Sanitation dynamics: toilet acquisition and its economic and social implications.

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Abstract

Poor sanitation is an important policy issue facing India, which accounts for over half of the 1.1 billion people worldwide that defecate in the open (JMP 2012). Achieving global sanitation targets, and reducing the social and economic costs of open defecation, therefore requires effectively extending sanitation services to India's citizens. The Indian Government has shown strong commitment to improving sanitation. However, uptake and usage of safe sanitation remains low: almost 50% of Indian households do not have access to a private or public latrine (2011 Indian census). This highlights the need for novel approaches to foster the uptake and sustained usage of safe sanitation in this context. This study contributes to addressing this need in three ways: (1) we use primary data collected in sums and peripheral villages in Gwalior, India, to understand determinants of toilet ownership and acquisition. (2) Toilet acquisition is analyzed in the context of an intervention that alleviated one of the major constraints to acquisition – financial resources - highlighting the importance of attending this constraint. (3) While ours is not a randomized control trial, we are able to offer tentative evidence on the cost and benefits of these acquired toilets to the households. These three contributions have important implications for the design of strategies to promote sanitation, a major focus of many governments of developing countries and international organizations at present.

1 Introduction

More than 1 billion of the world's population lack access to improved sanitation [JMP, 2012]. Many antipoverty programs have aimed to increase uptake and usage by alleviating informational constraints and fostering demand and perceived need. Other programs have (partly) relaxed resource constraint by providing subsidies and more recently there are also attempts of improving access to formal financial services for individual sanitation needs of the poor.

The Government of India (GoI) for example established the Nirmal Bharat Abhiyan (NBA) policy (formerly known as the Total Sanitation Campaign) in 1999. This community led policy aims to increase demand for safe sanitation by providing information on the benefits of sanitation, subsidies for the poorest (Below Poverty Live, BPL) households and funds for construction of

sanitation facilities in schools. These efforts are complemented by a (primarily financial) incentive, known as the Nirmal Gram Puraskar (clean village) (NGP) prize, awarded to communities (Gram Panchayats[1]) which become open defecation free (ODF).

Evidence suggests that this program achieves its ultimate aim of improving the health of Indian's citizens. Spears [2012] and Spears and Lamba [2011] used survey data matched to census and program administrative data to exploit exogenous variation resulting from the temporal implementation of the program and from a discontinuity in the function mapping village population to prize sizes. They found that the TSC had a positive impact on reducing infant mortality and children's height [Spears, 2012], and cognitive achievement at age six [Spears and Lamba, 2011].

However, despite having constructed several million toilets to date, the remaining task for the GoI is daunting. Estimates suggest that construction would need to happen at a rate of one toilet per second to meet set targets [WaterAid-India, 2011]. Apart from these sheer numbers, other challenges include sustainability and accessing the excluded and marginalized (ibid.). Current programs also tend to neglect slum-dweller populations for whom technically feasible and affordable solutions are far and beyond. The 2008-09 National Sample Survey Organisation [NSSO, 2010] survey estimates that 81 per cent of slum-dwellers in India have inadequate access to sanitation.

We use data collected as part of an evaluation effort of a sanitation intervention, to understand determinants of sanitation uptake and acquisition in urban slums and peripheral villages of Gwalior city. Gwalior is a historical and major city in the state of Madhya Pradesh, India, with an estimated slum population of one fourth of its citizens (Kumar & Aggarwal, 2008). This puts Gwalior above the country average of about 17% or urban households living in slums according to the 2011 slum census.

Possibly driven by the fact that the slums in our sample are all officially recognized by the state government (i.e. notified slums), we find a 53% coverage of sanitation in the slums and a 35% coverage in the peripheral villages at the time of the first survey round in 2010. Of the sample households that did not own a toilet, 36% made the transition to own their private toilet by the time of the second round of data collection approximately 3.5 years later. These features of the data allow us to analyze determinants of toilet ownership in the two waves as well as determinants of acquisition between waves. Many of the determinants are in line with expectations: We for example find that richer and more educated households as well as households from higher castes are more likely to own a toilet in both waves. An interesting finding from this first analysis is however is that we observe a shift towards greater inclusion over time along all these margins.

We further analyze potential impacts of toilet ownership by exploring the panel structure of the data, controlling for a large set of covariates, household fixed effects and common-time shocks. We conduct a number of robustness checks on our findings, which show consistency. However, we raise caution that the lack of clear exogenous variation in toilet ownership makes it difficult to attribute observed impacts undoubtedly to toilet ownership.

Our findings in this part of the study indicate that households with toilets experience gains primarily related to their status and living conditions. We find that the reported value of their dwelling increases significantly. Almost 30% of the dwelling's value at the time of the second wave

[1] A Gram Panchayat is a local self government unit, comprising of a small number of villages.

can be attributed to the toilet. Households with sanitation - despite having similar incomes – also own more household and transportation assets.

Our results further provide evidence that female labor supply was reduced both along the extensive and intensive margin for households that acquired sanitation assets. Such a reduction in working (hours) can be related to social status along the same lines as acquisition of sanitation. Around 80% of toilet owners in sample report that their status in the community increased because of the toilet they constructed. It is then not surprising to find that women in our sample report that sanitation mattered in their decision to get married. Coupling this with findings on determinants of toilet ownership there is evidence that marriage and women moving into the husband's family's house are important motivating factors for the acquisition of toilets.

In addition to these changes in status related outcomes, we see a strong correlation of toilet ownership with perceived health. Changes in health expenditures and more objective health measures (such as stool samples and anthropometric measures) are on the other hand not observed.

Finally, as already alluded to through the determinants of toilet ownership in the two waves, our findings suggest that over time, households with less means gained access to sanitation. We find that at the time of the first round of data collection, households with savings were more likely to have toilets, but this relationship is not significant anymore at the time of the second round of data collection. We also find that households with a toilet have larger loans outstanding and this holds particularly true during the second wave. While most households claim to have used their savings for the construction of the toilet, it provides evidence that access to credit plays an important role to allow households to make investments in sanitation.

We are likely to find this evidence due to the program the data collection activities were associated with. The initial purpose of the data was the evaluation of a sanitation intervention called FINISH, which stands for Financial Inclusion Improves Sanitation and Health. This program worked with a local NGO and the key features of the program are the provision of loans for sanitation and awareness creation activities. The evaluation design was experimental in nature, allocating randomly half of the slums and peripheral villages to the intervention and the remaining ones were not to be covered until after the endline survey. Unfortunately, due to the microfinance crisis, which hit the Indian sector just after the baseline data was collected, and other challenges in the field, the randomization was not adhered to.

We are therefore not able to evaluate the impact of the intervention as a whole. However, we note that during the two data collection rounds sanitation activities under the FINISH program took place and credit was provided. While we cannot make any clear statement about its impact, we might expect that some of the increase in coverage would be at least partially driven by program activities. Findings like the ones on importance of loan access support this hypothesis.

The rest of this paper is organized as follows. After this introduction, Section 2 presents the data and more details about the FINISH intervention in Gwalior. Next, Section 3 describes the empirical strategy and considerations to take into account. This is followed by the main results in Section 4 and discussion and conclusion in Section 5.

2 Data: FINISH evaluation in Gwalior

The data we use in this study was collected with the intention of evaluating the FINISH intervention implemented by the NGO Sambhav in Gwalior (Madhya Pradesh). The baseline survey (BL) was conducted between February and April 2010, and the follow-up survey (FU) between March and December 2013. In total, 56 communities were included, 39 slums and 17 peripheral villages (henceforth we will refer to them jointly as communities). 1,982 households (HHs) were interviewed at BL, covering 11,032 individuals. These households are a representative sample of HHs at the community level at that time. For the FU survey 2,020 HHs were interviewed, covering 12,360 individuals. 1,816 of these 2,020 HHs are in both BL and FU, the remaining were included as a replacement sample[2]. The attrition of panel households is hence 8%.

The evaluation design allocated communities randomly allocated to be exposed to the FINISH sanitation intervention (treatment) or a control group. However, due to the implementation issues mentioned above, there is no distinction in terms of treatment and control in the data. As a result, the FINISH intervention cannot be evaluated as planned. We can however - and that is the purpose of this study - use the two survey rounds to gain a deeper understanding of toilet ownership and acquisition. The comprehensive amount of information collected in the two survey rounds makes this possible.

Apart from HH general characteristics, the data includes comprehensive information on living standards, assets, consumption, income, risk perceptions, credits, savings and insurance and demand for health care. A distinguishing feature of the data is an extensive module on sanitation and hygiene facilities, practices and perceptions. On top of that, it also includes a report on observations by the interviewer which provides a second measure on toilet ownership[3] and other hygiene-related facilities.

At the individual level, apart from HH members' socioeconomic characteristics, the survey included a dedicated module for one women per HH. They include time-utilization, hygiene practices and knowledge, and cultural background and empowerment. For children, apart from subjective measures of health status, there is information on time utilization, nutrition and hygiene-related behaviour as well.

Moreover, in terms of objective health information, a stool analysis and anthropometric measurements are available for reduced samples. The anthropometrics data allows for the calculation on stunting, underweight and wasting z-scores designed by the WHO. There is data for 5,429 individuals from 1,673 HHs at the 1st survey round, and 1,035 children in 724 HHs at the second round of data collection. The stool sample,allows for the analysis of bacteria, worms and other signs of diseases that might be related to sanitation and quality of water. It includes Information from 656 children aged 0 to 5 in 499 HHs at the FU. It is important to notice than 300 women refused to provide samples on their children stool, which was collected by them and handed-in to the survey team.

Besides this data, GPS data on HHs, water supplies and open defecation areas (OD) was col-

[2] 14 are observations which were added in the FU to the sample without following the sample criteria.

[3] Respondents and interviewer disagree in less than 5% of the cases. The first case is for respondents who report having a toilet, either the interviewer says that there is no toilet or that the toilet is not observed. The other option is that the respondent says that there is not a toilet but the interviewer says the opposite.

lected as part of the second survey round. This allows for the calculation on distances to OD areas and water supplies for 37 of the communities. Moreover, there are water samples for most HHs of the FU which provide a more detailed picture of one of the potential mechanisms through which sanitation might impact families' lives.

2.1 Descriptive Information

Table 1 provides descriptive statistics of our sample households. These households were a randomly drawn from the study communities, impying that they were representative of these slums and peripheral villages in 2010.

Around 23% of the HHs reported to be Muslim and almost all the remaining Hindu (less than 10 were from other religious background). In terms of caste, 27% HHs report to belong to forward castes (FC), 23% to scheduled castes (SC), 3% to scheduled tribes (ST), 41% to backward classes (BC), 6 % to most backward caste (MBC). On average, our sample HHs comprise of almost 6 members, 3 of which are males. Around 40% of the HHs have at least one child under the age of 6 years. The main woman in the housheold is on average 37 years of age and the large majority (90%) is married. 61% have no formal education, and 13% completed less than grade 5.

Average HH income was around 51,300 Rs per year at the first survey round, while it was 72,400 Rs at the second round approximately three years later. As India's inflation rates are 8.9%, 9.3% and 10.9% for 2011, 2012, 2013 (WDI, World Bank), the general increase on national consumer prices between thetwo survey rounds was around 32%. That means that the round one average income figure at 2013 prices is around 67,716 Rs. Households hence experienced a real increase in their average yearly income of apx. 7% between the two survey rounds.

At these income levels, housheolds are way below the commonly used international poverty line of 1.25 USD per person per day. Taking the 2010 first quarter exchange rate of about 1 USD to 46.5 INR, our households - which consiste of on average 6 members - earned on average 3 USD per day at the time of the first survey round.

Close to 90% of the HHs were owners of their dwelling, and they estimate their houses to be valued at 121000 Rs at the BL (160,010 Rs at 2013 prices) and 175000 Rs at the FU. 25% of them had access to water through piped-water. For those HHs for which there is information on distance to Open Defecation (OD) areas (80%), the average distance is 1.3 Km. For the case of the distance to the nearest water source (available for 83% apx.), it is 6.6 Km.

As describe before, we have information on a wide set of characteristics of the HHs. The average of such variables are available in Tables ??, ??, ??, and ??, which also include our results. We will discuss these tables in detail will describing the results from our empirical strategies.

Table 1: Descriptive Statistics

	Round 1 (2010)			Round 2 (2013)		
	N HHs	Mean	SD	N HHs	Mean	SD
HH Income						
Income, 1000s of Rs†	1958	67.7	67.7	1952	67.7	47.4
Income Quartile 2 or above	1958	74.9%	74.9	1952	74.9%	43.7
Income Quartile 3 or above	1958	49.5%	49.5	1952	49.5%	49.8
Income Quartile 4	1958	24.9%	24.9	1952	24.9%	43.3
Any household shock last 12 months (lost job, robbery, natural disaster, bad har	2182	7.6%	7.6	2182	7.6%	30.1
Social background						
Muslim vs Hindu	2177	23.2%	23.2	2177	23.2%	42.2
Caste FC vs BC	2149	27.3%	27.3	2149	27.3%	44.5
Caste MBC vs BC	2149	5.8%	5.8	2149	5.8%	23.3
Caste SC vs BC	2149	22.8%	22.8	2149	22.8%	41.9
Caste ST vs BC	2149	3.0%	3.0	2149	3.0%	17.1
HH Demographic Composition						
HH: size	1977	5.6	5.6	2008	5.6	2.3
HH: number of males	1977	3.0	3.0	2008	3.0	1.4
HH: 1 if at least 1 children 0 to 5	2182	44.6%	44.6	2182	44.6%	49.9
Risk Everything (50Rs): One if bet all to the riskiest scenario	1649	18.8%	18.8	0	18.8%	.
Discount factor: 1 if accepts only 1000, close to 0 if accepts almost nothing fo	1631	0.6	0.6	1976	0.6	0.3
Main Woman: Age	1913	36.6	36.6	1834	36.6	12.5
Main Woman: Never Married vs. Married	1916	1.3%	1.3	1831	1.3%	17.4
Main Woman: Widowed vs. Married	1916	6.4%	6.4	1831	6.4%	24.3
Main Woman: Educ I-V vs. No Educ	1934	12.9%	12.9	1838	12.9%	35.0
Main Woman: Educ VI-VIII vs. No Educ	1934	10.6%	10.6	1838	10.6%	33.9
Main Woman: Educ IX or above vs. No Educ	1934	6.9%	6.9	1838	6.9%	29.8
Dwelling Characteristics						
Dwelling: own	1978	86.9%	86.9	2182	86.9%	38.4
Dwelling: in a Slum	2182	61.6%	61.6	2182	61.6%	48.6
Distance to the border of the closest OD area (100m)	2182	0.9	0.9	2182	0.9	1.4
Distance from HH to nearest water source (100m)	2182	5.8	5.8	2182	5.8	6.8
Distance to the nearest Water Source not available	2182	24.1%	24.1	2182	24.1%	42.8
Distance to the OD border not available	2182	27.1%	27.1	2182	27.1%	44.5
Village: % Water piped to HH (1pp)	2182	21.4	21.4	2182	21.4	18.8
Village: sample size	2182	71.5	71.5	2182	71.5	53.9

† Rupees of 2013: Round 1 values where adjusted by a factor of 1.32. It was calculated based on national level figures for 2011, 2012 and 2013.

2.2 Sanitation data

The main component of the instrument is the module on sanitation. From this we know that about 42% of the HHs at the time of round 1 data collection reported to have a toilet of their own (826 out of 1,978 HHs). This figure changes considerably by the location of the community: in peripheral villages about 24% of households had a toilet and in urban slums it was 53%. By the time of the second survey round sanitation coverage was close to 60% in our study communities: 43% in peripheral villages and 71% in urban slums. These figures are shown in Table 2.

Table 2: Reported Toilet Ownership

Community	**Round 1 (%)**	**Round 2 (%)**
Peripheral village	24.48	43.06
Slum	52.73	70.75
Total	41.76	59.96

Of the 1,152 households that did not have a toilet at the first survey round, 1,053 were reinterviewed during the second round and 36% of them made the transition to become owners of toilets. This substantial transition will allow us to analyse the dynamics of toiler-ownership.

Most of this sanitation access expansion in our study area in the city of Gwalior is based on toilets that are not linked to a drainage system. As shown in Table 3, only 13% of households reported their toilets to be linked to a drainage system in 2010. We see an increase of this percentage to 31% in 2013. However, 77% of the toilets that were constructed between the two waves do not rely on drainage systems. In most cases they were single-pits, twin-pits and a small percentage of households report to have a septic tank.

Table 3: Types of Toilet

Grouped Type	**Round 1 (%)**	**Round 2 (%)**	**Round 2 New (%)**
No drainage system	61.7	66.6	77.4
Drainage system	12.8	30.8	20.8
Other	25.2	2.4	1.8
Don't know	0.3	0.3	0.0

Interviewers were asked to inspect the toilets and reported that above 85% of them were at least 'reasonably clean' (see Table 4). Most (about three quarters) were also reported to have handwashing facilities on site.

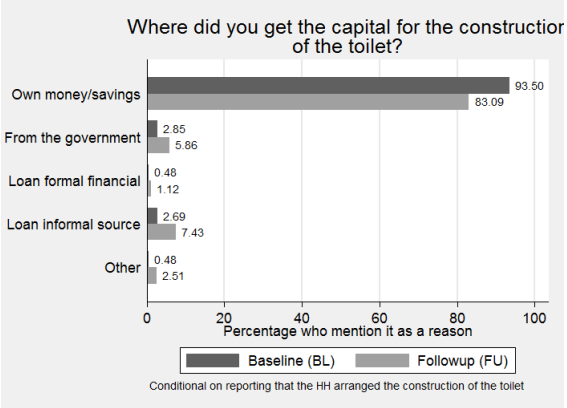
Figure 1a provides information on financing of toilets. In both survey rounds the predominat sources reported by households were own savings: 94% reported in 2010 to have financed their toilet with savings and 83% in 2013.Most of the remaining 6% of households in round 1 mentioned otherwise subsidies from the government and informal loans as sources for capital for the construction

Table 4: Toilet General State

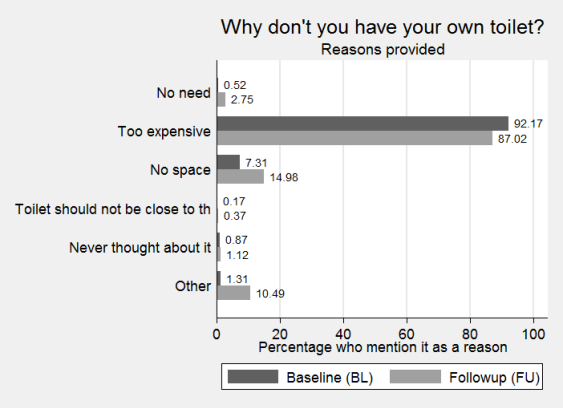
Grouped State	**Round 1 (%)**	**Round 2 (%)**	**Round 2 New (%)**
At least "reasonably clean"	85.0	90.3	86.4
Hand washing facilities	74.6	70.0	67.5

Figure 1

(a)



(b)



of their toilet. These two sources gained in importance between the two survey rounds with 13% of households reporting them.

Given the average yearly income of our sample households and the fact that funding for toilets are primarily savings, it then comes at no surprise that financial constraints are the main constraint to toilet acquisition reported (as shown in Figure 1b). It is noteworthy though that the percentage of households citing funds as the main constraint drops from 92% in 2010 to 87% in 2013. This comes with a dramatic increase in access to credit market between the two waves: loans as a proportion of income increase from around 10% to 20% of the HH income, and having taken a loan during the last year changed from 26% to 48%. Is this greater financial inclusion related to toilet acquisition? We will analyse that with more detail later.

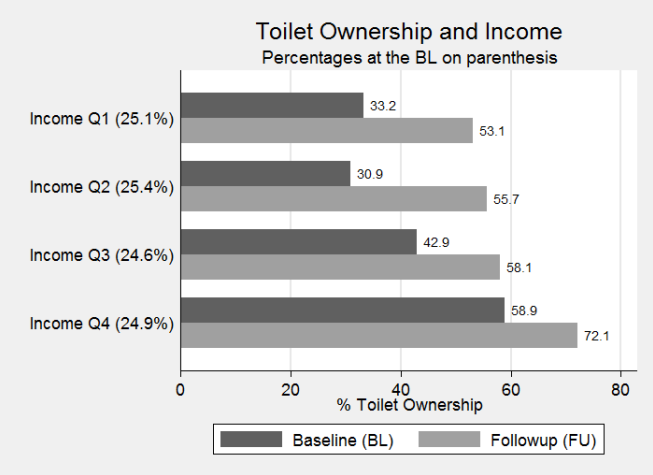
3 Methods and results

Our analysis has two main objectives: (1) Assessing determinants of toilet ownership and acquisition and (2) understanding impacts of toilet ownership on a number of outcomes. The latter analysis tries to tease out causality attached to observed correlates.

Take the example of household income. Our data confirms the common observation that income is a major driver of toilet-ownership: HHs with higher income are more likely to own a toilet. This is depicted in Figure 2, where we plot the percentage of HHs owning a toilet against the income quartile they fall into. We observe a strong gradient in the first survey round, which declines in the second round but still shows that rhicher households are more likely to have a toilet. In this example, our analysis on determinants of toilet ownership looks at whether such correlations remain even when accounting for other household characteristics. The second part of the analysis tries to understand whether owning a toilet affects the amount of income a household receives.

A well executed experimental evaluation design would allow to clearly attribute any role that toilet ownership plays in an observed change in household income. In our setting however, where no such clear exogenous variation is introduced, stronger assumptions need to be made. For some

Figure 2



outcomes - such as income - the task becomes particularly difficult as the direction of causality is not easily defined: more income implies further access to sanitation but improved health can yield to higher income. We describe in section 3.2 the approach we use and assumptions we need to make.

Before doing so, we however dive into the analysis of determinants of toilet ownership and acquisition, discussing in more detail the methodology used and presenting our findings.

3.1 Determinants of toilet ownership and acquisition

In this section we explore what household characteristics are associated with sanitation uptake. The features of our data allow us to analyze two types of variation: cross-sectional and longitudinal. Exploring the cross-sectional variation informs us about characteristics that are correlated with toilet ownership at a specific point in time, even if these characteristics vary little over time, such as religion or caste. We can compare findings for the two survey rounds and learn which covariates are important determinants consistently in both years. The longitudinal feature of our data enables the analysis of the role of variables that show variation over time. It further allows us to analyze determinants of toilet acquisition. By zooming in on households that had no toilet at the time the first round of data was collected, we can correlate household characteristics on toilet acquisition.

Methodology

For the cross-sectional analysis we use a linear probability model. It establishes the correlation between a set of covariates X and toilet ownership status T at data collection wave τ as shown in Equation 1. Variables vary at the level of the HH i, the community j and at time t. The vector of estimated parameters $\hat{\beta}_1$ gives us an idea of the correlation between each variable on the right hand side and toilet ownership, assuming that it is linear relationship.We cluster the error term at the community level. This parameter $\hat{\beta}_1$ would provide the causal effect only if any omitted variable, that is unobserved but is related with T, is uncorrelated with the variable of interest x. Further, the

direction of causality would have to be clearly determined - as discussed previously taking income as an example. An example of a variable where the direction would be easily established is caste: a household's caste might influence toilet acquisition but the reverse is unlikely to hold: acquisition of a toilet would not change the caste of a household.

$$T_{i,j,t=\tau} = X'_{i,j,t=\tau}\beta_1 + \eta_j + u_{i,j,t=\tau} \tag{1}$$

To analyse determinants of toilet acquisition we constrain our sample to households that had no toilet in 2010. We again estimate a linear probability model, but make now use of the longitudinal feature of our data: the left-hand side is the status of toilet-ownership in 2013, while the right-hand side are covariates measured at the time of the first survey round in 2010. This is shown in Equation 2. The same caveats on identification on causal effects apply, but in terms of policy implications it provides an interesting framework: we can learn whether some particular characteristics actually determine the decision of a HH to invest in sanitation. As before, error terms are clustered at the community level.

$$T_{i,j,t=2} = X'_{i,j,t=1}\beta_2 + \eta_j + u_{i,j,t=2} \quad | \quad T_{i,j,t=1} = 0 \tag{2}$$

We can go a step further and exploit not only variation on access to sanitation over time but also variation on some of the covariates. This motivates the implementation of a linear panel specification as shown in Equation 3, which controls for HH fixed effects and common-time shocks. For some variables it is possible to get closer to a causal link once such within HH variation is available. For instance, cross-sectional variation on income and access to sanitation might be masking fixed characteristics of the HHs that are correlated with both of them, such as for example unobserved cultural behaviour that might differ in a pattern similar to income. This issue can be addressed once we exploit the longitudinal feature of the data. It is important to notice that for some variables this might not only provide no advantage at all, but it might also generate further biases on the estimation. That is the situation of variables with low within-individual variability, like cultural background.

$$T_{i,j,t} = X'_{i,j,t}\beta_3 + \alpha_i + \gamma_t + u_{i,j,t} \tag{3}$$

Results

Table 5 presents the results of the analysis of determinants of toilet ownership and acquisition. We look at the same covariates as used to describe our sample households in section 2.1. We repeat the sample averages for each covariate in columns 1, 3 and 5. Since sample sizes change slightly with each specification, the averages might differ somewhat in each column and in comparison to those presented in Table 1. Columns 2, 4, 6 and 7 present the estimated coefficient β for the covariates under the three different specifications discussed above (equations 1, 2 and 3).

We will start by discussing findings about which household characteristics are correlated with toilet ownership, presented in column 2 for 2010, column 4 for 2013.

Determinants of toilet ownership

The top panel of Table 5 concentrates on the role of household income. As income itself might be and outcome, due to the potential improvement of health and productivity, the variable is aggregated by quartiles for this cross-sectional analysis. In both survey rounds we find confirmed that households of higher income are significantly more likely to have a toilet - this holds particularly for households of the fourth quintile. While the estimated coefficient is statistically significant at the conventional level of 5% in both years (columns 2 and 4), the size of the coefficient decreases over time. In other words, the correlation is declining over time, possibly reflecting that poorer households catch up with richer ones in terms of the likelihood of owning a toilet. This is a finding our descriptive analysis already suggested. It is worth stressing though that reverse causality is likely to play an important role: part of that positive correlation might be because HHs with improve hygiene might be more productive. This issue is not solved in this analysis.

We find a very similar pattern to that of household income for the social background of the households. Even when we take into account household income (as done throughout in the analysis), forward caste households are more likely than backward caste ones to have own a toilet whereas schedule castes and tribed are less likely to have one in ocmparison to backward caste households. There are slight differences over time, but the genral picture is consistent in both years.

The data does not reveal any significant difference in toilet ownership patterns by the religion of the household.

However, we further look at the correlation of demographic composition of the household with toilet ownerhip. While one might expect larger households to be more likely to own a toilet due to higher demand, we do not see this reflected in the context of our data. Interestinlgy though, in 2010 the presence of more females made toilet ownership more likely. This correlation is not found anymore in 2013. Consistently over the years though is a positive and significant correlation between toilet ownerhisp and the education level of the main woman in the household.

The final set of variables we look at is the location of the hosuehold's dwelling. We find that at the time of the first survey round, living in a slum is associated with a significantly lower probability of having a toilet - a relationship not applicable anymore in 2013. No significant relationship between toilet ownership and distance to open defecation (OD) areas or community water sources is found. However, a particularly interesting point is that having a toilet is *less* likely in larger communities as well as in communities that have access to piped water (despite already controlling for village fixed effects). The former might be driven by space constraints. As can be seen in Figure 1b, space was the second most important constraint mentioned by households that do not have a toilet.

Determinants of toilet acquisition

Results on our estimations on correlations with toilet acquisition are presented in columns 6 and 7 of Table 5. Column 6 reflects a static approach, where we look at how household characteristics in round 1 influence toilet uptake by the time of round 2. Column 7 presents a dynamic approach to the estimation. The results from estimating equation2 do not show any significant correlations between toilet acquisition and variables related to household income, social background and household composition, except for some indication that households in which the main woman was younger

never married were less likely to acquire a toilet.

The dynamic analysis throws some more light on acquisition of toilets between the two waves. We for example see that increasing household yearly income by 10,000 Rs (close to £120 GBP in 2013) would increase the likelihood of having constructed a toilet between waves by 1.5 percentage points. This is a surprisingly low percentage especially when considering that - according to the implementing organisation of the sanitation intervention - 10,000 Rs were enough at that time to cover the costs of a complete and usable toilet, comprising of a pit, seat and platform, as well as a superstructure with roof and a door. A possible explanation would be that the average yearly household income increased around 7% in real terms over the three years, and this common shock might be enough to allow most of the HHs to get access to sanitation, if they wished.

Of further importance seems to be changes in the household composition: The arrival of a new HH member does increase the likelihood of constructing a toilet significantly. We also find though that this increase is not due to the birth of a household member. This new adult member might bring additional resources that allow making the investment in a toilet. A possible explanation is marrigae and two mechanisms come to mind: the first one is that the construction of a toilet might have been one of the conditions to agree to the marriage. This is not unlikely considering campaigns of the Indian Government using slogans such as "no loo no bride". The second mechanism could be a dowry, which allows the construction of a toilet. While some households might have reported any income from dowry in the section on household income (which is already accounted for in the analysis), it is likely that the majority would not have reported this source as dowries are illegal in India. Findings we present in the next section where we analyse the link between toilet ownership and outcomes suggest that the marriage itself rather than the dowry paid plays a larger role.

Toilet acquisition can come from construction but it is also possible that households moved from a dwelling without a toilet to one with. Households that migrated within a community where tracked at the followup survey to the extent possible. Such a change in dwelling is however not found to be relevant, possibly because the majority of households own their dwelling. In addition to the ownership status, we find that the location in terms of living in a slum or peripheral village is not a siginficant determinant of toilet acquistition. We again look also at the location of the household's dwelling in relation to OD areas and water sources. While an intuitive hypothesis would be that HHs that are located far from OD areas would be more willing to invest in sanitation, our results suggest a different picture: being closer to the OD area increases the likelihood of construct a toilet between the two survey rounds. However, this finding should be taken with caution as for one our sample size is reduced by about 20% due to missing information. Observables suggest that the data is missing at random though. Second, the variation in distance to OD areas is low with an average of one kilometer between the OD area and the household's location.

Table 5: Toilet ownership Determinants: cross-section

Eq1. Cross-section τ : $Toilet_{i,j,t=\tau} = \beta X_{i,j,t=\tau} + \eta_j + u_{i,j,t=\tau}$
Eq2. Cross-section Construction: $Toilet_{i,j,t=2} = \beta X_{i,j,t=1} + \eta_j + u_{i,j,t=2}$
Eq3. Panel: $Toilet_{i,t} = \beta X_{i,t} + \alpha_i + \gamma_t + u_{i,t}$
Sample: All available data in each survey at HH level. **Restricted (R):** HHs that did not report having a toilet at the BL.

	Cross-section analysis						Panel
	Baseline		Follow-up		Restricted Construction		Linear Panel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent Variables X	$\bar{X}_{t=1}$	Eq1	$\bar{X}_{t=2}$	Eq1	$\bar{X}_{t=1}$	Eq2	Eq3
HH Income							
Income Quartile 2 or above	*77.9%*	0.61	*74.3%*	2.33	*74.9%*	4.64	
		(3.11)		(3.83)		(3.80)	
Income Quartile 3 or above	*51.9%*	5.76*	*45.6%*	2.73	*44.0%*	2.98	
		(3.33)		(3.03)		(5.00)	
Income Quartile 4	*24.2%*	12.78***	*25.3%*	9.67***	*17.3%*	−1.25	
		(3.07)		(2.98)		(5.38)	
Income, 1000s of Rs†	*68.1*		*73.0*		*59.8*		0.06**
							(0.03)
Social background							
Muslim vs Hindu	*24.8%*	−4.05	*22.8%*	−1.12	*25.2%*	−7.09	
		(4.18)		(4.80)		(7.03)	
Caste FC vs BC	*28.7%*	4.68	*27.7%*	8.90**	*27.3%*	6.12	
		(4.45)		(3.44)		(6.35)	
Caste MBC vs BC	*6.4%*	−0.53	*5.5%*	3.90	*6.6%*	−0.97	
		(4.90)		(4.82)		(7.10)	
Caste SC vs BC	*23.7%*	−6.84**	*22.8%*	−9.19***	*24.7%*	−5.80	
		(3.23)		(3.28)		(5.39)	
Caste ST vs BC	*2.3%*	−17.36**	*3.1%*	−5.90	*2.9%*	−2.43	
		(6.58)		(4.74)		(6.48)	
HH Demographic Composition							
HH: size	*5.5*	0.70	*6.1*	0.30	*5.5*	−0.57	4.55***
		(0.70)		(0.65)		(0.92)	(1.01)
HH: number of males	*3.0*	−2.29*	*3.1*	0.03	*3.0*	0.13	−0.58
		(1.21)		(1.03)		(1.71)	(1.51)
HH: 1 if at least 1 children 0 to 5	*40.4%*	−2.02	*41.2%*	0.52	*41.0%*	−0.92	−5.71**
		(2.16)		(2.61)		(4.09)	(2.66)

Continued on next page

Table 5: (Continued)

	Cross-section analysis						Panel
	Baseline		Follow-up		Restricted Construction		Linear Panel
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Independent Variables X	$\bar{X}_{t=1}$	Eq1	$\bar{X}_{t=2}$	Eq1	$\bar{X}_{t=1}$	Eq2	Eq3
Main Woman: Age	*36.2*	-0.27^{*}	*37.9*	0.17	*36.1*	-0.46^{*}	
		(0.16)		(0.12)		(0.24)	
Main Woman: Never Married vs. Married	*0.9%*	0.91	*3.1%*	6.69	*0.6%*	-43.22^{**}	
		(13.47)		(7.98)		(19.07)	
Main Woman: Widowed vs. Married	*5.3%*	−6.43	*6.7%*	−5.39	*5.0%*	−6.12	
		(5.25)		(3.95)		(10.25)	
Main Woman: Educ I-V vs. No Educ	*11.9%*	3.40	*14.4%*	8.09^{***}	*11.0%*	0.62	
		(4.68)		(2.77)		(5.31)	
Main Woman: Educ VI-VIII vs. No Educ	*10.7%*	8.33^{**}	*13.2%*	8.10^{**}	*7.6%*	4.78	
		(3.53)		(3.64)		(7.32)	
Main Woman: Educ IX or above vs. No Educ	*7.0%*	9.88^{*}	*9.3%*	14.34^{***}	*3.7%*	6.61	
		(5.15)		(4.29)		(10.34)	
Dwelling Characteristics							
Dwelling: own	*86.7%*	5.02	*90.1%*	4.43	*90.4%*	0.92	2.15
		(4.39)		(4.05)		(6.09)	(4.05)
Dwelling: in a Slum	*60.1%*	-75.05^{***}	*57.6%*	19.90	*46.3%*	−204.87	
		(14.57)		(37.03)		(179.49)	
Distance to the border of the closest OD area (100m)	*1.0*	−0.06	*1.0*	−2.50	*1.1*	-3.44^{*}	
		(2.17)		(1.53)		(1.99)	
Distance from HH to nearest water source (100m)	*5.9*	−0.31	*6.5*	−0.27	*6.8*	−0.20	
		(0.23)		(0.42)		(0.44)	
Village: % Water piped to HH (1pp)	*21.0*	-4.89^{***}	*22.5*	−1.53	*12.3*	1.69	0.27
		(1.02)		(1.16)		(1.82)	(0.17)
Village: sample size	*57.7*	-4.22^{***}	*58.6*	−0.39	*62.9*	1.58	
		(0.88)		(0.26)		(1.58)	
Total N Observations		1535		1572		882	3478
R^2		0.42		0.31		0.24	0.05
Adjusted R^2		0.39		0.27		0.17	0.05

† Rupees of 2013: BL values where adjusted by a factor of 1.32. It was calculated based on national level figures for 2011, 2012 and 2013.
X_i includes socio-demographic controls of the main woman, HH head and the HH demographics and socio-economic status. Robust SE on parenthesis. Significance: * 10%, ** 5%, *** 1%.

3.2 Toilet ownership and outcomes

We now turn to understanding links between toilet ownerhip and an number of outcomes. Idealy, we would like to answer the question of what the impact of owning a toilet is on vairables reflecting for example health and productivity of household memebers. However, as discussed before, we lack of a clear exogenous variation on toilet ownership makes it hard to address this question. We proceed in line with our analysis above to move away from correlations and get closer to causality.

Methodology

We can gauge the direction and size of potential impacts by analysing how outcomes Y_i are related to toilet ownership T_i, conditional on the determinants X_i. This regressions we run is essentially the same as presented in the previous section, but changing the depentent variable (concentrating on outcomes) and adding toielt ownerhip as the main covariate of interest. Equation 4 presents the cross-section analysis and Equation 5 the between one.

$$Y_{i,j,t=\tau} = \delta T_{i,j,t=\tau} + X'_{i,j,t=\tau}\omega_1 + \eta_j + u_{i,j,t=\tau} \tag{4}$$

$$Y_{i,j,t} = \delta T_{i,j,t} + X'_{i,j,t}\omega_2 + \alpha_i + \gamma_t + u_{i,j,t} \tag{5}$$

We furthermore make now also use of information at the individual level, such as results from stool samples and anthropometic measurements as well as information on economic activities. A lot of this information was only collected during the second survey round which motivates Equation 6.

$$Y_{i,j,t=2} = \delta T_{i,j,t=2} + X'_{i,j,t}\omega_3 + \eta_j + u_{i,j,t=2} \quad | \quad T_{i,j,t=1} = 0 \tag{6}$$

Results

We present our findings clustered around different areas: Health, productivity and time use, household's wealth and finances and a set of variables focusing on the main woman in the household. The result tables are all set-up similar to those presenting findings on determinants of toilet ownership and acquisition (Table 5). The main difference is columns 3, 6, 9, and 11 now present the estimator for δ (associated with toilet ownership) for each dependent variable Y. As before, we provide the average for each outcomes (columns 2, 5, 8) for the relevant sample. Sample sizes are shown in columns 1, 4, 7 and 10.

Results - Health & Environment

One of the main objectives of improving sanitation coverage is an improvement in the health situation. Sanitation in its broad sense is the maintencance of hygienic conditions. Toilets in this context act to prevent human contact with faeces. To gauge whether the construction of toilets improved the health of our study population, we distinguish between two sets of health outcomes: subjective and objective measures.

Our subjective health indicators are perceived health, health seeking behaviour and incidence of illnesses. Regression estimates are reported in the upper panel of Table 6.

Respondents were asked to rate their own and their family's health on a scale from 1 to 10 (with one presenting very poor health). They were also asked to rate their health in comparison to other community members of simlar age and gender. While the coefficients on toilet ownership are all estimated to be positive, none is significant at the convetional level of 5% in our cross-sectional analysis. However, in our panel specification we find an interesting pattern: While having a toilet is not correlated with rating ones own and ones family's health higher, the main respondent is 9.72 percentage points more likely to perceive him/herself as healthier than peers in thecommunity and 9.72% more likely to perceive his/her family as healthier than other families in the community.

In terms of reported illnesses and health seeking behaviour we find little evidence for impacts of toilet ownership.This might be driven by the fact that HHs that invested in sanitation are more likely to adhere to hygienic and preventive behaviour, but at the same time, healthier individuals require less health care. The only significant relationship we find is again in the panel specification where the coefficient on toilet ownership suggests a reduction in visits to any type of health care providers that did not lead to hospitalization. For incidence of diarrhoea, only siz percent of children were affected at the time of the survey rounds which is likely to limit our ability to detect any chances with the sample size at hand.

In terms of more objective health measures we have information on stool sample analysis for children under the age of 6 as well as anthropometric measures. Findings on outcomes based on anthropometric measures are inconclusive and suggest primarily zero impacts. A number of estimated coefficients are negative but not significant. We however do not present them here for two main reasons (i) the measure of age of the children turned out to suffer from significant measurement error and (ii) the set of children that could be followed and matched over the three year period is too small for any meaningful analysis. We therefore are not able to present any reliable evidence of links between our sample toilets and changes in measures such as wasting, stunting and underweight.

Stool sample examination results are only available for the second survey round, hence constraining us in the methods we can apply. Overall we do not find important correlations and patterns. There is some indication that constructed a toilet might be more likely to experience a small degree of malabsorption (based on higher likelihood of mucus and fat in the stool), but no difference is found for indicators of parasite infections for households with and without toilets (based on OVA and cysts in the stool as well as acid reaction).

We finally present results on water samples that were taken at the household level and tested for colony counts and other water quality indicators. Again, we do not find any difference in the quality that could be related to toilet ownership. The coefficient on the colony count is positive but not significant, providing therefore no reason to believe that toilets might be of bad quality and leading to bad quality drinking water. This could also be driven by a high chlorine coverage in the water. For both household types (with and without toilets) the PH is with a level of 7.2 within the commonly accepted range of 6.5-8.5.

Table 6: Toilet ownership and Outcomes - Health

Eq4. Cross-section τ **:** $Y_{i,j,t=\tau} = \delta Toilet_{i,j,t=\tau} + \beta X_{i,j,t=\tau} + \eta_j + u_{i,j,t=\tau}$, **Eq5. Panel:** $Y_{i,t} = \delta Toilet_{i,t} + \beta X_{i,t} + \alpha_i + \gamma_t + u_{i,t}$

	Cross-section analysis									Panel	
	Round 1 (2010)			Round 2 (2013)			Restricted Round 2†			DID on R.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome Variables Y	N	$\bar{Y}_{t=1}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	Eq5
Rating own health (1-10; 1=very poor)	1847	*7.0*	0.10	1592	*8.6*	0.04	951	*8.6*	0.08	1042	0.12
			(0.07)			(0.09)			(0.12)		(0.11)
Perceive himself as healthier than others	1838	*32.2%*	4.53	1559	*29.1%*	−0.85	929	*29.7%*	0.28	1019	9.72**
			(3.20)			(2.37)			(2.64)		(4.22)
Rating family's health (1-10;1=very poor)	1841	*6.9*	0.06	1589	*8.8*	0.15*	949	*8.7*	0.19	1040	0.11
			(0.07)			(0.09)			(0.12)		(0.11)
Perceive family as healthier than others	1836	*29.8%*	2.37	1552	*28.0%*	0.73	925	*27.5%*	4.03	1015	8.87**
			(2.82)			(3.04)			(3.99)		(4.19)
Did any children have diarrhoea last week?	1858	*11.6%*	−0.43	1592	*6.3%*	1.40	951	*6.2%*	2.44	960	0.65
			(2.06)			(1.36)			(2.16)		(2.67)
Health provider visited, last 4 weeks	1841	*25.4%*	1.78	1592	*44.0%*	2.82	951	*44.6%*	−1.30	1042	−8.66**
			(2.29)			(2.64)			(3.82)		(3.96)
Average medical costs over all visits, Rs††	1769	*132.9*	27.24	1474	*311.1*	7.21	882	*320.5*	9.00	969	67.44
			(38.32)			(59.08)			(83.44)		(73.54)
Hospitalization, last 12 months	1867	*8.9%*	−0.80	1592	*14.4%*	2.40	951	*13.0%*	−0.96	1042	−3.95
			(2.19)			(2.39)			(2.97)		(2.63)
Presents mucus in the stool				317	*46.4%*	15.06**	197	*47.2%*	10.00		
						(7.23)			(9.67)		
Presents stool acid reaction				317	*67.2%*	−4.72	197	*72.1%*	−7.04		
						(3.89)			(6.94)		
Presents OVA in the stool				317	*23.0%*	1.45	197	*20.8%*	−11.69		
						(5.68)			(7.77)		
Presents Cyst in the stool				317	*4.1%*	0.40	197	*5.1%*	−0.60		
						(3.20)			(3.51)		
Presents fat in the stool				317	*49.2%*	13.57	197	*53.3%*	13.36*		
						(8.70)			(7.88)		
Water Sample: chlorine present				1592	*47.9%*	0.43	951	*54.6%*	0.96		
						(2.73)			(3.30)		
Water Sample: Colony count (1000s)				578	*104.3*	0.29	341	*102.8*	−2.01		
						(2.60)			(3.06)		

† Restricted sample to HHs that reported NOT having a toilet at survey round 1.; †† Round 1 Rs values adjusted for national inflation (factor 1.32).
Notes: Data source: Round 1 and 2 data. Variables defined at the HH level except for stool samples which are at the individual level. X_i includes socio-demographic controls of the main woman, HH head, HH demographics and socio-economic status. Robust SE in parenthesis. Significance: * 10%, ** 5%, *** 1%.

Productivity and children's time allocation

One of the possible results of sanitation policies is an increase in productivity due to improved health. That might be reflected in wages and in participation on the labour market, but it is not straightforward how. For instance, improved productivity might increase potential wages which may drive more people into de labour market; as a result, wages might not increase and even could decrease. However, the picture found in the data is richer than this.

Cross-sectional analysis from both the two survey rounds shows that there is a positive correlation between the total number of hours supplied by the HH and sanitation. However, when we include controls, such links fade out. The interesting pattern that emerges is when we look at labour supply by gender (presented in Table 7). We find that while male labour supply is the same for households with and without a toilet, female labour supply is reduced for households with sanitation. When breaking it down by age of the women (not shown) we find that it is mainly women above the age of 25 years that work more. An analysis at the individual level confirms the household level results, showing that having a toilet is associated with individual women working on average about 4 hour less per week. While a possible explanation is that male wages can grow faster than female, so the HH increase in that margin and reallocate male one, there is no significant evidence of wage differences. On terms of the extensive margin, the picture is not as clear.

If we consider the sample of those who construct the toilets between the two survey rounds, the same signs for male and female labour supply arise but they are not significant. This could be either that the relationship is more related to fixed HHs characteristics that are not captured by either castes or income, or more inefficient estimators due to sample size. Besides that, the between analysis is clear in showing that in those HHs that got access to a toilet between the two survey rounds, female labour supply was reduced both in the extensive and on the intensive margin.

Are these results causal? As before, our strategy requires strong assumptions for claiming this. However there is a strong correlation between female labour participation conditional on HH income level and demographics. We have seen that HHs that construct toilets also have women who work less. One possible theory is that both sanitation and non-female labour participation are related to social status, and some HHs are willing to invest their resources to achieve it.

We do not have information on time allocation of the women beyond working hours, but results we present next might suggest that women take over tasks that were previously undertaken by children, including certain home chores and collection of water. The lower panel of Table 7 shows estimates of toilet ownership on time allocation of children age 3-15 years in the housheold. Consistently across all specifications we find evidence that children living in households with a toilet spend less time on domestic housework. We also find evidence in some of the specifications that these children spend significantly less time carrying water. Our findings suggest that some of these hours are spent on education. Estimates using the 2010 data suggest that children living in households with toilets spend more time on extracurricula education activities and both cross-sectional regression results show a positive asspciation of toilet ownership and the likelihood of attending school.

Table 7: Toilet ownership and Outcomes - Productivity and time use

Eq4. Cross-section τ **:** $Y_{i,j,t=\tau} = \delta Toilet_{i,j,t=\tau} + \beta X_{i,j,t=\tau} + \eta_j + u_{i,j,t=\tau}$, **Eq5. Panel:** $Y_{i,t} = \delta Toilet_{i,t} + \beta X_{i,t} + \alpha_i + \gamma_t + u_{i,t}$

	Cross-section analysis									Panel	
	Round 1 (2010)			Round 2 (2013)			Restricted Round 2†			DID on R.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome Variables Y	N	$\bar{Y}_{t=1}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	Eq5
Labour martket											
HH: N Males 25-65 who work (a32)	1867	*0.9*	0.01	1592	*0.8*	−0.01	951	*0.8*	−0.04	1042	−0.00
			(0.04)			(0.04)			(0.05)		(0.04)
HH: N Females 25-65 who work (a32)	1867	*0.2*	−0.03	1592	*0.2*	−0.06	951	*0.2*	−0.05	1042	−0.07**
			(0.03)			(0.04)			(0.05)		(0.04)
Total male paid working hours of the household	1867	*74.6*	−4.36	1592	*64.7*	−2.51	951	*63.3*	0.87	1042	−0.44
			(3.14)			(2.78)			(3.50)		(3.48)
Total female paid working hours of the household	1867	*12.8*	−2.69	1592	*14.9*	−4.10**	951	*15.0*	−3.53	1042	−6.02***
			(1.69)			(1.95)			(2.48)		(2.32)
Children Time Utilization											
Children 3-15: avg. hours doing domestic housework	1491	*0.3*	−0.11***	1146	*0.5*	−0.12*	708	*0.5*	−0.17*	784	−0.13*
			(0.03)			(0.07)			(0.09)		(0.08)
Children 3-15: avg. hours carrying water	1491	*0.3*	−0.08	1139	*0.4*	−0.13**	704	*0.5*	−0.13	780	−0.22***
			(0.05)			(0.06)			(0.09)		(0.08)
Children 3-15: avg. hours working HH business	1491	*0.0*	−0.03	1138	*0.2*	0.05	703	*0.3*	0.06	779	−0.04
			(0.02)			(0.05)			(0.06)		(0.07)
Children 3-15: avg. hours extra education	1491	*0.2*	0.17***	1146	*0.5*	0.11	708	*0.4*	0.03	784	−0.02
			(0.05)			(0.10)			(0.11)		(0.10)
Attend to school (indiv. level)	8525	*25.7%*	2.99**	9048	*25.7%*	2.66**	5412	*26.3%*	1.75	4170	0.42
			(1.30)			(1.30)			(1.59)		(1.36)
HH: No Girls 6-12yrs attending school	1867	*0.3*	−0.01	1592	*0.3*	−0.00	951	*0.3*	0.01	1042	−0.01
			(0.04)			(0.03)			(0.04)		(0.03)

† Restricted sample to HHs that reported NOT having a toilet at survey round 1.
Notes: Data source: Round 1 and 2 data. Variables defined at the HH level, except where indicated. X_i includes socio-demographic controls of the main woman, HH head, HH demographics and socio-economic status. Robust SE in parenthesis. Significance: * 10%, ** 5%, *** 1%.

Wealth and Finances

Sanitation can affect the wealth of households in a number of ways. We discussed above that through improved health households might become more productive and hence work more or earn higher wages. Sanitation might however also increase the value of the dwelling. And we see this to be indeed the case. Table 8 shows thatw owning a toilet increases the value of the dwellings significantly - a finding that is consistent across all our specifications. And the increase in value is much above the investment needed to construct the toilet. As mentioned before, the typical toilet owned in our sample (a single pit toilet) can be built with 10,000 Rs. The reported increase in value of the dwelling due to the toilet is on the other hand approximately five times this cost, i.e. 50,000 Rs. This is for houses that are on average worth 170,000 Rs in 2013. It is worth stressing though that these values are self-reported and it is conceivable that respondents have a biased view on the value of an investment as large as 20% of average household annual income. However, having said that, a toilet typically come with bathing space and we indeed find that households with a toilet are about 30% more likely to also own a bathroom. This finding is highly significant and robust across specifications (not shown).

Interestingly, we also find significant relationships between sanitation and other assets the households own. Specifically, the value of other household asset is significantly higher if housholds have a toilet and there is some indication that also transportation assets (bicycle, scooter, motorbike and fourwheeler) increases with sanitation ownership. These results tell us more on the idea of social status: despite having similar income, HHs with sanitation might also have better quality of life in general. An alternative explanation could be that there are two types of households: Those that invest in their dwelling and household assets more generally, and those that invest rather in productive assets. Weak support for this are the negative coefficients of toilet ownership on farm assets, which are however not significant. Some additional support is seen when considering the composition of household income: The second panel of Table 8 shows estimates for likelihood and earnings of wage income and income from self-employment (farm and non-farm). Plain correlations show that toilet-ownership is positively associated with wage income and negatively with self-employment income (particularly farm income, not shown). However, once we take into account controls, these correlations fade-out.

We finally consider savings and credit of our study households. Results on savings suggest thathouseholds with toilets are slightly more likely to have savings in 2010, but not in 2013. This supports once again that toilet-ownership is spreading towards household with less means. We already saw that households of lower income and lower castes caught up in terms of toilet ownership between the two waves.

Results on credit outcomes suggest that the invesment in toilets was facilitated by greater credit access. We see that households which own a toilet have larger loans (as a proportion of their income), especially at the time of the second survey round in 2013. The result holds in the cross-sectional as well as longitudinal specification. This is a very interesting result with respect to the descriptive analysis: most of the HHs claimed that they used their own resources to build a toilet, however it seems that access to credit is essential for allowing HHs to make such investments.

Table 8: Toilet ownership and Outcomes - Wealth and finances

Eq4. Cross-section τ **:** $Y_{i,j,t=\tau} = \delta Toilet_{i,j,t=\tau} + \beta X_{i,j,t=\tau} + \eta_j + u_{i,j,t=\tau}$, **Eq5. Panel:** $Y_{i,t} = \delta Toilet_{i,t} + \beta X_{i,t} + \alpha_i + \gamma_t + u_{i,t}$

	Cross-section analysis									Panel	
	Round 1 (2010)			Round 2 (2013)			Restricted Round 2†			DID on R.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome Variables Y	N	$\bar{Y}_{t=1}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	Eq5
Dwelling and other assets											
Value of the Dwelling	1397	*158.9*	74.01***	1484	*169.4*	50.08***	909	*150.0*	46.14***	997	42.69***
			(10.82)			(10.47)			(11.98)		(14.34)
Assets: Transport (1000 Rs††)	1867	*6.6*	4.55**	1592	*22.7*	1.57	951	*8.9*	2.79	1042	3.45*
			(1.82)			(5.54)			(2.13)		(1.78)
Assets: House elements (1000 Rs††)	1867	*69.7*	15.84***	1592	*181.6*	53.32*	951	*146.4*	25.00	1042	62.93**
			(2.99)			(27.01)			(29.21)		(27.99)
Assets: Farm (1000 Rs††)	1867	*21.3*	−7.38	1592	*47.9*	0.30	951	*54.0*	−31.26	1042	−32.67
			(4.77)			(16.32)			(19.12)		(21.36)
Income											
Income from wages	1867	*94.1%*	−1.48	1591	*85.4%*	−2.60	950	*86.3%*	1.33	1041	5.18**
			(1.27)			(1.76)			(1.97)		(2.38)
Income earned from wages (1000s ††)	1867	*55.4*	1.24	1592	*55.4*	−6.34**	951	*50.2*	−4.70	1042	−0.19
			(1.35)			(3.05)			(3.04)		(2.49)
Income from ANY business	1867	*12.9%*	−2.60	1591	*29.0%*	1.45	950	*30.7%*	−0.10	1041	−8.88***
			(2.30)			(2.12)			(2.44)		(3.12)
Income earned from ANY business (1000s††)	1867	*4.8*	−1.32	1591	*12.3*	3.25**	950	*11.8*	1.22	1041	−3.11*
			(1.40)			(1.29)			(1.41)		(1.75)
Savings and loans											
HH borred> Rs 500, last 12 months	1717	*24.5%*	−3.40	1146	*44.9%*	0.08	702	*47.7%*	5.86	761	−1.56
			(3.27)			(4.29)			(4.47)		(5.02)
Amount borred, last 12 months (1000s††)	1717	*11.2*	1.25	1148	*14.3*	6.69**	703	*14.1*	6.80**	762	−4.86
			(4.25)			(3.13)			(3.11)		(5.57)
Loans as a proportion of Income	1674	*17.5%*	4.57	1145	*27.6%*	12.97**	701	*27.0%*	11.55*	760	−11.48
			(8.26)			(6.07)			(5.76)		(10.48)
HH: any savings?	1867	*27.1%*	4.24*	1588	*29.4%*	1.58	948	*29.1%*	−1.53	1038	−0.96
			(2.27)			(2.92)			(3.07)		(3.95)
Amount saved, 1000s of Rs†	1867	*4.6*	0.42	1588	*5.0*	1.21	948	*4.8*	1.56	1038	2.18
			(1.47)			(1.75)			(1.42)		(1.79)
Savings as a proportion of income	1815	*5.0%*	1.24	1585	*5.5%*	2.37*	946	*6.3%*	3.72**	1036	4.93*
			(0.88)			(1.33)			(1.52)		(2.61)

† Restricted sample to HHs that reported NOT having a toilet at survey round 1.; †† Round 1 Rs values adjusted for national inflation (factor 1.32).
Notes: Data source: Round 1 and 2 data. Variables defined at the HH level. X_i includes socio-demographic controls of the main woman, HH head, HH demographics and socio-economic status. Robust SE in parenthesis. Significance: * 10%, ** 5%, *** 1%.

Main woman of the household

Our final set of outcomes focusses on the main woman in the household. They are shown in Table 9.

The outcomes considered link back to our previous findings on household composition and toilety ownership, which we hypothesised suggest a link between sanitation and marriages. While no link can be established between age at marriage or whetehr the marriage was an arranged one, we show here that the main woman in our households with toilets report significantly more often that the ability of their future husband to provide sanitation played an important role in their decision to get married. The coefficient is large: anadditional 7.75pp on the probability to answer positively to the question when the average positive answers is 15%. An interesting bit is that they report to be more likely to live with their husband family. If we consider the case of the HHs where the transition is observed, the signs are the same but they are not significant.

We consider two more outcomes, one an indicator for knowledge of correct hygiene practices, which provides no evidence on differences for women living in households with or without toilets.

Finally, in the second survey round, women were asked a set of questions that measure their level of disgust and an interesting figure arises: HHs with toilets are less disgusted by unexpectedly sharing a soda can with a relative. This finding can be linked to observational evidence that cultural concerns of sharing toilets with the other gender are sometimes a reason not to construct a toilet. Not being disgusted about sharing a glass and sanitation uptake is therefore a sensible link to find.

3.3 Robustness Checks

We performed several alternative specifications in order to analyse the sensitivity of the findings presented. The first one is to test the sensitivity of estimates to the inclusion of different set of covariates, X. The second one is to use non-linear models instead of LPM for the determinants of toilet ownership and for the dichotomous outcomes. The third one is to estimate Equation 2 on a sample of households matched based on the probability that they will construct a toilet in the future. These checks are supportiove of our findings presented here.

Table 9: Toilet ownership and Outcomes - Main woman

Eq4. Cross-section τ **:** $Y_{i,j,t=\tau} = \delta Toilet_{i,j,t=\tau} + \beta X_{i,j,t=\tau} + \eta_j + u_{i,j,t=\tau}$, **Eq5. Panel:** $Y_{i,t} = \delta Toilet_{i,t} + \beta X_{i,t} + \alpha_i + \gamma_t + u_{i,t}$

	Cross-section analysis									Panel	
	Round 1 (2010)			Round 2 (2013)			Restricted Round 2†			DID on R.	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Outcome Variables Y	N	$\bar{Y}_{t=1}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	$\bar{Y}_{t=2}$	Eq4	N	Eq5
For how many years are/were you married?	1782	*21.0*	−0.06	1537	*22.0*	−0.52	924	*22.2*	−0.61	932	0.11
			(0.35)			(0.39)			(0.54)		(0.95)
How old were you when you got married?	1803	*16.0*	0.25	1538	*16.5*	0.27	923	*16.4*	0.36	931	0.43
			(0.17)			(0.20)			(0.26)		(0.27)
Was it an arranged marriage?	1777	*98.9%*	−0.17	1542	*95.1%*	0.86	927	*95.4%*	0.60	935	−1.59
			(1.03)			(1.15)			(1.30)		(1.71)
When looking for a husband, did it matter whether he could offer sanitation?	1801	*49.1%*	9.72**	1542	*14.7%*	7.58***	926	*10.3%*	2.86	934	−4.93
			(4.05)			(1.95)			(2.12)		(4.20)
Was a dowry paid?	1769	*76.3%*	7.05***	1518	*83.6%*	2.85	907	*83.7%*	2.29	915	5.08
			(2.58)			(2.58)			(2.78)		(3.95)
With whom do you live? You in-laws	1867	*12.4%*	−3.22	1592	*23.9%*	5.90**	951	*21.7%*	5.38	1042	3.33
			(2.21)			(2.77)			(3.72)		(3.23)
Knowledge test: correct answers	1852	*34.8*	0.31	1592	*42.6*	−0.25	951	*42.3*	−0.11	959	0.28
			(0.49)			(0.27)			(0.31)		(0.77)
Knowledge test: INcorrect answers	1851	*12.7*	0.24	1592	*8.7*	0.05	951	*8.7*	−0.19	959	−1.18**
			(0.34)			(0.18)			(0.25)		(0.58)
Disgust: shared soda glass (1-5, 5 ext. disg)				905	*4.0*	−0.61***	502	*4.1*	−0.67***		
						(0.18)			(0.18)		

† Restricted sample to HHs that reported NOT having a toilet at survey round 1.
Notes: Data source: Round 1 and 2 data. Variables defined at the HH level. X_i includes socio-demographic controls of the main woman, HH head, HH demographics and socio-economic status. Robust SE in parenthesis. Significance: * 10%, ** 5%, *** 1%.

4 Discussion and Conclusions

We make use of primary data collected as part of an evaluation exercise of a sanitation intervention called FINISH. While not experimental, this data provides us with the opportunity to study important determinants of toilet ownership and acquisition of slum-dwellers and households in peripheral villages of Gwalior city in India.

This is an important for two important reasons: India's slum population is growing rapidly while at the same time having no or only inadequate access to safe sanitation. High population density coupled with improper means of disposing feces provides a breeding ground for preventable disease epidemics.

At the same time – contrary to common perception - willingness to pay exists in these markets and households are aware of benefits they can reap from having access to safe sanitation[Sinroja, 2013].

Our findings suggest that an important motivator for toilet construction is status and living standards. Households not only report their status to have increased due to acquisition of a private toilet, they also report the value of their dwelling to be significantly higher and we find other changes that could be related to improved status such as a reduction in labor of the main woman in the household.

Contrary to studies that suggest that health considerations play only a minor role in the decision to acquire sanitation, we find that households perceive to be healthier than their neighbours because of the constructed toilet. While we cannot draw a clear conclusion from the data whether households are actually healthier, our evidence strongly suggests that they personally feel that the toilet made them better off compared to other households.

We also provide evidence that financial constraints are particularly binding for households in the lower end of the income distribution and that access to finance facilitates uptake. This could be through finance for the specific purpose of building sanitation, but also by freeing other resources that can now be invested to construct a toilet.

These findings can provide important input in designing sanitation interventions tailored to slum-dweller populations. They suggest that messaging around status and moving up in society might resonate well with this type of population. Our findings also suggest that campaigns such as the 'no loo, no bride' campaign launched by the government of Haryana in 2005 might work particularly well in a slum-setting. A paper by Stopnitzky (2011) shows in line with this that increasing proportions of females with strong sanitation preferences drive male investment in toilets.

Overall, our findings suggest that despite being an investment of considerable size for poor households, they value the decision and perceive to have gained along a number of margins.

References

Manisha Cameron, Lisa; Shah. Scaling up rural sanitation: Findings from the impact evaluation baseline survey in indonesia. Technical report, World Bank, 2010. URL `https://openknowledge.worldbank.org/handle/10986/17271`. License: CC BY 3.0 IGO.

Dean Hammer, Jeffrey; Spears. Village sanitation and children's human capital : Evidence from a randomized experiment by the maharashtra government. Technical report, World Bank, 2013. URL `https://openknowledge.worldbank.org/handle/10986/16014`. License: CC BY 3.0 Unported.

Jean H Humphrey. Child undernutrition, tropical enteropathy, toilets, and handwashing. *The Lancet*, 374(9694):1032–1035, 2009.

NSSO. Some characteristics of urban sslum 2008-09. Report 534, National Sample Survey Office, National Statistical Organization, Ministry of Statistics and Programme Implementation, Government of India, May 2010.

Subhrendu K Pattanayak, Katherine L Dickinson, Jui-Chen Yang, Sumeet R Patil, Purujit Praharaj, and Christine Poulos. Promoting latrine use: Midline findings from a randomized evaluation of a community mobilization campaign in bhadrak, orissa. Working Paper 2, Research Triangle Institute, 2007.

Subhrendu K Pattanayak, Jui-Chen Yang, Katherine L Dickinson, Christine Poulos, Sumeet R Patil, Ranjan K Mallick, Jonathan L Blitsteinb, and Purujit Praharajf. Shame or subsidy revisited: social mobilization for sanitation in orissa, india. *Bulletin of the World Health Organization*, 87: 580–587, 2009.

Ratna Sinroja. Slum sanitation in india - is there a case for private toilet provision? Blog, March 2013. URL `http://businessinnovationfacility.org/profiles/blogs/slum-sanitation-in-india-is-there-a-case-for-private-toilet`. Last accessed 10th of September 2014.

Dean Spears. Effects of rural sanitation on infant mortality and human capital: Evidence from india's total sanitation campaign, 2012. Princeton.

Dean Spears and Sneha Lamba. Effects of early-life exposure to rural sanitation on childhood cognitive skills: Evidence from india's total sanitation campaign, 2011. Princeton.

WaterAid-India. India country strategy 2011-2016, Dec 2011.