Durham University
Business School

Centre for Economic Growth and Policy

Demand for household sanitation in India using NFHS-3 data

Anurag N Banerjee, Nilanjan Banik and Ashvika Dalmia

Working Paper 2016 (05)

Demand for household sanitation in India using NFHS-3 data

Anurag N Banerjee,
Durham Business School, UK,

Nilanjan Banik,
Bennett University, India,

Ashvika Dalmia.
Durham Business School, UK.

September 4, 2016

Abstract

India has the highest number of people defecating in the open and the Indian Government is trying to eradicate by constructing toilets for its citizens. This paper is about whether the government is likely to succeed in its cleanliness drive mission by a supply side policy. We examine the household preference and other the factors leading to open defecation in India. We examine preference for having a toilet in the household over the preference of other household durable goods. Our results suggest toilets get a lower preference – ranked 12, out of 21 different types of consumer durables we investigate. The results also indicate a strong case for imparting education and public awareness, especially, among the female cohort. We find the odds of using toilet in a household, with an educated woman (18 years of schooling) is 3.1 times more than a household with illiterate or pre-school educated women. Among other factors households living in urban areas are 19 times more likely to use toilet in comparison to their rural counterparts.

JEL Classification: C01, I18, O11

Key words: India, Toilets, Preference.

1 Introduction

Background

On October 2, 2014 the Indian Prime Minister Mr. Narendra Modi launched the *Swachh Bharat* (Clean India) mission, aimed at creating a 'Clean India' over the next five years. The mission is a response to the rising perception about Indian cities as not being clean. This, unfortunately, is true to a certain extent. In the rural areas, only 32.70 percent of rural households have access to toilets. Over 40 per cent of government schools in India do not have a functioning toilet. On a global scale, India has the highest number of people defecating in the open, at a staggering number of 597 million (WHO and UNICEF, 2014). In 2012, the average concentration of open defecate per square kilometer area was highest in India, that was more than double of the world average (Coffey et al., 2014). Each day, about 100,000 tons of human faeces are found in the open (UNICEF, 2012).

Through *Swachh Bharat* mission, the government plans to build 110 million toilets across the country between 2014 and 2019. The success however is conditional upon toilets being delivered,

and more importantly, that there will be takers. In fact, when the government allocates money for developmental activities such as education, health, and sanitation, it has to prioritize its spending, ideally in a fashion so that a sector with a higher social return gets more funding relative to the others. In this case, returns from constructing toilets will be higher provided people start using toilets and stops defecating in the open.

Preference for a Household toilet

Given the policy focus on the supply side economics of toilet construction, we ask the question as to how the households value the construction of toilets vis-a-vis the accumulation of other consumer durables. This paper addresses this important aspect and characterizes household's decision to construct toilets within their household.

In terms of household preference, we rank the demand for toilets vis-à-vis 20 other consumer durables, such as cots, watches, mattresses, chairs, bicycles, tables, electric fans, televisions, pressure cookers, radios, motorcycles, water pumps, mobile telephones, telephones (fixed), sewing machines, refrigerators, tractors, animal drawn carts, threshers, and computers. We also examine preference structure for using toilets among residents from various states in India. In this way, we can comment about the state-wise difference in toilet coverage that is determined by cultural factors (exogenous) or the lack of sanitation related infrastructure (endogenous) for example, availability of water in the household.

This study takes into account the first large dataset – Demographic and Health Survey (DHS) data collected in 2005-2006. The Indian version of the DHS data, that is the third round of the National Family and Health Survey (NFHS-3) contains information about use of toilets by various household characteristics, namely, gender, religion, area, and geography.

Our results suggest that for any individual building toilets gets a far lower preference among lists of other household items. Toilets are ranked at 12, out of 21 different types of consumer durables, considered for this study. Regional (state-level) ranking reveals that the North-Eastern part of the country and Kerala (a southern state in India) has a higher preference for toilets compared to other durables. The Northern and Western states have worse rankings.

When the analysis is done conditioning on other socio-economic characteristics, in terms of odds ratio we found that a household in which a woman has attained higher education (18 years of schooling) is 3.1 times more likely to use toilets. Geographically, households living in urban areas are 19 times more likely to use toilets in comparison to their rural counterparts. Religion and caste (religious sub-divisions) plays a role as well. The effect of religion shows that Muslim households are 5.4 times more likely to use a toilet than a Hindu household is. Even Christian households are 1.3 times more likely to adopt a toilet in comparison to their Hindu counterparts. Hindu households have lowest coverage of sanitation facilities in comparison to other religions. The results suggest a strong case for imparting education and public awareness.

The rest of the article is organized as follows. Section 2 is about the previous literature. In Section 3 we describe the data and discuss preliminary statistics. In Section 4 we develop our empirical methodology and discuss results from our analysis. Section 6 concludes the article

with relevant policy prescription.

2 Related Literature

Throughout the world, poor sanitation is one of the leading risk factors for infant mortality. Faeces contain germs that may cause diarrhoea among children, and in the long run, can also cause change in the tissues of their intestines that prevent absorption and use of nutrients in food (Hollm-Delgado, et al., 2008). Every 15 seconds a child dies of a preventable disease relating to contaminated water, sanitation and hygiene (UNICEF, 2000). Recent evidence from Bangladesh and India suggest that children exposed to worse sanitation environment are likely to have stunted growth and are likely to develop enteropathy (Spears, 2012). George (2008) estimates that for each dollar spent on sanitation it is likely to yield a return of US$ 7 to an individual, as he/she is less likely to remain absent from work (that is, remain productive) or visit a doctor. Working with district-level income data from India, Banerjee and Banik (2014) show closed drainage system has the maximum impact on income.

Swachh Bharat mission is not one-of-a-kind sanitation and hygiene interventions. In 1986, the government launched *Central Rural Sanitation Programme* (CRSP), giving incentives in the form of full or partial funding to households for building toilets. However, this supply-driven programme met with a limited success. Banerjee and Mandal (2011) show between 1981 and 2001, the average yearly expansion of toilet was a meagre 1 per cent. As economic agents such as firms and non-profit organizations (NPOs) were not involved: there was lack of awareness and the demand for sanitary facilities could not be generated.

Later, CRSP inculcated a demand driven approach. Launched in 1999, and titled '*Total Sanitation Campaign* (TSC), the programme emphasized more on Information, Education and Communication (IEC), human resource development, and capacity development activities, to increase awareness about better sanitation practices among rural households. Subsequently, in 2003, the government also launched *Nirmal Gram Yojana* (Clean Village Campaign) providing monetary incentives to *Gram Panchayats* (political subdivisions comprising of multiple small villages), NPOs, and economic agents, assisting toilet coverage in villages. Unfortunately, this effort too met with limited success. Reports (Shah et. al., 2013) indicated that over 40 per cent of the funds under TSC, especially those allocated under IEC remained unused, and the government subsidies were often unavailable to households which needed them the most.

Studies have examined the reasons behind the limited success of TSC. Ramani (2008) attributes this to market failure. For a poor person, the short term opportunity cost of constructing a toilet is high since there are no short-term benefits. The poor care less about long-term health impact of sanitation compared to the everyday survival instincts. From the supply-side, construction of toilets are undertaken by NPOs which are particularly driven by their organizational aims rather than by market incentives. In addition to these demand and supply-side factors, a study undertaken by J-PAL (2012) attributes institutional constraint as a factor. For instance, constructing a closed drainage system requires coordination between centre, states, and municipalities/gram panchayats at the local-level – the latter amongst these are sometime

not forthcoming.

Finally, there are cultural issues. Coffey et al. (2014) find that in rural northern India there is a definite preference for defecating in the open. In a survey covering 3235 households spreading across five north Indian states – Bihar, Rajasthan, Uttar Pradesh, Madhya Pradesh and Haryana – results indicate that in spite of having toilets, over 40 per cent of the households practiced open defecation. Many more in India's rural belts felt it was pleasurable, comfortable and convenient to defecate in the open. They find it hard to break this decade hold habit and had in some cases converted toilets into a small store room. [1]

O'Reilly and Louis (2014) have a better story to tell. In a survey covering households from rural Himachal Pradesh and West Bengal, this study finds successful adoption of toilet is conditioned upon three factors. First is the political will to govern so that the toilets are delivered, and also to mobilize an awareness programme to educate the citizens about the benefits of using toilets. Second is the peer pressure, arising from social stigma of defecating in the open, when everyone else in the neighbourhood is using toilets. Third is the political ecology arising from the government bodies guaranteeing supply of water, and ecological factors such as soil quality – makings some areas better suited for building toilets than the others.

Although the previous studies find out the sets of demand, supply-side, and cultural factors contributing to use of toilets, none of these map preference structure for using toilet vis-à-vis other consumer durables. We believe mapping preference structure is essential in understanding effective demand for toilets. We have use various household characteristics to map this preference structure. Additionally, the earlier studies use case based approach, something that we are complementing with the statistical analysis.

3 Description of Data

We have used NFHS-3 data collected in 2005-2006. NFHS-3 survey interviewed 1,09,041 households spreading across 28 states in India. Information about 1,08,933 are found and are reported in Table 1. Administered under Ministry of Health and Family Welfare, Government of India, NFHS-3 collected information on women and children about health, family welfare, and nutritional intake. Throughout the analysis household is the unit of measurement.

Regarding the use of inhouse toilet, the survey asked the following question [[Question Number 31]]: *'What kind of toilet facility do members of your households usually use?'* (IIPS and Macro International, 2007c, p.48). Respondents were asked to choose among the following options: (a) Flush or pour flush toilet – piped sewer, septic tank, pit latrine, flush to somewhere else; (b) Pit latrine – ventilated improved pit/biogas; pit latrine with slab; without slab, open pit; (c) Twin pit/composting toilet; (d) Dry toilet; and (e) No facility. Additional information about whether households were first time users of toilet, and what kind of existing toilet facility did they have, were also asked. We construct our *use of toilet variable* as zero when there is

[1] Available at http://timesofindia.indiatimes.com/city/bareilly/UP-villagers-prefer-open-fields-raze-Swachh-loos/articleshow/50582495.cms. (Accessed on 24th August 2016)

no toilet facility, and one if there is any facility and the households say that they are using the toilets.

In accordance with the DHS methodology, missing values for categorical items (for example, source of drinking water) were not reassigned, and were treated as 'non available (NA)' observations. Missing values for dichotomous variables (for example, electricity and durable goods) were assigned to the category of failure, that is, the household does not possess these goods. Table 1 reports the summary statistics of the variables that we use for our empirical analysis.

Table 1: Summary Statistics of the Variables

Table 2: Conditional probability of a household practising open defecation, given various characteristics.

Table 2 presents a preliminary analysis of the conditional probability of a household's access to toilet given various characteristics. This was done using simple contingency table analysis. Our conditional probability estimates in Table 2 suggest that use of toilets is considerably low among households residing in rural areas (0.613). People who are economically poor usually do not have toilets (0.727 for *kaccha* house) [2]. Culturally, Hindu households have a lower propensity to use toilets (0.441). On the contrary, households who are economically better-off (having computers, televisions, and motorcycles) and have access to bank accounts, have a larger proportion of toilets users among them. So we need to analyse the household preference of having toilets in relation to other durable goods conditional on the level of wealth. We have done this in the next section.

4 Empirical Methods and Results

The empirical analysis is presented in two parts. Firstly, we examine the preference for having toilets vis-à-vis other consumer durables. Secondly, we look at various household characteristics, including, preference structure for having toilets across residents from various states.

4.1 Wealth threshold and preference for toilet

For the first part of the analysis we create a wealth/asset index. The motivation is to examine importance of toilets vis-à-vis other major components of consumer durables. Although DHS provides a wealth index, but the constituents of this wealth index are consumer durables alongside with toilets. Bonu and Kim (2009) use this wealth index as an independent variable. Although they use a large data-set obtained from the 60th round of National Sample Survey (January-June 2004), a limitation in their methodology arises from toilets featuring both as dependent and independent variables which leads to problems of endogeneity.

We define wealth in the conventional sense, as net stock of financial and real assets that are appreciating over time. OECD (2013) considers immovable property such as house, savings in

[2] A *kaccha* house is a building made of natural materials such as mud, grass, bamboo, thatch or sticks and is therefore a short-lived structure.

banks, equities and bonds, and land ownership as components of wealth. One obvious problem with the data we have is that we do not know the market value of these assets. Filmer and Pritchett (2001), uses the principal factor of PCA to construct the wealth index, but their methodology suffers from the usual problem of interpreting the PCA weights, which tries to orthogonalise the variance covariance matrix, assuming that the component variance is finite. The variance is a good measure of "spread" for symmetric distributions, but it fails when we consider skewed or asymmetric distributions. PCA tries to maximize the variance in the projected dimension. If the distribution follows Pareto distribution (in case of wealth) then variance drops quickly. This happens because as α (the tail-index) grows, then the data starts to group around the small mean. At times, large swings are associated with the Pareto distribution, something that a small variance would not describe well. So, we construct a simple model to implicitly price the assets based on holding observables assuming the underlying Wealth is distributed Pareto(α):

Let P_a be the price of the non-divisible asset a. Suppose, individual i with disposable income I_i buys this asset. Then we must have $P_a \leq I_i$. Therefore the proportion of that asset any individual has is given as:

$$\Pr\left(P_a \leq I_i\right) = 1 - F_I(P_a) = p_a,$$

where, F_I is the disposable income distribution.of the population.

From above we have $P_a = F_I^{-1}(1 - p_a)$. If the disposable income is Pareto distributed, that is, $F_I(P) = 1 - \underline{I}P^{-\alpha}$, then

$$P_a = \underline{I}p_a^{-1/\alpha}. \tag{1}$$

Here, $\underline{I}$ is the threshold for minimum level of consumption.

Note that even if F_I is not Pareto, P_a and p_a are negatively related.

$$\frac{dP_a}{dp_a} = -\frac{1}{f_I(P_a)} < 0 \tag{2}$$

Here, $f_I(p_a)$ is the density function. Thus higher is the market value, the lower is the likelihood of having the assets.

With this idea, we create an asset index comprising of various assets, $a_1, a_2, \ldots, a_N$ that any household is likely to have, with probabilities $p_1, p_2, \ldots, p_N$, respectively. The probabilities are empirically estimated taking the proportion of assets in the sample. The expected wealth for any household i is given as the weighted average of assets that the household hold $I(a_{ik}), \ldots, I(a_{iN})$, where the weights are inversely proportional to the probabilities of the assets ownership.

$$Wealth_i = \sum_{n=1}^{N} \frac{I(a_{ik})}{p_n} \tag{3}$$

where $I(a_{in}) = 1$, if household i holds the asset n, zero otherwise.

We consider whether the household has a house and the types of house *Kaccha* (KHo_i) and

Pucca (PHo_i), bank savings accounts ($Bank_i$), [3] and land ($Land_i$), as components of wealth following OECD (2013). Note that the magnitude of this wealth index is not a nominal variable but ordinal, therefore monotonic transformations will not change the ordering (See equation 2).

Given a level of expected wealth, we compute the conditional probabilities with which any household is likely to own any particular consumer durable. The parameters of the probability function are estimated using maximum likelihood method of estimation. We compute the the odds ratio as:

$$\log \frac{\widehat{q}^g}{1-\widehat{q}^g} = \widehat{\beta_0^g} + \widehat{\beta_1^g} Wealth_i.$$

Odds ratio gives the likelihood that a consumer will prefer any particular consumer durable. We then compute the threshold wealth level for which the probability of adopting a particular durable good is $q^g = 0.5$. Thus for a particular durable good g the threshold level of wealth is given as $\widehat{Wealth}^g = -\widehat{\beta_0^g}/\widehat{\beta_1^g}$.

Once we compute these 21 different probabilities function with respect to the wealth, we rank them to determine demand for toilets in comparison to 20 other consumer durables.

After obtaining the threshold wealth levels, we order these goods according to their thresholds. Lower is the threshold wealth the higher is the preference for having that consumer durables. In other words, the better the rank of a toilet in a household's wealth preference ordering, the lower is the level of wealth it will be adopted. Since the wealth index is not nominal but ordinal, any monotonic transformation will preserve this ordering.

Results

Using the methodology described in section 4.1, we rank households demand for toilets.

Table 3: Preference for Toilets.

The findings gives an idea of the households' preference ranking with respect to other consumer durables. Table 3 indicates toilets get a lower preference - ranked 12 out of 21 different types of consumer durables that we investigated. Demand to have televisions and motorcycles both ranks higher than toilets. It means that these two items are more likely to be adopted at a lower level of wealth before toilets. A limitation of this data is that it is relatively old (NFHS-3 was implemented in 2005-2006). A newer data set is most likely to reveal mobile phones getting a better rank than toilets. A lower ranking of toilets indicates that the problem of sanitation in India is not solely determined by the supply side factors. Thus supply side government policy such as construction of toilets is unlikely to succeed, and a proper policy might requires behavioral alterations. This will help develop market for toilets (O'Reilly, 2014).

Accounting for cultural, social, educational and infrastructural differences across India, we also map how toilets will be adopted across various states in India in (See Table 5). Our results indicate Kerala and North-Eastern states have a higher preference for toilets. This is consistent with the analysis by Ghosh and Cairncross (2014) and Bonu and Kim (2009) who finds that

[3] Although we do not have any data regarding the amount of money in the accounts.

access to toilets are highest among the North-Eastern states. North-Eastern states and Kerala are educationally better-off in comparison to rest of India. Female empowerment is also higher. For example, communities such as the Nairs and Ezhavas in Kerala, and the Khasi, Jaintias, and the Garo tribes in Meghalaya (comprising majority of the population) practice matriarchy, where women have power in activities relating to allocation, exchange, and production.

Table 5: Regional (state-wise) Preference for Toilets.

Consistant with Coffey et al. (2014) find that in Northern and North-West India there is a definite preference for defecating in the open. In our ranking analysis, Bihar (rank 8), Madhya Pradesh (rank 11), Haryana (rank 12), Maharashtra (14), Uttar Pradesh (rank 15), Rajasthan (rank 18), are some of the worst performers in using toilets. Cultural differences matter. For example, villagers in tribal areas in Northern and West Indian states are not used to the practice of using toilets. For them, to relieve inside four walls of toilets is like defecating in the house. In fact, these villagers use toilets for storage purpose (storing valuables) as government built toilets are the only concrete stucture they had in the house.[4]

4.2 Controlling for other household characteristics

In the second part of the analysis we control for other household characteristics which might influence the probability of using the toilets. We estimate a multivariate logit model, controlling for various household characteristics, namely, gender, age, religion/caste, area, institution, and geography which are proxies for cultural differences in a vast country like India.

Gender: Jenkins and Curtis (2005), and Santos et al. (2011) argue that since there is an element of safety and dignity associated with it, women are more likely to use toilets in comparison to their male counterparts.

Age: Santos et al. (2011) find younger respondents in Salvador and Brazil prefer to use toilets in comparison to their older cohorts. Accordingly, we use age as a variable.

Geography: Bonu and Kim (2009) find regional factors such as state-level toilets intake, and urban-rural residence as factors, affecting uptake in toilet usage. To account for the region specific effect, we differentiate respondents from urban and rural areas. And, within urban areas, we differentiate between mega cities, large cities, small cities, large towns, and small towns. Rural residence is taken to be the base category.

Religion/Caste: Bonu and Kim, (2009) show the importance of religion and caste. Hence, we control for religion and caste factors using dummy variables. Hindu religion and general category caste are taken as the base dummy variables.

Institution: A study by J-PAL (2012) shows the importance of including institutional factors. We consider percentage of household in any particular state with water connection as a proxy for institution. This factor also serves as a proxy for network/demonstration effect as well.

[4][http://timesofindia.indiatimes.com/city/pune/In-rural-areas-newly-built-toilets-too-pretty-to-use/articleshow/53472232.cms].

We think proximity or in-house water connection is necessary to encourage households to use toilets.

Female empowerment has been proxied by using level of female literacy and the sex of the household-head. Using 2011-Census data (survey conducted by Government of India), Ghosh and Cairncross (2014) find an inverse relation between female literacy rates and open defecation. Wei et al. (2004) reports a similar finding - female literacy rates explain 24.3 per cent of the variance in the distribution of toilet usage. We take into consideration different levels of female literacy, with base level being taken as pre-school or illiterate, and the higher level was constructed using data related to primary, secondary and higher education (post-secondary) levels.

Wealth: Wealth is an important indicator of economic well-being so we use the wealth index $EWealth_i$ that we created earlier (See, equation 3). In addition to the wealth index we also include the *amount* of agricultural land a household owns to indicate the level of wealth in the rural area. This is to adjust against higher house prices of urban households who may not have agricultural land.

Standard of Living Index: To aggregate the effect of other consumer durables and their relative preference to toilets we create a standard of living index. We use 21 durable goods $d_1, d_2, \ldots, d_{21}$ that any household is likely to have, with probabilities $q_1, q_2, \ldots, q_{21}$, respectively. The Standard of Living Index for any household i is given as $SLI_i = \sum_{l=1}^{21} d_{i,l}/q_l$. Figure 1 shows the empirical distribution of the standard of living index. It is a skewed distribution, with a majority population having a lower standard of living.

Figure 1: Distribution of households by Standard of Living Index.

Finally, regional specific variation is captured by introducing state-specific dummy variables.

Results

We report regression results in Table **??**. We present an unrestricted model (Model 1 in Table **??**), and a restricted version (Model 2 in Table 5). In the restricted version we drop the gender and the house variables. [5]

Table **??**: Regression Results.

Table **??** indicates the importance of female literacy rates. The coefficient on female literacy rates suggests that as the level of education increases, women are more likely to use toilets. The odds ratio for households in which a woman has attained a higher education is 3.1 times more in comparison to households where a woman has attained education till the pre-school level. Our result is consistent with Wei et al. (2004) and Ghosh and Carincross (2014) stressing the need for female literacy rates.

[5] The predictive power of Model 2 gets increased when we drop these two variables. For selecting models, we use Akaike Information Criteria (AIC). Given a number of potential models, the model with the lowest AIC value was chosen.

Interestingly we find, as the number of women in any household increases, that household is less likely to use toilets. The gender variable is also not statistically significant. Results from Jenkins and Curtis (2005) and Santos et al., (2011) indicate otherwise. Women are more likely to use toilets than men due to perceived benefits of greater dignity and safety.

However, there is an explanation for our results. The positive impact of households head being a woman, may be negated by the fact that such households have a lower mean standard of living index score in comparison to the households headed by men, -0.071 (for female) compared to 0.012 (for male) (See, Figure 2 and 3).

Figure 2: Histogram of Standard of Living scores where the household head is a Female

Figure 3: Histogram of Standard of Living scores where the household head is a Male

Households with a better standard of living are likely to use toilets more than the ones who are poor. Our model predicts that the odds of using a toilet becomes 7.6 times higher if standard of living index variable increases by 1 unit. A richer household with a *pucca* house[6] is more likely to use toilets. Research by Dickinson and Pattanayak (2007) yields similar findings, with correlation between housing characteristics such as type of walls and toilet usage. Halder and Kabir (2008) demonstrated that the absence of a toilet facility is linked to a lower socioeconomic status (based on household assets, housing conditions, etc.) in Bangladesh.

We find that urban households are more likely to use toilets in comparison to their rural counterparts. In comparison to rural areas, the odds for using toilets in mega cities such as Mumbai and Kolkata are nearly 35 times higher. The odds ratio for households using toilets in small cities, in turn is higher than ones residing in small towns. And all these urban-odd ratios are higher than the odd ratios computed for the rural areas. A household in a small town is 2.8 times more likely to use a toilet than his counterpart from rural areas. Our findings is similar to that of Bonu and Kim (2009) who demonstrate that the rural-urban differential in household possession of latrines has remained large over the past decade - diminishing slightly from 62 per cent in 1992-1993 to 57.8 per cent in 2004-2005.

The Planning Commission, Government of India (2002) has cited two reasons as to why urbanization might lead to more use of toilets. First, is the higher concentration and construction of toilet facilities in urban areas are facilitated by government-private initiatives, which is not so prevalent in rural areas. Second, is because of other factors such as lower awareness about possible health benefits, higher levels of poverty, beliefs that owning a household toilets have higher costs, and a simple lack of modernization could be a barrier to improved sanitation in rural areas.

The positive sign on the coefficient of agricultural land (Hectare variable) indicates that as number of units of agricultural land holding increases, the household becomes wealthier and is more likely to use toilets. This finding is similar to Salter (2008) and O'Connell (2014). Additionally, the odds ratio for households that own a bank or post office account is 1.2 times more likely to use a toilet than the ones who do not have access to these amenities. Wealthier people not only have better access to financial institutions but also more likely to use toilets.

[6]Pucca housing (or pukka) refers to dwellings that are designed to be solid and permanent.

Then there are religion and cultural factors affecting use of toilets. In terms of odds, the religion variables demonstrate that Muslim households are 5.4 times more likely to use a toilet than a Hindu household is. Even a Christian household is 1.3 times more likely to adopt a toilet in comparison to their Hindu counterparts. Using DHS data, Bonu and Kim (2009) obtained a similar result, with the Hindu households having the lowest coverage of sanitation facilities in comparison to other religions.

This result is surprising, as Indian Muslims are on average both poorer and less educated than the Hindus (Bhalotra et al., 2010). There could be two plausible reasons. First is because of cultural and behavioral attitudes. The example from Bangladesh (a predominantly Muslim dominated country) suggests a reason for superior sanitation rate in the former in comparison to that of India is because culturally Muslims are accustomed to offering prayer (azan) five times a day. And, each time they do, they have a practice of washing their hands and feet, and physically cleaning themselves. Muslim women are more likely to use toilets than their male counterparts due to the perceived benefits of dignity and safety. There is a second approach to understanding why Indian Muslims are more likely to use toilets. We find Muslims are more likely to live in urban areas than Hindus are. The conditional probability of a household residing in a urban area is 0.45 for Hindu and 0.55 for Muslims. Spatially, households living in urban areas are 19 times more likely to use a toilet in comparison to their rural counterparts. According to the National Sample Survey report (Government of India, 2015), while 87.9 per cent of the urban households were found to have access to water for use in toilets, only 42.5 per cent rural households had this facility. Banerjee and Banik (2014) show for 1 per cent increase in a closed drainage system, the income increases between 0.96 per cent and 2.58 per cent.

The coefficient of the Caste variable predicted by Model 2 is -0.253, implies that Scheduled Caste (SC), Scheduled Tribe (ST) and Other Backward Class (OBC) households have a lower probability of using toilets when compared with households from general caste Hindu, Muslims and Christians. When it comes to accessing different types of public goods in India, Banerjee and Somanathan (2007) find there is a pronounced caste-based differential, with ST households continuing to be significantly deprived. They contend that this is a result of these tribal castes living in relatively inaccessible areas of the nation, and thus having lower access to public goods in comparison to others. This line of argument is supported by our results. For the households living in rural areas and countryside, the conditional probability that these household belongs to SC, ST or OBC is over 0.60, in comparison to 0.41 for people from other communities. Additionally, Srinivasan and Mohanty (2004) have found that the level of abject poverty is higher among these castes, which could be another potential reason for poorer sanitation coverage among SC, ST, and OBCs.

Finally is the state-level variance in the use of toilets. The odds ratio for households in the North-Eastern Indian States of Manipur, Mizoram, Tripura, Meghalaya etc. and the southern state of Kerala using toilets are much higher than a household in Delhi (the reference state). For example, a household in Tripura is 761.5 times more likely to use toilets than a household in Delhi. The state dummies for Rajasthan, Jammu & Kashmir, Himachal Pradesh, Jhark-

hand, Chhattisgarh and Tamil Nadu have negative coefficients implying that the probability of households using toilets in these states is lower than in Delhi. Such findings have been observed in previous academic literature as well, with the backward states of Rajasthan, Jharkhand and Chhattisgarh having lower levels of toilets usage in comparison to other states (Coffey et al., 2014). For Tamil Nadu - a Hindu dominated state - the reason for its poor performance on sanitation is again cultural. Ramaswamy (2005) and Bathran (2011) argue that open defecation among Hindu households is due to caste system, where the customary circumvention of excreta is sustained by keeping defecation away from the house and entrusting the clean-up job to the so-called 'untouchables' or 'lower' castes. To sum up, even after controlling for the usual socio-economic factors like caste, religion, education, women-empowerment, wealth and access to water, we find that state-level variation exists. The main reason for open defecation is behaviour and mindset of the people who have continued this practice of defecating in the open for centuries.

To check robustness of our results and also that the literature indicates that the rural households are prone to open deification, we do a sub-sample analysis with only rural households. The coefficient of a variable originally considered is robust if its sign and level of significance do not change. Considering rural households only, we find that our results are consistent with the previous analysis. The results are shown in Table 6.

Table 6: Rural Sub-Sample Regression Results

5 Conclusions and policy implications

There are a number of policy implications. First, governments from developing countries, India in particular, should concentrate on creation of demand for using toilets. They must ensure that a larger proportion of funds are directed towards IEC component of the policy. The lesson from the *Nirmal Gram Yojana* experience suggests cash incentives will not necessarily increase awareness to use toilets. Rather than counting the number of toilets being built, the approach should be about tracking regionwise number of open defecators. **Not only is monitoring required but introduction of more programmes in the line of TSC is expected to be fruitful.**

Second, empirical analysis indicates female literacy rate is an important factor. Use of toilets can be improved by policies that aim to emancipate and increase education levels among women. For increasing sanitation coverage it will be wise to target women, and actively involve them in policymaking.

Third, there is a rural-urban divide, with sanitation problem concentrated in rural parts of India. There is a need for government policies specifically focusing on improving sanitation in rural areas.

Fourth, the religion and caste-based differentials in adoption of toilets are more difficult to eradicate. Religion and caste-based differentials are rooted in some ingrained beliefs and attitudes. To change this behavioral attitude, the government needs to recast its effort to

communicate the benefits of not defecating in the open.

A limitation of this study is that we have not considered the market demand for toilet. It will be interesting to consider factors, such as the price for providing a toilet. Additionally, a more encompassing income and wealth variables will be useful to evaluate if sanitation subsidies that target the poor have actually reached the intended groups. These variables will enable construction of a precise demand function for a toilet.

References

Banerjee A., and Somanathan R. (2007) 'The political economy of public goods: Some evidence from India', Journal of Development Economics, Vol. 82, pp. 287-314.

Banerjee A., and Banik N. (2014) 'Is India Shining?',Review of Development Economics, Vol. 18, No. 1, pp. 59-72.

Banerjee T., and Mandal K. (2011) 'Revisiting the Midnapore Model after Ten Years of Total Sanitation Campaign (TSC) in India', SSRN Working Paper. Available at: http://ssrn.com/abstract=176

Bathran R. (2011) 'Indian Sanitation', Economic and Political Weekly, Vol. XLVI, pp. 34-37.

Bhalotra S., Valente C., and van Soest A. (2010) 'The puzzle of Muslim advantage in child survival in India', Journal of Health Economics, Vol. 29, pp. 191-204.

BonuS., and Kim H. (2009) 'Sanitation in India: Progress, Differentials, Correlates and Challenges', Asian Development Bank, South Asia Occasional Paper Series No. 2.

Coffey D., Gupta A., Hathi P., Khurana N., Spears D., Srivastav N., and Vyas S. (2014) 'Revealed Preference for Open Defecation: Evidence from a New Survey in Rural North India', Economic and Political Weekly, Vol. XLIX, No. 38, pp. 43-55.

Dickinson K., and Pattanayak S.(2007) 'Open sky latrines: Do social interactions influence decisions to use toilets?', Duke University, Working Paper. Available at: http://aae.wisc.edu/events/papers/

Filmer D. and Pritchett, L.H, (2001), Estimating Wealth Effects without Expenditure Data-or Tears: An Application to Educational Enrollments in States of India, Demography, Vol. 38, No. 1, pp. 115-132

George R., (2008), The Big Necessity: The Unmentionable World of Human Waste and Why It Matters, New York City: Holt Paperbacks.

Ghosh A., and Cairncross S. (2014) 'The uneven progress of sanitation in India', Journal of Water, Sanitation and Hygiene for Development, Vol. 4, No. 1, pp. 15-22.

Government of India, Planning Commission (2002) 'India Assessment 2002: Water Supply and Sanitation, 2002, a WHO-UNICEF sponsored study', Delhi: Planning Commission, Available at: http://planningcommission.gov.in/reports/genrep/wtrsani.pdf.

Government of India (2015) 'Houselisting and Housing Census Data – 2011', Available at: http://www.censusindia.gov.in/2011census/hlo/HLO_Tables.html.

Jadhav, R., (2016) 'In rural areas, newly-built toilets 'too pretty' to use', Times of India, 31 July 2016.

Halder A.K., and Kabir M. (2008) 'Child Mortality Inequalities and Linkage with Sanitation Facilities in Bangladesh', Journal of Health, Population and Nutrition, Vol. 26, No. 1, pp. 64-73.

Hollm-Delgado MG, Gilman, R.H., Bern, C., Cabrera L, Sterling CR, Black RE., and Checkley, W. (2008) 'Lack of an adverse effect of Giardia intestinalis infection on the health of Peruvian children', American Journal of Epidemiology, Vol. 168, No.6, pp. 647-55.

International Institute for Population Sciences (IIPS) and Macro International (2007) National Family Health Survey (NFHS-3), 2005–06: India: Vol II, Mumbai: IIPS.

Jenkins M.W., and Curtis V., (2005), 'Achieving the 'good life': why some people want latrines in rural Benin', Social Science and Medicine, Vol. 61, No. 11, pp. 2446–2459.

J-PAL, 2012, 'J-PAL Urban Services Review Paper', Cambridge, MA: Abdul LatifJameel Poverty Action Lab.

O'Connell K. (2014) 'What Influences Open Defecation and Latrine Ownership in Rural Households? : Findings from a Global Review', Water and Sanitation Program: Working Paper, Washington: World Bank.

O'Reilly, and Louis E. (2014) 'The toilet tripod: Understanding successful sanitation in rural India', Health and Place, Vol. 29, pp. 43-51.

OECD (2013) OECD Guidelines for Micro Statistics on Household Wealth, OECD Publishing, Available at: http://www.oecd.org/statistics/OECD-Guidelines-for-Micro-Statistics-on-Household-Wealth.pdf.

Ramani S.V. (2008) 'Playing in Invisible Markets: Toilet Innovations and Empowerment', The Charles Cooper Annual Memorial Lecture, UNU-MERIT Working Paper Series.

Ramaswamy G. (2005) India Stinking: Manual Scavengers in Andhra Pradesh and their Work, Chennai: Navayana Publishing.

Salter D. (2008) 'Identifying Constraints to Increasing Sanitation Coverage: Sanitation Demand and Supply in Cambodia', Water and Sanitation Program, Available at: http://www.wsp.org/sites/wsp.org/files/publications/ Sanitation_demand_and_supply_fieldnote_final__1.pdf.

Santos A.C., Roberts J.A., Barreto M.L., and Cairncross S. (2011) 'Demand for sanitation in Salvador, Brazil: a hybrid choice approach', Social Science and Medicine, Vol. 72, No. 8, pp. 1325–1332.

Shah A., Thathachari J., Agarwal R., and Karamchandani A. (2013) 'A market led, evidence based, approach to rural sanitation', Monitor Inclusive Markets, on behalf of The Bill & Melinda Gates Foundation.

Spears D. (2012) 'Health and Cognitive Achievement among Indian Children', Economics and Human Biology, Vol. 10, No. 2, pp. 210-19.

Srinivasan K., and Mohanty S.K. (2004) 'Deprivation of Basic Amenities by Caste and Religion: Empirical Study using NFHS Data', Economic and Political Weekly, Vol. 39, No. 7, pp. 728-735.

The DHS Program: Demographic and Health Surveys (2015), Available at: http://dhsprogram.com/.

The DHS Program STAT compiler (2015), Available at: http://www.statcompiler.com/.

Tiwari, M., (2016) 'UP villagers prefer open fields, raze Swachh Loos', Times of India, 14 January 2016.

UNICEF (2000) Learning from Experience: Evaluation of UNICEF's Water and Environmental Sanitation Programme in India, 1966-1998, New York: Evaluation Publications.

UNICEF (2012) 'An overview of status of drinking water and sanitation in schools in India', UNICEF WASH, Available at: http://in.one.un.org/img/uploads/Snapshot_WASH%20in%20Schools_Ind

Wei F., Pillai V., and Maleku A. (2004) 'Sanitation in India: Role of Women's Education', Health Science Journal, Vol. 8, Issue 1, pp. 90-101.

WHO (2004) Water Sanitation and Hygiene: Facts and Figures (updated March 2004), Available at: http://www.who.int/water_sanitation_health/publications/factsfigures04/en/.

WHO and UNICEF (2014) Progress on Drinking Water and Sanitation: 2014 Update, Geneva: World Health Organisation, Available at: http://www.wssinfo.org/fileadmin/user_upload/resources/JMP

Table 1: Summary Statistics of the Variables

			Latrine Users		**Non-Latrine Users**	
		Sample Total	Number	% of group	Number	% of group
Total sample		108939	67483	61.95%	41456	38.05%
Type of residence	Rural	58753	22713	38.66%	36040	61.34%
	Urban	50186	44770	89.21%	5416	10.79%
Households highest education level	No education/Preschool	9088	2586	28.46%	6502	71.54%
	Primary	15859	5856	36.93%	10003	63.07%
	Secondary	59940	37180	62.03%	22760	37.97%
	Higher	24038	21853	90.91%	2185	9.09%
Household heads gender	Male	93246	57933	62.13%	35313	37.87%
	Female	15693	9550	60.86%	6143	39.14%
Household heads religion	Hindu	79941	44681	55.89%	35260	44.11%
	Muslim	13341	10033	75.20%	3308	24.80%
	Christian	10037	8552	85.20%	1485	14.80%
	Other	5592	4200	75.11%	1392	24.89%
Household has electricity	Yes	85766	61931	72.21%	23835	27.79%
	No	23173	5552	23.96%	17621	76.04%
Households wealth	Owns house	91445	53684	58.71%	37761	41.29%
	Owns agricultural land	43850	20803	47.44%	23047	52.56%
	Owns a bank or post office account	49253	38324	77.81%	10929	22.19%
House type	Kachcha (Mud/Bamboo house)	11355	3102	27.32%	8253	72.68%
	Semi-pucca	39590	16568	41.85%	23022	58.15%
	Pucca (Brick house)	57215	47300	82.67%	9915	17.33%

Table 2: Conditional probabilities for open defecation

Attributes	**Conditional Probabilities**
Living standards Attributes	
Pr(Open defecation— has computer)	0.018
Pr(Open defecation— has car)	0.024
Pr(Open defecation— has refrigerator)	0.064
Pr(Open defecation— has mobile telephone)	0.065
Pr(Open defecation— has motorcycle/scooter)	0.123
Pr(Open defecation— has television)	0.188
Pr(Open defecation— has radio)	0.241
Pr(Open defecation— has electricity)	0.278
Pr(Open defecation— has bicycle)	0.393
Wealth Attributes	
Pr(Open defecation— has a bank or post office account)	0.222
Pr(Open defecation— owns this or other house)	0.413
Pr(Open defecation— owns land usable for agriculture)	0.526
Pr(Open defecation— house is pucca)	0.173
Pr(Open defecation— house is semi-pucca)	0.582
Pr(Open defecation— house is kaccha)	0.727
Cultural Attributes	
Pr(Open defecation— head of household is Muslim)	0.248
Pr(Open defecation— head of household is Hindu)	0.441
Pr(Open defecation— urban residence)	0.108
Pr(Open defecation— rural residence)	0.613

Table 3: All India Ranking: Preference for Toilets ranked by Wealth Index

Rank	**Other Durable Goods**
1	Cot/bed
2	Watch
3	Mattress
4	Chair
5	Bicycle
6	Table
7	Electric fan
8	Television
9	Pressure cooker
10	Radio
11	Motorcycle/scooter
12	**Toilet**
13	Water pump
14	Mobile telephone
15	Telephone (non-mobile)
16	Sewing machine
17	Refrigerator
18	Tractor
19	Animal-drawn cart
20	Thresher
21	Computer

Table 4: Regional (state-wise) preference for Toilets

State	**Ranking**
India	12
Arunachal Pradesh	1
Manipur	2
Assam	2
Kerala	2
Nagaland	3
Tripura	3
Sikkim	4
Mizoram	5
West Bengal	5
Meghalaya	6
Goa	7
Bihar	8
Andhra Pradesh	8
Uttaranchal	9
Gujarat	10
Delhi	11
Jammu & Kashmir	11
Orissa	11
Madhya Pradesh	11
Karnataka	11
Himachal Pradesh	12
Punjab	12
Haryana	12
Chhattisgarh	14
Maharashtra	14
Tamil Nadu	14
Uttar Pradesh	15
Jharkhand	15
Rajasthan	18

Table 5: Use of Toilets conditional on Household characteristics

Characteristic	**Variable**	**Model 1**	**Model 2**
	Intercept	-1.363***	-1.464***
Womens Education	Primary	0.159***	0.160***
	Secondary	0.535***	0.535***
	Higher	1.130***	1.130***
Number of Women in the Household	Women	-0.167***	-0.168***
Type of Residence	Megacity	3.534***	3.547***
	Large city	2.954***	2.966***
	Small city	1.785***	1.792***
	Largetown	1.888***	1.891***
	Small town	1.025***	1.029***
Wealth Variables	House	-0.102	-
	Hectare	0.011**	0.011
	Bank	0.192***	0.190***
Standard of Living Index		2.029***	2.031***
Infrastructure	Water Availability	0.563***	0.561***
Household head	Muslim	1.695***	1.695***
	Christian	0.229**	0.227**
	Other religion	0.537***	0.540***
	Caste	-0.255***	-0.253***
	Gender	-0.029	-
	Age	0.004***	0.004***
State Dummies	Jammu & Kashmir	-0.746***	-0.746***
	Himachal Pradesh	-0.197	-0.183
	Punjab	0.470**	0.480**
	Uttaranchal	0.827***	0.833***
	Haryana	0.097	0.098
	Rajasthan	-0.453**	-0.455**
	UttarPradesh	0.389**	0.386**
	Bihar	0.831***	0.837***
	Sikkim	3.689***	3.690***
	Arunchal Pradesh	4.121***	4.140***

	Nagaland	3.885***	3.903***
	Manipur	4.721***	4.723***
	Mizoram	5.647***	5.654***
	Tripura	6.626***	6.635***
	Meghalaya	3.321***	3.323***
	Assam	3.703***	3.705***
	West Bengal	2.564***	2.565***
	Jharkhand	-0.061	-0.063
	Orissa	0.309	0.312
	Chhattisgarh	-0.008	-0.01
	Madhya Pradesh	0.536***	0.538***
	Gujarat	0.316	0.319
	Maharashtra	0.062	0.066
	AndhraPradesh	0.649***	0.655***
	Karnataka	0.357*	0.361*
	Goa	0.889***	0.900***
	Kerala	3.844***	3.847***
	Tamil Nadu	-0.249	-0.25
Overall Significance	LR test Statistics	$\chi^2(47)$=64.00***	$\chi^2(45)$=61.66***

Table 6: Use of Toilets conditional on Rural Household characteristics

Type of Variable	**Variable**	Model 1	**Model 2**
	Intercept	**-0.711****	-0.700**
Womens Education	Primary	0.172***	0.172***
	Secondary	0.566***	0.565***
	Higher	1.117***	1.116***
Number of Women	Women	-0.155***	-0.155***
Household head Type	Gender	-0.045	-
	Age	0.005***	0.005***
	Muslim	1.679***	1.678***
	Christian	0.333***	0.332***
	Other_religion	0.575***	0.574***
	Caste	-0.195***	-0.195***
Wealth Variables	House	-0.016	-
	Hectare	0.012**	0.013**
	Bank	0.238***	0.238***
Standard of Living Index	Durable_Dwelling	1.966***	1.966***
Infrastructure	Water Availability	0.665***	0.613***
State Dummies	JammuandKashmir	-1.452***	-1.453***
	HimachalPradesh	-1.082***	-1.091***
	Punjab	-0.394	-0.396
	Uttaranchal	-0.068	-0.073
	Haryana	-0.802***	-0.803***
	Rajasthan	-1.517***	-1.516***
	UttarPradesh	-0.537*	-0.538*
	Bihar	-0.026	-0.033
	Sikkim	2.754***	2.754***
	ArunchalPradesh	3.154***	3.152***
	Nagaland	2.827***	2.826***
	Manipur	3.661***	3.660***
	Mizoram	4.590***	4.588***
	Tripura	5.669***	5.669***
	Meghalaya	2.247***	2.245***
	Assam	2.734***	2.734***

	WestBengal	1.761***	1.761***
	Jharkhandi	-1.430***	-1.432***
	Orissa	=-0.517*	=-0.519*
	Chhattisgarh	-0.979***	-0.979***
	MadhyaPradesh	-0.414	-0.412
	Gujarat	=-0.578*	=-0.576*
	Maharashtra	-0.895***	-0.894***
	AndhraPradesh	-0.324	-0.324
	Karnataka	-0.580**	=-0.582*
	Goa	0.134	0.126
	Kerala	2.959***	2.960***
	TamilNadu	-1.129***	-1.131***
Overall Significance	LR test Statistics	$\chi2$=58.12	$\chi2$ =55.76

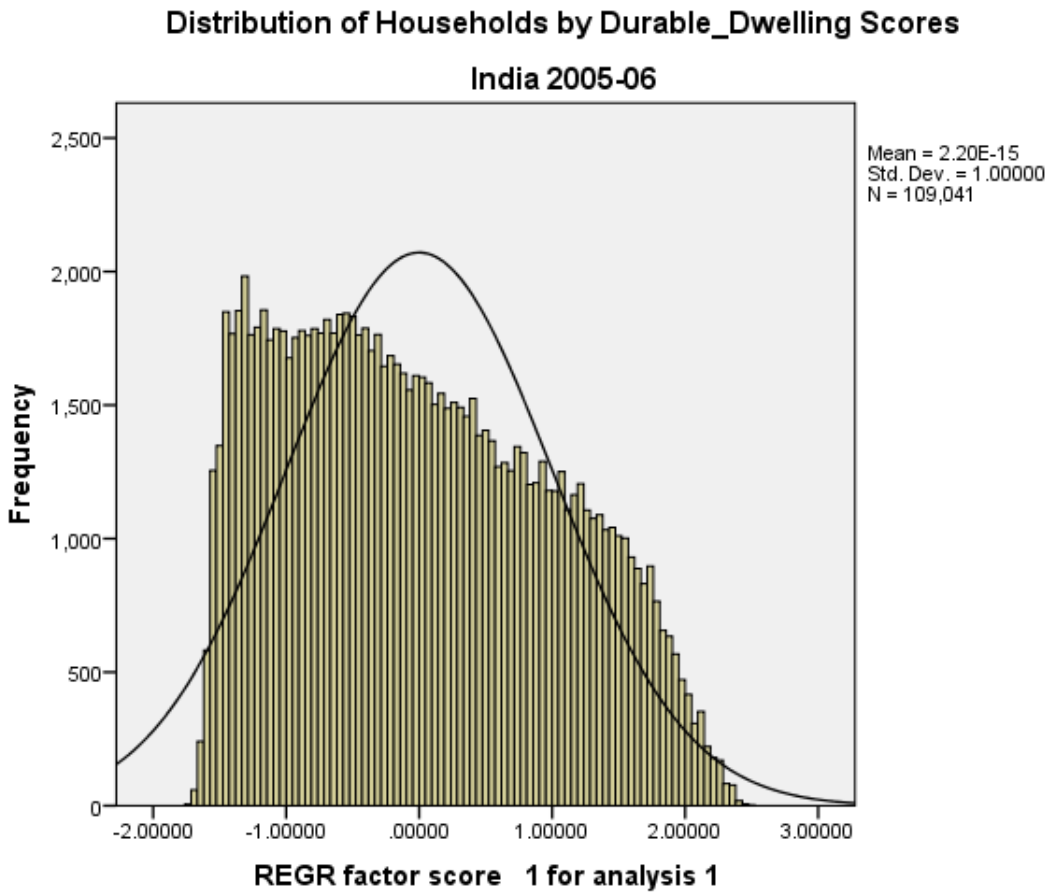

Figure 1: Distribution of households by Standard of Living Index

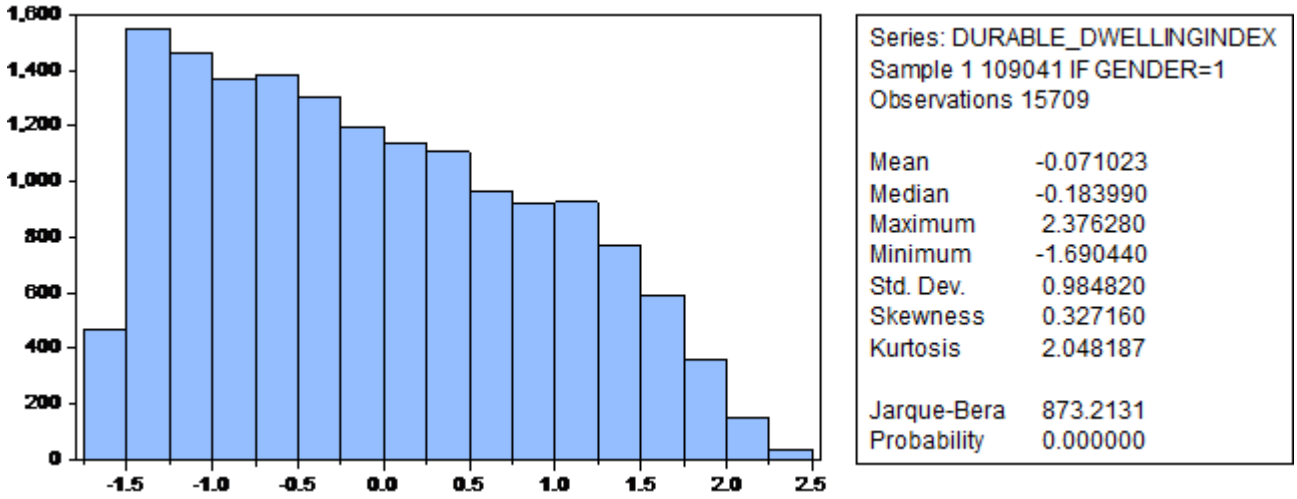

Figure 2: Histogram of Standard of Living scores where the household head is a Female

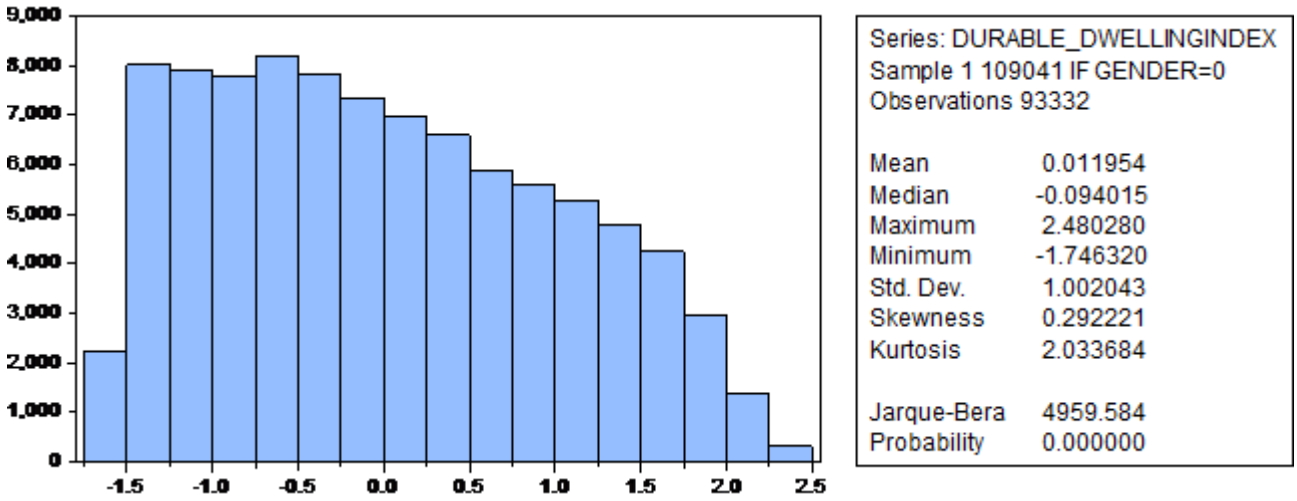

Figure 3: Histogram of Standard of Living scores where the household head is a Male