



No toilet no bride? Intrahousehold bargaining in male-skewed marriage markets in India

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ABSTRACT

Haryana state in India is characterized by widespread discrimination against women, including a severe population-level sex imbalance. In this context an innovative social marketing campaign, which targeted pro-sanitation messages to households active in local marriage markets, was implemented with the goal of increasing toilet ownership. This paper estimates the impact of this program, known colloquially as “No Toilet No Bride”, on household-level latrine ownership. Private sanitation coverage in Haryana increased by 21% specifically among households with boys active on the marriage market. This effect is larger and concentrated in marriage markets where women are relatively scarce and absent when women are relatively abundant, which together suggest the program operated by successfully linking sanitation outcomes with marriage market competition induced by local scarcities of women due to male-biased sex ratios.

1. Introduction

Women in rural Haryana suffer from discrimination, both in terms of prenatal and postnatal outcomes, that is pervasive enough to generate the most skewed state-level sex ratio in all of India.² Haryana, like most of northern India, is characterized by cultural norms that favor sons, which results in a number of common forms of household behavior that combine to cause biased sex ratios (Sen, 1992). For example, in much of northern India parents provide differential post-natal care to boys and girls (Gupta, 1987), invest preferentially in male fetuses (Bharadwaj and Leah, 2013), and/or selectively abort female fetuses (Arnold et al., 2002; Qian, 2008). Further, if women survive to adulthood, they face numerous gender-specific constraints on their ability to travel, seek health care, and work outside of the household (Eswaran et al., 2013; Anderson and Ray, 2010).

In this social context of discrimination, an unusual sanitation campaign commonly known as “No Toilet, No Bride” was initiated by Haryana state authorities in 2005. The social marketing campaign encouraged families of marriage-age girls to demand that potential suitors’ families construct a latrine prior to marriage. Mass media messaging via billboards, posters, and radio advertisements empha-

sized phrases such as “no toilet, no bride” and “no loo, no I do”.³ These messages were framed by women’s concerns about privacy and dignity when they defecate in the open, a behavior that is routine among roughly 70% of rural households in Haryana in 2004, according to data from the District-Level Household and Facility Survey. Women arguably value toilets to a greater extent than males because they suffer disproportionately from male harassment when they defecate, urinate, or attend to menstrual hygiene in public places (see, e.g., Jadhav et al., 2016; Aid et al., 2013). For this reason, private latrines generate benefits that are disproportionately enjoyed by females. Although the rationale for public investment in sanitation programs is the reduction of fecal pollution and the morbidity associated with widespread open defecation, the emphasis of *No Toilet No Bride*, combined with the fact that private benefits accrue largely to women, provides a unique opportunity to study female bargaining power under widespread discrimination.

Given its narrow messaging on the link between sanitation and marriage, the *No Toilet No Bride* program generates a plausible shock to status quo norms that structure inter-household interactions at the time of marriage. I study the impact of this program on latrine adoption using two rounds of the *District-Level Household and Facility Survey* (2004, 2008/9), a nationally representative, household

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² Source: Indian Census, 2011. Note that two non-state union territories, Chandigarh and Delhi, both adjacent to Haryana, have slightly worse sex ratios.

³ “It’s No Toilet No Bride in Haryana”, *The Times of India*, March 22, 2009.

data set, and three rounds of the [Demographic and Health Survey / National Family Health Survey \(1992, 1998, 2005\)](#). I employ an empirical strategy based on the intuition that the *No Toilet No Bride* campaign exerts disproportionate pressure to adopt a latrine on those households with boys active on the marriage market. If the program was successful in linking sanitation with the marriage market, then households with boys of marriageable age face exogenous pressure to build a latrine, and they should therefore have higher rates of latrine ownership after exposure to the program. Because such households could differ from households without marriageable age boys in a variety of unobserved ways, my econometric specification controls explicitly for these unobserved characteristics. My preferred identification strategy is a difference-in-difference-in-difference model that compares latrine ownership in households with and without boys of marriageable age, in Haryana and comparison states from northern India, before the program started and three to four years after the program began.

I find an increase of 6.1 percentage points (a 21% increase from a base of 29%) in the latrine ownership differential between households with and without marriage-age boys in Haryana over the period 2004 to 2008 relative to the difference between latrine ownership of households with and without marriageable boys in comparison states. In addition, I provide strong, complementary evidence that latrine adoption is driven by whether households have marriageable boys active in a particularly competitive marriage market, i.e. one with an undersupply of women due to highly skewed sex ratios. Specifically, the estimated program effect is 23% over baseline in marriage markets where women are scarce. In marriage markets without this scarcity, however, the *No Toilet No Bride* treatment effect is statistically indistinguishable from zero.

The magnitude of *No Toilet No Bride's* estimated effect is large and economically meaningful, especially given the relatively inexpensive nature of the social marketing campaign. These effect sizes are comparable to estimates from randomized controlled trials of the impact of India's Total Sanitation Campaign on latrine adoption ([Patil et al., 2014](#)), yet the latter program includes expensive hardware subsidies. This difference in cost suggests that *No Toilet No Bride* has been a relatively cost-effective way of increasing sanitation coverage. Back-of-the-envelope calculations suggest that the program caused 670,000 toilets to be built among Haryana's 4.3 million households between 2004 and 2008.

The paper then provides additional, complementary evidence on the mechanism by which the program affects household behavior. I show results from two robustness checks that the estimated program effect operated through a marriage market channel as opposed to competing mechanisms outside the marriage market. In particular, I show there is no identifiable effect on households with boys in a cohort above typical marriageable age, who were thus too old to be affected by the program when they were active on the marriage market, and I show that unmarried girls of marriageable age do not obtain toilets independently of marriageable boys.

These findings suggest that (i) the *No Toilet No Bride* campaign has significantly increased latrine ownership by linking marriage matching to the acquisition of a good that females particularly value, and (ii) biased sex ratios have increased the relative bargaining power of women (or of their families negotiating on their behalf) on the marriage market, thereby improving their ability to demand goods. Thus, in a region with one of the most severely skewed sex ratios on earth, a local scarcity of women appears to have increased women's bargaining power, allowing them to obtain additional goods that they value.

This paper contributes to the limited literature on how marriage markets affect premarital behavior, which has focused previously on the US ([Angrist, 2002](#); [Lafortune, 2013](#)), France ([Abramitzky et al., 2011](#)) and China ([Edlund et al., 2013](#); [Wei and Zhang, 2011](#)), but it highlights a new role for coordinated behavior in one side of the market in shaping marriage outcomes. It also contributes to our understanding of sanitation policy at large scales. Recent evaluations of sanitation

campaigns have found modest impacts on latrine adoption and no impacts on health (e.g. [Guiteras et al., 2015](#) and [Patil et al., 2014](#), respectively). Instead of health this paper focuses on women's status and advances toilets (in some social contexts) as an assignable “female food”, which generates sex-specific benefits that improve on the earlier literature on collective households (e.g. [Browning et al., 1994](#)). This focus suggests that sanitation improvements can generate important benefits to certain subgroups even in the absence of improvements to child health, which may prove valuable to future sanitation and health promotion campaigns. Finally, the means by which this program was successful is unique and of potential policy relevance, in particular, by carefully and explicitly linking a desirable public policy goal (sanitation) to existing, deeply rooted social norms (marriage).

This paper is organized as follows. [Section 2](#) discusses sanitation in rural India and important features of the *No Toilet No Bride* program. [Section 3](#) provides a social and economic background to marriage markets in northern India and Haryana, where the *No Toilet No Bride* program operates. [Section 4](#) explains the empirical strategy, identification issues, and data used. [Section 5](#) contains the key empirical results. Robustness to competing hypotheses is examined in [Section 6](#) and a discussion of social and economic mechanisms that explain these results is discussed in [Section 7](#). [Section 8](#) concludes.

2. Context

2.1. Overview of the empirical argument

To examine the effect of *No Toilet No Bride* in Haryana, I develop an empirical strategy that takes advantage of a natural policy experiment. In 2005, Haryana state authorities implemented a state-level messaging campaign, which was inspired by the work of a local NGO, that explicitly linked potential brides' bargaining power (or, given local custom, that of their families) over marriage with the state's low levels of sanitation.⁴ Women and their families were encouraged to demand from potential suitors a latrine prior to marriage. In this way the campaign created a new link between long-standing customs related to arranged marital negotiations and one particular good that women value.

The empirical argument proceeds in the following steps. I first explain why latrines are much more valuable to women than men, i.e. why they can be considered a type of female good. The second step discusses the sanitation campaign known as *No Toilet No Bride*. By focusing on women's ability to demand latrines, the program provides a means of studying their bargaining power on the marriage market. Subsequently, I show evidence that the policy has indeed caused an increase in latrine ownership, that this effect is mediated by the marriage market, and that sex ratios appear to be driving the program effect. Finally, I present complementary evidence that the program was effective via marriage market pressures by showing no discernible effect on households not likely to be active on the marriage market.

2.2. Sanitation, gender, and the *No Toilet No Bride* program

2.2.1. Sanitation as a female good

In rural India, a large majority of people lack access to sanitation and must defecate in the open ([World Bank, 2015](#)). In a recent household survey conducted in Madhya Pradesh, for example, 80% of respondents reported that their primary places of defecation were fields, bushes, rivers/streams, and other public spaces rather than an improved latrine ([Patil, 2010](#)). Access to sanitation, and the lack thereof, affects all people but is of particular significance to women. It is, first of all, a matter of convenience to have a private toilet at home, to be used at one's whim with little effort; this value exists for all

⁴ “It's No Toilet No Bride in Haryana”, *The Times of India*, March 22, 2009.

members of the household. For women, however, private latrines also provide significant benefits in terms of personal dignity and physical security (WSP, 2010). The impact of sanitation on female dignity is reflected well in the comments of a sixteen-year-old girl, who explained that “the toilet campaign is like a liberation...I would feel so conscious and ashamed [setting off in the mornings toward the open fields]. But just before my brother got married, we got a toilet in the house.”⁵ To mitigate embarrassment, Indian women often relieve themselves before sunrise or after dark, putting them at greater risk of sexual assault and other attacks from either humans or, in many rural areas, dangerous wild animals.⁶

These strong preferences for privacy result in uncomfortable strategies to minimize exposure. It is common for women to refrain from drinking during the day in order to avoid needing to use a toilet before sunset, as can be heard in the following interview with Tehelka Magazine, an Indian weekly: “You can spot men all over the hills and in the main town parking themselves on the side of the roads. But when we go down...we keep in mind that we shouldn't consume too much liquids, or else we might have to use the dirty loos. We have got used to holding it forever.” These coping mechanisms have psychological and physical consequences. “Women suffer the most [from lack of sanitation] since there are prying eyes everywhere”, said Ashok Gera, a doctor who works in a one-room clinic in Haryana. “It's humiliating, harrowing and extremely unhealthy. I see so many young women who have prolonged urinary tract infections and kidney and liver problems because they don't have a safe place to go.”⁷ The health impacts notwithstanding, qualitative studies and interviews suggest the fundamental role that toilets play for Indian women's dignity and safety (Nallari, 2015). These often unmet needs motivate a female preference for privacy in a social context characterized by routine male efforts to view any uncovered women. Finally, menstruation provides another significant reason for why women value private latrines: toilets provide females with the privacy, time, and comfort necessary to attend to personal hygiene (World Bank, 2005).⁸ Thus, because of the high and gender-specific value that women ascribe, latrines can be understood as a type of private female good.

2.2.2. The No Toilet No Bride program

In Haryana state, local authorities initiated a massive media campaign in 2005 organized around the message of respecting the right of women to use latrines in privacy and security. This campaign is part of India's Total Sanitation Campaign (TSC), a national initiative of the Government of India whose primary objective is to ensure access to and use of sanitation facilities in rural areas. Although a federal initiative, states shoulder a portion of the costs and have substantial flexibility in local design and implementation.

This information campaign encouraged the families of women to demand of boys' families that they construct a latrine prior to the woman marrying and relocating into the boys' family compound (Haryana, like the rest of northern India, is predominantly patrilocal). Slogans such as “no loo, no I do” and “no toilet, no bride” were disseminated via radio, banners, and other advertising channels. In particular, village walls were painted with the message: “I won't allow my daughter to marry into a home without toilets.”⁹ This initiative thus emphasized a novel linkage between social norms around the marriage market and access to sanitation.

Popular media reports suggest widespread exposure to these ideas.¹⁰ In an interview conducted by the Washington Post, a young male, age 22, who was hoping to marry soon, explained: “I will have to work hard to afford a toilet. We won't get any bride if we don't have one now.” “I won't be offended when the woman I like asks for a toilet,” he added. As part of the information and education campaign, blank building walls were converted into billboards and painted with the slogan (in Hindi): “I won't get my daughter married into a household which does not have a toilet”. A recurring radio jingle sang a tune with the lyrics: “no loo, no I do” (*ibid.*). The founder of Sulabh International, an NGO that designs low-cost improved latrines, states: “The ‘No Toilet, No Bride’ program is a bloodless coup. When I started, it was a cultural taboo to even talk about toilets. Now it's changing. My mother used to wake up at 4am to find someplace [in the fields or rivers] to go quietly. My wife wakes up at 7am and can go safely in her home” (*ibid.*). These vignettes help to characterize the social context in which the *No Toilet No Bride* campaign operates.

In addition to anecdotal evidence, administrative data from the Haryana health department suggest a large increase in latrine ownership in recent years. According to state officials, 1.42 million toilets were built between 2005 and 2009.¹¹ Among this total, 950,000 latrines were built by families above the poverty line and 470,000 by households below the poverty line. Further, household survey data provides additional support for the claim of increased latrine coverage. According to data from two rounds of the District-Level and Household Survey (these data will be described in greater detail below), the proportion of households that owned improved latrines increased from 29% in 2004 to 46% in 2008.

Note that latrines are moderately costly capital investments. The cost of an improved latrine (e.g. a pit latrine with protective slab or a flush toilet to septic tank) typically ranges between 1000 and 2000 rupees (approximately \$20–40 USD). For purposes of comparison, Haryana's state-mandated minimum wage for “Scheduled Appointments” of unskilled laborers was 135 rupees in 2004. According to the Indian NSS, Haryana has the second highest daily wage rate for agricultural labor (195 rupees). Therefore, the cost of typical latrine will range from five to 14 days of paid labor for these two unskilled groups. However, the Government of India provides subsidies through the Total Sanitation Campaign that reimburse households for up to 80% of latrine costs if they possess a Below Poverty Line (BPL) card.¹² Given the Total Sanitation Campaign's incentive scheme, households below the poverty line (BPL) are able to construct an improved latrine at an actual cost of approximately Rs. 200–300 (roughly \$4.50–6.75 USD). This amount would be only two days labor for an unskilled worker at Haryana's public position minimum wage or for an agricultural daily wage laborers with BPL card (NSS 2010).

3. Marriage markets in northern india

Marriage markets in northern India are fundamentally shaped by social norms around patrilocality and caste endogamy. Moreover, the marriage negotiation process is structured by the phenomena of arranged marriage and dowry. Marriages are typically arranged by the parents of both families, often with the help of an intermediary matchmaker, who helps identify suitors according to the criteria established by the families. The most important dimensions along which potential spouses are valued include caste, religion, kinship, profession, education, and physical attractiveness; the attractiveness of women is a characteristic particularly

⁵ Source: Tehelka Magazine (Indian weekly), Vol.7, Issue 29, July 24, 2010.

⁶ One respondent explained: “During the monsoons it is worse. In the dark when we visit the water logged field overgrown with grass and floating with night soil, the danger of getting bitten by snakes and scorpions is also high.” Source: Lesley D. Biswas, The Women's International Perspective, October 1, 2010.

⁷ Source: Tehelka Magazine (Indian weekly), Vol.7, Issue 29, July 24, 2010.

⁸ Adukia, 2017 finds that latrine construction increases school enrollment of pubescent girls and that this behavior is motivated by concerns of privacy and safety.

⁹ Source: Washington Post Foreign Service, “In India, More Women Demand Toilets Before Marriage”, October 12, 2009.

¹⁰ See, e.g., The Times (UK): “Show us your loo before you woo, men are told” (March 26, 2009) and the Washington Post: “In India, more women demand toilets before marriage” (October 12, 2009).

¹¹ Household survey data from the DLHS indicates this figure is 1.9 million between 2004 and 2008.

¹² India's Ministry of Rural Development renamed this program *Nirmal Bharat Abhiyan*, or Clean India Mission, in 2012 and later *Swachh Bharat Abhiyan*, or Clean India Movement, by the Modi government.

important for men (Banerjee et al., 2013). Together, these interlocking institutions play a primary role in shaping the opportunity sets faced by marriage-age individuals and in determining marital outcomes. In this section I provide an overview of these social practices and highlight those characteristics significant for the empirics of this paper.

3.1. Patrilocality exogamy

A key aspect of marriage in northern India, of which Haryana is a part, is the practice of patrilocal/virilocal exogamy, i.e. the migration of newlywed brides out of their households and into the residence of their husbands' family located outside of the brides' home village (Gould, 1961). For example, data from the 1994 PGIRCS survey in the states of Uttar Pradesh and Karnataka suggest that 90% of imported brides originated from villages located within 67 kilometers of the sample villages (Bloch et al., 2004). In their study of how village exogamy serves as a form of insurance against spatially correlated risks, Rosenzweig and Stark (1989) note that the average distance across which two rural Indian households linked through marriage was approximately 30 kilometers. These empirical findings are broadly consistent with other qualitative evidence such as Dutt et al. (1981), which details marriage-generated links for two Punjabi villages and finds that 80% of households had a marriage distance of 40 kilometers. Thus, although households practice strict village exogamy (and appear to seek villages whose incomes do not covary strongly with the home village), households are typically searching for partners within a geographically defined area. This descriptive fact is important for the purposes of this paper because later I adopt an empirical definition of marriage markets in reference to a household's home district.¹³

3.2. Caste endogamy

A second, crucial feature of Indian marriage matching is caste endogamy, i.e. the practice of marrying a spouse from within one's own caste. For example, Banerjee et al. (2013) cite an opinion poll in which 74% of respondents from West Bengal define themselves as opposed to inter-caste marriage, and the authors note the practice of caste endogamy is so widespread that matrimonial classified advertisements, which are common in Indian newspapers, often group listings by caste. In addition, these authors present evidence that individuals are willing to trade substantial benefits in terms of spousal beauty, education, and/or wealth in order to marry within-caste. Later in the empirical section of this paper, I use such widespread and strong preferences for caste endogamy, coupled with the pervasiveness of patrilocal exogamy described above, to justify my empirical definition of a marriage market.

3.3. Sex ratios in contemporary India

In India, particularly in the northern states, the phenomenon of “missing women”, i.e. women absent from the population due to skewed sex ratios, has a long history. For example, under British rule in the 19th century, census officials documented low ratios of women to men in northern India and British officials suspected the Rajputs, a large northern clan, of female infanticide (Chakraborty and Kim, 2010). Whereas in the past much of the observed sex imbalance was explained by such infanticide and/or differential neglect of girls (Gupta, 1987), the spread of ultrasound, amniocentesis, and doctor-provided abortion technology in recent decades has driven sex ratios among younger cohorts.¹⁴ Estimates using data from the National Family Health Survey (NFHS-2, 1998/9) indicate that more than

100,000 sex-selective abortions of female fetuses were being performed each year in India, many of them by private providers in contravention of (unenforced) government regulations (Arnold et al., 2002).

The underlying driver of both differential neglect and selective abortion is a strong parental preference for sons (Edlund, 1999). Parents prefer boys over girls for each birth order, but this effect increases dramatically for higher birth order children (Jayachandran, 2017; Anttila-Hughes et al., 2017). In data from the District Level and Household Survey (DLHS 2008/9), 34% of married female respondents who want a or another child want a boy but only 11% desire a girl. For birth orders higher than four, nearly 10 times more mothers state a preference for another son as compared to another girl (65% and 6%, respectively). Moreover, these patterns are dominated by preferences among households in northern Indian states.¹⁵

The consequence of these widespread preferences, coupled with abortion technology and differential neglect/care in the intrahousehold allocation, is a dearth of women relative to men as compared to sex ratios assumed to be natural in countries without discrimination. In this broad regional context, the Punjab region stands out as having the most imbalanced sex ratios. According to the 2011 Census of India, the overall ratio in India is 940 women for every 1000 men. But this aggregate figure masks substantial heterogeneity across Indian states. For example, the Indian state with the most favorable sex ratio for women is Kerala with a female-male ratio of 1084; Kerala is followed by Pondicherry and Tamil Nadu with ratios of 1038 and 995, respectively. The most sex-imbalanced state is Haryana with only 877 females for every 1000 males. Punjab, which has close historical, cultural, and economic ties with Haryana, has a sex ratio of 893 females for every 1000 males. These data are summarized in Fig. 1, which depicts state-level variation in sex ratios.

Marriage markets are, of course, shaped by these relative proportions of men and women, and the phenomenon of missing women thus increases competition between men for the remaining women. Using this context as motivation, I develop in the next section an empirical approach for estimating the impact of *No Toilet No Bride* on latrine adoption and for understanding how the program interacts with sex ratios.

4. Empirical strategy

Haryana's *No Toilet No Bride* campaign can be understood as generating exogenous variation in the pressure that certain families feel to build a latrine at home. The program is targeted to girls and their families in the sense that the female side of the marriage market is encouraged accept the campaign's message and take action to demand a latrine. The female side of the market is thus the first step in the sequence of behavior change related to latrine ownership. However, if the program is effective and women either express their preference (perhaps via the increased coordination provided by the social marketing) or otherwise demand a latrine from potential suitors, then the program will exert disproportionate pressure, which is plausibly exogenous, specifically on those households that have boys of marriage age, i.e. households with boys active or nearly active on the marriage market. To study whether women are able to demand and obtain latrines, therefore, I explore changes in latrine ownership among these particular households with marriageable boys, who comprise the treatment group in which the relevant outcome can be measured. After exposure to the program, households with boys of marriageable age have a higher probability of latrine adoption as compared with households without marriageable boys.

¹³ The full definition I use is the intersection of caste, religion, marriage-age cohort, and district.

¹⁴ Induced abortion has been legal in India since the Medical Termination of Pregnancy Act (1971) but only under specific conditions that exclude preferences over the child's sex or overall family gender composition.

¹⁵ The largest discrepancies between stated preferences for sons and daughters were found in Bihar, Chattisgarh, Gujarat, Haryana, Jharkhand, Madhya Pradesh, Orissa, Punjab, Rajasthan, Uttarakhand, and Uttar Pradesh. Among households in these states, the average ratio of son to daughter preference was 4.4, conditional on wanting another child. By contrast, among the southern states of Andhra Pradesh, Goa, Karnataka, Kerala, Maharashtra, and Tamil Nadu the same average was 1.6.

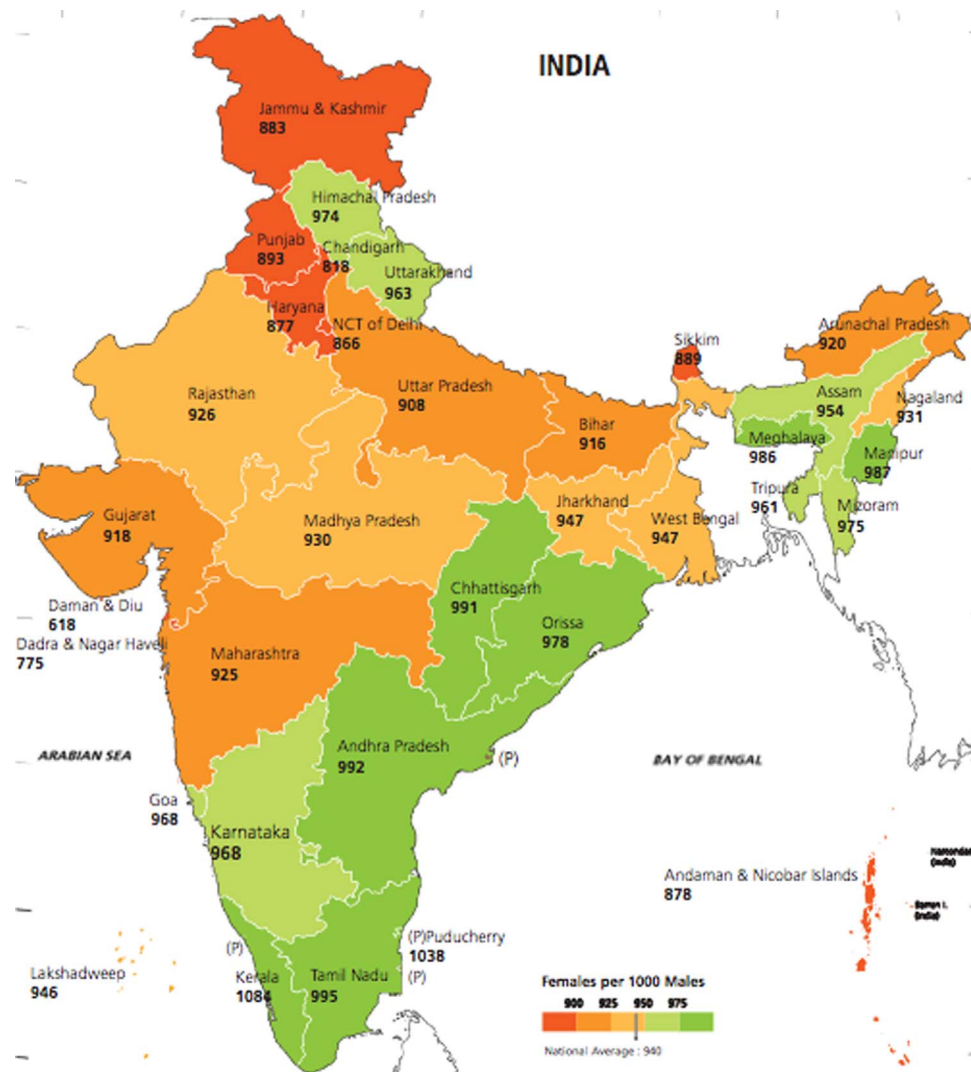


Fig. 1. Sex Ratios Across Indian States, 2011. Source: Census of India, 2011.

Since the campaign began in 2005, households are unable to choose the number of marriageable boys as a response to program incentives.¹⁶ In this sense, program exposure in Haryana is plausibly exogenous to the presence of a marriageable boy. Still, households with marriageable boys might differ systematically from non-marriageable boy households, which raises concerns about endogeneity in any simple comparison of these two groups over time.

To address these econometric concerns, I propose two complementary analyses. Estimation begins with a difference-in-difference (DD) specification, which controls explicitly for potential differences in marriageable boy and non-marriageable boy households. I lay out the identifying assumptions required for this analysis, discuss unresolved issues, and propose an additional method based on significantly weaker assumptions. In particular, I then use a difference-in-difference-in-difference (DDD) specification, which captures the change in the difference between households with and without marriageable boys on ownership of a latrine after the program was implemented, using northern Indian states other than Haryana as a comparison group. As discussed in Section 3, these states are an appropriate choice for comparison with Haryana because of their relative similarity on matters of son preference and sex ratios as compared to southern

Indian or the easternmost Indian states. For these reasons, the factors that mediate women's or their family's bargaining power and marriage market processes are likely to be comparable across treatment and comparison households. Estimates of the *No Toilet No Bride* program effect are shown to be consistent and similar in magnitude across the DD and DDD specifications, despite being based on different identifying assumptions, due to both specifications satisfying the parallel trends assumption, as can be seen in Figs. 2 and 3.

4.1. Data

The principal sources of data for this study are two rounds of household microdata from the District Level Household and Facility Survey (DLHS 2004, 2008), a nationwide survey implemented by the Government of India to track the national Reproductive and Child Health Program,¹⁷ and three rounds of the Demographic and Health Survey (DHS 1992, 1998, 2005). The primary survey modules interview a representative sample of ever-married women and gather household information on maternal and child health outcomes, family planning and reproductive health, utilization of health care services, access to health facilities, and health knowledge. Additional modules focus on household, village, and health facility characteristics, but they

¹⁶ Households could choose, of course, how and when to become active on the marriage market. The manner in which I construct my marriageable boy variable, explained in greater detail in Section 4.2, addresses this concern explicitly.

¹⁷ DLHS is an initiative of India's Ministry of Health and Family Welfare and is implemented by the International Institute for Population Sciences in Mumbai.

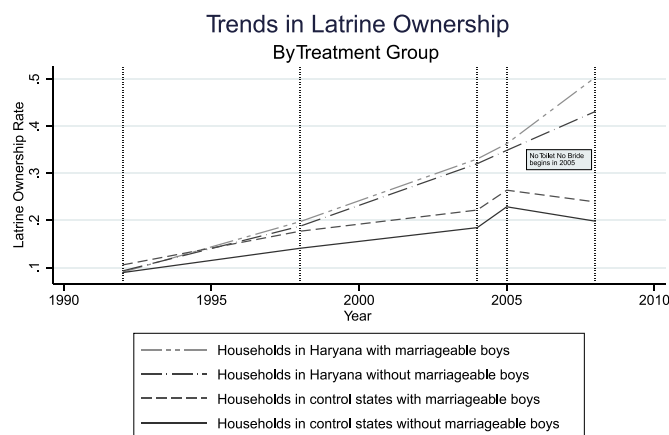


Fig. 2. Parallel Trends in Latrine Ownership. Source: To examine the parallel trends assumption in periods preceding the DLHS 2004 dataset, I use Demographic and Health Survey (DHS) data from the 1992/3, 1998/9, and 2005/6 rounds, in addition to the 2004/5 and 2008/9 DLHS data on which the main results in this paper are based.

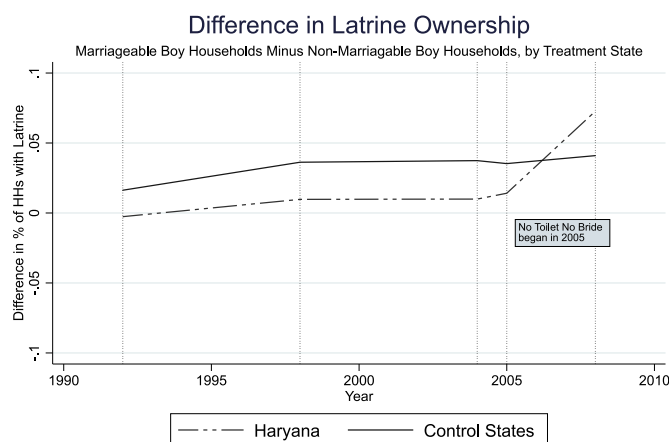


Fig. 3. Parallel Trends in Difference in Latrine Ownership. Source: To examine the parallel trends assumption in periods preceding the DLHS 2004 dataset, I use Demographic and Health Survey (DHS) data from the 1992/3, 1998/9, and 2005/6 rounds, in addition to the 2004/5 and 2008/9 DLHS data on which the main results in this paper are based.

are not used in this analysis. The DLHS data form a repeated cross-section that is representative at the district level for 601 districts in 34 Indian states and territories. I use the two latest survey rounds, DLHS-2 (2004) and DLHS-3 (2008/9), which provide data immediately preceding the project period as well as after three/four years of program exposure.¹⁸ The DHS data are used to examine trends in latrine ownership and household characteristics prior to the program as well as in regression analyses at the state level; the 2005 DHS survey is excluded from analyses of marriage market competition because district identifiers are not publicly available for that survey round.

I restrict the sample to focus on rural households from northern states, which are those states characterized by the strongest cultural preference for sons, as discussed in Section 3.3.¹⁹ Using these restric-

tions, my data contains information on roughly 370,000 households and between 19,000 in Haryana in 2004 and 16,000 in Haryana in 2008.

4.2. Variable construction

In my empirical analysis, I construct the following variables. *Latrine* is a binary indicator that takes the value of one if household *i* has access to a private latrine. The requirement that toilets be private to a household is closely related to women's concerns around privacy and dignity and is thus important in the context of the *No Toilet No Bride* program.

The marriageable boy and girl variables, *mboy* and *girl*, are based on the gender-specific mean age of marriage in 2004 \pm one standard deviation (and rounded to the nearest integer). This variable adopts a value of one for any household that has a boy/girl of marriageable age, irrespective of marital status. Given my empirical strategy, I am implicitly defining the *No Toilet No Bride* treatment group as those households with boys of marriageable age, the vast majority of which have been active on the marriage market during the program. I considered alternative definitions of the marriageable criterion, including one based exclusively on single, unmarried children, one based on strictly married men, as well as one using different intervals around the gender-specific mean. Increasing the interval size around mean age at marriage is undesirable because it includes larger numbers of households who might not be affected by treatment. I did not use the variable definition requiring the marriageable boys to be single because it excludes by construction any households with marriageable boy(s) who married after the program began, thereby eliminating from the treatment sample exactly those households most likely to have responded to the program. At the same time, the use of strictly married young men as *mboys* would exclude households with marriageable boys who purchased a toilet in anticipation of marriage.²⁰ My preferred definition, therefore, is the gender-specific mean age at marriage \pm one standard deviation because it best balances these concerns.

My empirical definition of *marriage market* builds on the discussion in Section 3, where I reviewed evidence that (i) nearly all women marry within their caste group, and (ii) nearly all women move, upon marriage, to villages that are between 30 and 70 km away from their home villages. Together, these facts provide a natural means of defining a given household's marriage market. Unfortunately, the DLHS/DHS data does not contain geocoded data on households, nor does it identify previous residences, so I am unable to define marriage markets in this explicitly spatial manner. Instead, I assume marriage occurs predominantly within one's administrative district. Districts in India are heterogeneous in terms of area, but their size ranges are comparable to the ranges reported in the studies of marriage migration. For example, the largest district in Haryana is roughly 70 km across from the western to eastern administrative boundary, while the smallest district is roughly 17 km in diameter. Thus, districts provide a reasonable approximation to the distance across which marriages typically form.

The second descriptive fact from Section 3 used when defining marriage markets is caste endogamy, which refers to practice of marrying within one's own caste group. For the purposes of this marriage institution, the relevant grouping is the *jati*, which is sometimes referred to, imprecisely, as sub-caste. The *jati* is a community that plays the principal role in providing one's social identity, including providing potential marital partners, providing some forms of insurance against consumption risk, and serving as a professional network across labor markets (Munshi and Rosenzweig, 2006). In the absence

¹⁸ For the remainder of the paper, I will simply refer the DLHS-3 survey year as 2008.

¹⁹ The 16 states included in my sample are: Jammu and Kashmir, Himachal Pradesh, Punjab, Chandigarh, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Jharkhand, Orissa, Chhatisgarh, Madhya Pradesh, and Gujarat. My empirical results are robust to alternative sample selection that includes only Haryana and adjacent states as well as a regional criterion that includes all states in the northwest quadrant of the country. However, the policy that I examine in my empirical section is at the state-level. Therefore, due to matters of inference using clustered data, it is desirable to include the largest number of states that could serve as plausible controls. Given the close relationship between son preference and women's outcomes in society, the most appropriate control group is comprised by those states with similar levels of stated son preference.

²⁰ Numerous popular media accounts contain interviews in which young men report they are building a latrine in preparation for the marriage market, even if a potential spouse is not yet identified.

of this detailed, *jati*-specific data, I use the DLHS question on broad caste grouping. This variable represents an aggregation of finer social categories, but it still divides the sample population into four categories (scheduled caste, scheduled tribe, other “backward”, and other).²¹ Finally, because the relatively large caste category of “other” might include more than one religion (and marriages almost never happen across religions), I also include religion in my marriage market definition. Thus, a *marriage market* for the purposes of this paper will be those households in household *i*’s home district with marriageable boys/girls of the same caste grouping and religion. This definition results in 93 marriage markets in Haryana and 1137 in comparison states.

The variable for *sex ratio* is the ratio of women to men in a particular marriage market. I exclude households in marriage markets where either the number of marriageable boys or girls is less than fifteen individuals; this omits unusual and pathological (e.g. missing) values for the sex ratio. There exists substantial variation in the sex ratios across marriage markets, despite the overall sex imbalance in the population.

Finally, the *wealth* variable is constructed from a set of assets that appear in all survey rounds. It is a summary index as in Anderson (2008), which maximizes the information that each asset provides to the overall score via inverse covariance weighting. The assets used in construction of this index are: whether a household has a television, a car, a motorbike, access to electricity, a fan, a radio, a bicycle, and whether the house structure was constructed with pucca (solid, inorganic structure), semi-pucca (partially solid), or kacha (typically mud or other organic material). The wealth index is interpreted in standardized effect sizes. Thus, Haryana is 0.335 standard deviations more wealthy (in 2008) in terms of ownership of these assets as compared to the sample comprised of Haryana and all northern comparison states; similarly, the comparison states are 0.015 standard deviations less wealthy than the northern average. In all regressions where I have included this wealth index as a control, I also ran the alternate regression where wealth is controlled for using the asset variables directly; results were always consistent with use of the wealth index.

Tables 1 and 2 present summary statistics on key variables for Haryana and comparison states, and for marriageable boy households and non-marriageable boy households, in 2004 and 2008. Haryana is substantially more wealthy in 2004 than the average of other northern states. Haryana also has higher initial latrine coverage, is slightly better educated, and has substantially more imbalanced sex ratios (as mentioned earlier, Haryana has the worst state-level sex ratios in the country). Similar differences exist between households with and without marriageable boys. Marriageable boy households are larger on average than non-marriageable boy households, wealthier, more educated, and have higher latrine ownership. All of these differences are statistically significant at the 1% level and thus motivate the identification strategy of this paper, which is based on differences-in-differences.

Despite differences in levels across treatment groups, overall trends for each of these variables moves in the same direction between 2004 and 2008. For example, latrine coverage over time is increasing in each group, education is improving, household size is decreasing, and sex ratios are worsening. Similar trends can be observed in these variables within treatment groups defined by marriageable boy status. Although, these broadly similar trends in observables provide some support for the identification strategy, later I present more detailed graphical and empirical analysis to support the identifying assumptions on which this analysis rests.

Of particular note is the estimated sex ratios in these summary

Table 1
Summary Statistics.

VARIABLE	haryana		control States	
	2004	2008	2004	2008
Latrine at home	0.293 (0.455)	0.462 (0.499)	0.187 (0.390)	0.213 (0.409)
% households with marriageable boys	0.413 (0.492)	0.408 (0.491)	0.360 (0.480)	0.352 (0.478)
% households with marriageable girls	0.371 (0.483)	0.362 (0.480)	0.361 (0.480)	0.342 (0.474)
Wealth index	0.301 (0.561)	0.335 (0.622)	-0.016 (0.522)	-0.015 (0.510)
Number of people in household	6.055 (2.813)	5.616 (2.590)	5.916 (3.003)	5.560 (2.726)
Age of household head	45.621 (14.742)	46.119 (14.531)	45.469 (14.452)	46.090 (14.429)
Years of schooling (household head)	4.707 (4.754)	5.349 (4.732)	3.832 (4.660)	4.275 (4.594)
Marriage market size (males)	124.863 (91.963)	143.242 (80.778)	120.805 (123.263)	170.535 (118.202)
Marriage market size (females)	108.111 (79.703)	129.587 (90.175)	122.563 (135.375)	163.175 (110.255)
Sex ratio (females to males)	0.877 (0.193)	0.888 (0.169)	1.024 (0.308)	0.987 (0.268)
Observations	18962	15614	347910	354155

Notes: Unweighted sample averages reported with standard errors in parentheses. Marriageable boys are aged 19–27 and marriage girls are aged 16–23; each of these was defined as the gender-specific mean age of marriage in 2004 \pm one standard deviation. Marriage market size and sex ratios are calculated at the marriage market level, which is defined by age cohort, caste group, religion, and district. These statistics are calculated using the 2004 and 2008 rounds of the District Level Household and Facility Survey. The 16 states included in this sample are: Jammu and Kashmir, Himachal Pradesh, Punjab, Chandigarh, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Jharkhand, Orissa, Chhatisgarh, Madhya Pradesh, and Gujarat.

statistics. Given the severity of sex imbalance in Haryana, there is a few percentage point difference in the ratio of women to men across these groups, although the trend is similarly declining (i.e. becoming more skewed against women) over time in both Haryana and control states. Note that the sex ratios differ, in particular, are higher, than commonly estimated (e.g. in the census data summarized in Fig. 1) for both Haryana and control states. There are two reasons why this is the case. First, the marriage market definition internalizes the average age gap between men and women at the time of marriage. On average, men marry girls that are 3.5 years younger than them. With population growth, each successive, younger cohort is larger than its predecessor. Thus, by defining marriageable boys and girls in this way, the fact of sex imbalance due to son preference is countervailed by the impact of population growth. The second reason is that the variance of the distribution of female age at marriage is lower than that for males. Hence, when I define the marriage market in respect to male and female mean ages at marriage \pm one standard deviation, the age range for males is larger for males than females. This additionally causes more males to be included in a marriage market, thereby decreasing the sex ratio. The net effect of these two definitional considerations is a sex ratio slightly higher (female-to-male) than is typically estimated from sex ratio at birth or sex ratios in specific cohorts.

²¹ These categories encompass 19.4%, 13.3%, 39.9%, and 27% of my sample, respectively.

Table 2
Summary Statistics.

VARIABLE	marriageable Boy Households		non-Marriageable Boy Households	
	2004	2008	2004	2008
Latrine at home	0.213 (0.409)	0.252 (0.434)	0.181 (0.385)	0.207 (0.406)
Average number of marriageable boys	1.297 (0.576)	1.273 (0.547)	0.006 (0.079)	0.005 (0.071)
% households with marriageable girls	0.628 (0.483)	0.589 (0.492)	0.209 (0.406)	0.208 (0.406)
Wealth index	0.091 (0.547)	0.092 (0.543)	-0.051 (0.511)	-0.051 (0.499)
Number of people in household	6.783 (3.456)	6.288 (3.078)	5.407 (2.543)	5.164 (2.411)
Age of household head	46.001 (15.688)	46.355 (15.403)	45.163 (13.671)	45.948 (13.871)
Years of schooling (household head)	4.238 (4.707)	4.627 (4.583)	3.672 (4.635)	4.153 (4.609)
Marriage market size (males)	144.520 (130.111)	173.599 (120.140)	143.078 (132.299)	167.036 (115.092)
Marriage market size (females)	147.618 (141.445)	162.981 (111.543)	149.977 (146.921)	161.056 (108.598)
Sex ratio (females to males)	1.018 (0.282)	0.957 (0.237)	1.062 (0.334)	0.997 (0.279)
Observations	133076	131032	233796	238737

Notes: Unweighted sample averages reported with standard errors in parentheses. Marriageable boys are aged 19–27 and marriage girls are aged 16–23; each of these was defined as the gender-specific mean age of marriage in 2004 +/- one standard deviation. Marriage market size and sex ratios are calculated at the marriage market level, which is defined by age cohort, caste group, religion, and district. These statistics are calculated using the 2004 and 2008 rounds of the District Level Household and Facility Survey. The 16 states included in this sample are: Jammu and Kashmir, Himachal Pradesh, Punjab, Chandigarh, Uttaranchal, Haryana, Delhi, Rajasthan, Uttar Pradesh, Bihar, West Bengal, Jharkhand, Orissa, Chhatisgarh, Madhya Pradesh, and Gujarat.

4.3. Specification

To estimate the impact of Haryana's *No Toilet No Bride* campaign on improved latrine ownership, I begin with a difference-in-difference (DD) specification that compares latrine ownership between Haryana households with and without *mboys* before and after program exposure. This analysis highlights the core intuition driving the empirical strategy, namely that No Toilet No Bride targeted the behavior of *mboy* households in particular. I run a regression of the following form:

$$\text{Latrine}_{it} = \alpha + \beta_1(\text{mboy}_i \times \text{post}_t) + \beta_2(\text{mboy}_i) + \beta_3(\text{post}_t) + \epsilon_{it} \quad (1)$$

where *mboy* is an indicator variable that adopts the value of one if household *i* has a male household member between the ages of 19–27 (males' mean age at marriage +/- one standard deviation) and ϵ_{it} is a household-specific error term, which I allow to be correlated across households within districts.

In addition to the primary definition of *mboys*, I use an alternative *mboy* variable that is the number of *mboys* in the household. This alternate definition explores whether the impact of the program increases with the number of boys a household has on the marriage market. The DD specification controls for unobserved time-invariant traits of *mboy* and non-*mboy* households, as well as secular trends in Haryana. The coefficient of interest β_1 is therefore identified from changes in latrine ownership among *mboy* households over time. Consistent identification in this case depends on the common trends assumption for *mboy* and non-*mboy* households, i.e. observed changes in latrine ownership between these two groups of households would have been identical in the absence of the program.

One concern with this approach, which would invalidate the identifying assumption, is that an unobserved shock in Haryana is positively correlated with latrine ownership in *mboy* households or negatively correlated with latrine ownership in non-*mboy* households. For example, since *mboy* are on average slightly wealthier than non-*mboy* households, any economic shock that differentially affects wealthier households could affect latrine ownership as well.

I address this concern about potential endogeneity by using a triple difference (DDD) regression specification, where the three differences are households with and without marriageable boys, in Haryana and comparison states, before and after (three to four years of) program exposure. I regress a binary variable for latrine in household *i* in Haryana or control states *j* at time *t* on a set of interactions and fixed effects:

$$\begin{aligned} \text{Latrine}_{ijt} = & \alpha + \beta_1(\text{mboy}_i \times \text{haryana}_j \times \text{post}_t) + \beta_2(\text{mboy}_i \times \text{post}_t) \\ & + \beta_3(\text{mboy}_i \times \text{haryana}_j) + \beta_4(\text{haryana}_j \times \text{post}_t) + \beta_5(\text{mboy}_i) \\ & + \beta_6(\text{haryana}_j) + \beta_7(\text{post}_t) + \epsilon_{ijt} \end{aligned} \quad (2)$$

where *mboy* is defined as both an indicator and a fraction, as explained above, *j* is binary for treatment and control states, and ϵ_{ijt} is a household-specific error term possibly correlated within state-year clusters. The fixed effects control for unobserved time-invariant factors at the state level and time-varying factors across both states. The double interaction terms allow the relationship between marriageable boys and improved latrines to vary across states and across time, in addition to capturing state-specific linear time trends. In this formulation, the primary coefficient of interest is β_1 on the triple interaction, which captures the change in the effect of marriageable boys on latrine adoption in Haryana between 2004 and 2008 relative to the change in effect of marriageable boys on latrine adoption in control states between 2004 and 2008. This is the period during which the *No Toilet No Bride* campaign likely generated additional social pressure on these households. Because I condition on state-year fixed effects, *mboy*-state, and *mboy*-year interactions, β_1 is identified through Haryana-specific changes over time in differential rates of latrine ownership between households with and without marriageable boys.

Consistent estimation of this fully saturated linear probability model requires that $E(\epsilon_{ijt} | \mathbf{X}, \delta_{jt}) = 0$, where \mathbf{X} is a vector comprised of the *mboy* variable interacted with Haryana and year dummies, and δ_{jt} reflects state-year fixed effects.²² This assumes that changes in this differential across states and time are orthogonal to unobserved determinants of latrine ownership.

In assessing the validity of this identification strategy, note that the most likely explanations for a positive effect of marriageable boys on latrine ownership can be ruled out. For example, if households with young male adults typically enjoy higher income, which allows them to purchase latrines, we would expect to see a positive correlation

²² The linear probability model is particularly appropriate in this context because the fully saturated specification implies the conditional expectation function of latrine ownership is linear. Still, I run similar regressions using probit and logit specifications, which yields nearly identical results.

between marriageable boy households and latrine ownership across both states, but we would not expect a Haryana-specific change over time. Another rationale for an observed positive correlation between marriageable boy households and latrine ownership is that transfers associated with marriage, such as dowry and gift-giving, could also facilitate latrine ownership. A similar counterargument, however, can also rule out this hypothesis: we would expect this story to affect households with marriageable boys equally in Haryana and control states.

For the identifying assumption to be invalid, an unobserved factor must cause the trend in the difference in latrine ownership between households with and without marriageable boys to diverge across Haryana and control states. In such a case, this factor would cause the common trends assumption to be violated, i.e. the trend in the differential between *mboy*/non-*mboy* households would inaccurately reflect the counterfactual scenario in Haryana in the absence of the program. This identifying assumption would be violated if there are unobserved Haryana-specific shocks that covary with latrine adoption and the presence of a marriage age boy. This assumption is impossible to defend with certainty, but it is difficult to generate hypotheses on the types of shocks on Haryana's marriageable boy households that would undermine identification. Nevertheless, I provide direct evidence on parallel trends in latrine ownership, as well as household composition (a concern related to the son preference), for key treatment and control subgroups in Figs. 2 and 4. Finally, I present below additional findings that lend further support to the marriage market channel interpretation of observed changes in latrine ownership among marriageable boy households, thereby providing added, indirect support for this identification strategy.

5. Results

5.1. Marriageable boys and household latrine adoption

I focus first on the main program effect of *No Toilet No Bride* on latrine ownership.

The first test of this prediction uses the DD specification given in Eq. (1); estimates are presented in Table 3. The DD estimates suggest that *No Toilet No Bride* has increased *mboy*'s investment in latrines by between 6.6 and 6.8 percentage points over a baseline mean of 29%, i.e. the program increased latrine ownership by approximately 23%. When using the number of *mboys* variable that allows the program to have differential effects for larger numbers of *mboys*, which is reported in columns (3) and (4), results are consistent and each additional *mboy* increases the probability of latrine ownership by 4.5 percentage points. These results are unchanged by the inclusion of demographic and socio-economic control variables that differed systematically across treatment and control groups (as seen in Tables 3 and 4).

As suggested earlier, however, any changes in *mboy* households, e.g. wealth shocks, would violate the identifying assumption in this DD framework and yield inconsistent estimates. For this reason, the preferred DDD analysis includes a much larger sample of states, which have similar son preferences to Haryana. Table 4 presents these preferred DDD estimates of the *No Toilet No Bride* campaign on latrine adoption. Specifically, there was a 6.1 percentage point change in the differential over time between Haryana and control households with and without marriageable boys above a baseline mean of 0.29 for Haryana's *mboy* households, i.e. a 21% increase among those households likely to be affected by females demanding/desiring improved sanitation.

Because the program specifically targeted those households whose boys are on the marriage market, and having a marriageable boy is plausibly exogenous to household decisions regarding improved latrines, conditional on the full set of interactions and fixed effects, these results provide evidence that either (i) marriageable women or their families in Haryana have successfully pressured men into sanitation

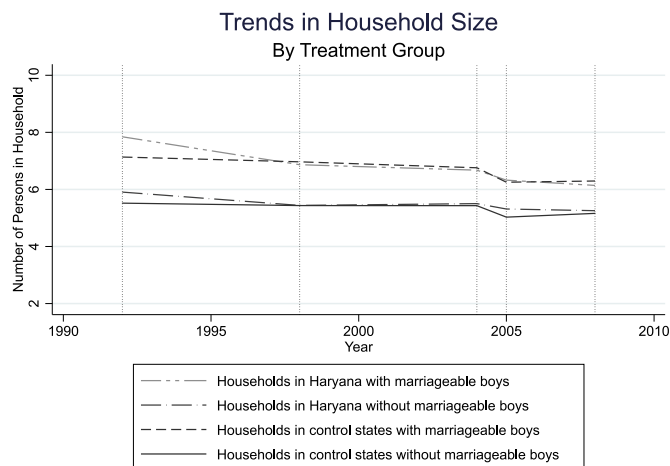


Fig. 4. Parallel Trends in Household Size. Source: To examine the parallel trends assumption in periods preceding the DLHS 2004 dataset, I use Demographic and Health Survey (DHS) data from the 1992/3, 1998/9, and 2005/6 rounds, in addition to the 2004/5 and 2008/9 DLHS data on which the main results in this paper are based.

investments, or (ii) men have anticipated this pressure and responded by increasing their premarital investment in latrines. There is an additional possibility, outside of this bargaining interpretation, which suggests that new couples invest in latrines as a form of health-seeking behavior and health investment in children.²³ While the DDD specification cannot rule out this possibility, the following sections present evidence on each of these channels and support the idea that marriage market factors are driving these results.

5.2. Marriage markets, sex ratios, and latrine adoption

To study the cross-partial effect of how sex imbalance in the marriage market mediates male investment responses to *No Toilet No Bride*, I use regression specification (2) in two subsamples, where one is comprised of households in marriage markets with an oversupply of women and one with an undersupply of women. This formulation is desirable for expositional purposes, but it is equivalent to interacting an indicator for sex ratio being greater or less than unity with the set of interactions and fixed effects from (2). As before, I first present estimates from the DD (using *mboy*/non-*mboy* and pre/post treatment) and then turn to the preferred DDD analysis.

Tables 5 and 6 report estimates from these analyses. For both the DD and DDD specifications, the difference in magnitude is larger than the estimated effect from Table 4 and is significant at the one percent level. When women are abundant, the estimated average treatment effect of *No Toilet No Bride* ranges between statistically indistinguishable from zero and 0.033 (in the full DDD model with controls). By contrast, when women are scarce and the marriage market is highly competitive for men, the treatment effect ranges from 1.6 to 3.5 times the estimated effect in marriage markets with an abundance of women. The differences in these point estimates are large and statistically significant: in the double interaction they are statistically different from each other at the 10 percent level (prob $> \chi^2 = 0.076$ in the models without controls and 0.091 in the models with controls). In the DDD specification, the differences are statistically significant at the one percent level for both models with and without controls.

²³ I am unable to explore whether other health-seeking behavior is being affected by the program because the data lacks information on bednets, and water treatment data exist for 2008 only. Note, however, this hypothesis of unitary household preferences for investment in children is ruled out by the analysis of sex ratios below. If women favor child investments more than men, however, then Haryana women demanding toilets, and therefore program effects, could be explained more by child health than private female benefits. This interpretation is fully consistent with the bargaining interpretation of the empirical results.

Table 3
No Toilet No Bride Effect on Latrine Ownership (DD Estimates).

	(1)	(2)	(3)	(4)
Marriageable boy x Post	0.066*** (0.014)	0.068*** (0.013)		
Marriageable boy	0.007 (0.007)	−0.029*** (0.007)		
Post	0.148*** (0.038)	0.120*** (0.034)	0.151*** (0.039)	0.123*** (0.034)
Household size		−0.003 (0.002)		−0.003 (0.003)
Age of household head		0.001 (0.001)		0.001 (0.001)
Age of wife		0.003*** (0.001)		0.003*** (0.001)
Years of schooling of head		0.012*** (0.002)		0.012*** (0.002)
Years of schooling of wife		0.016*** (0.002)		0.016*** (0.002)
Wealth index		0.201*** (0.008)		0.200*** (0.008)
Number of marriageable boys x Post			0.044*** (0.010)	0.045*** (0.010)
Number of marriageable boys			0.013** (0.005)	−0.014** (0.005)
Constant	0.284*** (0.023)	0.014 (0.054)	0.280*** (0.024)	0.012 (0.054)
Adj. R ²	0.035	0.167	0.036	0.167
N	32915	31725	32915	31725

Notes: The dependent variable is a dummy variable for whether household *i* has a latrine. Column (1) reports the basic DD regression using the marriageable boy variable. Column (2) adds the following control variables: age and education of the household head, wife/mother's education, household size, and summary index for wealth. Column (3) uses total number of marriageable boys in the household. Column (4) adds the same control variables to the regression from Column (3). The primary coefficient of interest in all cases is the double interaction. All standard errors are clustered at the district level. Due to this clustering, the DHS 2005 round is dropped because it does not contain district identifiers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

These results show that skewed sex ratios mediate the impact of women's ability to obtain latrines on the marriage market. When women are scarce, they or their families are able to negotiate successfully for latrines, but when they are abundant, men have less incentive to invest and women are unable to secure latrines to the same degree. In this sense, the phenomenon of missing women in a marriage market appears to have increased bargaining power on the bride's side of the market, conditional on the girl's survival to marriage age. Finally, these results lend additional support to the marriage market hypothesis because evidence of marriage market-driven latrine adoption bolsters the case that *No Toilet No Bride* exerted disproportionate pressure on marriageable boys.

6. Competing hypotheses

The previous sections provided a series of results that together provide compelling evidence that male premarital investments respond to marriage market constraints generated by local sex imbalances. This section considers four arguments that challenge this interpretation of program effects.

Table 4
No Toilet No Bride Effect on Latrine Ownership (DDD Estimates).

	(1)	(2)	(3)	(4)
Marriageable boy x Haryana x Post	0.057*** (0.012)	0.061*** (0.009)		
Marriageable boy x Haryana	−0.026*** (0.006)	−0.025*** (0.005)		
Marriageable boy x Post	0.009 (0.011)	0.006 (0.009)		
Haryana x Post	0.118** (0.058)	0.103** (0.046)	0.123** (0.057)	0.107** (0.045)
Haryana	0.115*** (0.041)	0.028 (0.035)	0.114*** (0.041)	0.026 (0.035)
Post	0.023 (0.049)	0.010 (0.037)	0.022 (0.049)	0.009 (0.037)
Marriageable boy	0.032*** (0.005)	−0.003 (0.005)		
Household size		−0.005*** (0.002)		−0.005*** (0.002)
Age of household head		0.001*** (0.000)		0.001*** (0.000)
Age of wife		0.002*** (0.000)		0.002*** (0.000)
Years of schooling of head		0.009*** (0.001)		0.009*** (0.001)
Years of schooling of wife		0.017*** (0.002)		0.017*** (0.002)
Wealth index		0.222*** (0.017)		0.221*** (0.017)
Number of marriageable boys x Haryana x Post			0.035*** (0.009)	0.037*** (0.007)
Number of marriageable boys x Haryana			−0.019*** (0.005)	−0.016*** (0.004)
Number of marriageable boys x Post			0.009 (0.008)	0.007 (0.007)
Number of marriageable boys			0.033*** (0.004)	0.003 (0.004)
Constant	0.175*** (0.027)	0.009 (0.026)	0.172*** (0.027)	0.009 (0.027)
Adj. R ²	0.013	0.196	0.015	0.196
N	736641	704900	736641	704900

Notes: The dependent variable is a dummy variable for whether household *i* has a latrine. Column (1) reports the basic DDD regression using the marriageable boy dummy variable. Column (2) adds the following control variables: age and education of the household head, wife/mother's education, household size, and a summary index for wealth. Column (3) uses total number of marriageable boys in the household. Column (4) adds the same control variables to the regression from Column (3). The primary coefficient of interest in all cases is the triple interaction. All standard errors are clustered at the state-year level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

The first issue that arises is the role of migration. Perhaps males elect to move out of tight marriage markets with dim prospects, or alternatively, they import brides from other marriage markets.

Table 5
Sex Ratios and the *No Toilet No Bride* Effect on Latrine Ownership (DD Estimates).

	(1)	(2)	(3)	(4)
Marriageable boy x Post	0.070*** (0.015)	0.030 (0.027)	0.072*** (0.014)	0.045 (0.027)
Marriageable boy	0.006 (0.009)	0.009 (0.014)	−0.030*** (0.009)	−0.024* (0.014)
Post	0.151*** (0.030)	0.114 (0.152)	0.128*** (0.032)	0.108 (0.119)
Household size			−0.000 (0.002)	−0.012*** (0.004)
Age of household head			0.001 (0.001)	0.000 (0.001)
Age of wife			0.003*** (0.001)	0.004*** (0.001)
Years of schooling of head			0.013*** (0.002)	0.007** (0.003)
Years of schooling of wife			0.015*** (0.002)	0.023*** (0.004)
Wealth index			0.203*** (0.008)	0.201*** (0.016)
Constant	0.286*** (0.018)	0.282*** (0.054)	−0.016 (0.042)	0.097 (0.067)
Adj. R^2	0.037	0.016	0.170	0.158
N	26427	6038	25496	5793

Notes: The dependent variable is a dummy for whether household i owns a latrine. I run this specification separately for households in a competitive marriage market (from the marriageable boy's perspective), which is defined as having more marriageable boys than marriageable girls, and for households in a less competitive marriage market. These are the low and high sex ratio columns, respectively. The coefficients of interest (the double interactions) are statistically different from each other at the 99% level. Standard errors, clustered at the district level, are reported in parentheses. Due to this clustering, the DHS 2005 round is dropped because it does not contain district identifiers. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Similarly, males could seek brides from younger cohorts, which will be larger than older cohorts, on average, because of population growth. There are in fact a wide variety of possible means by which men could relax the constraints imposed on them in a particular marriage market. Unfortunately, the DLHS/DHS data do not contain information that allows me to identify such migration. To the extent men are able to alleviate the pressure they experience on the marriage market, however, my estimates of the program effect will underestimate the program effect in the absence of migration across marriage markets.

Two additional, competing hypotheses explore distinct mechanisms by which the observed changes in latrine ownership might arise, which are outside of marriage market effects, while the fourth hypothesis examines whether any unobserved factors related to household size and/or fertility are driving my results. Given the evidence presented here, I reject each of these competing hypotheses regarding the *No Toilet No Bride* effect.

6.1. Does the program change male preferences?

Depending on how campaign messages are received by men, the main result from Section 5.1 could arise not because women are exerting pressure via the marriage market on male investments, but because male preferences have changed in response to the program. Consider a scenario whereby *No Toilet No Bride* changed young adult male preferences for sanitation among both households with boys

Table 6
Sex Ratios and the *No Toilet No Bride* Effect on Latrine Ownership (DDD Estimates).

	(1)	(2)	(3)	(4)
Marriageable boy x Haryana x Post	0.064*** (0.013)	0.018 (0.015)	0.066*** (0.010)	0.033** (0.014)
Marriageable boy x Haryana	−0.024** (0.010)	−0.015 (0.012)	−0.028*** (0.008)	−0.014 (0.013)
Marriageable boy x Post	0.006 (0.010)	0.010 (0.011)	0.005 (0.009)	0.004 (0.006)
Haryana x Post	0.135* (0.071)	0.100** (0.044)	0.114** (0.053)	0.104** (0.041)
Haryana	0.069 (0.047)	0.147*** (0.036)	−0.011 (0.038)	0.090** (0.034)
Post	0.009 (0.065)	0.012 (0.032)	0.003 (0.046)	0.004 (0.030)
Marriageable boy	0.029*** (0.006)	0.027*** (0.006)	−0.005 (0.006)	−0.006* (0.004)
Household size			−0.005* (0.002)	−0.003** (0.001)
Age of household head			0.002*** (0.000)	0.001** (0.000)
Age of wife			0.003*** (0.000)	0.002*** (0.000)
Years of schooling of head			0.010*** (0.002)	0.009*** (0.001)
Years of schooling of wife			0.018*** (0.002)	0.015*** (0.002)
Wealth index			0.234*** (0.019)	0.195*** (0.013)
Constant	0.224*** (0.036)	0.138*** (0.020)	−0.012 (0.034)	0.031 (0.024)
Adj. R^2	0.011	0.007	0.206	0.161
N	398726	321041	382138	306648

Notes: The dependent variable is a dummy for whether household i owns a latrine. This specification is run separately for households in a competitive marriage market (from the marriageable boy's perspective), which is defined as having more marriageable boys than marriageable girls, and for households in a less competitive marriage market. These are the low and high sex ratio columns, respectively. The coefficients of interest (the triple interactions) are statistically different from each other at the 99% level. Standard errors, clustered at the state-year level, are reported in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

active on the marriage market as well as those with relatively recent experience on the marriage market. Perhaps the program raised the salience of sanitation in Haryana, changed men's preferences, and thereby caused an increase in latrine adoption. In this way households with young men, which are relatively wealthy, became convinced about the value of sanitation and made the sanitation investment. Then even in the triple difference empirical framework it might be possible to observe a program effect, yet this hypothesized shift would operate entirely outside of the marriage market.

I test this hypothesis by studying whether *No Toilet No Bride* has caused any change in latrine adoption among households with men slightly older than marriageable age. Recall that the definition of marriageable boy is \pm one standard deviation from males' mean age at marriage; this yields an age range of 19 to 27. Here I create a new indicator that takes the value of one if a household has anyone in the age range 27 to 34 years. This age group is young and close enough in age to serve as a reasonable comparison group to very late teens and

twenty-something year olds, but due to their age are almost certainly married already and therefore immune from marriage market pressures generated by the program. I run a regression using the same DDD specification as above, but add the *oldboy* variable and all relevant interactions to the main DDD specification. This model therefore examines whether older boys in Haryana alter their latrine adoption after exposure to the program, controlling for the effect of the program on *mboys*.

As can be seen in Table 7 in the online appendix, the main coefficient of interest is statistically zero when the model excludes controls and slightly negative when controls are included (−0.020, significant at the 1% level). These households, like *mboy* households, are more wealthy on average than households without these *oldboys*. Given the focus on a cohort of men who are otherwise likely to be very similar to younger men active on the marriage market (if anything, they should have more income/wealth, on average, which they could use to purchase a latrine), the null result suggests that male preferences have not changed as a result of the program and/or older men are not responding to the program's implicit message of how important toilets are for women if they are not subject to marriage market pressure. This provides additional evidence that the mechanism through which the program operates is the marriage market channel.

6.2. Are young women driving latrine adoption outside of marriage?

A second possibility regarding the behavioral mechanism driving latrine adoption is that young females are empowered by the campaign's messages to demand latrines not just from potential suitors but in their own households as well. For example, girls might learn from *No Toilet No Bride*'s emphasis that latrines are valuable, or that they may demand them widely without shame, and subsequently push their parents or husbands into buying them. Under this hypothesis, women still push for latrines as a result of the program but they obtain the goods for reasons that have nothing to do with marriage *per se*.

To study this issue, I use a DDD regression that focuses on *mgirls* while controlling for the effect of *mboys*. Table 8 in the online appendix reports the results from this analysis. In this case, the coefficient of interest is again statistically indistinguishable from zero. This suggests that among girls who are active on the marriage market, and who are thus a primary target of the *No Toilet No Bride* message, there is no program-induced ability to obtain latrines when controlling for the effect of *mboys*. These results provides an instructive counterpoint to the results from Table 4. In that case, women are able to obtain latrines through marriage, in accordance with their preferences. But when these marriages are controlled for in the regression here, we observe no program effect at all operating via a change in empowerment or status of *mgirls* in the absence of marriage.

6.3. Household composition

Household structure might play a particularly important role in this context because of the strong son preference in the greater Punjab region. One form this son preference can take is fertility behavior that follows a stopping rule, i.e. when families have children until they have a boy, who will continue to live in the family compound and care for the parents in old age (girls will typically marry and move away from the village). If households practice a stopping rule, then households with any girl children will be, on average, larger and slightly older than households without girls. This reasoning suggests that the demographic and age structure of the household might vary systematically with the gender composition of the children.

I present two forms of evidence to mitigate this concern. First, Fig. 4 graphs trends in household size by treatment status. Over the entire sample period from 1992 to 2008, the trends in household size for *mboy* and non-*mboy* households in Haryana and control states are parallel, which argues against household size and stopping rules

driving differential results for *mboy* households. In addition, the regression results from Section 6.1 above also alleviate concerns about trends in household composition, e.g. those driven by stopping rule behavior and sex-selective abortion being correlated with trends in latrine ownership. This placebo treatment group, comprised of men only slightly older than the treatment group, is otherwise extremely similar to the *mboy* treatment group in terms of household characteristics, such as wealth effects associated with dowry (either not needing to save for one or receiving one). That no effect is observed for this cohort slightly older than those currently active on the marriage market argues against a role for differential trends in household composition driving the results.

7. Possible mechanisms

The combined evidence suggests that *No Toilet No Bride* was effective in increasing latrine adoption by influencing actors in the marriage market. The program changed latrine ownership among households with marriage-age boys, but not marriage age girls if no similarly aged boys were present. Nor did it alter latrine ownership among households with boys just beyond the age at which most boys marry. Moreover, the effect is concentrated in marriage markets with a relative scarcity of women, so marriage market competition appears to play a key role.

These empirical results are consistent with multiple theoretical interpretations. For example, the program can be understood in the context of a transferable utility model of the marriage market with premarital investment, as in Chiappori et al. (2009), with the investment choice being made by men over whether to invest in a latrine. In this framework, *No Toilet No Bride* could have reduced the cost to women of expressing their latent preferences on latrines, while men increase their desirability on the marriage market by investing in a latrine. As in other collective household models, the sex ratio in a marriage market acts as a distribution factor that shifts the division of marital surplus toward the scarcer sex, in this case by women obtaining this good they particularly value. This interpretation of the program leaves unanswered, however, precisely how the program might have reduced the cost to women of asking for a latrine.

The most likely explanation for how the program worked focuses on the role of *No Toilet No Bride* in changing the bargaining environment of the marriage market. In particular, the program seems to have acted as a coordination mechanism, which altered the social acceptability of demanding a latrine and so made it easier for any given female to demand a latrine knowing that other females would be doing the same. Indeed, this interpretation is supported by anecdotal evidence, such as the comment (cited earlier) by founder of Sulabh International when he said: "The No Toilet No Bride program is a bloodless coup. When I started, it was a cultural taboo to even talk about toilets. Now it's changing." Additional evidence of the importance of social coordination in fostering the acceptability of demanding a toilet can be seen in the case of Anita Bai Narre from Madhya Pradesh, who earned national press²⁴ a large monetary reward, and a visit from then president Pratibha Patil²⁵ after refusing to stay at her husband/in-laws' home due to a lack of latrine (her husband ended up building her a latrine and she returned to his household). Narre's story, and an advertisement based on it featuring the Bollywood actress Vidya Balan, have both been credited with increasing females demanding (and obtaining) latrines in Madhya Pradesh.²⁶ These stories support the idea that an element of coordination has been important, if not critical, to success.

²⁴ Source: <http://www.thehindu.com/news/national/bride-who-demanded-toilet-after-marriage-rewarded/article3013568.ece>

²⁵ <http://pib.nic.in/newsite/erelease.aspx?relid=81328>

²⁶ Source: http://www.huffingtonpost.com/2013/06/26/total-sanitation-campaign_n_3504285.html

8. Conclusion

This paper focuses on an innovative natural policy experiment known as *No Toilet No Bride*, which highlighted the link between latrines, for which women have a strong preference due to concerns about privacy and security, and marriage markets in Haryana state in the historical Punjab region. Because the program encouraged girls' families to demand from boys' families a latrine prior to marriage, it generated disproportionate pressure to construct a latrine specifically among those households whose boys were of marriageable age and seeking a bride. I demonstrate that marriageable boy households were indeed affected disproportionately by the program, and I estimate the *No Toilet No Bride* treatment effect to have increased latrine ownership by 21% over the baseline mean among Haryana households with marriageable boys in 2004. In addition, estimates of latrine adoption in Haryana post-treatment are larger in marriage markets characterized by a scarcity of women as compared to marriage markets with more women than men.

These results are invulnerable to competing hypotheses focused on something other than marriage market pressures. In particular, I have shown (i) there is no evidence that unobserved factors correlated with household size are driving my estimates, (ii) the program does not appear to have changed non marriage-age males' preferences for latrines, and (iii) girls of marriageable age are unable to obtain latrines if there is not a boy of similar age in the household (either a brother or husband). The *No Toilet No Bride* program thus appears to have caused a significant increase in latrine ownership in Haryana specifically through marriage market pressure generated by male-biased sex ratios.

The underlying mechanism that drives latrine adoption among households with marriageable boys is thus competition on the marriage market and a household's desire to marry successfully its boys. In exploring the impact of skewed sex ratios on women's bargaining power, as reflected in female demand (or that of their families on their behalf) for latrines under *No Toilet No Bride*, this paper provides direct evidence that, despite widespread and persistent discrimination, heightened competition on the male side of the market has shaped the overall bargaining environment.

Finally, in addition to the literature on sex ratios, bargaining power, and marriage, this paper also makes an important contribution to the limited evidence that exists on the effectiveness of sanitation campaigns at large scale. According to the 2011 Census, nearly 70% of India's rural population still lacks access to sanitation. This situation is associated with severe morbidity and mortality: an estimated half a million children under five die each year in the country due to diarrheal disease, which is exacerbated by inadequate sanitary behavior and sanitation infrastructure (Black et al., 2003). Recent estimates suggest that open defecation accounts for 9% of India's current infant mortality (Geruso and Spears, 2015).

In this critical policy context, a low-intensity information campaign—*No Toilet No Bride*—cleverly exploited deeply rooted social norms and marriage market conditions in order to increase investment in sanitation. The estimates in this paper and back-of-the-envelope calculations suggest that, as a result, there are approximately 670,000 more toilets among Haryana's 4.3 million households in 2008 than in 2004.²⁷

It is instructive to compare the effectiveness of this program with other large-scale efforts to improve sanitation. Most relevant are sanitation promotion campaigns in India motivated by community-led total sanitation (CLTS), such as the Total Sanitation Campaign (1999–2014) and later Prime Minister Narendra Modi's renamed

version Clean India Mission (2014–present), which focus on increasing demand for toilets at the village level. In India, these large programs have focused not only on social drivers of behavior change, as was the initial concept behind community-led total sanitation, but also on reducing costs for households with Below Poverty Line cards by providing subsidies. The added focus on hardware subsidies limits the comparability to this evaluation but is useful for establishing benchmarks on sanitation program effectiveness, which is variable. For example, Patil et al. (2014) find that the Total Sanitation Campaign, which includes an expensive subsidy component, increased latrines by 19% in Madhya Pradesh, an estimated program effect of similar magnitude to *No Toilet No Bride*. Meanwhile, two cluster-randomized studies in Orissa/Odisha state find increases of 50 percentage points Clasen et al. (2014) and 27 percentage points Dickinson et al. (2015) in latrine ownership. In a cluster randomized trial in Bangladesh, however, promotion campaigns alone failed to increase in latrine ownership and only worked in conjunction with subsidies; together these treatments increased latrine access by 9.4% (Guiteras et al., 2015).

The estimates of *No Toilet No Bride*'s effect are thus comparable with the lower end of the range of existing estimates on the Total Sanitation Campaign, and are substantially higher than evidence from Bangladesh. But given these programs' emphasis on costly subsidies, it is likely that the cost-effectiveness of *No Toilet No Bride* is quite favorable. Precise data on program expenditures are not available, but it is possible to use administrative data from the Total Sanitation Campaign to assess relative cost-effectiveness. For simplicity, I compare component-wise Total Sanitation Campaign expenditures in Haryana only between 2005 and 2008. During that period, the Total Sanitation Campaign spent 3.75 times more on subsidies for physical construction of private latrines than on information and education, which includes social marketing like *No Toilet No Bride* (420 million versus 111 million Indian rupees, or \$8.2 million versus \$1.1 million USD at 2008 exchange rates). This general pattern of greater expenditures on latrine hardware over social marketing is a characteristic of state-level TSC expenditures in all of India, which suggests that expanding effective social marketing like *No Toilet No Bride* could be a highly cost-effective means of increasing toilet coverage elsewhere in the right social conditions, such as those that exist in northern India.

No Toilet No Bride's success in Haryana, which was largely anecdotal until now, has since spread and has been promoted recently in public messages by politicians and celebrities. For example, India's Minister of Rural Development Jairesh Naresh explicitly linked toilets to marriage in a 2012 speech: "You consult astrologers about *rahu-ketu* (the alignment of sun and moon) before getting married. You should also look whether there is a toilet in your groom's home before you decide don't get married in a house where there is no toilet [sic]."²⁸ This statement was part of a series of speeches that elevated the status of the program to a national (rather than Haryana-specific platform). Bollywood actress Vidya Balan created advertisements aired on national TV (sponsored by the Total Sanitation Campaign), which depict two different women leaving their husbands houses because they lack latrines.²⁹ In this context my estimates of *No Toilet No Bride*'s effect, and the important role played by marriage market competition, suggest that the program could potentially be effective in much of northern India, which is characterized by male-biased sex ratios. My conclusions are therefore informative not only about female bargaining power in the context of skewed sex ratios, but also instructive regarding the design and scale-up of sanitation policy and behavior change programs more generally.

²⁸ Source: The Telegraph UK, 22 Oct 2012. <http://www.telegraph.co.uk/news/worldnews/asia/india/9625629/Indian-government-launches-no-lavatory-no-bride-campaign.html>

²⁹ Source: Times of India, 21 March 2015. <http://timesofindia.indiatimes.com/city/varanasi/Inspired-by-Vidya-Balan-bride-pressurises-in-laws-for-toilet-in-village-home/articleshow/46643372.cms>

²⁷ The main estimate of the *No Toilet No Bride* effect (0.061) comprises 35% of the overall change in latrine ownership among *mboy* households in Haryana between 2004 and 2008 (0.172). Haryana gained a total of 1.91 million toilets in this timeframe, according to DLHS data, so 35% of this figure is 668,500.

Appendix A. Supplementary data

Supplementary data associated with this article can be found in the online version at <http://dx.doi.org/10.1016/j.jdeveco.2017.04.003>.

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