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Access to Toilets and Violence Against Women*

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Abstract

This paper examines if in-home access to toilets reduces the risk of violent crimes against women. We use the roll out of the *Swachh Bharat Mission*, a flagship toilet construction program in India, to ascertain if assault and rape of women reduce when women have access to in-home toilets relative to open defecation. We bolster our findings by using political alignment of locally elected representatives in close elections with the national government's political party, post the launch of the program, as an instrument in an instrumental variable strategy. Our IV estimation is robust to conditioning on average luminosity as a proxy for growth though we do not observe any correlation between our instrument and local economic growth measures in this time period. We find that construction of toilets reduces sexual assault of women, but we do not discern consistent changes in rape. Our findings are robust to a variety of controls, specifications, and identification approaches. We address reporting changes as a plausible alternative explanation.

JEL classification: D78, J16, O18

Keywords: Toilets, Violence Against Women, Open-Defecation

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1 Introduction

Despite growing standards of living worldwide, open defecation remains a widespread public health issue. Open defecation results in health externalities and has deleterious intergenerational impacts. Lack of toilet facilities at home, resulting in open defecation by household members, has been associated with lower health outcomes for children - lower height premiums, anaemia, and cognition among children (Geruso & Spears (2018), Coffey *et al.* (2017), Hammer & Spears (2016), Spears & Lamba (2016)). Access to gender-specific toilets in schools improves enrollment of pubescent-age girls due to privacy concerns (Adukia, 2017). Yet neither government interventions nor private markets have adequately addressed this lack of access to in-home toilets in many parts of the world. A leading example of this state and market failure was India prior to 2019, which had one of the largest rates of open defecation in the world even though the income per-capita had been growing rapidly in the preceding decade. While the proportion of people defecating in the open decreased from 70% in 2001 to 37% in 2013, these numbers continued to remain large in comparison to the world average of 12% and Sub-Saharan African countries average of 23%.[1]

Lack of in-home toilets can have a disproportionately large detrimental effect on girls and women. Anecdotal evidence suggests that open defecation threatens safety of women as it makes them vulnerable to violent crimes in secluded areas often at dark hours of the day.[2] Women and girls are often sexually assaulted when alone. In a recent survey conducted by WASH institute and Sambodhi across 10 states of India, women defecating in the open report 32 percent higher rate of sexual assault and rapes. Majority (58 percent) of the households in rural India reported safety concerns for women as the main reason for getting a toilet constructed within the house premises.[3] However, prior research has not addressed gender based consequences of the lack of proper sanitation facilities.

[1] World Development Indicators at https://databank.worldbank.org/source/world-development-indicators.

[2] Women tend to use the open spaces very early in the morning or after dark as they do not want to be seen because of embarrassment.

[3] The survey and the relevant data are available from the Bill and Melinda Gates Foundation.

A heinous 2014 gang rape followed by the death of two adolescence girls in rural north-western India highlighted the plight of women without in-home toilets. These girls were attacked when they were alone in the open field near their house in the evening hours to defecate there.[4] Subsequent to this incidence, toilet construction took a priority in the ensuing policy discourse in India. In the 2014 elections for the national parliament, Bharatiya Janata Party (BJP) formed the federal government and announced its flagship scheme 'Swachh Bhaarat Mission' (SBM) to combat open-defecation.

In this paper, we use the variation generated in the in-home toilet construction by this policy to test if access to in-home toilets affected sexual assault and rape of women in India. This program was viewed by the government as a safety enhancing policy lever for women and girls, in addition to addressing health concerns emerging from open defecation and lack of proper sanitation in rural and peri-urban areas of the country. The main mandate of the program was to reduce open defecation through construction of household toilets though the program also had other components to enhance cleanliness by provision of other sanitation services and a mass awareness campaign.[5]

This program has been a policy success and has led to the construction of 97.6 million toilets across India since October, 2014 when it was launched. In 2014, only 38.8 percent of the population had access to in-home toilets (individual household latrines). As of 2019, the official statistics put this percentage at 99 percent.[6] Despite this surge in toilet construction over time, there has been spatial variation in the density of toilets constructed during the initial years of the program. Figure 1 shows the district level access to toilets and how it changed between 2013-2016. Clearly there is an increase in access to toilets but the rate of increase has been different across districts. In Table 1, we document the state-by-year variation in access to toilets for the period 2012 to 2017. We exploit this variation at the level of Indian districts for identification. First, we estimate a two way fixed effects specification for

[4]This incident was covered by many newspapers in India and worldwide. https://www.theguardian.com/global-development/2014/aug/28/toilets-india-health-rural-women-safety.

[5]Details can be found at https://swachhbharatmission.gov.in/sbmcms/index.htm

[6]Statistics available at https://sbm.gov.in/sbmReport/home.aspx

our count outcomes analogous to differences-in-differences strategy. We control for district and year fixed effects in order to allay concerns about confounding effects of district-specific time invariant unobservables and year-specific common macro shocks, respectively.

However, construction of toilets is unlikely to be exogenous. Time varying district specific omitted variables which might have influenced construction of toilets and at the same time are correlated with violence against women, can result in biased estimates. To overcome this potential bias, we use an instrumental variable strategy which exploits the fact that the largest push for toilets occurred in areas where a greater proportion of state legislative members belonged to the party forming the national government. We use the results in close elections in which legislative assembly election winners by close margins were aligned with BJP to construct the instrument.

We find that an increase in household toilet facilities led to a significant reduction in sexual assaults reported by women. While reduced form estimation indicates a reduction in rapes, these results do not hold in our instrumental variable strategy and are not robust to additional specifications. The consistent and robust negative and statistically significant decline in assaults is indicative of a causal effect on assaults. Crimes against women typically are under-reported. In so far as this reporting tendency is time invariant and varies by regions, this is accounted for in our district fixed effects. This implies that if areas that benefit in terms of toilet construction under the SBM policy are the areas with regressive attitudes towards women and this does not change with time, our results would remain unbiased.

An issue would be that there is a change in reporting of crimes against women. For example, if the mass awareness campaign/waste management component or other income shocks result in more awareness and empower women, then we would see an increase in reporting of crimes. However, we find a consistent decline in assaults. Even if there is a reporting effect of this nature resulting in more reporting, then incidence must have declined enough such that on the net we still see a reduction. Conversely, there could be a reduction

in reporting and our results could only be picking that up. This could happen, for example, if government officials do not accurately record the assault cases in areas with more toilet construction. There are two reasons that cast doubt on this as a possible driver of our results. One, we do not find changes in other crimes against women which should have also decreased if this was a channel. Two, we find heterogeneous results along several dimensions which would be difficult to reconcile with a reporting change mechanism. A related alternative explanation could be that the mass awareness campaign, with gender at its helm, led to gender sensitization and a reduction in incidences of crimes against women in general. This too is inconsistent with a series of our results and our heterogeneous findings.

There are two possible critiques of political alignment as an instrument. It is possible that BJP has a broad policy of crackdown on crimes and all crimes fall when BJP affiliates are elected to local assemblies. Another possible hypothesis is that BJP alignment helps the local elected officials to bring more resources to the districts and improve economic prosperity which leads to building of more toilets and reduction in assaults against women.[7] Related to this, BJP alignment could also lead to changes in public service delivery which enhance the safety of women. However, the instrument used in the paper is an interaction of political alignment with BJP with time period post which the SBM was implemented. Thus, we control for the absolute level effect of the political alignment in all our specifications, and any such concern should be allayed by this control.

Additionally, we also show that the instrument led to no visible gain in economic prosperity using nightlights data, which has been used as a measure of economic growth in the existing literature on political alignment effects on economic growth in India (Asher & Novosad (2017)). Nevertheless, we still control for "average luminosity" (nightlights) as a proxy for economic prosperity following Henderson *et al.* (2012) and find that our results do not change. We also control for trends in a series of public goods and our results remain robust. But to address this concern further, we address each of the above possibilities em-

[7] Asher & Novosad (2017) show that this type of alignment (with state governing party) affects economic prosperity in India.

pirically. Aside from sexual assaults against women, we do not find large reductions in other crimes which plausibly should also have been affected by the route of economic prosperity. A consistent crackdown across crime categories due to political alignment in a region also does not bear out in the data.[8]

Our paper extends and complements three strands of literature. A growing body of work shows that infrastructure improvements can positively influence development outcomes and improve the status of women (Dinkelman (2011), Adukia (2017), Amaral *et al.* (2018), Bhuller *et al.* (2013), Sekhri & Hossain (2019), Hossain *et al.* (2019)).[9] Our paper complements this work and establishes that improved access to in-home toilets can increase the safety of women and reduce sexual assaults. While prior literature on linkages between infrastructure and welfare of women has focused on labor, health, and human capital formation, we make a novel contribution in showing that infrastructure improvements can enhance safety of women.

We also contribute to a body of work investigating the links between levers that affect economic well being and violence against women. Narrowing of gender wage gap reduces domestic violence (Aizer (2010)). Poverty can lead to killing of girls and women in developing countries (Rose (1999), Miguel (2005), Sekhri & Storeygard (2014)). Confluence of improved relative wages and autonomy resulting from increase in foreign direct investment can reduce rapes (Li *et al.* (2019)). Our paper augments this literature and shows that improved access to sanitation by way of in-home toilets can reduce sexual assaults. Finally, we also connect to the literature exploring the causes and consequences of unsanitary conditions, lack of

[8] A different mechanism through which construction of toilets can affect other crimes, without invalidating our instrument, is through the broken window theory of crime. This theory claims that visible signs of disorder can give rise to criminal behaviour. Construction of toilets was accompanied by a mass campaign on general cleanliness and upkeep of both household and public premises. Engel *et al.* (2014) undertake an extensive review of studies and do not find robust evidence in support of it in the developed countries. We also do not find evidence favoring this theory: other crimes do not decline across the board.

[9] More broad development outcomes are studied for example by Duflo (2001), Duflo & Pande (2007), Asher & Novosad (2019). Devoto *et al.* (2012) focus on access to piped water and conflict. There is also a literature focusing on how infrastructure affects trade costs and urbanization (Donaldson (2018) and Storeygard (2016) and citations therein).

toilets, and open defecation.[10] The focus of this literature has largely been health (Duflo *et al.* (2015), Patil *et al.* (2014), Geruso & Spears (2018), Coffey *et al.* (2017), Hammer & Spears (2016), Spears & Lamba (2016)) and mortality (Cutler & Miller (2005), Alsan & Goldin (2019)). None of these previous papers focus on investigating how violence against women is influenced. Our paper is the first to document the causal effects of in-home toilets on sexual assaults.[11]

Our findings are of significant policy relevance. Aside from staggering social and financial costs, concerns over safety can also lead to under-investment in human capital by women and reduce their welfare (Borker (2017) and Chakraborty *et al.* (2018)). We show that improving sanitation facilities in developing countries can be one channel for increasing public safety of women. Prior work indicates that policies aimed at alcohol prohibitions and regulation of drinking in bars are successful at reducing violent crimes against women (Khurana & Mahajan (2019) and Luca *et al.* (2015)). Our paper augments this work and highlights that state policies aimed at providing in-home sanitation facilities to women can also reduce violence against women in developing countries.

Rest of the paper is organized as follows. Section 2 provides the background for the sanitation conditions in India and the SBM policy. Section 3 describes the data we use. In Section 4, we discuss our estimation strategies. Main results are summarized in Section 5. The heterogeneous results are discussed in Section 6 while robustness tests including those for instrumental variable validity are documented in Section 7. Section 8 provides concluding remarks.

[10] A burgeoning literature has also explored how to reduce open defecation and improve sanitation (Gertler *et al.* (2015)

[11] Srinivasan (2015) notes a correlation between violence against women and lack of access to in-home toilets using a large scale cross sectional survey in India.

2 Background

According to a National Sample Survey (NSS) conducted in 2012, only 38.8 percent of rural households had access to an in-home toilet in comparison to about 90% urban households.[12] In rural areas, lack of access to public toilets leads to large scale open defecation. The proportion of people practicing open defecation stood at more than 50% in rural India in 2015 (National Family Health Survey 2015-16). As discussed earlier, inadequate sanitation has been recognized as a leading cause of premature mortality of children and also has other negative effects on child health (Hammer & Spears (2016); Geruso & Spears (2018); Alsan & Goldin (2019)). An assessment by the World Bank (Bank (2011)), puts total economic cost associated with inadequate sanitation in India at 2.4 trillion ($53.8 billion) in 2006.

While sanitation policies were routinely pursued in India since 1986, it was not until 2014 that they received a big push and impetus to succeed. A program launched in 1986 known as the Central Rural Sanitation Program did not have a significant impact on improving access to toilets. The proportion of households having a toilet increased from 24% in 1991 to 37% in 2001 (Census 1991 and 2001): a paltry increase of 13% over a ten year period. This program was then restructured and renamed the 'Total Sanitation Campaign' (TSC) in 2000, and 'Nirmal Bharat Abhiyan' (NBA) in 2012. But these programs again only had minimal impact on access to in-home toilets. According to Census 2011, the proportion of households having toilets stood at 47% in 2011; again, only a 10% increase during 2001-2011.

2.1 Launch of the *Swachh Bharat Mission*

In 2014, following the rape and deaths of two young girls while defecating in the open, the newly formed national government under prime minister Narendra Modi put access to toilets at the helm of its policy goals. On October 2^{nd}, 2014 the PM announced the government's flagship program, the 'Swachch Bharat Mission' (SBM) managed by the Ministry of Drink-

[12] NSS 69^{th} Report on Key Indicators of Drinking Water, Sanitation, Hygiene and Housing condition in India.

ing Water and Sanitation (MDWS). This initiative (also called 'Clean India') was the PM's biggest endeavour after assuming office in 2014 to accelerate efforts towards universal sanitation in India. SBM put a strong emphasis on achievement of targets (100 percent access to toilets) by 2019 since open defecation rates remained staggeringly high in the past two decades despite policy efforts.

Under the program, an end to open defecation was to be achieved through construction of toilets and solid and liquid waste management. Under SBM for rural areas, the main policy has been to provide subsidy toward construction of household toilets since low access to toilets and consequent open defecation is largely a rural phenomenon.[13] The share of the Individual Household Latrine (IHHL) subsidy is the largest component of expenditure under the SBM (97 per cent in Financial Year 2015-2016) with the overall program cost of USD 9.3 billion (Kapur & Deshpande (2018)). According to the guidelines, the toilets had to adhere to certain requirements. However, the state governments were given a free hand in the actual design and implementation since health is a state subject in India. This has led to a significant variation in the pace of success of this policy across states.

Government of India had conducted a baseline survey in 2012 to ascertain the number of households who did not have toilets. This survey provided the information subsequently for identifying the households which should be eligible for subsidy towards construction of IHHL. All the households below the poverty line (BPL) without an IHHL were eligible for this subsidy. Among the Above Poverty Line (APL) households, those belonging to Scheduled Caste, Scheduled Tribes, small and marginal farmers, landless laborers with homestead, physically handicapped and women headed households were also made eligible for the subsidy. The incentive amount provided under SBM to BPL and eligible APL households was up to INR 12,000 for construction of one unit of IHHL with water availability for handwashing and cleaning of the toilet.[14] This payment was given as a reimbursement in two

[13] According to Census 2011 of India, 92% of households without access to a toilet or latrine were rural. Similarly, IHDS reports that 90% of households practicing open defecation live in rural areas.

[14] The Centre-State split was 75%-25% (except for special North-Eastern and other special states such as Jammu & Kashmir).

equal installments. The first was disbursed when the household dug the pit and the second was given on completion of the complete structure.[15] Data from the MDWS shows that there has been a steady expansion of toilets since the start of the program in 2014. Consequently, the proportion of rural households having in-home toilets has increased from 44% in 2014 to 66% in 2016 and nearly 99 percent in 2019. There has been a 10 percentage point increase in household toilet construction every year since the program's launch in October 2014, a rate much higher than the previous years.

2.2 Validating Administrative Data

One of the critiques of the program has been that the number of toilets constructed under the program are over-reported and that the actual construction is much lower than that claimed by the government (Coffey & Spears (2018)). This critique especially gained momentum as the program drew to its end in 2019 when the target for 100% toilet coverage of households was to be attained by all districts. We compare the household toilet access proportion in 2015-16 from the administrative source to the toilet access statistics from National Family and Health Survey-4 (NFHS-4), a nationally representative survey of households conducted from January 2015 - December 2016. This allows us to ascertain the validity of the administrative data up to 2016, which is the time period of this study. Figure 2 shows the bin scatter plot for district level proportion of households having a toilet according to the administrative data in 2015-16 (fiscal year) and that reported by the households in NFHS survey 2015-16. We find a very high correlation between the reported toilet access in the administrative data and toilet ownership of households as reported in the household survey.[16] Based on this evidence, we are inclined to think that the administrative data is reliable atleast till 2016.

[15] Since the subsidy was made available only if the toilet was built, income changes driven outcomes are not likely to explain our finding.s

[16] The administrative data reports the proportion of toilets constructed till the end of the fiscal year (as on March 2016) whereas NFHS is conducted in a two year time span - 2015 and 2016 - with each state covered in a different time period. Hence, we do not expect perfect alignment.

2.3 Descriptive Evidence on Usage

Another widespread critique of increasing toilet access is that construction of toilets does not necessarily imply that open defecation will reduce because household behaviour may be enduring due to cultural beliefs and they may not take to using the toilets (Coffey & Spears (2017)). While there may not be a one to one relationship between toilet construction and reduction in open defecation, studies have found a substantial positive correlation between the two (Patil *et al.* (2014)). A number of surveys document high usage. The National Sample Survey Organization (NSSO) conducted a survey during May-June 2015 and found that 95% of rural households and 98% of urban households use a toilet, conditional on having it. This survey also shows that a higher percentage of women use it relative to men. Another independently conducted survey in Bihar, Madhya Pradesh, Rajasthan, and Uttar Pradesh between 2014-2018 reveals a 24 percentage point decline in open defecation during this period, largely on account of new toilet construction ((Gupta *et al.* (2019)).

The WASH Institute (Bill and Melinda Gates Foundation) and Sambodhi conducted a survey in 10 states in 2016 which too documents a high usage of toilets conditional on having one. In the survey, females in 88 percent of the rural households reported always using the toilet. More recently, the World Bank and the MDWS conducted the *The National Rural Sanitation Survey (NARSS)* during November 2018-February 2019, and found that 93.1% rural households had access to toilets. Among those with access, 96.5 percent used the facilities regularly. These surveys reveal two important points: One, usage of the in-home toilets may not be a 100 percent but it is reasonably high. Two, women use the in-home toilets much more than the men. Hence, toilets can be safety enhancing for women.

2.4 Research related to the SBM

The survey by WASH Institute and Sambodhi in 2016 inquired the reasons for toilet construction by a household. The proportion of households reporting various reasons is graphed in Figure 3. Majority of the households (58% and 53% of rural and urban households re-

spectively) decided to get a toilet constructed within the premises of the house due to safety concerns for women. The other salient reasons are control of spread of disease (reported by 37% households) and hygiene (by 25% households). The survey also inquires about the challenges faced by women when defecating. These challenges include sexually motivated offensive behaviors and crimes such as men peeping and flashing, women experiencing sexual assault or rape and eve teasing in the past one month.[17] We use this cross sectional data to estimate the probability of women facing these challenges when defecating. The dependent variable is a binary variable which takes the value 1 if a woman ever experienced a particular challenge in the past month and zero otherwise. Accounting for village/town fixed effects, open defecation is positively associated with the probability of facing these sexual assaults. The coefficients are plotted in Figure 4. A woman in a household with no toilet is 47 percent more likely to face peeping by men while defecating in comparison to a woman from a household with an in-home toilet. The corresponding numbers are 36 percent for flashing, and 32 percent for eve teasing. The probability of experiencing assaults or rape is 30 percent higher for the women defecating in the open. These estimates clearly bear out unsafe conditions for women while defecating in the open.

Currently, no study has evaluated the effect of the massive toilet construction program on outcomes. A few studies look at the factors which affect adoption of toilets under the scheme. Augsburg *et al.* (2019) examine whether provision of credit along with the subsidy can affect adoption of toilets by households. Chaturvedi *et al.* (2020) look at whether women politicians matter to provision of toilets across Gram Panchayats under the SBM policy. We use the variation generated by this program both temporally and spatially across Indian districts to identify causal impacts of access to in-home toilets on violent crimes of sexual nature against women.

[17] Eve teasing is euphemism used in South Asia for verbal or physical public sexual harassment or altercation.

3 Data

We combine several datasets to examine the effect of toilet construction on crimes against women outside their homes. Table 2 shows the summary statistics of all the variables constructed using these datasets. The description of datasets and the construction of variables is discussed below.

3.1 Crime

The crime data for the period of 2012 - 2016 are from the National Crime Records Bureau (NCRB), Ministry of Home Affairs.[18] NCRB data gives the number of reported crimes by district, year, and category of crime. It provides data for crimes at district level after aggregating them from all police stations. Crimes against women are reported separately under the following categories - rape, sexual assaults, insults (involves verbal attacks), domestic violence as cruelty by husband or other relatives, dowry deaths, kidnapping of girls and importation of girls from foreign countries.

Of all these crimes, sexual assaults constituted 25%, rape 11%, insults 3%, domestic violence 35% and dowry deaths 2% on average over the period of our analyses. The three category of crimes which are likely to be committed outside homes are rape, sexual assault and insult. Of these, verbal insults is a very small category and in this paper we focus only on sexual assaults and rapes. Note that these are reported crimes and in general there is under-reporting of gender based violence. We discuss the implications of this for our results in a later section.

[18] Crime data for 2017-18 has been made available recently by NCRB, however, given the empirical strategy in the paper we restrict our analyses to the initial two years of the program. By 2016, 25% of the districts had more than 90% households having a toilet and another 25% had toilet access between 70-90%. Thus, about half the districts had very high toilet access by 2016 due to differences in pace of construction in the initial years of the program and this is the variation we wish to exploit in the estimation strategy.

3.2 Toilets

The data on number of toilets constructed each year is obtained from the Ministry of Drinking Water and Sanitation (MDWS). The MDWS is the nodal ministry for the implementation of Swachh Bharat Mission in rural areas, which primarily involves construction of toilets in each household. The ministry provides district/block/gram panchayat level details of number of toilets constructed on its website.[19] In our paper, we use district level aggregate data on toilets since detailed crime data is only available at the district level.

As discussed earlier, there has clearly been an uptick in the toilets constructed since the program was launched towards the end of 2014 (Table 1). The proportion of households having toilets increased from 44% in 2014 to 66% in 2016 and further increased to 86% in 2017. There is considerable state level variation in adoption of the program post the launch of the scheme. The district level maps in Figure 1 clearly show the differential rates in adoption of toilets across the districts of India during 2013-2016. By 2017, most states had 90% household toilet coverage rate, except Bihar, Uttar Pradesh, Tripura, Odisha, Jharhand and Jammu & Kashmir.

3.3 Political and Voting Data

The detailed data for the local state level elections (legislative assembly elections) are from the Election Commission of India. These data are used to define the proportion of Members of Legislative Assembly (MLA's) in each state who are aligned with the national party which came to power in 2014, i.e. the Bharatiya Janata Party (BJP). We construct this variable by calculating the proportion of MLA's in each year who came to power by winning a close election and were aligned with BJP, of the total close elections. This proportion is calculated for the most recent, preceding state election. We use data on close elections at various margins of victory to look at the robustness of this instrument variable. We focus on close elections as the outcomes in such elections are less likely to be affected by local

[19]The data can be obtained from https://sbm.gov.in/sbmReport/Home.aspx

conditions.

3.4 Demographic Variables

The district level demographic characteristics that we use as controls come from the Population Census 2011. These include - total population and the ratio of adult male to female population in a district. We control for differential trends in crimes based on these initial level of demographic characteristics of the districts. [20]

3.5 Census Development Variables

We construct a variety of variables which capture the extent of economic development in a district using the data from Census 2011 - proportion of villages in a district having middle school, having a secondary school, having a senior secondary school, having a paved approach road, median distance of village (km) from the nearest town and proportion of villages where electricity is available for domestic use. These variables are highly correlated with each other and using a principal component analyses we construct an index of development which is used to control for trends in economic development starting at the pre-program levels of development. The first principal component obtained is defined as the development index. Trends in crime resulting from initial differences in the development index are controlled for. We also construct caste based population measures - proportion of population that is scheduled caste and proportion of population that is scheduled tribe - since regions with greater proportion of such castes are more backward and again control for trends in crime due to initial conditions.[21]

[20] These levels are interacted with year indicators to construct the trend.

[21] Scheduled Castes are the marginalized population groups historically facing discrimination.

3.6 Nightlights

The nighttime average luminosity data called VIIRS (Visible Infrared Imaging Radiometer Suite) Day/Night Band (DNB) popularly called 'nightlights' are produced by National Oceanic and Atmospheric Administration (NOAA). We obtained and processed this data for each year to construct year wise nightlight luminosity in each district. This variable is used to capture overtime development changes within a district that can possibly affect crimes.[22]

3.7 Police

The police force data is obtained from Bureau of Police Research and Development. The data is provided at the State level for each year. This is normalized by the population of each state in each year to arrive at the population served by each policeman. The reports also provide data on number of women police officers at State level. These data are used as controls in the robustness checks.

The district level panel data on crimes, toilet construction and other variables is collated for 2012-16. The first year of baseline administrative toilet data collection at district level was 2012 and as discussed earlier by 2016 half the districts had very high toilet access due to differences in pace of construction in the initial years of the program. Table 2 shows the descriptive statistics for each of the above variables used in the analyses. The mean number of *Assault* cases reported in a year, across districts of India are 103 while for rape it is 49. The reported incidence is higher for domestic violence at 178 reported incidents per-annum. The cases registered under *Attempts to Rape* and *Insults* are very small at 4.5 and 11 respectively. Among the other crimes, theft is the largest with mean reported incidents at 647. Each district has an average population of 1.9 million. On an average the number of males for each female is larger than one at 1.06, which reflects the skewed sex ratios in India. About 76% of population in India resides in rural areas. On an average there is one police officer for 739 people in India and there are about 5300 women police officers (this

[22] See Henderson *et al.* (2012) for details on how to use this data.

is approximately 6% of the total police force) over the period of analyses. Among the rural households 48% have an in-home toilet during 2012-2016. An outcome of close elections at 10% margin in any constituency was observed in 2809 district-year pairs. In India, assembly elections across states are held in different years and we use percentage close election winners aligned with BJP in a districts in the immediate preceding election for the state and interact it with a post program indicator for *SBM* to create our instrument. On an average BJP won in 24% of such close elections during 2012-16.

4 Identification Strategy

We take two approaches to identification. We first utilize the variation generated by the SBM in access to in-home toilets in a reduced form approach. We rely on a two way fixed effects approach analogous to differences-in differences strategy. We use a panel from 2012 to 2016 for our estimation as we have crime data for this period. Our reduced form estimation model is as follows:

$$Y_{it} = \alpha_o + \alpha_1 \ \left(\text{Proportion of Households with Toilets}\right)_{it} + \alpha_2 X_{it} + D_i + \tau_t + \epsilon_{it} \quad (1)$$

where Y_{it} is the count of either rape or assault in district i at time t. X_{it} are time varying district characteristics. D_i are the full set of district fixed effects and τ_t are the year fixed effects. α_1, the coefficient on proportion of households in district i in year t with in-home toilets, is our parameter of interest. Accounting for district fixed effects and year fixed effects allays concerns about time invariant unobserved district characteristics and year specific macro shocks confounding our results. Standard errors are clustered at the district level.

Since we are working with count data censored at zero, we use a Poisson model to estimate this empirical specification. We follow Sekhri & Storeygard (2014) and use a quasi-maximum

likelihood procedure to handle the incidental parameters problem.[23] Thus, the parameter α_1 can be interpreted as a semi-elasticity. We conduct a variety of robustness tests and control for several additional controls in alternative specifications. Our results are robust to linear empirical model instead of a Poisson and also to using crimes normalized by population as a dependent variable.

In order to address endogeneity of the toilets construction over time, we then resort to using an instrumental variable approach. In this approach, we use the proportion of local legislative assembly election winners (MLAs) in a given year who are aligned with the national government's political party (BJP) in closely contested elections, interacted with an indicator for the time period post the policy reform, as an instrument for the pace of toilet construction during initial years of the program. Asher & Novosad (2017) show that political alignment between state ruling party and MLA's can affect economic growth via channels of employment. They use nightlights data for measuring economic growth. However, our instrument is an interaction of alignment with BJP and post SBM implementation. The level effect of political alignment on crimes is thus netted out by controlling for overall political alignment with BJP in a district each year.

However, the exclusion restriction can be violated to the extent that the state ruling party becomes BJP in 2014 which is the national elections winning party in the same year thereby leading to a new alignment post 2014. We check whether our instrument affects economic growth captured through nightlights and find no evidence for it, thus ruling out a channel which violates the IV strategy. Nevertheless, to break this link between our instrument and economic growth, we control for nightlights in all our specifications using the instrumental variable approach. Our identifying assumption is that conditional on a measure of economic growth (nightlights), this party alignment post the implementation of SBM program affects sexual violent crimes against women only through construction of toilets. It is also plausible that the alignment affects public goods provision such as policing, transportation, and road

[23] They use the Hall *et al.* (1986) correction to transform their data.

connectivity that matter for crimes. As discussed earlier, we control for the absolute effect of political alignment on crimes, so any affect on crimes through public good provision via the channel of alignment can be ruled out. The possibility of any differential effect post the SBM, is addressed through inclusion of a number of additional controls for infrastructure and public goods. We also conduct a placebo test to rule out pre-existing trends in crimes in areas with political alignment in close elections with BJP.

Our empirical model is discussed below. The first stage is estimated as:

$$T_{it} = \beta_0 + \beta_1 \ \text{BJP}_{it} + \beta_2 \ \text{BJP}_{it} \ \times \ Post \ SBM_t + \beta_3 X_{it} + D_i + \tau_t + e_{it} \tag{2}$$

where T_{it} is the proportion of households with toilet in district i in year t. BJP_{it} is the share of BJP MLAs in the closely contested constituencies within a district i in year t.[24] D_i and τ_t are the district and year effects respectively. X_{it} are set of district-year level controls. $\text{BJP}_{it} \ \times \ Post \ SBM_t$ is the interaction of the BJP_{it} variable described above with an indicator post that takes the value one for years after the introduction of the SBM (2015 and 2016) and zero prior to that.

In the second stage, the proportion of households with in-home toilets is instrumented with the $BJP_{it} \ \times \ Post \ SBM_t$. The second stage model is:

$$Y_{it} = \gamma_0 + \gamma_1 T_{it} + \gamma_2 \text{BJP}_{it} + \gamma_3 X_{it} + D_i + \tau_t + \mu_{it} \tag{3}$$

where Y_{it} is the crime count and T_{it} is the proportion of households with toilet in district i in year t. We cluster the standard errors at the district level.

We use a control function approach to two stage instrumental variable strategy given our non-linear structural equation. In this approach, we control for the predicted value of the residual from the first stage regression in the second stage and estimate the second stage

[24] State Assembly constituencies completely nest within district boundaries.

using a transformed Poisson model using quasi-maximum likelihood method. We bootstrap the standard errors to take into account the two-step procedure and continue to cluster them at the district level. We also test the robustness to a linear empirical model instead of a Poisson (where the dependent variable is transformed to logs) and additionally to using crimes normalized by population as a dependent variable. These are discussed later in Section 5. All other variables are as described above.[25]

5 Results

We first report our reduced form results for rape and sexual assault in Table 3. Columns 2 and 4 control for additional district-year characteristics. These include the demographic characteristics, the index for development based on public goods availability, and nightlights. In our preferred specifications in columns 2 and 4 (with the above mentioned controls), we observe a negative and statistically significant coefficient for sexual assaults reported by women. The effect is negative and marginally significant for rape. The estimates imply that a change in the percentage of households with toilets by 10 percentage points would reduce sexual assaults by 2 percent, significant at the 5 percent level. We also find a 1.4 percent decline in rapes but this is not significant when all controls are included.[26]

We now discuss the instrumental variable estimates. The first stage results are reported in Table 4. Columns 1 and 4 limit the margin of close wins to ten percent votes, columns 2 and 5 to five percent votes, and 3 and 6 to one percent votes. In Columns 4-6, we control for the additional district-year characteristics and these are our preferred specifications. While the BJP indicator bears a negative sign and varies in precision across columns 4-6, proportion of BJP MLAs in close contests in the districts interacted with the post SBM indicator is

[25]To deal with the problem of crime count being 0 in some districts, we add 1 to the crime count and then take logs for such observations in the linear specification.

[26]In a Poisson Quasi Maximum Likelihood Regression, the marginal effects in terms of proportionate change in the dependent variable are obtained by calculating $exp(\beta)-1$, where β is the coefficient of interest. The marginal effects in Table 3 are for 100 percentage point changes and we multiply the coefficients by 0.1 to get the marginal effects for a 10 percentage point change.

positive and highly statistically significant across the board.

This positive relation is also robust to including Asher & Novosad (2017) measure of economic growth – nightlights.[27] We also report the F-statistics from the first stage regression and it is always large enough to rule out weak instruments problem. The results in the table clearly bear out that the alignment of the local MLAs with the national government's political party that launched the *SBM* program is highly correlated with increase in access to toilets, but only after the program is announced. It is only post SBM that the BJP emphasis on toilet construction changes because of the big push by the Prime Minister. As noted before, we restrict our sample to close elections because in such elections the determination of the winner is less likely to be correlated with local conditions. Our sample size changes in this table because of different winning margins used.[28]

The second stage is reported for the ten percent margin in Table 5. Panel A reports the results for sexual assaults and Panel B reports it for rapes. Column 1 in both the panels shows the results from the control function approach with crimes in each category as the dependent variable. In column 1, we observe a negative and statistically significant (at 1 percent significance level) coefficient of magnitude -1.2 for sexual assaults. This is a reduction of 7 percent assaults for a 10 percentage point increase in proportion of households with toilets.[29] In terms of elasticity, this implies that a 25 percent increase in toilets leads to a fall in sexual assaults by 7 percent. These estimates are larger than the reduced form estimates. Between 2014 and 2016, percentage households having toilets increased by 22 percentage point in India. This implies a 15 percent reduction in sexual assaults against women due to construction of toilets during this period.

Column 2 reports the results from a log-linear specification where the dependent variable

[27] While Asher & Novosad (2017) rely on village level data in a regression discontinuity design framework, we do not have crimes data at the village level and hence use district level analysis.

[28] We have enough power because 2014 and following years were unexpectedly dominated by the BJP in the Indian elections.

[29] The marginal effect in terms of proportionate change in the dependent variable is given by 70 percent, for 100 percentage point change in toilets. We multiply the coefficients by 0.1 to get the marginal effects for a 10 percentage point change.

is log of crimes and a linear IV-2SLS estimation is used. The linear estimates show that a 10 percentage point increase (or 25 percent increase) in toilets leads to a fall in sexual assaults on women by 8.5%. The magnitude is comparable to the previously discussed control function estimate and is statistically significant at conventional levels of significance. In column 3, the dependent variable is crimes per million women and a linear IV-2SLS specification is used for estimation. Here we find that a 10 percentage point (or a 25 percent increase) increase in proportion of households having a toilet decreases sexual assaults by 12.7 cases per million women. Lastly, in column 4 we show the estimates from a specification controlling for state-specific time trends and the dependent variable as crimes per million women. These also continue to indicate a statistically significant reduction in assaults by 62 incidents per million women for a 10 percentage point increase in toilet access.

Panel B reports the estimates from analogous specifications for reported rape. Both the control function (column 1) and the linear IV approach across different dependent variables (columns 2 and 3) yield a positive and significant coefficient in contrast to the reduced form estimates reported in columns 3 and 4 of Table 3. On controlling for the state-specific trends in our IV specification, the estimate reported in column 4, Panel B of Table 5 for rape, changes sign (from positive to negative) and is not significant any longer. Clearly, rape coefficient is not stable across specifications.

From this analysis we conclude two things. One, increase in access to in-home toilets led to a significant decline in sexual assault but we do not discern any consistent effects for rape and two, there does not appear to be a substitution across violent sexual crimes against women. We observe a reduction in assault but not in rape. During this period, rape laws had been changing and reporting was increasing substantially (See Figure A1). It is plausible that incidence of rape did not fall enough to offset the increase in reporting whereas it did for assault. Our data does not allow us to parse this out. Hence, with our data we cannot conclusively rule out effects on rape though we do not discern consistent changes in reported rapes. We do however check the robustness of our results later to excluding years

when overall reporting trend was on the rise (2012, 2013).

6 Heterogeneity

Large scale toilet construction under the SBM was a rural phenomenon. Hence, we evaluate whether our results vary by rural nature of the districts. Rural is defined as proportion of population in a district that resides in rural areas (Census 2011). The results are documented in Table 6. In column 1, we observe that the results are driven by the rural areas. The large negative coefficient for the interaction of proportion of households with toilets and rural population share is statistically significant at the 1 percent significance level.[30]

Another dimension of heterogeneity that we explore is by comparison of North and South states. States in the Southern part of India are relatively richer and progressive.[31] In columns 2 , we report the rural-urban difference for the Northern states of India. The F-Stat is large and statistically significant for the Northern States but not for the South. Consequently, the rural coefficient is large, negative, and statistically significant for the northern states. While it is negative and large for the Southern states, it is imprecisely measured (estimates omitted for brevity). From these findings, we infer that the program was successful in reducing assault on women in rural areas and was driven by toilet construction in the North Indian states.

In column 3, we show that the reduction in assault occurred in districts with smaller population shares of scheduled caste and tribes population.[32] Finally, we also shed light on how the toilet construction effect varies by level of development. In column 4, we show the interaction effect with the development index of the districts. The effects are concentrated in less developed areas as opposed to more developed ones. In Figure 5, we plot the

[30] Slums in urban areas and peri-urban settlements have a much higher degree of crime incidence and very high population density in India plausibly explaining the positive urban effect.

[31] Southern states include Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Kerala, Goa and Puducherry.

[32] Scheduled castes are historically marginalized population group in India who face discrimination in many domains of life. However, women in SC and ST households have been shown to have greater autonomy (Eswaran *et al.* (2013)).

marginal effects by the development index.[33] Largest reduction in assault happens in the least developed areas. Hence, poor areas of India see a decline in assaults.

7 Discussion

7.1 IV Validity

As mentioned earlier, one concern with the instrumental variable may be that political party affiliation can affect other economic outcomes. However, this concern is minimal in our case since the instrument is an interaction of political affiliation with BJP with an year indicator for post program launch in 2015-16. Any level effect on economic outcomes due to BJP affiliation is controlled for by including political affiliation of state legislative members with BJP in all the regressions. Moreover, we use close elections to construct our instrument. Second, Asher & Novosad (2017) find a substantial effect of state political party affiliation in close elections on economic growth using data on nightlights. While we control for nightlights, there is still a possibility that we may miss out on other economic growth variables. To check this, we estimate the effect of our instrumental variable on nightlights in a reduced form setting. Table A1, column 1, reports the results from this estimation. However, we see no effect of our instrument (BJP $\times$ Post SBM) on nightlights, alleviating such a concern.

We also rule out that that BJP influenced incidence of riots in areas where it came to power post 2014 in close elections to promote its political agenda. Hence, a change in sexual assaults is not likely to be a spill over of such incidents. Our instrumental variable results are reported in column 2 of Table A1. We find no direct effect of our instrument (BJP $\times$ Post SBM) on riots during this period.[34] We also estimate the effect of toilet construction on

[33] The positive coefficient in the developed areas is not significant for most of the support. Whereas the negative coefficient for the less developed areas is negative and significant over the entire range of the support.

[34] The coefficient on affiliation to close election winning legislative members to *BJP* itself is negative. This is suggestive that in closely contested areas the party follows a more centrist political ideology.

riots using a linear IV model and report the results in column 3 of Table A1. This confirms our previous results.

Lastly, we undertake a placebo test to show that the IV estimates are not driven by pre-existing trends. We use the crimes data for 2012-2014, when the program was not in place and merge with toilet construction and electoral data from 2014-2016. We then use our instrumental variable strategy to estimate the impact of toilets on sexual assaults that occured in the period prior to policy change. The results are reported in Table A2 for both the linear IV (column 1) and the control function approach (column 2) and show that there was no significant negative effect of toilet construction on assaults during the placebo period. This further supports the validty of our identification strategy.

7.2 Mechanism

We modify our baseline specification for assaults to rule out other mechanisms affecting sexual assaults during this period. If BJP increased policing intensity to crack down on crimes after forming the federal government in 2014, our exclusion restriction would be invalidated. Three facts cast doubt on this possibility: one, in our additional robustness tests reported in Table 7, we vary our specification on four dimensions and find the results stable across these. In column 1, we conduct a sensitivity analysis excluding insurgency affected states in the North-East and Jammu and Kashmir. Since these states have political unrest, crime incidence and reporting in these areas could have been very different here subsequent to the BJP (with a strong nationalist ideology) forming the federal government. Then, we control for state level overall police numbers and women police numbers, in our control function IV estimates (specification analogous to column 1 of Table 5). We find that our results remain very similar across these specifications (column 1, 2 and 3 of Table 7) to that in column 1, Panel A of Table 5 for assaults. Controlling for total crimes as a measure of lawlessness, in column 4, we still see a comparable negative and statistically significant estimate.

Two, in Table 6, we reported that our results vary by rural and urban living conditions of the districts. The results are driven by rural areas while urbanization is a positive correlate of crimes. Three, other crimes such as domestic violence (Table 8), theft, kidnapping, and murder (Table A3) do not exhibit any systematic changes with toilet construction and are not consistently significant or negative in different specifications.[35] Increased policing or crackdown on crimes would have born out in these crimes as well. These facts cast doubt on this alternative hypothesis.

As an additional robustness check, we adjust the inference to account for multiple hypothesis testing. The results in Table 8 show effects of toilet construction for various crimes against women - sexual assaults, rapes, and domestic violence. Since we have multiple dependent variables, we calculate (False Discovery Rate) FDR-q values which adjust for proportion of rejections that are "false discoveries" (Anderson (2008)). The statistically significant negative effect of toilet construction on assaults continues to be statistically significant at the conventional levels of significance after this adjustment is made in our non-linear as well as linear estimation procedures (Panel A and B, Table 8). Note that rape has a positive coefficient and is also significant here. However, as shown in Column 4, Panel B of Table 5, it flips signs and becomes insignificant when we account for state trends unlike for sexual assaults reported in column 4, Panel A of that table. Therefore, we infer that there are no consistent effects on rape. Similarly, for regressions on other crimes in Table A3 we report the FDR-q values. While kidnapping bears a positive and significant coefficient in the linear estimates, it is not robust across specifications (Panel A). Theft and murder are insignificant too.

Yet another concern might be that the BJP launched other programs which confound our results. The other flagship policy launched by the government which received a significant push by the PM was the distribution of subsidized LPG connections to women in households below poverty line through *Ujjwala scheme*. This was launched in May 2016, almost at the

[35]Having an in-house toilet can result in decrease in theft and domestic violence if women stay at home for longer (thus able to deter thieves and spend time on chores whose completion reduces conflict at home.)

end of the period of consideration in our study from 2012-2016.

7.3 Reporting Bias

Our crimes data is from the crimes reported to the police. Crimes against women tend to be under-reported. One concern with the interpretation of our results could be that crime incidence has not changed, rather reporting of assaults has gone down. There are several reasons which cast doubt on this as a driving mechanism:

- During this time in India, there was a significant increase in reporting in crimes against women. An infamous gang rape in 2012 was extensively covered by the media and led to widespread protests in India.[36] This led to a surge in reporting of sexual crimes against women (see trends for rape and assault in Figure A1). Against this backdrop, it is unlikely that reporting of assault reduced selectively in areas getting more toilets. In Table A4 and Table A5, we ensure that excluding these years that see an increased trend in reporting does not alter our findings. Estimates of impact of toilet construction on assaults against women are similar if we exclude 2012 or 2012 and 2013 (columns 1 and 2). The sign and the magnitude of the rape coefficient does not change. However, it is significant on excluding 2012 and 2013 whereas it is insignificant if we only exclude 2012. This further substantiates the fact that results for assaults are very robust and being generated by toilet construction unlike rape.

- In addition, in Table 6 we document that the effect varies along several dimensions: rural population shares, baseline development of districts, and share of scheduled castes. If reporting were to be driving our results, reporting would have to systematically change along these various dimensions which are consistent with reduction in assault due to building of more toilets in northern rural less developed areas.

- In order to consistently explain our instrumental variable framework results, reporting

[36] Source: Harvard Kennedy School

changes would also have to occur systematically in closely contested elections of state assemblies where BJP politician was the winner, in years after 2014.

- Finally, in Tables 8 and A3, we show that other crimes do not systematically reduce.

Given these arguments, we believe our findings disfavor reporting changes as an explanation of our results.

8 Conclusion

Our findings demonstrate that access to in-home toilets leads to a reduction in sexual assault of women. Our estimates imply that reported incidents of sexual assaults against women fell by 25 incidents per million women due to construction of toilets during 2014-16. Access to sanitation facilities is promoted because of its impact on health and human capital, but we show that it also has a crucial safety enhancing impact on women. Sexual assaults are costly not only for women but also for the society as they escalate health care and policing costs. Policy evaluations examining costs and benefits of toilet construction programs underestimate the benefits of such programs by overlooking this important yet under researched benefit accruing to women.

Prior research shows that there is a complementarity in access to water and sanitation in improving health (Duflo *et al.* (2015); Alsan & Goldin (2019)). Sekhri & Hossain (2019) establishes that water shortages increase rape of women in India. Thus, an avenue of future research is to examine if such complementarities between water and sanitation access also exist for abating sexual crimes against women.

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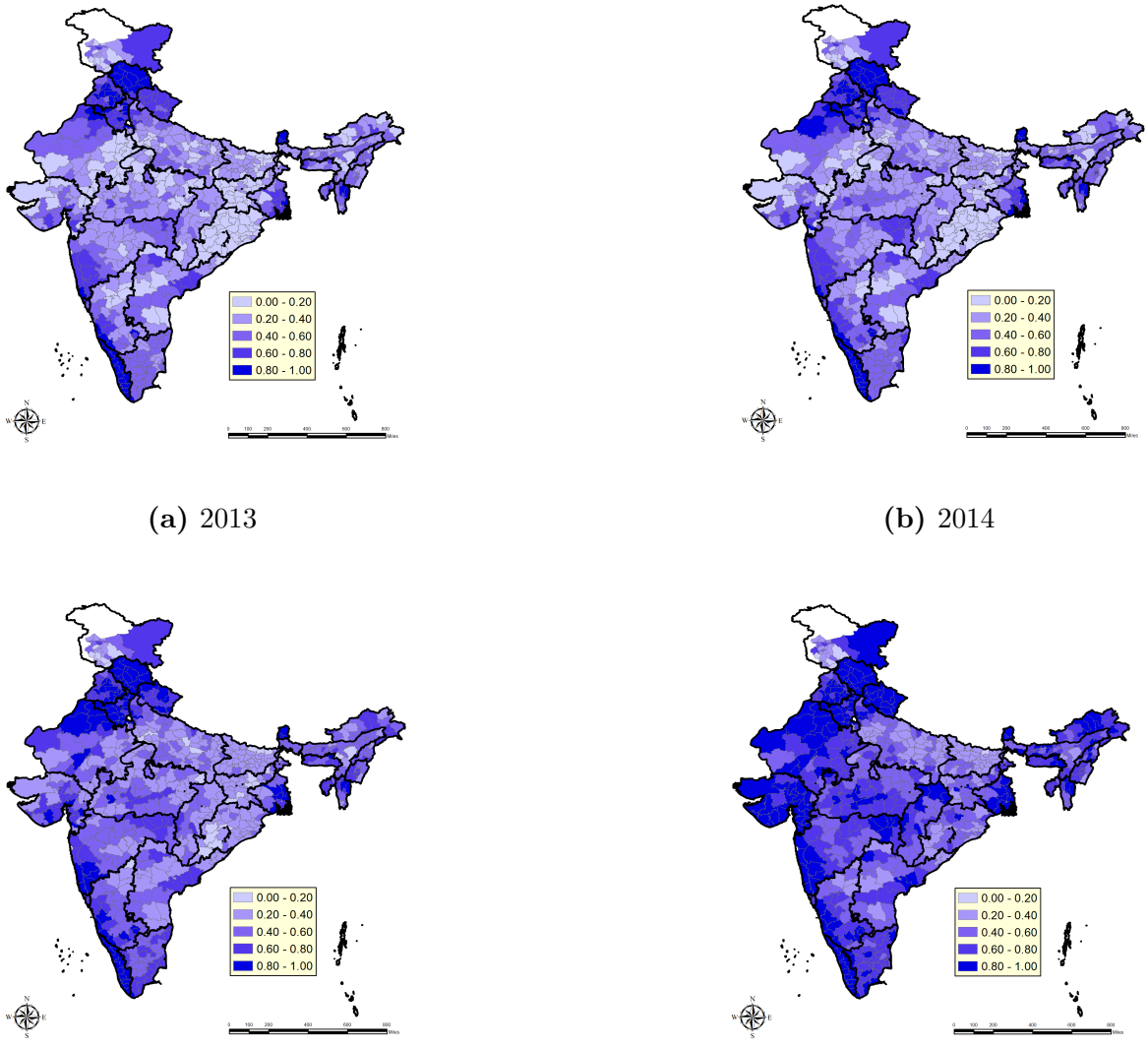
Figure 1: Proportion of rural households having a toilet

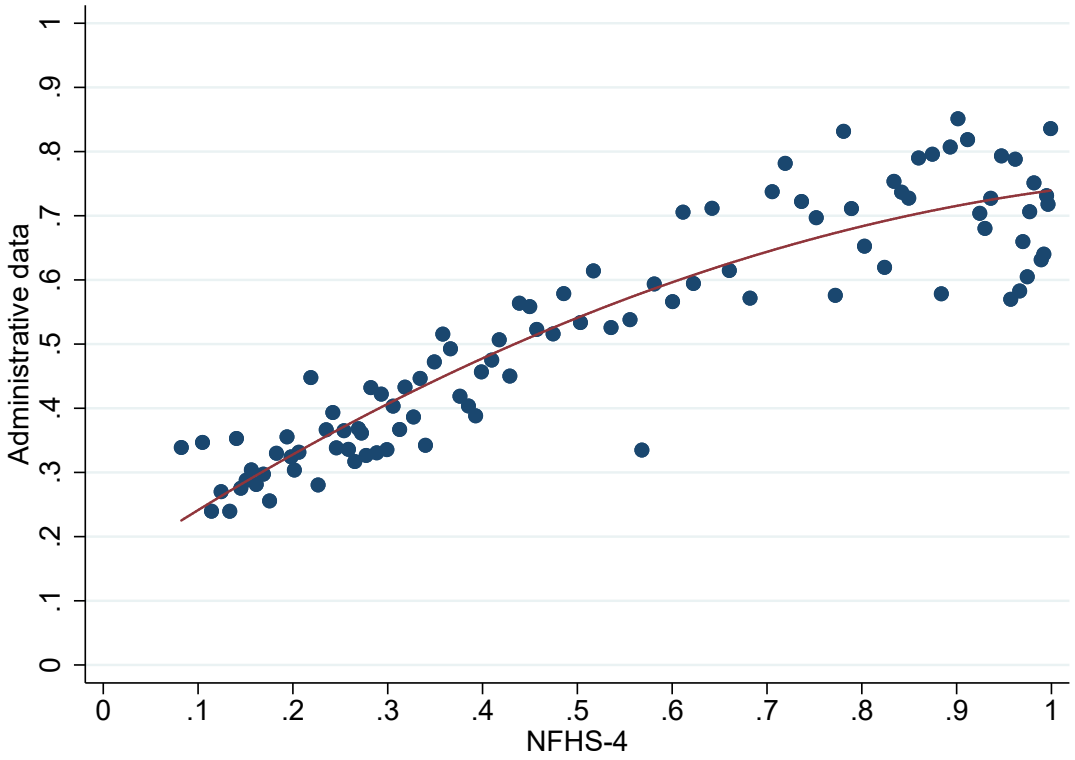


(a) 2013 **(b)** 2014

(c) 2015 **(d)** 2016

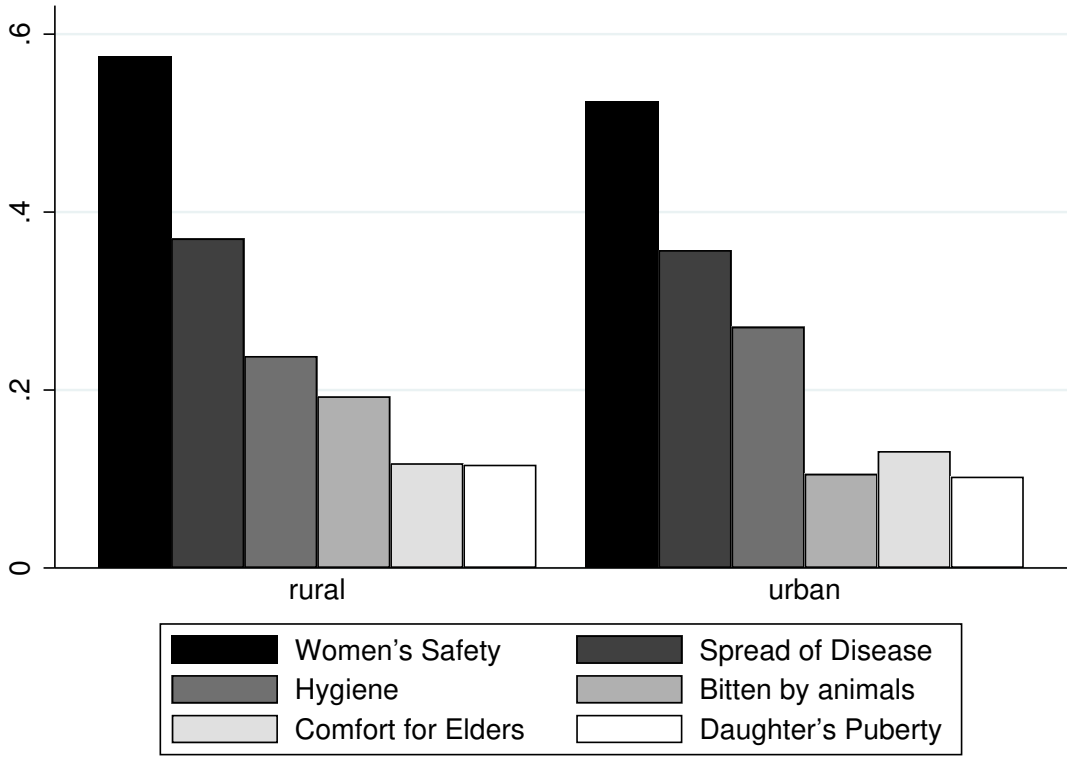
Source: Ministry of Drinking Water and Sanitation (MDWS), India

Figure 2: Percentage Households Having Toilet: Administrative Data versus Survey Data (2015-16)



Source: Ministry of Drinking Water and Sanitation (MDWS), India for administrative toilet data and National Family Health Survey (NFHS)-4 (2015-16) for sanitation survey data.
Note: The figure plots the proportion of households having a toilet in the administrative data (March 2016) and the proportion of households having a toilet in the NFHS survey data for the same district. A quadratic relationship between the two is fitted in the graph. The districts are grouped together using a bin-scatter for easy interpretation.

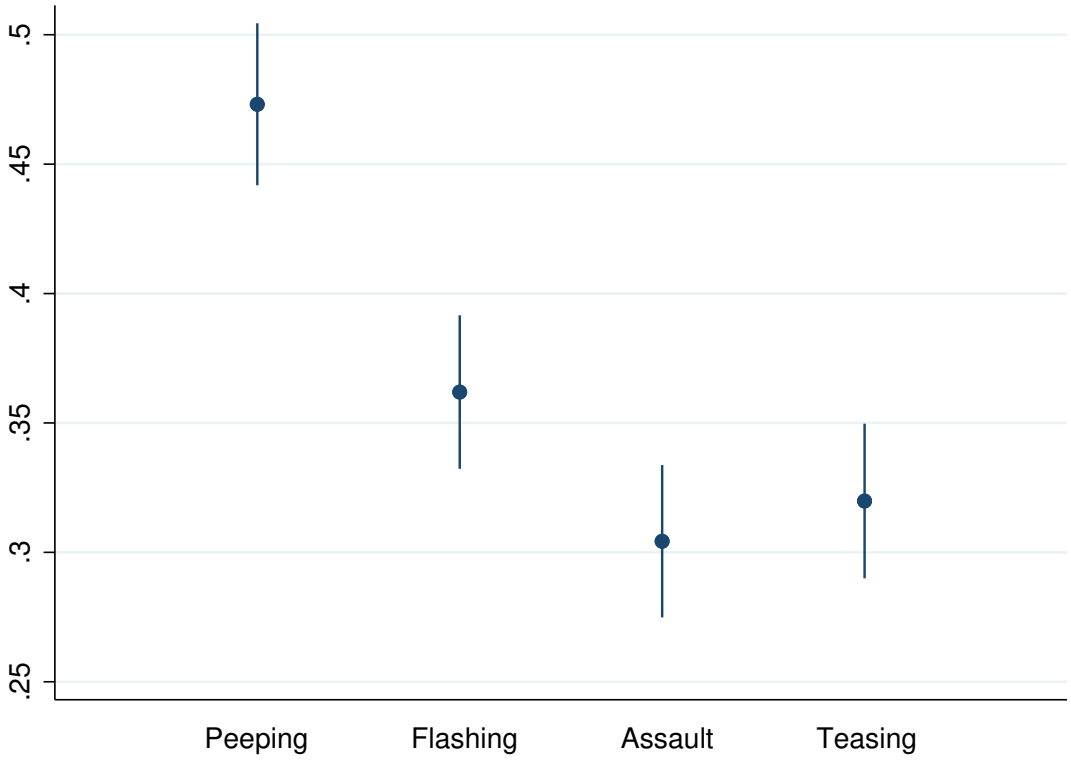
Figure 3: Reasons for Toilet Construction



Source: Rapid Survey on Gender Norms and Sanitation and Hygiene, and Implications by life-stage conducted by WASH Institute and Sambodhi, 2016

Note: The survey asks the respondents whether their house has a toilet and what were the reasons for constructing it. The graph plots the proportion of households reporting the stated reason for toilet construction. A household can report more than one reason.

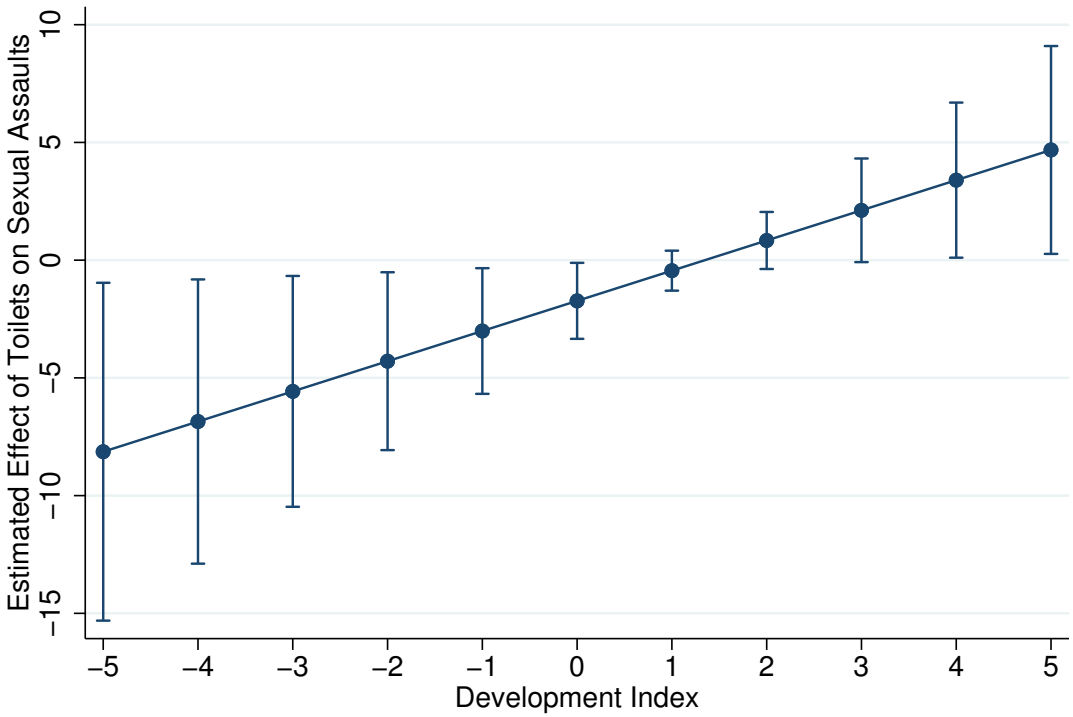
Figure 4: Challenges Faced by Women: Effect of Not Having an in-Home Toilet



Source: Rapid Survey on Gender Norms and Sanitation and Hygiene, and Implications by life-stage conducted by WASH Institute and Sambodhi, 2016

Note: *Peeping* refers to boys peeping, *Flashing* refers to men flashing, *Assault* refers to sexual assault or rape and *Teasing* refers to eve teasing. Whether a woman experienced each of the above episodes while defecating is regressed on the absence of in home toilet in the household and village/town fixed effects. The figure plots the coefficients along with the 95% confidence interval from this regression.

Figure 5: Heterogeneity in Marginal Effects of Toilets on Sexual Assaults: Development Index



Note: The figure plots the marginal effects from Table 6 column (4) for different values of the development index.

Table 1: Expansion in Toilets across Indian States over Time

	2012	2013	2014	2015	2016	2017
Andhra Pradesh	41%	44%	47%	52%	63%	94%
Arunachal Pradesh	33%	42%	49%	59%	82%	104%
Assam	38%	41%	44%	52%	73%	88%
Bihar	25%	26%	27%	30%	36%	58%
Chhattisgarh	31%	32%	33%	41%	71%	100%
Gujarat	35%	38%	45%	63%	93%	101%
Haryana	73%	75%	79%	83%	88%	100%
Himachal Pradesh	86%	86%	90%	94%	100%	100%
Jammu & Kashmir	23%	28%	29%	33%	39%	79%
Jharkhand	15%	17%	20%	28%	48%	79%
Karnataka	35%	43%	54%	61%	71%	92%
Kerala	95%	95%	96%	96%	100%	100%
Madhya Pradesh	28%	34%	40%	51%	71%	97%
Maharashtra	45%	50%	55%	63%	80%	101%
Manipur	43%	51%	57%	68%	77%	91%
Meghalaya	49%	56%	66%	76%	86%	106%
Mizoram	60%	64%	64%	69%	72%	92%
Nagaland	49%	57%	57%	65%	80%	88%
Odisha	12%	12%	14%	31%	47%	57%
Punjab	75%	75%	75%	78%	82%	84%
Rajasthan	24%	27%	34%	54%	80%	101%
Sikkim	84%	87%	93%	100%	100%	100%
Tamil Nadu	46%	49%	53%	63%	75%	99%
Telangana	27%	32%	35%	40%	53%	89%
Tripura	52%	53%	57%	67%	74%	79%
Uttar Pradesh	31%	34%	36%	39%	46%	68%
Uttarakhand	67%	67%	70%	75%	97%	99%
West Bengal	51%	56%	62%	72%	90%	97%
India	37%	41%	44%	52%	66%	86%

Source: Ministry of Drinking Water and Sanitation (MDWS), India

Note: The table shows the proportion of households having toilets in rural India.

Table 2: Summary Statistics

	Observations	Mean	Std. Dev.	Min.	Max.
Number of reported crimes					
Rape	3025	49.01	48.91	0	511
Assault	3025	103.45	122.75	0	1213
Domestic violence	3025	178.22	282.01	0	3599
Attempt to rape	3025	4.49	18.77	0	389
Insults to women	3025	10.95	37.89	0	750
Theft	3025	647.49	1,076.67	0	14064
Kidnapping	3025	99.14	119.63	0	1439
Murder	3025	49.08	42.09	0	356
District level demographics in 2011 (unweighted)					
Total population	608	1,902,610	1,523,840	8,004	11,100,000
Male/Female population	608	1.06	0.06	0.88	1.45
% SC population	605	0.16	0.10	0	0.53
% ST population	605	0.20	0.29	0	0.99
Development Index	599	0.01	1.60	-5.46	5.18
% Rural population	608	0.76	0.17	0	1.00
Variables varying over time					
Nightlight luminosity	3025	13.62	17.05	0	255
Police Intensity (population per police officer)	3025	738.54	351.89	95	1468
Women Police	3025	5300.60	4934.80	164	26208
Percentage rural households having toilet	3025	0.48	0.26	0	1
Close elections won by BJP (10% margin)	2809	0.24	0.33	0	1

Source: NCRB (crime data), MDWS (toilet construction), Census 2011 (demographic and census controls), NOAA/NCEI (nightlights), Bureau of Police Research and Development (Police)

Table 3: Reduced Form Estimates: Toilet Construction and Sexual Assaults/Rapes (Quasi Maximum Likelihood Estimates)

	(1) Assault	(2) Assault	(3) Rape	(4) Rape
HH Toilet proportion	-0.231*	-0.248**	-0.183**	-0.151
	(0.122)	(0.120)	(0.091)	(0.094)
Observations	3,025	2,980	3,025	2,980
Base Controls				
Demographic		✓		✓
Census		✓		✓
Nightlights		✓		✓

Notes: The dependent variable is the number of reported rapes and sexual assaults in a district-year. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. Quasi-maximum likelihood estimates with district and year fixed effects. Demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: First-Stage Regression Results for the Instrumental Variable Estimates

	(1) HH Toilet proportion	(2) HH Toilet proportion	(3) HH Toilet proportion	(4) HH Toilet proportion	(5) HH Toilet proportion	(6) HH Toilet proportion
	10%	5%	1%	10%	5%	1%
BJP ×Post SBM	0.124***	0.095***	0.066**	0.132***	0.100***	0.063**
	(0.018)	(0.019)	(0.041)	(0.017)	(0.019)	(0.041)
BJP	-0.034**	-0.048***	-0.048	-0.027**	-0.043***	-0.058
	(0.014)	(0.015)	(0.050)	(0.014)	(0.015)	(0.055)
Constant	0.397***	0.402***	0.428***	0.398***	0.403***	0.428***
	(0.004)	(0.004)	(0.008)	(0.004)	(0.006)	(0.013)
Observations	2,809	2,431	981	2,764	2,390	965
Base controls				✓	✓	✓

Notes: The dependant variable, HH Toilet Proportion, measures the proportion of households having a toilet in a district. BJP is the proportion of close elections which BJP won in the most recent preceding state election in a district-year. PostSBM=1 for years 2015 and 2016. The instrumental variables vary in the bandwidth used to define close elections and the bandwidth is mentioned in each column heading. These are linear estimates with district and year fixed effects. *Base controls* include - Demographic, Census and Nightlights. Demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Instrumental Variable Estimates: Effect of Toilet Construction on Rapes & Sexual Assaults

	(1) 10%	(2) 10%	(3) 10%	(4) 10%
Dependent variable	Crimes	log(Crimes)	Crimes per million women	Crimes per million women
			Panel A: Assault	
HH Toilet proportion	-1.209***	-0.895*	-127.982**	-621.263**
	(0.405)	(0.468)	(53.566)	(302.235)
BJP	0.107	0.104	23.163***	2.823
	(0.073)	(0.0967)	(8.557)	(10.518)
			Panel B: Rape	
HH Toilet proportion	0.764**	1.319***	77.170***	-16.733
	(0.384)	(0.404)	(27.286)	(120.325)
BJP	0.007	0.0464	4.378	2.273
	(0.046)	(0.0478)	(3.485)	(4.051)
Observations	2,764	2,764	2,764	2,764
F-Stat	73.26	73.26	73.26	7.425
Specification	CF	Linear-IV	Linear-IV	Linear-IV
Base controls	✓	✓	✓	✓
State time trends				✓

Notes: The dependent variable is the number of reported sexual assaults and rapes in a district-year in control function approach in column (1) and log of total number of crimes in Linear-IV approach in column (2). In columns (3) and (4) the dependent variable is reported crimes per million women in a district-year. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. All specifications include district and year fixed effects, demographic controls of district population and male-female ratio and census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. The Control function method with state time trends does not converge, hence linear estimates are shown for this specification. F-Stat is for the excluded IV in the first stage. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: Instrumental Variable Estimates: Heterogeneity in the Effect of Toilet Construction on Sexual Assaults (Linear-IV Estimates)

X=	(1) Assault Rural 10%	(2) Assault Rural 10%	(3) Assault SC-ST 10%	(4) Assault Devt Index 10%
HH Toilet proportion	7.102**	4.087	-1.760*	-1.728**
	(2.855)	(3.100)	(0.949)	(0.828)
HH Toilet proportion*X	-11.06***	-10.05**	2.378	1.282**
	(4.209)	(4.721)	(1.829)	(0.589)
BJP	-0.258	-0.818	0.409**	0.049
	(0.675)	(0.841)	(0.198)	(0.107)
BJP*X	0.519	1.021	-0.912*	0.146**
	(0.864)	(1.080)	(0.471)	(0.073)
X*Post SBM	2.028***	1.099	-0.955*	-0.344**
	(0.700)	(0.851)	(0.571)	(0.137)
Observations	2,764	1,687	2,764	2,764
F-Stat	16.58	9.685	18.99	6.422
Specification	All States	North States	All States	All States
Base controls	✓	✓	✓	✓

Notes: The dependent variable is the log of number of reported rapes and sexual assaults in a district-year. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. F-Stat is the weak identification Wald F-Stat for the excluded IV's in the first stage. Linear estimates are shown since they are more straightforward than control-function approach with two endogenous variables. In the second column we drop the north-eastern states and J & K and all states below Deccan namely, Andhra Pradesh, Karnataka, Maharashtra, Tamil Nadu, Kerala, Goa and Puducherry. Rural is defined as proportion of population in a district that resides in rural areas (Census 2011). Devt. Index is the Index of village level census variables generated using principal component analyses. SC-ST is the proportion of population in a district which is Scheduled Caste or Scheduled Tribe. All specifications include district and year fixed effects, demographic controls of district population and male-female ratio and census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Instrumental Variable Estimates: Effect of Toilet Construction on Sexual Assaults (Control Function Estimates, Robustness Checks)

	(1) Assault 10%	(2) Assault 10%	(3) Assault 10%	(4) Assault 10%
HH Toilet proportion	-1.840***	-1.497***	-1.241***	-1.018**
	(0.577)	(0.423)	(0.399)	(0.401)
BJP	0.084	0.116	0.071	0.061
	(0.076)	(0.073)	(0.071)	(0.071)
Observations	2,402	2,764	2,764	2,764
F-Stat	41.49	74.36	70.57	73.58
Specification	Restricted sample	Police Intensity Control	Women Police Control	Other Crimes Control
Base controls	✓	✓	✓	✓

Notes: The dependent variable is the number of reported rapes and sexual assaults in a district-year. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. F-Stat is for the excluded IV in the first stage. In the restricted sample states in the North East and JK are dropped. Police Intensity is measured by total population per policeman in the state. Women police force is measured as total women in the police force in a state. Other crimes include theft, kidnapping and murder in a district-year. All specifications include district fixed and year fixed effects, and demographic controls of district population and male-female ratio and census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: Crimes Against Women: Multiple Hypothesis Testing

Panel A: Control Function Estimates				
	Effect	Original p-value	FDR q value	Observations
Outcome				
Assault	-1.209	0.003	0.009	2,764
Rape	0.764	0.047	0.07	2,764
Domestic violence	-0.62	0.099	0.099	2,764
Panel B: Linear-IV Estimates				
	Effect	Original p-value	FDR q value	Observations
Outcome				
Assault	-0.895	0.056	0.085	2,764
Rape	1.319	0.001	0.004	2,764
Domestic violence	-0.125	0.815	0.816	2,764

Notes: The dependent variable is the reported number of crimes in Control Function estimates and log of number of reported crimes in the Linear specification, in a district-year. The explanatory variable whose effect is shown is the proportion of households having a toilet in a district-year. All specifications include district fixed and year fixed effects, demographic controls of district population and male-female ratio and census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. The original p-values correspond to clustered standard errors (at district level) and the FDR q-values are calculated according to the procedure described in Anderson (2008).

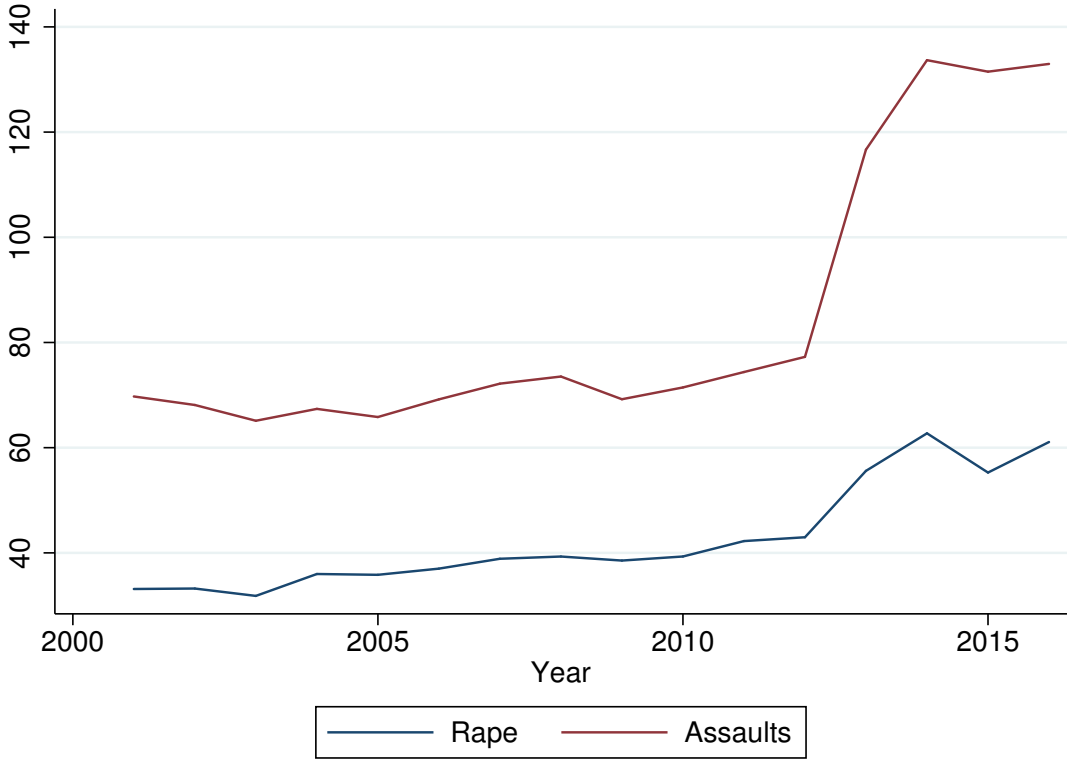
Table 9: Instrumental Variable Estimates: Effect of Toilet Construction on all Crimes against Women outside home (Control Function Estimates)

	(1) CAW 1 Outside home 10%	(2) CAW 2 Outside home 10%
HH Toilet proportion	-0.827**	-0.845**
	(0.325)	(0.340)
BJP	0.068	0.012
	(0.053)	(0.055)
Observations	2,764	2,764
Base controls	✓	✓

Notes: The dependent variable CAW 1 is the number of reported crimes of rape, sexual assaults and attempts to rape in a district-year. The dependent variable CAW 2 adds reported number of Insults towards women to the CAW 1. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. All specifications include district fixed and year fixed effects, demographic controls of district population and male-female ratio and census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

ONLINE APPENDIX

Figure A1: Crimes against women: Rapes and Sexual Assaults



Source: NCRB

Note: The figure plots total number of rape and sexual assaults reported in India per one million Indian women.

Table A1: IV Validity

	(1) Nightlights	(2) Riots	(3) Riots
BJP × Post SBM	-0.459	0.026	
	(1.281)	(0.070)	
BJP	0.700	-0.146*	-0.140*
	(1.740)	(0.078)	(0.077)
HH Toilet proportion			0.196
			(0.537)
Observations	2764	2764	2764
Specification	Linear-RF	Linear-RF	Linear-IV
Base controls	✓	✓	✓

Notes: The dependent variable is nightlight luminosity in column (1), the log of number of reported riots in columns (2) and (3) in a district-year. Column (1) and (2) look at the impact of the instrumental variable (BJP × Post SBM) on nightlights and riots. Column (3) shows the IV estimate of impact of toilet construction on riots. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. All specifications include district and year fixed effects, demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A2: Instrumental Variable Estimates (Placebo): Effect of Toilet Construction on Sexual Assaults)

	(1) Assault	(2) Assault
HH Toilet proportion	0.571	0.558
	(0.737)	(0.707)
BJP	-0.414	-0.991
	(0.527)	(0.631)
Observations	1789	1789
FStat	59.3	59.3
Specification	Linear-IV	CF
Base controls	✓	✓

Notes: The dependent variable is the number of reported sexual assaults in a district-year in CF approach and the log of crimes in Linear-IV approach. The explanatory variable HH Toilet Proportion measures the proportion of households having a toilet in a district-year. Linear estimates in column (1) refer to linear IV estimates and CF estimates in column (2) refer to Quasi-maximum likelihood estimates. All specifications include district and year fixed effects, demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A3: Other Crimes: Multiple Hypothesis Testing

Panel A: Control Function Estimates				
	Effect	Original p-value	FDR q value	Observations
Outcome				
Theft	-0.531	0.06	0.181	2,764
Kidnapping	0.104	0.831	0.832	2,764
Murder	0.082	0.678	0.832	2,764
Panel B: Linear-IV Estimates				
	Effect	Original p-value	FDR q value	Observations
Outcome				
Theft	-0.110	0.65	0.66	2,764
Kidnapping	1.843	0.001	0.005	2,764
Murder	0.101	0.66	0.66	2,764

Notes: The dependent variable is the reported number of crimes in Control Function estimates and log of number of reported crimes in the Linear-IV specification, in a district-year. Theft includes incidences of theft, burglary and robbery. Kidnapping refers to abduction crimes. The explanatory variable whose effect is shown is the proportion of households having a toilet in a district-year. All specifications include district fixed and year fixed effects, demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. The original p-values correspond to clustered standard errors (at district level) and the FDR q-values are calculated according to the procedure described in Anderson (2008).

Table A4: IV Estimates (Control Function, Excluding Years)

	(1) Assault 10%	(2) Assault 10%	(3) Rape 10%	(4) Rape 10%
HH Toilet proportion	-1.257***	-1.512***	0.635	0.930*
	(0.406)	(0.500)	(0.386)	(0.535)
BJP	0.147	0.268	-0.077	-0.226*
	(0.107)	(0.290)	(0.059)	(0.123)
Observations	2,206	1,653	2,206	1,653
F-Stat	70.49	57.88	70.49	57.88
Specification	Exc 2012	Exc 2012, 2013	Exc 2012	Exc 2012 2013
Base controls	✓	✓	✓	✓

Notes: The dependent variable is the reported number of crimes in a district-year. The explanatory variable whose effect is shown is the proportion of households having a toilet in a district-year. All specifications include district and year fixed effects, demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table A5: IV Estimates (Linear-IV, Excluding Years)

	(1) Assault 10%	(2) Assault 10%	(3) Rape 10%	(4) Rape 10%
HH Toilet proportion	-1.051**	-1.342*	0.964**	0.759
	(0.480)	(0.720)	(0.373)	(0.465)
BJP	0.201	1.100**	-0.020	-0.128
	(0.157)	(0.432)	(0.061)	(0.119)
Observations	2,206	1,653	2,206	1,653
F-Stat	70.49	57.88	70.49	57.88
Specification	Exc 2012	Exc 2012, 2013	Exc 2012	Exc 2012 2013
Base controls	✓	✓	✓	✓

Notes: The dependent variable is the log of number of reported crimes in a district-year. The explanatory variable whose effect is shown is the proportion of households having a toilet in a district-year. All specifications include district fixed and year fixed effects, demographic controls of district population and male-female ratio and Census controls for proportion of SC population and ST population and development index are interacted with year indicators. The luminosity in a district is controlled using nightlights data. Clustered standard errors (at district level) in parentheses. *** p<0.01, ** p<0.05, * p<0.1.