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Public service delivery and free riding: experimental evidence from India

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Public Service Delivery and Free Riding: Experimental Evidence from India*

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Abstract

This paper provides novel evidence on the trade-off between public service delivery and free riding in low- and middle-income countries. We implement a field experiment in the slums of two major Indian cities, where inadequate access to sanitation restricts residents to either free ride, by disposing human waste in common-property areas, or use a fee-funded public service provided by community toilets. Using original survey, behavioral and objective measurements, we show that top-down incentives for the quality of service provision improves delivery and reduces non-payment of fees, but excludes a share of residents from using the service, forcing them into free riding. Willingness to pay for the service is unaffected, but demand for public intervention in the quality of delivery increases, replacing the demand to address free riding. Adding a campaign sensitizing the consequences of free riding among residents raises awareness, but does not induce any behavioral change. Supplementing reduced form estimates with structural estimates, we show that eliminating free riding requires subsidizing use beyond free basic services. (*JEL* C93, H40, I15, Q53)

Keywords: public service, basic services, infrastructure, maintenance, free riding, willingness to pay, water and sanitation, information, health.

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Can the improvement of public service delivery eradicate free riding? Around the globe, limited access to public services forces citizens to satisfy their needs by free riding common-property and open-access resources, such as air, water and land (Stavins, 2011). Evidence shows how waste is disposed in the environment when sanitation facilities and garbage processing are inadequate (Coffey et al., 2018), and more polluting alternatives are chosen when the provision of clean water and electricity or public transportation are unreliable (Zivin et al., 2011; Lee et al., 2020; Gendron-Carrier et al., 2022). While health and socio-economic costs of free riding are well-established in the literature, there is limited understanding on how to address this behavior in poor institutional settings (Ostrom, 2011; Greenstone and Jack, 2015). In particular, the extent to which improvements in public service provision can reduce free riding remains an open question with crucial economic implications (Bryan et al., 2020; Heblich et al., 2021).

This paper analyzes a field experiment designed to stimulate the quality of public service delivery. We focus on the important context of access to sanitation and hygiene: in 2020, 80 percent of all human waste produced worldwide was discharged untreated into the environment, not only due to inadequate sewage infrastructures but also to the lack of safely managed services among 3.6 billion people, almost half of the world's population (WHO, 2021). Focusing on one of the most challenging settings for public services, informal settlements (or *slums*), we provide one of the few economic analyses of provider–user interactions in the delivery of basic services in low- and middle-income countries (L&MICs). We establish an important trade-off between public services and free riding: improvements in the quality of delivery excludes a share of users from accessing the service, increasing free riding and worsening environmental quality and public health.

In partnership with governmental and non-governmental organizations (NGOs), we implemented a cluster randomized controlled trial (cRCT) in the slums of the two main cities of Uttar Pradesh, the largest and the fourth-most-densely populated state of India (Government of India, 2011). The experiment is centered around *potential free riders*, i.e., those residents that, in the absence of adequate private sanitation, are left with two options: to free ride by disposing human waste in common-property areas, contaminating water and imposing significant externalities for the community, or to use a fee-funded public service provided by community toilets (CTs). These shared complexes operate on a pay-to-use model and, contrary to public toilets, serve a defined group of residents – a model that is also present in many other L&MICs.[1] However, this service provides only a partial alternative to free riding: CTs are characterized by the poor maintenance and dirtiness of the facilities with widespread presence of bacteria harmful to human health. The low-quality of the service disincentivizes use and reinforces free riding, which is captured by the low willingness to pay (WTP) for the service among residents and by the widespread non-payment of fees among its users.

Following extensive efforts to map the universe of slums and CTs in the two cities and census slum residents to identify potential free riders, we randomly allocated 70 of the 110 CTs to a *maintenance* treatment group, with the remaining 40 serving as the control group. The intervention targeted the person in charge of fee collection and service delivery in the facility (the *caretaker*), and was structured in two subsequent components. In the first two months, labeled the *grant* period, a one-off grant was offered to primarily improve the structural quality of the facility, such as repairing taps and doors. In the following 10 months, labeled the *incentive* period, caretakers were offered a large bimonthly financial reward (roughly 40 percent of their monthly salary), conditional on keeping the facility clean, to improve the quality of the routine side of service delivery.

To understand whether citizens' mobilization can further increase demand of improved public service delivery and reduce free riding, we implemented a sensitization campaign among potential free riders in a randomly-selected half of the *maintenance* treatment group. The campaign was designed to raise awareness about the importance of a clean environment in the community and a well-maintained facility through face-to-face sessions, distribution of leaflets, voice message reminders sent to mobile phones, and posters hung in the facilities.

Based on a unique set of measurements, combining observations, survey responses and incentivized behavioral measurements, we map intervention effects into behavioral responses of both local service providers and potential free riders. We show that the maintenance treatment generates sustained improvements in the observed quality of the service. Improvements are achieved mostly by incentivizing caretakers, who improve

[1]Safely-managed private toilets remain the first-best solution (WHO, 2021). In India, the country-wide *Swachh Bharat Mission (SBM)* provides subsidies for their construction and targets public awareness through mass media and inter-personal communication. In urban areas, household-level subsidies are envisioned for 80 percent of the population lacking access, the remaining to be catered by CTs (Government of India, 2017). Various other constraints hinder the take-up of these subsidies (see, e.g., Routray et al., 2017; Guiteras et al., 2018; Augsburg et al., 2021).

routine maintenance and become more knowledgeable about best practices for maintaining the facility.

Incentivizing quality of service delivery also affects non-payment among users, resulting in the exclusion of users from the use of the service. For the facilities in the maintenance treatment group, we observe a significant reduction in the share of users that do not pay the user fee by 17.8 percent as compared to the control group, accompanied by a small decrease in the total number of users. This pattern is not driven by an increased willingness of users to pay the service fee, but rather by a strategic response to incentives among service providers. The maintenance intervention leads caretakers to allocate a larger share of their time to monitoring (i.e., the collection of fees and the supervision of cleaning), which is sufficient to reduce non-payment among users. This behavioral change reduces the share of time allocated by caretakers to operating activities, while leaving their total labor supply and pro-social motivation unchanged. Among potential free riders, we do not observe any treatment impact on the incentive-compatible WTP for the service in the overall study period. While we document an effect on their probability to appreciate the upgrade in quality, their willingness to contribute for the quality of service delivery is also unaffected.

This 'cream-skimming' effect among potential users of the service results in increased free riding. At endline, near the CTs of the maintenance treatment group, the average share of respondents who free ride by practicing OD is 39.1 percent as compared to 20.6 percent for the control group, an increase of 89.8 percent. The negative consequences for public health are confirmed by an increase in the share of study households who report positive health expenditures in treated areas.

Raising the quality of basic services mobilizes citizens to demand further public intervention to local politicians. Using a purposefully designed structured community activity to measure such demand in the study area, we show that the maintenance intervention increases the share of residents that demand the cleanliness of the facility increases by 52.0 percent over the control mean. The share demanding local politicians to address free riding is instead significantly reduced by 17.3 percent over the control mean. These results show that mobilization in poorer settings can be incentivized by visible interventions, while so far it has been associated more closely to the provision of information (see, e.g., Banerjee et al., 2020). Impacts are not driven by changes in attitudes toward cooperation in the slum, as measured by individual contributions in a public good game.

The sensitization campaign raises awareness about the risks of a high degree of free riding in the community, despite the several governmental and non-governmental awareness creation initiatives. Nevertheless, we observe no effect of sensitization on slum residents' or caretakers' behavior. We highlight not only the weak complementarity between incentivizing the quality of existing services and demand-side sensitization, but also the limited effectiveness of bottom-up incentives at influencing public service delivery in poorer settings.[2]

Our results provide novel insights to the literature on public service delivery in L&MICs. First, we shed light not only on the mechanisms driving their quality, but also on the obstacles to public infrastructure maintenance, a crucial issue largely ignored in the literature (Duflo et al., 2012).[3] We show that improvements along these dimensions are driven by top-down incentives, complementing the theoretical evidence on the management of public goods when coordination among citizens fail (Banerjee et al., 2008). Within this line of incentives, we document the importance of decentralized mechanisms based on local providers, highlighting the role of performance-based incentives and of multi-tasking for these pro-socially motivated jobs (see Besley and Ghatak, 2018, for a review on incentives and pro-social motivation). These findings complement centralized mechanisms of public service delivery centered around state capacity and governance, which are more prevalent in the literature (Best et al., 2017; Rasul and Rogger, 2018; Bandiera et al., 2021; Fenizia, 2022).

Second, we contribute to the understanding of sustainability of these services. In L&MICs, basic services financed with user fees are characterized by a large prevalence of non-payment and by under-provision (Burgess et al., 2020). By documenting that quality improvements raise the demand for public intervention but do not shift private valuations, we highlight how under-provision is potentially driven by citizens treating access to basic services as a right rather than a pay-to-use service. Where the

[2]In relation to poor sanitation, available evidence on the role of information is centered around the adoption of household level products (Ashraf et al., 2013; Guiteras et al., 2015; Pickering et al., 2015; Cameron et al., 2019).

[3]Available evidence focuses on newly constructed infrastructure. For L&MICs, it covers the education (Duflo, 2001), electricity (Dinkelman, 2011; Rud, 2012; Lipscomb et al., 2013), housing (Galiani et al., 2017; McIntosh et al., 2018), water and sanitation (Devoto et al., 2012; Meeks, 2017; Alsan and Goldin, 2019; Bancalari, 2020), and transportation infrastructures (Gonzalez-Navarro and Quintana-Domeque, 2016; Donaldson, 2018; Asher and Novosad, 2020).

share of these citizens is sufficiently large, fighting free riding requires funding services with general taxation, a challenging instrument in L&MICs (Besley and Persson, 2013; Weigel, 2020; Jensen, 2022).

To understand the consequences of providing access to public services for free, in Section 6, we supplement reduced-form estimates with structural estimates of a model in which agents can choose between free riding or a fee-funded service. Our estimates indicate that providing the service for free is not sufficient to eradicate free riding: the fee that would set free riding to zero is estimated to be negative with a magnitude similar to the current service fee. In presence of negative externalities, this result highlights the potential of subsidizing use, perhaps with conditional transfers, as a solution to eliminate free riding and contamination in the poorest settings.

1 Background

Our experiment is implemented in the slums of Lucknow and Kanpur, the capital and the second largest cities in the Indian state of Uttar Pradesh. These cities provide a unique setting to study the constraints to public service delivery in L&MICs as they exemplify the urbanization processes experienced by growing cities in the poorest regions of the world. In 2015, Lucknow was the 129$^{\text{th}}$ largest city worldwide with 3.2 million inhabitants, and Kanpur was the 141$^{\text{st}}$ with 3.0 million inhabitants. Their populations are expected to grow by 2035 by 59 and 37 percent, respectively (United Nations, 2018). These prospects are similar to those of cities such as Accra (Ghana), Amman (Jordan), or Hyderabad (Pakistan), and of metropolises such as Karachi (Pakistan), Cairo (Egypt) or Manila (the Philippines). The result of such a rapid growth is the proliferation of slums, home to more than 1 billion people worldwide and mostly located in L&MICs (United Nations, 2020). In Lucknow and Kanpur, slum residents are 13 and 15 percent of the population, respectively, comparable to the 15 percent of India's capital, Delhi.

Slums represent an extreme case of both poor access to public services and high prevalence of free riding (Marx et al., 2013). In particular, the lack of access to water, sanitation and hygiene (WASH) is a major issue. While shared solutions are common in the slums of L&MICs (UNICEF, 2019), a large share of slum populations have access only to unimproved facilities or revert to open defecation (OD). A large literature highlights how these types of free riding can increase mortality (Geruso and Spears, 2018) and generate long-lasting effects on human capital accumulation (Miguel and Kremer, 2004; Bleakley, 2007; Adukia, 2017; Augsburg and Rodríguez-Lesmes, 2018; Orgill-Meyer and Pattanayak, 2020; Spears, 2020). Of the estimated half a billion people practicing OD worldwide, about 10 percent live in urban areas, with India being the most affected (WHO, 2021).

These conditions are common in our study area, where more than 40 percent of slum residents lack access to private toilets (Government of India, 2011). For these households, CTs provide the only access to WASH. Arranged in gender-specific areas, they offer sanitation, hand-washing and bathing facilities. The buildings are constructed by municipal corporations (or *Nagar Nigam*), i.e., the institution responsible for community services in cities with more than 1 million inhabitants. Facilities are connected either to sewerage systems or to septic tanks, providing an upgrade in the sanitation ladder compared with rudimentary private facilities or OD. Services are generally rendered on a long-term public–private partnership funded by user fees, with a single access costing a standard fee of 5 Indian rupees (INR, corresponding to US$ 0.07).[4]

Service delivery is performed by caretakers. They are in charge of the daily operation and management (O&M) of the CT, which includes collecting user fees, implementing routine maintenance by cleaning the facility or supervising cleaners, maintaining the stock of cleaning agents, and demanding and/or implementing repairs and maintenance of sanitation systems. Caretakers are hired centrally by the organization managing the CT and are supervised by zone managers who are charged with multiple facilities. They receive a fixed salary, equal on average to INR 5,000 (US$71) per month. Caretakers can be fired or moved to another facility in the case of poor performance. This option is not common as, in our sample, caretakers have on average 10 years of experience in the same job, and 4 years working in the same facility. Qualitative interviews with caretakers and with higher-level managers highlight that salaries do not include any performance-based incentive (Armand et al., 2020a).

The quality of the service rendered is poor and correlates with caretaker's characteristics and behavior.[5] On average, CTs serving slums are poorly maintained, reflected by low

[4]There is almost no variation of the fee across the two cities. Nominal INR are converted to nominal US$ using the 2019 average exchange rate of 70.42 US$/INR (IMF, 2020).

[5]Recent improvements are more prevalent if caretakers spend more time in operations. Non-payment is lower if the caretaker is male, is pro-socially motivated, spends more time monitoring the payment, and implements better maintenance (Supplementary Material S.1).

quality of construction, lack of functioning hand-washing facilities, and dirtiness. Less than 40 of facilities have finished walls for the compound, and hand-washing is available in only half of the facilities. Female areas are generally in a worse state.

The low quality of service delivery is perceived by slum residents with less than half reporting liking the services offered. An incentivized measure of WTP for using the CT among potential users (detailed in Section 4.2) shows that, at baseline, WTP is particularly low (panel A in Figure 1). On average, WTP is INR 1.40 (28 percent of the official fee), higher for male respondents (INR 1.46 versus 1.36 for female respondents) and for households that use the service frequently (INR 1.53). At current conditions, WTP is unrelated to the quality of the facility, but slum residents are, on average, willing to pay above the market price of INR 5 to access a hypothetical higher-quality CT.

Beyond the low WTP for the service, there is also a high degree of non-payment among users (panel B in Figure 1). An average household of four members could spend 8 percent of their average household income to use the service, a share that is smaller than the one spent on intoxicants. However, 34 percent of users do not pay the fee, with a higher percentage among female users (50 percent versus 24 percent among male users). Payments are only partly enforced by caretakers, with just 8 percent of slum residents reporting having been prevented from using the facility for not been willing to pay the fee. At low levels of OD in the slum, non-payment and OD are negatively related, indicating that stricter payment monitoring may lead residents to free ride. At high levels of OD in the slum, however, the relationship turns positive, which characterizes areas with a poor quality of the service and rampant non-payment.

2 The interventions

In partnership with city governments and NGOs,[6] we implemented two interventions with the objectives of improving the quality of the public service delivered by CTs and of raising awareness among slum residents about the importance of eradicating free riding in the community and of receiving a basic service of adequate quality. Supplementary Material S.2 provides the timeline and operational details.

Maintenance intervention. The first intervention was designed to promote the qual-

[6]The partnership includes Lucknow and Kanpur Municipal Corporations, Sulabh International, and the zone and city managers of the CTs. The interventions were implemented by FINISH Society, a Lucknow-based NGO working in the WASH and waste management sectors.

ity of public service delivery. Following Holmstrom (2017), we targeted this goal by stimulating multiple components of service delivery by splitting the intervention in two subsequent periods. During the first two months of the intervention, labeled the *grant period*, we aimed at rehabilitating and improving the structural quality of the facility by providing a one-off grant. This component was offered to the caretaker who, according to the facility's needs, could choose to spend the grant in one of three equally-valued packages: repairs and/or refurbishments (chosen by 41 percent of caretakers), deep cleaning of the facility and the sanitation system (chosen by 41 percent), or the provision of tools and agents coupled with a training session on maintenance best practices (chosen by 18 percent). The average value of each package was INR 25,000 (US$ 355). From the second to the twelfth months of the intervention, labeled the *incentive period*, we aimed at improving the routine side of service delivery. We provided a bimonthly financial reward to caretakers conditional on complying with various indicators of a clean and healthy facility, selected based on the main determinants of inadequate service delivery at baseline. First, visible cleanliness of latrines rewarded caretakers with INR 500 (US$ 7.10). Second, the availability of soap in the hand-washing facilities rewarded caretakers with an additional INR 500 (US$ 7.10). Finally, bacteria counts kept to a minimum standard rewarded caretakers with a further INR 1,000 (US$ 14.20).[7]

We opted for an output-based absolute payment scheme with discrete incentive on the base of previous empirical evidence. First, we targeted own performance, rather than relative performance or rankings, because social comparisons have been found to reduce performance in the health sector (Ashraf et al., 2014b). Second, in line with Bénabou and Tirole (2003) and Bandiera et al. (2015), we linked payments to contemporary performance to minimize gaming across periods, and we provided caretakers with information about their past performance during each round to help them estimating the effort required for the conditions. Third, to facilitate communication and implementation, the announcement of the scheme was made by a member of the implementing team, who provided a face-to-face explanation of the reward and shared a summary page with the main conditions, including a contact number to request further information. Finally, because in the context of pro-social tasks rewards have been found to be effective when

[7]We selected a larger amount for the latter component because it reduces the exposure to pathogens (Flores et al., 2011), which is not guaranteed by visible cleanliness alone. The minimum standard is the baseline median value of the E. coli bacteria count in the cubicles of the study CTs.

their value relative to the baseline pay is high (Ashraf et al., 2014a), we set the magnitude of the bonus using baseline and qualitative data among caretakers and other service providers. In each round, the potential incentive is INR 2,000 (US$ 28.40), equivalent to 40 percent of their average monthly salary. In all rounds combined, this amount sums up to INR 8,000 (US$ 113.60), or 13 percent of the annual salary. The incentive is large as compared to other interventions that showed effects on exerted effort.[8]

Every two months and for a total of four times during the study, the conditions for the reward were verified by enumerators during random visits, and payments were delivered accordingly. Caretakers received on average INR 779 (US$ 11.06) in the first round of incentives, INR 1,036 (US$ 14.71) in the second round, INR 1,058 (US$ 15.02) in the third round, and INR 972 (US$ 13.80) in the last round. Paid amounts correspond to 39, 52, 53 and 49 percent of the potential reward, respectively. At the end of the intervention, caretakers were given a certificate signed by all implementing partners with the results achieved.

Sensitization campaign. The second intervention complemented the maintenance intervention with a sensitization campaign among slum residents. The campaign aimed to increase awareness of negative externalities resulting from free riding and contamination, the importance of paying the fee to fund the delivery of the public service offered by CTs, and the role of users in holding caretakers accountable for the quality of the service. The campaign was provided through four different means. First, door-to-door visits were implemented three times in April–June 2018, July–September 2018 and January–March 2019. This component targeted all members of study households, and was implemented using a flip chart with pictures to allow participants with low literacy to process key messages. Second, at the end of the visit, a leaflet summarizing the main messages was left with the households. Third, posters highlighting messages provided during the door-to-door campaign were placed in the CTs. Fourth, voice message reminders were sent to study households' mobile phones with a monthly frequency.

[8]For India and in the context of education, Duflo et al. (2012) and Muralidharan and Sundararaman (2011) offer a reward equivalent to 1 percent and 3 percent of a typical teacher's annual salary, respectively. Larger magnitudes are more aligned to the incentives schemes provided to managers in the private sector (see, e.g., Bandiera et al., 2005).

3 Research design

The research design is a two-stage cRCT. In the first stage, the cluster is the CT serving slum residents and its catchment area. In the second stage, our unit of analysis is represented by potential free riders, i.e., slum residents that either use the service or free ride by disposing human waste in common-property areas. Supplementary Material S.4 provides further details about the experimental design and about sampling.

The lack of information for a sampling frame at both stages and the focus on a volatile population presented two main challenges for this research design. The first challenge was to locate CTs. For this purpose, we conducted a census of all CTs in the study area in 2017, followed by a geographical mapping of the slums surrounding each facility. For each facility, we gathered data on the location, the physical characteristics, the management of the service, maintenance practices, and the users. These data formed the basis for selecting as part of the study the active CTs offering the most common model of basic service delivery: a fee funded service used mostly by slum residents. To prevent potential risks of treatment contamination, we imposed distance requirements between CTs by removing areas served by multiple facilities. In addition, while caretakers work only in one facility, we limited their rotation to different facilities in agreement with service managers at the city level.[9] A total of 110 facilities were identified, 52 in Lucknow and 58 in Kanpur.

The second challenge was to obtain a sampling frame for potential free riders, which requires first identifying slum residents without access to adequate private sanitation infrastructure, and, among those, the ones that can potentially use the service rendered by a CT. In the second half of 2017, we then conducted a census of all slum residents in the surrounding of the selected facilities. In total, we collected information on more than 30,000 households in both cities, covering demographics, dwelling characteristics (including geolocation) and access to basic services.

Using this information, we first define households without access to adequate private sanitation infrastructure as households where at least one member reported *not* to use a private toilet during the resident census, and with no intention to migrate in the 18 months following the census. To select potential free riders, we restrict this population

[9] During the study period, we do not observe rotation. In a share of facilities (ranging from 2 percent in follow-up 2 to 22 percent in follow-up 4), caretakers were replaced and the implementing team paid regular visits to inform the new caretakers about the intervention.

to the households residing in the catchment area of a CT, defined as the space inside the slum borders and within a radius of not more than 250 meters from the facility. We fix this parameter after studying how service use among households without access to adequate private sanitation infrastructure is affected by the distance (computed using geolocation) from a resident's dwelling to the closest facility. We find that proximity is crucial: beyond 250 meters service use declines rapidly and free riding becomes the main option (Supplementary Material S.1). Using these criteria, we identified 5,553 potential free rider households from which we sampled 1,575 households for the study. The average characteristics of the sample are highly comparable to the population of slum residents in India (Supplementary Material S.4).

To create exogenous variation in the provision of the interventions discussed in Section 2, each CT was randomly allocated to one of three groups: the *maintenance only* treatment group receives the maintenance intervention, the *maintenance plus sensitization* treatment group receives the maintenance intervention and the sensitization campaign in the catchment area, and a control group does not receive any intervention. For randomization, we first stratified CTs according to the main organization managing the facility and the city. Using the rich census information, we then built blocks of three CTs using Mahalanobis-distance relative proximity, and we randomly allocated each CT within a block to a treatment group using a lottery with equal probability of assignment. To further minimize the risk of treatment contamination, CTs that are within 400 meters from each other are allocated to the same treatment arm. As a result, 35 catchment areas were allocated to the maintenance treatment, 35 catchment areas were allocated to the maintenance plus sensitization treatment, and 40 catchment areas were allocated to the control group.

4 Data

To obtain information on both the service provision and potential free riders, we gathered a substantial amount of original data. Appendix A provides a definition of the variables used in the study. Supplementary Material S.4 provided detailed descriptions and scripts of each measurement.

4.1 CT survey and objective measurements

For each facility selected for the study, we administered a panel survey with the caretakers. The baseline survey was administered in April–June 2018, followed by five waves of follow-up data collection to document bimonthly the behavior of caretakers, starting one month after the baseline: in July–September 2018 (follow-up 1), October–November 2018 (follow-up 2), January–March 2019 (follow-up 3), April–May 2019 (follow-up 4) and July–September 2019 (follow-up 5). The questionnaire covered management and maintenance practices in the provision of the basic service. Appendix Table B1 presents descriptive statistics of facilities and their caretakers at baseline. In 80 percent of facilities, the CT is operated by a single caretaker; caretakers are generally male (82 percent), have roughly 10 years of experience in their job, and 44 percent live in the local community. Caretakers allocate 68 percent of their time to monitoring (collecting fees and supervising cleaners), while the remaining is allocated to conducting repairs, cleaning the facility, or spending time with the zone manager.

Survey data were supplemented with objective measurements of service delivery. First, in each wave of survey data, independent observers collected information about the quality, cleanliness and maintenance of facilities. Second, observers documented payment behavior at the facility by recording the number of users and the share of them paying the fee. This activity was performed for the duration of one hour between 4 and 6 am, when most residents of the community use the facility. Third, observers collected samples from randomly selected spots on the floor of facilities. These were then analyzed in a laboratory to identify the presence and counts of bacteria. On average, more than three types of hazardous bacteria were found in each facility in each round.

We further implemented an adapted dictator game played with caretakers to measure pro-social motivation for the cause. In each survey round, caretakers were provided with an endowment of INR 100 (US$ 1.42) with the option to donate all or part of it to a project improving access to WASH in disadvantaged areas of India, implemented by a partner NGO. Similar versions of this game have proven effective at identifying socially-motivated workers (see, e.g, Ashraf et al., 2014a).

Attrition was kept to a minimum between baseline and follow-up surveys. The average number of observations per facility equaled 4.9 out of 5 follow-up measurements, with no differential attrition across treatment groups (Appendix Table B4).

4.2 Household measurements

In conjunction with the baseline CT survey, a baseline survey was administered among study households in each catchment area. The survey covered a sample of 1,575 households. The main respondent was the household's main decision-maker, being in most cases the household head and always falling in the age range 18–64 years. The questionnaire covered the household's socio-demographic characteristics, the health status of family members, hygiene- and sanitation-related behavior and attitudes. Appendix Table B2 presents descriptive statistics for households at baseline. On average, household heads are 45 years old, mostly men, with primary education or less. Religious composition is highly heterogeneous within slums: the share of potential free riders of Hindu religion is on average 81 percent, but it ranges from 0 to 100 percent.

After the baseline, households were revisited three times in correspondence to the follow-ups 1, 3 and 5 of the CT survey. All follow-up surveys covered hygiene- and sanitation-related behavior and attitudes. In addition, follow-ups 3 and 5 collected data related to the health of family members. To measure free riding among study households, in follow-up 5, the survey was supplemented with a list randomization question about sanitation behavior. This technique addresses potential stigma in questions related to sensitive behavior (see, e.g., Karlan and Zinman, 2012).[10]

Each baseline household was interviewed on average in 2.6 out of 3 follow-up measurements, implying attrition rates for individual follow-up surveys ranging from 9 to 19 percent. Only 2.7 percent of baseline households was never re-interviewed. To minimize sample loss, we interviewed additional households during follow-up surveys, which were randomly chosen from the baseline sampling frame. We observe no differential attrition across treatment groups (Appendix Table B5).

Survey data were supplemented with incentive-compatible behavioral measurements. First, in each wave of the household survey, we elicited individual-level WTP for service use for the most senior male and the most senior female decision-makers in the household, who are commonly spouses. Following extensive piloting and the low level of literacy in the sample, we opted for the incentivized version of the multiple price

[10]Respondents were randomly allocated to report the number of true statements from either a list of statements on general behavior (short list) or the same list with an additional statement concerning the sensitive behavior (long list). The difference in the average number of true statements in the short and the long lists estimates the proportion engaging in the sensitive behavior.

list (or take-it-or-leave-it) methodology, which performs well in settings where market prices are well-known (Andersen et al., 2006; Berry et al., 2020). The methodology prompts the participant to choose between different amounts of cash or a bundle of 10 tickets to use the CT in their catchment area. We do not focus on ability to pay because a single use is relatively cheap and highly recurrent.[11] One of the options is then randomly drawn and the decisions are realized. The game was played with each member alone, without other senior members present. While the market value of 10 tickets is INR 50 (US$ 0.71), we offered different amounts of cash, ranging from INR 0 to 60 (US$ 0.85, above the current market price to deal with truncation) with increases of INR 5 (US$ 0.07). We define the WTP for a single use as the point at which the participant switches from preferring the bundle of tickets to preferring the cash, divided by 10.

Second, similar to the game implemented with caretakers (Section 4.1), in each survey round we played with all participants an adapted dictator game to measure their willingness to contribute for the quality of service delivery. Each player was provided with an endowment of INR 50 (US$ 0.71) with the option to donate all or part of it to the purchase of cleaning products for the local facility. Within each area, the total amount donated was used to purchase cleaning products, then delivered to the caretaker.

Third, to measure attitudes towards cooperation among study households, we implemented a standard public goods game (PGG) at follow-up 5. The game is based on the voluntary contribution mechanism, in which participants receive an endowment of INR 100 (US$ 1.42), and they have to decide whether to keep the endowment or to invest part or all of it in a public pot. The contributions in the group are increased by a multiplier (randomly varied at catchment-area level to either 2 or 3), and shared equally among participants. We played simultaneously with three groups of four or six participants in each catchment area. As standard in the literature, we interpret private contributions to the public pot as willingness to cooperate.

Finally, we measured incentivized demand for public intervention using a novel SCA, labeled the *voice-to-the-people* initiative. In this activity, slum residents were provided with an anonymous card containing a list of predefined issues in the community, and were given the opportunity to report the most pressing issue. Unique numerical identi-

[11] In the presence of new products, when ability to pay is more binding, price subsidies and microcredit have proven to be effective for adoption (Kremer and Miguel, 2007; Ashraf et al., 2010; Dupas, 2014; Ben Yishay et al., 2017).

fiers allowed us to identify cards returned by study households. Each distributed card informed participants that the responses would be aggregated and provided to the city's municipal corporation. For the purpose of the study, we introduced in the list of issues the lack of cleanliness in the local CT and the contamination of the slum due to free riding. We introduced these two issues in a random order among other pressing issues, which included the poor health of children, the limited water availability, the poor quality of roads, the lack of trash collection, the absence of jobs, the limited access to healthcare and the poor lighting at night. We conducted this activity after follow-up 3, and reported the summary of issues to municipal corporations at the end of the study. A similar activity was implemented in different settings by Batista and Vicente (2011) and Armand et al. (2020b).

5 Results

As described in Section 4, to study behavioral responses of both service providers and study households to interventions, we collected up to five follow-up measurements that can be used to estimate treatment effects (i.e., t ranges from 0 to 5, with 0 indicating the baseline measurement). When outcomes are measured with a varying degree of noise and present low serial correlation, like in our setting, the availability of multiple follow-up measurements allows averaging out noise in the outcome variables and increase power by pooling measurements (McKenzie, 2012). Exploiting the design of the experiment, we estimate treatment effects by restricting the sample to post-baseline observations. We begin by estimating the impact of the maintenance treatment on the outcome $Y_{ij,t}$ of individual/household/CT i in catchment area j at time t using the following specification:

$$Y_{ij,t} = \beta T_j + \alpha \mathbf{X}_{ij} + \delta_t + \epsilon_{ij,t} \tag{1}$$

where T_j is an indicator variable equal to 1 if the catchment area j received the *maintenance* intervention (with or without the additional sensitization campaign), and 0 otherwise. $\mathbf{X}_{ij}$ is a set of indicator variables capturing randomization strata, while δ_t are survey round indicator variables. The error term $\epsilon_{ij,t}$ is assumed to be clustered by catchment area and data collection round when the outcome of analysis is at individual or household level, and by catchment area when the outcome of analysis is at catchment area level. Results are robust to alternative assumptions about clustering.

To estimate the effect of providing only the maintenance intervention or implementing the sensitization campaign in addition to the maintenance intervention, we estimate the following specification:

$$Y_{ijt} = \beta_1 T1_j + \beta_2 T2_j + \alpha \mathbf{X}_{ij} + \delta_t + \epsilon_{ij,t} \tag{2}$$

where $T1_j$ is an indicator variable for whether the catchment area j is in the *maintenance only* group, and 0 otherwise, and $T2_j$ is an indicator variable for whether the catchment area j is in the *maintenance plus sensitization* group.

We provide evidence that supports the interpretation of β, β_1 and β_2 as the causal effect of the interventions. First, randomization was successful in creating observationally-equivalent groups in the experiment for both household and catchment area characteristics (Appendix Tables B1–B2). Beyond the features we implemented in the design of the experiment to minimize the potential treatment contamination (Section 3), we show evidence against spillover effects across treatment arms (Appendix B.5).

Second, we support main estimates with estimates using alternative specifications, such as ANCOVA or correcting for attrition using inverse probability weights (Appendix C), including control variables selected with the post-double selection LASSO procedure (Appendix B.6), and using the Athey et al. (2019) causal forest procedure (Appendix B.7). Appendices B.7–B.9 present estimates of heterogeneous effects based on machine learning techniques, and by prespecified dimensions, by gender and religion.

Finally, we supplement standard inference with multiple hypothesis testing. In each table, we present both p-values for the significance of each individual coefficient and p-values adjusted for multiple hypotheses using the List et al. (2019) bootstrap-based procedure. The latter considers all hypotheses tested within a table.

Section 5.1 presents estimates of treatment effects using equation (1) focusing on the following groups of outcomes: the quality of service provision, the payment for service use, the private valuation of the service, the demand for public intervention, the extent of free riding, and health. Tables 1–6 present estimates of treatment effects by pooling all available follow-up measurements. The hypothesis of interest in these tables is therefore whether the *maintenance* treatment T has an average impact throughout the study.

Multiple follow-up measurements also allow to study the timing of treatment effects within the study period. To this purpose, we pool follow-up observations according to the two periods of the maintenance intervention (Section 2): the *grant period*, which includes only follow-up 1, and the *incentive period*, which includes follow-up surveys 2–5. Appendix B.12 shows estimates for individual follow-up measurements, including the evolution of mean values of y_{it} in the control group. Section 5.2 presents estimates of treatment effects using equation (2) and discusses whether the *maintenance only* and the *maintenance plus sensitization* treatments generate impacts, and whether these impacts differ.

5.1 The effect of the maintenance treatment

The successful implementation of the *maintenance* intervention is reflected in significant differences in exposure measures across experimental arms (Appendix Table B6). To measure exposure using two indicators. First, we define a *transfer to a CT* as the sum of the value of the initial grant, which only treated CTs received, and of the amounts transferred from the subsidized use of tickets from the WTP game and from the provision of products donated by slum residents as part of the adapted dictator game, both of which were played in treated and control clusters (see Section 4). Second, we define a *transfer to a caretaker* as the sum of the financial incentive provided in treated CTs and the amounts kept by the caretaker in each round of the adapted dictator game. Over the study period, the average transfer to a treated CT amounted to INR 25,270 (US$ 358.84), 16 times larger than the average transfer to a control CT. Similarly, caretakers in the control group received on average INR 373 (US$ 5.30), while caretakers in the treatment groups received an additional INR 4,179 (US$ 59.34).

Quality of the service

Table 1 presents estimates of treatment effects related to the quality of the service. Column (1) report impacts on the likelihood of a facility to provide a service of higher quality. To build this indicator we aggregate into an index all objective measurements about service delivery, including the information about the rendered service as collected by observers, and the lack of harmful bacteria as collected with samples from the floors. We define a service of higher quality if the facility delivers a service that is in the top quartile of the sample distribution of the index across all follow-up measurements. Appendix B.4 details the construction of the index and discusses impacts on the index and its overall distribution. The remaining columns focus on inputs to the quality of service provision. Column (2) focuses on structural maintenance, measured with an indicator variable equal to 1 if the facility received repairs and/or deep cleaning in the month previous to the visit, and 0 otherwise. Column (3) focuses on routine maintenance, measured with the number of tools, equipment and cleaners used during the last routine cleaning of the facility. Column (4) refers to the number of hours worked daily by the caretaker, while column (5) focuses on the caretaker's knowledge about maintenance, measured by an indicator variable equal to 1 if the caretaker knows the recommended practices, and 0 otherwise.

The interventions consistently improved the quality of service delivery. On average, the maintenance treatment leads to an increase of 11.6 percentage points in the share of facilities providing a service of higher quality. The effect, which is robust to multiple hypothesis testing with a p-value of 0.04, corresponds to an increase by 63.4 percent over the control mean. The maintenance treatment pushes upwards the whole distribution of the quality of service delivery index, detectable already at low levels of quality (Appendix Figure B1). A Kolmogorov-Smirnov test of the equality of the distributions of the index in the control and in the maintenance treatment group is rejected at the 1 percent level of confidence (Appendix B.4). Underlying drivers of quality improvements are improvements in the structural quality of the facility and in visible cleanliness, while no effect is observed for the presence of harmful bacteria.

Improvements in quality are specific to the incentive period, while we do not observe any significant effect during the grant period (panel A of Figure 3). To further understand how quality of service delivery increases, in columns (2)–(5) we therefore look at inputs. We observe a positive but insignificant effect on structural maintenance when pooling all follow-up rounds, but a large and significant effect during the grant period, equal to an increase by 32.6 percentage points in the likelihood to have received this type of maintenance, as compared to the control group (panel B of Figure 3). This suggests that the rehabilitation of the infrastructure providing the basic services is strongly tied to external funding. Combining this result with the timing of the effect on the quality of service delivery, we show that structural maintenance does not translate into an overall improvement in quality.

Improvements in quality are instead accompanied by inputs to the routine side of the service delivery. In the overall period, routine maintenance increases by 3.4 percentage points, corresponding to a 5.6 percent increase over the control mean. In addition, the share of caretakers who are knowledgeable raises by 8.9 percentage points, as compared with an average share of 6.8 percent in the control group. This effect is mainly driven by caretakers with higher pro-social motivation at baseline (Appendix B.8). Correcting for multiple hypothesis testing, the effects on routine maintenance and knowledge have p-values of 0.13 and 0.06, respectively. The effect on routine maintenance is significant only in the incentive period, when caretakers are financially incentivized to keep the facilities clean (panel C of Figure 3). This highlights how the quality of the service is closely related to routine rather than structural maintenance. These results are not achieved by an increase in labor supply, as caretakers do not change their workload in terms of time input, continuing to work on average 12 hours a day in all treatment arms. Changes along this dimension might be limited by labor supply being closely aligned with the opening times of facilities.

The effects of the maintenance treatment on the quality of the service tend to be homogeneous across facilities (Appendices B.7–B.8). We highlight that the effect on routine maintenance in driven by catchment areas where the average WTP for the service is low, and positive effects on quality and routine maintenance are driven by areas where potential free riders are more prevalently of Hindu religion (Appendix B.9).

Payment for the service

Table 2 turns to outcomes related to the payment for the service. Column (1) documents the effect on the total number of users (reported in logarithms), while column (2) shows the effect on non-payment, defined as the share of users who use the service without paying the fee. Both outcomes rely on data collected by independent observers (Section 4.1). Columns (3)–(5) focus instead on the caretakers' efforts to obtain the payment. Column (3) refers to the enforcement of payment, computed as the share of study households that reported having been refused entry to the facility for not paying the fee. Column (4) reports the effect on monitoring, defined as the share of time the caretaker reports allocating to collecting fees and supervising cleaners, as opposed to conducting repairs, cleaning the facility, or interacting with the zone manager. Finally, column (5) focuses on the caretaker's pro-social motivation for the cause, measured through the share of the endowment that the caretaker donates in the adapted dictator game.

The maintenance treatment reduces the number of users by 5.9 percentage points, but the estimate is not statistically significant, although the point estimate is consistently below zero in the incentive period (Appendix Figure B7). On the contrary, the maintenance treatment leads to a significant reduction in non-payment by 7.5 percentage points on average (a 17.8 percent increase over the control mean). While the estimate for the overall period is not robust to multiple hypothesis testing (the corrected p-value is 0.30), it is robust if we restrict the sample to the incentive period, when the effect is present. In addition, these estimates are also robust to using machine learning techniques (Appendices B.6 and B.7). We estimate that the reductions in users and non-payment translate into a small positive effect on revenues, but the estimate is not statistically significant (Appendix B.3).[12]

These effects are driven by monitoring of payments rather than their enforcement or caretaker's pro-social motivation. The maintenance treatment leads caretakers to spend a significantly larger share of their time on monitoring activities, which increase by 5.2 percentage points. This result suggests that the caretaker's presence at the facility's payment point is sufficient to disincentivize non-payment among users. At the same time, it does not induce caretakers to employ more stringent payment enforcement, which is rarely applied as only 8.0 percent of study households report being refused entry for not having paid the service fee. Increases in enforcement in response to the maintenance treatment are only observed in facilities characterized by a high degree of non-payment at baseline (panel D of Appendix B.8). In terms of pro-social motivation for the cause, caretakers donate on average 35 percent of the transfer each time the game is played, with no statistically significant difference across treatment arms.

In line with the effects on the quality of the service and on inputs to provision (Section 5.1), the effects on non-payment and on monitoring are specific to the incentive period, while no effect is recorded during the grant period (panel D and panel E in Figure 3). These results highlight how improving the quality of the service and reducing non-payment are closely related to the incentives of the service providers delivering the service to the users.

[12]Costs and revenues at the facility level are not observable available. We estimate revenues using observers' data on users and payments, but restricted to the times during which these data are collected.

Private valuation of the service

Table 3 focuses on the private valuation of the service among potential free riders, as well as their awareness of risks associated with free riding and contamination. Column (1) reports on whether improvements in the service were appreciated by potential free riders, while column (2) shows impacts on their incentivized WTP for a single service use. Column (3) looks at respondent's willingness to contribute for the quality of the service, measured as the share of the endowment that a respondent donates in the adapted dictator game. Column (4) refers to whether the respondent is aware of the health externalities linked to free riding in the slum.

The maintenance treatment increases the share of respondents who reports liking the service by 3.1 percentage points, as compared to an average share of 10.1 percent in the control group. This effect is significant at conventional levels when accounting for multiple hypothesis testing. On the contrary, we find no significant effect on the WTP for using the service. The average WTP for a single use is equal to INR 1.15 in both the control and the maintenance treatment groups, as compared with the market price of INR 5. While we do not record an effect on WTP during the overall period, we highlight that WTP experiences a (marginally-insignificant) reduction during the grant period, while no significant effect is observed in the incentive period (panel F in Figure 3). The increase in the share of study househods that appreciates the service is also larger in the grant period, when WTP decreases (Appendix Figure B9). We conclude that externally funding improvements in the quality of service delivery has the capacity to crowd out users' private contributions when external funding is tied to the structural quality rather than the routine side of the service delivery, the latter being more visible to users. This mechanism is confirmed by the reduction in WTP being driven by potential free riders that live in higher proximity with the facility (Appendix B.8). A crowding out effect of private investments in response to an increase of public investments has been observed in other health-related settings (Bennett, 2012; Armand et al., 2017).[13]

This conclusion is confirmed by looking at estimates of the inverse demand curve for the service. Figure 4 shows the estimates separately for the control and the maintenance treatment group. The share of respondents willing to accept the tickets for using the

[13]The interventions were carried out by the partner NGO without any governmental link. At follow-up 5, 65 percent of study households in treated catchment areas reports believing that the maintenance intervention was funded by the government.

service at INR 0 is 63 percent in both the grant and the incentive periods, suggesting that a large share of potential free riders are not willing to use the service even when it is offered for free. The share of respondents willing to accept the tickets drops quickly at positive fees, reaching a share at the market price (INR 5) of only 5 percent in the grant period and 11 percent in the incentive period. During the grant period (panel A), the maintenance treatment shifts the demand curve downwards as compared with the control group. Statistically significant differences are at lowest prices: at fees between 0 and 1, the share of respondents willing to pay the corresponding fee is always higher in the control group as compared to the maintenance treatment group. This statistically significant effect is not observed at the upper end of the curve during the grant period, and throughout the curve during the incentive period (panel B). In terms of the price elasticity of the demand, the demand at low prices is relatively inelastic in both the control and the maintenance treatment group, and it becomes more elastic for prices closer to the market price (INR 5). We do not observe any significant effect of the maintenance treatments in either the grant nor the incentive period (Appendix B.10).

The pattern of results observed for WTP is driven by male residents, while it is not observed for female residents (Appendix B.9). This result highlights how the effects of improving the quality of the service depends on the basic needs of a resident. Women have greater biological needs and face more psychosocial stress in regard to access to sanitation and hygiene (Stopnitzky, 2017). In our setting, women face a worse quality of service delivery, also reflected in higher degrees of non-payment and a lower WTP among women. These differences can explain why the WTP among female respondents is not changing in response to the maintenance treatment.

Concerning the study households' incentivized willingness to contribute for the quality of service delivery, we observe no effect of the maintenance treatment. In both treatment and in control catchment areas, the share donated by study households during the adapted dictator game is on average 21.2 percent of the transfer. Finally, the maintenance treatment increases the share of study households that are aware of the health externalities that OD generates for their family by 3.1 percentage points, an impact that loses significance when accounting for multiple hypothesis testing. Households are generally aware of the risks associated with contamination, with 66.0 percent of households in the control group aware of the risks.

Demand for public intervention

Table 4 analyzes the effects on the demand for public intervention and on attitudes toward cooperation. Columns (1)–(3) focus on data collected through the voice-to-the-people initiative. Column (1) considers the share of households demanding public intervention for improvements in the quality of basic services, in particular on the cleanliness of the CT. Column (2) captures the share of households demanding public intervention to reduce free riding and the associated contamination. Column (3) aggregates the demand for public intervention for other issues in the slum, including the health of children, the availability of water, the quality of roads, the collection of trash, the lack of jobs, the limited access to healthcare, and the poor lighting at night. Column (4) focuses instead on attitudes toward cooperation in the slum, computed as the share contributed to the public pot in the public goods game.

Free riding is a more pressing issue in the community as compared the quality of the service delivered by the CT. In the control group, the first issue is reported by 43.2 percent of households, as compared to 9.8 that report the second. The maintenance treatment group leads to important changes in the demand for public intervention. First, it leads the share of households reporting to local politicians that the quality of basic services associated to access to WASH to increase by 5.1 percentage points, an increase of 52.0 percent over the control group. The effect is significant at the 5 percent level, and at the 17 percent level when correcting for multiple hypothesis testing. This effect is balanced by a reduction of 7.5 percentage points in the demand for addressing free riding in the slum, while we do not observe any treatment effect on the demand for other issues in the slum. In addition, we do not observe changes in attitudes toward cooperation among study households. During the public goods game, the contribution to the public pot is on average 17.4 percent of the endowment in both the maintenance treatment and the control groups.

We highlight some important heterogeneity of the effect of the maintenance treatment (Appendix B.8). First, trust plays an important role in determining the demand for improving the quality of the service, as the increase is driven by catchment areas where potential free riders have lower trust in the community. Second, the quality of service delivery at baseline determines the shift in the demand to address free riding. The maintenance treatment induces larger decreases in such demand where, at baseline, the average WTP for the service was higher and non-payment lower. Finally, political representation plays an important role in determining demand for public intervention, especially in light of the political salience of Hinduism in our study area. Decreases in the demand for addressing free riding are driven by respondents of Hindu religion, and by areas where potential free riders are prevalently of Hindu religion (Appendix B.9).

Free riding and health outcomes

Because the maintenance treatment leads to a small reduction in the number of the users of the service (Section 5.1), we study how interventions impact free riding. Using the list randomization technique detailed in Section 4.2, Figure 2 shows the share of potential free riders practicing OD at follow-up 5. The maintenance treatment increases the share of respondents who practice OD by 18.5 percentage points, compared to a share of 20.6 percent in control group.[14]

These findings combined with the increase in monitoring among caretakers and a reduction in non-payment among users serve as evidence that incentivizing the quality of service delivery results in the exclusion of a share of potential free riders from the service. Excluded users are those not willing to pay the user fee, who then revert to free riding by practicing OD. Similar to the effect on the WTP for the service (Section 5.1), this effect is driven by male respondents, who are also the category that experiences a higher degree of payment enforcement (Appendix B.9).

We provide further evidence on the exclusion of users by comparing the characteristics of study participants that reportedly stopped using the service between baseline and endline to those that did not change their sanitation behavior. Appendix Table B3 shows that characteristics that proxy poverty correlate significantly with a switch from service use to free riding, such as female-headed households and those with fewer assets. Households that had access to a toilet at baseline but reported using the CT are also more likely to stop using the public facility.

To understand the impacts on health on study households, Table 5 focuses on morbidity and health expenditures. Column (1) refers to the (self-reported) morbidity, measured by an indicator variable equal to 1 if any household member had fever, diarrhea or

[14]Using the same technique, we estimate that, in the control group, the service is used by 58.0 percent of respondents and soap is used by 81.6 percent of respondents. We do not find any significant effect of the maintenance treatment for these variables (Supplementary Material S.4). We also do not observe any impact on self-reported behavior, which under-report sensitive behavior (Appendix B.11).

cough during the two weeks prior to the interview, and 0 otherwise. Columns (2)–(5) focus on reported health expenditures, distinguishing between curative and preventive expenditures, and analyzing changes both at the extensive and intensive margins. Curative expenditures include costs associated with doctor visits during illnesses, medicines and diagnostics, and hospitalization. Preventive expenditures include all costs associated with CT fees, access to drinking water and hygiene, medical checks and preventive goods like vaccines, bed-nets, and anti-worm tablets.

Slums are a high-disease environment: the share of study households in the control group with positive curative expenditures in the two weeks previous to the interview is 64 percent. While, on average, we find no treatment effect on morbidity, the maintenance treatment increases the probability of spending a positive amount on curative healthcare by 4.6 percentage points (equivalent to an increase of 7 percent over the control mean), albeit this effect is not robust to multiple hypothesis testing. This effect is driven by a significant increase in the first follow-up of the incentive period. In line, we find that the maintenance treatment increased self-reported morbidity by 7.6 percentage points in the same period (Appendix Figure B10). We find no effects on the intensive margin of curative expenditures, and no effects on preventive expenditures.

5.2 The role of demand-side sensitization

The exposure to WASH campaigns is relatively high among study households. Nevertheless, the sensitization campaign was effective at reaching the targeted population (Appendix Table B.2). The maintenance plus sensitization treatment increases the share of study households reporting exposure to a WASH campaign previous to the interview by 8.3 percentage points, as compared to an average share in the control group of 64.5 percent. The maintenance plus sensitization treatment group also raises the recall for all means used in the campaign, with the largest effect recorded for posters (15.8 percentage points compared to the control group), and the exposure to voice messages, which double as compared to the exposure in the control group (0.83 versus 0.19).

For all outcomes presented in Tables 1–5, Table 6 reports estimates of the effect of the maintenance only treatment and of the maintenance plus sensitization treatment, estimated with equation (2). Columns (1)–(2) and columns (4)–(5) report coefficients and standard errors, while p-values for the individual hypotheses are shown in columns (3) and (6). Column (7) tests the hypothesis that the impact of the two treatment arms do not differ.

For most outcome variables there is no differential effect of providing the sensitization campaign in addition to the maintenance intervention as compared to the providing the maintenance intervention alone. This suggests that the quality of service delivery and the means to achieve it are mostly driven by top-down incentives. Nevertheless, we record three important effects of providing bottom-up incentives through the sensitization campaign in addition to top-down incentives.

First, the increases in the awareness of the externalities of free riding described in Section 5.1 are driven by the demand-side sensitization, in line with the aim of the campaign. Study households that were targeted by the sensitization campaign are 5 percentage points more likely to report being aware, as compared to a 1 percentage point, not statistically significant, in the maintenance only treatment arm. The effect remains significant when considering multiple hypothesis testing.

Second, the sensitization campaign affects the incentive-compatible WTP for the service. While in the maintenance only group the WTP increases by INR 0.04, not statistically significant, the sensitization campaign leads to a short-term drop in WTP by INR 0.12 over the whole period. While the impact is significantly different across treatment arms, the effect does not survive multiple hypothesis testing (p-value of 0.24). The timing of the impact confirms that this effect materializes only in the grant period, when the structural improvements in the facility are more visible (panel E of Figure 3). While externally-funding improvements in the structural quality of the facility has the capacity to crowd out private contributions (Section 5.1). We establish that the capacity of externally-funding improvements to crowd out private contributions is particularly pronounced when the demand-side is sensitized.

Finally, demand-side sensitization has an impact in the number of users using the service. Providing only the maintenance treatment leads to a marginally significant decrease in the number of users as compared to providing the maintenance plus sensitization treatment. This pattern is observed in the grant period and the first follow-up measurement of the incentive period, while it converges to zero at later stages of the experiment (Appendix Figure B8). This effect is not observed in the maintenance plus sensitization treatment group, suggesting that sensitization compensates for the reduction in users caused by the maintenance only treatment. The lower reduction of users in the maintenance plus sensitization treatment group can explain a higher exposure to the grant component of the maintenance intervention, further justifying a crowding out of WTP among these households.

6 Funding basic services in L&MICs

The findings discussed in Section 5 highlight an important trade-off in a model in which basic service delivery is funded by user fees: it is possible to achieve better service quality and reduce non-payment, but at the expense of free riding. In this section, we delve into this trade-off to further understand the mechanisms behind it and discuss implications of alternative instruments to reduce free riding.

We consider a static framework where individuals can satisfy their basic needs by either accessing a service offered for fee (S) or free ride common-property areas (F). Assume a slum is composed of a continuum of residents that are potential free riders, i.e., they have no alternative beyond the action set $a \in \{S, F\}$. We therefore define the share who chooses S as r, and the share who chooses F as $(1 - r)$. Residents are heterogeneous in the parameter θ, which captures tastes, norms or socio-economic characteristics that favor free riding.[15] We assume that θ is distributed with a density function $f(\theta)$ uniform in the interval $[0, \bar{\theta}]$, where $\bar{\theta}$ indicates the resident's type with the largest value associated with free riding.

Service funded by user fees. The resident i who chooses $a_i = F$ receives a utility θ_i at no direct cost. The resident i who chooses the service ($a_i = S$) obtains a fixed utility $u(f, q)$, where f is the structural quality of the infrastructure/facility, which is more time invariant, and q is the routine side of the service, which is closely related to service providers. To access the service the resident pays a service fee c (generally set at INR 5). To introduce non-payment, in line with the results discussed Section 5, we assume the fee is paid only if the provider monitors the payment, which happens with probability $\pi \in [0, 1]$. We define $\tilde{c} \equiv c \cdot \pi$ as the *effective fee* of the service.

Because free riding contaminates the slum, we introduce an externality that is increasing in the share $(1 - r)$. While the externality negatively impacts all residents, we assume that its severity is larger for the choice F because it exposes to contamination more directly. This is standard in settings in which contamination leads to negative ex-

[15] We do not model budget constraints explicitly because in our context the service is relatively cheap and we are interested in aggregating choices at the slum level.

ternalities, and proximity worsen their effects. For each action a, the externality is thus equal to $\gamma_a(1-r)$, where $\gamma_a > 0$ captures its severity and $\gamma_F > \gamma_S$. While in other settings, residents might be uncertain about the presence and severity of externalities, we assume no uncertainty with respect to both dimensions because slum residents are highly aware of their presence in our setting (Section 5.1).

The utility derived by resident i from action F is therefore equal to $U_i^F = \theta_i - \gamma_F(1-r)$, while the expected utility from action S is equal to $E[U_i^S] = u(f,q) - \tilde{c} - \gamma_S(1-r)$. For a given share r, resident i chooses the service if $E[U_i^S] \geq U^F$. We can rewrite the condition as:

$$\theta_i \leq u(f,q) - \tilde{c} + \Delta_\gamma(1-r) \equiv W \tag{3}$$

where $\Delta_\gamma = \gamma_F - \gamma_S$, and W indicates the resident's type that is indifferent between the two actions. To avoid the straightforward case in which the parameters set r equal to either 0 or 1, we assume that $0 < W < \bar{\theta}$. The share of residents who opt for the service is thus defined by $R(r) = \int_0^W f(\theta)d\theta = {}^W/_{\bar{\theta}}$. The (rational expectations) equilibrium is such that $r^* = R(r^*)$, which results in the following expression:

$$r^* = \underbrace{\frac{u(f,q)}{\bar{\theta}+\Delta_\gamma} + \frac{\Delta_\gamma}{\bar{\theta}+\Delta_\gamma}}_{\text{benefit from service}} - \underbrace{\frac{\tilde{c}}{\bar{\theta}+\Delta_\gamma}}_{\text{cost}} \tag{4}$$

Starting in a situation in which r^* is smaller than one, how can we aim at r^* approaching 1 by eradicating contamination? One option is to fund increases in quality by raising revenues, which demands increasing the effective fee. Conducting a simple accounting exercise based on the current cost of service delivery of a CT suggests that raising revenues by increasing users and reducing non-payment is sustainable. The current O&M costs for a CT with median characteristics is estimated at INR 10,200 (US$ 144.85) per month, while the cost of providing an improved service (conditional on the existing infrastructure) is estimated at INR 13,544–28,800 (US$ 192.33–408.97), or 1.3–2.8 times the current cost (refer to Supplementary Material S.3 for details).[16] Setting $r^* = 1$ and removing non-payment ($\pi = 1$) cover up fully the lower bound in the improved sce-

[16]An alternative model involves monthly passes, which provide unlimited access to the service for all family members at a fixed price. Only 8 percent of CTs in our sample provide this option at the (median) price of INR 80 (US$ 1.14). The Indian Government is considering the introduction of a monthly pass at the price of INR 200 (US$ 2.84). At follow-up 5, we measure the incentive-compatible WTP for monthly passes, which is found to be very low at INR 25 (US$ 0.35).

nario and 71 percent of the upper bound of the improved scenario, which suggests that targeting non-payment can indeed sustain an improvement in the service. However, equation (4) highlights that raising both quality and revenues does not eradicate free riding: while increases in $u(f, q)$ attracts more users by raising the benefits of the service, the need of revenues to support operations demands higher effective fees, which in turn pushes users towards free riding.

Our findings show that even raising q_I and q_P without changing the effective fee translates into the exclusion of a share of users, possibly due coordination failure between slum residents and service providers. To further understand users-providers coordination in our setting, we study how demand- and supply-side factors further affect non-payment by exploiting our experimental setting and decomposing the effect of the maintenance treatment T on non-payment Y using a mediation analysis. We follow the approach of Gelbach (2016) for the sample in the incentive period, when non-payment is mostly affected by interventions. Using a set of mediators $(m_1, .., m_k)$, i.e., outcome variables that can be affected by T and can indirectly induce a change in Y, the treatment effect $\frac{dY}{dT}$ is decomposed into:

$$\frac{dY}{dT} = \underbrace{\sum_{j=1}^{k} \frac{\partial Y}{\partial m_j} \frac{\partial m_j}{\partial T}}_{\text{explained by mediators}} + R \tag{5}$$

where the first part is explained by mediators, and R is the residual (unexplained) part. Figure 5 plots the decomposition of the effect in these two components by grouping mediators according to Tables 1–5 and considering different sets of mediators. The negative net effect of the maintenance treatment on nonpayment is driven by supply-side factors, which tend to decrease non-payment. Increases in the quality of service delivery and in caretaker's effort explain the largest part of the decrease in non-payment (15.6 percent and 11.3 percent of the main effect, respectively). The negative effect would however be larger, were it not for demand-side factors that push non-payment in the opposite direction. Increases in the demand for public intervention is one of the key drivers of non-payment with a magnitude of 29.1 percent of the main effect. A share of the effect remains unexplained likely due to the role of unobserved mediators.

Free access to basic services. These hurdles towards users-providers coordination highlights an alternative solution to eradicate free riding: free access to basic services.[17] To test whether this approach eradicates free riding in our setting, we use the sample of catchment areas and exploit variation in time and across areas in r, q, and $\tilde{c}$ to provide structural estimates of the parameters in equation (4). We define $r_{j,t}$ as the share of households in the slum j that reported not to have practiced OD at time t (see Section 4.2). To approximate $u(f, q)$ in equation (4), we first assume that f is equal to the sum between a basic benefit for using the service in general, α_0, and a benefit for using the service at a specific facility, a_j. In addition, we assume q is equal to a constant α_1 multiplied by a dummy variable, $higher_{j,t}$, for whether the service is observed to be of higher quality at time t (measured with the variable *higher quality* in Table 1). [18] For catchment area j at time t, we define $u(f_j, q_{j,t})$ with the following expression:

$$u(f_j, q_{j,t}) = (\alpha_0 + a_j) + \alpha_1 \cdot higher_{j,t} + \Omega_t + \epsilon_{j,t} \tag{6}$$

where time fixed effects Ω_t capture the fact that using the service might provide lower or higher benefits at different time of the year, and $\epsilon_{j,t}$ captures idiosyncratic differences in the benefit obtained from the service j at time t.

Variation in $\tilde{c}_{ij,t}$ is achieved at the CT level through π_j, determined by the share of time the caretaker spend in monitoring activities (variable *monitoring* in Table 2), and at the household level through c_i, determined by the distribution of tickets for free use of the CT as part of the incentivized WTP measurement (see Section 4.2), and variation in π_j, determined by the share of time the caretaker spend in monitoring activities (variable *monitoring* in Table 2). If households received the tickets as part of the WTP game in period $t-1$, then the fee c is reduced. Because tickets account for multiple uses and because we do not know ex-ante the times a household uses the facility, we need to consider alternative scenarios to compute the reduction in c. In *Scenario A*, receiving the tickets corresponds to setting c to zero, while in *Scenario B*, we assume that the household uses the facility once per day, and we calculate the exact discount introduced by the tickets in the time frame between two consecutive rounds of the WTP game. If households did not receive the tickets, then c is set at INR 5.

[17]Evidence on free basic services has shown so far limited effects on user behavior (Szabo, 2015). In addition, subsidized services can deter investment to modernize the infrastructure (Mcrae, 2015).

[18]Estimates are robust to approximating $u(f, q)$ with a non-linear function in a continuous measure of observed quality to proxy for q.

To address the potential endogeneity of $\tilde{c}_{ij,t}$, deriving from household's WTP and from caretaker's behavior, we instrument it with the random number extracted as part of the WTP game. This number determines whether the household receives the tickets or the cash. We perform a first stage regression and predict the household-level effective fee assuming exogeneity of the instrument and compute the slum level effective fee, $\tilde{c}_{j,t}$, by averaging for each period the effective fee predicted from the first stage. Substituting equation (6) in equation (4), we obtain the following equation:

$$r_{j,t} = \lambda_0 + \lambda_1 q_{j,t} + \lambda_2 \tilde{c}_{j,t} + \tilde{\Omega}_t + \tilde{a}_j + \tilde{\epsilon}_{j,t} \tag{7}$$

where $\lambda_0 = \frac{\alpha_0 + \Delta_\gamma}{\bar{\theta} + \Delta_\gamma}$, $\lambda_1 = \frac{\alpha_1}{\bar{\theta} + \Delta_\gamma}$, and $\lambda_2 = -\frac{1}{\bar{\theta} + \Delta_\gamma}$, while $\tilde{\Omega}_t$, $\tilde{a}_j$, and $\tilde{\epsilon}_{j,t}$ are Ω_t, a_j and $\epsilon_{j,t}$ rescaled by $\bar{\theta} + \Delta_\gamma$. Exploiting the panel dimension of our dataset, columns (1)–(4) in Table (7) provide estimates of equation (7) using a fixed effect model.[19] Columns (1)–(2) consider *Scenario A* to compute the effective fee, while columns (3)–(4) consider *Scenario B*. Columns (2) and (4) estimate equation (7) imposing $\lambda_1 = 0$ (i.e., higher quality does not contribute to r beyond the fixed benefit). For comparison, in columns (5)–(6), we estimate a reduced form regression at the household level of whether the respondent reported not to free ride at time t on $\tilde{c}_{ij,t}$, instrumenting this variable with the random number extracted as part of the WTP game.

Table (7) provides a set of important results. First, free riding is determined by the basic benefit derived from the service being smaller than the benefit obtained from free riding for positive share of slum residents. The parameter λ_0 is estimated at 0.78–0.83, which represents the share of the (externality-adjusted) basic benefit α_0 as compared to the (externality-adjusted) benefit of free riding for the resident that derives the larger benefit from free riding, i.e., $\bar{\theta}$. This indicates that free riding characterizes around 20 percent of households in our setting, in line with findings in Section 5.1.

Second, lowering the effective fee reduces free riding. The effect of the effective fee on r, λ_2, is estimated to be negative, with an increase of INR 1 leading to an increase in free riding equal to 3.1–3.8 percentage points. Exogeneity of our measure of effective fee is reinforced by estimates being comparable when removing the constraint on λ_1. However, in our sample characterized by highly-marginalized individuals, offering a

[19]This approach assumes strict exogeneity, i.e., $E(\epsilon_{j,t}|q_{j,m}, \tilde{c}_{j,m}, a_j) = 0$ where $m = 0, .., T$. The constant term λ_0 is estimated by imposing the restriction $E[\tilde{a}_j] = E[a_j] = 0$.

higher quality service provides a reduction in the benefit from choosing S, as λ_1 is estimated to be negative. Such penalty captures the mechanisms associated with the exclusion of users from the service at higher level of quality.

Third, from the parameters of equation (7), we recover $\tilde{c}^* = \alpha_0 - \bar{\theta}$, the effective fee that would set free riding to zero (assuming either $\lambda_1 = 0$ or a lower quality of service delivery). This parameter is estimated to be negative at INR 4.8–6.3, indicating that eradicating free riding requires subsidizing the use of the service beyond providing it for free by offering transfers to potential free riders conditional on using the service. [20] However, offering such transfers demands monitoring and could result in overcrowding, leading to lower quality services at constant expenditure levels. In line, free-to-use CTs in our study area are found in highly degraded status, a condition that is also observed in the rest of India (Armand et al., 2020a). Keeping quality of services constant while increasing users might demand larger investments in the infrastructure, while the alternative of introducing fines for free riders is expected to be ineffective in slums, because it requires further monitoring and could also lead to extortion (Ashraf et al., 2016).

7 Conclusion

Understanding the roots of inadequate public service delivery and of free riding is fundamental to unleash the economic development of L&MICs. We provide novel insights by studying both supply- and demand-side incentives in the quality of public services. Incentivizing the quality of service delivery allows achieving sustained improvements in the observed quality of services and significant reductions in non-payment among users. However, these come at the cost of the exclusion of a share of users from the service, with subsequent increases in free riding. Our results highlight an important dilemma in the delivery of public services in L&MICs: while externally funding improvements of services results in the exclusion of users, in line with the effects of policies enforcing financial sustainability through threats to disconnection (see, e.g., Coville et al., 2020), offering poor-quality services for free does not eliminate free riding either.

These findings open new avenues for future research. First, if citizens treat access to basic services as a right, as highlighted by our results on the demand for public inter-

[20] In India, this instrument has been used in pilot projects, for example, in the city of Ahmedabad in Gujarat, and in the Barmer district in Rajasthan (BBC News, 2015; The Times of India, 2017).

vention, then fee-funded models of public service delivery fail and free riding persists. As the international community aims to achieve universal access to safe and affordable basic services as part of the United Nations' Sustainable Development Goals, we need to enhance knowledge on how to provide sustainable basic services in the poorest settings. This requires further research on how to stimulate not only an improved quality of service delivery, but also the take-up of public services among citizens and the eradication of free riding. For instance, conditional transfers have been used to reduce free riding in other settings such as deforestation (Jayachandran et al., 2017). In addition, we also need to enhance knowledge on the design of effective mechanisms for tax collection and redistribution, which remain challenging in the poorest settings (see, e.g., Pomeranz and Vila-Belda, 2019 for a review of this research agenda).

Second, while our results highlight the centrality of top-down incentives, improvements in public service delivery demand further evidence on the design of effective mechanisms that stimulate bottom-up incentives. In particular, understanding the limits to collective action in areas where coordination failures are more prevalent and social norms are more difficult to change is a crucial objective. For instance, further research is needed to understand the effectiveness of monitoring technologies in these environments by creating and reinforcing a new local norm of respect for the public good.

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Table 1: Quality of the service

Dep. variable:	Delivery	Inputs to the quality of provision			
	Higher quality	Maintenance Structural	Routine	Hours worked	Caretaker's knowledge
	(1)	(2)	(3)	(4)	(5)
Maintenance (T)	0.116	0.045	0.034	0.175	0.089
	(0.043)	(0.049)	(0.017)	(0.356)	(0.035)
	[0.01 ; 0.04]	[0.36 ; 0.60]	[0.05 ; 0.13]	[0.62 ; 0.62]	[0.01 ; 0.06]
Mean (control group)	0.183	0.623	0.608	11.754	0.068
Std. dev. (control group)	0.388	0.486	0.162	3.690	0.253
Observations	542	542	542	542	542
Catchment areas	110	110	110	110	110
Observation rounds	5	5	5	5	5
Follow-ups	1–5	1–5	1–5	1–5	1–5

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) *Higher quality*: indicator variable equal to 1 if the quality index is above the 75$^{\text{th}}$ percentile, and 0 otherwise; (2) *Structural maintenance*: 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; (3) *Hours worked*: number of hours worked by the caretaker; (4) *Routine maintenance*: number of tools, equipment and cleaners used during the last routine maintenance of the facility, normalized to be between 0 and 1; (5) *Awareness*: indicator variable equal to 1 if the caretaker knows the recommended practices of the cleaning routine and the need for deep cleaning, and 0 otherwise. 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.

Table 2: Payment for the service

Dep. variable:	Traffic		Caretaker's effort		
	Users	Non-payment	Enforcement	Monitoring	Pro-social motivation
	(1)	(2)	(3)	(4)	(5)
Maintenance (T)	-0.059	-0.075	0.002	0.052	-0.024
	(0.050)	(0.042)	(0.024)	(0.028)	(0.025)
	[0.24 ; 0.58]	[0.07 ; 0.30]	[0.92 ; 0.92]	[0.07 ; 0.29]	[0.33 ; 0.56]
Mean (control group)	3.477	0.422	0.080	0.686	0.345
Std. dev. (control group)	0.429	0.290	0.107	0.226	0.219
Observations	542	542	110	542	542
Catchment areas	110	110	110	110	110
Observation rounds	5	5	1	5	5
Follow-ups	1–5	1–5	5	1–5	1–5
Incentivized measurement	-	-	-	-	Yes

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) *Users*: total number of users observed (reported in logarithms); (2) *Non-payment*: observed share of users who do not pay the entry fee; (3) *Enforcement*: share of surveyed households in the catchment area that reported having been refused entry to the CT by the caretaker for not paying the fee; (4) *Monitoring*: share of worked hours allocated by the caretaker to collecting fees and supervising cleaners, rather than conducting repairs, cleaning the facility, or spending time with the manager; (5) *Pro-social motivation (for the cause)*: share of the endowment that is donated by the caretaker in the adapted dictator game (Appendix S.4.6). 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.

Table 3: Private valuation of the service

Dep. variable:	Appreciates the service (1)	WTP for service use (2)	Contribution to service quality (3)	Awareness of externalities (4)
Maintenance (T)	0.031	-0.042	-0.005	0.031
	(0.013)	(0.065)	(0.006)	(0.018)
	[0.02 ; 0.09]	[0.52 ; 0.52]	[0.38 ; 0.64]	[0.08 ; 0.23]
Mean (control group)	0.101	1.149	0.212	0.660
Std. dev. (control group)	0.302	1.809	0.170	0.474
Observations	4793	8635	8635	4793
Catchment areas	328	328	328	328
Observation rounds	3	3	3	3
Follow-ups	1, 3, 5	1, 3, 5	1, 3, 5	1, 3, 5
Level of analysis	Household	Respondent	Respondent	Household
Incentivized measurement	-	Yes	Yes	-

Note. Estimates based on respondent- and household-level OLS regressions using equation (1). Standard errors clustered by catchment area–round 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) *Appreciates the service*: indicator variable equal to 1 if the respondent mentions liking the infrastructure and cleanliness of the CT, and 0 otherwise.; (2) *WTP for service use*: incentivized willingness to pay 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) *Contribution to service quality*: share of the endowment that is donated by the respondent in the adapted dictator game (Appendix S.4.6); (4) *Awareness of externalities*: indicator variable equal to 1 if the respondent reports that OD generates a health externality for their family, and 0 otherwise. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Specifications where the level of analysis is the respondent also include gender. Additional details about the variables are presented in Appendix A.

Table 4: Demand for public intervention

Dep. variable:	**Demand for public intervention**			**Cooperation**
	Quality of the basic service	Free riding	Other issues	PGG contribution
	(1)	(2)	(3)	(4)
Maintenance (T)	0.051	-0.075	-0.021	0.001
	(0.026)	(0.037)	(0.024)	(0.013)
	[0.05 ; 0.17]	[0.04 ; 0.18]	[0.38 ; 0.61]	[0.92 ; 0.92]
Mean (control group)	0.098	0.432	0.844	0.174
Std. dev. (control group)	0.297	0.496	0.363	0.110
Observations	1551	1553	1551	1228
Catchment areas	109	109	109	109
Observation rounds	1	1	1	1
Follow-ups	3	3	3	5
Level of analysis	Household	Household	Household	Household
Incentivized measurement	Yes	Yes	Yes	Yes

Note. Estimates based on household-level OLS regressions using equation (1). Standard errors clustered by catchment area–round 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) *Quality of the basic service*: indicator variable equal to 1 if the household asks for public intervention in the CT's O&M as incentivized through the voice-to-the-people initiative (Appendix S.4.8), and 0 otherwise; (2) *Free riding*: indicator variable equal to 1 if the household asks for public intervention in keeping the community OD free as incentivized through the voice-to-the-people initiative (Appendix S.4.8), and 0 otherwise; (3) *Other issues*: indicator variable equal to 1 if the household asks for public intervention in any other issues in the community captured on the 'voice-to-the-people' cards as incentivized through the voice-to-the-people initiative (Appendix S.4.8), and 0 otherwise; (4) *PGG contribution*: share contributed in the public good game (Appendix S.4.7). This table includes only 109 catchment areas in the sample because the dependent variables were measured only at rounds 3 (columns 1 to 3) and 5 (column 4), 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. Specifications where the level of analysis is the respondent also include gender. Additional details about the variables are presented in Appendix A.

Table 5: Health outcomes

Dep. variable:	Morbidity	Curative expenditure		Preventive expenditure	
		Extensive	Intensive	Extensive	Intensive
	(1)	(2)	(3)	(4)	(5)
Maintenance (T)	0.006	0.046	-35.152	-0.002	5.571
	(0.019)	(0.024)	(190.451)	(0.004)	(49.785)
	[0.75 ; 0.98]	[0.05 ; 0.20]	[0.85 ; 0.97]	[0.54 ; 0.96]	[0.91 ; 0.91]
Mean (control group)	0.401	0.637	1701.871	0.992	741.117
Std. dev. (control group)	0.490	0.481	5229.974	0.087	1035.497
Observations	4793	3276	3276	3301	3300
Catchment areas	328	218	218	218	218
Observation rounds	3	2	2	2	2
Follow-ups	1, 3, 5	3, 5	3, 5	3, 5	3, 5
Level of analysis	Household	Household	Household	Household	Household

Note. Estimates based on household-level OLS regressions using equation (1). Standard errors clustered by catchment area–round 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) *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; (2) *Curative expenditure - extensive*: indicator variable equal to 1 if the respondent had positive curative expenditures, and 0 otherwise; (3) *Curative expenditure - intensive*: level of curative healthcare expenditures (in Rupees); (4) *Preventive expenditure - extensive*: indicator variable equal to 1 if the respondent had positive preventive expenditures, and 0 otherwise; (3) *Preventive expenditure - intensive*: level of preventive healthcare expenditures (in Rupees). Columns (2)–(5) 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.

Table 6: The effect of sensitization

	Maintenance only (T1)			Maintenance + sensitization (T2)			T1=T2
	β	se	p-value	β	se	p-value	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Quality of the service							
Higher quality	0.14	0.06	0.01 ; 0.06	0.09	0.05	0.06 ; 0.25	0.44
Physical maintenance	0.02	0.05	0.68 ; 0.90	0.07	0.06	0.22 ; 0.40	0.32
Routine maintenance	0.04	0.02	0.05 ; 0.21	0.03	0.02	0.13 ; 0.32	0.80
Hours worked	-0.03	0.42	0.95 ; 0.95	0.38	0.38	0.32 ; 0.32	0.28
Caretaker's knowledge	0.08	0.04	0.08 ; 0.26	0.10	0.05	0.04 ; 0.25	0.66
Payment for the service							
Users	-0.10	0.06	0.10 ; 0.44	-0.02	0.06	0.76 ; 0.76	0.19
Non-payment	-0.06	0.05	0.20 ; 0.58	-0.09	0.05	0.06 ; 0.24	0.50
Enforcement	-0.02	0.02	0.53 ; 0.53	0.02	0.03	0.50 ; 0.77	0.25
Monitoring	0.04	0.03	0.20 ; 0.51	0.06	0.03	0.04 ; 0.21	0.40
Pro-social motivation	-0.02	0.03	0.50 ; 0.76	-0.03	0.03	0.33 ; 0.68	0.82
Private valuation of the service							
Appreciates the service	0.03	0.02	0.13 ; 0.44	0.02	0.02	0.24 ; 0.44	0.76
WTP for CT use	0.04	0.08	0.62 ; 0.85	-0.12	0.07	0.08 ; 0.24	0.05
Preferences for improvements	-0.01	0.01	0.18 ; 0.47	-0.00	0.01	0.80 ; 0.80	0.23
Awareness of externalities	0.01	0.02	0.69 ; 0.69	0.05	0.02	0.01 ; 0.04	0.04
Demand for public intervention							
Demand for public intervention:							
Quality of the basic service	0.05	0.03	0.11 ; 0.30	0.05	0.03	0.12 ; 0.36	0.95
Free riding	-0.08	0.04	0.06 ; 0.21	-0.07	0.04	0.08 ; 0.29	0.90
Other issues	-0.03	0.03	0.26 ; 0.48	-0.01	0.03	0.64 ; 0.87	0.58
PGG contribution	-0.00	0.02	0.89 ; 0.89	0.00	0.02	0.77 ; 0.78	0.67
Health outcomes							
Morbidity	0.01	0.02	0.75 ; 0.93	0.00	0.02	0.82 ; 0.96	0.91
Curative expenditure:							
Extensive	0.04	0.03	0.20 ; 0.65	0.06	0.02	0.03 ; 0.13	0.45
Intensive	26.45	225.99	0.91 ; 0.91	-93.74	223.23	0.67 ; 0.97	0.61
Preventive expenditure:							
Extensive	-0.00	0.00	0.57 ; 0.96	-0.00	0.00	0.63 ; 0.98	0.91
Intensive	22.13	60.44	0.71 ; 0.97	-10.34	55.16	0.85 ; 0.85	0.58

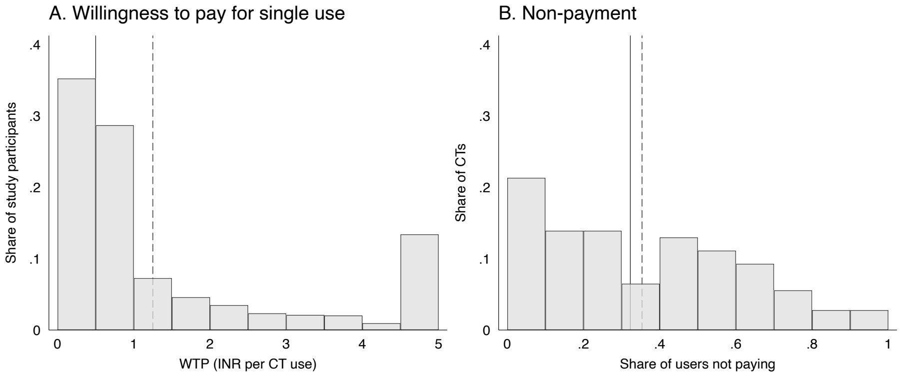
Note. In columns (1)–(6), estimates are based on CT-, respondent- or household-level OLS regressions using equation (2) for each outcome. $p-$values are presented in columns (3) and (6), the first from individual testing, the second adjusting for jointly testing that each treatment is different from 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.

Table 7: Effective fee and free riding

Dependent variable:	**Share choosing S (r)**				**Household chose S**	
Scenario for fee c:	*A*		*B*		*A*	*B*
	(1)	(2)	(3)	(4)	(5)	(6)
Effective fee (λ_2)	-0.031	-0.034	-0.034	-0.038	-0.031	-0.049
	(0.014)	(0.014)	(0.018)	(0.020)	(0.017)	(0.024)
	[0.03]	[0.02]	[0.06]	[0.06]	[0.06]	[0.04]
Higher quality (λ_1)		-0.040		-0.040		
		(0.020)		(0.019)		
		[0.04]		[0.04]		
λ_0	0.812	0.833	0.786	0.803		
	(0.057)	(0.058)	(0.050)	(0.056)		
	[0.00]	[0.00]	[0.00]	[0.00]		
$\tilde{c}^*$	-6.033	-4.833	-6.263	-5.209	.	.
$\alpha_0 + \Delta_\gamma$	26.109	24.159	22.947	21.269	.	.
α_1	.	-1.145	.	-1.049	.	.
$\bar{\theta} + \Delta_\gamma$	32.143	28.992	29.211	26.478	.	.
Observations	428	428	428	428	3723	3716
Measurements	0, 1, 3, 5	0, 1, 3, 5	0, 1, 3, 5	0, 1, 3, 5	0, 1, 3, 5	0, 1, 3, 5
Level of analysis	Slum	Slum	Slum	Slum	Household	Household

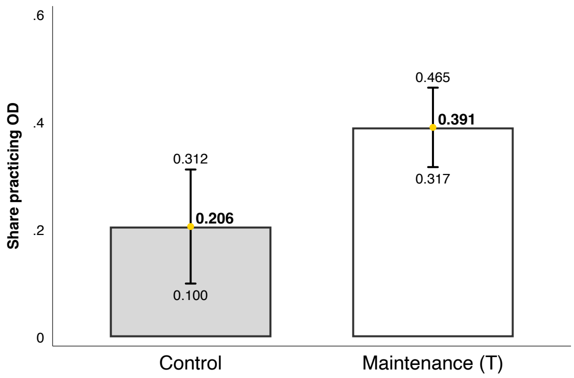
Note. In columns (1)–(4), estimates are based on fixed effects regressions using equation (7) and standard errors (reported in parentheses) are computed using stratified bootstrap with 1000 repetitions. The dependent variable is the share of households in the slum that reported not to have practiced OD at the time t of the interview. Columns (1)–(2) and (5) use an effective fee computed assuming that receiving the tickets in the WTP games corresponds to setting c to zero. Columns (3)–(4) and (6) use an effective fee computed assuming that receiving the tickets in the WTP games corresponds to a discount in c that is calculated assuming a daily use of the facility. In columns (5)–(6), estimates are based on a 2SLS regression and standard errors are clustered by catchment area–round. P-values are presented in brackets. The dependent variable is an indicator variable equal to 1 if the household reports not to have practiced OD at the time t of the interview, and 0 otherwise. All specifications include indicator variables for data collection rounds. In column (4), controls also include strata indicators for the city and the provider of the CT. Additional details about the variables are presented in Appendix A. The effective fee is instrumented with the random number extracted as part of the WTP game. $\tilde{c}^*$ is the effective fee that set free riding to zero (assuming either $\lambda_1 = 0$ or a lower quality of service delivery).

Figure 1: Willingness to pay for CT use and non-payment, at baseline



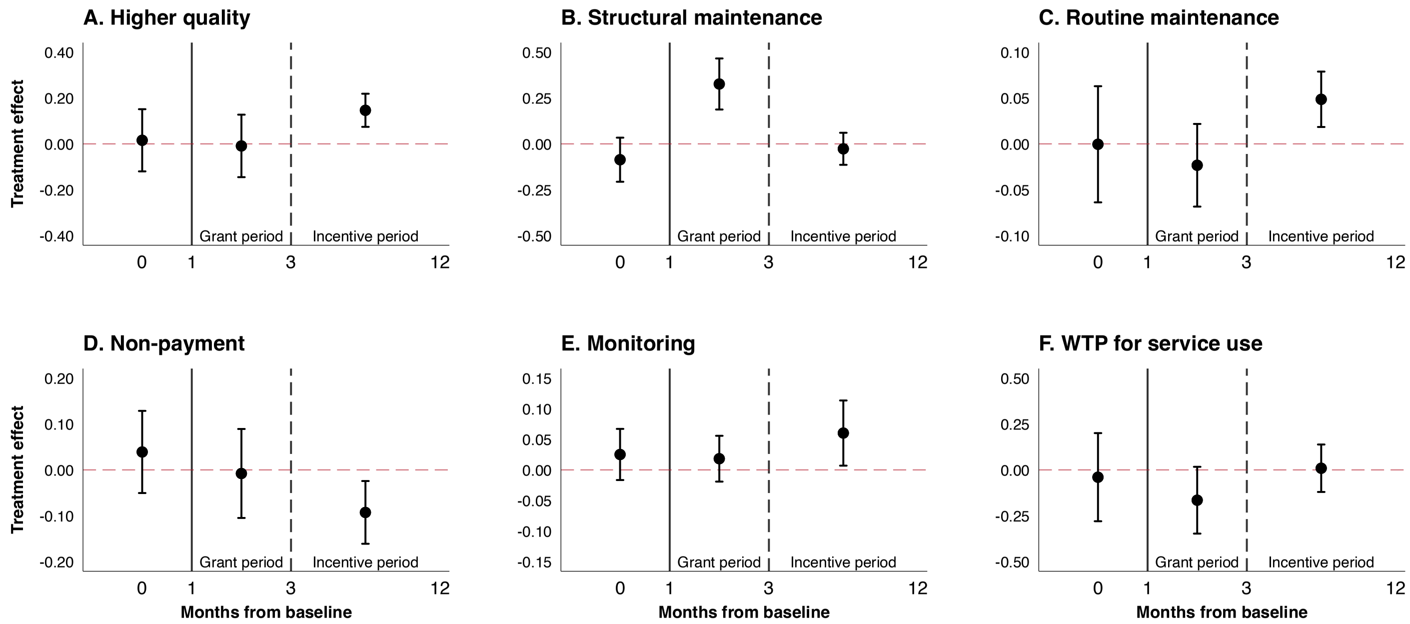
Note. Data collected at baseline. Panel A shows the distribution of the WTP for a single use of the service among slum residents, measured using the incentivized elicitation of WTP. The distribution is censored at INR 5, the most common market price for a single CT use. Panel B reports the share of users who do not pay the fee for the use of the CT during 1 hour at dawn, measured by observers. The solid vertical lines represent the sample median, and the dashed vertical lines represent the sample mean. Additional details about the variables are presented in Appendix A. Supplementary Material S.4 provides details about measurement.

Figure 2: Environmental contamination driven by free riding



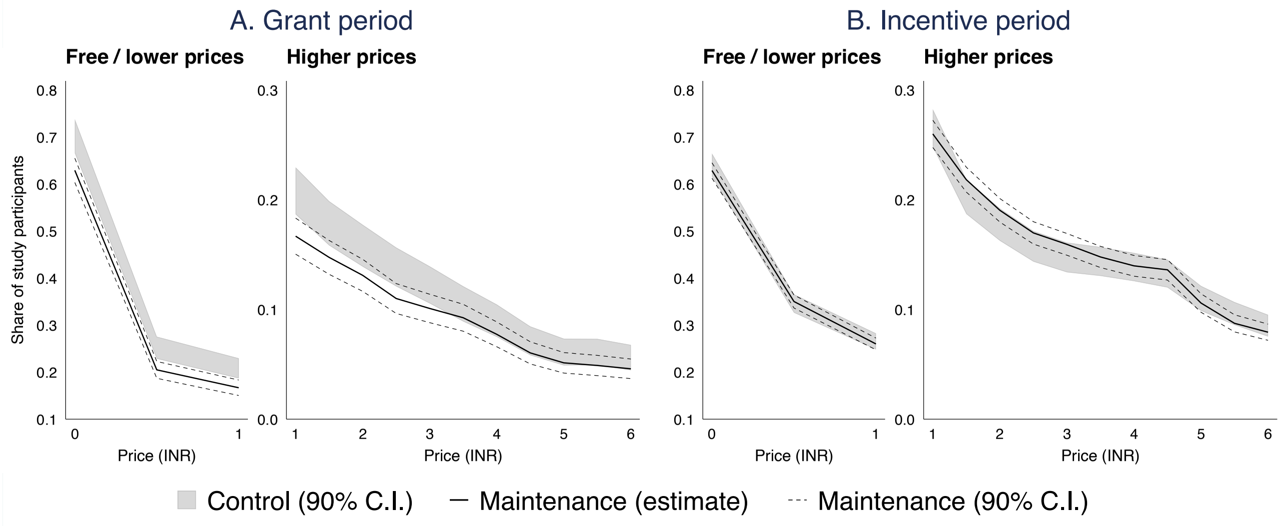
Note. The figure shows the share of slum residents practicing OD in the day previous to the interview. We estimate shares using a list randomization technique., in which shares are the difference in the number of items reported by respondents who faced a long list of itimes (which includes OD), and the respondents who faced the short list (which excludes OD). We compute this average separately in the control group and in the maintenance treatment group. Confidence intervals are built using statistical significance at the 10 percent level and assuming errors are clustered at the level of the catchment area. Randomization of lists was performed at individual level, and data were collected during follow-up 5. Supplementary Material S.4 provides details about measurement.

Figure 3: The timing of the maintenance treatment effects: grant versus incentive periods



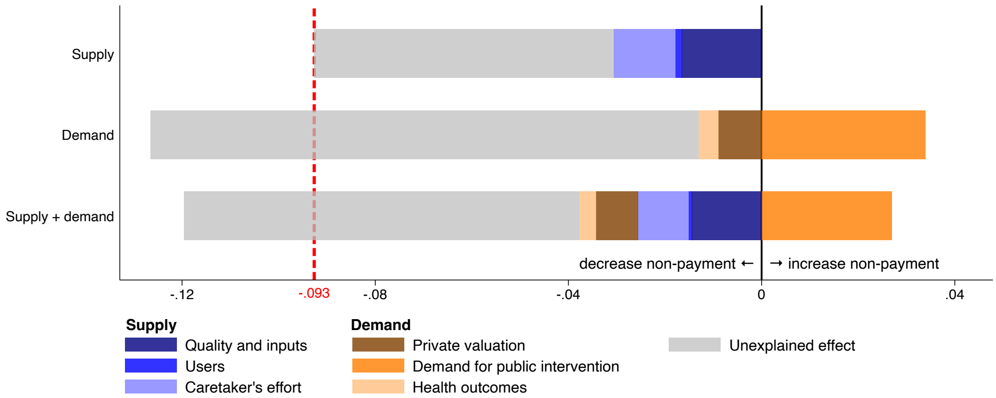
Note. Each panel presents estimates of treatment effects based on OLS regressions using equation (1) at the CT level or at the respondent level. Confidence intervals are built using statistical significance at the 10 percent level. *Baseline* includes the measurement at baseline, *Grant period* includes the measurement from follow-up 1, and *Incentive period* pools all subsequent follow-up measurements. See Section 1 for details about each intervention. When the regression is based on a single measurement period, robust standard errors are used for CT-level outcomes, and standard errors clustered at the catchment area are used for respondent level outcomes. When multiple measurement periods are pooled, standard errors are clustered at the catchment area for CT-level outcomes, and at the catchment area by collection round for respondent-level outcomes. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. For outcomes at the respondent-level, gender is also included as a control variable. Additional details about the variables are presented in Appendix A. Estimates pooling all post-baseline measurements are presented in Tables 1–5.

Figure 4: Inverse demand curve for service use



Note. Each curve indicates the share of respondents who prefer tickets for CT use versus cash at the corresponding price. This is elicited using a standard incentivized version of the multiple price list (or take-it-or-leave-it) methodology (Andersen et al., 2006). Point-wise inference is computed using OLS regressions at prices ranging from INR 0 to 6 with increases of INR 0.5. For graphical representation, panels are split among free and lower prices (INR 0–1) and higher prices (INR 1–6). Panel A restricts the sample to the *Grant period*, which includes the measurement from follow-up 1, and Panel B restricts the sample to the *Incentive period*, which pools all subsequent follow-up measurements. See Section 1 for details about each intervention. When the regression is based on a single measurement period, standard errors are clustered at the catchment area. When multiple measurements are pooled, standard errors are clustered at the catchment area by collection round for respondent-level outcomes. Confidence intervals are built using statistical significance at the 10 percent level. Supplementary Material S.4 provides details about measurement.

Figure 5: The effect on non-payment: a mediation analysis



Note. The figure shows the decomposition of the effect of the maintenance treatment on non-payment. We follow the procedure of Gelbach (2016) applied to non-payment in the incentive period (follow-ups 2–5). We include as mediators all outcome variables (with the exception of non-payment) included in Tables 1–5, grouped by table. We distinguish two groups of mediators: *supply* mediators, which include CT and caretaker outcomes, and *demand* mediators, which include the median value in the catchment area of slum resident outcomes. The decomposition is presented by including only *supply* mediators in the top bar, only *demand* mediators in the middle bar, and both groups in the bottom bar. The dashed vertical line indicates the estimate of the effect of the maintenance treatment on non-payment in the incentive period and estimated using equation (1). The shaded gray areas represent the part of the effect not explained by mediators. 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.

ONLINE APPENDIX

Public Service Delivery and Free Riding: Experimental Evidence from India

Alex Armand, Britta Augsburg, Antonella Bancalari

A Definition of variables

Variable	Description
Higher quality	Indicator variable equal to 1 if the quality index is above the 75th percentile, and 0 otherwise. Quality index computed aggregating indicator variables about the structural quality of the facility, its cleanliness and the lack of bacteria. The index is re-scaled to be between zero and one. The variable aggregate survey responses from the CT survey, data from observers, and data from laboratory tests.
Structural maintenance	Indicator variable equal to 1 if facility received structural maintenance (repairs and/or deep cleaning intervention) in the month previous to the visit, and 0 otherwise. The variable aggregates responses from the CT survey, and administrative data from the implementing team.
Routine maintenance	Number of tools, equipment and cleaners used during the last routine maintenance for the CT. The variable aggregate survey responses from the CT survey. The number is normalized to be between 0, indicating that no tools reported in the questionnaire were used, and 1, indicating that all tools reported in the questionnaire were used. Tools include broom, mop, and safety equipment. Liquid tools include water, pressurized water and disinfectants. The baseline survey asks for information only on use of the broom, and disinfectants, while the full list is available for the following rounds of follow-ups.
Hours worked	Number of hours worked by the caretaker, self-reported during each CT survey.
Caretaker's knowledge	Indicator variable equal to 1 if the caretaker knows the recommended practices for cleaning routine and the need for deep cleaning, and 0 otherwise. The variable evaluates the correctness of questions about routine maintenance. These questions are asked during each CT survey.
Users	Total number of users entering the CT (reported in logarithms). The variable uses data from observers.
Non-payment	Share of users who do not pay the entry fee. The variable uses data from observers.
Enforcement	Share of surveyed households in the catchment area that reported having been refused entry to the CT by the caretaker for not paying the fee.
Monitoring	Share of worked hours allocated by the caretaker to collecting fees and supervising cleaners. Alternative activities include conducting repairs, cleaning the facility, and meeting the manager. The variable is self-reported by the caretaker during each CT survey.
Pro-social motivation	Share of the endowment donated by the caretaker in the adapted dictator game. The variable is incentivized and is measured for each caretaker.
Appreciates the service	Indicator variable equal to 1 if the respondent mentions liking the infrastructure and cleanliness of the CT, and 0 otherwise. The variable is self-reported by the household head during the household survey.
WTP for service use	Willingness to pay for a single CT use (in INR). The variable is incentivized and elicited for a bundle of ten tickets, and is collected for both the household head and any partner separately during the household survey. We divide the WTP for the bundle by 10 to get at measure of single use WTP.
Preference for improvement	Share of the endowment that is donated by the slum resident in the adapted dictator game. The variable is incentivized and is measured for both the household head and the partner separately during the household survey.
Awareness of externality	Indicator variable equal to 1 if the respondent reports that OD generates a health externality for their family, and 0 otherwise. The variable is self-reported by the household head during the household survey.

(continued on next page)

Variable	Description
Demand for public intervention	*Service* is an indicator variable equal to 1 if the household asks for public intervention in the CT's O&M, and 0 otherwise. *Free riding* is an indicator variable equal to 1 if the household asks for public intervention to keep the community OD free, and 0 otherwise. *Other issues* is an indicator variable equal to 1 if the household asks for public intervention in categories unrelated with sanitation (i.e. children are frequently ill, water availability is limited, the quality of roads is poor, there is no waste collection, jobs are missing, access to healthcare is limited, and lighting at night is poor), and 0 otherwise. Since up to two participants per household could participate, the indicator variable is equal to 1 if any household member asks for public intervention in the CT's O&M. The information is incentivized and collected during the SCA voice-to-the-people initiative at the time of follow-up 3.
PGG contribution	Share contributed by the participant in the public good game. The variable is incentivized and is measured at the end of all the activities of the experiment.
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. The variable is self-reported by the household head during the household survey.
Health expenditures	We consider *curative expenditures*, which include costs associated with doctor visits when the person is ill, with the purchase of medicine, with hospitalization, and with x-rays, and include travel costs associated with these expenses, and *preventive expenditures*, which include all expenses associated with regular doctor checks, vaccines, anti-worm tablets, bed-nets, and prenatal tests, and travel costs associated with these expenses. *Extensive* (margin) is an indicator variable equal to 1 if the respondent had positive expenditures, and 0 otherwise. *Intensive* (margin) is the level of expenditures (in rupees). The variable is self-reported by the household head during the household survey, but is not collected during follow-up 1.
Open defecation	Aggregate share of slum residents who practiced open defecation the day before the interview. Data are obtained using the list randomization technique. Information is obtained from both the household head and any partner in conjunction with follow-up 5.
CT use	Aggregate share of slum residents who used the CT the day before the interview. Data are obtained using the list randomization technique. Information is obtained from both the household head and any partner in conjunction with follow-up 5.
Hand-washing with soap	Aggregate share of slum residents who washed their hands with soap after defecating on the day before the interview. Data are obtained from using the list randomization technique. Information is obtained from both the household head and any partner in conjunction with follow-up 5.
Implementation	
Transfer to the CT	Transfer provided to the CT in the corresponding period as part of the intervention (in thousands of rupees). This includes the value of the initial grant to treated CTs, the subsidized use of tickets from the WTP game to both treated and control CTs, and the value of products bought with the transfer from slum residents as part of the adapted dictator game to both treated and control CTs. Information is based on administrative data from the implementing team.
Transfer to the caretaker	Transfer provided to the caretaker in the corresponding period as part of the intervention (in thousands of rupees). This includes the financial incentive provided in treated CTs and the amounts kept from each round of the adapted dictator game. Information is based on administrative data from the implementing team.
Interactive activities	Indicator variable equal to 1 if the respondent is aware of any personal or community activities about WASH, and 0 otherwise. The variable is self-reported by the household head during the household survey.
Posters at CT	Indicator variable equal to 1 if the respondent is aware of any messages about WASH posted in the CT, and 0 otherwise. The variable is self-reported by the household head during the household survey.
Voice messages	Proportion of voice messages about WASH and CTs listened to by the participant. The variable is built from administrative data derived from the implementation of voice messages as part of the sensitization campaign.

Note. Supplementary Material S.4 provides further details about the measurement of these variables.

B Additional analysis

B.1 Balance in observable characteristics and attrition

Tables B1 and B2 present the balance test for characteristics at baseline.

Table B1: CT characteristics at baseline, by treatment group

	Descriptive statistics		**Differences from control group, by treatment group**			
	All	Control	Any treatment	Maintenance	Maintenance + sensitization	*p*-value joint test (4)-(5)
	(1)	(2)	(3)	(4)	(5)	(6)
Year of construction	1996.98	1995.26	2.78	2.34	3.23	0.32
	[8.85]	[9.29]	(1.88)	(2.11)	(2.19)	
Distance to closest CT	0.54	0.58	-0.06	-0.04	-0.07	0.76
	[0.44]	[0.66]	(0.11)	(0.11)	(0.11)	
Surrounding market	0.33	0.35	-0.04	-0.01	-0.06	0.82
	[0.47]	[0.48]	(0.10)	(0.11)	(0.11)	
Surrounding road	0.84	0.88	-0.06	-0.05	-0.08	0.67
	[0.37]	[0.33]	(0.07)	(0.09)	(0.09)	
Surrounding government office	0.25	0.20	0.07	0.08	0.06	0.69
	[0.43]	[0.41]	(0.08)	(0.10)	(0.10)	
Only residents use CT	0.12	0.07	0.07	0.07	0.07	0.53
	[0.32]	[0.27]	(0.06)	(0.07)	(0.07)	
Single caretaker	0.80	0.82	-0.04	0.03	-0.11	0.28
	[0.40]	[0.39]	(0.07)	(0.08)	(0.09)	
Share of female caretakers	0.18	0.22	-0.06	-0.02	-0.10	0.42
	[0.37]	[0.39]	(0.07)	(0.08)	(0.08)	
Caretaker is also cleaner	0.27	0.28	-0.02	-0.02	-0.03	0.96
	[0.45]	[0.46]	(0.09)	(0.10)	(0.10)	
Caretaker is from local community	0.44	0.49	-0.07	-0.11	-0.02	0.60
	[0.50]	[0.51]	(0.10)	(0.12)	(0.12)	
Caretaker's experience (months)	125.28	129.91	-5.43	1.37	-11.53	0.86
	[103.45]	[109.34]	(22.81)	(26.60)	(25.96)	
CT is cleaned frequently	0.86	0.87	-0.02	-0.02	-0.02	0.97
	[0.35]	[0.34]	(0.07)	(0.08)	(0.08)	
Time allocated to managing	0.68	0.66	0.03	0.03	0.02	0.58
	[0.14]	[0.11]	(0.03)	(0.03)	(0.03)	
Capacity	13.00	13.21	-0.32	-0.46	-0.17	0.94
	[5.57]	[5.52]	(1.11)	(1.27)	(1.34)	
Daily opening hours	17.76	17.88	-0.19	-0.35	-0.02	0.53
	[1.49]	[1.59]	(0.28)	(0.36)	(0.27)	
Share of functioning toilets	0.90	0.88	0.03	0.05	0.01	0.47
	[0.22]	[0.23]	(0.04)	(0.04)	(0.05)	
WTP (avg. catchment area)	1.41	1.44	-0.05	-0.03	-0.06	0.95
	[0.83]	[0.65]	(0.15)	(0.17)	(0.20)	
Distance from CT (avg. catchment area)	128.71	128.77	-0.01	-2.22	2.21	0.94
	[49.56]	[43.87]	(9.26)	(10.21)	(12.25)	

Note. Columns (1) and (2) report sample mean with standard deviation in brackets for the whole sample and for the control group, respectively. Column (3) reports the difference from the control group with any treatment group. Columns (4) and (5) report the difference from the control group for each treatment group. Differences in columns (3)–(5) are estimated using OLS and controlling for strata indicators for the city and the provider of the CT. Robust standard errors are reported in parentheses. Column (6) presents a joint test of significance of the coefficients for each treatment dummy. Statistical significance denoted by *** p<0.01, ** p<0.05, * p<0.1.

Concerning attrition, we limit our analysis at verifying whether attrition created differences across treatment arms, while details about the collection of the CT survey and of the slum resident surveys are provided in Supplementary Material S.4.2 and S.4.4. For the CT survey, Table B4 shows estimates of treatment effects on the number of CT observations and caretaker surveys and the opening of new CTs in study catchment

Table B2: Household characteristics at baseline, by treatment group

	Descriptive statistics		Differences from control group, by treatment group			
	All	Control	Maintenance	Maintenance only	Maintenance + sensitiza-tion	*p*-value joint test (4)-(5)
	(1)	(2)	(3)	(4)	(5)	(6)
Household head is male	0.75	0.73	0.02	0.04	0.01	0.30
	[0.43]	[0.44]	(0.02)	(0.03)	(0.03)	
Household head is married	0.77	0.76	0.01	0.01	0.01	0.93
	[0.42]	[0.43]	(0.03)	(0.03)	(0.03)	
Age of household head	45.44	46.04	-0.87	-0.89	-0.84	0.55
	[12.82]	[13.42]	(0.80)	(0.97)	(0.86)	
Age of spouse	39.14	39.39	-0.33	-0.75	0.07	0.61
	[11.39]	[12.00]	(0.76)	(0.94)	(0.79)	
Household head has no education	0.54	0.55	-0.02	-0.07	0.03	0.05
	[0.50]	[0.50]	(0.04)	(0.05)	(0.04)	
Spouse has no education	0.45	0.45	-0.00	0.01	-0.01	0.91
	[0.50]	[0.50]	(0.03)	(0.04)	(0.04)	
Household members	4.94	4.94	0.00	0.01	-0.00	1.00
	[1.99]	[2.08]	(0.13)	(0.15)	(0.14)	
Household members (0-5 y.o.)	0.47	0.50	-0.06	-0.05	-0.07	0.59
	[0.77]	[0.82]	(0.06)	(0.06)	(0.07)	
Household members (older than 5 y.o.)	4.47	4.44	0.06	0.05	0.07	0.85
	[1.83]	[1.92]	(0.11)	(0.13)	(0.12)	
Muslim	0.17	0.12	0.09**	0.11*	0.06	0.12
	[0.37]	[0.32]	(0.04)	(0.06)	(0.04)	
Spent on religious items	0.94	0.94	-0.01	-0.01	-0.00	0.84
	[0.25]	[0.24]	(0.01)	(0.02)	(0.02)	
General caste	0.07	0.05	0.03	0.03	0.02	0.25
	[0.26]	[0.23]	(0.02)	(0.02)	(0.02)	
Asset index	0.53	0.53	0.00	0.01	-0.00	0.77
	[0.15]	[0.16]	(0.02)	(0.02)	(0.02)	
Household members per room	3.99	3.90	0.14	0.05	0.21	0.31
	[1.86]	[1.94]	(0.14)	(0.16)	(0.15)	
Access to piped water	0.71	0.70	0.01	-0.01	0.04	0.67
	[0.45]	[0.46]	(0.05)	(0.06)	(0.06)	
Access to private toilet	0.08	0.07	0.01	0.01	0.02	0.67
	[0.27]	[0.26]	(0.02)	(0.02)	(0.02)	
Expenditure on CT use (INR)	180.75	173.72	11.09	-2.37	23.85	0.65
	[244.60]	[221.49]	(23.04)	(23.00)	(30.62)	
Prevalence of diarrhea (last 15 days)	0.08	0.07	0.02	0.01	0.03	0.25
	[0.28]	[0.26]	(0.02)	(0.02)	(0.02)	
Prevalence of fever (last 15 days)	0.18	0.18	-0.01	-0.01	-0.01	0.89
	[0.38]	[0.39]	(0.02)	(0.03)	(0.03)	
Distance to CT (meters)	126.22	126.42	-1.08	-2.09	-0.12	0.97
	[79.90]	[80.42]	(8.74)	(9.63)	(11.55)	

Note. Columns (1) and (2) report sample mean with standard deviation in brackets for the whole sample and for the control group, respectively. Column (3) reports the difference from the control group with any treatment group. Columns (4) and (5) report the difference from the control group for each treatment group. Differences in columns (3)–(5) are estimated using OLS and controlling for strata indicators for the city and the provider of the CT. Standard errors clustered at slum level are reported in parentheses. Column (6) presents a joint test of significance of the coefficients for each treatment dummy. Statistical significance denoted by *** p<0.01, ** p<0.05, * p<0.1.

areas. For all outcomes, we do not observe any significant impact of the interventions. Concerning the slum resident survey, columns (1)–(5) in Table B5 estimates the probability of attrition as a function of the treatment status. Attrition does not differ between treatment and control groups for any of the attrition indicators. In order to maintain a comparable sample size in all follow-up surveys, we handled attrition with replacements at random using the sampling frame used for the baseline sampling. Column (6) tests whether the replacement was introduced differently across treatment arms, showing no statistical difference across treatment arms.

Table B3: Selection in sanitation behavior, by baseline characteristics

Dep. variable:	**Stopped using the service**		**Continued to free ride**	
Sub-sample:	Maintenance treatment	Control	Maintenance treatment	Control
	(1)	(2)	(3)	(4)
Household head is male	-0.154***	-0.227***	0.159	0.121
	(0.056)	(0.056)	(0.127)	(0.159)
Household head is married	0.093	0.127	-0.225	-0.401**
	(0.074)	(0.078)	(0.153)	(0.145)
Age of household head	-0.000	0.002	-0.004	-0.012**
	(0.002)	(0.002)	(0.003)	(0.005)
Household head has no education	0.037	-0.049	-0.011	0.110
	(0.043)	(0.049)	(0.094)	(0.141)
Spouse has no education	-0.000	-0.044	0.013	0.328***
	(0.041)	(0.053)	(0.091)	(0.107)
Household members	0.016	-0.008	0.046	0.063
	(0.014)	(0.015)	(0.028)	(0.038)
Muslim	0.011	-0.006	0.062	-0.118
	(0.061)	(0.069)	(0.102)	(0.214)
Spent on religious items	0.020	-0.028	0.123	0.078
	(0.090)	(0.089)	(0.164)	(0.189)
General caste	0.014	0.081	-0.160	0.102
	(0.082)	(0.118)	(0.238)	(0.425)
Asset index	-0.529***	-0.599***	-1.138***	-0.586*
	(0.168)	(0.177)	(0.246)	(0.332)
Household members per room	-0.038**	-0.012	-0.042	-0.067*
	(0.015)	(0.019)	(0.029)	(0.037)
Access to piped water	-0.018	-0.005	0.027	-0.091
	(0.058)	(0.072)	(0.092)	(0.126)
Access to private toilet	0.168*	0.248*	0.042	-0.119
	(0.084)	(0.132)	(0.164)	(0.205)
Expenditure on CT use (INR)	-0.000***	-0.000***	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Distance to CT (meters)	0.001***	0.001**	0.000	-0.000
	(0.000)	(0.000)	(0.001)	(0.001)
WTP for CT use	-0.016	0.002	-0.008	0.004
	(0.010)	(0.010)	(0.017)	(0.028)
Preference for CT clean	0.000	0.002	-0.005	0.002
	(0.002)	(0.002)	(0.004)	(0.007)
Awareness of externalities	0.025	-0.080	-0.000	0.124
	(0.041)	(0.057)	(0.082)	(0.109)
Morbidity	-0.003	-0.084	0.107	0.066
	(0.040)	(0.060)	(0.104)	(0.108)
Health expenditure (extensive)	-0.065	-0.039	-0.117	0.006
	(0.045)	(0.053)	(0.078)	(0.190)
Observations	658	420	175	103

Note. Dependent variables by column: (1) *Stopped using the service*: indicator variable equal to 1 if used the CT at baseline and stopped using it at endline, and equal to 0 if continued using CT at endline; (2) *Continued to free ride*: indicator variable equal to 1 if at least one member of the household practices OD at baseline and endline, and equal 0 if practiced OD only at baseline. Sample restricted to households interviewed at baseline. All specifications include strata indicators for the city and the provider of the CT. Standard errors clustered at slum level are reported in parentheses. Statistical significance denoted by *** p<0.01, ** p<0.05, * p<0.1.

Table B4: Attrition in CT observations and caretaker surveys

	Observations collected FU rounds (1)	**Caretaker surveyed** FU rounds (2)	**New CT in catchment area** (3)
Panel A			
Maintenance (T)	0.100	0.125	0.014
	(0.100)	(0.135)	(0.010)
	[0.32]	[0.36]	[0.16]
Panel B			
Maintenance only (T1)	0.100	0.052	0.028
	(0.100)	(0.170)	(0.020)
	[0.32]	[0.76]	[0.15]
Maintenance + sensitization (T2)	0.100	0.198	0.001
	(0.100)	(0.124)	(0.002)
	[0.32]	[0.11]	[0.82]
T1 = T2 (p-value)	0.942	0.238	0.153
Mean (control group)	4.900	4.775	0.000
Catchment areas	110	110	110

Note. Estimates based on CT-level OLS regressions using equation (1) in panel A, and equation (2) in panel B. Robust standard errors in parentheses. p-values are presented in brackets. Dependent variables by column: (1) *Observations collected*: number of follow-up surveys where CT observation were collected; (2) *Caretaker surveyed*: number of follow-up surveys where the CT caretaker was surveyed; (3) *New CT in catchment area*: indicator variable equal to 1 if an additional CT opened in the same catchment area and hence was included in the study later on, and 0 otherwise. All specifications include strata indicators for the city and the provider of the CT.

Table B5: Attrition in the household measurements

	Follow-up interviews per baseline household	**Interviewed at baseline and not re-interviewed in ...**				**Household is a re-placement**
		Any follow-up	Follow-up 1	Follow-up 3	Follow-up 5	
	(1)	(2)	(3)	(4)	(5)	(6)
Maintenance only (T1)	0.025	0.006	0.013	-0.024	-0.013	0.001
	(0.074)	(0.011)	(0.025)	(0.037)	(0.035)	(0.015)
	[0.74]	[0.61]	[0.62]	[0.52]	[0.70]	[0.97]
Maintenance + sensitization (T2)	0.009	0.012	0.012	-0.013	-0.008	-0.007
	(0.079)	(0.014)	(0.023)	(0.042)	(0.034)	(0.014)
	[0.91]	[0.38]	[0.59]	[0.75]	[0.81]	[0.62]
T1 = T2 (p-value)	0.824	0.661	0.985	0.738	0.867	0.616
Attrition rate	2.525	0.027	0.110	0.209	0.156	0.171
Observations	1555	1555	1555	1555	1555	6614

Note. Figure S.2.1 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 the 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).

B.2 Implementation of interventions across treatment groups

Table B6 shows the effect of treatments on indicators of exposure to the interventions. We focus on transfers as part of the maintenance intervention, and of indicators of the sensitization campaign.

Table B6: Exposure to the interventions, by component

	Maintenance		Sensitization campaign		
	Transfer to the ...		Recall of WASH campaign		Voice messages
	CT	Caretaker	Interactive activities	Posters at CT	Exposure
	(1)	(2)	(3)	(4)	(5)
Panel A					
Maintenance (T)	4.739	0.761	0.054	0.089	0.403
	(0.060)	(0.034)	(0.020)	(0.026)	(0.059)
	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]
Panel B					
Maintenance only (T1)	4.645	0.746	0.023	0.017	-0.038
	(0.081)	(0.045)	(0.024)	(0.030)	(0.047)
	[0.00]	[0.00]	[0.33]	[0.58]	[0.42]
Maintenance + sensitization (T2)	4.839	0.776	0.083	0.158	0.827
	(0.074)	(0.047)	(0.023)	(0.029)	(0.086)
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
T1 = T2 (p-value)	0.063	0.636	0.014	0.000	0.000
Mean (control group)	0.315	0.063	0.645	0.327	0.188
Std. dev. (control group)	0.358	0.025	0.479	0.469	0.347
Observations	560	560	4793	3301	4793
Catchment areas	110	110	328	218	328
Observation rounds	5	5	3	2	3

Note. In columns (1) and (2), estimates are based on CT-level OLS regressions using equation (1) in panel A, and equation (2) in panel B. Standard errors clustered by catchment area are reported in parentheses. Transfers are reported in thousands of INR. In columns (3)–(8), estimates are based on household-level OLS regressions using equation (1) in panel A, and equation (2) in panel B. Standard errors clustered by catchment area–round are reported in parentheses. p-values are presented in brackets, 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. See Section 5 for details. Dependent variables are reported in the column header and are defined in Appendix A. Dependent variables by column: (1) *Transfer to the CT*: total transfers provided to the CT as part of the intervention (in thousands of Rupees); (2) *Transfer to the caretaker*: total transfers provided to the caretaker as part of the intervention (in thousands of Rupees); (3) *Interactive activities*: is an indicator variable equal to one if the respondent participated or is aware of a water, sanitation and hygiene interactive activities, and zero otherwise; (4) *Posters at CT*: is an indicator variable equal to one if the respondent has seen or is aware of posters promoting safe sanitation behaviour placed in the CT, and zero otherwise; (5) *Exposure to voice messages*: Share of voice message listened multiplied by the number of words in the message related to water, sanitation and hygiene. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT.

B.3 Treatment effects on revenues

Table B7 provides estimates of treatment effects on monthly revenues estimated using observation during the rush hour. Revenues are imputed using information from observers about the number of people using the CT and the share of them who are is paying the fee (assuming a standard fee of INR 5).

Table B7: Service revenues

	Monthly revenues			
	All periods		Incentive period	
	Extensive	Intensive	Extensive	Intensive
	(1)	(2)	(3)	(4)
Panel A				
Maintenance (T)	0.033	267.073	0.033	267.073
	(0.033)	(254.664)	(0.033)	(254.664)
	[0.32]	[0.29]	[0.32]	[0.29]
Panel B				
Maintenance only (T1)	0.020	127.399	0.020	127.399
	(0.041)	(293.467)	(0.041)	(293.467)
	[0.62]	[0.66]	[0.62]	[0.66]
Maintenance + sensitization (T2)	0.045	407.935	0.045	407.935
	(0.029)	(290.198)	(0.029)	(290.198)
	[0.13]	[0.16]	[0.13]	[0.16]
T1 = T2 (p-value)	0.379	0.330	0.379	0.330
Mean (control group)	0.948	3027.202	0.948	3027.202
Std. dev. (control group)	0.222	1870.703	0.222	1870.703
Observations	542	542	542	542
Catchment areas	110	110	110	110
Observation rounds	5	5	5	5
Follow-ups	1–5	1–5	2–5	2–5

Note. In columns (1), (3), (5) and (7), estimates are based on CT-level OLS regressions using equation (1) in panel A, and equation (2) in panel B. In columns (2), (4), (6) and (8), estimates are based on CT-level tobit regressions using equation (1) in panel A, and equation (2) in panel B, and imposing censoring at zero. Standard errors clustered by catchment area are reported in parentheses. p-values are presented in brackets. See Section 5 for details. Dependent variables are reported in columns. *Extensive* is an indicator variable equal to 1 if the revenues are larger than zero, and 0 otherwise. *Intensive* is the revenues reported in levels. 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.

B.4 Effect on the quality of the service

To construct a measure capturing the overall **quality of service delivery**, we use all the observed indicators related to the facility's structural quality and cleanliness, and to the lack of harmful bacteria. Since quality is unobserved and multidimensional and varies over time, we build the index using item response theory (IRT), a technique used to describe the relationship between individual responses to questionnaire items and an unobserved latent trait (Gordon et al., 2012; Kline, 2014). We build the index using a two parameter IRT model with the two parameters being an ability score, which could be used as a weight in constructing the index, and a discrimination score, which measures how well the indicator differentiates between low- and high-quality. The index is re-scaled to be between 0 (lowest quality) and 1 (highest).[2] Table B8 provides the list of all indicators included.

Figure B1 shows the distribution of the quality of service delivery index by treatment

[2] We compute the index separately for baseline and for all follow-up measurements due to the fact that the baseline survey includes a lower number of indicators. At baseline, due to convergence, we adopt a one parameter IRT model.

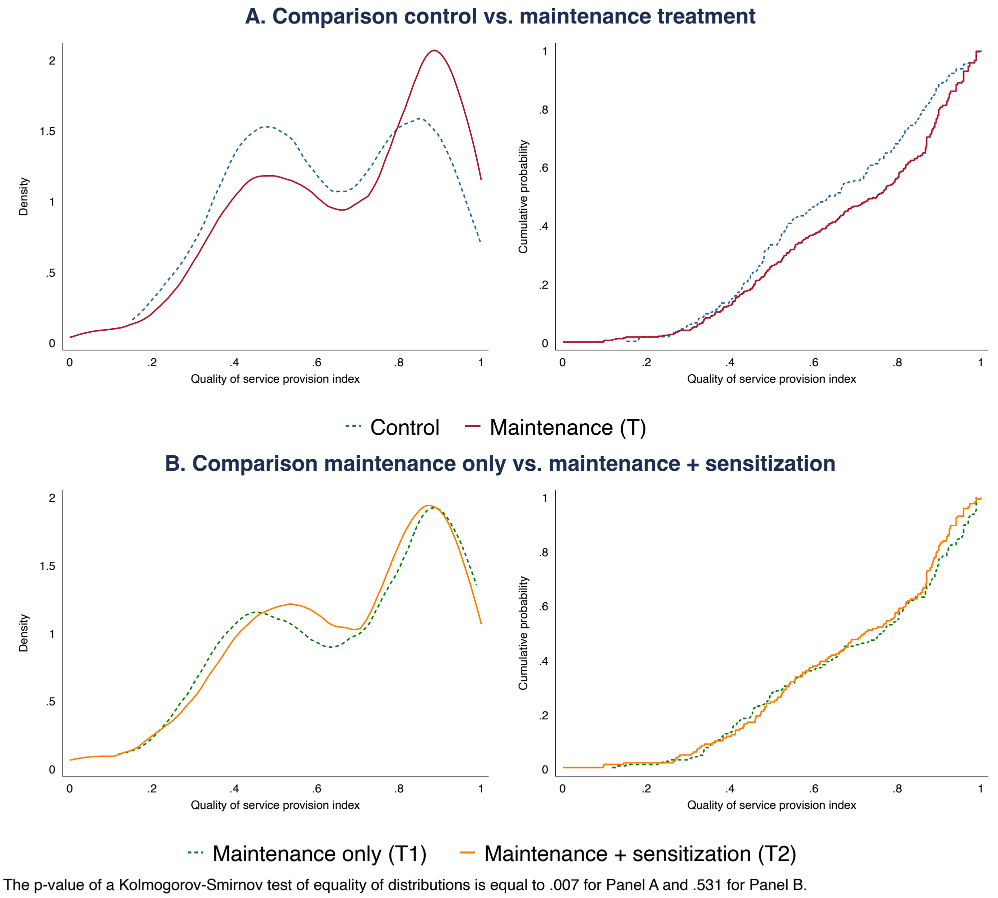
Table B8: Indicators used for the construction of the quality index

Indicator variables	Ability score (1)	Discrimination (2)
Structural quality		
All cubicle doors are functioning	1.971	0.247
All locks are functioning	-0.603	0.435
Compound has finished walls	2.259	0.412
Internal walls are in good condition	3.156	0.294
Soap is available and visible for both genders	1.731	0.572
Hand-washing facility available for both genders	1.667	0.811
Female area has lighting	1.842	1.002
Male area has lighting	1.751	1.059
Common area has lighting	2.960	0.762
Cleanliness		
Toilets in female area are not dirty	0.699	3.705
Toilets in female area do not stink	0.640	4.121
Flies not present in the female area	0.837	3.904
Toilets in male area are not dirty	0.570	4.843
Toilets in male area do not stink	0.771	3.431
Flies not present in the male area	0.525	5.990
Feces not visible inside the latrine in the female area	1.009	5.186
Feces not visible outside the latrine in the female area	1.200	4.523
Feces not visible inside the latrine in the male area	0.987	3.699
Feces not visible outside the latrine in the male area	1.192	3.134
Common area is not dirty	1.276	2.924
Common area does not stink	1.254	3.254
Flies not present in the common area	1.272	2.764
No visible sewage leaks inside the compound	2.449	2.235
Lack of bacteria		
Bacteria count of E. coli is low	-0.379	-0.196
Bacteria of bacillus are not detected	2.148	-3.145
Bacteria of staphylococcus are not detected	-25.405	-0.097
Bacteria of salmonella are not detected	38.091	0.025
Bacteria of klebsiella are not detected	10.820	-0.123
Mold is not detected	3.537	-0.455

Note. All indicator variables are equal to 1 if the condition is true, and 0 otherwise. The table reports the main parameters in the index build using IRT, with the ability score reported in column (1) and the discrimination reported in column (2). Observations are restricted to follow-ups 1–5 for computing the index. The manual for observers defines the rules for the visual evaluation of CTs (Supplementary Material S.4.2). *Finished walls* are defined as built in cement, and bricks, with no cracks or crumbles on the paintwork or tiles. *Dirt* is reported as the presence of mud, mold, red spitting, urine or feces on floors or walls. *Stink* is reported as the presence of an unpleasant smell from urine or feces. *Sewage leaks* are identified by fecally contaminated black waters leaking from a septic tank, pit/cesspool or pipes.

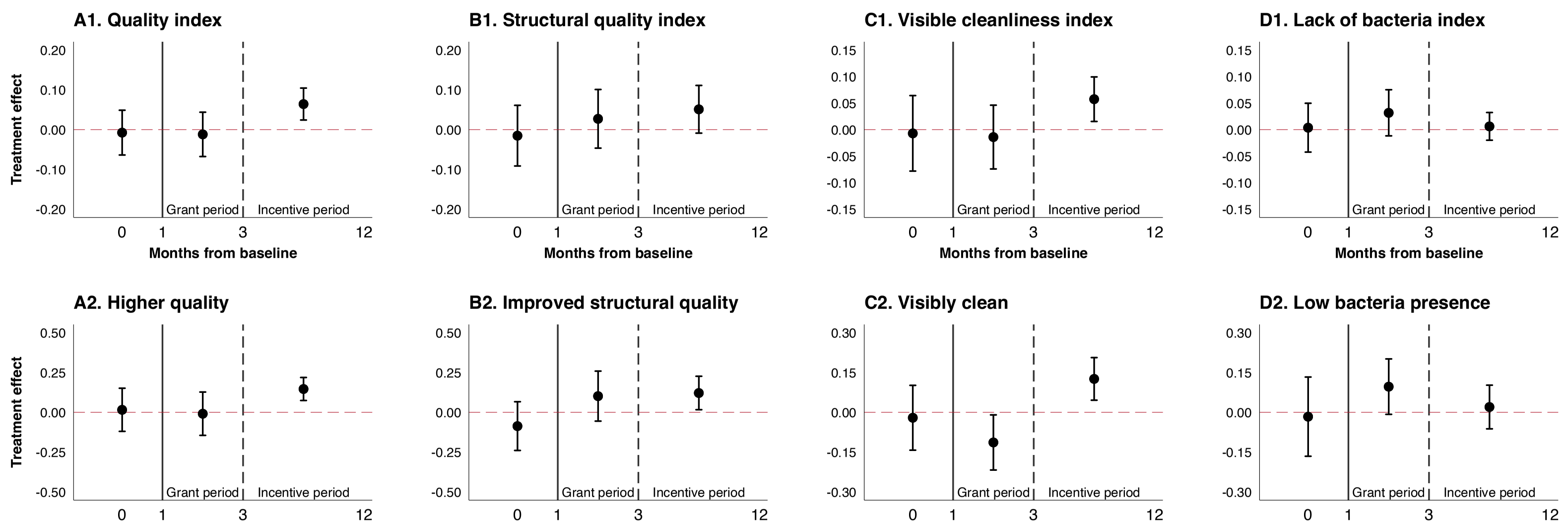
arm. Panel A compares the control group with the maintenance treatment group, while panel B restricts the sample to the maintenance treatment group and compares the maintenance only treatment group and the maintenance plus sensitization treatment group. The left figures present distribution fits, while the right figures show the empirical cumulative distribution functions. In addition to the quality of service delivery index, we build three separate indices using IRT to measure the structural quality of the facility, the cleanliness of the CT, and the lack of bacteria. Figure B2 shows the effect of the maintenance treatment on the oveall quality index and by component.

Figure B1: Distribution of the quality of service delivery index at follow-up



Note. The distributions include all follow-up measurements. The quality of service delivery index is built using a two parameter IRT model. Panel A shows the comparison between the control group and any treatment group. Panel B shows the comparison between the two treatment groups individually (maintenance and maintenance plus sensitization). The left figures show the distribution fits estimated non-parametrically using kernel density estimation assuming an Epanechnikov kernel function. Bandwidths are estimated by Silverman's rule of thumb (Silverman, 1986). The right figures show the empirical cumulative distribution functions.

Figure B2: Effect on CT quality by component: grant versus incentive period



Note. Each panel presents estimates of treatment effects based on OLS regressions using equation (1) at the CT level. Confidence intervals are built using statistical significance at the 10 percent level. *Baseline* includes the measurement at baseline, *Grant period* includes the measurement from follow-up 1, and *Incentive period* pools all subsequent follow-up measurements. See Section 1 for details about each intervention. When the regression is based on a single measurement period, robust standard errors are used. When multiple measurement periods are pooled, standard errors are clustered at the catchment area. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Supplementary Material S.4 provides details about measurement.

B.5 Spillover analysis

Table B9 shows a test for contagion or spillover effects by estimating heterogeneous treatment effects according to the average distance of a CT or catchment area to another treated CT or catchment area. We define a catchment area to be close to (far from) another treated catchment area if the distance is below or equal to (above) the sample median. Among all outcome variables, we do not observe any heterogeneous effect, suggesting the absence of spillover effects.

Table B9: Contagion and spillover effects

	Effect of any treatment, by average distance to another treatment						**Het. test**
	β	se	N	β	se	N	p-value
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Close to T			**Far from T**			
Higher quality	0.12*	0.06	266	0.12*	0.06	276	0.97
Structural maintenance	0.02	0.05	266	0.07	0.09	276	0.62
Routine maintenance	0.03	0.02	266	0.04	0.03	276	0.86
Hours worked	-0.25	0.40	266	0.66	0.59	276	0.20
Caretaker's knowledge	0.08***	0.03	266	0.09	0.06	276	0.95
Users	-0.04	0.07	265	-0.06	0.07	277	0.85
Non-payment	-0.08*	0.04	265	-0.07	0.07	277	0.89
Enforcement	0.03	0.02	54	-0.01	0.04	57	0.36
Monitoring	0.01	0.02	266	0.10*	0.05	276	0.13
Pro-social motivation	-0.02	0.04	266	-0.03	0.03	276	0.80
Appreciates the service	0.02	0.02	2425	0.04**	0.02	2368	0.59
WTP for CT use	-0.07	0.10	4309	-0.01	0.08	4326	0.72
Contribution to service quality	-0.01	0.01	4309	-0.00	0.01	4326	0.85
Awareness of externalities	0.06**	0.03	2425	0.01	0.02	2368	0.13
Demand for pub. int. (service)	0.05	0.04	797	0.05	0.03	754	0.92
Demand for pub. int. (free riding)	-0.10*	0.05	798	-0.04	0.05	755	0.42
Demand for pub. int. (other)	-0.01	0.04	797	-0.03	0.03	754	0.81
PGG contribution	-0.00	0.02	604	0.00	0.02	624	0.87
Morbidity	0.02	0.02	2425	-0.01	0.03	2368	0.42
Curative exp. (extensive)	0.07**	0.03	1677	0.02	0.03	1599	0.41
Curative exp. (intensive)	-254.09	250.70	1677	181.19	269.82	1599	0.27
Preventive exp. (extensive)	-0.00	0.01	1692	-0.00	0.00	1609	0.48
Preventive exp. (intensive)	11.24	68.20	1691	-1.04	72.54	1609	0.90

Note. Close to (*far from*) indicates whether the average distance is below or equal to (above) the sample median. Variables referring to catchment areas are averages of the corresponding variable within the catchment area. In columns (1)–(6), estimates are based on CT-, respondent- or household-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. 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. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1.

B.6 Robustness to the inclusion of control variables

Table B10 presents estimates of the effect of any treatment (T) using equation (1) in columns (1)–(3), and the post-double selection LASSO (PDSL) procedure (Tibshirani, 1996; Belloni et al., 2013) in columns (4)–(6). The PDSL procedure provides a method for model selection in the presence of a large number of control variables.

Table B10: Effect of any treatment: comparison between main estimates and PDSL

	No control variables			**Post-double selection LASSO**			
	β	se	p-value	β	se	p-value	N
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
CT-/caretaker-level outcomes							
Higher quality	0.12	0.04	0.01	0.09	0.04	0.02	542
Structural maintenance	0.04	0.05	0.36	0.04	0.05	0.45	542
Routine maintenance	0.03	0.02	0.05	0.03	0.01	0.03	542
Hours worked	0.17	0.36	0.62	0.14	0.36	0.69	542
Caretaker's knowledge	0.09	0.04	0.01	0.09	0.03	0.01	542
Users	-0.06	0.05	0.24	-0.06	0.05	0.21	542
Non-payment	-0.08	0.04	0.07	-0.07	0.04	0.10	542
Enforcement	0.00	0.02	0.83	0.01	0.02	0.79	111
Monitoring	0.05	0.03	0.07	0.05	0.02	0.05	542
Pro-social motivation	-0.02	0.02	0.33	-0.03	0.02	0.29	542
Respondent/household-level outcomes							
Appreciates the service	0.03	0.01	0.02	0.04	0.02	0.01	4793
WTP for CT use	-0.04	0.07	0.52	0.03	0.07	0.66	8635
Contribution to service quality	-0.01	0.01	0.38	-0.00	0.01	0.62	8635
Awareness of externalities	0.03	0.02	0.08	0.03	0.02	0.10	4793
Household-level outcomes							
Demand for pub. int. (service)	0.05	0.03	0.05	0.05	0.03	0.04	1551
Demand for pub. int. (free riding)	-0.07	0.04	0.04	-0.08	0.04	0.03	1553
Demand for pub. int. (other)	-0.02	0.02	0.38	-0.02	0.02	0.49	1551
PGG contribution	0.00	0.01	0.92	0.01	0.01	0.57	1228
Morbidity	0.01	0.02	0.75	0.01	0.02	0.75	4793
Curative exp. (extensive)	0.05	0.02	0.05	0.04	0.03	0.10	3276
Curative exp. (intensive)	-35.15	190.45	0.85	-23.65	210.20	0.91	3276
Preventive exp. (extensive)	-0.00	0.00	0.54	-0.00	0.00	0.48	3301
Preventive exp. (intensive)	5.57	49.78	0.91	9.49	51.85	0.85	3300

Note. Columns (1)–(3) show estimates using equation (1), while columns (4)–(6) show estimates using the PDSL procedure (Tibshirani, 1996; Belloni et al., 2013), with selection over a large number of baseline-level control variables. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. N indicates the sample size. In order to have the same sample size of estimates as in the main tables, missing values are replaced by the value 0 and an indicator variable equal to 1 if the observation had a missing value is introduced for all variables. To build the set of potential control variables, we include the following observable characteristics in the procedure (all continuous variables are also included in their squared term and are standardized): *CT characteristics* (variables describing the facility at baseline included in Table B1); *caretaker characteristics* (variables related to caretakers at baseline included in Table B1); *catchment area characteristics* (for CT- and caretaker-level outcomes, we include the catchment-area average at baseline for the household head's gender, education, marital status, religion and caste, WTP for service use, trust of the community, bacteria contamination in water sources, share practicing OD, and distance from the CT); *individual characteristics* (for household- and respondent-level outcomes, we include the baseline characteristics of the household and of the respondent included in Table B2); *outcome variables* (for CT- and caretaker-level estimates, we include the baseline value of outcomes presented in Tables 1–2, while for household- and respondent-level outcomes, the baseline values of outcomes are presented in Tables 3–5). Additional information about outcome variables is provided in Appendix A.

B.7 Robustness to estimation of treatment effects via causal forest

Table B11 presents estimates of ATE of any treatment on all outcome variables using the causal forest procedure of Athey et al. (2019) and following the cluster-robust procedure of Basu et al. (2018) and Athey and Wager (2019). In the procedure, we use the set of variables from Appendix B.6. Columns (1)–(3) present estimates of the ATE and the p-value of a two-sided test for the ATE being different from 0. To verify the overall presence of heterogeneity in the impacts, Columns (4)–(5) implement a calibration test based on the best linear predictor method of Chernozhukov et al. (2017). Column (4) presents the p-value for the equality to 1 of the coefficient on the mean forest prediction, with 1 indicating that the mean forest prediction is correct. Column (5) presents the p-

value for the equality to 1 (no heterogeneity) of the coefficient on the quality of the estimates of treatment heterogeneity.

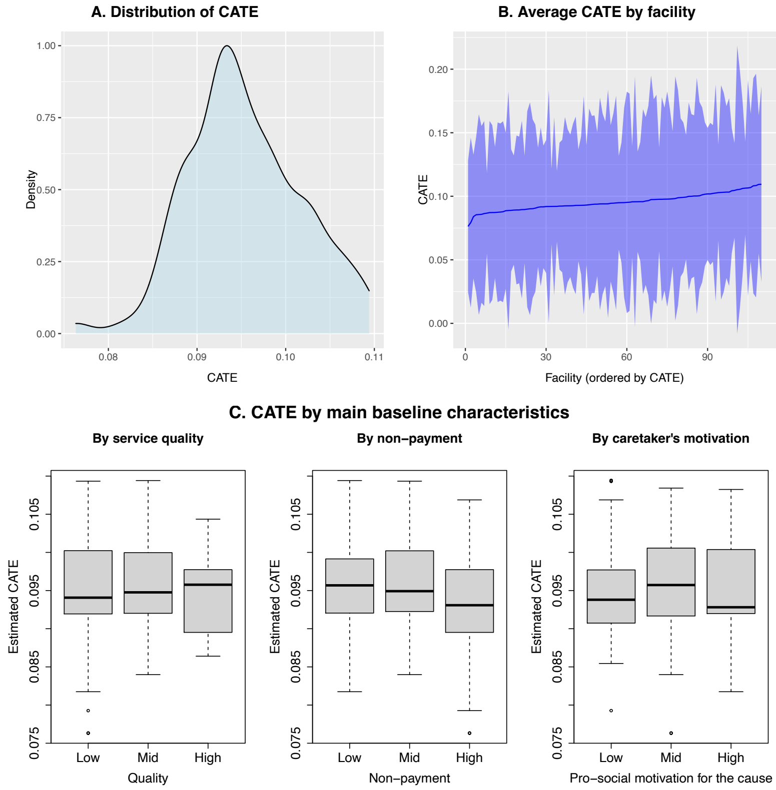
Table B11: Effects of maintenance treatment: causal forest procedure

	ATE via causal forest procedure			**Calibration test**	
	β	se	p-value	Mean prediction (p-value)	Heterogeneity (p-value)
	(1)	(2)	(3)	(4)	(5)
CT-/caretaker-level outcomes					
Higher quality	0.109	0.044	0.014	0.002	1.000
Structural maintenance	0.037	0.050	0.461	0.202	1.000
Routine maintenance	0.036	0.016	0.027	0.001	1.000
Hours worked	0.403	0.461	0.381	0.179	0.921
Knowledge of maintenance	0.094	0.037	0.012	0.003	1.000
Non-payment	-0.092	0.043	0.034	0.000	1.000
Users	-0.051	0.051	0.318	0.172	0.501
Enforcement	0.007	0.023	0.761	0.314	1.000
Monitoring	0.042	0.029	0.151	0.003	1.000
Pro-social motivation for the cause	-0.023	0.025	0.37	0.228	1.000
Household-/respondent-level outcomes					
Appreciates the service	0.044	0.012	0.000	0.000	1.000
WTP for service use	-0.027	0.059	0.642	0.373	0.968
Contribution to service quality	-0.005	0.005	0.335	0.268	0.143
Awareness of externality risks	0.025	0.017	0.14	0.116	1.000
Demand for pub. intervention (CT)	0.05	0.029	0.088	0.038	0.057
Demand for pub. intervention (OD)	-0.077	0.041	0.061	0.010	1.000
Demand for pub. intervention (other)	-0.019	0.026	0.471	0.185	1.000
PGG contribution	0.007	0.014	0.645	0.305	0.885
Morbidity	0.007	0.017	0.669	0.389	0.949
Curative expenditure (extensive)	0.042	0.023	0.069	0.052	0.925
Curative expenditure (intensive)	-16.481	176.526	0.926	0.399	1.000
Preventive expenditure (extensive)	-0.002	0.003	0.484	0.136	1.000
Preventive expenditure (intensive)	-1.722	48.353	0.972	0.482	0.893

Note. Estimates presented in the first column are based on the cluster-robust causal forest procedure of Athey et al. (2019). We use the set of variables used in Appendix B.6, and we maintain the same assumptions about clustering implemented in Tables 1–5. Columns (1)–(3) present estimates of the ATE and the p-value of a two-sided test for the ATE being different from zero. Columns (4)–(5) implement a calibration test based on the best linear predictor method of Chernozhukov et al. (2017). Column (4) presents the p-value for the equality to 1 of the coefficient on the mean forest prediction, with 1 indicating that the mean forest prediction is correct. Column (5) presents the p-value for the equality to 1 of the coefficient on the quality of the estimates of treatment heterogeneity, with 1 indicating that the forest has captured heterogeneity in the underlying signal. Additional information about outcome variables is provided in Appendix A.

Figure B3 summarizes the causal forest results on heterogeneity of the effect on non-payment. Panel A shows the distribution of the Conditional ATE (CATE), while panel B averages the CATE at CT level and includes the 90 percent confidence interval. Panel C shows instead how CATE estimates vary according to three baseline characteristics of the CT: quality, non-payment, and caretaker's pro-social motivation for the cause. Results show the relatively homogeneous impact of the interventions on non-payment.

Figure B3: Conditional ATE of any treatment on non-payment



Note. Panel A shows the distribution of the Conditional ATE (CATE) of any treatment on non-payment computed using the cluster-robust causal forest procedure of Basu et al. (2018) and Athey and Wager (2019). Panel B shows the average CATE at CT level with the 90 percent confidence interval. Panel C shows variation of the CATE by baseline characteristics of the facility using a box plot. Low, mid and high indicates the first, second and third terciles in the distribution of the characteristic. In the box plot, each rectangle represents the inter-quartile range, with the top indicating the upper quartile, the bottom the lower quartile, and the middle line the median. The vertical line indicates the whiskers, i.e., the smallest value greater than the lower quartile minus 1.5 times the inter-quartile range, and the largest value less than the upper quartile plus 1.5 times the inter-quartile range. Additional information about the variables is provided in Appendix A.

B.8 Treatment heterogeneity by pre-specified dimensions

This section presents estimates of heterogeneous effects by a series of pre-registered variables. Table B12 presents an analysis of heterogeneity for CT- and caretaker-level outcomes. Tables B13 and B14 refer instead to respondent- and household-level outcomes.

Table B12: Heterogeneity by catchment area or CT characteristics

	Effect of maintenance treatment, by category						Het. test
	β	se	N	β	se	N	p-value
Outcome variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. WTP in catchment area		**Lower**			**Higher**		
Higher quality	0.15**	0.06	272	0.09	0.06	270	0.48
Structural maintenance	0.08	0.06	272	0.01	0.07	270	0.39
Routine maintenance	0.08***	0.03	272	0.01	0.02	270	0.05
Hours worked	0.28	0.54	272	0.08	0.45	270	0.77
Caretaker's knowledge	0.08	0.06	272	0.03	0.03	270	0.39
Users	0.05	0.07	273	-0.13*	0.07	269	0.07
Non-payment	-0.08	0.06	273	-0.07	0.05	269	0.90
Enforcement	-0.05	0.04	57	0.07*	0.04	54	0.02
Monitoring	0.07**	0.03	272	0.03	0.04	270	0.38
Pro-social motivation	-0.03	0.04	272	-0.01	0.04	270	0.81
B. Quality of the service		**Lower**			**Higher**		
Higher quality	0.11*	0.06	294	0.11*	0.06	248	0.98
Structural maintenance	0.13**	0.06	294	-0.06	0.07	248	0.05
Routine maintenance	0.02	0.02	294	0.04*	0.02	248	0.48
Hours worked	-0.16	0.56	294	0.46	0.40	248	0.37
Caretaker's knowledge	0.13**	0.05	294	0.04	0.04	248	0.16
Users	-0.05	0.06	294	-0.07	0.08	248	0.85
Non-payment	-0.07	0.06	294	-0.08	0.06	248	0.91
Enforcement	0.01	0.03	60	-0.00	0.03	51	0.85
Monitoring	0.05	0.05	294	0.06**	0.03	248	0.87
Pro-social motivation	-0.01	0.03	294	-0.05	0.04	248	0.36
C. Users		**Lower traffic**			**Higher traffic**		
Higher quality	0.08	0.07	204	0.13**	0.05	338	0.56
Structural maintenance	0.06	0.08	204	0.05	0.06	338	0.98
Routine maintenance	0.01	0.03	204	0.05**	0.02	338	0.29
Hours worked	-0.01	0.54	204	0.33	0.45	338	0.59
Caretaker's knowledge	0.16**	0.06	204	0.05	0.04	338	0.12
Users	-0.21**	0.10	203	0.03	0.05	339	0.05
Non-payment	-0.08	0.06	203	-0.07	0.05	339	0.92
Enforcement	0.01	0.03	41	0.01	0.03	70	0.94
Monitoring	0.03	0.03	204	0.06	0.04	338	0.71
Pro-social motivation	-0.12***	0.04	204	0.02	0.03	338	0.01
D. Non-payment		**Lower**			**Higher**		
Higher quality	0.11	0.07	270	0.14***	0.04	272	0.74
Structural maintenance	0.04	0.07	270	0.06	0.08	272	0.88
Routine maintenance	0.02	0.02	270	0.05*	0.03	272	0.56
Hours worked	-0.33	0.36	270	0.75	0.59	272	0.12
Caretaker's knowledge	0.15***	0.05	270	0.01	0.05	272	0.04
Users	-0.08	0.07	270	-0.04	0.07	272	0.62
Non-payment	-0.07	0.05	270	-0.10*	0.06	272	0.65
Enforcement	-0.04	0.03	55	0.05*	0.03	56	0.04
Monitoring	0.03	0.02	270	0.07	0.05	272	0.50
Pro-social motivation	-0.03	0.04	270	-0.02	0.03	272	0.93
E. Caretaker's motivation		**Lower**			**Higher**		
Higher quality	0.11**	0.05	264	0.09	0.07	278	0.72
Structural maintenance	0.16**	0.08	264	-0.08	0.06	278	0.01
Routine maintenance	0.02	0.03	264	0.04	0.02	278	0.71
Hours worked	0.60	0.60	264	-0.25	0.40	278	0.23
Caretaker's knowledge	0.03	0.05	264	0.15***	0.05	278	0.08
Users	0.04	0.08	265	-0.14**	0.06	277	0.07
Non-payment	-0.08	0.07	265	-0.06	0.05	277	0.77
Enforcement	0.02	0.03	54	-0.01	0.03	57	0.42
Monitoring	0.04	0.05	264	0.05*	0.03	278	0.95
Pro-social motivation	-0.05	0.03	264	-0.00	0.04	278	0.37

Note. Categories for heterogeneity analysis are defined at baseline, with *lower* (*higher*) indicating whether the variable is smaller than or equal to (larger than) the sample median. Variables referring to catchment areas are averages of the corresponding variable within the catchment area. In columns (1)–(6), estimates are based on CT- or caretaker-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT- or caretaker-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. The p-value is relative to the significance of the coefficient on the interaction term. Standard errors clustered by catchment area. 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. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1. *Caretaker's motivation* refers to the caretaker's pro-social motivation for the cause.

Table B13: Heterogeneity by individual characteristics: household-level outcomes

	Effect of maintenance treatment, by category						Het. test
	β	se	N	β	se	N	p-value
Outcome variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. WTP for service use		**Lower**			**Higher**		
Appreciates the service	0.05***	0.02	2307	0.02	0.02	2486	0.22
WTP for service use	-0.07	0.07	4045	-0.02	0.08	4590	0.61
Contribution to service quality	-0.00	0.01	4045	-0.01	0.01	4590	0.88
Awareness of externalities	0.01	0.02	2307	0.05**	0.02	2486	0.18
Demand for pub. int. (service)	0.09*	0.05	717	0.03	0.04	834	0.25
Demand for pub. int. (free riding)	-0.01	0.05	719	-0.13***	0.05	834	0.05
Demand for pub. int. (other)	-0.05	0.04	717	-0.02	0.03	834	0.58
PGG contribution	-0.01	0.02	564	0.01	0.02	664	0.11
Morbidity	-0.00	0.03	2307	0.02	0.03	2486	0.61
Curative exp. (extensive)	0.04	0.04	1487	0.03	0.03	1789	0.76
Curative exp. (intensive)	321.12	329.16	1487	-230.92	295.83	1789	0.20
Preventive exp. (extensive)	-0.01	0.01	1499	0.00	0.01	1802	0.07
Preventive exp. (intensive)	-24.58	69.69	1499	58.67	78.51	1801	0.35
B. Awareness of externality		**Lower**			**Higher**		
Appreciates the service	0.03*	0.02	1359	0.03*	0.02	3434	0.75
WTP for service use	0.01	0.10	2474	-0.07	0.07	6161	0.57
Contribution to service quality	-0.00	0.01	2474	-0.01	0.01	6161	0.57
Awareness of externalities	0.01	0.03	1359	0.04**	0.02	3434	0.21
Demand for pub. int. (service)	0.06	0.05	435	0.05	0.03	1116	0.92
Demand for pub. int. (free riding)	-0.05	0.06	436	-0.09*	0.05	1117	0.54
Demand for pub. int. (other)	-0.06	0.04	435	-0.02	0.03	1116	0.42
PGG contribution	-0.02	0.02	344	0.01	0.02	884	0.21
Morbidity	0.03	0.03	1359	-0.00	0.03	3434	0.58
Curative exp. (extensive)	0.05	0.04	880	0.03	0.03	2396	0.62
Curative exp. (intensive)	253.62	432.30	880	-71.43	246.38	2396	0.48
Preventive exp. (extensive)	-0.01	0.01	887	-0.00	0.00	2414	0.64
Preventive exp. (intensive)	23.50	80.25	886	16.20	67.98	2414	0.94
C. Trust in the community		**Lower**			**Higher**		
Appreciates the service	0.03**	0.01	3897	0.04	0.02	896	0.81
WTP for service use	-0.06	0.07	7041	-0.00	0.12	1594	0.59
Contribution to service quality	-0.00	0.01	7041	-0.01	0.01	1594	0.63
Awareness of externalities	0.02	0.02	3897	0.08**	0.03	896	0.07
Demand for pub. int. (service)	0.08**	0.04	1218	-0.04	0.05	333	0.05
Demand for pub. int. (free riding)	-0.06	0.04	1220	-0.13*	0.07	333	0.41
Demand for pub. int. (other)	-0.06*	0.03	1218	0.05	0.05	333	0.06
PGG contribution	-0.01	0.02	966	0.02	0.02	262	0.15
Morbidity	0.00	0.02	3897	0.05	0.04	896	0.40
Curative exp. (extensive)	0.03	0.03	2510	0.05	0.05	766	0.83
Curative exp. (intensive)	-24.18	258.10	2510	229.48	468.62	766	0.65
Preventive exp. (extensive)	-0.01	0.01	2526	0.01	0.01	775	0.10
Preventive exp. (intensive)	2.25	61.18	2525	83.10	122.57	775	0.48
D. Distance to CT		**Shorter**			**Longer**		
Appreciates the service	0.03	0.02	2370	0.04**	0.02	2423	0.57
WTP for service use	-0.16*	0.09	4256	0.07	0.08	4379	0.06
Contribution to service quality	-0.01	0.01	4256	0.00	0.01	4379	0.28
Awareness of externalities	0.03	0.02	2370	0.03	0.02	2423	0.87
Demand for pub. int. (service)	0.06	0.04	774	0.04	0.04	777	0.62
Demand for pub. int. (free riding)	-0.07	0.05	774	-0.09*	0.05	779	0.67
Demand for pub. int. (other)	-0.01	0.04	774	-0.05	0.03	777	0.36
PGG contribution	-0.01	0.02	600	0.01	0.02	628	0.36
Morbidity	0.02	0.03	2370	-0.01	0.03	2423	0.51
Curative exp. (extensive)	0.03	0.04	1615	0.04	0.04	1661	0.96
Curative exp. (intensive)	-406.57	344.41	1615	435.42	285.31	1661	0.05
Preventive exp. (extensive)	-0.00	0.01	1626	-0.00	0.00	1675	0.85
Preventive exp. (intensive)	-3.32	72.57	1625	41.79	81.77	1675	0.68

Note. Categories for heterogeneity analysis are defined at baseline, with *lower* (*higher*) indicating whether the variable is smaller than or equal to (larger than) the sample median. In columns (1)–(6), estimates are based on respondent- and household-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. The p-value is relative to the significance of the coefficient on the interaction term. Standard errors are clustered by catchment-area–round of observation. 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. Specifications where the level of analysis is the respondent also include gender. Statistical significance denoted by *** p<0.01, ** p<0.05, * p<0.1. *Trust in the community* refers to the trust in the community to keep the CT clean.

Table B14: Heterogeneity by catchment area characteristics: household-level outcomes

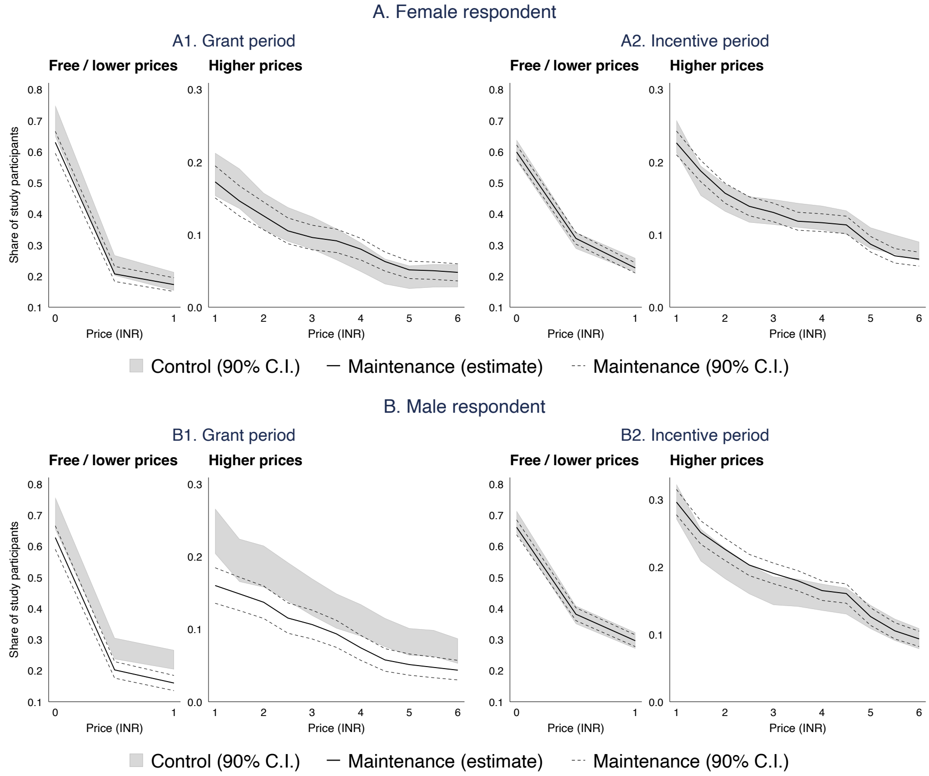
	Effect of maintenance treatment, by category						Het. test
	β	se	N	β	se	N	p-value
Outcome variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Water quality		**Lower**			**Higher**		
Appreciates the service	0.04**	0.02	2357	0.02	0.02	2436	0.38
WTP for service use	-0.03	0.08	4257	-0.05	0.10	4378	0.90
Contribution to service quality	0.00	0.01	4257	-0.01*	0.01	4378	0.20
Awareness of externalities	-0.00	0.03	2357	0.06**	0.02	2436	0.10
Demand for pub. int. (service)	0.05	0.06	756	0.05	0.04	795	0.93
Demand for pub. int. (free riding)	-0.05	0.06	756	-0.10*	0.06	797	0.51
Demand for pub. int. (other)	-0.06*	0.04	756	0.01	0.03	795	0.14
PGG contribution	0.05**	0.02	619	-0.04**	0.02	609	0.00
Morbidity	0.05	0.03	2357	-0.03	0.03	2436	0.09
Curative exp. (extensive)	0.06	0.04	1598	0.01	0.04	1678	0.37
Curative exp. (intensive)	597.79*	306.78	1598	-464.56	308.78	1678	0.02
Preventive exp. (extensive)	-0.00	0.01	1610	-0.00	0.01	1691	0.79
Preventive exp. (intensive)	147.57*	78.42	1610	-97.19	85.63	1690	0.05
B. Quality of the service		**Lower**			**Higher**		
Appreciates the service	0.04**	0.02	2517	0.01	0.02	2276	0.21
WTP for service use	-0.19**	0.09	4571	0.08	0.10	4064	0.08
Contribution to service quality	-0.01	0.01	4571	0.00	0.01	4064	0.48
Awareness of externalities	0.05*	0.03	2517	0.02	0.02	2276	0.46
Demand for pub. int. (service)	0.09	0.05	818	0.04	0.03	733	0.54
Demand for pub. int. (free riding)	-0.08	0.05	818	-0.07	0.06	735	0.78
Demand for pub. int. (other)	-0.05*	0.03	818	0.00	0.04	733	0.31
PGG contribution	-0.01	0.02	647	0.01	0.02	581	0.64
Morbidity	0.03	0.03	2517	-0.02	0.04	2276	0.30
Curative exp. (extensive)	0.01	0.04	1709	0.07*	0.04	1567	0.26
Curative exp. (intensive)	-426.43	273.95	1709	471.68	341.07	1567	0.04
Preventive exp. (extensive)	-0.00	0.01	1721	-0.00	0.01	1580	0.80
Preventive exp. (intensive)	-32.22	86.42	1720	73.73	84.60	1580	0.44
C. Non-payment		**Lower**			**Higher**		
Appreciates the service	0.04**	0.02	2330	0.02	0.02	2463	0.41
WTP for service use	-0.03	0.09	4184	-0.06	0.10	4451	0.85
Contribution to service quality	-0.01	0.01	4184	-0.01	0.01	4451	0.82
Awareness of externalities	0.06***	0.02	2330	0.00	0.03	2463	0.10
Demand for pub. int. (service)	0.06	0.05	754	0.04	0.05	797	0.83
Demand for pub. int. (free riding)	-0.14**	0.05	755	-0.02	0.06	798	0.11
Demand for pub. int. (other)	-0.02	0.04	754	-0.03	0.03	797	0.99
PGG contribution	0.00	0.02	600	-0.01	0.02	628	0.80
Morbidity	0.06*	0.03	2330	-0.04	0.03	2463	0.03
Curative exp. (extensive)	0.03	0.05	1608	0.04	0.04	1668	0.86
Curative exp. (intensive)	-158.36	329.89	1608	239.20	309.46	1668	0.38
Preventive exp. (extensive)	-0.00	0.01	1617	-0.00	0.01	1684	0.91
Preventive exp. (intensive)	55.10	98.36	1617	-5.91	76.73	1683	0.69
D. Caretaker's motivation		**Lower**			**Higher**		
Appreciates the service	0.01	0.02	2292	0.04**	0.02	2501	0.27
WTP for service use	0.12	0.08	4124	-0.20*	0.10	4511	0.03
Contribution to service quality	0.00	0.01	4124	-0.01	0.01	4511	0.35
Awareness of externalities	0.03	0.03	2292	0.04*	0.02	2501	0.73
Demand for pub. int. (service)	0.05	0.05	731	0.07	0.05	820	0.80
Demand for pub. int. (free riding)	-0.07	0.07	732	-0.08	0.05	821	0.86
Demand for pub. int. (other)	-0.03	0.04	731	-0.03	0.03	820	0.95
PGG contribution	-0.01	0.02	595	-0.01	0.02	633	0.99
Morbidity	0.01	0.03	2292	0.01	0.03	2501	0.89
Curative exp. (extensive)	0.03	0.04	1561	0.07*	0.04	1715	0.54
Curative exp. (intensive)	145.83	346.06	1561	-126.53	290.99	1715	0.55
Preventive exp. (extensive)	0.00	0.01	1573	-0.01	0.01	1728	0.20
Preventive exp. (intensive)	37.24	84.80	1573	21.52	85.39	1727	0.90

Note. Categories for heterogeneity analysis are defined at baseline, with *lower* (*higher*) indicating whether the variable is smaller than or equal to (larger than) the sample median. In columns (1)–(6), estimates are based on respondent- and household-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. The p-value is relative to the significance of the coefficient on the interaction term. Standard errors are clustered by catchment area–round of observation. 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. Specifications where the level of analysis is the respondent also include gender. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1. *Caretaker's motivation* refers to the caretaker's pro-social motivation for the cause.

B.9 Treatment heterogeneity by gender and religion

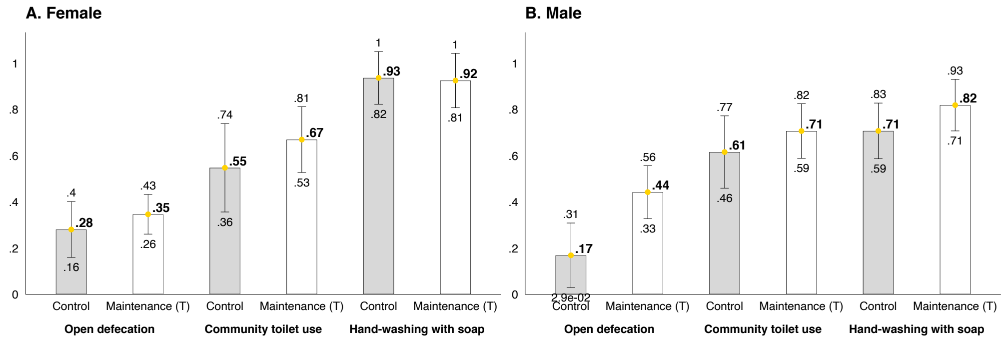
Supplementary Material S.1 discusses the differences by gender for the WTP for the service and for non-payment. Figure B4 shows estimates of the inverse demand curve for service use separately for female and male respondents, while Figure B5 shows estimates of the effect of interventions on hygiene- and sanitation-related behavior using the list randomization technique distinguishing by the gender of the respondent. Tables B15–B16 presents an analysis of heterogeneity by religion for CT- and caretaker-level outcomes and for respondent- and household-level outcomes.

Figure B4: Inverse demand curve for the service, by gender and price level



Note. Each curve indicates the share of respondents who prefer tickets to use the CT to cash at the corresponding price. Panels A1 and A2 restrict the sample to female respondents only, while panels B1 and B2 restrict the sample to male respondents only. The inverse demand curve is elicited using a standard incentivized version of the multiple price list (or take-it-or-leave-it) methodology (Andersen et al., 2006). Confidence intervals are built using statistical significance at the 10 percent level. Supplementary Material S.4 provides details about measurement.

Figure B5: Sanitation- and hygiene-related behavior, by gender



Note. The figure shows the share of slum residents practicing each behavior in the day previous to the interview, estimating using a list randomization technique. Panel A restricts the sample to female respondents, while panel B restricts the sample to male respondents. Randomization of lists was performed at individual level, and data were collected during follow-up 5 only. Supplementary Material S.4 provides details about measurement.

Table B15: Heterogeneity by of religion of potential free riders: CT-level outcomes

	Effect of maintenance treatment, by category						Het. test
	β	se	N	β	se	N	p-value
Outcome variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share of Hindu in catchment area		**Lower**			**Higher**		
Higher quality	0.04	0.06	282	0.19***	0.06	260	0.10
Structural maintenance	0.05	0.08	282	0.05	0.06	260	0.99
Routine maintenance	-0.01	0.03	282	0.07***	0.02	260	0.02
Hours worked	0.14	0.54	282	0.21	0.49	260	0.92
Caretaker's knowledge	0.09**	0.04	282	0.12**	0.06	260	0.66
Users	-0.13*	0.07	281	0.01	0.07	261	0.17
Non-payment	-0.08	0.07	281	-0.07	0.06	261	0.90
Enforcement	-0.01	0.04	57	0.00	0.02	54	0.80
Monitoring	0.05	0.05	282	0.05	0.03	260	0.99
Pro-social motivation	-0.05	0.04	282	0.00	0.03	260	0.31

Note. Categories for heterogeneity analysis are defined at baseline, with *lower* (*higher*) indicating whether the share of potential free riders that are of Hindu religion is smaller than or equal to (larger than) the sample median. Variables referring to catchment areas are averages of the corresponding variable within the catchment area. In columns (1)–(6), estimates are based on CT- or caretaker-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT- or caretaker-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. The p-value is relative to the significance of the coefficient on the interaction term. Standard errors clustered by catchment area. 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. Statistical significance is denoted by *** p<0.01, ** p<0.05, * p<0.1. *Caretaker's motivation* refers to the caretaker's pro-social motivation for the cause.

Table B16: Heterogeneity by religion of potential free riders: household-level outcomes

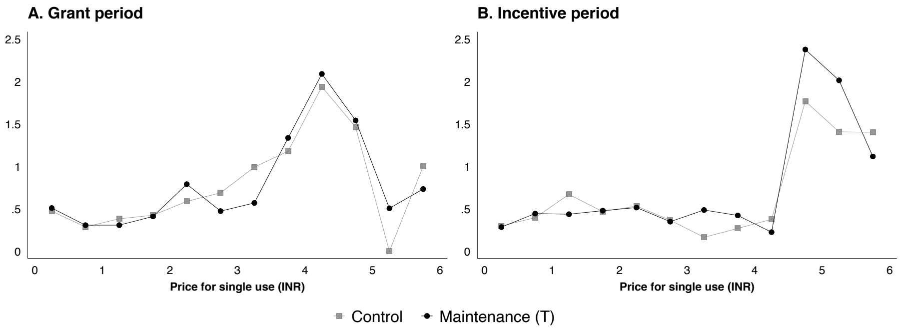
	Effect of maintenance treatment, by category						Het. test
	β	se	N	β	se	N	p-value
Outcome variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)
A. Respondent's religion		**Other religion**			**Hindu**		
Appreciates the service	0.01	0.03	634	0.04**	0.02	3112	0.25
WTP for service use	-0.28*	0.17	1139	-0.02	0.07	5623	0.22
Contribution to service quality	0.01	0.02	1139	-0.00	0.01	5623	0.52
Awareness of externalities	0.02	0.04	634	0.03	0.02	3112	0.76
Demand for pub. int. (service)	0.15**	0.07	196	0.07	0.04	973	0.48
Demand for pub. int. (free riding)	0.12	0.08	196	-0.09*	0.05	975	0.04
Demand for pub. int. (other)	-0.08	0.08	196	-0.05*	0.03	973	0.83
PGG contribution	-0.04**	0.02	145	-0.00	0.02	773	0.07
Morbidity	-0.03	0.05	634	0.02	0.03	3112	0.46
Curative exp. (extensive)	0.04	0.06	404	0.03	0.03	2011	0.87
Curative exp. (intensive)	170.27	687.22	404	-120.17	287.65	2011	0.72
Preventive exp. (extensive)	-0.02**	0.01	406	-0.00	0.01	2025	0.10
Preventive exp. (intensive)	11.67	150.83	405	-10.77	62.44	2025	0.88
B. Share of Hindu in catchment area		**Lower**			**Higher**		
Appreciates the service	0.02	0.02	2345	0.05**	0.02	2448	0.34
WTP for service use	-0.16*	0.10	4236	0.04	0.09	4399	0.25
Contribution to service quality	-0.01	0.01	4236	-0.00	0.01	4399	0.67
Awareness of externalities	0.03	0.03	2345	0.04*	0.02	2448	0.80
Demand for pub. int. (service)	0.09**	0.04	760	0.02	0.05	791	0.31
Demand for pub. int. (free riding)	0.01	0.05	761	-0.15***	0.06	792	0.04
Demand for pub. int. (other)	-0.07**	0.03	760	0.00	0.04	791	0.14
PGG contribution	-0.00	0.02	611	-0.01	0.02	617	0.74
Morbidity	0.03	0.03	2345	-0.00	0.03	2448	0.51
Curative exp. (extensive)	0.03	0.05	1600	0.03	0.04	1676	0.98
Curative exp. (intensive)	-24.68	321.23	1600	63.12	338.25	1676	0.83
Preventive exp. (extensive)	-0.01	0.00	1613	0.00	0.01	1688	0.28
Preventive exp. (intensive)	-5.05	79.91	1612	30.71	100.21	1688	0.84

Note. In panel A, categories for heterogeneity analysis are defined at baseline, with *Hindu* indicating whether the respondent's religion is Hindu. In panel B, categories for heterogeneity analysis are defined at baseline, with *lower* (*higher*) indicating whether the share of potential free riders that are of Hindu religion is smaller than or equal to (larger than) the sample median. In columns (1)–(6), estimates are based on respondent- and household-level OLS regressions using equation (1) separately for each category. Column (7) presents a heterogeneity test based on CT-level OLS regressions using equation (1) and adding an interaction term between the treatment indicator T and an indicator variable for the first category. The p-value is relative to the significance of the coefficient on the interaction term. Standard errors are clustered by catchment-area–round of observation. 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. Specifications where the level of analysis is the respondent also include gender. Statistical significance denoted by *** p<0.01, ** p<0.05, * p<0.1. *Trust in the community* refers to the trust in the community to keep the CT clean.

B.10 Price elasticity of the demand for CT use

Figure B6 shows the price elasticity of the demand for CT use.

Figure B6: Price elasticity of the demand for CT use, by intervention period



Note. The vertical axis is the price elasticity computed as an arc elasticity and calculated between each point and plotted at the midpoint of each segment. The elasticity is derived from the incentivized WTP for the service. Supplementary Material S.4 provides details about measurement.

B.11 Self-reported sanitation and hygiene behavior

Table B17 shows estimates of treatment effects on self-reported sanitation and hygiene behavior.

Table B17: Self-reported sanitation and hygiene behavior

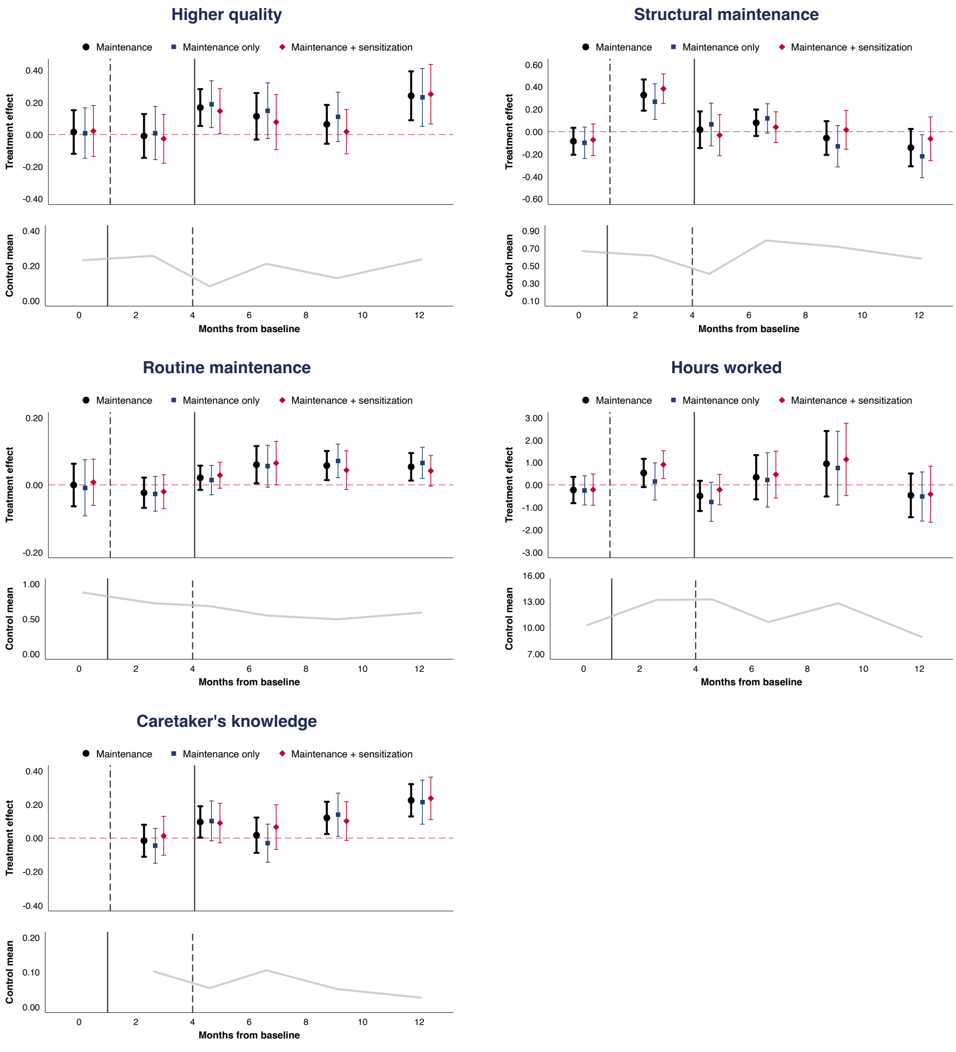
	Open defecation						**Soap use**
	Respondent	Spouse	Male child		Female child		Respondent
			$>$ 14yo	6–14yo	$>$ 14yo	6–14yo	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A							
Maintenance (T)	-0.013	-0.011	-0.010	-0.004	0.006	-0.001	0.014
	(0.025)	(0.022)	(0.015)	(0.014)	(0.013)	(0.012)	(0.007)
	[0.61]	[0.61]	[0.52]	[0.77]	[0.67]	[0.94]	[0.05]
Panel B							
Maintenance only (T1)	0.019	0.022	0.007	0.006	0.024	-0.000	0.017
	(0.032)	(0.028)	(0.019)	(0.019)	(0.018)	(0.014)	(0.007)
	[0.57]	[0.44]	[0.70]	[0.76]	[0.19]	[0.98]	[0.02]
Maintenance + sensitization (T2)	-0.042	-0.042	-0.026	-0.013	-0.012	-0.001	0.011
	(0.027)	(0.024)	(0.016)	(0.016)	(0.014)	(0.014)	(0.008)
	[0.12]	[0.08]	[0.12]	[0.40]	[0.39]	[0.92]	[0.17]
T1 = T2 (p-value)	0.075	0.025	0.103	0.338	0.063	0.944	0.305
Mean (control group)	0.148	0.116	0.090	0.089	0.057	0.058	0.967
Std. Dev. (control group)	0.355	0.321	0.286	0.285	0.232	0.234	0.178
Observations	9588	7908	9588	9588	9588	9588	9588
Catchment areas	110	110	110	110	110	110	110

Note. Estimates based on household-level OLS regressions using equation (1) in panel A, and equation (2) in panel B. Standard errors clustered by catchment area–round are reported in parentheses and p-values in brackets. Dependent variables by column: (1)–(6) *Open defecation*: is an indicator variable equal to 1 if the household member (by demographic group) is reported to have practiced open defecation the last time they defecated, and 0 otherwise; (7) *Soap*: is an indicator variable equal to 1 if the respondent reports washing her/his hands with soap, and 0 otherwise. 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.

B.12 Estimates of treatment effects by survey

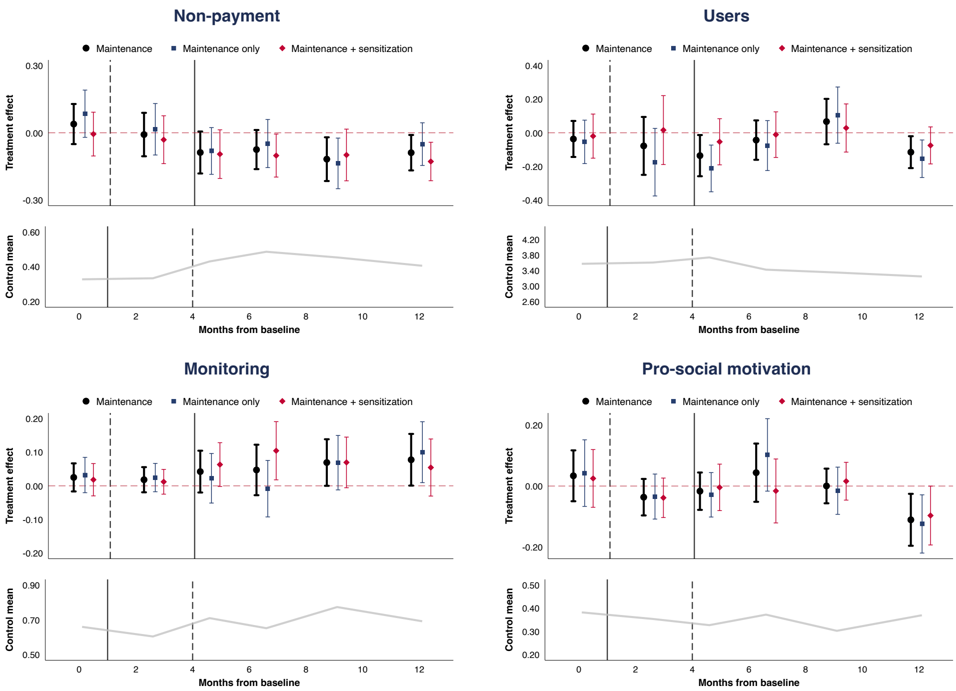
For the outcomes presented in Tables 1–5, this section presents estimates of equation (1) and equation (2) separately for each survey. Estimates are presented in Figures B9–B10. The upper part of each panel presents estimates of treatment effects on the corresponding variable, while the lower part reports the evolution over time of the average of the corresponding variable in the control group. Figures B9–B10 do not report variables that were measured only once.

Figure B7: Timing of effects for outcomes in Table 1



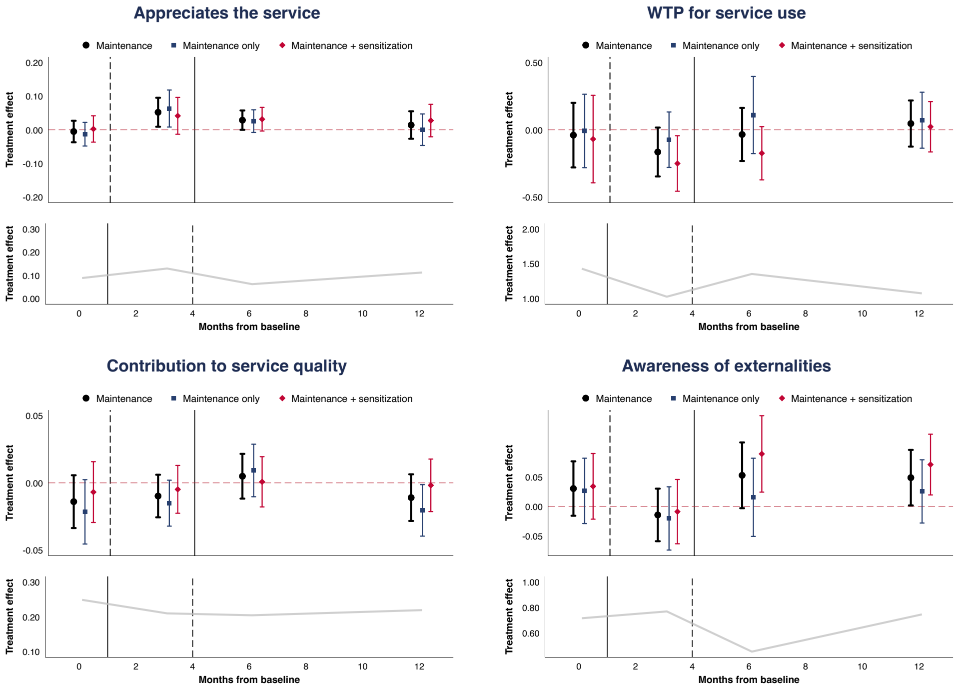
Notes. Estimates based on CT-level OLS regressions using equation (1) and equation (2) separately for each data collection period. Confidence intervals are computed at the 10 percent level of confidence using robust standard errors. Outcome variables are defined in Appendix A. All specifications include strata indicators for the city and the provider of the CT.

Figure B8: Timing of effects for outcomes in Table 2



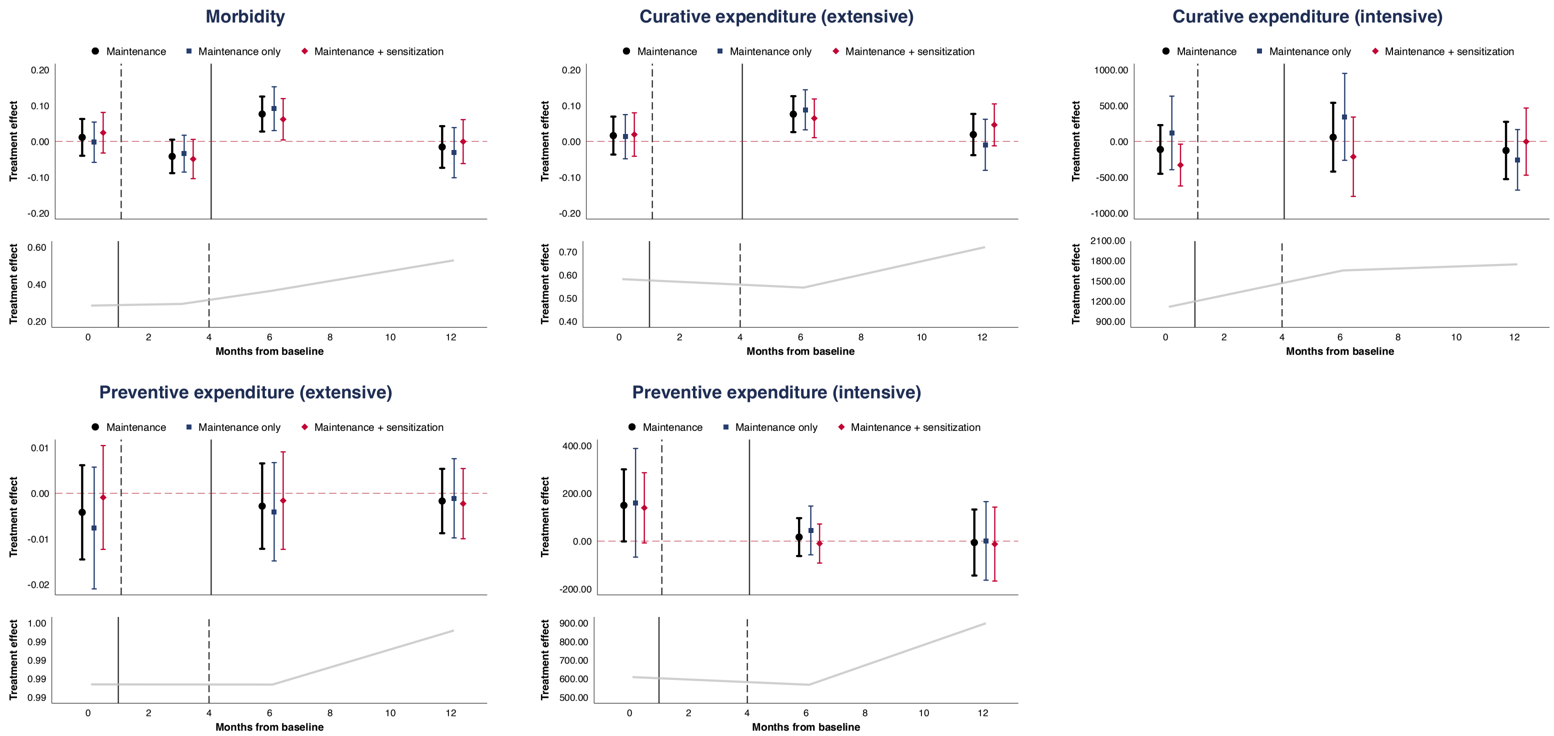
Notes. Estimates based on CT-level OLS regressions using equation (1) and equation (2) separately for each data collection period. Confidence intervals are computed at the 10 percent level of confidence using robust standard errors. Outcome variables are defined in Appendix A. All specifications include strata indicators for the city and the provider of the CT. *Enforcement* is excluded since the measurement is available for only one round.

Figure B9: Timing of effects for outcomes in Table 3



Notes. Estimates based on respondent- and household-level OLS regressions using equation (1) and equation (2) separately for each data collection period. Confidence intervals are computed at the 10 percent level of confidence using standard errors clustered at the catchment area. Outcome variables are defined in Appendix A. All specifications include strata indicators for the city and the provider of the CT. Respondent-level regressions include a control for the gender of the respondent.

Figure B10: Timing of effects for outcomes in Table 5



Notes. Estimates based on household-level OLS regressions using equation (1) and equation (2) separately for each data collection period. Confidence intervals are computed at the 10 percent level of confidence using standard errors clustered at the catchment area. Outcome variables are defined in Appendix A. All specifications include strata indicators for the city and the provider of the CT. Respondent-level regressions include a control for the gender of the respondent.

C Estimates using ANCOVA and IPW specifications

Tables C18–C19 present estimates of treatment effects using equations (1) and (2) adding the value at baseline of the dependent variable as a control variable (ANCOVA specification). The organization of the results and the order of the variables are the same as in Tables 1–5 in the main text. Table C19 also present estimates of treatment effects using equations (1) and (2) weighting observations by inverse probability weights (Wooldridge, 2002).

Table C18: Tables 1–2, estimates with ANCOVA specification

	β (1)	se (2)	p-value (3)	ANCOVA specif (4)
Higher quality	0.11	0.04	0.01	Yes
Structural maintenance	0.06	0.05	0.23	Yes
Inputs	0.03	0.01	0.02	Yes
Hours worked	0.19	0.32	0.55	Yes
Awareness	0.09	0.04	0.01	-
Non-payment	-0.08	0.04	0.04	Yes
Users	-0.05	0.05	0.30	Yes
Enforcement	0.00	0.02	0.92	-
Monitoring	0.05	0.03	0.09	Yes
Pro-social motivation	-0.03	0.02	0.17	Yes

Note. Estimates based on CT-level OLS regressions using equation (1), controlling for the baseline value of the dependent variable if available (see *ANCOVA specification* column). 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.

Table C19: Tables 3–5, estimates with ANCOVA and IPW specifications

	ANCOVA				IPW		
	β (1)	se (2)	p-value (3)	ANCOVA specif (4)	β (5)	se (6)	p-value (7)
Appreciates the service	0.03	0.01	0.02	Yes	0.03	0.01	0.02
WTP for CT use	-0.04	0.06	0.52	Yes	-0.05	0.07	0.43
Preference for maintenance	-0.00	0.01	0.49	Yes	-0.01	0.01	0.26
Awareness of OD externality	0.03	0.02	0.09	Yes	0.03	0.02	0.08
Demand for pub int (CT)	0.05	0.03	0.05	-	0.05	0.03	0.05
Demand for pub int (OD)	-0.07	0.04	0.04	-	-0.07	0.04	0.06
Demand for pub int (Other)	-0.02	0.02	0.38	-	-0.02	0.02	0.39
PGG contribution	0.00	0.01	0.92	-	0.01	0.01	0.61
Morbidity	0.01	0.02	0.78	Yes	0.01	0.02	0.78
Curative exp (extensive)	0.05	0.02	0.05	-	0.05	0.02	0.05
Curative exp (intensive)	-34.27	190.05	0.86	-	-54.28	197.03	0.78
Preventive exp (extensive)	-0.00	0.00	0.53	-	-0.00	0.00	0.48
Preventive exp (intensive)	0.62	49.47	0.99	-	2.59	47.01	0.96

Note. Estimates based on respondent- and household-level OLS regressions using equation (1), controlling for the baseline value of the dependent variable if available (see *ANCOVA specification* column) in columns (1) to (3), and weighting observations by inverse probability weights in columns (4) to (6). Weights are estimated at baseline using a probit regression on indicator variables for attrition at different follow-ups on observable characteristics of the household and of the catchment area where the household resides. All specifications include indicator variables for data collection rounds, and strata indicators for the city and the provider of the CT. Specifications where the level of analysis is the respondent also include gender. Additional details about the variables are presented in Appendix A.