Sanitation and Hygiene

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Chapter 4: Sanitation and Hygiene

1. Introduction

It is universally accepted that poor sanitation and hygiene are a major cause of disease in developing countries. In India, poor sanitation takes the form of an absence of toilets in households' dwellings which *ipso facto* compel their members to defecate in the open. This practice spreads bacterial infections like diarrhoea, cholera, and hook worm which, in turn, have repercussions on child development (Coffey et. al. 2017, Spears, 2013, Chambers and von Medeazza, 2013, Ghosh, et. al. 2014). Poor hygiene, particularly the failure of mothers to wash hands after defecation, is a prime cause of diarrhoea in children in developing countries. The vast majority of diarrhoeas are caused by infectious pathogens which reside in faeces and which employ a variety of routes to enter a new host. Since one such route is getting onto fingers and, thereby, into foods and fluids the incidence of diarrhoea can be reduced by improvements in domestic hygiene[1] Given that diarrhoea accounts for 1.8 million deaths in children in low and middle income countries it is important to examine hand washing practices (Borooah, 2004; Huang and Zhou, 2007, Ejemot-Nwadiaro *et. al.*, 2015).

Against this background, this paper examines, within the Indian context, patterns of toilet use and personal hygiene. Open defecation in India has attracted a great deal of academic interest and its eventual elimination, through a program of building toilets, has been an important object of successive Indian governments from the Total Sanitation Campaign, the *Nirmal Bharat Abhiyan*, and the *Swach Bharat Abhiyan*.[2] An important and influential line in academic thinking, as articulated in Coffey and Spears (2017) and Coffey *et. al.* (2017), is that "widespread open defecation in rural India is not attributable to relative material or educational deprivation but rather to beliefs, values, and norms about purity, pollution, caste and untouchability … that cause people to consider having and using a pit latrine as ritually impure and polluting. Open defecation, in contrast, is seen as promoting

[1] This is particularly important in India where children are fed by hand.
[2] In 1999, the Indian government launched its Total Sanitation Campaign which, in 2012, was renamed the *Nirmal Bharat Abhiyan* and which was relaunced in 2014, as a central plank of the new BJP government's policy, as the *Swach Bharat Abhiyan*. (Centre for Public Impact: https://www.centreforpublicimpact.org/case-study/total-sanitation-campaign-india/ accessed 18 September 2017.

purity and strength, particularly by men" (Coffey *et. al.* 2017, p. 59).[3] So, on this analysis, persons in rural India have an *aversion* to affordable toilets (of the pit latrine type) while simultaneously having a *preference* for open defecation.[4]

A combination of aversion and preference then is the prime reason, as the Planning Commission (2013) found, why in 73% of households in rural India at least one person practiced open defecation but the members of 66% of households had no option but to defecate in the open because their dwellings lacked toilets. So, while there might be some mild preference for open defecation – in the sense that some members of households that had toilets nevertheless defecated in the open – the root cause of open defecation was a lack of toilets.

The contribution of this paper is that it examines both toilet possession and personal hygiene in India. It shows that the strongest influences on households in India having a toilet were their standard of living, the highest educational level of adults in the households, and whether or not they possesses ancillary amenities like a separate kitchen for cooking, a *pucca* roof and floor, and water supply within the dwelling or its compound. However, in so doing, it also shows that whether households had toilets depended not just on household-specific factors but also on the *social environment* within which the households were located. More specifically, *ceteris paribus* households in more developed villages would be more likely to have a toilet than those in less developed villages.

The effect of households' social environment on their "consumption" of toilets in developing countries is termed in this paper - in homage to Duesenberry (1967) who, through his "demonstration effect" first drew attention to the influence on consumers, when making consumption decisions, of their social context - as the "developmental demonstration" effect.[5] Duesenberry (1967) maintained that a person's success and self-esteem was defined in terms of the acquisition of material goods and, so, in order to avoid a loss of self-esteem, an individual would try to "keep up with the Joneses". Thus, as McCormick (1983) writes, "frequent exposure to higher quality goods than one usually

[3] Coffey *et. al.* (2017) also claim that rural women prefer open defecation to using a household toilet because it gives them an opportunity to escape, however temporarily, the confines of their homes.
[4] Another source of aversion to pit latrines is anxiety about having them emptied.
[5] Other contributions to the effect of social norms on individual consumption decisions were due to Patten (1889) and Veblen (1899)

consumes will cause an increase in one's consumer expenditure" (p.1126). Duesenberry (1967) labelled this the "demonstration effect" (p.27).

However, the relentless march of neo-classical economics in the 1930s and 1940s, culminating with the publication of Paul Samuelson's *Foundations of Economic Analysis* in 1947) meant that all reference to inter-dependent consumers preferences, engendered by social interactions, were expunged from economics thereby reducing consumers to what Sen (1977) described as "rational fools".[6] This paper attempts to escape this neo-classical paradigm of a consumer oblivious of his/her social by formulating, and testing, a model in which households' demand for toilets in rural India varies according to the level of development of the villages in which they reside.

Jenkins and Curtis (2005) examined the motives for acquiring a latrine in Benin in terms of "desires for change arising out of dissatisfaction from a perceived difference between a desired or an ideal state and one's actual state or situation" (p.2447).[7] They found that the demand for toilets in rural Benin had less to do with a desire for a healthier environment and much more to do with the prestige and status that latrine ownership implied in terms of an urbanised modern style of living.[8] It was dissonance between what one had and, given the social context, what one thought one ought to have, that generated demand for toilets rural Benin.

These findings were echoed by Rosenboom's *et. al.* (2011) study of the demand for toilets in Cambodia. They found that there was a strong perception among rural Cambodians about the 'ideal' latrine consisting "of a pour-flush pan and solid walls and roof …with respondents expressing reluctance to purchase anything less than the ideal latrine preferring to wait until they could afford a better model" (p.24). Of the two types of toilet - the traditional pit latrine[9] or the flush (pour-flush or fully flushable) - by far the most common in India was the flush toilet: 64% of rural households had a toilet of this type compared to 36% that had a pit latrine.[10] So, it is likely that rural Indians prefer a

[6] See (Mason, 2000).
[7] See Bagozzi and Lee (1999)
[8] See Cairncross (2003).
[9] Given the cost of building sewers and sewage treatment plants, a common form of latrine in rural India are pit latrines which store faeces underground. Under WHO guidelines of a pit of around 60 cubic feet, a latrine pit is expected to fill up after approximately five years if used daily by a family two adults and four children after which it must be emptied or a new pit built (Coffey *et. al.* (2017).
[10] These figures are from the IHDS-2011 after grossing up by applying the household sample weights, FWT.

certain type of toilet and are prepared to wait until these can be afforded: the "preference for open defecation" that, according to Coffey *et. al.* (2017), exists among rural Indians may be nothing more than a willingness to wait until the right type of toilet could be bought.

Lastly, the paper considers the issue of personal hygiene, in particular, whether people washed their hands after defecation and, if they did, what they washed their hands with. The raw data show a greater ownership of toilets by Muslim, relative to Hindu, households but they also show that Hindus have a greater sense of personal hygiene, defined as post-defecation hand washing with soap, than Muslims. All these "facts" should, however, be treated with caution: Hindus and Muslims differ in more aspects than just religion and the question is whether their differences, in terms of toilet ownership and hygiene, survive after these non-religion variables have been controlled for. This paper imposes these controls and, in so doing, suggests that these differences between households from the two groups are not as stark as some people might like to believe.

The results reported in this paper should, however, be prefaced with some clarificatory remarks. The paper's analysis pertains to households and not to persons within them. Estimating the number of persons defecating in the open by computing the number of persons in households without a toilet would almost certainly be an underestimate since some persons from households with a toilet also defecated in the open. The Planning Commission's (2013) estimate was that of 100 rural persons, 73 defecated in the open and of these 66 were from households without a toilet; consequently, 7 persons, out of the 73 who defecated openly, (or 10%) did so in spite of living in houses with a toilet. Similarly, the data on handwashing analysed in the paper related to households with the implicit assumption being that, depending on a household's response, every member within it washed, or did not wash, their hands after defecation. Needless to say, this, too, will not always be true.

The results reported in this chapter are from the India Human Development Survey (hereafter, IHDS-2011) which relates to the period 2011-12.[11] This is a nationally representative, multi-topic panel survey of 42,152 households in 384 districts, 1420 villages and 1042 urban neighbourhoods across India. Each household in the IHDS-2011 was the subject of two hour-long interviews. These interviews covered *inter alia* issues of: health, education, employment, economic status, marriage,

[11] Desai *et. al.*(2015).

fertility, gender relations, and social capital. The IHDS-2011, like its predecessors for 2005 and 1994, was designed to complement existing Indian surveys by bringing together a wide range of topics in a single survey. This breadth permits the analysis of associations across a range of social and economic conditions.

2. A Preliminary Look at the Data

Of particular relevance to this study is that the IHDS-2011 reported on each household's housing conditions: *inter alia* whether the dwelling had a toilet and, if it did, what type of toilet[12]; whether it had a separate kitchen; whether it had a separate vent in the cooking area; whether the household had electricity; whether the household's water supply was within the dwelling or its compound; the nature of the dwelling's roof and floor.[13] Since the concern of this chapter is with open defecation, a small number of households (for example, living in *chawls*) that did not have toilets in their homes, but had access to communal or public toilets, were excluded from the analysis. After this exclusion it could be inferred that members of households that did not have a toilet would perforce have to defecate in the open.[14]

<Table 1>

Table 1 reports that of the total of households in the IHDS-2011: 52.6% had a toilet; 54.9% had a separate kitchen; 50.6% had their water supply within the dwelling; 64.3% had a *pucca* roof ; and 59.3% had a *pucca* floor.[15] These figures, however, mask a rural-urban divide. In the less developed villages, only 31.1% of households had a toilet and this rose to 45.2% of households in more developed villages. By contrast, 96.6% of households in metropolitan areas, and 83.5% of households in non-metropolitan urban areas, had a toilet within their homes.

[12] These were: traditional pit latrines; semi-flush toilets connected to septic tank; flush toilets.
[13] The roof and floor could be: '*kutcha*' (grass, mud, thatch, wood, tile, slate for the roof; mud or wood for the floor); or '*pucca*' (asbestos, metal, brick, stone, concrete for the roof; brick, stone, cement, tiles for the floor).
[14] Since some members of households with a toilet might also prefer to defecate in the open this is likely to be an underestimate of the number of persons practicing open defecation.
[15] The figures reported in Table 1 were obtained after grossing up by applying the household sample weights, FWT, in IHDS-2011.

For this reason, the analysis of the prevalence of toilets within the household dwelling reported in this paper is restricted to rural households.[16] Table 1 shows that, of rural households, the 'Other' social group, comprising Christians, Sikhs, and Jains, were most likely to have a toilet (and also amenities like a separate kitchen, water supply within their dwellings, and *pucca* roofs and floors) while the Scheduled Castes (SC) and Scheduled Tribes (ST) were least likely to have a toilet (only 27.2% of SC and 26.5% of ST households had a toilet) and other ancillary amenities.

<Figures 1 and 2>

Figure 1 shows the amenities in the homes of rural households that did not have a toilet: two in three rural households that did not have a toilet, did not also have a separate kitchen; one in two households that did not have a toilet, did not also have a *pucca* roof; and over two-thirds of households that did not have a toilet, did not also have a *pucca* floor. Thus a majority of households that could not afford a toilet could not also afford ancillary amenities like a separate kitchen or a *pucca* roof or floor.

Figure 2 shows the dwelling amenities of rural households that did have a toilet: only 30% of households that had a toilet did not have a separate kitchen or a *pucca* roof and one-third of households that had a toilet did not have a *pucca* floor. Thus only a minority of households that had a toilet did not have ancillary amenities like a separate kitchen or a *pucca* roof or floor.

3. Specifying the Demand for Toilets Equation

In estimating the demand for toilets in India, the dependent variable y_i, defined over N households (indexed, $i=1…N$), was assumed to take the value 1 if household i had a toilet (in its dwelling) and 0 if it did not.[17] It should be emphasised that in estimating the logit model, it was not possible, for reasons of multicollinearity, to include all the categories with respect to the variables: the category that was omitted for a variable is referred to as the reference category (for that variable).

[16] That is households living in 'less' or 'more' developed villages. After grossing up, these comprised 68.7% of the households in IHDS-2011with 39.4% and 29.3% of all households living in, respectively, 'less' and 'more' developed villages.

[17] As noted earlier, the small numbers of households without a toilet in their dwelling, but with access to a toilet elsewhere, were excluded from the analysis.

If $Pr[y_i=1]$ and $Pr[y_i=0]$ represent, respectively, the probabilities of a household having and not having a toilet, the logit formulation expresses the log of the odds ratio as a linear function of K variables (indexed $k=1\ldots K$) which take values, $X_{i1,}X_{i2}...X_{iK}$ with respect to household i, $i=1\ldots N$:

$$\log\left(\frac{\Pr[y_i=1]}{1-\Pr[y_i=1]}\right)=\sum_{k=1}^{K}\beta_k X_{ik}+u_i=Z_i \tag{1}$$

where: β_k is the coefficient associated with variable k, $k=1\ldots K$.

From equation (1) it follows that:

$$\Pr[y_i=1]=\frac{e^{z_i}}{1+e^{z_i}}=\frac{e^{X_i\hat{\beta}}}{1+e^{X_i\hat{\beta}}} \tag{2}$$

where, the term 'e', in the above equation represents the exponential term.

The variables used to explain the demand for toilets were grouped as follows:

A. Social Group.

These related to the social group, defined in terms of religion/caste, to which the households belonged: Brahmins; Forward Caste Hindus (FCH); Hindus from the Other Backward Classes (OBC), Scheduled Castes (SC); Scheduled Tribes (ST); Muslims; and an 'Other' category comprising Christians, Sikhs, and Jains.

A great deal has been made recently about the propensity of households from different social groups to have toilets. Coffey and Spears (2017) argue that Muslim households were more likely to have a latrine, even it was a rudimentary one, than Hindus and they ascribed this to Hindus facing the religious constraints of *ritual pollution* so that the presence of a toilet within the Hindu home was regarded as impure and unclean. They went on to attribute the lower infant and child mortality among Muslims vis-à-vis Hindus[18] to the lower propensity of Muslims, compared to Hindus, to defecate in the open: Muslim neighbourhoods would be less susceptible to the spread of infections caused by the greater likelihood contact with faecal matter under open defecation. However, over a decade earlier, Borooah and Iyer (2005) had pointed out that the lower infant mortality among Muslims was confined to the girl child with Muslim-Hindu infant mortality rates for boys being broadly similar and this was

[18] See Bhalotra *et. al.* (2010) on this point.

because while Hindus and Muslims had the same degree of "son preference" Hindus had a higher degree of "daughter aversion".

B. Income and Education.

It might be expected that a household's demand for a toilet in the home, like the demand for any commodity, would be affected by is income. To capture the "income effect" each household was placed in one of five quintiles of household per capita consumption (lowest, 2nd quintile, 3rd quintile, 4th quintile, highest quintile) depending upon its reported per-capita consumption.

It might also be expected that higher the educational level of a household's members the lower would its members' propensity to defecate in the open: higher levels of education would lead to greater awareness of the health hazards of open defecation; additionally, higher levels of education might be associated with a greater sense of the social impropriety of open defecation. The education level of a household was captured by the *highest* level of education of an adult member. Five levels of education were distinguished: (i) no education; (ii) up to primary level of schooling; (iii) above primary and up to secondary level of schooling; (iv) higher secondary; (v) graduate or above.

C. Region

The incidence of open defection (through not having a toilet in in the house) also varies according to the culture of a region. A district level map of the proportion of persons defecating in the open (Coffey *et. al.*, 2014) shows a high incidence of open defecation in the central and southern states, with a comparatively low incidence in the eastern and western states, of India. Open defecation was particularly common in four states of the "Hindi heartland" - Bihar, Madhya Pradesh, Rajasthan, Uttar Pradesh – with 82.4% and 78.2% and of *rural* households in Bihar and Uttar Pradesh not having a toilet; by contrast, in the north-eastern states of Mizoram and Manipur, only 14% and 15.4%, respectively, of rural households did not own a toilet (Coffey and Spears, 2017).

In order to capture this regional dimension to open defecation (or more precisely, household non-ownership of toilets) this study aggregated the Indian states into the following regions: *North* (comprising the states of Jammu & Kashmir, Delhi, Haryana, Himachal Pradesh, Punjab (including Chandigarh), and Uttarakhand); the *Centre* (Bihar, Chhattisgarh, Madhya Pradesh, Jharkhand, Rajasthan, and Uttar Pradesh); the *East* (Assam, Orissa, West Bengal, and the North-Eastern

states[19]); the *West* (Gujarat and Maharashtra); and the *South* (Andhra Pradesh, Karnataka, Kerala, and Tamil Nadu).

D. Other Housing Amenities

Figures 1 and 2 showed a strong association between households having a toilet in the dwelling and also having other amenities like a separate kitchen, *pucca* roof and floor, and water supply within the house or its compound. So, the other set of variables included in the equation were the presence or absence of these "non-toilet" amenities, the hypothesis being that a household was more likely to have a toilet if it already had a separate kitchen or *pucca* roof or floor or its water supply within the house and *ipso facto* less likely to have toilet if it did not have one or more of these amenities.

E. Households Practicing Untouchability

A recurring view on open defecation (Cofey et. al. 2014; Cofey and Spears, 2017; Coffey et. al. 2017; Spears and Thorat, 2015)is that people living in rural India are reluctant to have pit latrines in their home because they regard them as dirty and, in particular, are alarmed by the prospect of facing, after the toilet has been used for a certain period, the unpleasant task of emptying the pit: this they are not prepared to do themselves; nor are they prepared to pay the high charges of having it done by others.[20]

A way of testing this hypothesis is to examine whether the fact that some member of a household practices untouchability impacts significantly on the propensity of that household to possess a toilet. In the course of the IHDS-2011 interviews, each household was asked if "in your household, do some members practice untouchability?" Although the IHDS did not explicitly define what it regarded as 'practicing untouchability' it is reasonable to interpret this to mean the range of measures used in order to avoid proximity with persons who, for reasons of ritual pollution, were permanently 'unclean'. [21] This 'untouchability' variable – which took the value 1 if a household's

[19] Sikkim, Arunachal Pradesh, Nagaland, Mizoram, Manipur, Tripura, Meghalaya.
[20] Coffey *et. al.* (2017) quote ₹700-1,000 as the price of emptying a pit (which takes no more than a few hours) in rural Bihar where the daily wage does not exceed ₹200.
[21] Avoiding physical contact with them, including refusing to share food or drink with such persons by, say, having a meal in their company. More indirectly, any object or space that involved eating or drinking or

answer to the above question was 'yes' and 0 if its answer was 'no' – was, following Spears and Thorat (2015),the included in the equation as an explanatory variable.

F. The Developmental Demonstration Effect

The hypothesis lying at the heart of this paper is the 'developmental effect' whereby the rising tide of economic development lifts all boats and induces households to improve their dwelling's amenities by building kitchens, reinforcing their roofs and floors, improving their water supply and, yes, by installing toilets. As discussed in the introductory section, this idea derives from Duesenberry (1967) who argued that consumer demand could, and would, often be determined by social needs and the aspirations of individuals.

Since increased consumption expenditures arise to "eliminate the feelings of inferiority created by other people consuming superior goods" (McCormick, 1983, p. 1126), "inferiority feeling" and "superior goods" would depend upon the social and cultural environment of consumers. In the context of this paper, the lack of a toilet would not generate feelings of inferiority in a less developed village in which relatively few people had a toilet and open defecation was the norm; however, the same lack in a more developed village, in which several households had toilets, would generate a sense of inadequacy in those households that did not possess a toilet and would propel these towards building toilets for themselves. We label the demand for toilets emanating from this source as the "developmental demonstration effect" (DDE).

On the basis of their respective infrastructure, the IHDS-11 separated villages into two types: "less developed" villages (LDV) and "more developed" villages (MDV) with 57% of rural households living in the LDV and 43% living in the MDV.[22] The hypothesis of this study is that the operation of the DDE *systematically* raised the demand for toilets in the MDV vis-à-vis the LDV. By this is meant that the operation of the DDE affected each of variables under A-F in such a way that the likelihood of having a toilet would, for a given value of a variable, be greater in a MDV than in a LDV. So,

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worship – a plate, tumbler, kitchen utensil, the kitchen, the prayer room – which was touched by an 'untouchable' was instantly defiled and would have to be purified through ritual ablutions.

[22] The infrastructure used to classify villages into 'less developed' and 'more developed' were: the quality of roads; availability of public transportation; range of communication facilities; availability of electricity; sources of drinking water; types of cooking fuel most commonly used; presence of public institutions like police stations, banks, post office, public distribution shops; and the presence of voluntary organisations like a *Mahila Mandal*.

households in which the highest level of education of an adult was, say, higher secondary would *ceteris paribus* be more likely to have a toilet in a MDV than in a LDV; households which were, say, in the highest quintile of consumption would *ceteris paribus* be more likely to possess a toilet in a MDV than in a LDV.

In order to test this hypothesis, the variable V_i, defined over all *rura*l households indexed by *i*, was assumed to take the value 1if a household lived in a MDV and 0 if it lived in a LDV. The variable V_i was then allowed to interact with all the other variables so that the equation that was estimated was:

$$\log\left(\frac{\Pr[y_i=1]}{1-\Pr[y_i=1]}\right)=\sum_{k=1}^{K}\beta_k X_{ik}+\sum_{k=1}^{K}\alpha_k(X_{ik}\times V_i)+u_i=Z_i \qquad (3)$$

Equation (3) shows that that the coefficient associated with variable *k* in the context of a MDV (that is, V_i =1) is $(\beta_k+\alpha_k)$ while the coefficient associated with the same variable in the context of a LDV (that is, V_i =0) is β_k : consequently, in terms of the estimated coefficients, α_k represents variable *k's* associated DDE from a "less developed" to a "more developed" village.

However, the logit estimates shown in equations (1) and (3) themselves do not have a natural interpretation – they exist mainly as a basis for computing more meaningful statistics and the most useful of these are the predicted probabilities (of having a toilet) defined by equation (2).[23] Consequently, as suggested by Long and Freese (2014), the results from estimating equation (3) are presented in Table 1 in the form of the *predicted probabilities* from the estimated logit coefficients of the equation.

The Method of Recycled Predictions

The predicted probabilities were computed the method "recycled predictions" as described in Long and Freese (2014, ch. 4) and in the Stata manual.[24] Since this method underpins the results presented in this paper it is useful, at the very outset, to describe it in some detail. The variable y_i in equation (1) is defined over households distinguished by different characteristics – by social group,

[23] It should be noted that, by equation (3), the Z_i in equation (2) differ according to whether the household's village is a LDV or a MDV.
[24] https://www.stata.com/manuals13/rmlogitpostestimation.pdf (accessed on 23 September 2017).

education, region etc. Suppose that one of these characteristics is religion and households are identified, *inter alia,* by whether they are Hindu, Muslim, or Christian. The object is to identify the predicted probabilities of having a toilet which can be entirely ascribed to religion and, further, to test whether these differ significantly between the religions. The method of "recycled predictions" enables one to do so.

Suppose that the first variable relates to households' reigion so that $X_{i1}=1$ if household i is Hindu, $X_{i1}=2$ if it is Muslim; $X_{i1}=3$ if it is Christian. For ease of exposition assume that the households are ordered so that $X_{i1}=1$ for $i=1\ldots L$ and $X_{i1}=2$ for $i=L+1\ldots M$ and $X_{i1}=3$ for $i=M+1\ldots N$. Now, using the logit estimates from equation (1), equation (2) *predicts* for each household its probability of having a toilet, denoted $\hat{p}_i (i=1...N)$. The mean of the $\hat{p}_i$ defined over all the N households in the estimation sample will be the same as the (estimation) sample proportion of households that have toilets. Similarly, the mean of the $\hat{p}_i$ defined over the L Hindu (or, M-L Muslim, or N-M Christian) households will be the same as the (estimation) sample proportion of Hindu (or Muslim or Christian) households that have toilets. In other words, the estimated logit equation passes through the sample means.[25]

However, the difference between the three sample means – Hindu ($\hat{p}^H$), Muslims ($\hat{p}^M$), and Christians ($\hat{p}^C$) – does not reflect the differences, due to solely to religion, between households in the three groups in their probabilities of having a toilet. This is because the three groups differ not just in terms of religion but also with respect to variables like income, education etc. Computing the mean probabilities over each subgroup will not neutralise these differences and, hence, differences between $\hat{p}^H, \hat{p}^M,$ and $\hat{p}^C$ cannot be attributed *solely* – though, of course, some part may be - to differences in religion.

The method of "recycled predictions" isolates the effect on the predicted probability (of having a toilet) of households belonging to different religions. First, "pretend" that *all* the households, in the *entire* sample of N households are Hindu. Holding the values of the other variables constant

[25] It is important to draw a distinction between the *estimation* sample and the *total* sample; because the equation can only be estimated for non-missing values on *all* the variables, the estimation sample will, typically, be smaller than the total sample.

(either to their observed sample values, as in this paper, or to their mean values), compute the average probability (of having a toilet) under this assumption and denote it $\tilde{p}^H$. Next, "pretend" that *all* the households, in the *entire* sample of *N* households are Muslim and, again holding the values of the other variables constant, compute the average probability (of having a toilet) under this assumption and denote it $\tilde{p}^M$.

Since the values of the non-religion variables are unchanged between these two hypothetical scenarios, the only difference between them is that, in the first scenario, the Hindu variable is "switched on" (with the Muslim and Christian variables "switched off") - while , in the other, the Muslim variable is "switched on" (with the Hindu and Christian variables "switched off") - for *all* households. [26] Consequently, the difference between $\tilde{p}^H$ and $\tilde{p}^M$ is *entirely* due to differences in religion between Hindus and Muslims. In essence, therefore, in evaluating the effect of two characteristics *X* and *Y* on the likelihood of a particular outcome, the method of "recycled predictions" compares the two probabilities, first, under an "all have the characteristic *X*" scenario and, then, under an "all have the characteristic *Y*" scenario – the values of the other variables unchanged between the scenarios. The difference in the two probabilities is then entirely due to the attribute represented by *X* and *Y* (in this case, differences in religion, more specifically, differences in between Hindus and Muslims).[27]

4. Measuring the Development Demonstration Effect

In order to pass judgement on the existence (or otherwise) of the 'development demonstration effect' (DDE), the predicted probability of having a toilet (hereafter, abbreviated to PPT) was computed separately, with respect to every determining variable noted under A-F above, for households in the LDV and the MDV; the difference in these PPT were then tested to see if they were statistically significant: if the PPT with respect to a variable was *ceteris paribus* significantly higher in

[26] In operational terms, these hypothetical scenarios are constructed in STATA by estimating the logit equation and then using the predict command *after* the command "replace $X_{i1}=1$" has been executed,: the average of these predictions over the *N* households will yield $\tilde{p}^H$; next, use the predict command *after* the command "replace $X_{i1}=2$" has been executed: the average of these predictions over the *N* households will yield $\tilde{p}^M$. In practice, STATA's margin command will perform these calculations.

[27] For example, (i) *X*: all households are Hindus; *Y*: all households are Muslim; (ii) *X*: all households live in less developed villages; *Y*: all households live in more developed villages.

the MDV than in the LDV then that would be evidence of the presence of a DDE with respect to that variable; conversely, the absence of a significantly different PPT between households in the MDV vis-à-vis households in the LDV would be evidence that the DDE did not exist with respect to that variable. These inter-village type PPT are shown in Table 2.

<Table 2>

The second and third columns of Table 2 show these probabilities for, respectively, the LDV and the MDV. The PPT against the 'All Households' row and the "Less Developed Villages" column were computed using the method of "recycled predictions", discussed above, by assuming all the 19,225 households in the estimation sample lived in LDV or, in other words, by the applying the coefficients relevant to the LDV (that is, the β_k of equation (3)) to *all* the 19,225 households in the estimation sample and computing the average likelihood of households having a toilet under this 'all-LDV' scenario.[28] This yielded a PPT of 40.5%.

Similarly, the PPT against the 'All Households' row and the "More Developed Villages" column were computed by assuming all the 19,225 households in the estimation sample lived in MDV or, in other words, by the applying the coefficients relevant to the MDV (that is, the $\beta_k + \alpha_k$ of equation (3)) to *all* the 19,225 households in the estimation sample and computing the average likelihood of households having a toilet under this 'all-MDV' scenario. This yielded a PPT of 44.7%. The difference in the LDV and MDV probabilities was -4.2 points (column 4).

Dividing this difference by its standard error (column 5) yielded a t-value of 2.4: the observed difference of 4.2 points was, thus, significantly different from zero in the sense that the likelihood of observing this value, under the null hypothesis of no difference between the LDV and the MDV PPT, was less than 5% (superscript ** in Table 2). Since the only difference between the all-LDV and the all-MDV scenarios was the type of village in which the 19,225 households lived one can ascribe the (significant) difference of 4.2 points to differences in the levels of village development or, in other words, to the DDE.

The PPT against the 'Brahmins' row and the "Less Developed Villages" column was computed by treating *all* the households as Brahmin and applying to them the coefficients relevant to

[28] The non-caste attributes of the 19,225 households were unchanged at observed values.

the LDV (that is, the β_k of equation (3)). Computing the average likelihood of households having a toilet under this 'all-LDV/all-Brahmin' scenario yielded a PPT of 41.3%. [29] Similarly, the PPT under the 'all-MDV/all-Brahmin' scenario was obtained by treating *all* the households as Brahmin and applying to them the coefficients relevant to the MDV (that is, the $\beta_k + \alpha_k$ of equation (3)). Computing the average likelihood of households having a toilet under this 'all-MDV/all-Brahmin' scenario resulted in a PPT of 52.9%. The difference in the LDV and MDV 'all-Brahmin' probabilities was 11.5 points (column 4).

Since the only difference between the all-LDV/all-Brahmin and the all-MDV/all-Brahmin scenarios was the type of village in which the 19,225 Brahmin households lived, one can ascribe the inter-village type difference of 11.5 points between Brahmin households to differences in the levels of village development that is, to the DDE as it pertained to Brahmins. The t-value of 2.3 associated with this difference indicated that it was significantly different from zero. In other words, the DDE for Brahmin households meant that *ceteris paribus* they had a significantly higher PPT in the MDV than in the LDV.

The DDE effect also operated with respect to Forward Caste (FC) households and 'other' households. The PPT of FC households increased significantly from 41.6% in the LDV to 48.8% in the MDV while the PPT of 'other' households increased significantly from 54.9% in the LDV to 70.5% in the MDV. However, the PPT for households that were OBC, SC, ST, or Muslim was not significantly different between the LDV and the MDV. In brief, the DDE operated with respect to households in the more advantaged groups (Brahmins, FC, and Christians, Sikhs, and Jains) but not with respect to households in marginalised groups (OBC, SC, ST, and Muslim).

The DDE effect was particularly marked with respect to ancillary amenities. Thus households which had a separate kitchen, or a *pucca* floor or roof, or water supply within the dwelling or its compound were more likely to have a toilet if they were located in a MDV than a LDV: 47.5% versus 42.5% for a kitchen; 45.9% versus 41.9% for a *pucca* roof; 50.7% versus 44.6% for a *pucca* floor; and 52.3% versus 38.6% for an indoor water supply. However, in general, there was no significant difference between the MDV and the LDV in the PPT of households which did not have these

[29] The non-caste attributes of the 19,225 households were unchanged at observed values.

amenities. Thus households which already had an ancillary amenity were, in terms of also acquiring a toilet for their dwelling, more susceptible to the DDE than households which did not.

The DDE also operated with respect to households in the lowest and the highest quintile of consumption: the PPT for households in both groups was significantly higher in the MDV than in the LDV (36.4% versus 29.7% for the lowest quintile and 56.8% versus 49.2% for the highest quintile). However, there was no significant difference between the MDV and the LDV in the PPT of households in the other quintiles.

The DDE also operated with respect to households in which the highest level of adult education was primary or secondary: the PPT for households in both groups was significantly higher in the MDV than in the LDV (42.1% versus 35.7% for primary education and 46.2% versus 40% for secondary education). However, there was no significant difference between the MDV and the LDV in the PPT of households at other levels of education.

The operation of the DDE with respect to the practice of untouchability showed that households which *did not* practice untouchability were significantly more likely to have a toilet in the MDV compared to the LDV – 45.8% versus 40.6% - while there was no significant difference between the MDV and the LDV in the PPT of households that did practice untouchability.

5. Analysing Differences within Less and More Developed Villages

The preceding sub-section examined differences *between* the MDV and the LDV with a view to identifying the variables with respect to which DDE could be said to operate. This section examines, *within* each type of village, differences *between* variables in the predicted likelihood of having a toilet.

<Table 3>

The PPT of households in the different groups (social, consumption, educational etc.) was computed through a series of simulations. The first panel of Table 2 show these probabilities for the LDV and the second panel shows them for the MDV. The PPT against the row panel 'Social Group" and the column panel 'less developed village' were computed by assuming that all the 19,225 households lived in LDV and were, successively, all-Brahmin, all-FC, all-OBC, all-SC, all-ST, all-Muslim, and all-'Other'; the PPT against the row panel 'Social Group" and the column panel 'more

developed village' were computed similarly, but this time assuming that all the 19,225 households lived in MDV.

The average of these 'all-Brahmin' probabilities was 41.3% for the LDV and 52.9% for the MDV and these are shown in Table 2 against the row labelled 'Brahmin'. Similarly, the average of the 'all-Muslim' probabilities was 56.1% for the LDV and 57.1% for the MDV and these are shown in Table 2 against the row labelled 'Muslim'. Since the only factor that was different between these two calculations – all Brahmin, and all-Muslim - was the households' religion, *with the non-caste household attributes unchanged*, the difference between these PPT (that is, 41.3% and 56.1% for the LDV and 52.9% and 57.1% for the MDV) could be attributed entirely to differences in religion.[30]

The marginal probabilities, shown in column 3 of Table 2, represent the *differences* between the PPT of the households in the first six social groups and that of (the reference group of) 'other' households: so, the marginal probability associated with Brahmins was 41.3-54.9 =13.6 points). Dividing these marginal probabilities by their standard errors (column 4 of Table 2) yielded the t-values (column 5 of Table 2); these showed whether these marginal probabilities were significantly different from zero in the sense that the likelihood of observing these values, under the null hypothesis of no difference was less than 5% (superscript ** in Table 2) or 10% (superscript * in Table 2). The results for the LDV show that, except for Muslims, the PPT was significantly lower for every social group vis-à-vis the reference group of 'Other' (comprising Christians, Sikhs, and Jains); there was no significant difference between the PPT for Muslins (56.1%) and 'Other' (54.9%). For the MDV, the PPT for households in all the groups was significantly lower than that of the reference 'Other'.

The estimation program also allows one to draw statistical comparisons between the PPT of different groups. Since some of the discussion about toilets in the home has centred around the differential behaviour of Hindus and Muslims (Coffey et. al. 2017, p. 64), underpinned by issues of untouchability, the first port of call in making these comparisons was between Brahmin and Muslim households: the PPT of Brahmins (41.3%) was significantly lower than that of Muslims (56.1%) in the LDV but, in the MDV, there was no significant difference between the PPT of Brahmins (52.9%)

[30] In computing these probabilities, all the interactions between social group and village type were taken into account.

and Muslims (57.1%). A comparison of Brahmin and SC households yielded the opposite results: now there was no significant difference between the PPT of Brahmin (41.3%) and SC households (35.6%) in the LDV but, in the MDV, the PPT of Brahmins (52.9%) was significantly higher than that of the SC (38.2%).

A direct test of the effects of households practicing untouchability on their likelihood of having a toilet in the house, using the 'untouchability' variable ("does anyone in your household practice untouchability": yes/no) did not show any significant difference in the LDV between the PPT of households not practicing (40.6%) and not practicing (40.2%); however, in the MDV, the PPT of households not practicing untouchability (45.8%) was significantly higher, but only at the 10% level, than that of households practicing untouchability (41.7%).

These effects, however, were swamped by the effect of other variables. Computing the PPT by quintile of per capita consumption showed that, in both the LDV and the MDV, the PPT rose steadily and significantly as one progressed through the quintiles: the PPT, in the MDV, for households in the highest quintile (56.8%) was significantly higher than that of households in the fourth quintile (48.1%) while, in both the LDV and the MDV, the PPT for households in the lowest quintile (29.7% and 36.4%, respectively) was significantly lower than that of households in the next quintile (40.6% and 42.9%).

A similar story emerges with respect to education, as measured by the highest level of education of a household adult: the PPT by level of education, in both the LDV and the MDV, rose steadily and significantly as one progressed through the different education levels: the PPT, in both the LDV and MDV, for households with a graduate (54.3% and 56.3%, respectively) was significantly higher than that of households in which the highest level of education was higher secondary (48.5% and 51.7%, respectively); similarly, in both the LDV and MDV, the PPT for households with no education (30.9% and 32.1%, respectively) was significantly higher than that of households in which the highest level of education was primary school (35.7% and 42.1%, respectively).

Lastly, having an ancillary amenity – whether a separate kitchen or a *pucca* floor or roof or a water supply inside the dwelling or its compound – significantly increased the likelihood of having an

amenity compared to not having that amenity: for example, in both the LDV and the MDV, the PPT for households with a separate kitchen (42.5% and 47.2%) was significantly higher than that for households without a separate kitchen (35.2% and 38.6%); in both the LDV and the MDV, the PPT for households with an inside' water supply (48.8% and 52.3%) was significantly higher than that for households in which the water supply was outside (33.3% and 38.6%).

6. Post-defecation Handwashing

The IHDS-2011 gave information on the post-defecation handwashing habits of households both in terms of whether household members washed their hands (never, sometimes, usually, always) and in terms of what they washed their hands with (water only, mud or ash, soap). Table 4 shows the percentage of households by social group in terms of the frequency and the method of their hand washing habits.[31]

<Table 4>

Table 4 shows that 67.9% of households washed always washed their hands: Brahmins were the most frequent hand washers (81.9% of persons in Brahmin households always washed their hands) and persons in OBC, SC, and ST households were the least frequent (64.8% of those in OBC households, 66.8% of those in SC households, and 65.2% of those in ST households always washed their hands after defecating). In terms of the method of hand wash, 84.7% of persons in Brahmin households used soap compared to only 61.5% in OBC households, 57% in SC households, and 45.8% in ST households.

Since the social groups differed in other attributes like education, incomes, water supply, household amenities, isolating the handwashing habits of the social groups requires one to control for these non-caste/religion variables. The first step in doing so was to construct a variable h_i which assumed values over rural households, indexed *i*, such that $h_i = 1$ if members of the household *usually or always* washed their hands *with* soap after defecating and $h_i = 0$, otherwise.[32] The IHDS-2011 showed, after grossing up using the survey's sample weights for households, that the variable h_i took the value 1 (usually/always washed with soap) for 85% of Brahmin households, 80.8% of FC

[31] The numbers in Table 4 have been grossed up using the IHDS-1011 household weights, FWT.
[32] $h_i=0$ included households that always washed their hands but not with soap and also included households that usually washed their hands with soap.

households, 60.8% of OBC households, 56.5% of SC households, 42.5% of ST households, 68.3% of Muslim households, and 88.4% of 'other' households.

Following the methodology detailed in sections 3 and 4 of this paper, a logit model was estimated with h_i as the dependent variable and with the following as determining variables: (i) social group (subsection A); (ii) Income and Education (subsection B); (iii) Region (subsection C); (iv) Other Housing Amenities: toilet, kitchen; *pucca* roof and floor; water supply inside dwelling or compound (subsection D); (v) whether (some members of) the household practiced untouchability (subsection E); (v) village type: less or more developed village.

<Table 5>

The predicted probability of a household's members (usually or always) washing their hands with soap (hereafter, abbreviated to predicted probability of hygiene or PPH) was computed separately, with respect to every determining variable noted above. The PPH of households in the two different village types – less and more developed – were computed by first applying the less developed village coefficient to *all* the 18,836 households in the estimation sample and computing the average likelihood of households having a toilet under this 'all-LDV' scenario and then, applying the more developed village coefficient to *all* the 18,836 households in the estimation sample and computing the average likelihood of households having a toilet under this 'all-MDV' scenario. As the first item of Table 5 shows, the PPH was not significantly different between the two village types (58.2% and 59.9% for, respectively the LDV and the MDV) and hence the interaction between village type and the other variables, which underpinned the econometric work of section 4, is not pursued here.

The PPH of households in the different groups (social, consumption, educational etc.) were, as with the PPT of sections 3 and 4, computed through a series of simulations. The PPH against the row labelled 'Brahmin' were computed by assuming that *all* the 18,836 households in the estimation sample were Brahmin and computing the average likelihood of households practicing 'hygiene' (the PPH) under this 'all-Brahmin' scenario.[33] The average of these 'all-Brahmin' probabilities was

[33] The non-caste attributes of the 18,836 households were unchanged at observed values.

66.8%; this is shown in Table 5 against the row labelled 'Brahmin'. Similarly, the PPH of Muslims was 60% using the same methodology.

This difference between Brahmins and Muslims in their predicted probability of hygiene was not significantly different from zero; nor was there a significant difference between the PPH for Muslims the OBC. On the other hand, the PPH was significantly higher for Brahmin households than for OBC, SC, and ST households. The results from Table 5 show that, the PPH for households in all the groups was significantly lower than the 77.9% PPH for the 'other' group.

The predicted probability of hygiene was significantly higher for households in which someone practiced untouchability (61.2%) compared to households in which no one practiced untouchability (57.9%). This suggests that the former type of households were concerned not just with ritual purity but also with actual cleanliness!

The PPH of households rose with the quintile of consumption in which they were placed – from a low of 55.3% for households in the lowest quintile to a high of 65.8% for households in the highest quintile. Similarly, the PPH of households rose with the highest education level of an adult in the household: households in which adults did not have any education had a PPH of 55.3% compared to a PPH of 61.4% for households with at least one adult educated to secondary level, 64.5% for households with at least one adult educated to higher secondary level; and 65.8% for households with at least one adult who was a graduate.

The PPH of households also depended upon the amenities within their dwellings. Most particularly, households having a toilet had a significantly higher PPH than households which did not have a toilet (73.2% versus 50.1%). For a variety of plausible reasons – for example, difficulty of carrying soap and sufficient water to wash one's hands 'on site' or forgetting to do so on one's return home – defecating in the open also meant compromising on personal hygiene. Households that had a water supply within the dwelling or its compound were significantly more like to practice hygiene (PPH of 64.3%) than households whose water supply was outside the dwelling's compound (PPH of 55.7%).

7. Conclusions

This paper put forward a hypothesis to argue à la Duesenberry (1967) that the social context in which households were placed was an important factor in deciding whether to have a toilet within their dwelling. This hypothesis was tested by comparing the demand for toilets in "less developed" to that in "more developed villages". The instrument for making this comparison was an econometric model which allowed every household variable (income, education, non-toilet dwelling amenities etc.), which might impact upon this demand, to be influenced by the type of village in which the household resided. The results, detailed in Table 2, showed that *ceteris paribus* households were significantly more likely to have a toilet in more developed (44.7%) than in less developed villages (40.7%). This finding persisted at a more disaggregated level: households in the lowest and highest quintiles of consumption, households in which the highest adult education level was primary or secondary, households in most of the regions, were all *ceteris paribus* households significantly more likely to have a toilet in more developed, rather than less developed, villages. Equally importantly, households which had an existing amenity (separate kitchen, *pucca* roof or floor, inside water supply) were more likely to also have a toilet if they lived in more developed, compared to less developed, villages.

Given that some of the current literature on sanitation in India denigrates the process of development as an instrument of change in defecation habits (from outdoor to indoor) and emphasises, instead, the role of caste and untouchability in inhibiting change – and, indeed, even engendering a preference for open defecation among high-caste Hindus – the importance of this result cannot be overemphasised. For example, Coffey *et. al.* (2014) write about a "revealed" preference for open defecation, allied to distaste for having a toilet within the home, by (Hindu) Indians. The combined effect of preference and distaste then renders futile any governmental toilet-building program: toilets may be built but they will not be used.

The results reported in this paper show, however, that the link between the practice of untouchability and the demand for toilets is more nuanced than that articulated, for example, by Spears and Thorat (2015) in a paper based on IHDS-2011 data and using responses to the same untouchability question used in this paper. It is true that the raw data shows a greater proportion of households, in which no one practiced untouchability, having toilets (56%) compared to households in

which someone practiced untouchability (43%). Nevertheless, to conclude from this that there was a robust and significant association between households practising untouchability and the presence of toilets in their homes - and, indeed, that this association was *primus inter pares* among other possible associations – is, as this paper shows, simply wrong.

After controlling for other variables, allowing the effects of variables to vary between village-types (less and more developed), and employing the methodology of "recycled predictions" (described earlier), this paper shows that, based on whether or not they practiced untouchability, there was no difference between households in less developed villages in their predicted probabilities of having a toilet. In more developed villages, however, households practicing untouchability were significantly less likely at the 10%, *but not at the 5%*, level to have a toilet compared to households that did not practice untouchability (Table 3: 41.7% versus 45.8%). More to the point, as shown earlier, the size of the untouchability effect on the likelihood of households having a toilet was swamped by the effects of other variables: education, consumption, and ancillary facilities.[34]

Over and above the answers to the untouchability question in IHDS-2011, there could, of course, also be shards of ritual pollution and untouchability in say, the behaviour of Brahmins vis-à-vis Muslims regarding the presence of toilets in the home. According to Coffey *et. al.* (2017, p. 64), "if ideas about pollution and untouchability that have their origins in the Hindu caste system importantly influence defecation behaviour in rural India, we might expect to find differences in latrine ownership between Hindus and Muslims." The results of this paper show that, for less developed villages, the predicted likelihood of households a having a toilet was, indeed, lower for Brahmins than for Muslims but, in the more developed villages, there was no significant difference between the two groups in this predicted probability. Moreover, the likelihood of Brahmin households having toilets was significantly higher in the more developed, compared to the less developed, villages while, for Muslim households it was unchanged between the two village types.

[34] In both less and more developed villages, there was a gap of 25 points, in the predicted likelihood of having a toilet, between households without an educated adult and households which had a graduate (Table 3: 30.9% versus 54.3% and 32.1% and 56.3%). There was a gap, in both less and more developed villages, of nearly 15 points, in the predicted likelihood of having a toilet, between households whose water supply was within the dwelling and households which had to obtain their water from outside the home (Table 3: 48.8% versus 33.3% and 52.3% versus 38.6%).

This leads again to the central hypothesis of this paper. Whatever inhibitions Brahmins may have about having a toilet in the home – where these inhibitions may, in part, be derived from considerations of ritual pollution – were restricted to Brahmin households in less developed villages. The developmental process involved in moving from less developed to more developed villages swept away these inhibitions until, in the latter type of village, Brahmins were as likely to have toilets as Muslims.

Separate from the spread of germs through open defecation is also the spread of germs through lack of personal hygiene, specifically through not washing one's hands with soap after defecating. Now the predicted likelihood of Brahmins being "hygienic" was at 66.8% higher than the Muslim 60%. This would suggest that some or all of the cons of open defecation of Brahmin vis-à-vis Muslims was clawed back by the pros of greater personal hygiene. Moreover, the practice of untouchability actually promoted hygiene, with members of households in which someone practiced untouchability being more likely to habitually wash with soap than members of households in which no one practiced untouchability.

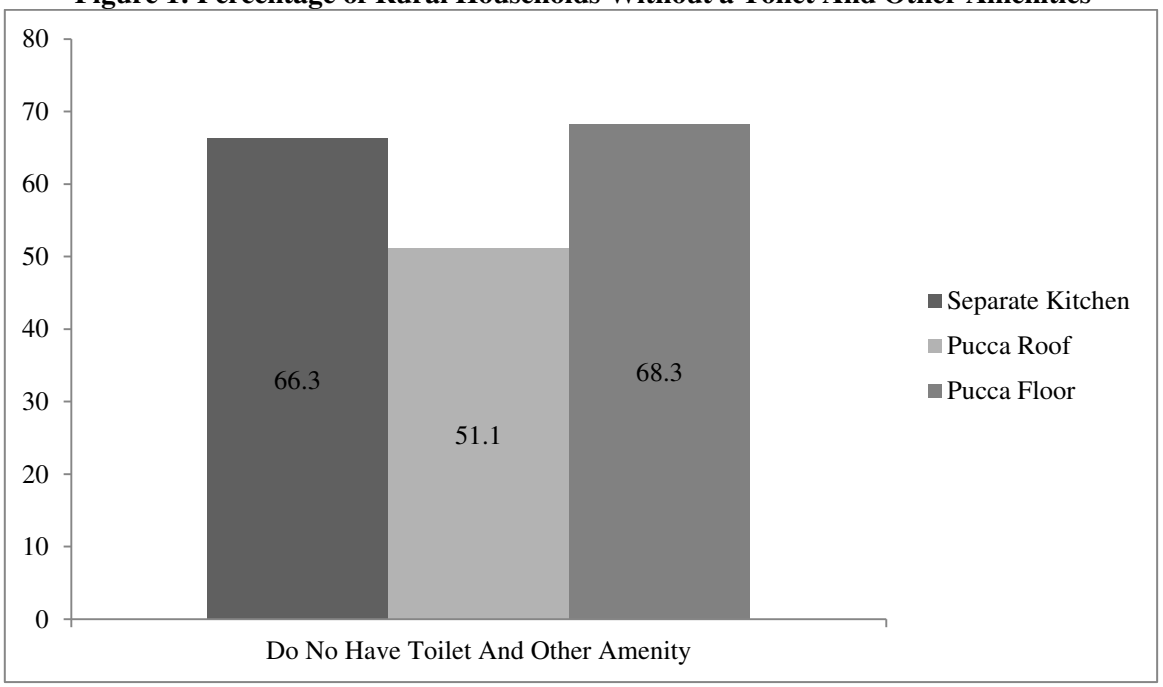
This leads to the policies that the Indian government should pursue in order to reduce, if not eliminate, open defecation. First, the government's toilet building program seems to be working both in terms of the proportion of the rural households having toilets and in terms of the usage of existing toilets. A 2017 Survey covering 140,000 households found that the number of rural households without a toilet has fallen from over a half (as per the 2011 Census) to under one-third. Moreover, toilets in nine out of ten households which had a toilet were actually using them (Zainulbhai, 2017). In addition to building toilets, which incidentally are all of the pit latrine type, the government needs to either subsidise, or provide them with cheap credit in the form of 'toilet loans', households which are prevented from installing flush toilets because their high cost. Lastly, the government needs to improve sewage and water supply in villages since these facilities complement toilet installation and use. But, above all, one needs to avoid the nihilism implicit in the idea that the problem of open defecation in India is an intractable one because caste, ritual pollution, and untouchability instil in rural Indians a preference for open spaces.

Table1: Housing Amenities by Location and Social Group of Household[§]

	Percentage of Households with Amenity				
	Toilet in House	Separate Kitchen	Water Supply in House or Compound	*Pucca* Roof[*]	*Pucca* Floor[**]
All Households	*52.6*	*54.9*	*50.6*	*64.3*	*59.3*
Location of Households					
Metropolitan Urban	96.6	74.5	76.9	87.3	97.4
Other Urban	83.5	71.7	70.2	78.5	89.7
More Developed Villages	45.2	53.6	46.9	59.6	60.0
Less Developed Villages	31.1	42.0	36.6	54.7	33.2
Social Group (Rural Households)					
Brahmin	50.6	60.9	48.9	72.4	54.5
Forward Caste	54.1	59.5	50.7	64.9	61.8
OBC Hindu	32.9	45.5	40.7	57.8	48.5
Scheduled Caste	27.2	39.9	34.9	56.1	49.2
Scheduled Tribe	26.5	42.1	25.6	36.9	22.3
Muslim	51.7	45.4	51.6	55.3	37.5
Other[***]	91.6	87.0	76.1	76.3	90.0

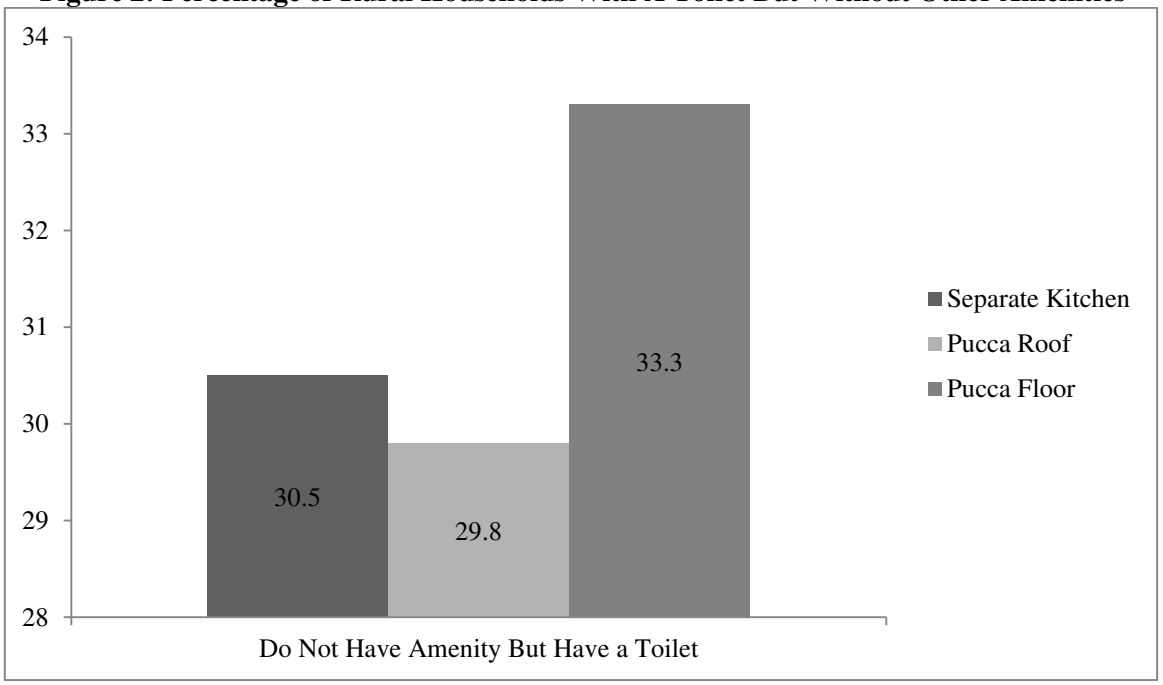
[§] Figures are obtained after grossing up using sample weights for households
[*] Asbestos, Metal, Brick, Stone, Concrete. [**] Not mud or wood. [***] Christian, Sikh, Jain
Source: Own calculations from IHDS-2011

Figure 1: Percentage of Rural Households Without a Toilet And Other Amenities



Source: Own calculations from IHDS-2011

Figure 2: Percentage of Rural Households With A Toilet But Without Other Amenities



Source: Own calculations from IHDS-2011

Table 2: Differences between Village Types in the Predicted Probabilities of Rural Households Having a Toilet[§]

	Predicted Probability in Less Developed Villages	Predicted Probability in More Developed Villages	Difference in Predicted Probabilities	Standard Error of Difference	t-value
All Households	0.405	0.447	-0.042	0.017	-2.4**
Brahmin	0.413	0.529	-0.115	0.049	-2.3**
Forward Caste	0.416	0.488	-0.072	0.033	-2.2**
OBC Hindu	0.384	0.418	-0.034	0.023	-1.5
Scheduled Caste	0.356	0.382	-0.026	0.031	-0.8
Scheduled Tribe	0.385	0.446	-0.062	0.048	-1.3
Muslim	0.561	0.571	-0.010	0.045	-0.2
Other	0.549	0.705	-0.156	0.092	-1.7
No Untouchability	0.406	0.458	0.052	0.020	-2.6**
Yes Untouchability	0.402	0.417	0.015	0.026	-0.6
Q1 of per-capita consumption	0.297	0.364	-0.067	0.025	-2.6**
Q2 of per-capita consumption	0.406	0.429	-0.022	0.025	-0.9
Q3 of per-capita consumption	0.424	0.464	-0.040	0.026	-1.6
Q4 of per-capita consumption	0.457	0.481	-0.024	0.027	-0.9
Q5 of per-capita consumption	0.492	0.568	-0.076	0.031	-2.4
No education	0.309	0.321	-0.011	0.025	-0.5
Primary	0.357	0.421	-0.064	0.027	-2.4**
Secondary	0.400	0.462	-0.062	0.021	-2.9**
Higher Secondary	0.485	0.517	-0.032	0.029	-1.1
Graduate and above	0.543	0.563	-0.020	0.037	-0.5
North	0.520	0.551	-0.031	0.060	-0.5
East	0.630	0.534	0.096	0.044	2.2**
West	0.404	0.415	-0.011	0.038	-0.3
South	0.301	0.399	-0.098	0.039	-2.5**
Central	0.320	0.419	-0.099	0.027	-3.6**
Kitchen: no	0.352	0.386	-0.034	0.026	-1.3
Kitchen: yes	0.425	0.472	-0.047	0.019	-2.4**
Pucca Roof: no	0.383	0.428	-0.045	0.025	-1.8*
Pucca Roof: yes	0.419	0.459	-0.040	0.019	-2.1**
Pucca Floor: no	0.352	0.377	-0.025	0.023	-1.1
Pucca Floor: yes	0.446	0.507	-0.061	0.023	-2.7**
Water: outside	0.333	0.488	-0.155	0.020	-7.9**
Water: Inside	0.386	0.523	-0.138	0.018	-7.5**

[§]Estimated on data for 19,225 rural households

** Significant at 5%; * significant at 10%.

See Notes to Table 1

Source: Own calculations from IHDS-2011

Table 3: Predicted and Marginal Probabilities of Rural Household Having Toilets by Type of Village[§]

	Less Developed Villages				More Developed Villages			
	Predicted Probability	Marginal Probability	Standard Error	t-value	Predicted Probability	Marginal Probability	Standard Error	t-value
Social Group								
Brahmin	0.413	-0.136	0.085	-1.6*	0.529	-0.177	0.054	-3.2**
Forward Caste	0.416	-0.133	0.082	-1.6*	0.488	-0.218	0.051	-4.3**
OBC Hindu	0.384	-0.165	0.079	-2.1**	0.418	-0.287	0.049	-5.9**
Scheduled Caste	0.356	-0.193	0.082	-2.4**	0.382	-0.324	0.050	-6.5**
Scheduled Tribe	0.385	-0.164	0.083	-2.0**	0.446	-0.259	0.063	-4.1**
Muslim	0.561	0.012	0.085	0.1	0.571	-0.135	0.057	-2.4**
Other [R]	0.549				0.705			
Household Practices Untouchability								
No	0.406				0.458			
Yes [R]	0.402	0.004	0.018	0.3	0.417	0.041	0.024	1.8*
Quintile of Per capita consumption								
Lowest: Q1 [R]	0.297				0.364			
Q2	0.406	0.109	0.017	6.3**	0.429	0.065	0.020	3.2**
Q3	0.424	0.127	0.021	6.1**	0.464	0.101	0.022	4.5**
Q4	0.457	0.160	0.022	7.1**	0.481	0.117	0.024	4.9**
Highest: Q5	0.492	0.195	0.027	7.3**	0.568	0.204	0.027	7.6**
Highest Education of Household Adult								
No education [R]	0.309				0.321			
Primary	0.357	0.048	0.019	2.6**	0.421	0.100	0.021	4.7**
Secondary	0.400	0.090	0.016	5.7**	0.462	0.141	0.019	7.5**
Higher Secondary	0.485	0.176	0.024	7.5**	0.517	0.196	0.024	8.2**
Graduate and above	0.543	0.233	0.027	8.5**	0.563	0.242	0.031	7.9**
Region								
North	0.520	0.200	0.050	4.0**	0.551	0.132	0.042	3.1**
East	0.630	0.310	0.030	10.2**	0.534	0.115	0.041	2.8**
West	0.404	0.085	0.036	2.4**	0.415	-0.004	0.033	-0.1
South	0.301	-0.019	0.037	-0.5	0.399	-0.020	0.033	-0.6
Central [R]	0.320				0.419			
Have not/have Amenity								
Kitchen: no	0.352	-0.074	0.017	-4.3**	0.386	-0.086	0.020	-4.4**
Kitchen: yes [R]	0.425				0.472			
Pucca Roof: no	0.383	-0.036	0.018	-2.0**	0.428	-0.031	0.020	-1.6*
Pucca Roof: yes [R]	0.419				0.459			
Pucca Floor: no	0.352	-0.094	0.018	-5.2**	0.377	-0.130	0.022	-6.0*
Pucca Floor: yes [R]	0.446				0.507			
Water: outside	0.333	-0.155	0.020	-7.9**	0.386	-0.138	0.018	-7.5**
Water: Inside [R]	0.488				0.523			

[§]Estimated on data for 19,225 rural households

** Significant at 5%; * significant at 10%; [R] denotes reference category

See Notes to Table 1

Source: Own calculations from IHDS-2011

Table 4: Post-Defecation Handwashing by Social Group of Household

	Frequency of Hand Wash (% of Households)				Handwashing Agent (% of Households)		
	Never	Sometimes	Usually	Always	Water only	Mud or Ash	Soap
All Households	0.4	3.6	28.1	67.9	11.6	23.8	64.6
Brahmin	0.0	0.5	17.6	81.9	2.7	12.6	84.7
Forward Caste	0.2	2.2	25.9	71.7	7.5	11.6	80.9
OBC Hindu	0.4	4.0	30.8	64.8	13.2	25.3	61.5
Scheduled Caste	0.5	3.7	28.9	66.8	14.9	28.1	57.0
Scheduled Tribe	1.3	6.5	27.1	65.2	11.1	45.8	43.2
Muslim	0.2	3.2	26.5	70.1	10.5	20.7	68.8
Other	0.0	1.2	26.6	71.4	9.7	1.8	88.6

Source: Own Calculations from IHDS-2011

Table 5: Predicted and Marginal Probabilities of Post-Defecation Handwashing by Rural Households[§]

	Members of a household usually or always wash their hand with soap			
	Predicted Probability	Marginal Probability	Standard Error	t-value
Village Type				
Less Developed	0.582	-0.016	0.021	-0.8
More Developed	0.599			
Social Group				
Brahmin	0.668	-0.111	0.054	-2.1**
Forward Caste	0.647	-0.131	0.046	-2.9**
OBC Hindu	0.582	-0.197	0.044	-4.4**
Scheduled Caste	0.581	-0.197	0.047	-4.2**
Scheduled Tribe	0.527	-0.252	0.049	-5.1**
Muslim	0.600	-0.178	0.052	-3.5**
Other [R]	0.779			
Household Practices Untouchability				
No	0.579	-0.033	0.015	-2.2**
Yes [R]	0.612			
Quintile of Per capita consumption				
Lowest: Q1 [R]	0.553			
Q2	0.579	0.027	0.014	1.9*
Q3	0.605	0.052	0.016	3.2**
Q4	0.614	0.061	0.019	3.2**
Highest: Q5	0.658	0.105	0.025	4.2**
Highest Education of Household Adult				
No education [R]	0.523			
Primary	0.547	0.024	0.017	1.4
Secondary	0.614	0.091	0.015	5.9**
Higher Secondary	0.645	0.122	0.020	6.1**
Graduate and above	0.687	0.164	0.023	7.2**
Region				
North	0.769	0.141	0.041	3.4**
East	0.546	-0.082	0.025	-3.3**
West	0.684	0.056	0.033	1.7*
South	0.451	-0.177	0.028	-6.2**
Central [R]	0.628			
Have not/have Amenity				
Toilet: no	0.501	0.231	0.015	-15.5**
Toilet: yes [R]	0.732			
Kitchen: no	0.571	0.030	0.014	-2.2**
Kitchen: yes [R]	0.601			
Pucca Roof: no	0.567	0.041	0.014	-2.9**
Pucca Roof: yes [R]	0.609			
Pucca Floor: no	0.568	-0.049	0.015	-3.2**
Pucca Floor: yes [R]	0.617			
Water: outside	0.557	-0.086	0.016	-5.5**
Water: Inside [R]	0.643			

[§]Estimated on data for 18,836 rural households.
** Significant at 5%; * significant at 10%; [R] denotes reference category
See Notes to Table 1
Source: Own calculations from IHDS-2011

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