

Complementarities between Micro-Credit and Government Subsidies: Evidence from India's Swachh Bharat Mission *

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Abstract

Whereas standalone subsidy programs often risk dependencies and administrative targeting inefficiencies, standalone microcredit programs are usually not accessible to all and do not always create sufficient incentive for households to make non-productive investments at the socially optimal level. In the context of Swachh Bharat Mission (SBM), the Government of India’s flagship sanitation programme which aims to reach an Open Defecation Free (ODF) India by October 2019, the results in this paper show that a smart combination of micro-credit and SBM subsidies solves a number of inefficiencies inherent to such programs when run in isolation from each other. Combining SBM administrative data with primary data of an RCT impact study conducted in 81 villages in rural Maharashtra that assesses the effectiveness of using microcredit for sanitation, we are able to show that (i) microfinance supports sanitation investment amongst subsidy ineligible households, implying a direct complementary role of micro-credit to the subsidy scheme; and that (ii) also subsidy eligible households avail the credit, supporting the notion that a post-construction subsidy fails to alleviate financial constraints of targeted beneficiaries. Looking at mechanisms, we show that reported toilet construction costs are double the subsidy amount, that there are significant delays in subsidy disbursement *after* toilet construction, and that microcredit reaches households that suffer from exclusion error of the subsidy scheme.

1 Introduction

The universal call for action to ‘end poverty, protect the planet and ensure that all people enjoy peace and prosperity’, manifested in the Sustainable Development Goals (SDGs), received a hefty price tag of between US\$5-7 trillion [UNCTAD, 2014]. This is in stark contrast to the financial resources available: The investment gap in developing countries is estimated to be as much as \$2.5 trillion. There is general agreement that developing country governments cannot shoulder this financial burden alone. At the same time, development assistance is only filling a small part of the gap, having reached its peak in 2016 at \$142.6 billion [OECD, 2018]. Using public funds more effectively and mobilising private investment to achieve the SDGs has therefore become a key priority of many governments, development agencies and donor organizations.

One approach with promising potential is to identify and stimulate connections between financial inclusion and development objectives. Financial inclusion, broadly defined as equitable access to financial products and services, is seen as an important enabler of most SDGs [CGAP, 2016]. At the same time, financial inclusion has been a successful vehicle in leveraging private capital, so much so that it created its own field, impact investing. Impact investment encompasses private capital investments that generate social or environmental benefits.

While the market has been seen to be characterised of strong potential for growth, it is hampered by a number of challenges, including on the one hand a lack of evidence

that allows assessing trade-offs between impact and risk-adjusted financial returns; and on the other hand identifying opportunities to leverage such private sector resources to complement public investments in order to sustainably address complex global issues.

In this paper, we are able to make a fundamental contribution by providing rigorous evidence on the potential of an innovative public-private financing arrangement that can significantly contribute to the SDGs, in particular SDG 7 of sanitation for all.

Specifically, we are able to demonstrate how one of the most prominent investment vehicles, microfinance, can be mobilised to complement government subsidies for private health investments that inhibit large positive externalities, household sanitation. We do so in the context of India, where, with more than half a million people defecating in the open in 2014 [WHO-UNICEF, 2014], the economic costs associated with these practices was estimated to amount to \$106.5 billion, 5.2 percent of India's gross domestic product [Lixil, 2016]. The Government of India (GoI) has responded to this urgent problem with the launch of its ambitious flag-ship sanitation programme called Swachh Bharat Mission (SBM), or 'Clean India' mission. The scheme, launched in October 2014, was estimated to cost \$9.3 billion. Two key components are its behavioural change campaigns as well as subsidies (or more commonly referred to as incentives) for poor households.

While the scheme is lauded for its success by its supporters, challenges and criticism are also raised. For one, the behavioural change campaigns are often portrayed as inefficient in conveying the importance of toilet usage, leading to a significant percentage of government supported toilets being unused, and unsupported households continuing to defecate in the open. Second, the subsidy is targeted to vulnerable households, a reasonable targeting criterion that however leaves room for financially restricted households to be excluded, and the fact that the subsidy disbursement is largely post-construction leaves even eligible households unable to avail the subsidy if they are unable to raise the necessary funds to start toilet construction in the first place. Moreover, administrative targeting errors could leave even vulnerable households without support. And finally, the scheme has been criticised for a strong focus on increasing toilet ownership, without targeting their use and, importantly, their sustainability.

And yet, the subsidy design has its rationale. Safe sanitation, (or its converse, open defecation), has a strong positive (negative) externality, providing the main argument why private sanitation investment should be subsidised in the first place (literature that supports the public good characteristics of private sanitation in the context of India includes Spears [2013], Hammer and Spears [2016], Augsburg and Rodriguez-Lesmes [2018]). There is also growing consensus that demand generation oriented policies are not sufficient to reduce open defecation (Guiteras et al. [2015]; Coffey et al. [2014]). Given the scale of the problem and high cost of toilet construction, a universal subsidy would however stress the GoI's budget significantly, making a targeted approach the right choice [Van de Walle, 1998]. Further, in a country as large and diverse as India, providing a toilet rather than funds for its construction seems administratively a virtually impossible task, making a cash subsidy a sensible choice. Providing cash pre-construction can however raise significant concerns about proper usage of funds,

which rationalises the choice of staggering the release of the funds as the toilet gets constructed.

In the context of SBM's subsidy scheme, we tested the effectiveness of providing microfinance for sanitation investment. While the provision of these loans was not purposefully implemented to complement the SBM scheme, and its evaluation not specifically designed to test for their complementarity, the setting and the timing of both interventions puts us in a unique position to analyse whether, and how, these two financial schemes designed to improve India's sanitation situation, can work to complement each other.

By combining SBM administrative data with primary data of an RCT impact study conducted in 81 villages in rural Maharashtra that assesses the effectiveness of using microcredit for sanitation, we are able to show that (i) microfinance supports sanitation investment amongst subsidy ineligible households, implying a direct complementary role of micro-credit to the subsidy scheme; and that (ii) also subsidy eligible households avail the credit, supporting the notion that a post-construction subsidy fails to alleviate financial constraints of targeted beneficiaries.

These results and others highlighted in this paper provide evidence that a smart combination of subsidy and microfinance programmes solves a number of inefficiencies inherent to such programmes when run in isolation from each other. In particular, microfinance serves subsidy-ineligible households that could otherwise not avail the funds for sanitation investment; microfinance can reach households that suffer from exclusion error of the subsidy scheme (i.e. that were for some reason or another not classified as eligible although they should have been). In addition, subsidy provides financial means to households that microfinance programs would deem too risky to serve, and in fact, the subsidy could serve as a risk-mitigating factor for credit provision; and finally the ex-post subsidy can serve as an incentive for households to use sanitation loans for the intended purpose.

2 Context

2.1 Swachh Bharat Mission and government subsidies

On 15 October 2014, the Government of India (GoI) launched its ambitious flag-ship sanitation programme called Swachh Bharat Mission (SBM), or 'Clean India' mission. One of its key objectives is to reach an Open Defecation Free (ODF) India by 2 October 2019, Mahatma Gandhi's 150th Anniversary. SBM was not India's first attempt to address its sanitation challenge. The first efforts go back to the Central Rural Sanitation Programme (CRSP) in 1986, where the focus was on the construction of new toilets. Since then, the CRSP was replaced by the Total Sanitation Campaign (TSC) in 1999 and the Nirmal Bharat Abhiyan (NBA) in 2012, which in 2014 evolved into the current SBM.¹

¹The innovation of the TSC was the introduction of Education and Communication activities around sanitation and the provision of financial awards to ODF villages, in addition to the construction

Government subsidies for toilet construction were first introduced by TSC, targeted at Below Poverty Line (BPL) households. The NBA programme in 2012 extended the reach of the subsidies beyond BPL households to specified Above Poverty Line (APL) households. The launch of SBM significantly scaled up all of GoI's previous sanitation efforts, including (among other activities such as Information and Education Campaigns) an increase of the subsidy amount to Rs. 12,000 (USD 167) per new latrine, a revision of the eligibility criteria and an expansion of the geographic scope to reach every single subsidy eligible household without a toilet in India.² Section 3.3 discusses the subsidy eligibility criteria in more detail.

Even though we sometimes refer to SBM more generally in this paper, we should note that SBM is being implemented separately for urban and rural areas. SBM (Urban) falls under the responsibility of the Ministry of Urban Development (MoUD), while SBM (Rural/Gramin) is run by the Ministry of Drinking Water and Sanitation (MoDWS).

The SBM subsidy scheme works on a remuneration post verification model, that is, citizens are expected to bear the bulk of the cost of toilet construction and only receive the subsidy amount upon verification of toilet completion by district authorities. For that reason, government subsidies are usually called 'incentives' in this context. In some regions households can request to receive a small share of the subsidy amount (around one third) prior to the completion of their toilet, after they have proved the start of construction works (e.g. by having digged a pit). But the bulk of the amount gets disbursed only after toilet completion.

SBM was launched in a context where India accounted for more than half of the 1.2 billion people around the world who defecated in the open and only 38.7% of all rural households in India had individual latrines. Nearly half of India's population (69.3% in rural areas and 18.6% in urban areas) had no access to toilets [WHO-UNICEF, 2014].

One notable innovation of the SBM programme was the use of social and digital media to monitor SBM's progress. This is a feature we exploit in this paper, by making use of the administrative data collected through these efforts (see Section 3.2 for more information).

2.2 Micro-credit for sanitation

The Reserve Bank of India (RBI) introduced priority sector lending in India to ensure that adequate finance reaches weaker sections of society, mainly in rural areas, to provide economic opportunities and to accelerate economic development. Commercial banks were mandated to allocate 40% of their credit to the priority sector. Categories for priority sector include agricultural and agri-allied activities and education and housing loans, but also micro-lending. Initially water and sanitation did not fall under PSL

of toilets. The NBA programme in 2012 introduced the concept of community-led total sanitation (CLTS), to create demand for toilets - as opposed to only building them.

²We use the following online currency converter:

<https://www.xe.com/currencyconverter/convert/?Amount=12%2C000&From=INR&To=USD>

and therefore had to compete with productive loans such as those for business investment, which are likely to yield more significant interest returns to the lender. Under pressure from advocacy groups, sanitation was eventually officially included under PSL in April 2015, making it easier for MFIs to raise funds for on-lending to sanitation.

Also the SBM guidelines encourage the use of micro-credit to finance the costs for toilet construction, particularly for subsidy ineligible APL households [SBM, 2017]. However, banks have generally been reluctant to release loans for sanitation purpose, given the non-income generating nature of the cause. Particularly in rural areas, lending for unproductive loans bears a risk of non-repayment. In 2009, our partner MFI, a large microfinance institution (MFI) active in five states in India, decided to start offering sanitation loans to their clients, i.e. women from low-income households in rural and semi-urban regions. Given its social mission, the MFI had committed itself to better health for its clients and to that end introduced various health related programs, including emergency loans that are meant to support clients in meeting unexpected health related expenditures in particular. Through customer surveys, which the MFI conducts to understand their clients' needs, it was revealed that clients on the one hand lacked proper sanitation and on the other hand, more than 90% of clients reported to be interested in toilet construction if credit was offered to support that purpose. Understanding that such a loan product does not generate income directly and immediately, the MFI decided to meet their customers' demand and offer the product, but at a lower interest rate than income generating loans, basically cross-subsidizing these special purpose loans. This was however also done on the understanding that a happier and healthier client would ultimately also be more able to pay back other loans.

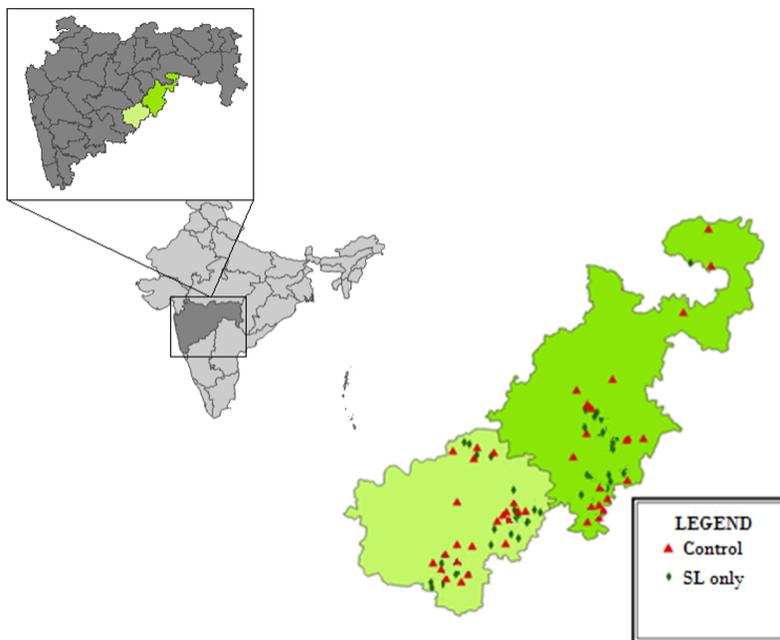
In addition to sanitation loans, the MFI's loan portfolio includes among others income-generating loans, emergency loans, education loans and festival loans. In the context of a Randomised Controlled Trial aimed at assessing the impact of the sanitation loan product, in February 2015 the MFI started offering sanitation loans in five of their branches in Maharashtra where they had not yet run any sanitation activities before. At baseline of the study, the partner MFI was the only provider of sanitation loans in the study area.

The sanitation loan offered amounts to maximum Rs 15,000 (USD209) which is 25% higher than the subsidy amount offered under SBM. Over the study period, it charged an 18-22 percent interest rate per annum at a declining balance over a 2-year repayment period. Even though clients were allowed to choose for either weekly or bi-weekly repayments, in practice they all chose to repay the loan on a weekly basis. Compared to other non-productive loans offered by the MFI, the sanitation loan amount is higher and carries a similar or lower interest rate and a longer repayment period. Business loans are typically of larger size, but have a higher interest rate. All loans are provided based on a joint-liability principle (lending groups consist of 5 - 10 members) and there is no collateral requirement. Each client can obtain only one sanitation loan, and only if she has been a client of the MFI for at least one year. For more detailed information about the MFI and its sanitation loan product we refer to Augsburg et al. [2018].

2.3 Geographical focus

The study concentrates on the study microfinance institute’s clients living in 5 blocks of 2 districts, Latur and Nanded, in the South-Eastern part of the Maharashtra, India (see Figure 1).

Figure 1: Geographical focus



At baseline of the study in 2014, only 27 percent of MF client households in the study area had access to a toilet and very few had access to community toilets. A significant 83 percent of households reported affordability or price as the key reason for not having a toilet. Although a number of microfinance institutions provide credit to poor households in the study area, there are only few institutions providing credit specifically for non-income generating purposes and none provided credit for sanitation when the experiment took place.

3 The Experiment

3.1 Experimental Design

We exploit the randomised controlled trial design of an experiment in which micro-credit for sanitation was offered to MF clients living in 40 randomly selected Gram Panchayats out of a set of 81 GPs in Latur and Nanded Districts, rural Maharashtra. All clients, in both the GPs where the sanitation loan product was offered (treatment) and in GPs

where it was not offered (control), continued to receive the remaining loan products offered by the MFI, primarily typical income-generating loans but also other purposes such as education loans. The randomisation of GPs into treatment and control was stratified by MFI branch and village size.³ The MFI started offering sanitation loans in the 40 treatment GPs from February 2015 onwards.

On the 15th of October 2014, the GoI launched the SBM(G) programme which was rolled out in all of rural India, including in Maharashtra. Given the randomised introduction of the micro-credit intervention, we expect, and confirm in our data, that the SBM(G) activities are balanced across treatment and control sites. Note that SBM subsidies were offered in all of our study GPs, which means that the experiment assesses the impacts of sanitation micro-credit provision in a context where credit eligible households might at the same time be eligible for sanitation subsidies provided by the government. In other words, we focus on an assessment of the additional impacts on toilet uptake and open defecation practice when complementing a subsidy programme with the provision of micro-loans marketed for sanitation investments.

3.2 Data

To assess potential complementarities between micro-credit for sanitation and government subsidies in the context of SBM, we match and combine three different data sources: (i) SBM(G) administrative data on household toilet ownership, subsidy receipts and official SBM subsidy eligibility status (henceforth referred to as SBM data); (ii) Administrative data on the amount and date of sanitation loan disbursements, obtained from the MFI that provided the sanitation loans in the experimental study (henceforth referred to as MFI data); and (iii) household census, baseline and endline survey data on toilet ownership, open defecation practice and various household socio-economic characteristics that were captured in the context of an experimental impact study of the micro-credit intervention in rural Maharashtra (henceforth referred to as survey data).

SBM Administrative Data

The SBM administrative data were downloaded from SBM(G)'s Management Information System (MIS), developed by the Ministry of Drinking Water and Sanitation (MDWS) to monitor SBM(G)'s progress towards its ODF mission. In 2012-2013, prior to the launch of SBM on 15 October 2014, the MDWS conducted a nationwide survey to assess SBM baseline levels of toilet coverage across the country and to identify households eligible for SBM subsidies (BPL households and vulnerable APL households, see Section 2.1). These baseline data were uploaded onto the SBM data portal. Since then, states have been required to update toilet ownership information on the SBM online portal on a continuous basis, the latest by April every year SBM [2017]. This MIS

³There are 5 branches in total in the study area and village size could be either 'large' (villages with more than 480 households) or 'small'.

portal used to make publicly available individual household level information on toilet ownership, subsidy receipts and official household subsidy eligibility status, among other variables⁴.

Our analysis will draw on information on household toilet ownership, subsidy receipts and official household SBM subsidy eligibility status from the SBM baseline data. In addition, we use a snapshot of the live SBM dataset which we took in September 2016 (two years after the launch of SBM and the launch of the micro-credit intervention), which we will refer to as the SBM 2016 snapshot. SBM has since then stopped making data available at the individual household level. Also, note that the SBM administrative data only report on subsidies received since SBM baseline in 2012-2013 and does not include any information on subsidies disbursed prior to SBM. Moreover, the date of toilet construction and subsidy receipt is missing for most observations in the SBM dataset. Finally, the SBM dataset only reports whether the toilet exists, no information is provided on their functionality at baseline or beyond. Once a household's toilet ownership status changes from zero to present, it continues to be recorded as such in the SBM's MIS, even if the toilet is no longer functioning or existing. In line, no information is recorded on the toilet quality.

Primary Survey Data and MFI administrative data

We augment the SBM administrative data with a combination of census, baseline and endline survey data that were collected of a sample of 2791 MF clients in our 81 study GPs in rural Maharashtra, at different points in time between Sept-Oct 2014 and Aug-Sept 2017. The census data come from a listing of a large number of neighbourhoods in the study GPs in September-October 2014, prior to the baseline household survey. This census was undertaken partly to identify households to sample for the baseline survey. The census data collection was completed on 14 October 2014, one day before the announcement of the SBM policy by the Indian Prime Minister, Narendra Modi. In addition to information on MF client households' socio-economic characteristics, these data include information on household toilet ownership, usage and quality, open defecation practice and self-reported subsidy receipts at *any* point in time, including data on the timing of toilet construction and subsidy receipts.

We also use MFI administrative data to obtain information on sanitation loan uptake and timing of sanitation loan receipt. For more information on the source of the survey and MFI administrative data we refer to Augsburg et al. [2018].

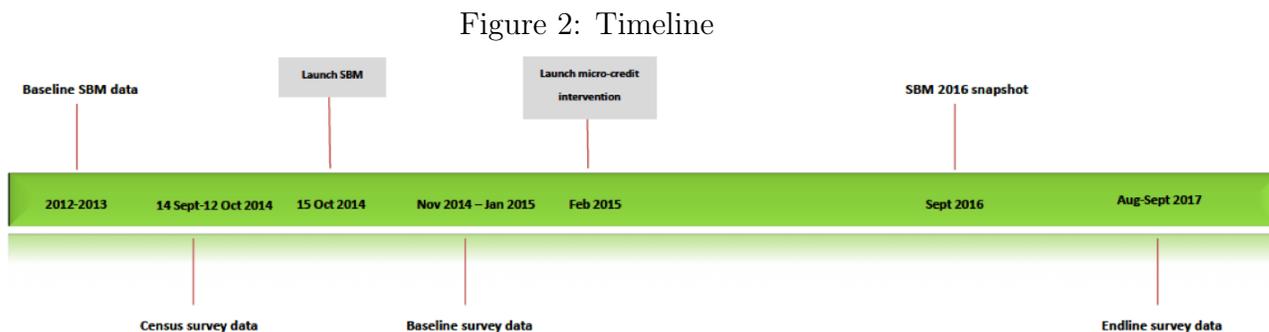
We used full household member names provided in the census and household roster data to match sampled households to the MFI admin data to identify MF clients. Using the full names of household heads, we subsequently matched the resulting endline dataset of MF clients to the SBM admin dataset to obtain official information on subsidy eligibility, toilet ownership and subsidy receipt. Matching was done using a fuzzy computer algorithm comparing different combinations of names provided in each dataset. Each identified match was subsequently scrutinized through a manual check

⁴<http://swachhbharatmission.gov.in/SBMCMS/sbm-mis.htm>

and matched records for which there remains some uncertainty about the quality of the match were flagged. All regressions in the analysis below will control for this uncertainty. Appendix A provides more information on the involved matching process. In Section 3.3 we discuss the outcome of this matching process and any important implications for the analysis conducted.

Timeline

Figure 2 gives an overview of the timings of the SBM snapshots and the survey data collection, the launch of the SBM programme and the micro-credit intervention.



3.3 Sample Descriptives and Sample Balance

Our main sample of interest are those households that are eligible for the sanitation loan (in practice as is the case for the treatment group, as well as in theory, as is the case in the control group) and that do not own a toilet when the sanitation loans are made available. Within this sample, we are interested in the distinction of subsidy eligible and non-eligible households. The main reason for this specific focus is that (i) we want to know how micro-credit can support households without a toilet, and (ii) we want to know whether, in addition to micro-credit potentially benefitting subsidy ineligible reasons (for obvious reasons), perhaps micro-credit also benefits those households that in principle are eligible for a government subsidy.

We therefore match our primary survey data on microfinance clients to the SBM baseline data to obtain a measure of the households' subsidy eligibility status as employed by SBM officials when targeting SBM subsidies.

SBM officially defines households to be eligible for SBM subsidies if at the time of the SBM baseline in 2012-2013 they (i) did not have a toilet, and (ii) they were either classified as Below Poverty Line (BPL) or as an Above Poverty Line (APL) household belong to any one of the following groups SBM [2017]:

- Scheduled Castes/Scheduled Tribes (SC/ST)

- Persons with disability
- Widow/old age pensioners
- Landless labourers with homestead
- Small farmers
- Marginal farmers
- Women headed households

In this paper we refer to BPL or vulnerable APL groups jointly as Vulnerable Groups (VGs). Note that belonging to a VG is only a necessary, not sufficient condition to be subsidy eligible. Toilet ownership at the time of the SBM baseline survey was also taken into account to define the final set of eligible households. Only those not owning a toilet at that time could avail an SBM(G) subsidy.

We use detailed information on households' VG status and toilet ownership available in the SBM baseline data to define subsidy eligibility⁵. In this paper, we distinguish between two types of subsidy eligibility: (i) we consider a household to be *de jure* subsidy eligible if it belongs to a VG group and if it did not have a toilet at the time of SBM baseline (following SBM's definition). This definition refers to VG households that should have been eligible as per the official SBM guidelines. Our second definition - which we refer to as *de facto* subsidy eligibility - takes into account the possibility that there are some VG households that have been recorded in the SBM administrative baseline dataset to be owners of a toilet (and therefore that were not officially eligible for subsidies) but that in reality did not own a toilet (as per toilet ownership reports and observations in our own baseline household survey). In our main analysis in Section 5 we focus on the *de jure* definition of subsidy eligibility, i.e. on VG households that reported not to have had a toilet at the time of our survey baseline. In Section 6 on mechanisms we then consider the extent to which *de facto* subsidy eligibility can explain observed impacts of the micro-credit intervention on *de jure subsidy* eligible households.

Throughout this paper, we focus on the sub-set of the endline survey sample of MF clients which was successfully matched to the SBM dataset. Section 3.3.1 gives an overview of the resulting matched sample size used in the analysis. Section 3.3.2 discusses the quality of the matched sample by comparing characteristics of matched and unmatched MF client households. Section 3.3.3 describes the sample and confirms balance of the matched sample between control and treatment groups.

⁵It is possible that SBM's categorisation of a household as VG or non-VG does not (or no longer) reflects the household's true socio-economic status. In on-going research focusing on targeting, we look at this into more detail. In this paper however we focus on complementarities between sanitation credit and subsidies for those who were officially eligible for subsidies versus those who were not. We therefore use SBM's official VG categorisation, rather than defining eligibility by who *should* have been eligible.

3.3.1 Sample size

We have baseline data available only for a sub-set of MF clients in our sample, since a significant portion of the GK client sample was added only at the time of endline to improve statistical power (see Augsburg et al. [2018] for more detail). For most of the analysis (unless specified otherwise) we focus on clients that did not have a toilet at the time of the baseline survey, where baseline toilet ownership is reconstructed using endline reports of time of toilet construction. We use the smaller matched panel dataset (for which we have actual baseline toilet ownership available) for robustness analysis (note: work in progress).

Table 1: Sample size (MF clients)

	Total N	Total GPs	Matched N	Matched N HHs w/o BL toilet	Matched GPs
Total	2,791	78	1,326 (48%)	946	75
Control	1,566	39	754 (48%)	548	38
Treatment	1,225	39	572 (47%)	398	37

Table 1 shows the number of MF client household observations and GPs available in the total baseline and endline sample, in their respective matched sub-samples and in the matched endline sample of households without a toilet at baseline. Of the total of 2,791 MF clients in our endline sample, we managed to uniquely match 1,326 observations to the SBM dataset i.e. 48%. The matching result was balanced across treatment and control groups. Of those matches, we have a sample of 946 MF client households that did not have a toilet at baseline. This is the sample we use for the main analysis in this paper.

There are various possible reasons for why we managed to only uniquely match half of our survey sample to the SBM dataset. The latter only includes names of household heads and the names of their fathers. That means that we could only match based on names of household heads (the father names are not available for household heads whose father does not live in their household). Most household head names in the SBM administrative list were entered in 2012-2013, which is 1-2 years prior to our survey census. By that time, it is possible that household members changed who they would define to be the head of their household (for instance, if a male household died and the female member became the head instead). Or, households may have split into two (or more) different households, or merged together with another household, each with a new household head. Moreover, some households in the survey dataset were matched to multiple households in the SBM dataset, or vice versa, and were dropped from the matched sample. We compare matched and unmatched sample of households in the next section.

3.3.2 Matching result

Table 2 investigates the determinants of the matching probability by showing the marginal effects of a probit regression of matching probability on a set of household level and village level characteristics. These results imply that the matched client sample is not representative of our study sample, which itself is representative of the client population in our study area. Not surprisingly, given that household records were matched based on the name of the household head, households that are female headed in the survey data were less likely to be matched to the SBM dataset. Female headed households are more likely to have experienced a recent change in the name of their household head (for instance, in case the husband recently died) which would affect their matching probability. Similarly, bigger households were more likely to be matched, which could reflect the possibility that these households are less likely to have recently experienced a change in household composition, e.g. by a split into two separate households. Households with older heads were also more likely to be matched, which could be driven by them being less likely to have recently migrated (and therefore not being present in the the SBM data for their respective community). Households with more educated heads were slightly more likely to be matched as well, possibly because they might be more likely to provide their names correctly, either during survey or during official SBM registration, or both. We do not find any significant difference in terms of households' endline OD practice and subsidy receipts. However, we observe a small imbalance in terms of endline toilet ownership, with households reported to own a toilet at endline being more likely to have been matched to the SBM dataset. Matched households are more likely to work in agriculture but otherwise they are similar to unmatched households in terms of their economic status (asset ownership and BPL status).

Table 2: Determinants of matching probability (Probit regression)

	(1)
	Matched
Age HH head	0.00600*** (0.00112)
Muslim (d)	0.000382 (0.122)
Hindu (d)	0.120 (0.121)
Buddhist (d)	0.112 (0.131)
Scheduled castes/tribes (d)	0.116 (0.175)
Backward castes/tribes (d)	-0.00206 (0.170)
General caste (d)	0.0385 (0.174)
Female headed household (d)	-0.137*** (0.0357)
HH size	0.0231** (0.00920)
Head able to write (d)	0.0173 (0.0633)
Head able to read (d)	-0.0683 (0.0518)
Years of education HH head	0.00867** (0.00418)
HH owns BPL card (d)	-0.00689 (0.0245)
Primary economic activity is agriculture (d)	0.0612* (0.0316)
HH owns agricultural land (d)	0.0172 (0.0284)
HH owns bicycle (d)	-0.0123 (0.0270)
HH owns motorcycle/scooter (d)	0.0197 (0.0298)
HH owns TV (d)	-0.0244 (0.0251)
HH owns livestock (d)	0.0647** (0.0311)
HH owns a toilet at endline (d)	0.107** (0.0446)
Someone in the household practices OD (d)	0.0457 (0.0437)
HH received an SBM subsidy (d)	0.00105 (0.0458)
N	2049

Standard errors clustered at the village level in parenthesis
 Marginal effects reported; 'd' indicates discrete variables

3.3.3 Sample balance and description

Notwithstanding the observed differences between the matched and unmatched sample, the matched sample is balanced across treatment and control arms, both in terms of their socio-economic characteristics and in terms of most of their SBM subsidy eligibility criteria. This can be seen in Tables 3 and 4. Note that here, unlike in the previous section, we focus on the matched sample and we focus on the households' VG characteristics as officially recorded in the SBM dataset (e.g. caste, BPL status etc.), which we present separately in Table 4.

Table 3: Matched sample balance: Socio-economic characteristics

	All	N	Control	N	Treatment	N
Age HH head	46.5 (10.3)	946	46.4 (0.57)	548	46.6 (0.60)	398
Muslim	0.13 (0.33)	946	0.14 (0.039)	548	0.12 (0.033)	398
Hindu	0.73 (0.45)	946	0.73 (0.042)	548	0.73 (0.040)	398
Buddhist	0.14 (0.34)	946	0.13 (0.033)	548	0.15 (0.032)	398
Female headed household	0.078 (0.27)	946	0.077 (0.012)	548	0.080 (0.014)	398
HH size	5.11 (1.99)	946	5.09 (0.10)	548	5.13 (0.11)	398
Head able to write	0.71 (0.45)	946	0.71 (0.020)	548	0.71 (0.021)	398
Head able to read	0.68 (0.47)	946	0.68 (0.020)	548	0.68 (0.023)	398
Years of education HH head	5.72 (4.77)	946	5.50 (0.24)	548	6.02 (0.26)	398

Note: Standard deviations in parenthesis in first column (All);

Standard Errors in parenthesis in other columns, clustered at the gram panchayat;

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 3 informs us that our matched MF client sample is largely hindu (73%), with the remaining client households being either muslim or buddhist. The average household is reported to have 5 members, its head is a male of around 47 years old, and is likely to be able to read or write (around 70%), despite having had less than 6 years of formal education, on average.

Table 4: Matched sample balance: SBM subsidy eligibility criteria

	All	N	Control	N	Treatment	N
HH owns BPL card	0.29 (0.45)	946	0.33 (0.035)	548	0.23** (0.033)	398
Landless with homestead	0.079 (0.27)	946	0.099 (0.034)	548	0.053 (0.018)	398
Physical disability	0.0021 (0.046)	946	0.0036 (0.0025)	548	0 (0)	398
Scheduled Caste	0.34 (0.48)	946	0.33 (0.051)	548	0.36 (0.059)	398
Scheduled Tribe	0.031 (0.17)	946	0.033 (0.014)	548	0.028 (0.015)	398
Small and Marginal Farmers	0.23 (0.42)	946	0.18 (0.031)	548	0.30** (0.051)	398
Female Headed	0.014 (0.12)	946	0.0091 (0.0044)	548	0.020 (0.0074)	398
VG	0.69 (0.46)	946	0.64 (0.063)	548	0.76 (0.045)	398
VG HH with toilet at SBM baseline	0.12 (0.33)	946	0.11 (0.028)	548	0.14 (0.027)	398
SBM eligible	0.65 (0.48)	946	0.63 (0.058)	548	0.68 (0.045)	398

Note: Standard deviations in parenthesis in first column (All);

Standard Errors in parenthesis in other columns, clustered at the gram panchayat;

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Turning to Table 4, we note that 29% of our sample is officially classified as being BPL. An additional 40pp is considered to be marginalised APL, yielding a total of 69% of MF client households in our sample to be officially categorised as VG. Not all of these VG households are considered eligible for SBM subsidies, however. More than one out of ten VG households was reported to own a toilet at SBM baseline. In sum, 65% of our MF client household sample is officially considered to be eligible for an SBM subsidy. We do observe two notable imbalances between the treatment and control group in Table 4. MF client households in the sanitation credit treatment group are more likely to be small and marginal farmers and they are less likely to be a BPL household. Overall, however, MF client households in the treatment group are almost exactly as likely as their counterparts in the control group to be categorised as SBM subsidy eligible. This means that even though we cannot generalise our findings to the population of all MF clients in Maharashtra (in light of the imbalances observed in the previous section), the results presented in this paper are internally consistent and suggestive for what could be happening elsewhere.

4 Empirical Model

The main analysis in Section 5 is restricted to matched MF client households that did not have a toilet at survey baseline (reconstructed baseline toilet ownership, using respondent’s report about the age of their toilet), unless specified otherwise,⁶ and is based on the following estimation equation:

$$Y_{iv} = \alpha_0 + \alpha_1 \textit{Credit}_v * VG_{iv} + \alpha_2 \textit{Credit}_v * \textit{noneVG}_{iv} + \alpha_3 VG_{iv} + \beta X_{iv} + \theta_v + \epsilon_{iv} \quad (1)$$

where \textit{Credit}_v takes the value of 1 if the household had access to sanitation loans and 0 otherwise. Dichotomous variables VG_{iv} and \textit{noneVG}_{iv} denote whether or not the household is officially classified as being a VG household (see Section 3.3). X_{iv} is a vector of household-level controls that helps to increase power and precision. These are chosen to be those that most explain the variation in toilet ownership among control households, and include a dummy for whether or not the household has a child aged 3 or 4, toilet uptake status at baseline, interviewer fixed effects, and village size. Vector X_{iv} also includes a dummy for whether or not a manual check of all matches revealed some uncertainty about the reliability of a particular match (see Section 3.2)⁷. We also control for a set of strata dummies θ_v for GP v . The main outcomes we consider for Y_{iv} are toilet ownership, toilet usage, toilet quality, open defecation practice, sanitation loan uptake and subsidy uptake. We add at the bottom of the impact tables statistics whether the coefficients for different sub-groups within treatment arms differ significantly from each other. Standard errors are clustered at the GP level.

5 Results

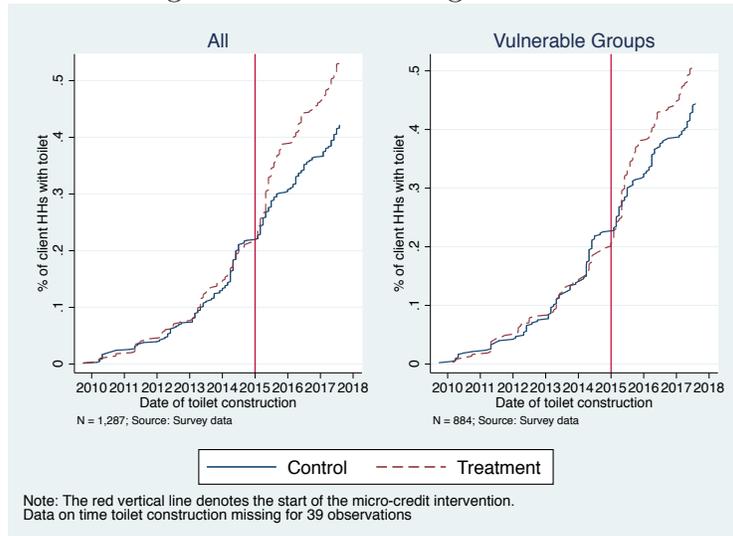
5.1 Toilet uptake

Augsburg et al. [2018] provide evidence of overall impact on toilet uptake of micro-credit labeled for sanitation purpose within the full client sample that underlines our analysis. Overall, MF client households that had access to sanitation loans were found to be 9 percentage points more likely to construct a new toilet. In this section we consider the impacts of the sanitation loan provision on our sample of interest (households without a toilet at baseline) and by whether or not the client household is officially classified as a VG household (and therefore in principle eligible for a subsidy), as defined in the previous section.

⁶We are in the process of doing a robustness check using the panel survey for which we have information on toilet ownership observed by interviewers at baseline.

⁷The reason for controlling for whether the household had a child aged 3 or 4 years is that the sampling strategy stratified households by whether or not they had a young child at the time of census, given the original study focus on health of young children. We control for village size since the endline sample of clients was selected in a manner that correlates with village size.

Figure 3: Toilet coverage over time



To start with, Figure 3 uses survey data on time of toilet construction to plot the trend in toilet coverage over time by treatment status, from 2010 up until survey endline at the end of 2017. The solid (blue) line reflects the average trend in control sites whereas the dashed (red) line depicts the toilet uptake evolution in the treatment areas. The vertical red line denotes the start of the micro-credit intervention (February 2015), which happened shortly after the start of SBM (October 2014). The panel to the left shows the trend in our sample overall whereas the panel to the right restricts the sample to those households that were officially eligible for a government subsidy.⁸

The figure clearly shows that, until the randomised introduction of the credit intervention, toilet baseline ownership rates and toilet uptake trends did not differ in treatment and control areas in the years preceding the intervention. The figure further reveals that toilet coverage steadily increased over time in the control villages, and experienced an increase in uptake shortly after the start of SBM. This evidence is consistent with the hypothesis of SBM having induced a successful sanitation drive in our study areas; though two years from the 2019 deadline to become ODF, toilet coverage amongst the MF client sample remains at less than 50% in control GPs. From the moment the sanitation loan product was introduced in the treatment sites, however, we observe a remarkable spurt in toilet uptake in the treatment arm, over and above the increase observed in the control villages.

Interestingly, we observe a similar pattern in the panel to the right, which restricts the sample to subsidy eligible households. The difference in trend between control and treatment post-intervention is not as stark as in the overall sample, but micro-credit nevertheless seems to have induced a shift in toilet coverage in treatment communities also for subsidy eligible households.

⁸In this figure we define subsidy eligibility by VG status, given that we are interested in subsidy eligibility over time, including the period preceding SBM. Sanitation programs prior to SBM (such as TSC or NBA) all targeting VG groups with their subsidies.

Regression estimation results presented in Table 5 formalise these findings. Columns (1)-(2) use measures of toilet ownership as reported by respondents during endline survey in Aug-Sept 2017.⁹ Using time of toilet construction reported during endline survey, Columns (3)-(4) consider toilet ownership as of September 2016. 6. Doing so makes these survey results more comparable to Columns (5)-(6) where we use household toilet ownership records from the SBM September 2016 snapshot as the dependent variable.

Table 5: Impacts on toilet uptake: Heterogeneity by vulnerability group (VG) status

	(1)	(2)	(3)	(4)	(5)	(6)
	Survey 2017	Survey 2017	Survey 2016	Survey 2016	SBM 2016	SBM 2016
Credit	0.138*** (0.0485)		0.109*** (0.0362)		0.108** (0.0534)	
Credit - VG		0.116** (0.0577)		0.0963** (0.0465)		0.101* (0.0603)
Credit - Non-VG		0.159** (0.0733)		0.124** (0.0533)		0.150** (0.0639)
VG		0.0794 (0.0579)		0.0424 (0.0477)		-0.0428 (0.0424)
Strata FE	Yes	Yes	Yes	Yes	Yes	Yes
Household covariates	Yes	Yes	Yes	Yes	Yes	Yes
F_survey		0.626				
F_survey2016				0.691		
F_sbm						0.476
controlmean	0.307		0.233		0.341	
controlmean_notvg		0.263		0.189		0.311
controlmean_vg		0.331		0.257		0.358
N	922	922	922	922	922	922

Standard errors clustered at the village level in parenthesis;

We drop 24 observations for which we do not have toilet ownership data available in the SBM dataset;
Sample restricted to households not having a toilet at survey baseline.

Column (1) in Table 5 shows that, overall for MF client households that did not own a toilet at survey baseline, the credit intervention significantly improved toilet coverage in treatment communities, by nearly 14 percentage points. This increase yields a toilet coverage in 2017 that is almost 50% higher than that in control communities for this sample (31% in control). Pooled regression results in Column (3) suggest that almost 80% of impacts of the micro-credit intervention significantly manifested themselves already one year earlier, in September 2016.¹⁰ Remarkably, results in Column (5) using toilet ownership records from the SBM 2016 snapshot confirm the survey data

⁹Results remain similar when we use interviewer observations of toilet ownership instead of respondent self-reports.

¹⁰Demonetisation in November - December 2016 greatly reduced MFI lending in the study areas, which could explain the slowdown in the trend between 2016-2017.

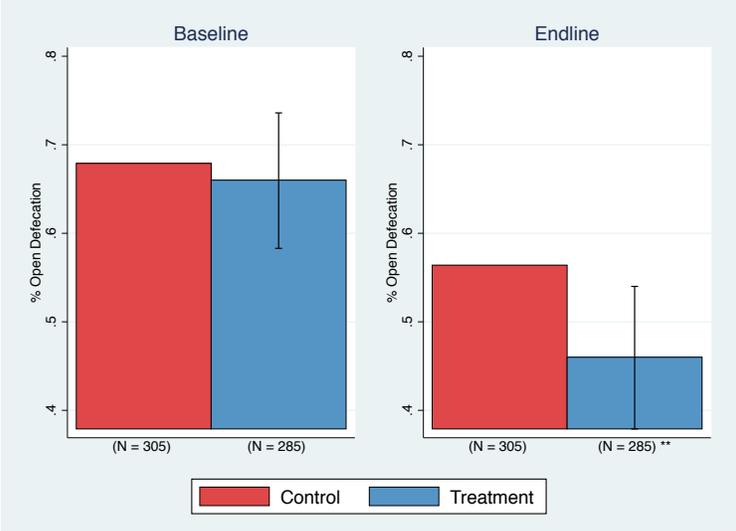
results almost exactly, showing a similar estimate of impact of 11 percentage points (statistically significant).

Looking at heterogeneity by VG status (Columns (2), (4) and (6)), we find that toilet uptake increases significantly as a result of the micro-credit intervention for both VG (*de jure* subsidy eligible) and none-VG (subsidy ineligible) households in the credit arm. Impacts for subsidy eligible households and subsidy ineligible households are not statistically different from each other. Again, results based on survey data are confirmed by results obtained using SBM administrative data. This result confirms that micro-credit incentivised or enabled both subsidy eligible households and subsidy ineligible households to access financial means to construct a toilet, which is suggestive of a complementary role for microfinance to the SBM scheme.

5.2 Toilet usage and Open Defecation

One of SBM’s main missions is to reach an Open Defecation Free (ODF) India by October 2019. To that end, it is not sufficient to find evidence of impact of sanitation credit on toilet uptake. Critics have argued that toilets constructed with government funding are not necessarily used and that many toilet owners continue to practice Open Defecation (OD) (Coffey and Spears [2017]). In this section we verify the extent to which improved toilet ownership as a result of improved access to credit has reduced OD practice in our context.

Figure 4: Open Defecation rate: Baseline versus endline



At baseline and endline survey we asked the household respondents whether anyone in their household practices OD. We consider a household to practice OD if any one member is reported to practice OD. Figure 4 compares the average OD rate reported by MF client household respondents in treatment sites to that of control sites, at baseline (left panel) and at endline (right panel). For comparability purpose, in this Figure

we restrict the sample to the panel sample. At baseline, self-reported OD practice was balanced across treatment and control communities and stood high at around 66-67%. At endline, 2.5 years later, the data suggest a big OD improvement in our study area in Maharashtra. In control communities, overall OD practice amongst MF client households dropped to 56% on average, a decrease of 16% since baseline. In treatment communities, however, OD reduced twice as fast (by 30%), from 66% down to 46%. The difference between control and treatment at endline is statistically significant at the 5% significance level.

Table 6 describes endline toilet usage and OD practice in more detail. Panel 1 of Table 10 presents descriptive statistics on toilet usage. We measure endline toilet usage by asking the head of the household whether the toilet they own is currently in use (i.e. used by at least one household member, not necessarily all). The first row in the first panel tells us that 46% of all MF client households in our matched sample report to use a toilet. The second row tells us that 95% of all (completed) toilets in our study area are reportedly currently in use. This finding is confirmed by interviewer observations related to toilet usage. Availability of soap, ashes and water nearby are often considered a proxy for toilet usage. Interviewers observed soap or ashes for hand-washing nearby the toilet for 89% of all toilets and 93% of all toilets were reported to have water for hand-washing available nearby (not shown in the table).

Table 6: : Toilet usage and Open Defecation (OD) practice at endline

	N	Total	Control	Treatment
<i>Toilet usage:</i>				
All households	1,326	0.4615 (0.0137)	0.4151 (0.0180)	0.5227*** (0.0209)
Households that own a constructed toilet	641	0.9548 (0.0082)	0.9485 (0.0122)	0.9614 (0.01094)
<i>All members OD:</i>				
All households	1326	0.5226 (0.0137)	0.5743 (0.0180)	0.4546*** (0.0208)
Households that own a constructed toilet	314	0.0421 (0.0079)	0.0545 (0.0125)	0.0289 (0.0095)
Households that do not own a constructed toilet	685	0.9722 (0.0063)	0.9788 (0.0070)	0.9617 (0.0119)
<i>At least one member OD:</i>				
All households	1326	0.5362 (0.0201)	0.5862 (0.0180)	0.4703*** (0.0209)
Households that own a constructed toilet	314	0.0686 (0.0149)	0.0788 (0.0133)	0.0579 (0.0010)
Households that do not own a constructed toilet	685	0.9737 (0.0061)	0.9811 (0.0066)	0.9617 (0.0119)

Note: Standard deviations in parentheses; * 0.10 ** 0.05 *** 0.01

Even if a household owns and uses a functioning toilet, some, if not all, household members might continue to practice open defecation. For instance, when they are out to work on the field. Our surveys collected information on where household members belonging

to different age and gender groups typically defecate, which allows us to construct measures on the extent of open defecation practice within a household. We focus on two extremes: i) whether all demographic groups in the household typically practice open defecation; and ii) whether at least one demographic group in the household typically practices open defecation. Panel 2 and Panel 3 in Table 10 provide descriptive statistics on reported open defecation practice at endline in our study villages, by treatment arm and by whether or not the household owns a toilet. Panel 2 shows the proportion of households where all demographics groups reportedly practice open defecation, Panel 3 reports the proportion of households where there is at least one demographic group that is reported to practice open defecation. Results in the two panels are very similar, suggesting that for most households, either everyone practices open defecation, or no one does. Overall, in control villages we find that to date around 57% of MF client households in our matched sample report to practice OD. In the treatment arm, OD practice reduced to a level of around 46%. Note that most, if not all, of this reduction comes from reported changes in behavior amongst those who own a constructed toilet. Almost all households without a toilet continue to practice OD, which is not surprising given that community toilets as well as sharing of toilets is uncommon in our study areas.¹¹

Given that toilet usage and OD practice appear to be equivalent to toilet uptake in our context, it is not surprising that regression results presented in Table 7 are in line with the results on toilet uptake presented in the previous section. Micro-credit for sanitation led to an increase in toilet usage and a decrease in OD practice, for both SBM subsidy ineligible and SBM subsidy eligible households.

¹¹Only 13% of 75 matched study GPs own a community toilet, as reported by GP officials; and sharing of toilets XXX.

Table 7: Impacts on toilet usage and OD practice: Heterogeneity by vulnerability group (VG) status

	(1)	(2)	(3)	(4)
	Toilet in use	Toilet in use	OD	OD
Treatment	0.117*** (0.0411)		-0.126*** (0.0441)	
Credit - VG		0.0841* (0.0462)		-0.0876* (0.0495)
Credit - Non-VG		0.168** (0.0676)		-0.196*** (0.0699)
VG		0.0797* (0.0476)		-0.0722 (0.0505)
Strata FE	Yes	Yes	Yes	Yes
Household covariates	Yes	Yes	Yes	Yes
F_usage		0.276		
F_OD				0.171
control_mean	0.219		0.766	
controlmean_noteligible		0.179		0.806
controlmean_eligible		0.241		0.744
N	946	946	946	946

Standard errors in parentheses; Standard errors clustered at the village level.

Finally, Table 8 shows (pooled) results by sub-category of household members. We find that the impact of the credit intervention on OD reduction was significant across all age and gender groups, except for kids 2-5 years of age.

Table 8: Impacts on toilet usage by sub-category: Conditional on not having a toilet at SBM baseline

	(1)	(2)	(3)	(4)	(5)
	Female > 16	Male > 16	Girls 6-15	Boys 6-15	Kids 2-5
Treatment	-0.124*** (0.0437)	-0.114** (0.0448)	-0.171*** (0.0615)	-0.129* (0.0705)	-0.0931 (0.0802)
Strata FE	Yes	Yes	Yes	Yes	Yes
Household covariates	No	No	No	No	No
controlmean	0.768	0.750	0.776	0.780	0.757
N	945	946	322	371	231

Marginal effects; Standard errors in parentheses; Standard errors clustered at the village level. Covariates: Toilet uptake status at BL, dummy =1 if HHs has a child aged 3 or 4.

5.3 Sanitation loan uptake

To assess whether it is indeed improved access to micro-credit labelled for sanitation purpose that triggered subsidy eligible households to invest in toilet construction, it

Table 9: Impacts on sanitation loan uptake: Heterogeneity by vulnerability group (VG) status

	(1)	(2)
	Sanitation loan uptake	Sanitation loan uptake
Treatment	0.186*** (0.0475)	
Credit - VG		0.159*** (0.0482)
Credit - Non-VG		0.239*** (0.0683)
VG		0.0463 (0.0289)
Strata FE	Yes	Yes
F_toilet		0.237
F_notoilet		
controlmean	0.00912	
controlmean_notvg		0
controlmean_vg		0.0142
N	946	946

Standard errors clustered at the village level in parenthesis

is important to estimate impacts on sanitation loan uptake. It is possible that toilet ownership amongst subsidy eligible households improved, not as a result of their improved access to micro-credit, but through other channels triggered by the provision of sanitation loans. Perhaps even households without any interest in or need for sanitation credit decided to construct a toilet, because the boost in toilet construction by those that did take up a sanitation loan motivated others (e.g. through peer effects), or perhaps it encouraged GP officials to boost subsidy provision (see Section 5.4).

Table 9 shows that, overall, MF client households without a toilet at baseline were 19 percentage points more likely than those in control to take up a sanitation loan from the MFI and that SBM subsidy eligible MF client households were (statistically) as likely as ineligible households to take up a sanitation loan.

This is remarkable, given that SBM subsidy eligible households should in principle have been able to access government subsidies to cover the costs of toilet construction. It is possible that at least some of these households took up sanitation credit for a purpose other than for sanitation investment. Indeed, Augsburg et al. [2018] find evidence that only about 50% of sanitation loans were converted into new toilets and provide further evidence that a significant percentage of loans were not used for any sanitation investment, neither construction of a new, nor repair or upgrade of an existing toilet. The quality of toilets that existed at baseline does not seem to improve significantly (neither in terms of coefficient estimate sizes, nor in term of statistical significance) and indeed, 16% of clients themselves report that they did not use any part of the sanitation loan for sanitation investment and 7% report to have used it for sanitation and other purposes. But the results in the previous section suggest that a significant

part of both subsidy eligible and ineligible households did convert the sanitation loan into new toilets.

5.4 Subsidy uptake

In this section we explore more specifically whether or not the introduction of micro-credit for sanitation (and the resulting boost in toilet construction) has led to an increase in SBM subsidy uptake in our study area. There are various reasons for why this is likely. Micro-credit could have encouraged or enabled subsidy eligible MF client households to construct toilets, making them more likely to apply for and receive SBM subsidies. For instance, by advancing the funds needed to construct the toilet prior to subsidy receipt, or by providing additional funds to construct a type of toilet more expensive than what could be afforded with a subsidy alone. Or, observing a boost in toilet construction by others around them, they might have been inspired to construct a toilet themselves and to apply for and receive a subsidy, irrespective of sanitation loan uptake. In those two cases, we would expect to see an impact on subsidy uptake, particularly for subsidy eligible households. On the other hand, it is possible that sanitation loans substitute, rather than complement subsidy uptake. This would be the case if, for instance, households that in theory are eligible for subsidies, are in reality not able to obtain one. If this was the case across the board, then we would not observe any impact on subsidy uptake as a result of an increase in toilet uptake by subsidy eligible households in treatment communities.

To start with, Table 10 shows for treatment communities the proportion of households without a toilet at survey baseline that since SBM baseline took (i) only a sanitation loan (SL only), (ii) only a subsidy (Subsidy only), (iii) a sanitation loan and a subsidy (SL + Subsidy), or (iv) neither a sanitation loan or a subsidy (None). We use sanitation loan receipts as recorded in the MFI admin data and subsidy receipts as recorded in the SBM 2016 snapshot. We should note that the SBM 2016 snapshot only reports subsidies received since SBM baseline (see Section 3.2). Hence, the statistics shown in Table 10 should be interpreted as subsidy and loan receipts since SBM baseline in 2012-2013, bearing in mind the possibility that some households in some categories might have received a subsidy in the past. Officially though, households that received a subsidy in the past and that built a toilet are no longer eligible for an SBM subsidy. Also, as we will see in Section 6, it generally takes time, after the toilet is constructed, for households to apply for and obtain a subsidy. It is therefore possible that households in categories (i) and (iv) will end up receiving a subsidy in the future.

Results in Table 10 show that virtually zero households with a toilet reported at SBM baseline (VG and non-VG) are recorded to have received a subsidy and that, by September 2016, only very few MF clients that took a sanitation loan ended up also receiving a subsidy since SBM baseline. A significant share of households (VG and non-VG) without a toilet at survey baseline ended up relying on just a sanitation loan without receiving a subsidy. The VG group without a toilet reported at SBM baseline (i.e. the official SBM subsidy eligible group) was most likely to receive either a loan

and/or a subsidy (only 60% of them did not receive any form of financial support). We find that 25% of them received a subsidy since SBM baseline (22% + 3%), out of which 3 percentage points received a sanitation loan in addition to the subsidy. Another 15% took a sanitation loan but did not (yet) receive a government subsidy. Sanitation loan uptake seems to be largest amongst non-VG MF clients that had a toilet reported at SBM baseline (despite having no toilet at survey baseline). Some (11%) of non-VG MF clients that did not have a toilet at SBM baseline were able to obtain a subsidy anyway, which might explain their slightly lower rate of sanitation loan take up, i.e. 19% out of which 3 percentage points received a loan in addition to receiving a subsidy. Note that VG households with a toilet reported at SBM baseline were least likely to receive either sanitation loan or subsidy: Almost 9 out of 10 received neither type of financial support (89%), despite being VG and not having a toilet at survey baseline. Only 9% of them took a sanitation loan, compared to 24% of their non-VG counterparts.

Table 10: Subsidy and sanitation loan (SL) uptake since SBM baseline

	No toilet at SBM baseline		Toilet at SBM baseline	
	VG	Non-VG	VG	Non-VG
SL only	15%	16%	9%	24%
Subsidy only	22%	8%	2%	0%
SL + Subsidy	3%	3%	0%	0%
None	60%	73%	89%	76%
N	245	62	54	37

Note: Stats on sanitation loan uptake are based on MFI admin data and stats on subsidy uptake are based on SBM admin data; Sample restricted to HHs without toilet at survey baseline.

These descriptive results suggest that most households benefited from either sanitation loan, or from a subsidy, but many received neither of these two financial aids. B. By September 2016, only very few households had benefited from both. (Note: We are in the process of improving the matching process to scrutinise these results. These results might be subject to change. Especially in light of the regression results on subsidy uptake presented below, we suspect that the low proportion of SL + Subsidy HHs shown in Table 10 might be due to imperfect matching; This could also be the result of the fact that our matched sample of clients is richer than average). Therefore, unless the micro-credit intervention had an impact on toilet uptake other than through the direct provision of credit (e.g. through peer effects coming from clients that took up a sanitation loan and built a toilet, or through critical mass effects), we do not expect there to be any impact on subsidy uptake (note: this conclusion would change if after improving matching we observe a higher proportion of households that have benefited from both credit and subsidy, i.e. the SL+subsidy category).

Regression results in Table 11 show a significant impact of the micro-credit intervention on subsidy uptake for VG households (conditional on not owning a toilet at baseline). Unsurprisingly, we do not find any significant impact for non-VG households (who were officially not eligible to receive any subsidies). These results suggest that at least some

VG households were *de facto* eligible to receive a subsidy but that prior to the micro-credit intervention they were not able to do so. Access to micro-credit allowed these households to construct a toilet and to obtain a subsidy as a result of this.

Table 11: Impacts on subsidy uptake: Heterogeneity by vulnerability group (VG) status

	(1)	(2)
	Subsidy uptake	Subsidy uptake
Treatment	0.0798**	
	(0.0363)	
Credit - VG		0.0880**
		(0.0430)
Credit - Non-VG		0.0198
		(0.0396)
VG		0.0764**
		(0.0292)
Strata FE	Yes	Yes
F_sbm		0.144
controlmean	0.117	
controlmean_notvg		0.0357
controlmean_vg		0.162
N	946	946

Standard errors clustered at the village level in parenthesis

6 Mechanisms

The results presented so far highlight impacts of the micro-credit intervention on toilet uptake and open defecation practice, for both households not eligible for SBM subsidies and households that are officially eligible to receive an SBM subsidy. That is, a significant proportion of VG households that did not have a toilet reported at baseline - took up a sanitation loan and translated this into higher toilet uptake and reduced OD practice.

This section looks at possible mechanisms through which the impacts of the micro-credit intervention materialised. We start with the most obvious channel, i.e. it might have helped subsidy ineligible households (i.e. none-VG households) accessing funds for toilet construction. In addition, it might have also helped VG households that were *de jure* eligible for a subsidy but that *de facto* were not (because of erroneous toilet ownership status recorded at SBM baseline). We then move on to discussing other channels that could possibly explain why even subsidy eligible households benefited from the micro-credit intervention: The timing of subsidy disbursements, the costs of toilets relative to available subsidy amounts and possible externality effects (e.g. peer effects and critical mass effects).

6.1 Subsidy eligibility requirement

Only a sub-set of MFI client households - 65% - are considered to be officially eligible for subsidies (see Section 3.3). The remaining 40% of the MF client households are not eligible, either because they have not been officially classified as a VG household and/or because they were recorded to have had a toilet at SBM baseline. This eligibility requirement provides us with the first, most obvious mechanism through which credit might complement subsidies: It provides those not eligible for subsidies with a means to fund toilet construction.

One reason might be that non-VG households in this context may also be in need of additional funding, just like their VG counterparts. Table 12 compares VG MF client households to non-VG MF client households in terms of their endline socio-economic characteristics. Other than non-VG households' heads being one year older, on average, we do not find any significant differences between them. It is therefore conceivable that non-VG households in this context struggle as much as VG households to gather sufficient funding to construct a toilet.

Table 12: Comparison characteristics subsidy eligible versus ineligible households

	All	N	Non-VG	N	VG	N
Age HH head	46.9 (10.1)	1326	47.7 (0.57)	411	46.6* (0.40)	915
HH size	5.23 (2.06)	1326	5.23 (0.100)	411	5.23 (0.087)	915
Head able to write	0.73 (0.45)	1326	0.76 (0.026)	411	0.71 (0.016)	915
Head able to read	0.70 (0.46)	1326	0.72 (0.029)	411	0.69 (0.015)	915
Years of education HH head	5.90 (4.77)	1326	6.03 (0.32)	411	5.84 (0.19)	915
Primary economic activity is agriculture	0.58 (0.49)	1326	0.56 (0.035)	411	0.59 (0.034)	915
HH owns agricultural land	0.37 (0.48)	1326	0.38 (0.035)	411	0.36 (0.024)	915
HH assets: Bicycle	0.24 (0.43)	1326	0.29 (0.037)	411	0.22* (0.021)	915
HH assets: Four wheeler	0.035 (0.18)	1326	0.041 (0.0076)	411	0.032 (0.0066)	915
HH assets: Chairs	0.55 (0.50)	1326	0.56 (0.030)	411	0.55 (0.029)	915
HH assets: Tables	0.40 (0.49)	1326	0.41 (0.026)	411	0.40 (0.029)	915
HH assets: Chairs/tables	0.60 (0.49)	1326	0.61 (0.032)	411	0.60 (0.029)	915
HH assets: Beds	0.47 (0.50)	1326	0.49 (0.028)	411	0.46 (0.022)	915
HH assets: Cupboard	0.41 (0.49)	1326	0.41 (0.025)	411	0.41 (0.019)	915
HH assets: Refrigerator	0.12 (0.33)	1326	0.16 (0.017)	411	0.11** (0.013)	915
HH owns TV	0.65 (0.48)	1326	0.67 (0.030)	411	0.63 (0.025)	915
HH assets: Radio	0.051 (0.22)	1326	0.061 (0.012)	411	0.046 (0.0072)	915
HH assets: Phone	0.91 (0.28)	1326	0.90 (0.016)	411	0.92 (0.011)	915
HH assets: Sewing Machine	0.16 (0.37)	1326	0.19 (0.022)	411	0.15 (0.014)	915
HH assets: Fans	0.79 (0.41)	1326	0.78 (0.021)	411	0.80 (0.018)	915
HH assets: Electric appliances	0.79 (0.41)	1326	0.78 (0.021)	411	0.80 (0.018)	915
HH assets: Jewellery	0.48 (0.50)	1326	0.53 (0.028)	411	0.46 (0.037)	915
HH owns livestock	0.23 (0.42)	1326	0.23 (0.029)	411	0.23 (0.019)	915
HH assets: Agricultural equipment (e.g. tractor etc.)	0.037 (0.19)	1326	0.049 (0.015)	411	0.032 (0.0095)	915

Note: Standard deviations in parenthesis in first column (All);

Standard Errors in parenthesis in other columns, clustered at the gram panchayat;

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Furthermore, perhaps the sanitation loans also allowed VG households affected by *exclusion* error to construct a toilet. We can check for this type of error with respect to the toilet ownership eligibility criteria. Some critics argue that there are many VG households that were reported to have a toilet at SBM baseline, whose toilets were however not functioning or some cases did not even exist. Table 13 shows results consistent with this concern. We find that 52% of MF client households identified as vulnerable but at the same time as owning a toilet in the 2012-2013 SBM data (making them ineligible for subsidy), did not own a toilet according to our survey data 1-2 years later, in 2014.¹² Whether their toilet became dysfunctional or never existed we cannot say. The table also provides an upper bound estimate for potential *inclusion* error, 23% of client households identified as vulnerable are said not to own a toilet at SBM baseline, whereas our survey data suggests that they owned a toilet at survey baseline. It is likely however that at least some of these households constructed a toilet in between SBM baseline and survey baseline.

Table 13: Baseline toilet ownership of VG households: A comparison of SBM baseline versus survey baseline reports

	No toilet at SBM baseline	Toilet at SBM baseline	N
No toilet at survey baseline	512 (77%)	105 (52%)	617
Toilet at survey baseline	151 (23%)	99 (49%)	250
N	663 (100%)	204 (100%)	867

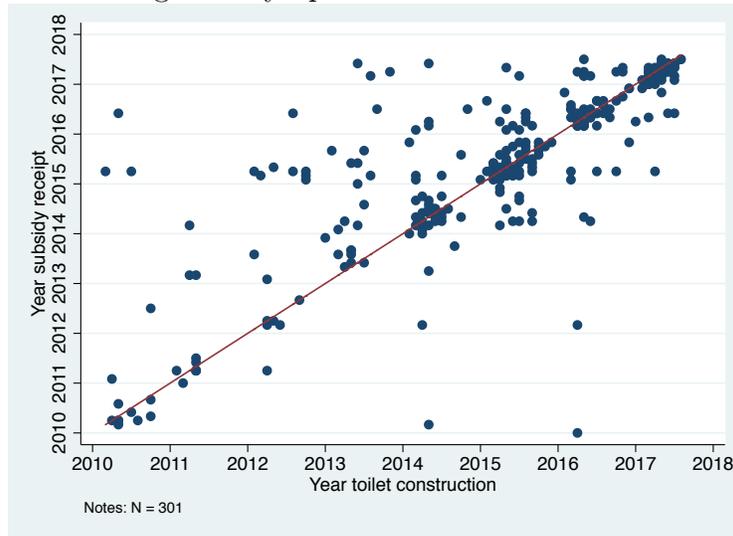
It is possible that some of these households under-reported actual toilet ownership at our baseline survey, in the hope of being considered eligible for subsidy. It is also possible that there are some reporting errors and/or that our matching process was not perfect ([note: we are in the process of scrutinizing our matching process to rule out matching issues to be the driving force here](#)). However, the significance of the share of such households in the overall sample (52%) makes it quite plausible that a substantial share of VG households was not eligible for SBM subsidy despite them being VG and de facto not owning a functioning toilet at the time of SBM baseline.

6.2 Timing of subsidy receipts

Given that the bulk of the SBM subsidy amount is disbursed only after a toilet has been successfully constructed, households need funding up-front to advance the money to cover toilet construction costs. If that is indeed the case in practice, then households might benefit from access to micro-credit to bridge the funding gap. Figure 5 shows the timing of subsidy disbursement reported in the endline survey and compares this to the timing reported for toilet construction.

¹²Table 13 uses reconstructed baseline toilet ownership using endline report on date of toilet construction. Results are almost identical when using actual baseline toilet ownership observations using the panel sample (results can be obtained on request).

Figure 5: Timing subsidy uptake versus time toilet construction



More than half of the households report to have received the subsidy after toilet construction. Those households had to wait, on average, 10 months after toilet construction to receive their subsidy. Almost 30% had to wait more than 3 months; One out of five had to wait for more than 6 months and more than one out of ten had to wait for more than a year after toilet construction for their subsidy to be disbursed. We observe that 50% of subsidy receiving households report to have received their subsidy either at the same time or *before* toilet construction. This finding could however be subject to recall error, particularly those not far below the 45 degree line. It is also possible that some households refer to the partial subsidy disbursed prior to toilet construction when responding to the time of subsidy receipt question.

These results are also consistent with SBM officials' report of delays in SBM disbursement: On average, half of the 78 GP officials reported that households in their community had to wait on average for at least 3 months after subsidy application before receiving the subsidy.

Figure 6: Timing loan uptake versus time toilet construction

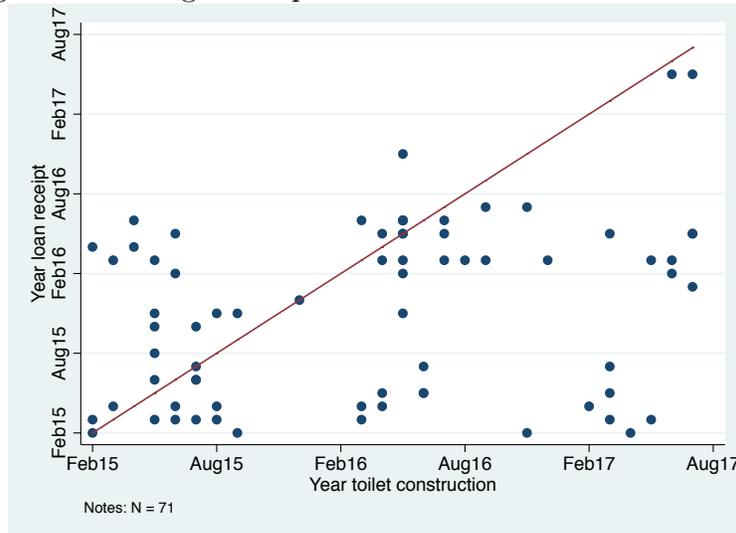


Figure 6 in turn plots the timing of toilet construction against the timing of sanitation loan uptake, as reported by loan takers that did not have a toilet at the time of baseline survey.¹³ Almost 70% of loan receiving households reported to have received the loan before toilet construction. Almost one out of four received the loan more than a year ahead of actual toilet construction. This is substantially faster than the average gap between toilet construction and subsidy receipt. If sanitation loans were used for their intended purpose, we would expect loan uptake to take place prior to toilet construction. And yet, 30% of loan takers report to have obtained the sanitation loan only *after* toilet construction. Note that it is mainly toilets constructed more than a year before endline survey for which we get observations reporting timing toilet construction to precede timing of loan uptake. This could well be because of recall error. As discussed in Section 5.3, however, this could also at least partially be driven by households taking a sanitation loan for purpose other than toilet construction.

Overall, these descriptive results confirm that there is a time gap between toilet construction and subsidy receipt, not just on paper but also in practice. And that this delay in subsidy disbursement can be substantial. This feature of government subsidies could possibly make sanitation loans, which are generally disbursed prior to toilet construction, an attractive alternative for credit constrained households to advance funds needed to construct a toilet.

6.3 Toilet costs and toilet quality

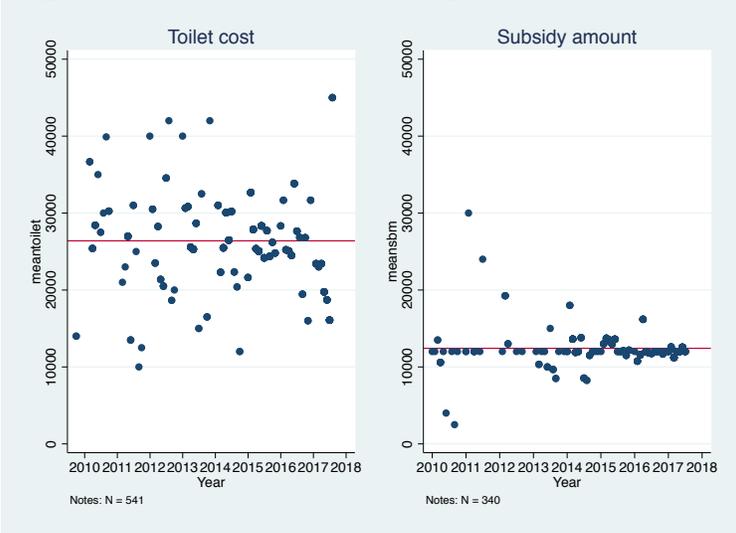
Coffey et al. [2014] and Coffey and Spears [2017] point out that most Indian households prefer to construct more expensive toilet types. They estimate that the average cost of

¹³Note that we choose to use self-reported time of sanitation loan disbursement from the survey data here, instead of the more reliable MFI admin data. We do this to make the measure more comparable to self-reported time of toilet construction.

a toilet that a typical Indian household desires costs more than Rs. 21,000, which is much higher than the subsidy amount offered (Rs. 12,000). Coffey et al. (2014) also talk about the ‘missing middle’ in the sanitation ladder in India - households want to move straight from Open Defecation to an expensive toilet, or not at all.

Figure 7 shows a similar pattern in our data. This figure plots toilets costs and subsidy amounts taken over time. Since 2010, the average reported subsidy amount has been steady around Rs. 12,000. There has been more variation in the average reported toilet cost for MF clients in our sample, but on average since 2010 it has always been around Rs. 26,000, more than double the subsidy amount. The sanitation loan product of Rs. 15,000 could well be used by subsidy eligible and ineligible households alike to complement subsidy funds and/or savings to cover the costs of these relatively expensive toilets.

Figure 7: Toilet cost and subsidy amount over time



We also considered impacts on toilet quality, in a similar way as done in Augsburg et al. [2018] but now focusing on heterogeneity of impacts in terms of subsidy eligibility status (results not shown in this paper given that they are very similar as in Augsburg et al. [2018]). As in Augsburg et al. [2018], we find no robust evidence that the credit intervention allows households to invest in a higher quality toilet. Not for subsidy eligible or for subsidy ineligible households and not for households that owned a toilet at baseline and those who did not. As in the credit paper, we find some suggestive evidence on overground quality for subsidy ineligible households, but that result is small in magnitude and not sufficiently robust to conclude much.

The failure to find significant impacts of the micro-credit intervention on toilet quality does not mean that toilet quality did not matter at all. If Coffey et al (2014) are right about the ‘missing middle’ then any toilet constructed in the area will have been of high quality, including in control sites. In that case, the introduction of micro-credit for sanitation could have supported more households to build the high quality toilet they desire, which would be reflected in higher toilet uptake, not in toilet quality.

6.4 Externality effects

e.g. peer effects, critical mass effects, etc.

TO BE COMPLETED: Consider impacts on credit ineligible households

7 Concluding remarks

Governments of developing countries worldwide struggle to find sufficient budget to cover all public investments needed to stimulate socio-economic growth and to meet the SDGs by 2030. Investments in public health and education in particular are often considered to be the responsibility of the government, in view of the market's failure to efficiently address moral hazard and/or externalities associated with this type of service provision. The latter has justified the use of subsidies to encourage certain private investments such as school subsidies or vouchers for the purchase of bednets, deworming medication or sanitation facilities. Microfinance on the other hand has been shown to provide numerous individual women and men across the globe with access to financial services otherwise not available to them, e.g. to start new businesses or, more recently also for investments not immediately income generating, such as to fund the education of their children.

There are a number of inefficiencies resulting from standalone subsidy or credit programs. The former risking dependencies and administrative targeting inefficiencies and the latter not always being accessible to all and most often do not considered sanitation a viable investment purpose. The merit of a model combining government subsidies and private sector micro-credit to promote investments that inhibit positive externalities has not yet been rigorously considered and is not yet understood. The evidence provided in this paper contributes to this knowledge gap in the context of Swachh Bharat Mission (SBM), the Government of India's flagship sanitation programme, launched in October 2014 with the aim of making India ODF by October 2019. A prominent feature of SBM is the provision of financial incentives to vulnerable households without a toilet recorded by government officials at the time of SBM baseline. We exploit the RCT design of a sanitation micro-credit intervention in rural Maharashtra, which started shortly after SBM was launched, to consider the complementary role that micro-credit can play alongside subsidies in government's efforts to stimulate private health investments.

Matching primary survey data to SBM administrative data, we show that the majority of MF client households in our sample without a toilet at survey baseline were officially eligible for SBM subsidies, i.e. 65%. However, a substantial share of vulnerable households classified as being officially ineligible for subsidies based on official records of toilet ownership during the official SBM baseline survey, did in fact not own a toilet (as per our survey data) and therefore should in principle have been eligible. It is possible that (at least some of) these households had a toilet at the time of SBM baseline, but that the toilet had not been of sufficiently good quality to sustain until the time of our survey baseline (1-2 years later). We find that micro-credit was able

to reach those vulnerable households that needed support but that had been left behind by administrative targeting inefficiencies. We also find significant sanitation loan take-up by non-vulnerable households. Remarkably, also a significant share of subsidy eligible households availed the sanitation credit and used this to construct a toilet. This evidence, combined with evidence of significant delays in subsidy disbursement and toilet construction costs being on average double the subsidy amount, suggest that even subsidy eligible households might be in need of bridge funding.

Our data show significant improvements in toilet uptake and reductions in OD practice in our study area, including in control villages. This suggests that SBM’s efforts in Maharashtra have started to pay off. Though two years from the 2019 deadline to become ODF, toilet coverage amongst the MF client sample remains at less than 50% in control GPs. We find significantly better results in communities where households had access to sanitation credit in addition to sanitation subsidies, a difference of 14 percentage points in toilet uptake over the 2.5 year study period and an equivalent reduction in OD practice. We find similar impacts for both non-vulnerable and vulnerable households without a toilet at baseline, the latter being the target group for SBM subsidies. Impacts are most significant for vulnerable and non-vulnerable households that are not officially eligible for the SBM subsidy.

Overall, the evidence presented in this paper supports a model that combines ex-post government subsidies and micro-credit as a means to promote specific private investments. Such a two-tier approach allows the government to target its scarce resources to the most vulnerable, whilst micro-credit can help other households to make the necessary investments. In addition, micro-credit can capture (at least some of the) vulnerable households that are being left behind as a result of administrative targeting failures, or those whose toilets need repair, upgrade or in fact a complete overhaul. At the same time, the remuneration post verification subsidy model provides an incentive to make sure that the desired investments are made - and that loans are used for their intended purpose. Whilst micro-credit allows subsidy eligible households to bridge funding, which ensures that financial constraints are not a barrier to uptake.

A Matching process

The process we used to match the list of clients provided by the MFI to our survey data and to the SBM dataset was based on name matching, using the guide to international names and naming practice provided by the British government UK [2016]. Most Indian names in Maharashtra follow a traditional naming convention. Their full name usually consists of three names. Personal name + Middle name + Family name. Men and unmarried women traditionally take their father’s personal name as their middle name. For instance, Sanjav Bharat Vadgama. On marrying, a woman traditionally drops her father’s name and family name and takes on her husband’s personal name and his family name in its place. There are some exceptions (e.g. for people who reject the caste system) which we took into consideration when matching.

Our census survey asked for the full names of every household head and his spouse. If there was no spouse available, then we asked for the full name of the eldest female member in the household. After census, we matched the full names provided in the census survey to the list of full names of female MF clients and their husbands provided by the implementing MFI. From the matched list of clients, we randomly drew a sample of clients for our study. The baseline and endline survey of sampled clients included a household roster, where the first and last name of all household members were listed. Those clients whom we did not match using census survey (either because the household had not been listed - given that in larger villages we only listed random segments - or because the client was not the head or the spouse of the head) were matched to the baseline/endline sample using the first and last names provided in the household roster.

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