Public Service Delivery, Exclusion and Externalities

Theory and Experimental Evidence from India

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(joint work with Alex Armand, Britta Augsburg, and Antonella Bancalari)

Quality of public service delivery

Governments consistently emphasize the importance of **improving the quality of public services to encourage utilization**.

- 8/17 SDGs make this reference [UN, 2020].
- May not hold when service delivery relies on **user fees**.
  - Prevailing model of use exclusion for (non-rival) public goods ⇒ **by-pass payment** or revert to **outside option**
  - **L&MICs**: most common model for essential services + largest portion of the overall tax burden [Bird, 2010; Paler et al., 2017].
- When quality improvements are incentivized it can create incentives for **stricter payment monitoring** ⇒
  - Negative externalities associated with persistent poverty [Stavins, 2011; Greenstone and Jack, 2015].
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This paper

- RCT in slums of two large cities in Uttar Pradesh, India to **boost quality** of community toilets (CTs) **but with no change in user fees**
  - Overall quality of the pay-to-use CTs improved in the treatment
  - However, so did fee collection, resulting in a great user exclusion which led to an increase in OD
- Striking, as improving quality can only be a good thing
- We outline a theory model where we separate out different effects we would expect from such reforms
- Our findings suggest that for public services that involve significant externalities, the nuances of incentives and user fees should be taken into account
- Long-standing view of the development community that improving quality would increase use of public services is challenged by this paper, zooming into the mechanisms and unintended consequences

This paper

Improvement in public service quality $\Rightarrow$ increased usage and fee compliance?

1. **Theoretical framework**: public service delivery funded by fees
2. **Field experiment** $\Rightarrow$ exogenously shifts quality of a basic service in the two major cities of Uttar Pradesh, India $\Rightarrow$ Community toilets (CTs)

- **Mechanisms driving quality of public services** [Duflo et al., 2012; Besley, 2017; Burgess et al., 2017; Rasul and Rogger, 2018; Bandiera et al., 2021; Akhtari et al., 2022; Fenizia, 2022; Best et al., 2023]
- **Underprovision of basic services in L&MICs** [Fafchamps and Minten, 2007; Kremer and Holla, 2009; Lucas and Mbiti, 2012; Szabo, 2015; Ito and Tanaka, 2018; Andrabi et al., 2020; Romero et al., 2020; Beuermann and Pecha, 2020; Jack and Smith, 2015, 2020; Burgess et al., 2020; Coville et al., 2020; Rockenbach et al., 2023]
- **User fees and tax collection in L&MICs** [Gertler, Locay, Sanderson, 1987; Gertler and Hammer, 1997; Hutton, 2004; Besley and Persson, 2013; Khan et al., 2016; Pomeranz and Vila-Belda, 2019, Weigel, 2020; Balan et al., 2022].

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A model of service delivery

- There is a discrete public service facility, users decide whether to use it or not
- Provider (caretaker) chooses effort:
  1. **Monitoring** $e_1 \in \{0, 1\} \Rightarrow$ probability of collecting a user fee from a given user is e_1, so expected fee to the user is $\tilde{p} \equiv pe_1$.
  2. **Quality-improving** $e_2 \in \{0, 1\} \Rightarrow$ quality that results is $q = e_2$
- **Cost function**

$$c(e_1, e_2) = \frac{1}{2}e_1^2 + \frac{1}{2}e_2^2$$

▸ Extension

- **Demand**: $\uparrow$ in quality and $\downarrow$ in fees

$$D = \alpha q - \frac{1}{2}\beta\tilde{p} + \varphi$$

  - α and β are the quality and the price elasticities of demand
  - $\varphi > 0$ e.g., social norms, could be shifted through information campaigns.
- **Social cost**: $s = \sigma - \gamma$, where γ is the cost of the service per user.

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A model of service delivery: First Best

- **Policymaker's payoff**:

$$\max_{\{e_1, e_2\}} \hat{\pi}(e_1, e_2) = (s + pe_1)\left(\alpha e_2 - \frac{1}{2}\beta e_1 p + \varphi\right) - \frac{1}{2}e_1^2 - \frac{1}{2}e_2^2.$$

- From FOCs:

$$\begin{aligned} e_1 &= \max\left\{\frac{p\left(\alpha e_2 - s\frac{1}{2}\beta + \varphi\right)}{1 + \beta p^2}, 0\right\}. \\ e_2 &= \alpha(s + pe_1). \end{aligned}$$

A model of service delivery: First Best

1. **Efforts are complements** via the demand for the service
   - $\uparrow$ quality, $\uparrow$ demand $\Rightarrow$ worthwhile to collect user fees, so $\uparrow e_1$
   - $\uparrow$ fee-collection $\Rightarrow$ more resources to boost quality, so $\uparrow e_2$
   - $\uparrow s$, $\uparrow e_2$ as e_2 boosts demand, mitigating $\downarrow e_1$
2. Monitoring is decreasing in the **social value**
   - $\uparrow \sigma$ or $\downarrow \gamma \Rightarrow \downarrow e_1$
   - $\uparrow s \Rightarrow \uparrow e_2$ as e_2 boosts demand, partly mitigating the direct negative effect of $\uparrow s$ on e_1.
3. Exogenous **increase in demand increases monitoring**
   - $\uparrow \varphi \Rightarrow \uparrow e_1$
   - Through higher return from fee-collection effort $\Rightarrow \uparrow e_2$.

A model of service delivery: First Best

Solving FOCs:

$$
\begin{aligned}
e_1^{**} &= \max\left\{ p\frac{\varphi - \left(\frac{1}{2}\beta - \alpha^2\right)s}{1 + p^2\left(\beta - \alpha^2\right)}, 0 \right\} \\
e_2^{**} &= \alpha\,\frac{s(1 + \frac{1}{2}\beta p^2) + p^2\varphi}{1 + p^2\left(\beta - \alpha^2\right)}
\end{aligned}
$$

- Condition under which e_1^{**} is decreasing in s: $\frac{1}{2}\beta - \alpha^2 > 0$
- For a sufficiently high value of s, namely $\frac{\varphi}{\frac{1}{2}\beta - \alpha^2} \Rightarrow e_1^{**} = 0$
- In the context of contracting out of public services, when $\sigma = 0$ we get the first-best by making the caretaker the full residual claimant in exchange for a flat fee
- But to the extent social benefits are present, this would lead to greater exclusion (via higher e_1) and also lower quality (lower e_2)

▸ Policy options

A model of service delivery: Second Best

Agency problem:

- Incentivize e_1 by keeping a fraction λ of the user fees
- Bonus b for higher values of e_2

$$\pi(e_1, e_2) = \lambda p e_1 \left(\alpha e_2 - \frac{1}{2}\beta e_1 p + \varphi \right) + b e_2 - \frac{1}{2} e_1^2 - \frac{1}{2} e_2^2.$$

From FOCs:

$$\begin{aligned} e_1 &= \frac{\lambda p (\alpha e_2 + \varphi)}{1 + \lambda \beta p^2} \\ e_2 &= \alpha \lambda p e_1 + b \end{aligned}$$

Solving FOCs:

$$\begin{aligned} e_1^* &= \lambda p \frac{\varphi + \alpha b}{1 + \lambda p^2 (\beta - \lambda \alpha^2)} \\ e_2^* &= \alpha \lambda^2 p^2 \frac{\varphi + \alpha b}{1 + \lambda p^2 (\beta - \lambda \alpha^2)} + b \end{aligned}$$

A model of service delivery

Comparing the first best with the second best:

- An increase in λ increases both efforts.
- But due to the social benefits (σ), which we assume the caretaker does not take into account, this may not be optimal as it may push e_1 higher than what the policymaker would prefer.
- Also, if $\lambda > 0$, an increase in b leads to **user exclusion** due to the complementarity between e_1 and e_2

▸ Policy options

Applying the model to CTs in slums

Goal: reduce OD and encourage the use of CTs.

- CT use depends on:
  - β price sensitivity, which depends on fee-collection efforts, e_1
  - α quality sensitivity, which depends on efforts to improve quality e_2
- Adding an exogenous component to quality $q(e_2) = e_2 + a$, so demand is:

$$\alpha(a + e_2) - \tfrac{1}{2}\beta e_1 p + \varphi$$

- High negative externalities associated with OD (σ)
- Instruments to improve use:
  1. Improving quality directly: $\uparrow a$
  2. Incentivising the caretaker's effort to improve quality: $\uparrow e_2$ through b
  3. Information campaign to increase awareness and that may boost demand: $\uparrow \varphi$

Applying the model to CTs in slums

- As long as $\lambda > 0$, the **net welfare effect is ambiguous with all these three interventions** given the complementarity between e_2 which increases demand and e_1 which excludes users!
- In our context, a fraction of user fees (λ) are used by higher-level managers to pay salaries to caretakers, and in the case of Sulabh (the NGO that manages half of the community toilets), salaries are directly paid out of the fees collected in each CT, with some caretakers reporting that they had a fee target and if not hitting it, they would not get their full salary.
- If $\lambda = 0 \Rightarrow$ no incentive for the caretaker to undertake e_1, hence any of the instruments would improve social welfare as long as the service is free to use, but otherwise, it is ambiguous.

Field experiment

- Field experiment in the two largest cities of **Uttar Pradesh, India**
- **Pay-to-use community toilets (CTs)**
  - Public services offer essential access to hygiene and sanitation through communal facilities targeting specific group of residents.
  - Informal settlements (or *slums*) $\Rightarrow$ overcrowding, limited space and inadequate housing constrain access to safely managed private toilets.
- **Outside option**: unimproved facilities or resorting to open defecation (OD) $\Rightarrow$ significant negative externalities.
  - Infectious diseases and mortality [Geruso & Spears 2018, Coffey et al. 2018, Pickering et al. 2018].
  - Stunted human capital [Miguel and Kremer, 2004; Bleakley, 2007; Adukia, 2017; Augsburg and Rodriguez-Lesmes, 2018; Orgill-Meyer and Pattanayak, 2020; Spears, 2020].
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- Prevalent nationwide and operate with user fees (public or PPPs)
- Managed by a **caretaker** $\Rightarrow$ collect fees + maintenance
- Conditions of service delivery:
  - Poorly maintained and dirty.
  - Non-payment among users is common and WTP is low.

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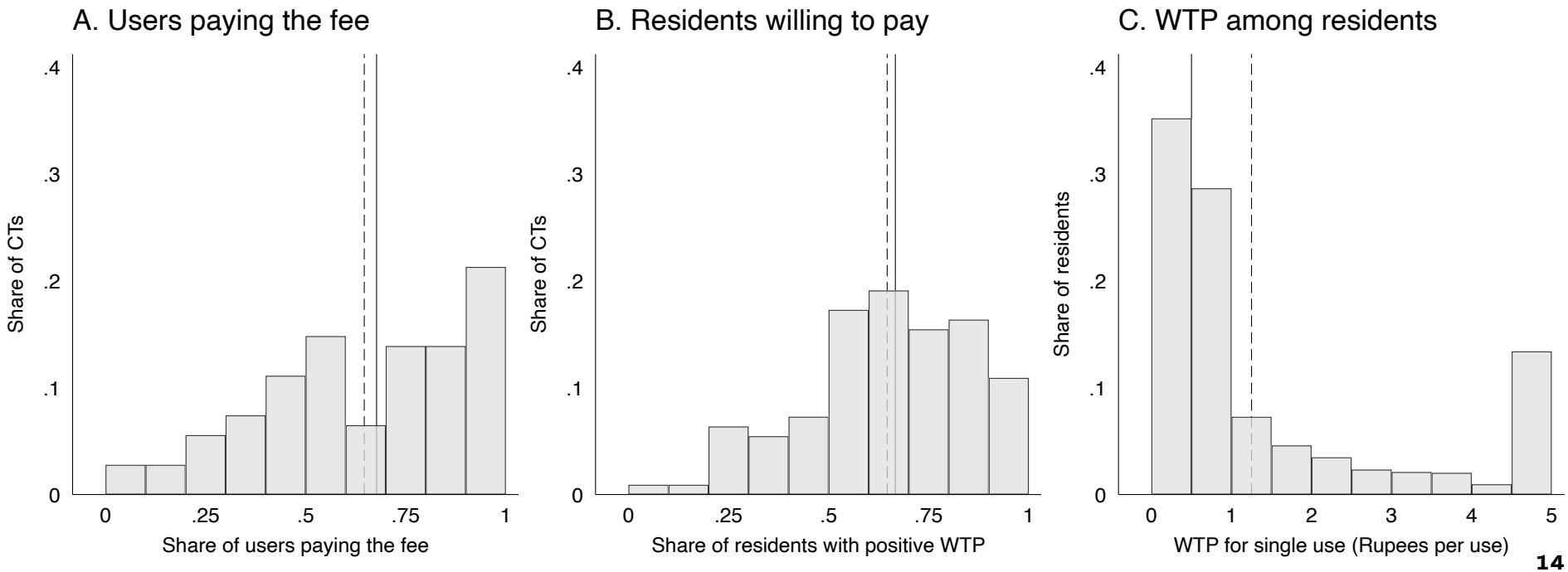

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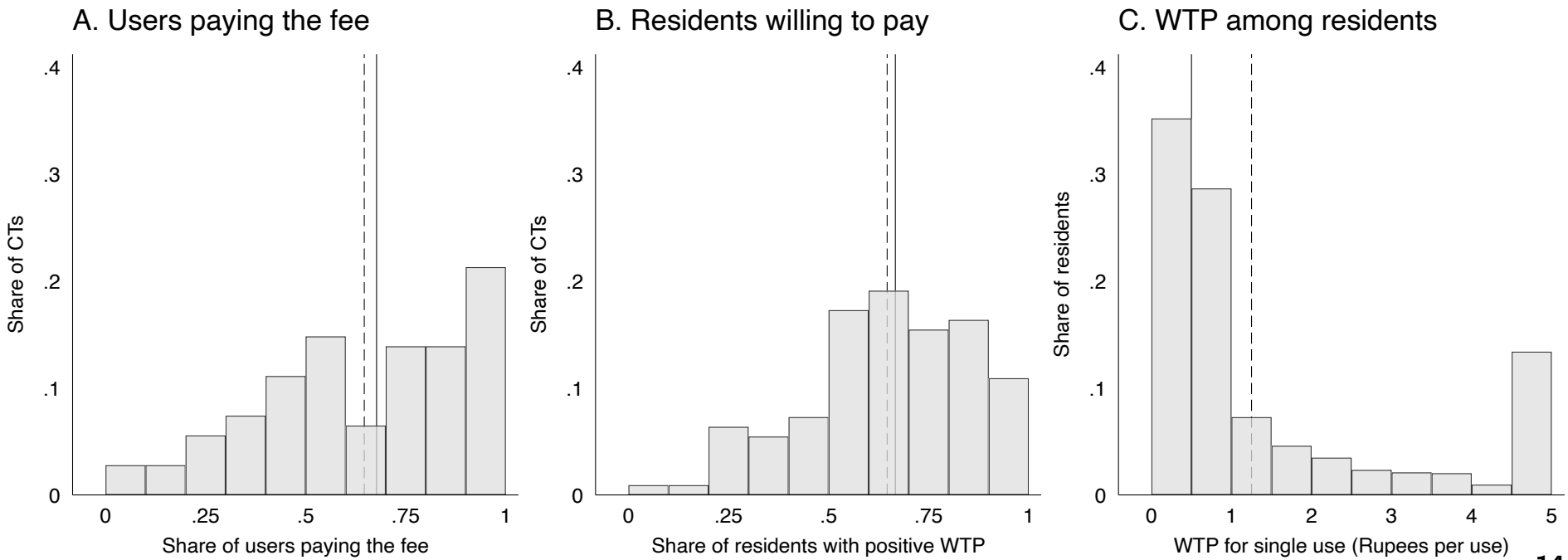

Field experiment: experimental design

- Identified all CTs serving slums $\Rightarrow$ census of slums and CTs
- 110 CTs randomly allocated to:
  1. **Control** group (40)
  2. **Maintenance** group (70) $\Rightarrow$ boost quality in public service delivery

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Maintenance intervention

Two components

1. **Grant**: one-off grant to rehabilitate the facility.
   - Caretaker(s) chose between different packages. examples
   - $\approx$ 90% of monthly O&M cost of adequate-quality CT.
2. **Incentive**: financial rewards for routine maintenance
   - Paid to caretakers conditional on objective cleanliness
   - 40% of average monthly x 4 payments ($\approx$ 13% annual salary)

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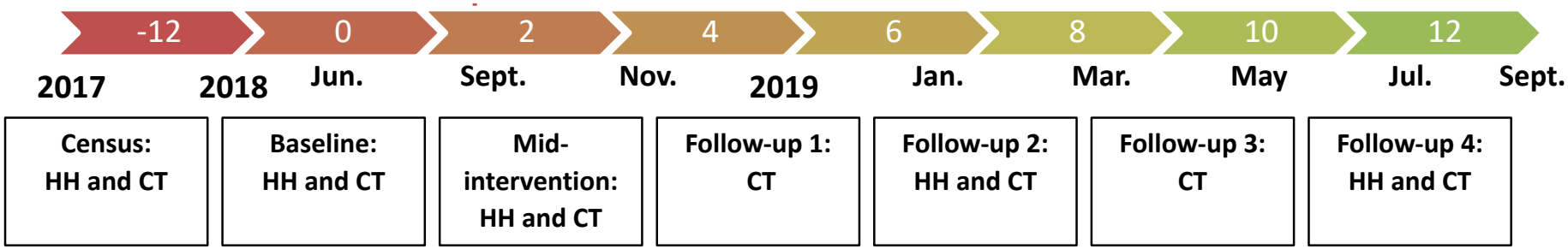
Data I: public service delivery

1. **Surveys** (BL + 4 follow-ups): 110 CTs
2. **Objective measurements**:
    1. CT survey: administered to caretakers.
    2. Observations: number of users and payment, structural quality and cleaning status.
    3. Laboratory tests for bacteria presence.



Data II: residents

Creating a sampling frame around all pay-to-use CTs in Lucknow and Kanpur

- Slum borders in each CT catchment area + census of residents within
- *Residents*:
  - Using the CT or practising OD
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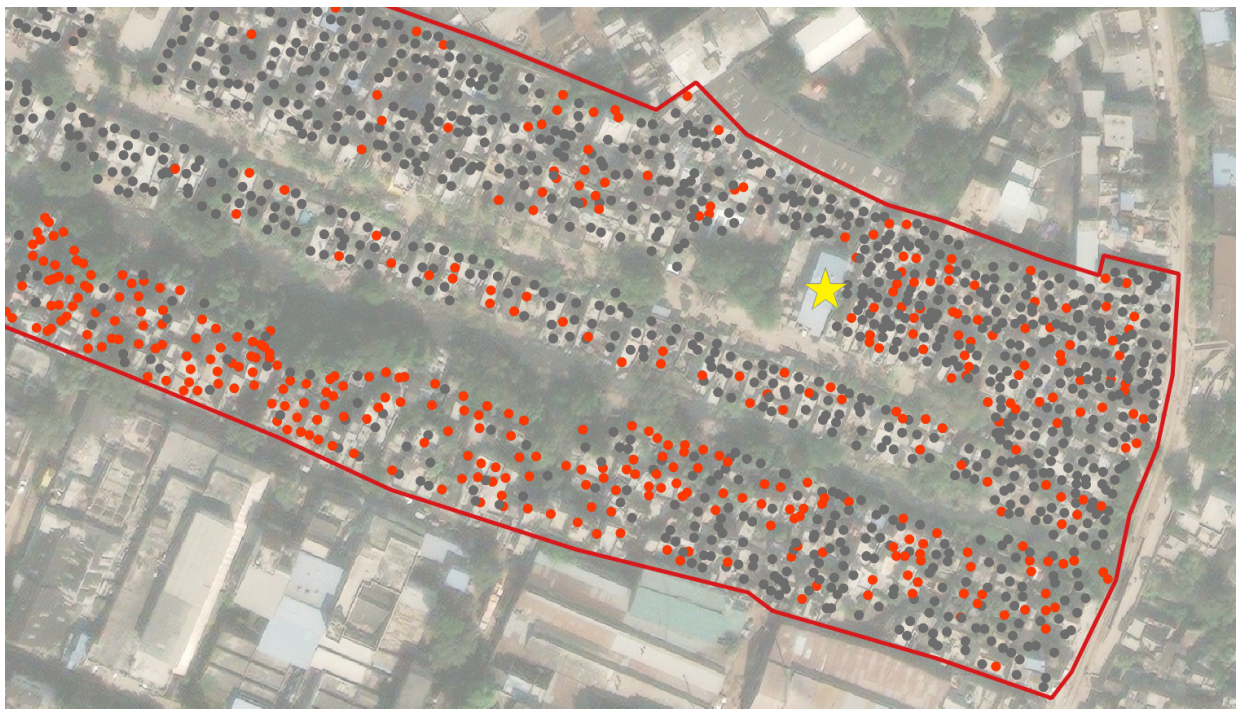

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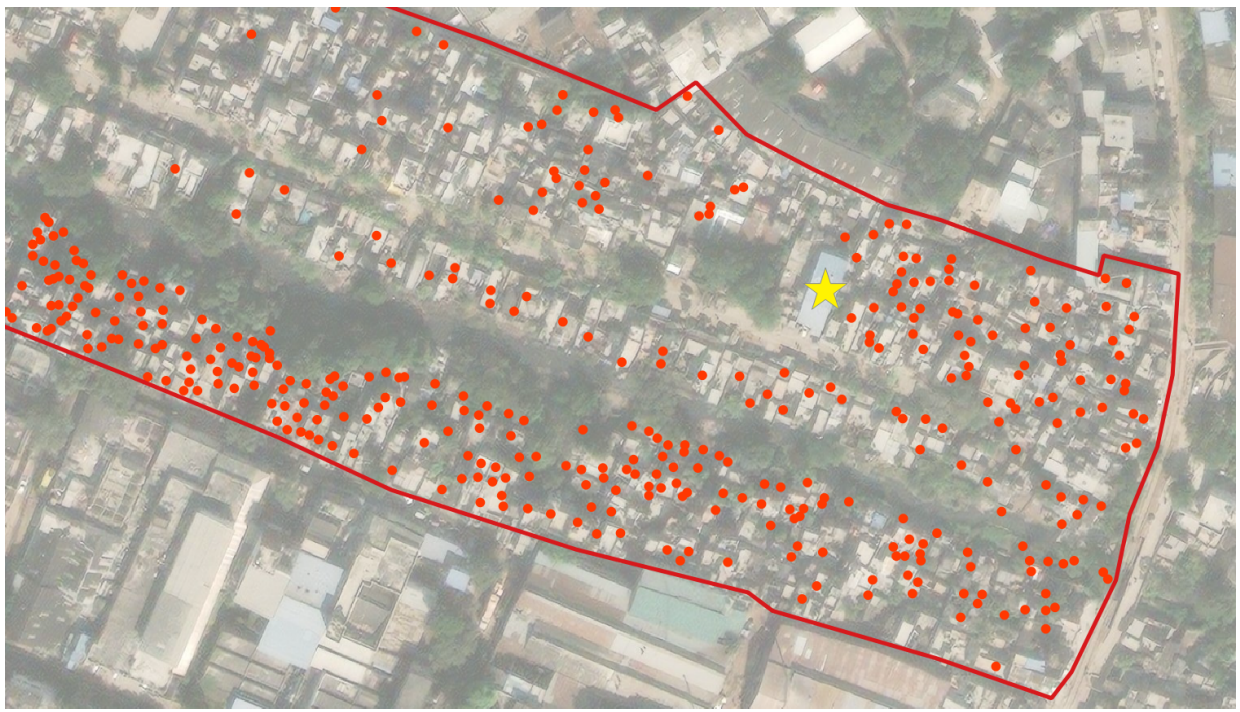

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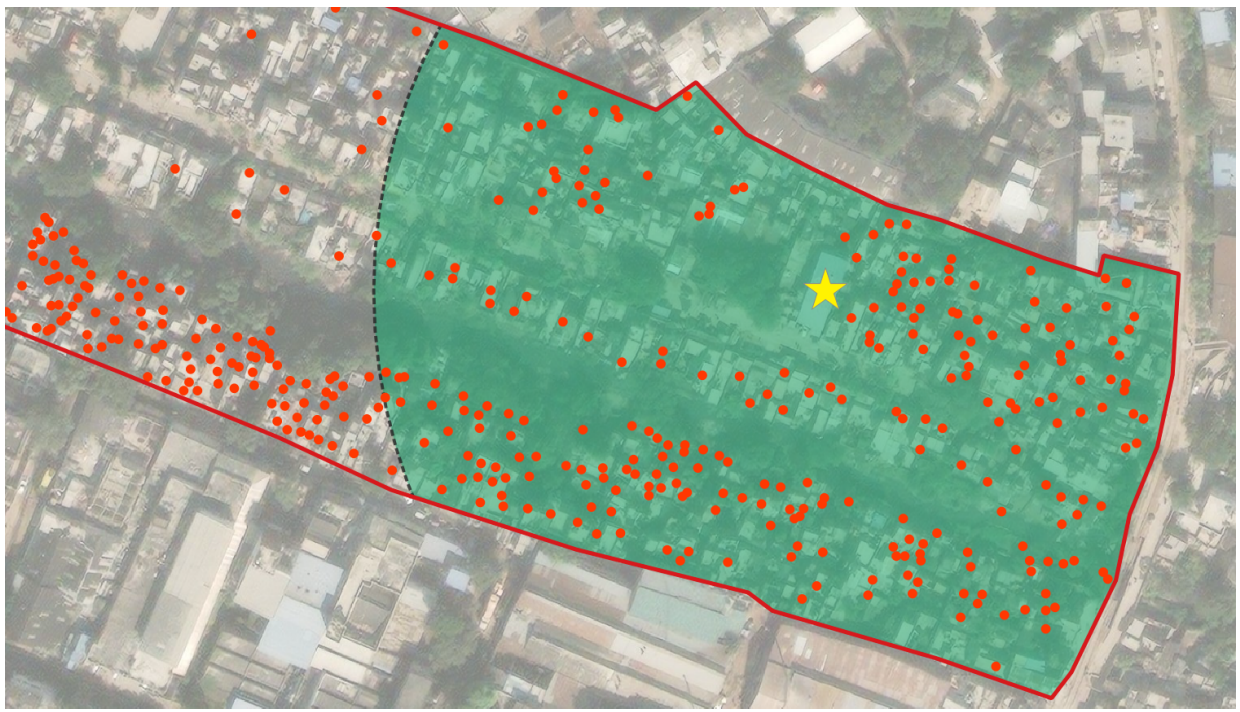
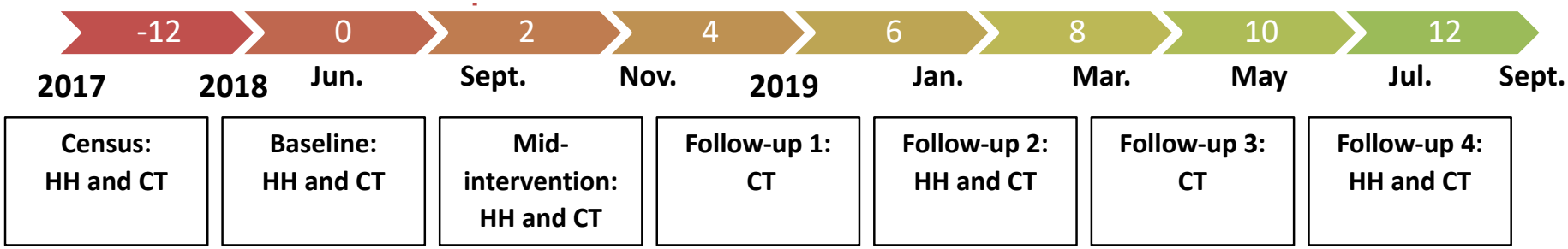


Data II: users and potential users

1. **Surveys** (BL + 3 follow-ups): 1500 residents
2. **Lab-in-the-field experiments**:
   - List randomization to measure outside option $\Rightarrow$ OD is a sensitive behaviour



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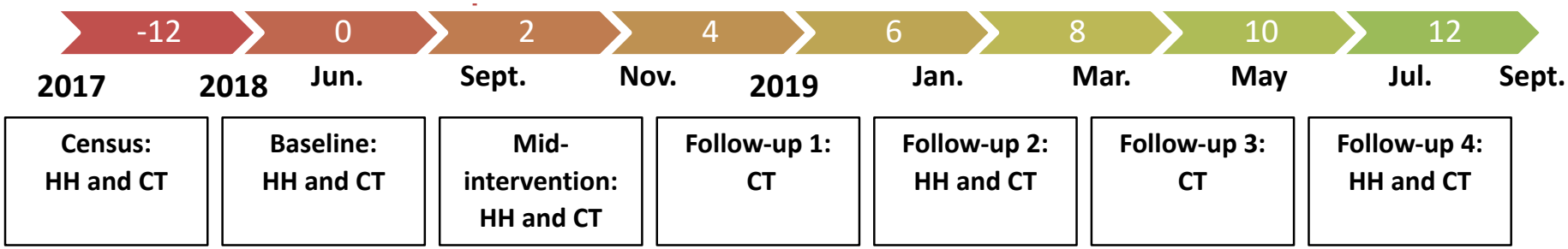


Specification

Maintenance (T_j) vs control comparison

$$Y_{ij,t} = \beta_0 + \beta_1 Tj + \beta_x X_{ij} + \delta_t + \epsilon_{ij,t} \quad (1)$$

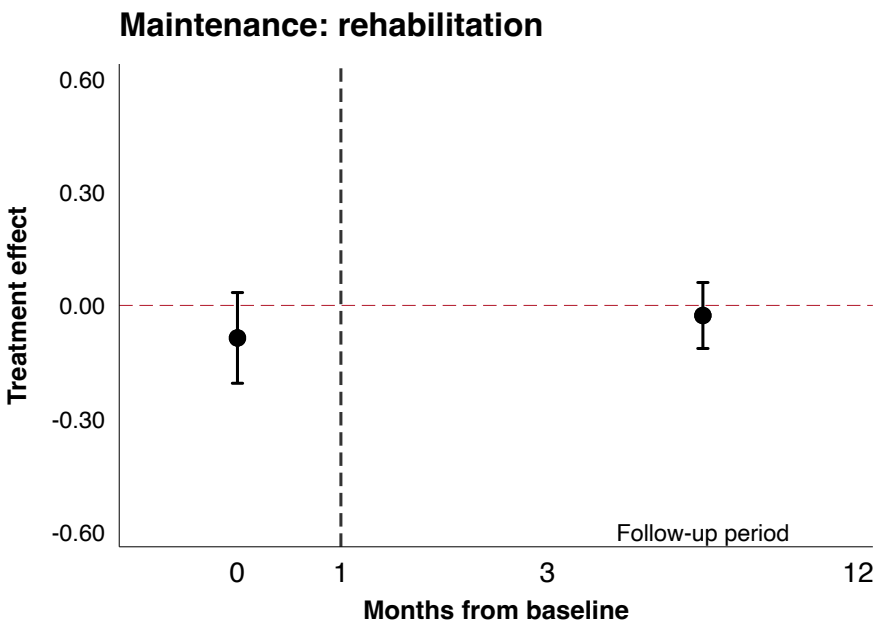
- Separate estimates for **2 periods**: BL and FUs $\Rightarrow$ assumes β_1 is constant within these periods.
- Pool follow-up measurements to reduce noise [McKenzie, 2012].

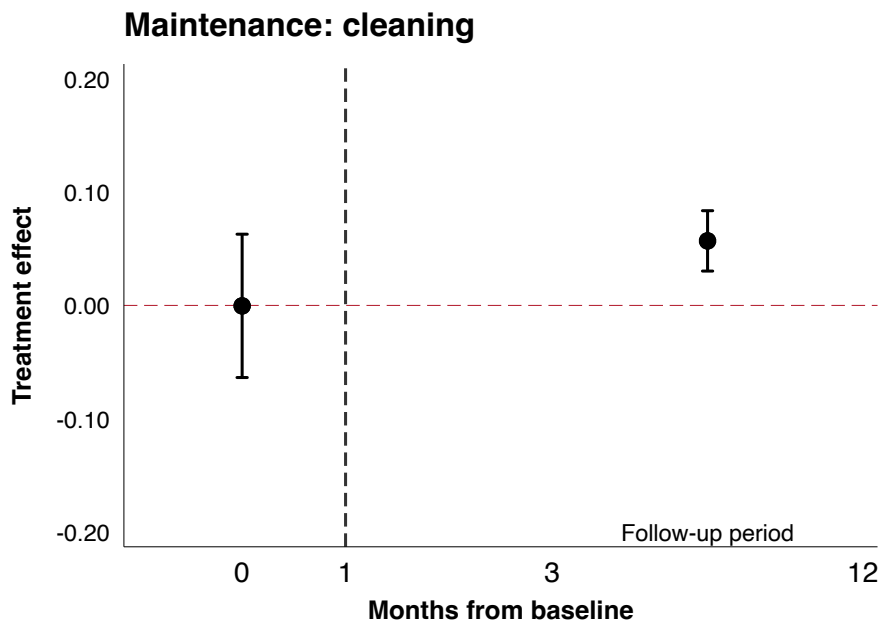
Robustness

- Baseline balance in all observables ▸ CT/caretaker ▸ HH
- Attrition orthogonal to treatment allocation ▸ Attrition

Inputs to service delivery

- **Maintenance ↑**
  - Rehabilitation is unaffected, but ↑ inputs used in cleaning and the correct implementation.
- **Monitoring ↑**
  - Caretakers respond to incentives by increasing share of time spent on monitoring (7.5%).





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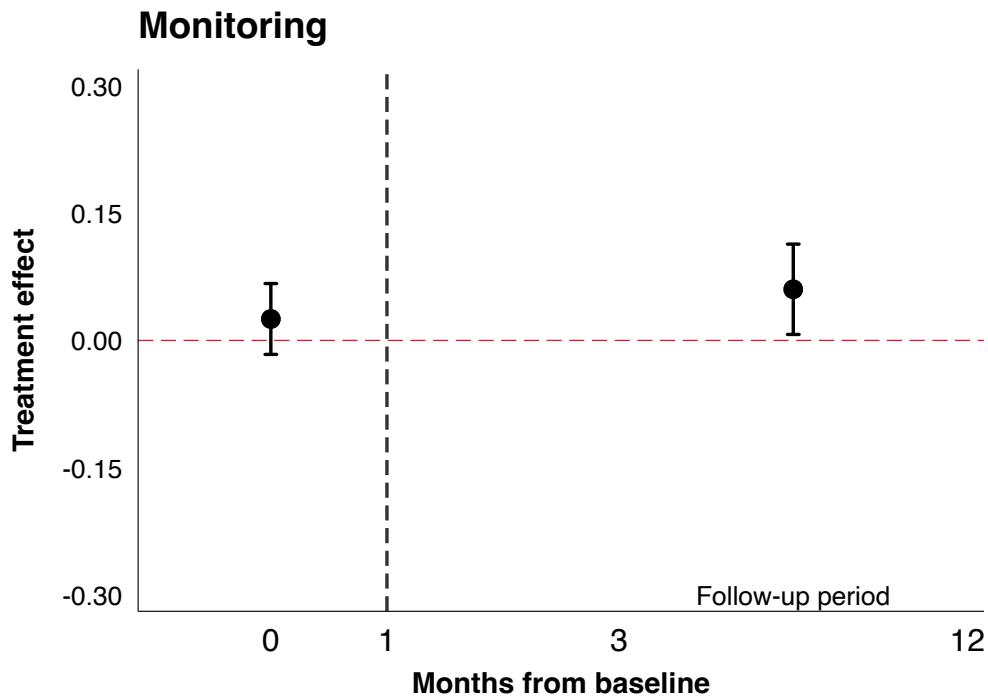
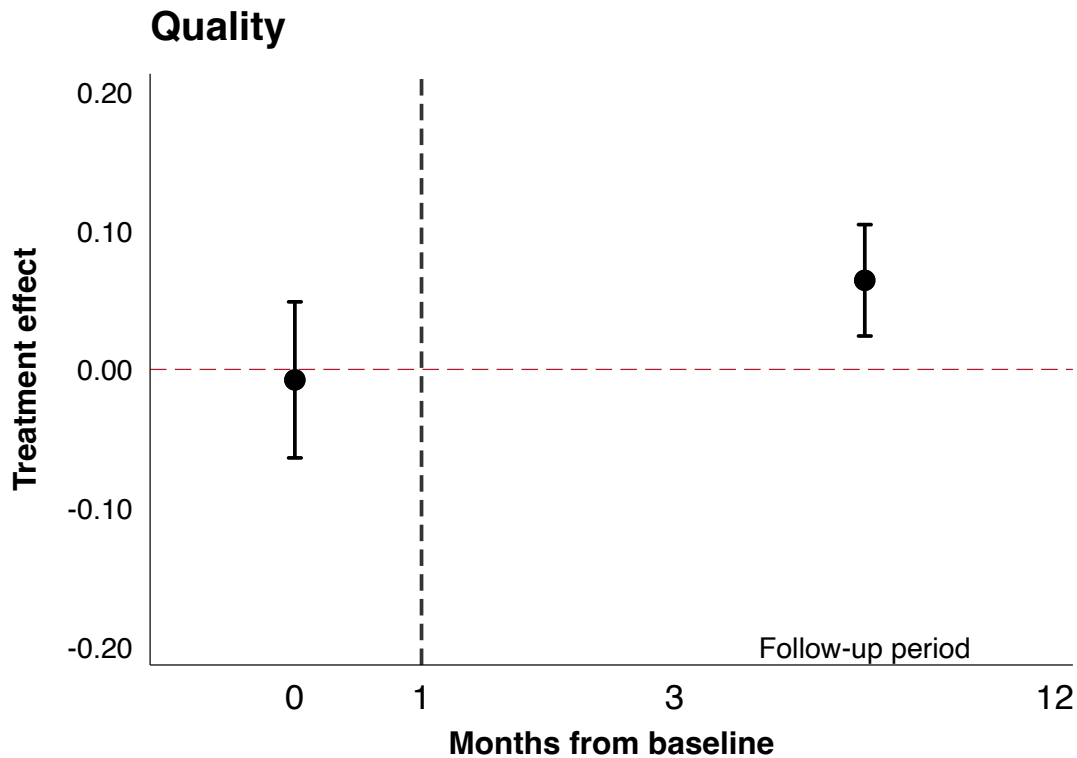


Quality of service delivery

- Index using **objective measurements of service delivery**:
  - Structural quality of the facility + cleanliness + presence of bacteria.
- Higher-quality provision ↑ 66% over control mean ▸ Factors ▸ Table
- Shift towards the top of the distribution



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- Higher-quality provision ↑ 66% over control mean ▸ Factors ▸ Table
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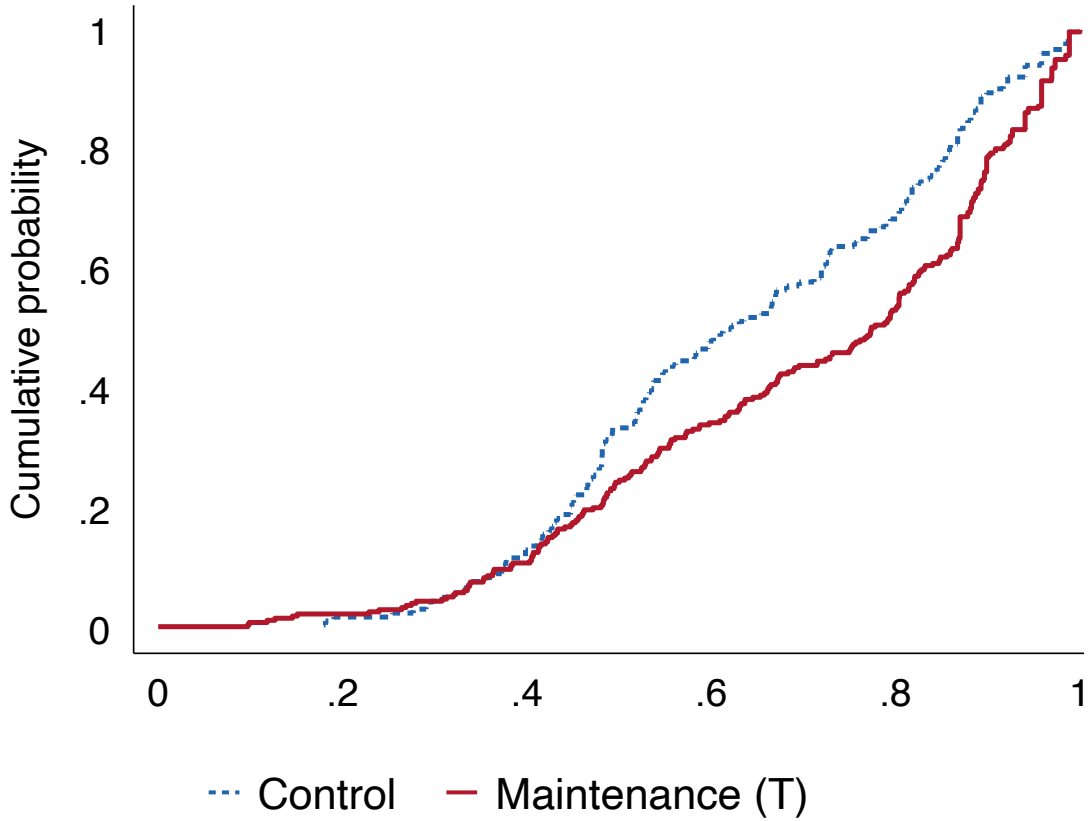


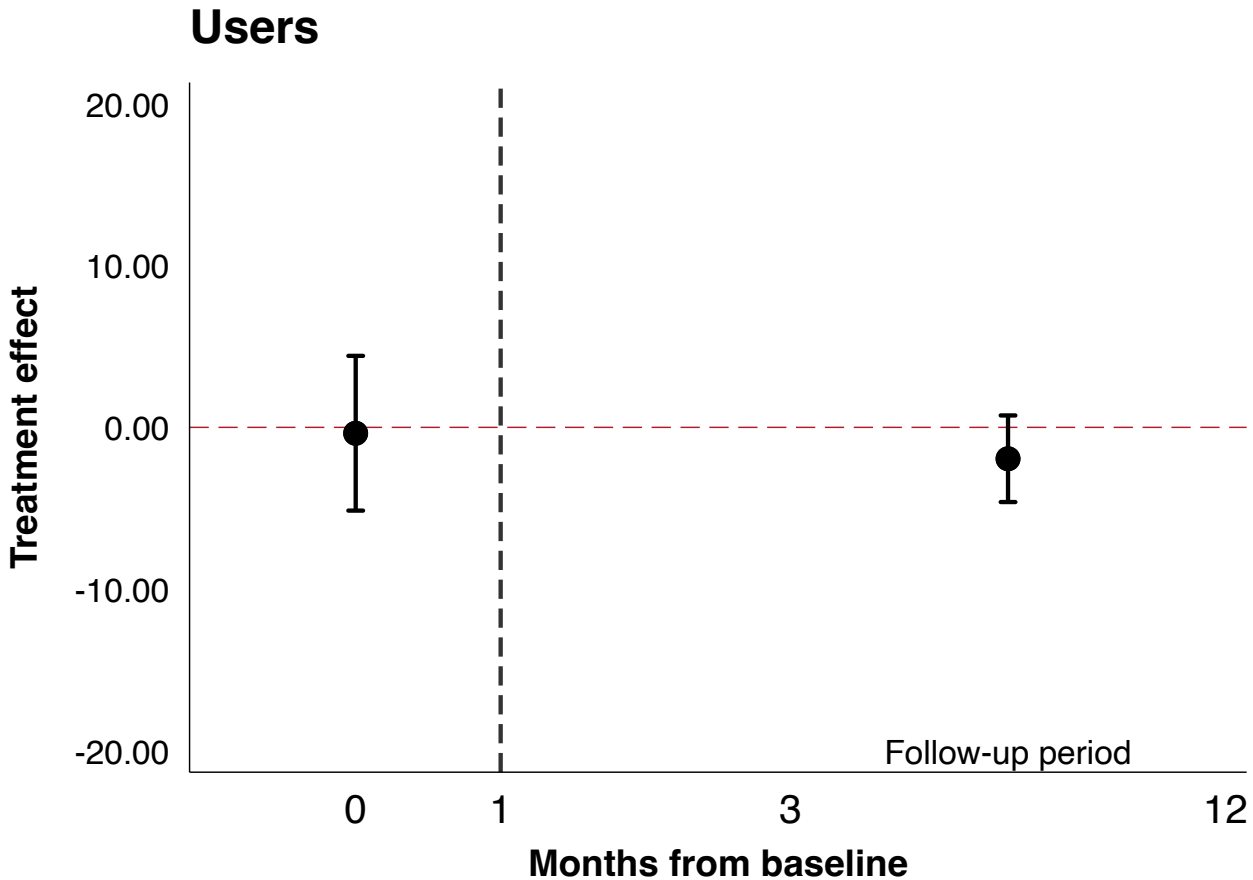
Users and payment

1. **Users**
   1. **Aggregate**: observed users during rush hour
   2. **Residents**: self-reported number of uses
2. **Payment**
   1. **Aggregate**: observed payment during rush hours.
   2. **Residents**: incentive-compatible WTP $\Rightarrow$ multiple price list
      - Random draw from 13 questions and payment based on corresponding choice.
      - Market price = Rs. 5 $\Rightarrow$ CT expenditure $\approx$ to 8% of HH income.

Option A	Option B
10 tickets	0 Rs
10 tickets	5 Rs (giving up 0.5 Rs/ticket)
10 tickets	10 Rs (giving up 1Rs/ticket)
10 tickets	15 Rs (giving up 1.5Rs/ticket)
10 tickets	20 Rs (giving up 2Rs/ticket)
10 tickets	25 Rs (giving up 2.5Rs/ticket)
.	.
.	.
10 tickets	60 Rs (giving up 6Rs/ticket)

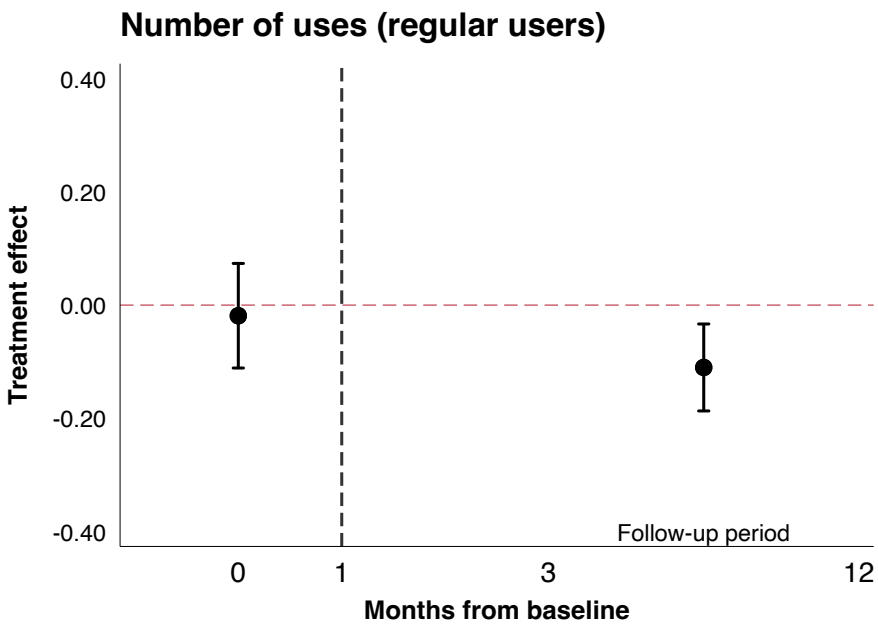
Use

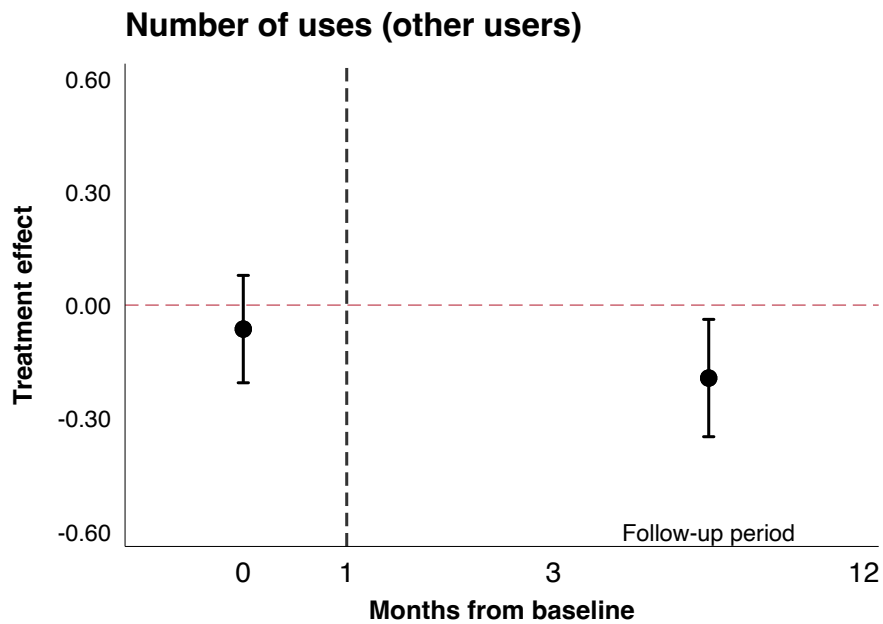
- ↓ users
- ↓ frequency of use
- Effect concentrated among regular users ▸ Residents ▸ Table



Use

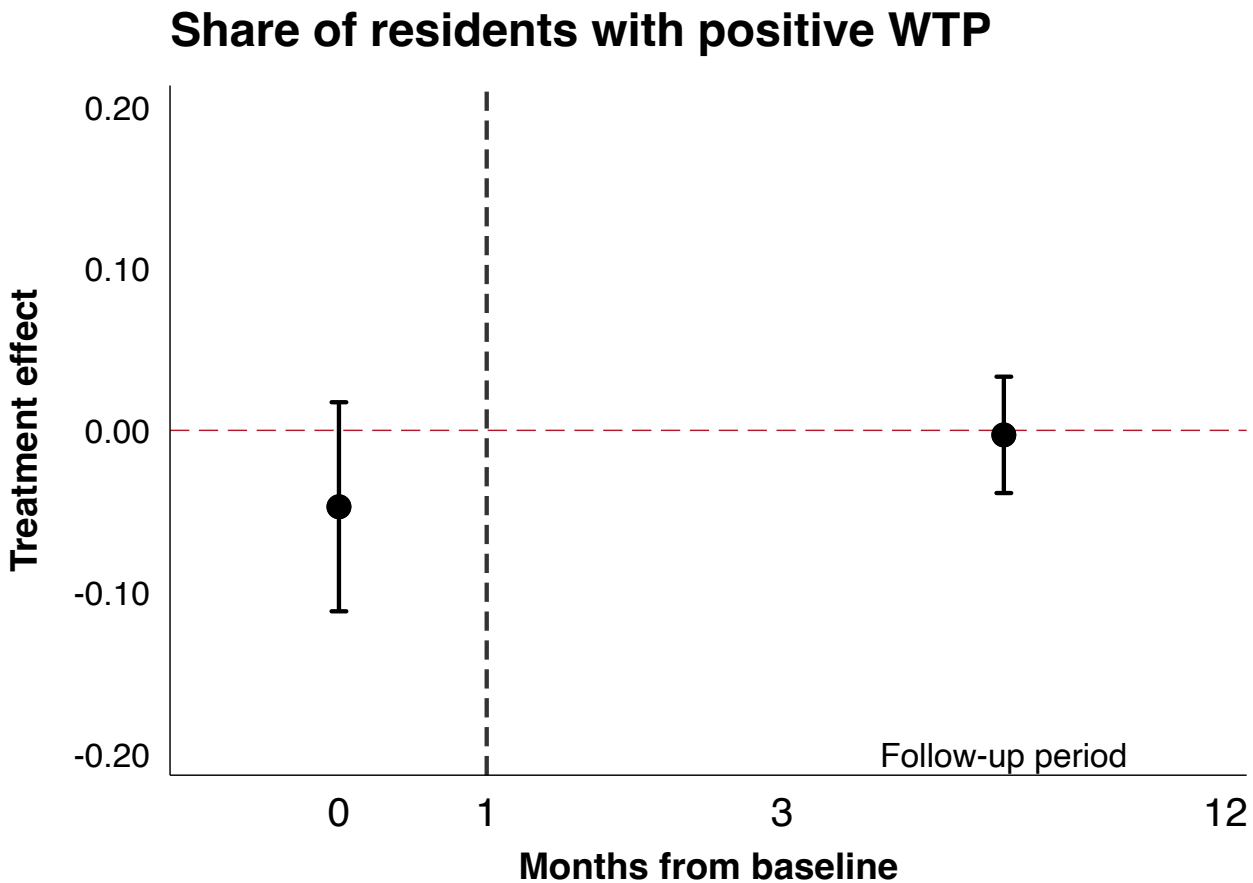
- ↓ users
- ↓ frequency of use
- Effect concentrated among regular users ▸ Residents ▸ Table





Payment

- Results consistent with enforcement of payment.
  - Quality has no effect on WTP
  - 17% ↑ in payment over control mean. ▸ heterogeneity



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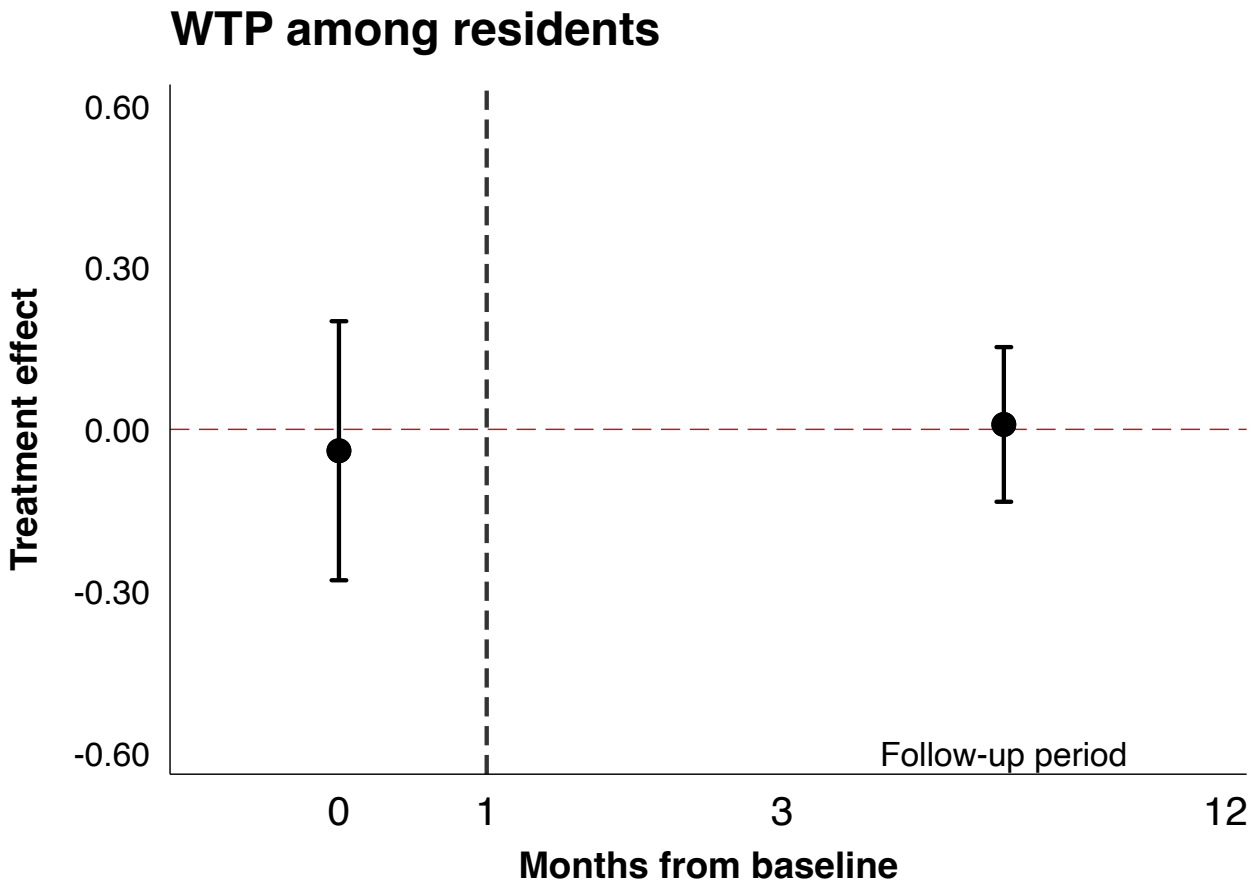

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  - Quality has no effect on WTP
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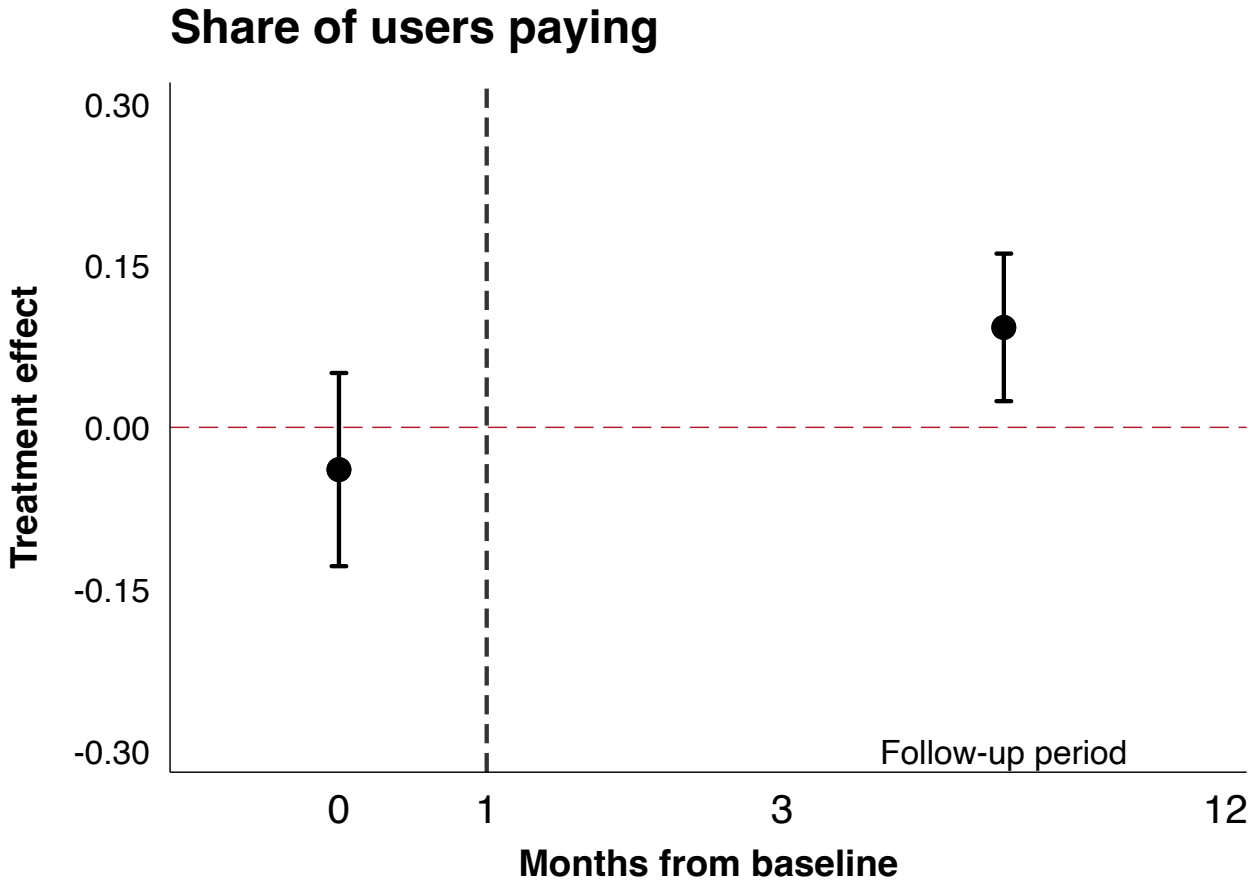
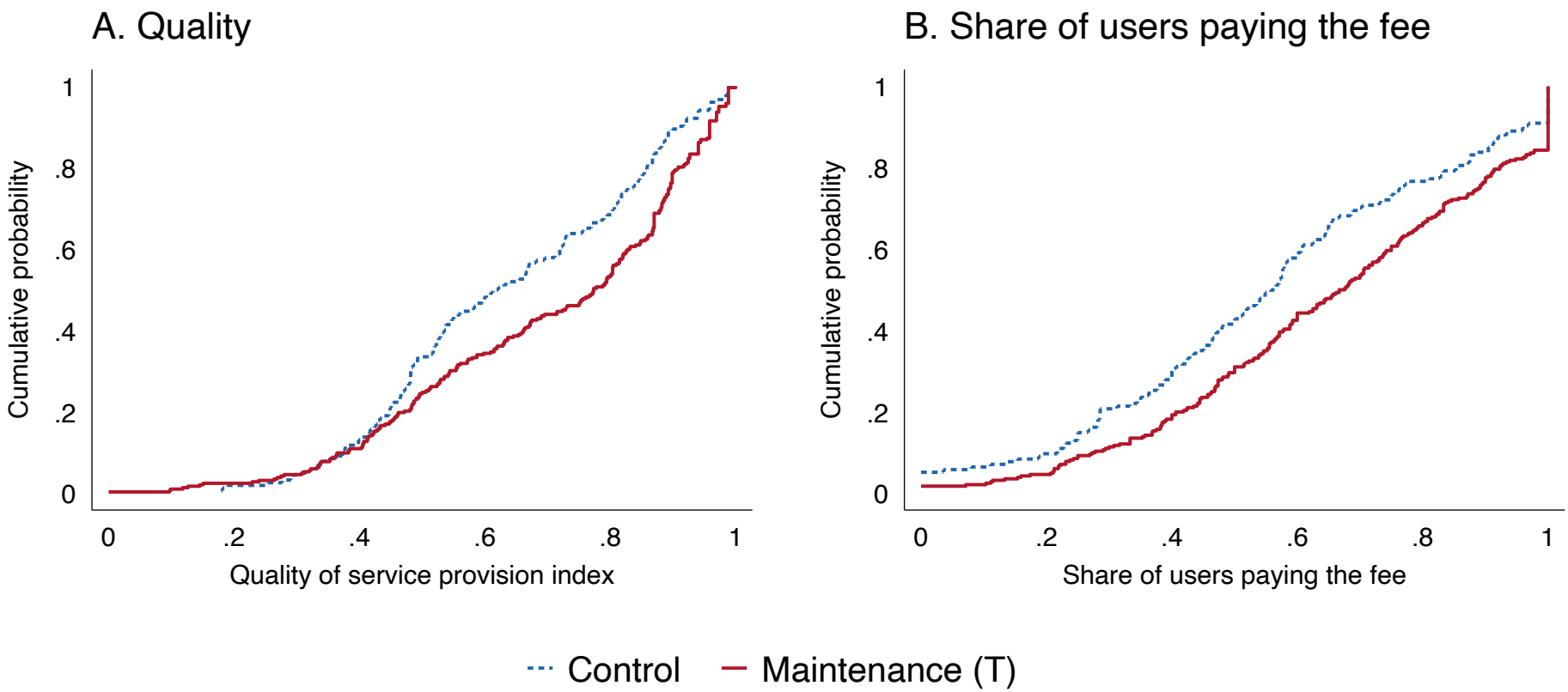


Quality and payment

- Results consistent with price-elasticity effect $>$ quality effect
- Increase in quality and payment comes at the cost of user selection
- No effect on revenues revenues



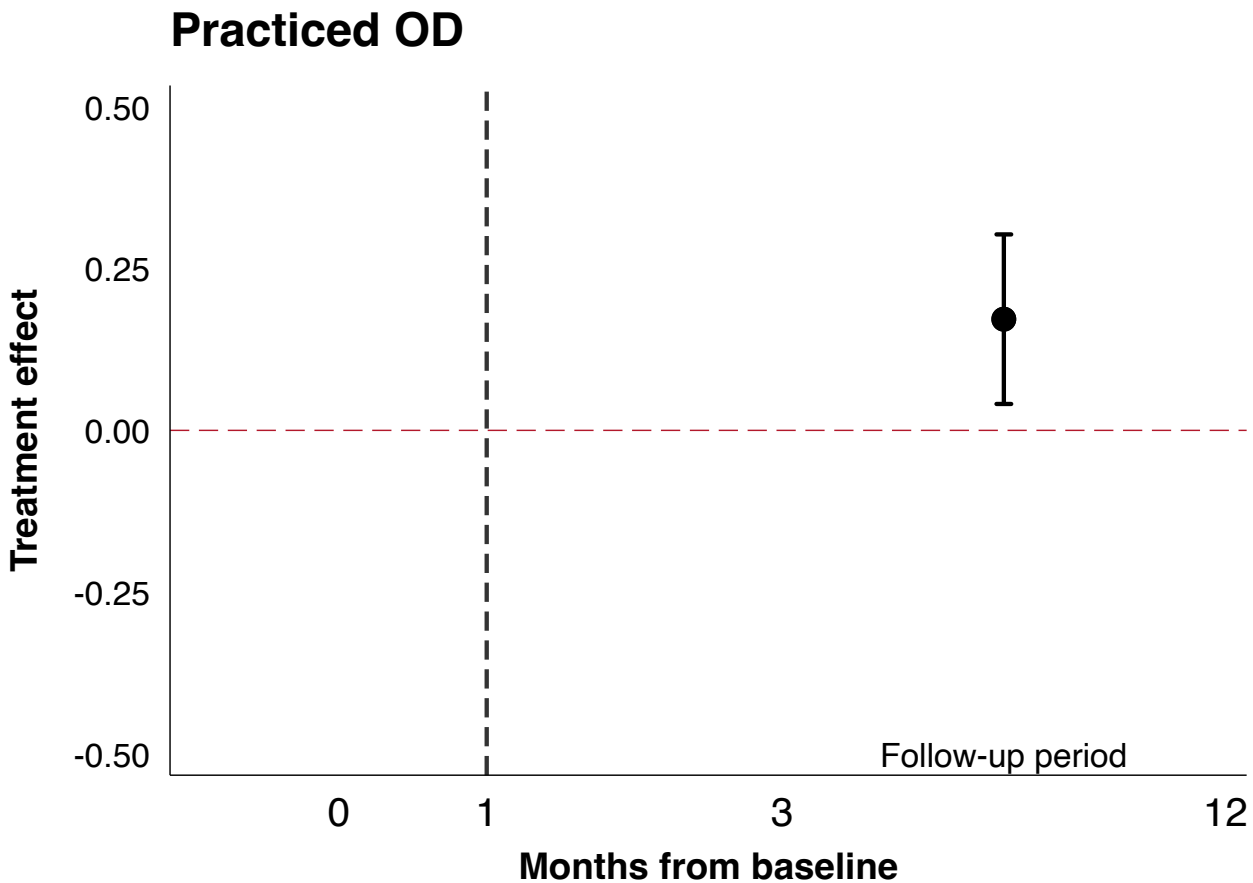
Outside option and externalities

1. **Practiced OD:** list randomization on behavior in the previous day
   - Randomly allocated to short or long list of statements.
   - Difference in average number of items between B and A gives prevalence.

Short (A)	Long (B)
- I cooked yesterday	- I cooked yesterday
- I bought milk yesterday	- I bought milk yesterday
- I watched TV yesterday	- I watched TV yesterday
	- I defecated in the open yesterday

Outside option

- OD almost doubles ▸ Table ▸ Gender
- Switch from CT use to OD over time (self-reported) correlates significantly with poverty



Summary

- **Theoretical framework** highlights how raising quality of public services can reduce users
  - Quality effect can outweigh or be outweighted by the price-elasticity effect.
- **Field experiment** shows mechanisms behind this effect:
  - Exogenous boost to maintenance increases **quality**
  - $\uparrow$ both **maintenance** and **monitoring** of fee-payment
  - Increase in **payment** is accompanied by **user exclusion**
- Quality of public services can reduce users (**price-elasticity effect $>$ quality effect**)

Thank you!

A model of service delivery

Cost function: Extension

- It is straightforward to allow for the two types of efforts to be complements or substitutes:

$$c(e_1, e_2) = \frac{1}{2}e_1^2 + \frac{1}{2}e_2^2 + \eta e_1 e_2$$

  Where:
  - $\eta > 0$ is the case of substitutability (due to time or resource constraints)
  - $\eta < 0$ is the case of complementarity (e.g., if the caretaker shows up at all, then he can do both tasks).

- However, even without a direct interaction term in the cost function, there is a natural complementarity between the two efforts via their effect on demand.

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First best: Policy Options

- In the first best scenario, if the policymaker wants to set $e_1 = 0$ which will be the case when σ is very high, then user fees should be scrapped and setting $b > 0$ will improve quality without leading to exclusion.
- In the context of contracting out of public services this implies that if there are no positive social externalities from the service (i.e., $\sigma = 0$) then the first-best can be achieved by making the caretaker the full residual claimant in exchange of a flat license/franchise fee
- But to the extent social benefits are present that are not taken into account by the caretaker, this would lead to greater exclusion (via higher e_1) and also lower quality (lower e_2), since under the first-best quality is increasing in the social benefits.

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Second best: Policy Options

- Suppose instead of a bonus based on quality, the caretaker is rewarded on usage of the facility, in addition to being incentivised to ensure user fee collection.
- Under such a scheme, the caretaker's expected payoff would be $(\delta + \lambda p e_1)\left(\alpha e_2 - \frac{1}{2}\beta e_1 p + \varphi\right) + b e_2 - c\left(e_1, e_2\right)$ where δ is the component of reward based on usage.
- In principle, this can balance the need to provide incentives to collect fees and also, not to induce exclusion when use of the facility has positive social externalities.
- For example, by setting $\delta = s$ and $\lambda = 1$ one can achieve the first-best.
- Since the caretaker would effectively be made the residual claimant in addition to being rewarded on usage due to the positive externalities, this would be a profitable proposition and the policymaker could charge a flat franchise fee to the operator in exchange of the permit to manage the facility.

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Other policy options

We do not explore what an optimal incentive scheme in these environments would be like but there are a few points to note.

- Unless usage can be with reasonable accuracy and separately from fee collection, or fees are capped by policy, the operator might have an incentive to exclude users who are poor and charge too high a fee, and so user fees would reduce access to care proportionally more for the poor than for the rich.
- This resonates with a key insight from the existing literature on user fees that while they can generate substantial revenues and are therefore attractive to cash-constrained local governments, they tend to be regressive (see Gertler, Locay, Sanderson, 1987) and this is a dilemma that is well-recognized in the policy world (see, for example, Hutton, 2004).

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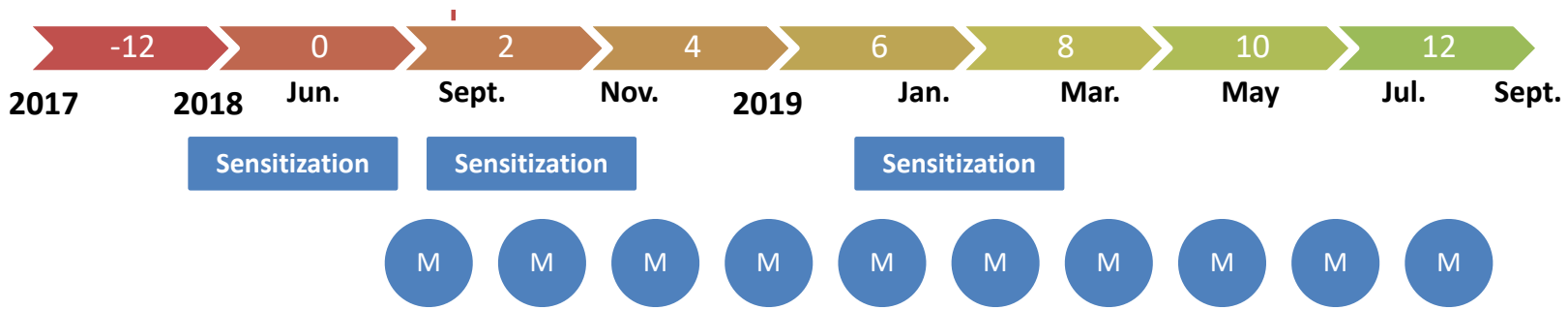
Sensitization campaign among potential users

Raise awareness about the **returns of a well-maintained facility**

1. Door-to-door campaign
2. Distribution of leaflets
3. Posters placed in CTs
4. Monthly reminder voice messages (M)



Sensitization campaign

- **Effective at reaching individuals**, but **no effect on behavior**

Table D9: Exposure to the interventions, by component

	Maintenance		Sensitization campaign		
	Transfer to the ...		Recall of WASH campaign		Awareness
	CT	Caretaker	Interactive activities	Posters at CT	
	(1)	(2)	(3)	(4)	(5)
Panel A					
Maintenance (T)	4.739	0.761	0.053	0.090	0.031
	(0.060)	(0.034)	(0.020)	(0.028)	(0.018)
	[0.00]	[0.00]	[0.01]	[0.00]	[0.10]
Panel B					
Maintenance only (T1)	4.645	0.746	0.023	0.019	0.008
	(0.081)	(0.045)	(0.025)	(0.031)	(0.022)
	[0.00]	[0.00]	[0.35]	[0.54]	[0.71]
Maintenance + sensitization (T2)	4.839	0.776	0.083	0.160	0.053
	(0.074)	(0.047)	(0.021)	(0.029)	(0.020)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]
T1 = T2 (p-value)	0.063	0.636	0.009	0.000	0.042
Mean (control group)	0.315	0.063	0.646	0.327	0.660
Std. dev. (control group)	0.358	0.025	0.478	0.469	0.474
Observations	560	560	4844	3323	4793
Catchment areas	110	110	110	109	110
Observation rounds	5	5	3	2	3

Sensitization campaign

- **Effective at reaching individuals**, but **no effect on behavior**

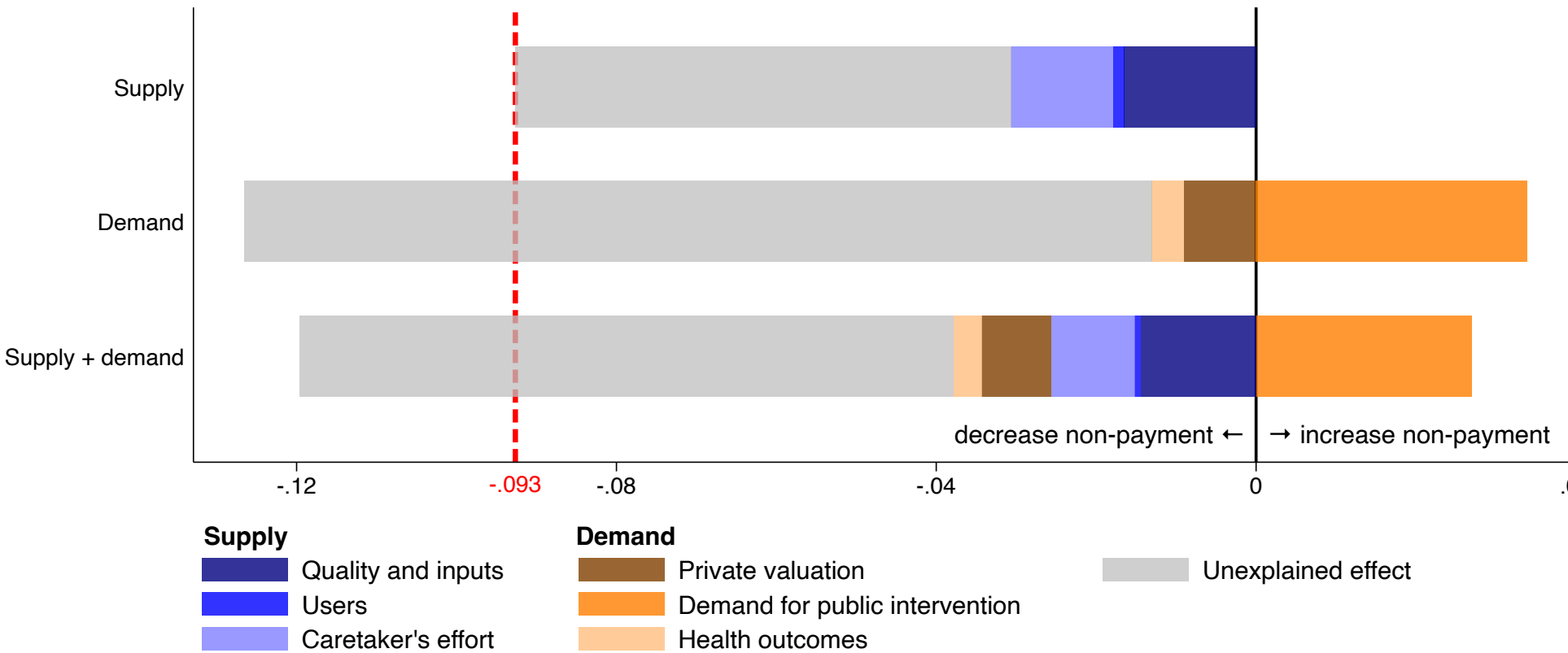
Table 4: The effect of sensitization

	Maintenance only			Maintenance + sensitization			$T1 = T2$
	β	se	p-value	β	se	p-value	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quality	0.07	0.03	0.01	0.05	0.03	0.09	0.58
Maintenance: cleaning	0.06	0.02	0.00	0.06	0.02	0.00	0.85
Maintenance: rehabilitation	-0.04	0.06	0.47	-0.01	0.06	0.85	0.60
Monitoring	0.05	0.04	0.22	0.07	0.04	0.04	0.35
Share of users paying	0.08	0.05	0.09	0.11	0.05	0.03	0.54
Share of residents with positive WTP	0.01	0.03	0.74	-0.03	0.02	0.28	0.22
WTP among residents	0.09	0.11	0.41	-0.07	0.10	0.49	0.16
Users	-2.61	1.85	0.16	-1.25	1.81	0.49	0.42
Number of uses among residents:							
Regular users	-0.06	0.05	0.28	-0.16	0.06	0.01	0.13
Other	-0.23	0.11	0.04	-0.16	0.11	0.16	0.58
Morbidity	0.03	0.03	0.36	0.03	0.03	0.34	1.00
Health expenditure:							
Curative (extensive)	0.04	0.03	0.17	0.06	0.03	0.04	0.52
Curative (intensive)	31.25	227.29	0.89	-98.73	226.54	0.66	0.58
Preventive (extensive)	-0.00	0.00	0.41	-0.00	0.00	0.60	0.73
Preventive (intensive)	20.09	64.90	0.76	-10.44	63.43	0.87	0.61
Practiced OD	0.19	0.10	0.05	0.16	0.09	0.08	0.71

Note. In columns (1)–(6), estimates are based on CT-, respondent- or household-level OLS regressions using equation (6) for each outcome. $p-$values are presented in columns (3) and (6), the first from individual testing, the second adjusting for jointly testing that each treatment is different from zero for all outcomes presented in the table. Column (7) presents a test based on equality of coefficients of the effects of T1 and T2. Standard errors are clustered by catchment area for CT-level outcomes and by catchment-area–round for respondent- and household-level outcomes. The dependent variables are indicated in the rows and are defined in Appendix A. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT.

Full payment

- Cost of improved services are 1.3–2.8x current cost ⇒ fully covered by eradicating non-payment at the market fee.
- Mediation analysis on the effect of the interventions on non-payment.
- While supply-side mediators mainly ↓ non-payment, demand-side factors ↑.



Status free versus pay-to-use CTs

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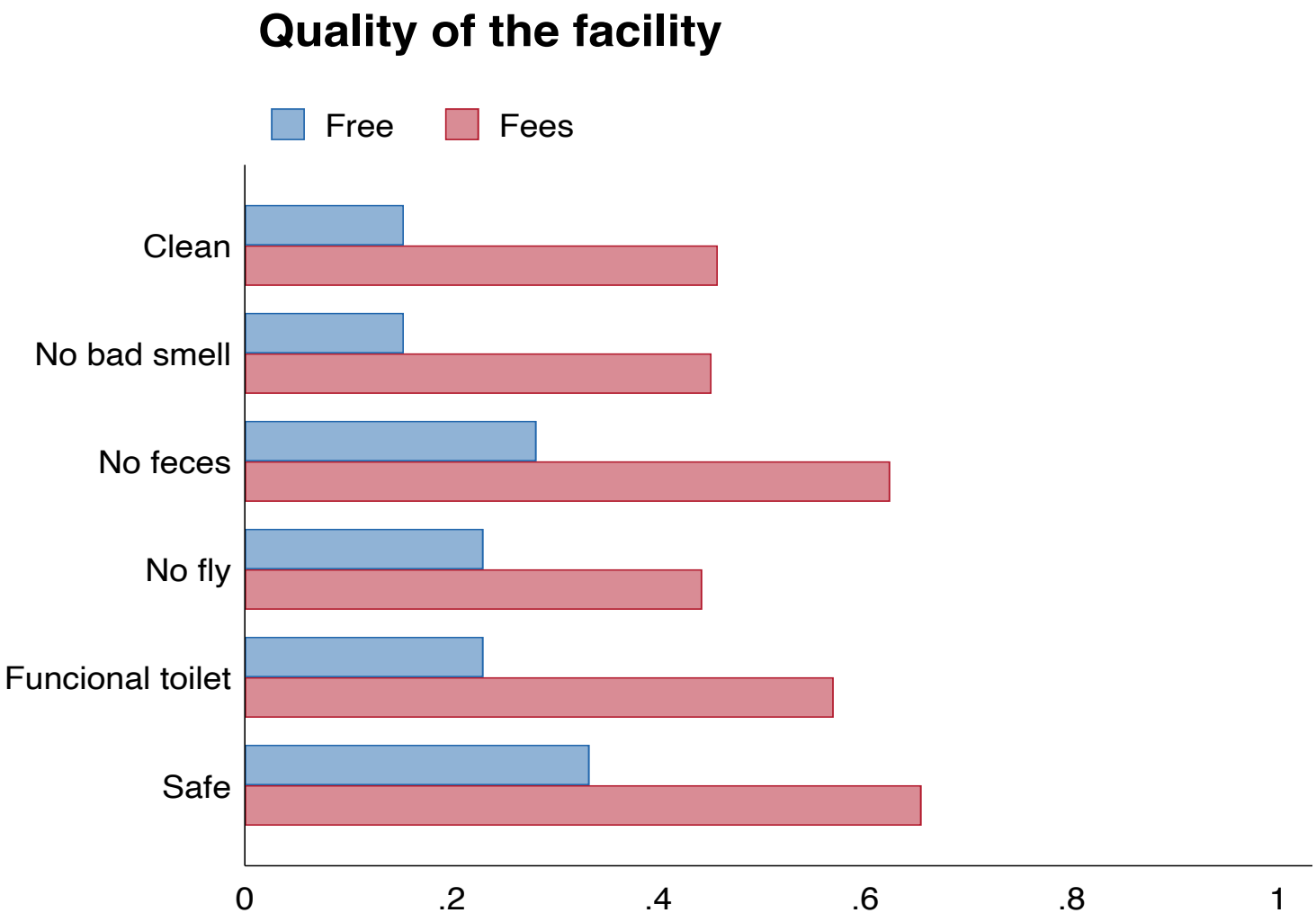

Intervention - CT

- **One-off CT grant scheme**
- Example of deep cleaning:

Intervention - CT

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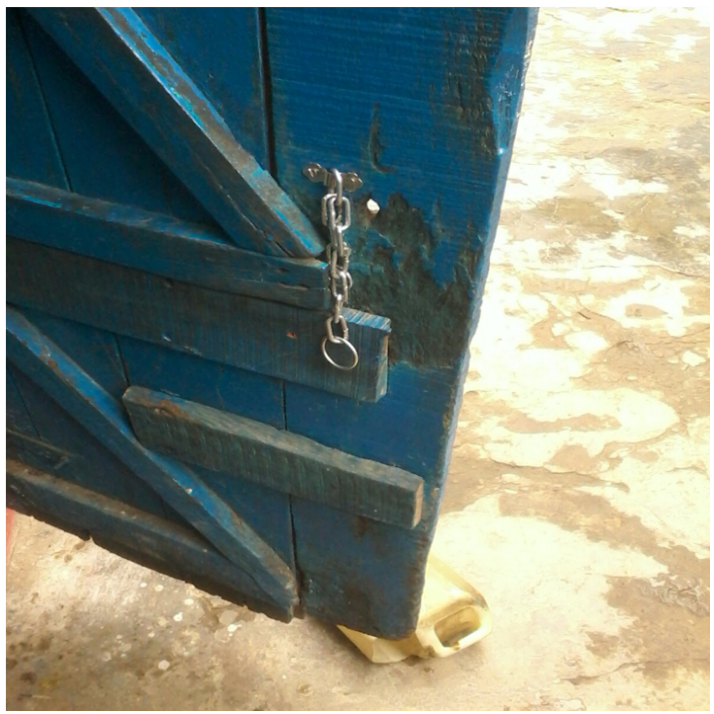
- **One-off CT grant scheme**
- Example of repair:



Intervention - sensitization

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- Door-to-door information campaign

Intervention - sensitization

Back

- **Distribution of leaflets**

सामुदायिक शौचालयों का उपयोग करने के लाभ

1. सामुदायिक शौचालय सीवरेज या सेप्टिक टैंक से जुड़ा होता है, जिससे खुले में शौच से होने वाले संक्रमण नहीं होते है.
2. उचित शुल्क, दैनिक साफ़ सफाई, रखरखाव, मरम्मत, बिजली और संचालन आदी सेवाएं प्रदान करता है.
3. महिलाओं के लिए सुरक्षित, दरवाजे और ताले के साथ रोशनी प्रदान करते हैं.
4. अतिरिक्त सेवाएं: हाथ धोने की सुविधा, साबुन, स्नानघर, कपड़े धोना और नियमित पानी की आपूर्ति.
5. सामुदायिक शौचालय आप, आपके परिवार और आपके समुदाय के लिए बेहतर स्वास्थ्य, सुरक्षा और गरिमा का प्रतीक हैं.

Institute for Fiscal Studies

सामुदायिक शौचालय बेहतर बनाने के लिए आप और आपका परिवार क्या कर सकता हैं?

1. नियमित रूप से भुगतान
2. सामुदायिक शौचालयों के कूड़ेदानों में ही कचरा फेंके।
3. उपयोग के बाद फ्लश करने के लिए पानी का उपयोग करें.
4. शौचालय परिसर को दूषित न करें.
5. शौचालयों का उपयोग करते समय वृद्ध लोगों और बच्चों की सहायता करें।
6. अँधेरे में महिलाओं और लड़कियों को अकेले न जाने दें.
7. शौचालय उपयोग करने के बाद स्वच्छ रखें जैसा की आप अपने उपयोग के लीये चाहते है.

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- **Posters placed in CTs**

Distance and use

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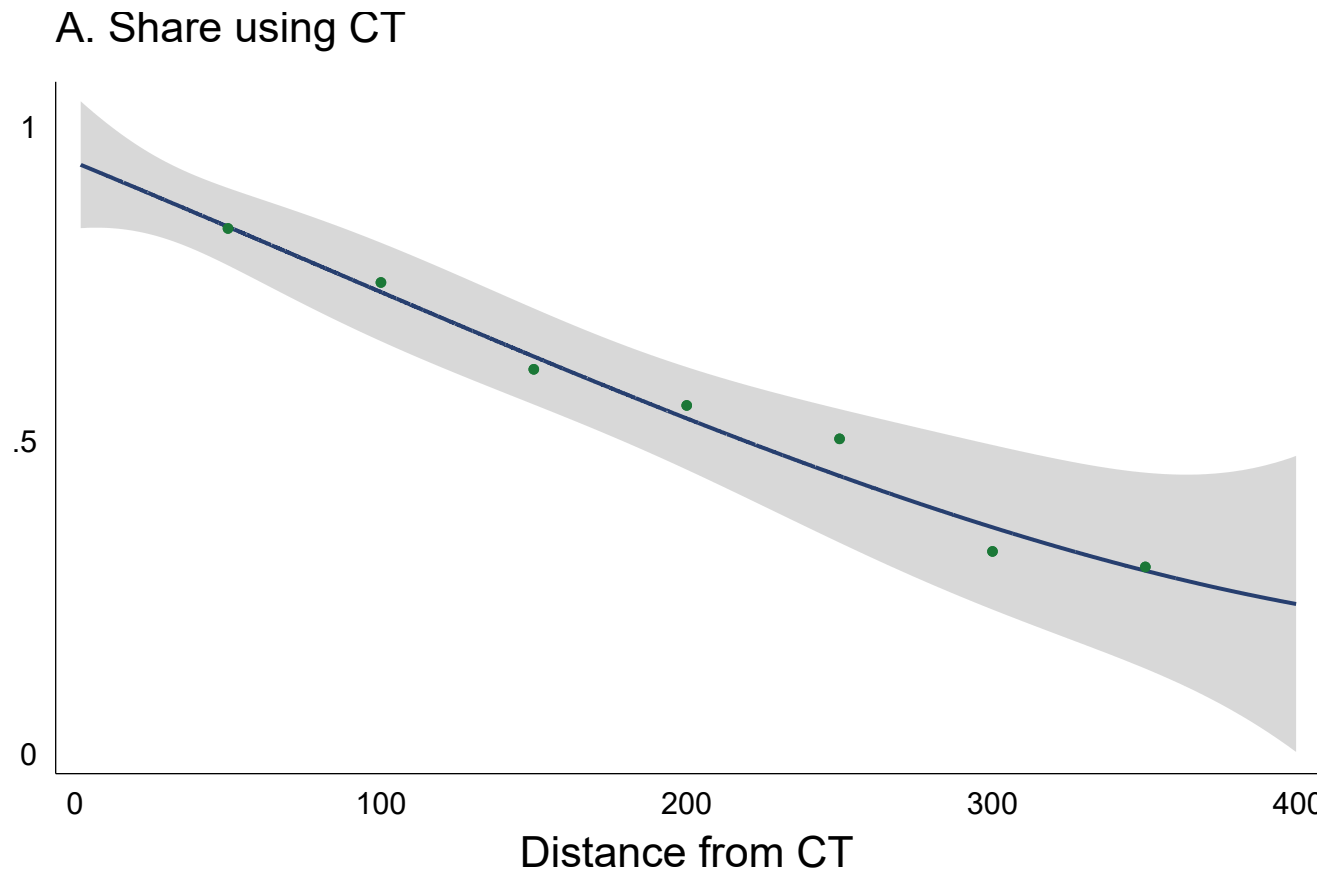
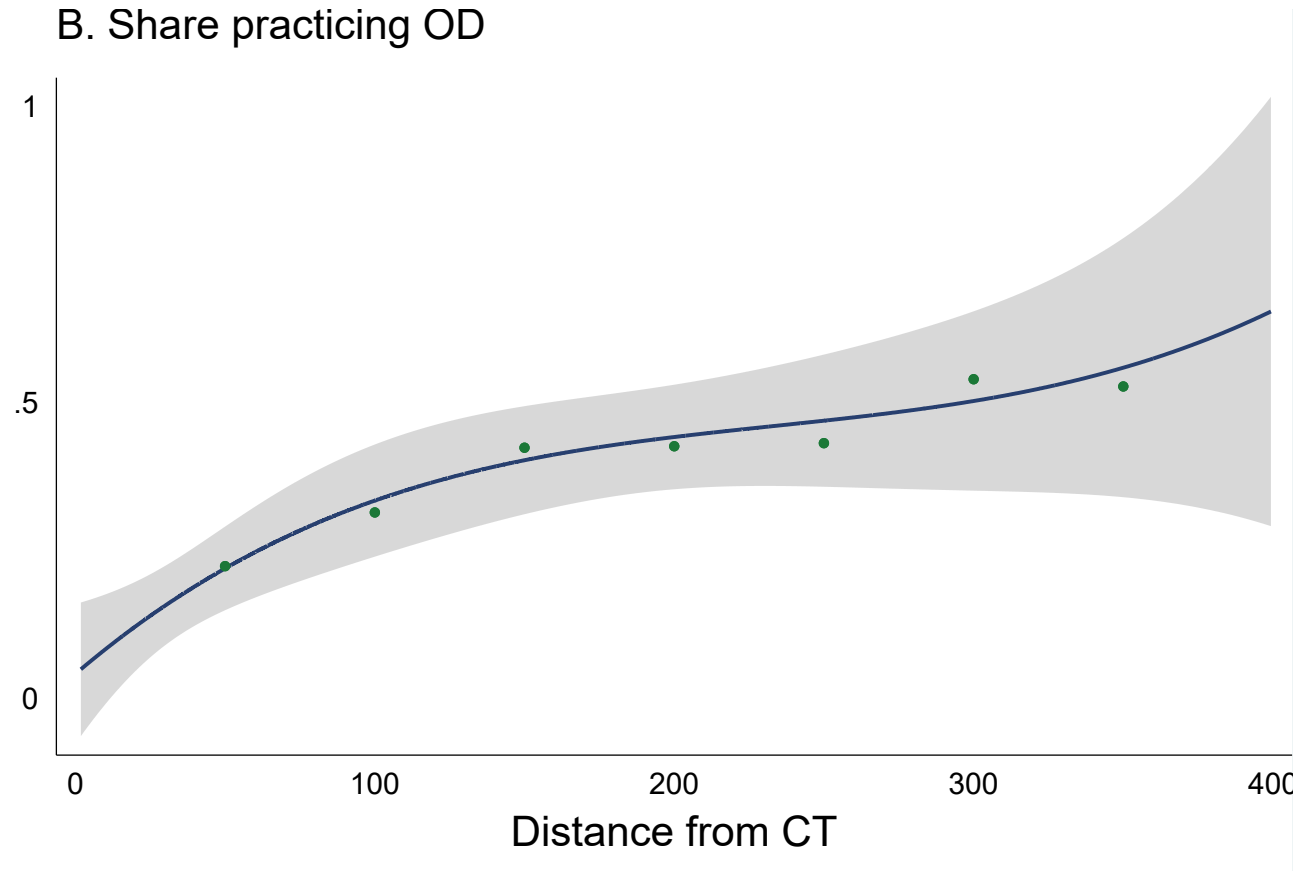


Distance and use

Back



Baseline balance: CT characteristics

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Table D1: CT characteristics at baseline, by treatment group

	Descriptive statistics		Differences from control group, by treatment group			
	All	Control	Any treatment	Improvement	Improvement + sensitization	P-value joint test (4)-(5)
	(1)	(2)	(3)	(4)	(5)	(6)
Year of construction	1997.11	1995.26	2.87	2.91	2.83	0.32
	[8.81]	[9.29]	(1.87)	(2.22)	(2.17)	
Distance to closest CT	0.54	0.58	-0.06	-0.04	-0.07	0.77
	[0.45]	[0.67]	(0.09)	(0.11)	(0.10)	
Surrounding: Market	0.33	0.36	-0.04	0.00	-0.08	0.69
	[0.47]	[0.49]	(0.10)	(0.11)	(0.11)	
Surrounding: Road	0.83	0.87	-0.06	-0.02	-0.09	0.54
	[0.37]	[0.34]	(0.08)	(0.09)	(0.09)	
Surrounding: Government office	0.25	0.21	0.07	0.10	0.04	0.64
	[0.44]	[0.41]	(0.09)	(0.10)	(0.10)	
Single caretaker	0.80	0.82	-0.04	0.03	-0.10	0.39
	[0.40]	[0.39]	(0.08)	(0.10)	(0.09)	
% Woman caretaker	0.18	0.22	-0.06	-0.05	-0.07	0.70
	[0.37]	[0.39]	(0.07)	(0.09)	(0.08)	
Caretaker is cleaner	0.27	0.28	-0.02	-0.04	-0.00	0.92
	[0.45]	[0.46]	(0.09)	(0.11)	(0.10)	
Caretaker from community	0.44	0.49	-0.07	-0.12	-0.01	0.54
	[0.50]	[0.51]	(0.10)	(0.12)	(0.12)	
Months caretaker in CT	125.28	129.91	-6.94	-0.61	-12.52	0.86
	[103.45]	[109.34]	(22.51)	(26.53)	(25.71)	
% Time collecting fees	0.35	0.36	-0.01	-0.02	-0.00	0.74
	[0.11]	[0.11]	(0.02)	(0.03)	(0.03)	
% Time cleaning	0.20	0.21	-0.01	-0.01	-0.01	0.64
	[0.06]	[0.06]	(0.01)	(0.01)	(0.01)	
Clean frequently	0.86	0.87	-0.02	-0.02	-0.01	0.96
	[0.35]	[0.34]	(0.07)	(0.08)	(0.08)	

Note. Columns (1)–(2) report sample mean and standard deviation in brackets for the whole sample and control group, respectively. Column (3) reports the difference with the control group with all treatment groups pooled together using an OLS regression of the correspondent outcome on the treatment indicator. Columns (4)-(5) report the difference with the control group for each treatment group. Standard errors clustered at slum level are reported in parentheses. Column (6) present a joint test of significance of the coefficients for each treatment dummy.

Baseline balance: HH characteristics

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Table D2: Household characteristics at baseline, by treatment group

	Descriptive statistics		Differences from control group, by treatment group			
	All	Control	Any treatment	Improvement	Improvement + sensitization	P-value joint test (4)-(5)
	(1)	(2)	(3)	(4)	(5)	(6)
Head, age	45.43	46.02	-0.93	-0.96	-0.90	0.55
	[12.82]	[13.42]	(0.84)	(1.00)	(0.94)	
Head, male	0.75	0.73	0.03	0.05	0.01	0.29
	[0.43]	[0.44]	(0.02)	(0.03)	(0.03)	
Head, educ $<$ primary	0.54	0.56	-0.03**	-0.09**	0.03	0.03
	[0.50]	[0.50]	(0.04)	(0.05)	(0.04)	
Head, married	0.77	0.76	0.01	0.01	0.01	0.88
	[0.42]	[0.43]	(0.03)	(0.03)	(0.03)	
Number of children below 6 years old	0.47	0.50	-0.05	-0.04	-0.06	0.69
	[0.77]	[0.82]	(0.06)	(0.07)	(0.07)	
Number of adult members	4.47	4.44	0.05	0.04	0.06	0.87
	[1.83]	[1.92]	(0.11)	(0.14)	(0.12)	
Muslim	0.17	0.12	0.08*	0.11*	0.06	0.13
	[0.37]	[0.32]	(0.04)	(0.06)	(0.05)	
General caste	0.07	0.05	0.03	0.03	0.02	0.29
	[0.26]	[0.23]	(0.02)	(0.02)	(0.02)	
Asset index	0.53	0.53	0.00	0.01	-0.00	0.79
	[0.15]	[0.16]	(0.02)	(0.02)	(0.02)	
Piped water	0.71	0.70	0.01	-0.01	0.04	0.72
	[0.45]	[0.46]	(0.06)	(0.07)	(0.07)	
Private toilet	0.08	0.07	0.01	0.01	0.02	0.71
	[0.27]	[0.26]	(0.02)	(0.02)	(0.02)	
CT expense	180.53	173.42	11.20	-2.50	24.23	0.65
	[244.52]	[221.41]	(22.92)	(22.57)	(31.01)	

Note. Columns (1)–(2) report sample mean and standard deviation in brackets for the whole sample and control group, respectively. Column (3) reports the difference with the control group with all treatment groups pooled together using an OLS regression of the correspondent outcome on the treatment indicator. Columns (4)-(5) report the difference with the control group for each treatment group. Standard errors clustered at slum level are reported in parentheses. Column (6) present a joint test of significance of the coefficients for each treatment dummy.

Random attrition and replacements

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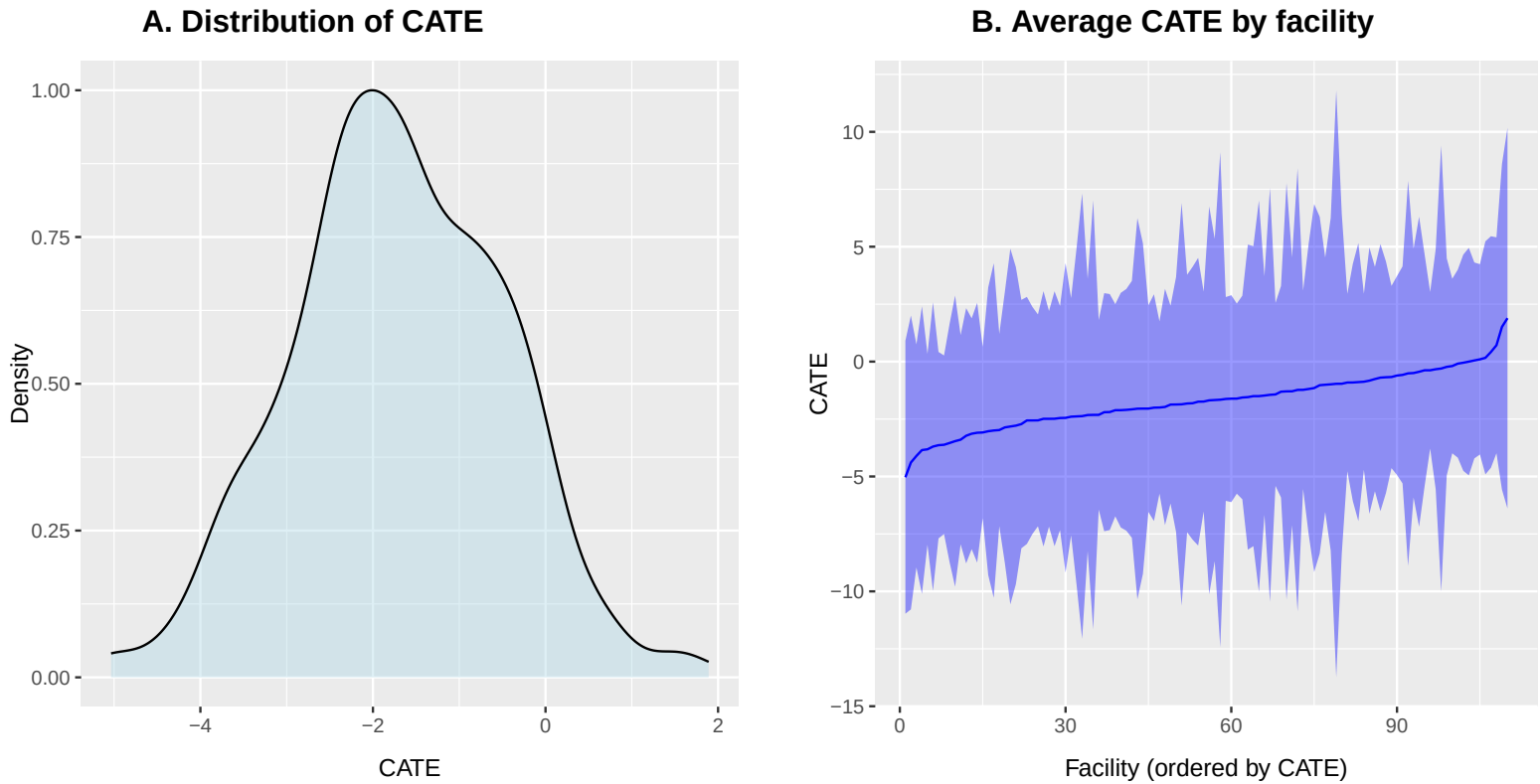
	Follow-up interviews per baseline household	Interviewed at baseline and not re-interviewed in ...				Replacements
		Any follow-up	Follow-up 1	Follow-up 3	Follow-up 5	Household is replacement
	(1)	(2)	(3)	(4)	(5)	(6)
Maintenance (T1)	0.029	0.004	0.013	-0.026	-0.016	0.008
	(0.072)	(0.011)	(0.022)	(0.037)	(0.035)	(0.015)
	[0.69]	[0.73]	[0.57]	[0.48]	[0.65]	[0.60]
Maintenance + sensitization (T2)	0.013	0.008	0.003	-0.014	-0.002	-0.000
	(0.078)	(0.014)	(0.021)	(0.041)	(0.034)	(0.014)
	[0.87]	[0.54]	[0.87]	[0.73]	[0.96]	[0.99]
T1 = T2 (p-value)	0.807	0.754	0.678	0.706	0.656	0.594
Attrition rate	2.575	0.025	0.090	0.194	0.142	0.161
Observations	1575	1575	1575	1575	1575	6711

Note. Figure B2 provides the timing of each follow-up survey. Dependent variables by column: (1) indicator variable equal to 1 if the household was interviewed at baseline and was not re-interviewed in any of the follow-ups, and zero otherwise; (2) indicator variable equal to 1 if the household was interviewed at baseline and was not re-interviewed in two out of three follow-ups, and 0 otherwise; (3)–(5) indicator variable equal to 1 if the household was interviewed at baseline and was not re-interviewed at follow-up 1 or follow-up 2 or follow-up 3, and 0 otherwise; (6) indicator variable equal to 1 if the household is part of the replacement sample (it was interviewed in any of the follow-ups, but it was not interviewed at baseline), and 0 otherwise. In columns (1)–(5), the sample is restricted to baseline observations, while in column (6) the sample is restricted to follow-up observations. All specifications include strata indicators for city and the provider of the CT. Standard errors clustered by catchment area are presented in parenthesis in columns (1)–(5). Standard errors clustered by catchment area and follow-up round are presented in parenthesis in column (6).

Heterogeneity of effect on non-payment

Conditional ATE of the maintenance treatment on non-payment computed using the causal forest procedure of Basu et al. (2018) and Athey and Wager (2019)



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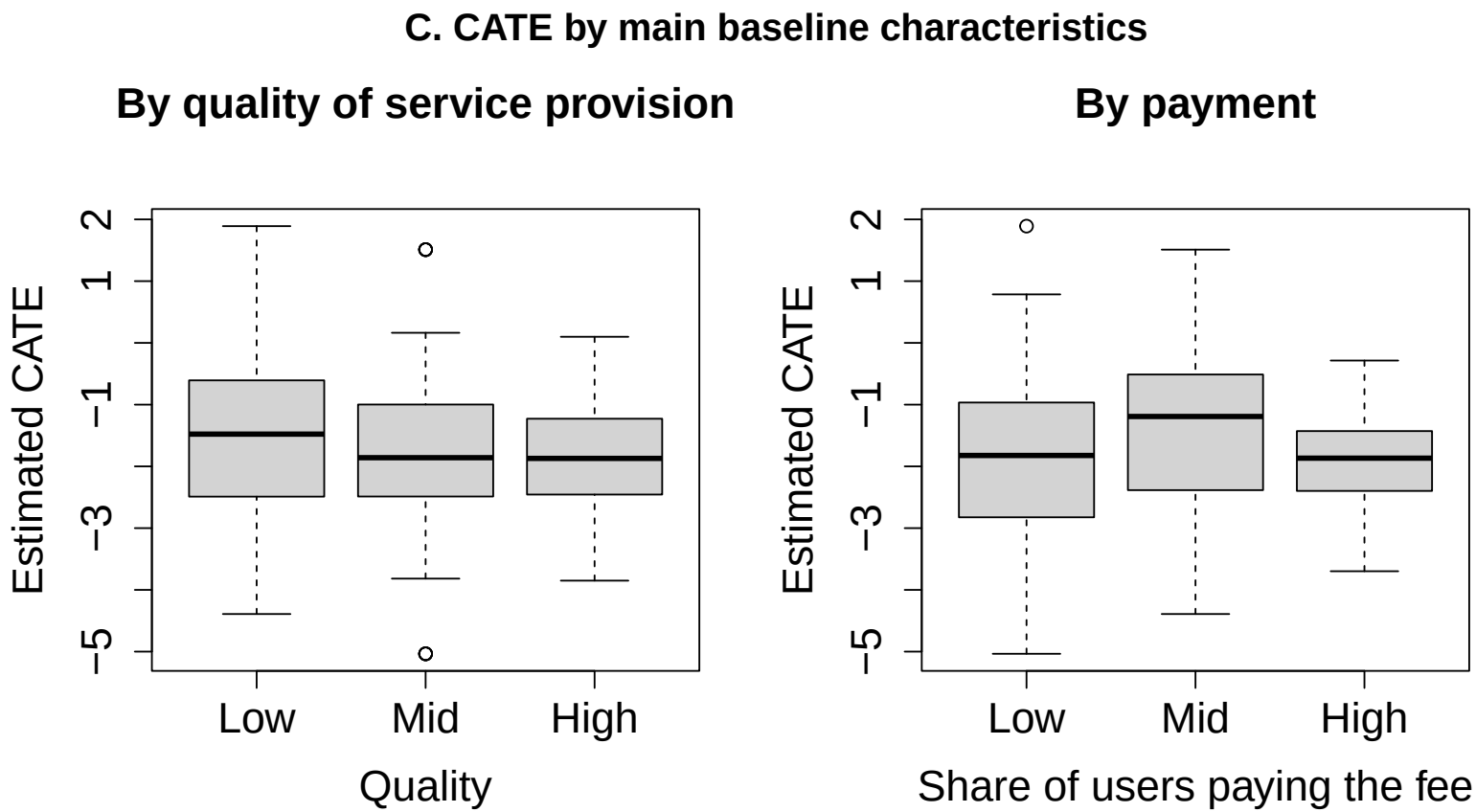
Heterogeneity of effect on non-payment

Conditional ATE of the maintenance treatment on non-payment computed using the causal forest procedure of Basu et al. (2018) and Athey and Wager (2019)



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OD prevalence, by gender

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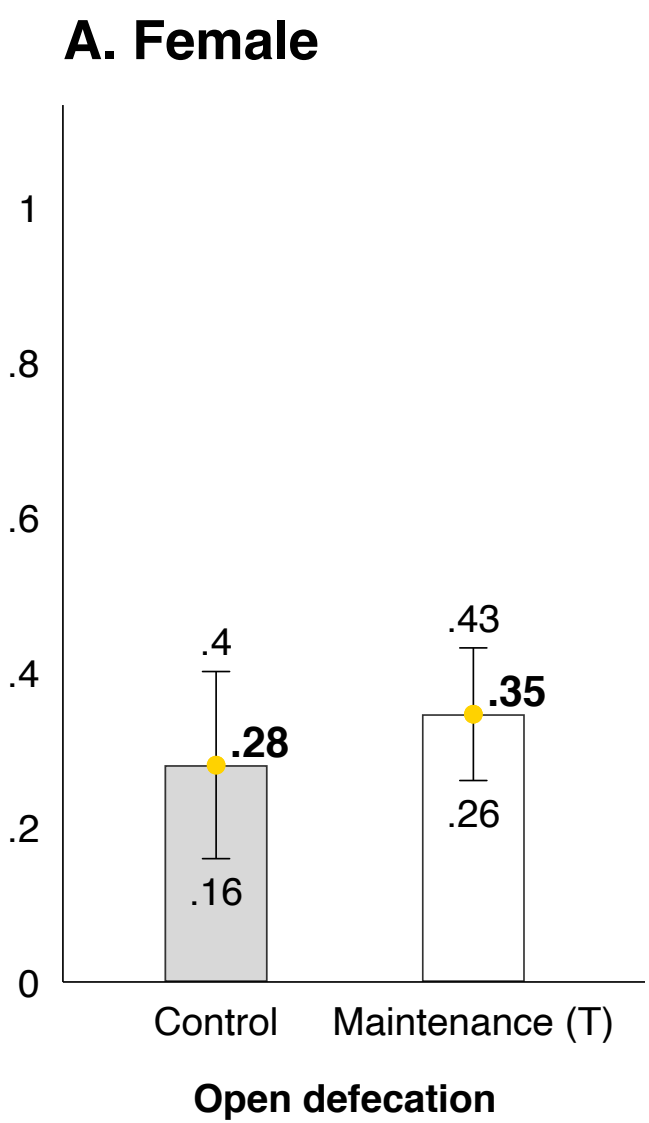

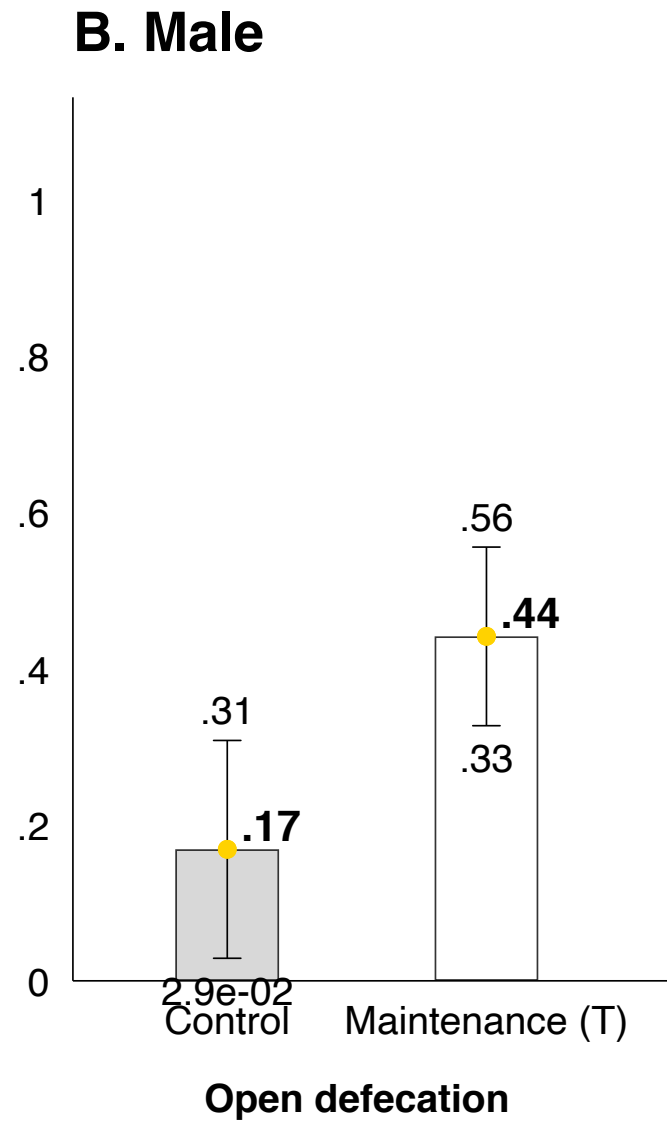

Increased awareness of externalities from OD

Sensitization campaign

- The campaign was **effective at reaching individuals**

	Recall of WASH campaign		Voice messages
	Interactive activities	Posters at CT	Exposure
	(1)	(2)	(3)
Maintenance only (T1)	0.023	0.017	-0.038
	(0.024)	(0.030)	(0.047)
	[0.33]	[0.58]	[0.42]
Maintenance + sensitization (T2)	0.083	0.158	0.827
	(0.023)	(0.029)	(0.086)
	[0.00]	[0.00]	[0.00]
T1 = T2 (p-value)	0.014	0.000	0.000
Mean (control group)	0.645	0.327	0.188
Std. dev. (control group)	0.479	0.469	0.347
Observations	4793	3301	4793
Catchment areas	328	218	328
Observation rounds	3	2	3

Regular vs other users

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Dep. variable:	Users			Non-payment		
	All	Regular users	Other users	All	Regular users	Other users
	(1)	(2)	(3)	(4)	(5)	(6)
Maintenance (T)	-1.941	-2.132	0.191	-0.093	-0.103	-0.020
	(1.626)	(1.380)	(0.883)	(0.042)	(0.044)	(0.023)
	[0.24]	[0.13]	[0.83]	[0.03]	[0.02]	[0.39]
Mean (control group)	33.903	27.519	6.383	0.444	0.511	0.080
Observations	434	434	434	434	434	337
Catchment areas	110	110	110	110	110	107
Observation rounds	4	4	4	4	4	4

Note. Estimates based on CT-level OLS regressions using equation (1). Standard errors clustered by catchment area are reported in parentheses. P-values are presented in brackets, the first from individual testing, the second adjusting for testing that each treatment is jointly different from zero for all outcomes presented in the table (see Section 5 for details). Dependent variables by column: (1-3) *Users*: total number of users observed; (4-6) *Non-payment*: observed share of users who do not pay the entry fee. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Additional details about the variables are presented in Appendix A.

Revenues

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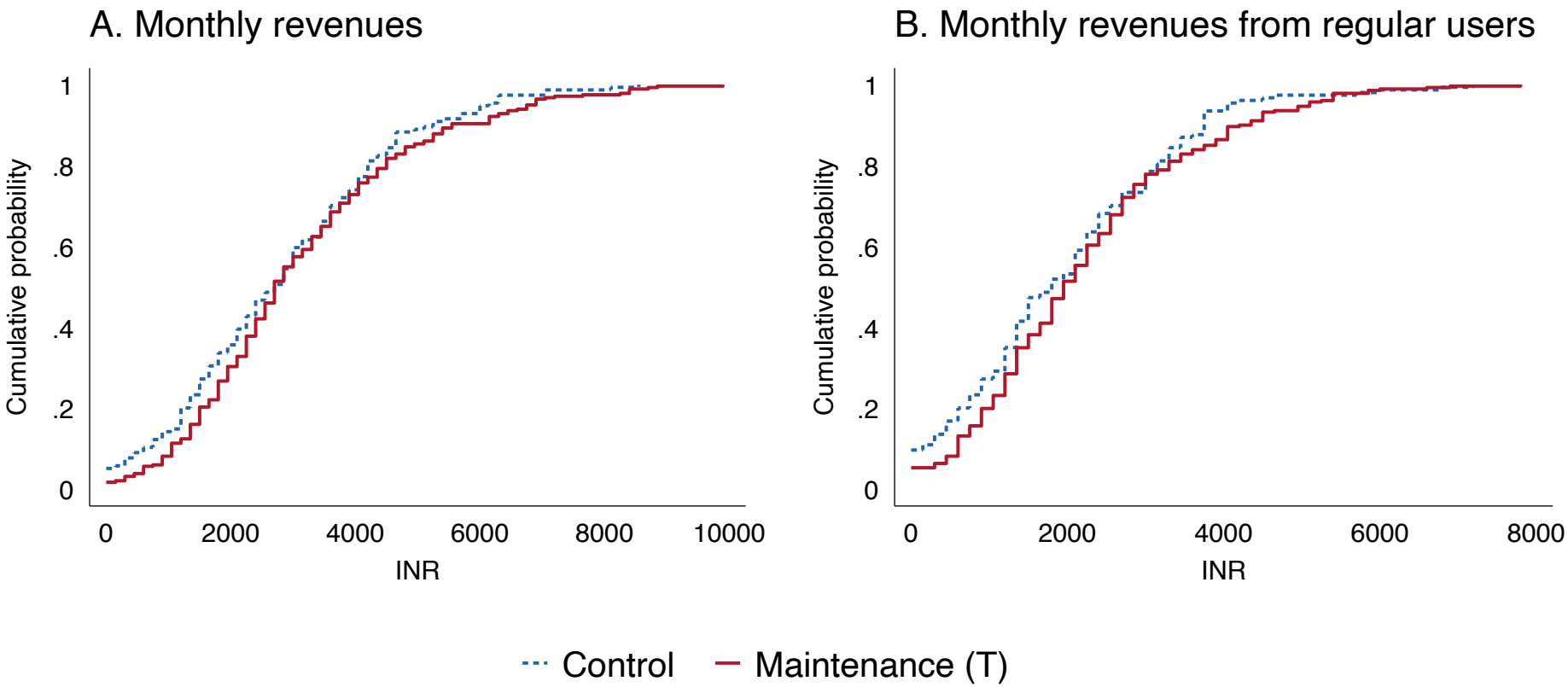

Quality of service delivery: factors

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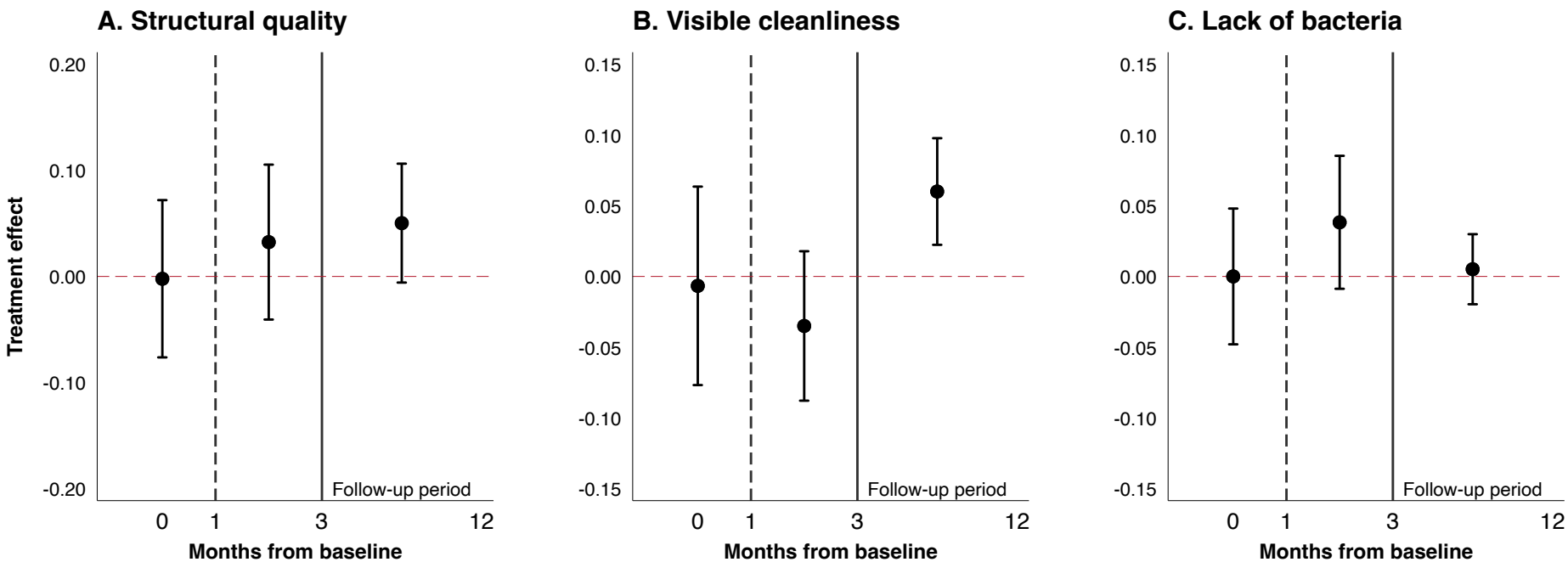

Service delivery

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Table 1: Service delivery

Dep. variable:	Service delivery	Inputs to service delivery		
	Quality	Maintenance		Monitoring
		Cleaning	Rehabilitation	
	(1)	(2)	(3)	(4)
Maintenance (T)	0.064	0.057	-0.027	0.060
	(0.024)	(0.016)	(0.053)	(0.032)
	[0.01, 0.03]	[0.00, 0.01]	[0.62, 0.62]	[0.07, 0.15]
Mean (control group)	0.636	0.513	0.625	0.707
Observations	434	434	434	434
Catchment areas	110	110	110	110
Observation rounds	4	4	4	4
Level of analysis	CT	CT	CT	CT
Measurement	Observed	Self-reported	Self-reported	Self-reported

Note. Estimates based on CT-level OLS regressions using equation (5). Standard errors clustered by catchment area are reported in parentheses. The p-values presented in brackets, the first from individual testing, the second adjusting for testing that each treatment is jointly different from zero for all outcomes presented in the table (see Section 6 for details). Dependent variables by column: (1) *Quality*, index computed by aggregating indicator variables about the structural quality of the facility, its cleanliness and the lack of bacteria, and rescaled to be between 0 (lowest in-sample quality) and 1 (highest in-sample quality); (2) *Cleaning*, index including the number of tools, equipment and cleaners used during the last cleaning of the facility and the caretaker's knowledge about this process, normalized to be between 0 and 1 (see Appendix Table D11 for individual components); (3) *Rehabilitation*, indicator variable equal to 1 if the CT received repairs and/or deep cleaning of the infrastructure in the month previous to the visit, and 0 otherwise; (4) *Monitoring*, share of worked hours allocated by the caretaker to collecting fees and supervising cleaners, rather than conducting activities away from the entrance or off-site. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Additional details about the variables are presented in Appendix A.

Use and payment

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Table 2: Use and payment for the service

Dep. variable:	**Payment for the service**			**Use of the service**		
	Share of users paying the fee	Share of residents willing to pay a positive amount	WTP among residents	Users	Number of uses among residents	
					Regular users	*Other residents*
	(1)	(2)	(3)	(4)	(5)	(6)
Maintenance (T)	0.093	-0.003	0.009	-1.941	-0.110	-0.193
	(0.042)	(0.022)	(0.087)	(1.626)	(0.047)	(0.094)
	[0.03, 0.08]	[0.90, 0.90]	[0.92, 0.92]	[0.24, 0.41]	[0.02, 0.06]	[0.04, 0.10]
Mean (control group)	0.556	0.648	1.205	33.903	1.383	0.763
Observations	434	222	6001	434	2417	883
Catchment areas	110	109	109	110	109	102
Observation rounds	4	2	2	4	2	2
Level of analysis	CT	CT	Respondent	CT	Household	Household
Measurement	Observed	Incentivized	Incentivized	Observed	Self-reported	Self-reported

Note. Estimates based on CT-level OLS regressions using equation (5). Standard errors clustered by catchment area are reported in parentheses. The *p*-values presented in brackets, the first from individual testing, the second adjusting for testing that each treatment is jointly different from zero for all outcomes presented in the table (see Section 6 for details). Dependent variables by column: (1) *Share of users paying the fee*, observed share of users who pay the entry fee; (2) *Share of residents willing to pay a positive amount*, share of residents with a positive WTP in the incentivized WTP for a single CT use (in rupees), elicited for a bundle of ten tickets and divided by 10 to get at single-use WTP; (3) *WTP among residents*, incentivized WTP for a single CT use (in rupees), elicited for a bundle of ten tickets and divided by 10 to get at single-use WTP; (4) *Users*, total number of users observed; (5)–(6) *Number of uses among residents*, number of times the respondent used the CT for defecation in the day previous to the interview (*regular users* are respondents that reported using the CT regularly). All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Columns (5) and (6) are estimated on relevant subsamples. Additional details about the variables are presented in Appendix A.

Outside option

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Table 3: Outside option and health consequences

Dep. variable:	Practiced OD	Morbidity	Health expenditure			
			Curative		Preventive	
			Extensive	Intensive	Extensive	Intensive
	(1)	(2)	(3)	(4)	(5)	(6)
Maintenance (T)	0.172	0.029	0.049	-35.277	-0.003	4.542
	(0.080)	(0.027)	(0.025)	(195.308)	(0.003)	(56.857)
	[0.03, 0.22]	[0.28, 0.73]	[0.05, 0.26]	[0.86, 0.97]	[0.44, 0.88]	[0.92, 0.92]
Mean (control group)	0.210	0.451	0.636	1700.010	0.992	741.053
Observations	817	3323	3298	3298	3323	3322
Catchment areas	107	109	109	109	109	109
Observation rounds	1	2	2	2	2	2
Level of analysis	Respondent	Household	Household	Household	Household	Household
Measurement	List randomization	Self-reported	Self-reported	Self-reported	Self-reported	Self-reported

Note. Estimates based on household-level OLS regressions using equation (5). Standard errors clustered by catchment area are reported in parentheses. The p-values presented in brackets, the first from individual testing, the second adjusting for testing that each treatment is jointly different from zero for all outcomes presented in the table (see Section 6 for details). Dependent variables by column: (1) *Practiced OD*, share of study participants who practiced OD the day before the interview, obtained using the list randomization technique applied to the most senior male and female household member in follow-up 4; (2) *Morbidity*, indicator variable equal to 1 if any household member had fever, diarrhea or cough during the two weeks previous to the interview, and 0 otherwise; (3) *Curative expenditure - extensive*, indicator variable equal to 1 if the respondent had positive curative expenditures, and 0 otherwise; (4) *Curative expenditure - intensive*, level of curative healthcare expenditures (in rupees); (5) *Preventive expenditure - extensive*, indicator variable equal to 1 if the respondent had positive preventive expenditures, and 0 otherwise; (6) *Preventive expenditure - intensive*, level of preventive healthcare expenditures (in rupees). Column (1) includes only 107 catchment areas because, due to the randomization of lists to respondents, a number of areas do not have respondents with the list of items including OD. Columns (2)–(6) include only 109 catchment areas in the sample because the dependent variables were measured only in rounds 3 and 5, after a catchment area was displaced. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Additional details about the variables are presented in Appendix A.

Consequences for public health

- ↑ 7% in positive curative expenditures over control.