter readings collected monthly between the 20th and 25th of each calendar month
- Keep only successful meter readings (i.e., drop months in which meter reading is estimated or meter reported as broken)
- Data from January 2012 through September 2016
## Sample characteristics

<table>
<thead>
<tr>
<th></th>
<th>Only screened HHs (1)</th>
<th>No incentive HHs (2)</th>
<th>Incentive HHs (3)</th>
<th>P-val (2)=(3) (4)</th>
</tr>
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<tbody>
<tr>
<td><strong>Quantity consumed</strong></td>
<td>20.940 (14.525)</td>
<td>18.995 (12.097)</td>
<td>18.247 (10.515)</td>
<td>0.239</td>
</tr>
<tr>
<td><strong>Any payment</strong></td>
<td>0.738 (0.195)</td>
<td>0.764 (0.166)</td>
<td>0.769 (0.166)</td>
<td>0.566</td>
</tr>
<tr>
<td><strong>Missing meter reading</strong></td>
<td>0.137 (0.188)</td>
<td>0.100 (0.157)</td>
<td>0.112 (0.170)</td>
<td>0.210</td>
</tr>
<tr>
<td><strong>Total monthly bill</strong></td>
<td>99.848 (88.152)</td>
<td>92.925 (69.044)</td>
<td>87.309 (60.949)</td>
<td>0.124</td>
</tr>
<tr>
<td><strong>Households</strong></td>
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<th>P-val (1) = (2) (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share sent to spouse by husband</td>
<td>0.702 (0.269)</td>
<td>0.690 (0.254)</td>
<td>0.398</td>
</tr>
<tr>
<td>Share sent to spouse by wife</td>
<td>0.520 (0.262)</td>
<td>0.513 (0.260)</td>
<td>0.597</td>
</tr>
<tr>
<td>W: Residual claimant</td>
<td>0.307 (0.462)</td>
<td>0.316 (0.465)</td>
<td>0.749</td>
</tr>
<tr>
<td>W: Bigger user</td>
<td>0.795 (0.404)</td>
<td>0.838 (0.369)</td>
<td>0.047</td>
</tr>
<tr>
<td>Households</td>
<td>664</td>
<td>618</td>
<td></td>
</tr>
</tbody>
</table>
Pre-intervention water use
Outline

- Model of household decision making about water
- Setting, study design, and data
- **Empirical specification and results**
- Next steps and conclusions
Regression model

- Estimating equation:

\[ y_{it} = \alpha + \beta_1 PricelIncentive_{it} + \beta_2 PostSurvey_{it} + \delta_1 PricelInfo_{it} + \delta_2 BillingCredibility_{it} + \gamma_i + \tau_t + \epsilon_{it} \]

- \( PricelIncentive_{it} \) equals 1 for treated HHs after survey/intervention
- \( PostSurvey_{it} \) equals 1 after HH is surveyed
- \( \gamma_i \) are HH fixed effects; \( \tau_t \) are year-month FEs
Regression model

- Estimating equation:

\[ y_{it} = \alpha + \beta_1 \text{PricIncentive}_{it} + \beta_2 \text{PostSurvey}_{it} + \delta_1 \text{PricInfo}_{it} + \delta_2 \text{BillingCredibility}_{it} + \gamma_i + \tau_t + \epsilon_{it} \]

- \( \text{PricIncentive}_{it} \) equals 1 for treated HHs after survey/intervention
- \( \text{PostSurvey}_{it} \) equals 1 after HH is surveyed
- \( \gamma_i \) are HH fixed effects; \( \tau_t \) are year-month FEs
- Include screened out households; \( \text{PostSurvey} \) based on when their neighborhood was surveyed

\[ y_{it} = \alpha + \beta_1 \text{PricIncentive}_{it} + \beta_2 \text{PostSurvey}_{it} + \beta_3 \text{Post}_{it} + \delta_1 \text{PricInfo}_{it} + \delta_2 \text{BillingCredibility}_{it} + \gamma_i + \tau_t + \epsilon_{it} \]

- Cluster standard errors by household
Predictions

- Price incentive lowers average consumption
Predictions

- Price incentive lowers average consumption
- Effect is larger for more efficient households, i.e., those with more sharing in the dictator game
Predictions

- Price incentive lowers average consumption
- Effect is larger for more efficient households, i.e., those with more sharing in the dictator game
- Effect is larger if person-specific incentive is directed toward:
  - Spouse who is not usually the residual claimant
  - Spouse who is the larger water user
## Price incentive average effect

**Outcome:** log (quantity)

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assigned incentive x Post</td>
<td>-0.076***</td>
<td>-0.068***</td>
<td>-0.067***</td>
</tr>
<tr>
<td></td>
<td>[0.026]</td>
<td>[0.025]</td>
<td>[0.025]</td>
</tr>
<tr>
<td>Survey sample x Post</td>
<td>0.054***</td>
<td>0.033*</td>
<td>0.022</td>
</tr>
<tr>
<td></td>
<td>[0.019]</td>
<td>[0.018]</td>
<td>[0.018]</td>
</tr>
<tr>
<td>Assigned incentive treatment</td>
<td>-0.009</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.033]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Survey sample</td>
<td>-0.087***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.025]</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**HH FE**  
**Month-Year FE**  
**Observations (HH)** 6,594 6,594 6,594  
**Observations (HH-months)** 129,899 129,899 129,899

**Implied price elasticity:** -0.28
Price incentive effect

Post-survey consumption / Reference window consumption

Density

Control
Incentive treatment
Heterogeneity by intrahousehold efficiency

<table>
<thead>
<tr>
<th>Outcome: log (quantity)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentive treatment</td>
<td>-0.034</td>
<td>-0.058*</td>
<td>-0.093**</td>
</tr>
<tr>
<td></td>
<td>[0.032]</td>
<td>[0.033]</td>
<td>[0.044]</td>
</tr>
<tr>
<td>Incentive x Sent above median on average</td>
<td>-0.071</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.050]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incentive x Husband sent above median</td>
<td></td>
<td>-0.022</td>
<td>-0.011</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.051]</td>
<td>[0.066]</td>
</tr>
<tr>
<td>Incentive x Wife sent above median</td>
<td></td>
<td>-0.003</td>
<td>-0.079</td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.058]</td>
<td>[0.075]</td>
</tr>
<tr>
<td>Total effect</td>
<td>-0.105***</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.038]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total effect, husband</td>
<td>-0.079*</td>
<td>-0.104*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.043]</td>
<td>[0.055]</td>
<td></td>
</tr>
<tr>
<td>Total effect, wife</td>
<td>-0.061</td>
<td>-0.172**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.055]</td>
<td>[0.072]</td>
<td></td>
</tr>
</tbody>
</table>

Sample

<table>
<thead>
<tr>
<th></th>
<th>Full</th>
<th>Full</th>
<th>Gender roles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observations (HH)</td>
<td>6,587</td>
<td>6,587</td>
<td>6,038</td>
</tr>
<tr>
<td>Observations (HH-months)</td>
<td>129,775</td>
<td>129,775</td>
<td>118,452</td>
</tr>
</tbody>
</table>
Heterogeneity by intrahousehold efficiency

[Graph showing treatment effect on log(quantity) over months pre/post treatment for below and above median efficiency.]
Price incentives for man, woman, and couple

Outcome: log (quantity)  

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Couple incentive</td>
<td>-0.050 [0.041]</td>
</tr>
<tr>
<td>Husband incentive</td>
<td>-0.043 [0.037]</td>
</tr>
<tr>
<td>Wife incentive</td>
<td>-0.095** [0.037]</td>
</tr>
</tbody>
</table>

Observations (HH) 6,594
Observations (HH-months) 129,899
### Heterogeneity by residual claimant and big water user

**Outcome: log (quantity)**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual incentive</td>
<td>-0.030</td>
<td>-0.054</td>
<td>-0.026</td>
<td>-0.024</td>
</tr>
<tr>
<td></td>
<td>[0.033]</td>
<td>[0.033]</td>
<td>[0.035]</td>
<td>[0.036]</td>
</tr>
<tr>
<td>Incentive to non-resid claimant</td>
<td>-0.091**</td>
<td>-0.087*</td>
<td>-0.084*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.043]</td>
<td>[0.046]</td>
<td>[0.046]</td>
<td></td>
</tr>
<tr>
<td>Incentive to bigger user</td>
<td></td>
<td>-0.045</td>
<td>-0.013</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.043]</td>
<td>[0.046]</td>
<td></td>
</tr>
<tr>
<td>Wife incentive</td>
<td></td>
<td></td>
<td></td>
<td>-0.018</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>[0.046]</td>
</tr>
<tr>
<td>Total effect claimant</td>
<td>-0.121***</td>
<td>-0.113**</td>
<td>-0.108**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.035]</td>
<td>[0.046]</td>
<td>[0.048]</td>
<td></td>
</tr>
<tr>
<td>Total effect user</td>
<td></td>
<td>-0.099***</td>
<td>-0.039</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.036]</td>
<td>[0.048]</td>
<td></td>
</tr>
</tbody>
</table>

Observations (HH) 6,412 6,412 6,412 6,412
Observations (HH-months) 126,136 126,136 126,136 126,136
Why don’t households make the large user the residual claimant?

- Seemingly easy solution: Make the larger water user the residual claimant
Why don’t households make the large user the residual claimant?

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- Only 30% of households have aligned incentives this way
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  - Husband is responsible for fixing leaky faucets
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- Suggests some other barrier
  - Larger user is more risk averse
  - Factors other than household usage affect bill
  - Husband is responsible for fixing leaky faucets
  - Existing norm hasn’t been updated as the environment has changed
**Heterogeneity by observability**

<table>
<thead>
<tr>
<th>Outcome: log (quantity)</th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentive treatment</td>
<td>-0.055**</td>
<td>-0.038</td>
<td>-0.054</td>
</tr>
<tr>
<td></td>
<td>[0.027]</td>
<td>[0.030]</td>
<td>[0.034]</td>
</tr>
<tr>
<td>Incentive x Know bill quantity</td>
<td>-0.081</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>[0.068]</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Incentive x Know spouse’s water use</td>
<td></td>
<td>-0.080</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>[0.051]</td>
<td></td>
</tr>
<tr>
<td>Incentive x Observability PCA</td>
<td></td>
<td></td>
<td>-0.028</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>[0.049]</td>
</tr>
<tr>
<td>Total effect</td>
<td>-0.137**</td>
<td>-0.118***</td>
<td>-0.081**</td>
</tr>
<tr>
<td></td>
<td>[0.063]</td>
<td>[0.041]</td>
<td>[0.035]</td>
</tr>
<tr>
<td>Observations (HH)</td>
<td>6,594</td>
<td>6,594</td>
<td>6,594</td>
</tr>
<tr>
<td>Observations (HH-months)</td>
<td>129,899</td>
<td>129,899</td>
<td>129,899</td>
</tr>
</tbody>
</table>
Outline

- Model of household decision making about water
- Setting, study design, and data
- Empirical specification and results
- Next steps and conclusions
Next steps

- Test other predictions, e.g., based on person-specific altruism (dictator-game sharing)
Next steps

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- Conduct small survey in Zambia to assess how observable water consumption is
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- Carry out open-ended interviews to ask households why they do not make women the residual claimant on water bills
  - Findings beg question of why couples don’t give the woman more residual claim on water expenses
Next steps

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- Carry out open-ended interviews to ask households why they do not make women the residual claimant on water bills
  - Findings beg question of why couples don’t give the woman more residual claim on water expenses
- Discussion of normative implications
  - Pigouvian tax helps HHs fix intraHH inefficiency
  - But, due to their high water use, they have marginal utility of income so tax hurts more
Conclusions

- Transactions for water and electricity are with the HH, not individual
- HHs cannot observe own and spouse’s consumption of water, leading to over-consumption relative to their own first best

Policy implications:

▶ In-kind household rewards that are especially valued by women
▶ Make HH-level water usage more observable, e.g., easy-to-access high-frequency usage data

Solving intraHH frictions might be easier/better than very high prices
Or, Pigouvian taxes need to be set especially high in settings where intraHH frictions are large
Conclusions

- Transactions for water and electricity are with the HH, not individual
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Conclusions

- Transactions for water and electricity are with the HH, not individual.
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- Also find that changes to individual price for women has largest effect.
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- **Policy implications:** Our intervention was not intended to be scalable.

In-kind household rewards that are especially valued by women, making HH-level water usage more observable, e.g., easy-to-access high-frequency usage data. Solving intraHH frictions might be easier/better than very high prices. Or, Pigouvian taxes need to be set especially high in settings where intraHH frictions are large.
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- Solving intraHH frictions might be easier/better than very high prices.
- Or, Pigouvian taxes need to be set especially high in settings where intraHH frictions are large.
Backup slides
Dictator game correlates

<table>
<thead>
<tr>
<th></th>
<th>Husband share sent (1)</th>
<th>Wife share sent (2)</th>
<th>Sent above median (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>H: Share NGO</td>
<td>0.192***</td>
<td>0.079***</td>
<td>0.262***</td>
</tr>
<tr>
<td></td>
<td>(0.030)</td>
<td>(0.030)</td>
<td>(0.057)</td>
</tr>
<tr>
<td>W: Share NGO</td>
<td>0.034</td>
<td>0.198***</td>
<td>0.269***</td>
</tr>
<tr>
<td></td>
<td>(0.033)</td>
<td>(0.033)</td>
<td>(0.063)</td>
</tr>
<tr>
<td>W: Residual claimant</td>
<td>0.003</td>
<td>0.001</td>
<td>0.013</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.016)</td>
<td>(0.030)</td>
</tr>
<tr>
<td>W: Bigger water user</td>
<td>0.003</td>
<td>-0.006</td>
<td>-0.000</td>
</tr>
<tr>
<td></td>
<td>(0.019)</td>
<td>(0.019)</td>
<td>(0.036)</td>
</tr>
<tr>
<td>Household size</td>
<td>-0.004</td>
<td>-0.009***</td>
<td>-0.015**</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.006)</td>
</tr>
</tbody>
</table>
### Dictator game correlates

<table>
<thead>
<tr>
<th></th>
<th>Husband share sent (1)</th>
<th>Wife share sent (2)</th>
<th>Sent above median (3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH assets</td>
<td>0.008***</td>
<td>0.018***</td>
<td>0.030***</td>
</tr>
<tr>
<td></td>
<td>(0.003)</td>
<td>(0.003)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>HH english fluency</td>
<td>0.022</td>
<td>0.082***</td>
<td>0.112***</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>Either underestimated price</td>
<td>0.009</td>
<td>0.017</td>
<td>0.033</td>
</tr>
<tr>
<td></td>
<td>(0.017)</td>
<td>(0.017)</td>
<td>(0.032)</td>
</tr>
<tr>
<td>Both blame high bill on SWSC</td>
<td>0.012</td>
<td>0.016</td>
<td>0.000</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.028)</td>
</tr>
</tbody>
</table>
### Robustness check: Endogeneity of intrahousehold efficiency

**Outcome: log (quantity)**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incentive x Sent above median</td>
<td>-0.071</td>
<td></td>
<td>-0.060</td>
</tr>
<tr>
<td></td>
<td>(0.050)</td>
<td></td>
<td>(0.050)</td>
</tr>
<tr>
<td>Incentive x Sent above median to NGO</td>
<td>-0.069</td>
<td>-0.037</td>
<td>-0.034</td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td>(0.050)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>Incentive x Above median SDB score</td>
<td>0.034</td>
<td>0.024</td>
<td>0.030</td>
</tr>
<tr>
<td></td>
<td>(0.049)</td>
<td>(0.050)</td>
<td>(0.050)</td>
</tr>
<tr>
<td>Incentive x Household size</td>
<td>-0.005</td>
<td>-0.006</td>
<td>-0.006</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.011)</td>
<td>(0.011)</td>
</tr>
<tr>
<td>Incentive x Maid</td>
<td>-0.046</td>
<td>-0.003</td>
<td>-0.001</td>
</tr>
<tr>
<td></td>
<td>(0.068)</td>
<td>(0.069)</td>
<td>(0.069)</td>
</tr>
<tr>
<td>Incentive x HH assets</td>
<td>-0.017*</td>
<td>-0.015</td>
<td>-0.013</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.010)</td>
<td>(0.011)</td>
</tr>
</tbody>
</table>

**Observations (HH)**

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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</thead>
<tbody>
<tr>
<td>HH</td>
<td>6,587</td>
<td>6,587</td>
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</table>

**Observations (HH-months)**

<table>
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<tr>
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<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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<tbody>
<tr>
<td>HH-months</td>
<td>129,775</td>
<td>129,775</td>
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</table>
## Price info and SWSC credibility interventions

<table>
<thead>
<tr>
<th>Outcome: log (quantity)</th>
<th>(1)</th>
<th>(2)</th>
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</thead>
<tbody>
<tr>
<td>Info treatment</td>
<td>-0.012</td>
<td>[0.055]</td>
</tr>
<tr>
<td>Info treatment × Underestimated price</td>
<td>-0.020</td>
<td>[0.073]</td>
</tr>
<tr>
<td>Provider credibility treatment</td>
<td>0.005</td>
<td>[0.033]</td>
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<tr>
<td>Provider credibility × Distrust billing</td>
<td>0.046</td>
<td>[0.049]</td>
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<tr>
<td>Total effect</td>
<td>-0.032</td>
<td>0.050</td>
</tr>
<tr>
<td></td>
<td>[0.048]</td>
<td>[0.036]</td>
</tr>
</tbody>
</table>

HH FE  
Month-year FE  
Observations (HH)  
Observations (HH-months)
Robustness check: Other margins of adjustment

<table>
<thead>
<tr>
<th></th>
<th>Any pay</th>
<th>Missing quant</th>
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<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>Incentive</td>
<td>0.011</td>
<td>-0.005</td>
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<tr>
<td></td>
<td>[0.014]</td>
<td>[0.008]</td>
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<tr>
<td>Surveyed</td>
<td>0.002</td>
<td>0.010</td>
</tr>
<tr>
<td></td>
<td>[0.014]</td>
<td>[0.007]</td>
</tr>
<tr>
<td>Observations (HH)</td>
<td>6,594</td>
<td>6,594</td>
</tr>
<tr>
<td>Observations (HH-months)</td>
<td>140,431</td>
<td>152,971</td>
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</tbody>
</table>