Does a Legal Ban on Sex-Selective Abortions Improve Child Sex Ratios? Evidence from a Policy Change in India

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Abstract

Despite strong recent economic growth, gender inequality remains a major concern for India. This paper examines the effectiveness of a public policy geared towards the reduction of gender inequality. The national Pre-Conception and Pre-Natal Diagnostics Techniques (PNDT) Act of 1994, implemented in 1996, banned sex-selective abortions in India. Although demographers frequently mention the futility of the Act, we are among the first to evaluate the law using a treatment-effect analysis framework. Using village and town level longitudinal data from the 1991 and 2001 censuses, we find a significantly positive impact of the PNDT Act on female-to-male child sex ratio. Given the almost ubiquitous decline in the observed child sex ratio during this period, we argue that the law was successful in preventing any further worsening of the gender imbalance. We find that a possible absence of the law would have led to at least 106,000 fewer female children.

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1 Introduction

The recently released data from the Indian 2011 census has refocused the world's attention on the dark side of India's demographic change – a low and falling ratio of girls to boys. For the last 40 years, each successive census has found the number of young girls shrinking relative to boys. Interestingly, the deterioration in the child sex ratio has occurred in the face of rising living standards and improvements in every other indicator of demographic change and human development – average life expectancy, infant mortality, male and female literacy, fertility rate, and schooling enrollment of children.

India is one of a handful of countries that has significantly more males than females. The problem is particularly severe at younger ages; the child sex ratio (i.e., the number of girls per 1,000 boys in the 0-6 years age group) has declined steadily – from 964 in 1971 to 962 in 1981, 953 in 1991, 927 in 2001, and 914 in 2011.[1] Although a distorted child sex ratio is observed in other Asian countries, including China, Taiwan, Singapore and Vietnam, India has one of the lowest child sex ratios in the world.

The low child sex ratio in India arises from the practices of sex-selective abortions and excess female infant mortality, both of which are the result of a strong cultural preference for

[1] The natural sex ratio in a population typically ranges from 950 to 970 girls per 1,000 boys. In the rest of the world, sex ratio is generally reported as male-to-female. The Indian Census has been historically reporting female-to-male ratios and we will use this definition throughout this paper.

sons over daughters.[2] Some estimates have put the number of 'missing females' (i.e., unborn girls) in India as high as 37 million (Sen 2003).

The low and falling child sex ratio in the country is a matter of grave policy concern, not only because it violates the human rights of unborn and infant girls but also because it deprives the country of the potential economic and social contribution of these 'missing women.' In addition, there may be longer-run adverse impacts from a marriage market squeeze caused by an excess supply of male relative to female youth.[3] Already, states like Haryana and Punjab, where the sex ratio has been extremely distorted for several decades, have been experiencing bride trafficking.

After abortion was legalized in India in 1971, and technologies to diagnose the sex of the fetus became widely available, the practice of sex-selective abortions became widespread. As the prices for sex-selection diagnostic tests fell during the 1980s and 1990s, the practice became even more rampant. The Indian government finally responded to this problem by passing the Pre-Conception and Pre-Natal Diagnostics Techniques (PNDT) (Prohibition of Sex Selection) Act in 1994. The PNDT Act prohibited the use of diagnostic methods to diagnose the sex of an unborn child. However, there is a general perception within India that the Act has not been effective, as the child sex ratio has continued to fall. India's home (interior) secretary, Mr. G.K. Pillai, echoed this sentiment when he admitted recently that "... whatever measures that have been put in over the last 40 years have not had any impact

[2] Zeng Yi et al. (1993), Park and Cho (1995), Chu (2001), Lin et al. (2008), and Zhu et al. (2009) study prenatal sex selection practices in East Asian countries. Almond and Edlund (2008), Almond et al. (2009) find male-biased sex ratio among the children of Asian immigrants in US and Canada. Li (2002), Das Gupta (2005), Qian (2009), Ebenstein (2010) evaluate the impact of family planning policies on gender imbalance. Rosenzweig and Schultz (1982), Das Gupta (1987), Clark (2000), Foster and Rosenzweig (1999), Duflo (2003), Jayaraj and Subramanian (2004), Qian (2008), Chamarbagwala (2010) examine the association between socioeconomic status of adult women with relative outcomes for girls versus boys. Drew et al. (1986), Norberg (2004), Oster (2005), Lin and Luoh (2008) discuss possible noneconomic factors affecting gender imbalance.

[3] Angrist (2002) studies the long-run impact of sex imbalance on marriage and labor markets. Messner and Sampson (1991) in the context of US and Edlund et al. (2007) in the context of China associate male-biased sex ratios with increased violence. Francis (2009) examines the impact of gender imbalance on bride price and child outcomes in Taiwan. Hudson and Den Boer (2002, 2004) argue that societies with high male-to-female sex ratio have always experienced higher violent crime rates. Hesketh (2009) discusses the possible marriage market related outcomes of the gender imbalance in China.

on child sex ratio and therefore that requires a complete review."[4]

Secretary Pillai's assertion is not quite accurate, since the child sex ratio could have deteriorated even more in the absence of policy measures, such as the PNDT Act. The problem is that while there have been a large number of empirical studies of the child sex ratio in India and in other countries in recent years, none has focused on the impact of legislation or a policy intervention on improving the boy-girl balance.[5]

To our knowledge, our paper is the first to explore the causal impact of a major legislation – the PNDT Act – on the child sex ratio. While the Government of India began enforcing the PNDT Act from 1996, it was non-binding for the western Indian state of Maharashtra, since that state already had its own PNDT-type law in place since 1988. Therefore, the implementation of the PNDT Act in 1996 in all the other Indian states provides us with an exogenous policy variation.We exploit this policy variation across states to analyze the causal impact of the legislation on gender imbalance, using a rigorous treatment-effect analytical framework.

Our main outcome variable of interest, the child sex ratio (number of girls per 1000 boys of age below 6 years), depends on two factors – sex ratio at birth and gender-specific mortality rates among children ever born. Preventing the abortion of girl fetuses will directly reduce the masculinity of the sex ratio at birth. However, the law might have induced an additional behavioral shift among households. Unwanted girl fetuses, if not aborted by virtue of the PNDT Act, could grow up as unwanted children in the household and be deprived of important resources such as nutrition and medical care, thus being more vulnerable to infant and child mortality. The use of the child sex ratio (instead of the sex ratio at birth) permits

[4] *The Economic Times*, 1 April 2011

[5] For example, Arnold, Kishor and Roy (2002) use NFHS 1998-99 data to link the prenatal use of ultrasound and amniocentesis by pregnant women with sex-selective abortions and the sex ratio at birth. Visaria (2007) uses primary data from the states of Gujarat and Haryana to find evidence of sex-selective abortions, particularly for higher birth orders. Patel (2007 ed.) provides a comprehensive overview of sex-selective abortions in India. Subramanian and Selvaraja (2009) employ a logistic regression approach to analyze the odds of the birth of a boy child between the pre-ban and post-ban periods. Using five rounds of data from the National Sample Surveys (NSS), they find no significant difference in the odds of a boy-birth before and after the 1996 PNDT.

us to capture the effect of the PNDT Act on both the number of female babies born relative to male babies as well as on differential mortality across young boys and girls.[6]

There is one other way in which our paper is unique. Unlike previous studies on child sex ratios in India, which use highly-aggregate state or district-level data, we use disaggregated Census data on more than half a million Indian villages and 1,500 towns over two time periods – 1991 and 2001 – to evaluate the impact of the PNDT Act on child sex ratios. Using these longitudinal datasets, our methodology incorporates various time-invariant and time-varying socioeconomic and cultural characteristics, which often determine the sex selection behavior of communities.

To anticipate our results, we find a significant positive causal effect of the PNDT Act on the child sex ratio, with the magnitude of the effect varying across different subsamples. The positive effect of the PNDT Act we obtain runs counter to the generally-perceived ineffectiveness of the law in the popular Indian press. One reason for the popular misperception is that the child sex ratio in much of India, including in the state of Maharashtra, worsened significantly during the 1991-2001 period. However, our empirical results suggest that the gender imbalance in India would have worsened even more in the absence of the PNDT Act.

Our research provides a silver lining to the generally bleak view of the 1996 PNDT Act. The significant impact of the PNDT Act in improving the child sex ratio suggests that, with better enforcement, a ban on sex-selective abortions can not only halt – but even reverse – the declining trend in the child sex ratio in India. Encouragingly, the Indian government has taken a step in the right direction by expanding the provisions of the PNDT Act in 2003, and by improving enforcement of the law in recent years.

[6] Another factor that may differentially affect the mortality rates of young boys and girls is the access to subsidized public goods. For example, with cheap access to healthcare facilities, households may be less likely to neglect girls. Hence, our analysis uses information on the access to healthcare and other infrastructural facilities, whenever possible.

2 Sex-selective Abortions in India

Abortion was legalized in India by the Medical Termination of Pregnancy Act of 1971. However, the law required abortions to be performed by registered medical practitioners, and only under certain acute medical conditions affecting the pregnant woman. Abortion as a choice, except for unwanted pregnancies resulting from rape, was not legalized.

Fetal sex determination techniques such as amniocentesis, originally intended for the detection of fetal abnormalities, were first introduced in 1975 (Luthra 1994). The rampant misuse of amniocentesis and other techniques, such as chorionic villas sampling and ultrasound, for aborting female fetuses rapidly became a major concern, and it remains so till this day (George and Dahiya 1998, Sudha and Rajan 1999, Arnold et al. 2002, George 2002, UNFPA 2001).[7] The astonishing pace at which the network of private clinics providing sex determination and abortion services grew was marked by two features – the tests were cheap (Wertz and Fletcher 1993) and they were widely available, even in remote rural areas bereft of basic amenities and health facilities (possibly because of the widespread use of portable ultrasound equipments and amniocentesis kits) (Menon 1996, Ganatra et al. 2001).

Although data paucity prevents us from obtaining dependable statistics on sex-selective abortions in India, several studies have attempted to estimate the number of unborn girl fetuses from secondary sources. The results, though marked by wide variation, indicate the severity of the problem. Jayaraman (1994) and Arnold et al. (2002) estimate the number of aborted girl fetuses to be between 50,000 and 100,000 every year. Other studies suggest that the incidence rate could be even higher – e.g. using data from the Special Fertility and Mortality Survey (1998) of 1.1 million Indian households, Jha et al. (2006a) estimate that

[7] The association between abortion laws and sex selection have been studied in some other countries. For example, Lin, Liu and Qian (2010) find that with widely available prenatal sex determination techniques in Taiwan, a legalization of abortion, in 1985, led to more male-biased sex ratios at birth. However, they also find that excess female child mortality may have reduced by 20% as a consequence. The negative association between sex-selection techniques and female-to-male sex ratios has also been studied, in the context of China by Li and Zheng (2009), and in the context of Nepal by Valente (2010).

between 450,000 to 540,000 sex-selective abortions take place in India each year.[8]

Anti-sex determination campaigns during the mid-1980s focused attention on the vast scale of the problem, especially in the urban areas of northern and western India (Retherford and Roy 2003). Prenatal sex determination was banned in public healthcare facilities nationwide as early as 1978. However, largely due to public awareness campaigns[9], the state government of Maharashtra was the first to impose a complete ban on all (public and private) prenatal sex determination in 1988[10]. The rest of the country followed suit with a similar ban by the Indian central government, known as the Pre-Conception and Pre-Natal Diagnostics Techniques (Prohibition of Sex Selection) Act of 1994 (PNDT Act, effective from 1996).[11]

There is a general consensus (Luthra 1994, Jha et al. 2006a, Hatti and Sekhar 2004, Arnold et al. 2002, Visaria 2007) that these bans have not been very effective. This perception is likely the result of continued deterioration of the child sex ratio observed in the 2001 Census (and, most recently, the 2011 Census). Despite the ban on sex-selective abortions, the child sex ratio declined from 945 in 1991 to 927 in 2001. In the wake of these findings and the large public outcry that ensued, the Indian government amended the PNDT Act in 2003 and doubled down on the campaign against sex-selective abortions.

Our objective is to evaluate the impact of the 1996 nationwide implementation of the PNDT Act. Unlike previous studies, we use the difference in timing of the Act's implementation in Maharashtra versus other states to identify the causal effect of the Act on the child sex ratio. The national PNDT Act was very similar to the Maharashtra Act of 1988 and

[8] However, the estimates by Jha et al. (2006a) have been contested. See further discussions in Bhat (2006), George (2006), Jha et al. (2006b).

[9] The 'Forum against Sex Determination and Sex Preselection' in Maharashtra is a prominent example of such campaigns (Gangoli 1998).

[10] Source: "Handbook on Pre-Conception & Pre-Natal Diagnostic Techniques Act, 1994 and Rules with Amendments", 2006, Ministry of Health and Family Welfare, Government of India. Following Maharastra, a few other states such as Punjab, Haryana, Rajasthan, and Gujarat implemented similar bans on fetal sex determination. However, we could not find any documentation and evidence on enforcement of these bans. Also, our results are robust to the exclusion of these states from our analysis.

[11] Under the law, first offenders face up to Rs. 10,000 fine and/or 3 year imprisonment. This includes persons or establishments performing sex-selective abortion, as well as the husband/relatives if the woman if forced to undergo the procedure. Repeat offenders are punishable with up to Rs 50,000 fine and/or 5 year imprisonment.

thus non-binding to Maharashtra by virtue of it already being in place in that state.

3 Data

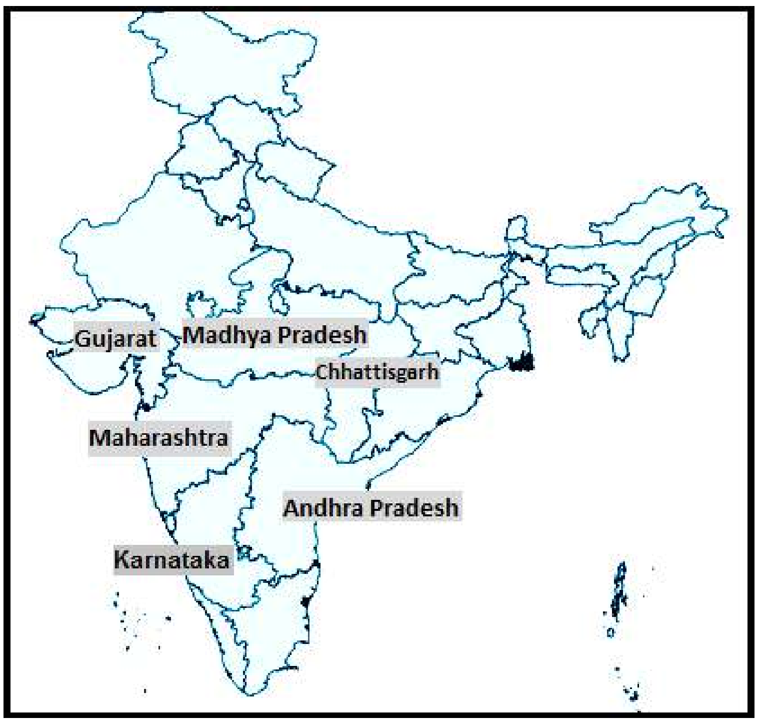
We use rural and urban data from the two decennial Indian censuses of 1991 and 2001. Our main study area is the western state of Maharashtra (MH) and its neighboring states of Gujarat, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh (Figure 1).[12]

The rural data for each census year come from two different Census sources. The Primary Census Abstract (PCA) provides demographic information on each village, such as age, gender, and caste composition and labor force participation rates. These data were merged with the Census Village-Level Amenities Data (VLAD), which provide information on the availability of various infrastructural facilities and amenities, such as health and educational facilities, electricity, roads, and sources of drinking water. At the next step, we matched the villages from two census years, 1991 and 2001, creating a village-level panel dataset containing information from both the PCA and the VLAD data sets.

We also estimate second set of models using the Primary Census Abstract (PCA) data on towns from the 1991 and 2001 censuses. The town PCA data provide information on population, age, caste, employment, and education in the urban centers. Towns across the two census periods have been matched to create a panel dataset at the town level. Unlike the village data, the census town data do not provide information on the availability of facilities and amenities, presumably because of the ubiquity of these basic services in the urban areas. As a result, we have a different set of controls in our rural and urban estimations.

[12] The state of Chhattisgarh was created from Madhya Pradesh in 2000. However, the census data allow us to exactly map villages and towns in the states that were divided in between the two time periods, thus avoiding any complications arising from the division of the state of Madhya Pradesh.

Figure 1: Indian States



Source: Census of India 2001. Map is for illustration purpose only and may not depict correct political boundaries. Only states belonging to our main study area are shown due to space consideration.

4 Empirical Strategy

Our empirical strategy exploits spatial variation in the timing of the ban on sex-selective abortions. Villages and towns in the state of Maharashtra, which had already passed and implemented legislation banning sex-selective abortions in 1988, were not affected by the national PNDT Act in 1996, and as such constitute the control group in our analysis. To avoid confusion with the conventional practice of referring to the group without any treatment as a 'control group', we will hereafter refer to villages and towns in Maharashtra as the 'pre-treated' group. The treatment (or the 'newly-treated') group consists of villages and towns in the states bordering Maharashtra – states that experienced the centrally-mandated PNDT Act during the study period 1991-2001.

Our estimating equation is:

$$y_{jt} = \tau Law_{jt} + \alpha_j + \beta_t + \gamma INF_{jt} + \delta X_{jt} + \epsilon_{jt} \tag{1}$$

where y_{jt} is the child sex ratio (number of females aged 0-6 per 1,000 males aged 0-6) in the *j-th* village at time $t = 1, 2$ (corresponding to years 1991 and 2001, respectively). On the right hand side, our main variable of interest is the treatment status indicator (PNDT implementation) Law_{jt}. For pre-treated Maharashtra villages, $Law_{jt} = 1 \forall t$, while for newly-treated non-Maharashtra villages, $Law_{j1} = 0$ and $Law_{j2} = 1$.

Among the control variables, $\boldsymbol{INF}$ is a time-varying vector of village and household infrastructure. Public healthcare infrastructure is captured by the presence of at least one public health facility – a primary health center, sub-center or a community health center. Additionally, we include the availability of a registered private doctor, a community health worker, and a maternal or child welfare center in a village. Educational facilities included in $\boldsymbol{INF}$ are the presence of a primary or middle school, and a high school, in a village. Other infrastructural variables include the availability of a paved road, telephone service, electricity, and clean drinking water (tap water) in a village.

A vector of village-level demographic characteristics is represented by the time-varying vector $\boldsymbol{X}$. It includes factors that may affect the strength of son preference among parents. Parental education is measured by female and male literacy rates. To control for differences across ethnic groups, we include the percentages of a village's population that belongs to scheduled (low) castes (SC) and scheduled tribes (ST).[13] The standard of living in a village is captured by the mean amount of cultivated land per cultivator and the percentage of cultivable land that is irrigated. Village size is controlled for by the inclusion of total log population of a village.

Unobserved heterogeneity across villages is denoted by α_j. It captures socioeconomic and cultural differences across villages – time-invariant factors that may differentially affect the parental preference of sons over daughters. β_t denotes a time-varying intercept and ϵ_{jt} is an *iid* error term. Taking the first-difference of equation (1), we obtain:

$$\triangle y_{jt} = \tau \triangle Law_{jt} + \lambda_t + \gamma \triangle INF_{jt} + \delta \triangle X_{jt} + \triangle \epsilon_{jt} \tag{2}$$

The time effect is $\lambda_t = (\beta_t - \beta_{t-1})$, and τ is the difference-in-difference marginal effect of PNDT. The first difference operator is $\triangle$, i.e. $\triangle y_{jt} = (y_{jt} - y_{jt-1})$ etc.

Another set of models similar to equation (4) are estimated for the census town level panel data:

$$\triangle y_{kt} = \tau \triangle Law_{kt} + \lambda_t + \delta \triangle X_{kt} + \triangle \epsilon_{kt} \tag{3}$$

where k denotes the $k-th$ census town. The vector $\boldsymbol{X}$ includes town-level demographic information, e.g. total log population, female literacy rate, male and female work participation rates and the percentages of SC and ST population to total population.

Assuming that the passage of the PNDT Act in 1996 did not have any effect on the pre-treated group, we can attribute any improvement in the child sex ratio of the newly-

[13] SC and ST subpopulations are socioeconomically backward groups designated by the Government of India

treated group to the 1996 PNDT Act, *ceteris paribus*. Therefore, the estimated coefficient τ will capture the difference-in-difference effect of the law. Even if we assume that the 1996 PNDT Act also affected the pre-treated group (say, by improving the enforcement of the state legislation), it will only dampen the observed impact of the PNDT Act on the newly-treated group. Thus, the true effect of the PNDT Act will be even larger than our estimates suggest.

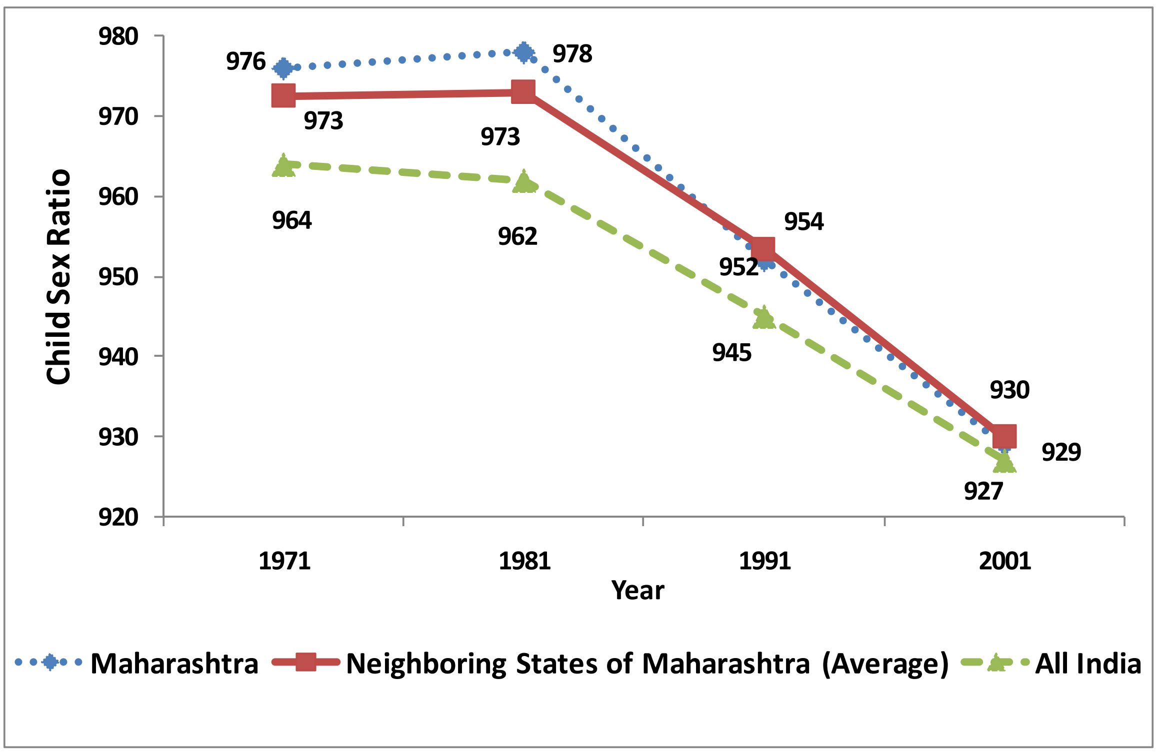
Our estimates may be biased for another reason. The child sex ratio is defined over children aged 0-6 years; but children aged 4-6 years in the pre-treated group (viz., villages in Maharashtra) in 1991 were never exposed to the treatment, as they were born before Maharashtra implemented its ban on sex-selective abortions (viz., 1988). However, as in the earlier case, the inclusion of this age subgroup in the analysis will reduce the observed difference in response rates between the pre- and newly-treated groups. In other words, our estimate of the impact of the PNDT Act in the newly-treated group is underestimated relative to the true estimate.

It should be noted that the PNDT Act may affect the sex ratio among young children in two ways. First, if successful, the law will improve the sex ratio at birth in favor of girls. However, child sex ratio is composed of sex ratio at birth, and the sex ratio of surviving children less that 6 years of age. Therefore, as the law results in unwanted female child births, it may reduce the survival rate of young girls, in turn.[14] We only observe the net result of these two opposing effects on the 0-6 year age group. Disaggregation of these effects is, unfortunately, beyond the scope of this study.

The validity of the so-called parallel trends assumption is crucial to any treatment-effect analysis. For our study, this implies that the child sex ratio in the pre-treated and newly-treated groups should follow a parallel time-path in the absence of a PNDT policy. Alternatively, there should not be any systematic difference between the two groups. Figure 2 presents the decadal child sex ratio from recent Indian censuses. The child sex ratio has

[14]The opposite of this effect is observed by Lin, Liu and Qian (2010) in Taiwan, where excess female child mortality reduces with the legalization of abortion.

Figure 2: Child Sex Ratio in Indian States, 1971-2001 (Females per 1000 Males in the 0-6 year Age Group)



Source: Census of India, 1971, 1981, 1991, 2001 been declining steadily over the last three decades nationally as well as in Maharashtra and neighboring states. While the latter group has always had a higher child sex ratio than the national average, the gap between the two has narrowed significantly since 1991.

Additionally, we calculate annual female-to-male sex ratios from the District Level Household Survey (DLHS 2002-04), a large household survey of over 620,000 Indian households. This survey provides information on a self-reported birth history of each mother. Using these data, we compute sex ratios at birth, and in the age group 0-6 years, presented in Appendix Figures A.3 and A.4, respectively. In Figure A.4, one can observe a clear structural break in the time series for Maharashtra after the passing of PNDT Act in 1988, indicating the success of the law. For the rest of the states, a mild upward trend starting in 1996 can be observed. Finally, Appendix Figure A.5 also shows the child sex ratio by birth cohorts, calculated using data from three consecutive National Family Health surveys (NFHS 1992-93, 1998-99 and 2005-06).

However, the evidence on the parallel trends assumption is not fully conclusive, owing to the inconsistent movement of the time series (especially sex ratio at birth) in all the above graphs – probably the result of different mortality rates affecting each age group, recollection bias affecting the birth history information in DLHS, and the small size of the sample.

4.1 Rural Areas

One common problem of a multi-state treatment-effect analysis is the heterogeneity of the pre-treated and newly-treated groups. The states in our study area are dissimilar in many respects (e.g., language). We control for time-invariant heterogeneity by estimating village fixed-effects estimates. Since these estimates do not control for time-varying heterogeneity, which may be important in our sample, we restrict our analysis to neighboring states in close proximity that are likely to share similar changes in social, cultural and linguistic traits over time. We start by restricting our study area to the villages along the administrative border of

Maharashtra and its neighboring states (Subsample I).[15] The resulting sample includes 7,800 villages from the border *taluks* (sub-districts) inside Maharashtra (pre-treated group) and 9,200 villages from non-Maharashtra *taluks* bordering Maharashtra (newly-treated group).[16]

One downside of this approach is that our study area is susceptible to spillover effects. In the absence of any cross-border migration restrictions, couples in the pre-treated group of villages seeking sex-selective abortions could have readily traveled to a clinic just outside Maharashtra's border (until the national PNDT Act of 1996 was implemented in the other states). If we consider the case of complete contamination, where couples from the pre-treated area continue to obtain tests across the border until a nationwide ban is implemented, we will observe no relative improvement in the child sex ratio in the newly-treated areas as compared to the pre-treated areas. Partial spillover will attenuate the observed impact of the PNDT Act on the newly-treated group.

Next, we expand the analysis to a second subsample which is less vulnerable to contamination. Villages are drawn from all the districts located along the border of Maharashtra and neighbor states; however, we drop the villages from the immediate *taluks* on both sides of the Maharashtra border (Subsample II). This gives us a sample of 16,300 pre-treated and 17,500 newly-treated villages. The motivation behind choosing this subsample is that a pre-treated Maharashtra village is similar in characteristics to a newly-treated village from a neighboring non-Maharashtra district, but the two villages are still adequately distant to prevent spillovers.

To check the robustness of our results and for the sake of comparison, two additional subsamples are used – Subsample III, which includes all villages from Maharashtra and neighboring states except the ones from immediate districts on both sides of the border.

[15] The administrative division of rural India is as follows – each state (median population size 44.1 million) is divided into several districts (median population size 1.5 million). Each district is divided into several sub-districts or *taluks* (median population size 170,638). Each *taluk* consists of numerous villages (median population size 747). Median population sizes are based on 2001 census data of 19 major states.

[16] District- and taluk-level administrative maps from Census 2001 were used to identify pre-treated and newly-treated villages in various subsamples. Official district maps from the Census are provided in the Appendix.

This subsample contains 15,640 pre-treated and 113,900 newly-treated villages. Subsample IV includes all villages from Maharashtra and all villages from neighboring states. There are 39,711 villages in Maharashtra and 140,622 villages in all the neighboring states.

Finally, Subsample V includes villages from Maharashtra and all other major states in the country (the latter forming the newly-treated sample).[17] The pre-treated group includes 39,711 villages from Maharashtra and 502,462 villages from the rest of the country.[18] [19]

Table 1 presents mean child sex ratios across various rural census subsamples. Figures A.6-A.10 in the Appendix provide a snapshot of changes in the child sex ratio over our study period across the rural subsamples. The Kernel density plots show that the pre-treated and newly-treated villages experienced very similar changes in the child sex ratio between 1991 and 2001. The distribution of the change in child sex ratio in the newly-treated villages, however, appears marginally to the right of the distribution in the pre-treated villages.

4.2 Urban Areas

For the urban areas, we analyze four different subsamples – first, a pre-treated group of 144 towns that belong to the districts along the state border inside Maharashtra and a newly-treated group of 49 towns from districts just outside the Maharashtra border (Subsample I).[20] [21] A second subsample includes towns in Maharashtra and neighboring states that are not in districts immediately along both sides of the Maharashtra border (Subsample II). This sample includes 90 pre-treated towns and 252 newly-treated towns. The third subsample (Subsample III) includes all towns in Maharashtra and neighboring states – 234 pre-treated

[17] We include Maharashtra and 18 other major states in the sample. Smaller north-eastern states (except Assam), Goa, Delhi and Union Territories have been excluded from the analysis.

[18] The actual number of observations used in our rural and urban regression models may be slightly fewer than described here and the next subsection, due to some missing observations. Brief descriptive statistics on the characteristics of all five rural subsamples are presented in Appendix Table A.6.

[19] We also evaluated the effect of PNDT on sex ratio at the household level by conducting a similar difference-in-difference analysis using microdata from NFHS 1992-93 and 1998-99 surveys. However, these results are not reported in this paper due to space constraints.

[20] Administratively, towns typically serve as taluk or district headquarters or state capitals.

[21] Unlike the rural analysis, the analysis is not disaggregated below the district level because the sample sizes would have been too small.

Table 1: Child Sex Ratio in Rural India, 1991 and 2001

	Mean Child Sex Ratio (Females per 1000 Males in 0-6 year Age Group)		
	Census 1991	**Census 2001**	**Change**
Subsample (I)			
Pre-treated villages from Maharashtra	977.7 (278.2)	957.4 (245.7)	- 20.3
Newly-treated villages from neighboring states	996.3 (365.1)	982.8 (243.2)	-13.5
Subsample (II)			
Pre-treated villages from Maharashtra	965.1 (242.7)	938.5 (228.4)	- 26.6
Newly-treated villages from neighboring states	989 (253.2)	982.2 (227.2)	- 6.8
Subsample (III)			
Pre-treated villages from Maharashtra	962.8 (236.3)	928.5 (219.5)	- 34.3
Newly-treated villages from neighboring states	964.5 (276.2)	957.3 (256.1)	- 7.2
Subsample (IV)			
Pre-treated villages from Maharashtra	966.7 (246.7)	938.3 (228.7)	- 28.4
Newly-treated villages from neighboring states	969.6 (272.9)	962.1 (252.1)	- 7.5
Subsample (V)			
Pre-treated villages from Maharashtra	966.7 (246.7)	938.3 (228.7)	- 28.4
Newly-treated villages from the rest of India	954.8 (294.7)	946 (267.8)	- 8.8

Source: Indian Census 1991 and 2001 rural data for 19 major states. Outlier observations have been dropped. Standard deviations are in parenthesis. 'Change' represents the difference between 1991 and 2001 values.

towns and 301 newly-treated towns. Finally, the fourth subsample treats all 234 towns in Maharashtra as pre-treated and all 1,213 towns from the rest of the country as newly-treated (Subsample IV).

Table 2 presents mean child sex ratios across the urban census subsamples. Kernel density plots of the change in child sex ratio (1991 to 2001) for the town subsamples are presented in Figure A.11 through Figure A.14 in the Appendix. The distributions are generally less smooth than their rural counterparts, mainly due to the smaller sample sizes. However, the distributions of the pre-treated and newly-treated groups are distinctly different; in most subsamples, the pre-treated group shows a stronger deterioration in the child sex ratio.

Table 2: Child Sex Ratio in Urban India, 1991 and 2001

	Mean Child Sex Ratio (Females per 1000 Males in 0-6 year Age Group)		
	Census 1991	**Census 2001**	**Change**
Subsample (I)			
Pre-treated towns from Maharashtra	942.8 (37.2)	902.7 (49.5)	- 40.1
Newly-treated towns from neighboring states	949.7 (28.4)	926.3 (32.8)	- 23.4
Subsample (II)			
Pre-treated towns from Maharashtra	939.3 (42.9)	897.3 (39.6)	- 42
Newly-treated towns from neighboring states	944 (41.1)	920.2 (56.8)	- 23.8
Subsample (III)			
Pre-treated towns from Maharashtra	941.5 (39.4)	900.6 (45.9)	- 40.9
Newly-treated towns from neighboring states	944.9 (39.3)	921.2 (53.7)	- 23.7
Subsample (IV)			
Pre-treated towns from Maharashtra	941.5 (39.4)	900.6 (45.9)	- 40.9
Newly-treated towns from the rest of India	928.6 (46.7)	899.9 (63.7)	- 28.7

Source: Indian census town PCA data 1991 and 2001. Figures in the parenthesis represent standard deviation. 'Change' represents the difference between 1991 and 2001 values.

5 Empirical Findings

The basic results from the village fixed-effects models estimated using the first two rural subsamples are presented in Table 3. Results from rural subsamples (III), (IV), and (V) serve as robustness checks. These results are presented in Appendix Table A.5 and mentioned, whenever relevant, in our current discussion. A fully interacted model for rural subsample (V) is also presented, alongside other subsamples, in the above table.[22] Since the PNDT policy is at the state level, we cluster the standard errors of all regression models at the state level to mitigate any serial correlation in the error terms. To avoid the asymptotic inconsistency generated by using a small number of clusters, all our regression models use the wild boostrapping method proposed by Cameron et al. (2008).[23] Results are robust to clustering at district or taluk levels.

The outcome variable in our rural data is the village level sex ratio, while we are interested evaluating the effect of PNDT at the population level. Therefore, all our rural regression models are weighted using the census 2001 population size in the age group 0-6 years at the village level.[24]

The first row in Table 3 presents the treatment effect estimates. Results from the first subsample – pre-treated and newly-treated villages from immediate taluks on both sides of Maharashtra border – do not exhibit any significant impact of the PNDT Act. Given that these geographically close communities are susceptible to spillover effects, a ban on sex-selective abortions is not expected to be effective in this subsample. In contrast, the second subsample where the risk of spillovers is lower – villages in neighboring districts on both sides of the Maharashtra border, but not in the *taluks* on either side of the border –

[22] In other fully interacted subsample regression models, the marginal effect of the PNDT indicator on child sex ratio is often insignificant. This is presumably due to the fact that sex selection behavior is likely to be correlated with the socioeconomic characteristics (time-varying) of villages. Some interaction terms themselves are statistically significant. We do not present these additional results due to lack of space.

[23] The estimation of cluster-robust standard errors are only valid for a very large number (theoretically, infinite) of clusters. Regression models with a small number of clusters tend to over-reject the null hypothesis of the insignificance of regression coefficients. We perform wild bootstrapping in Stata using cgmwildboot.ado.

[24] Our urban regression results are weighted by the overall census 2001 population size (not in the 0-6 year old age group) at the town level, due to lack of data.

Table 3: Village Fixed-effect Regression of Child Sex Ratio

	Subsample (I)		**Subsample (II)**	
	No *INF* Variables	**With *INF* Variables**	**No *INF* Variables**	**With *INF* Variables**
First Difference Regression of Child Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	9.21	13.08	17.80*	19.90*
Log village population	1.70	-9.06	-18.04**	-20.13**
Male literacy rate	1.11**	0.99**	0.81**	0.72**
Female literacy rate	-0.77**	-0.61**	-0.57	-0.55
Scheduled Caste (% of population)	0.86	0.59**	0.21	0.25
Scheduled Tribe (% of population)	1.98	0.54	-0.13	-0.09
Acres of cultivable land per cultivator	-0.80	-1.31	0.55*	0.47*
% of irrigated cultivable land	-0.14	-0.14	-0.08	-0.07
Availability in the village of:				
Primary or Middle School		-2.46		8.39*
High School		-3.40		-1.86
Any public health facility		4.83		-1.15
Maternal/child welfare center		-4.01		5.93
Registered medical practitioner		-4.98		-8.35
Community health worker		-1.90		-4.57
Tap water		-2.66		1.00
Paved approach road		2.49		4.75**
Electricity		9.58		11.93**
At least one telephone		-0.90		0.04
Intercept term	-34.22**	-34.58**	-33.40**	-32.90**
R^2	0.009	0.005	0.004	0.005
Number of Villages	16,548	15,368	32,881	32,436

Note: Data are from village-level Indian Censuses 1991 and 2001. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . Standard errors are clustered at the state level, and corrected using wild bootsrapping. All regression models are weighted with the 2001 village-level population size in the age group 0-6 years.

Table 4: Town Fixed-effect Regression of Child Sex Ratio

	Subsample (I)	**Subsample (II)**	**Subsample (III)**	**Subsample (IV)**
First Difference Regression of Child Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	17.07	20.48	19.91	13.87**
Schedule Caste (% of population)	-2.58	0.87	0.28	-0.66
Schedule Tribe (% of population)	-1.95	-0.68	-1.92	-1.37
Female literacy rate	0.41	1.18	0.81	0.98
Male work force participation rate	0.42	1.83	1.48	4.08**
Female work force participation rate	-1.50	-3.57**	-3.16**	-2.20**
Log town population	4.26**	-2.68*	2.11*	-10.50*
Constant	-37.34**	-38.17**	-35.99**	-36.12**
R^2	0.06	0.10	0.10	0.10
Number of Towns	193	342	535	1,447

Note: Data are from town-level Indian Censuses 1991 and 2001. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . Standard errors are clustered at the state level, and corrected using wild bootsrapping. All regression models are weighted with the 2001 town-level population size.

shows a weakly significant improvement of 19.9 points in the child sex ratio as a consequence of the PNDT Act. Among the rest of the rural subsamples, including the fully interacted regression model, the positive impact of the PNDT Act ranges between 13.7 and 26.4 points (Appendix Table A.5), all significantly different from zero at the 5% level.

Table 4 presents the results for towns. The largest subsample of all towns exhibits a significant positive effect of 13.9 points of the PNDT Act. The law does not appear to have any significant effect in other subsamples.

Our results suggest that the 1996 PNDT Act was far from an utter failure, particularly in rural areas. The partial effect of the Act, controlling for other factors, was an increase in the child sex ratio over our study period. Although the observed child sex ratio decreased almost across the board, the marginal effect of PNDT was positive. In other words, in the absence of this Act, the child sex ratio would have declined further.[25] Of course, this does not mean that the PNDT Act could not have been enforced better.

Among the other results we obtain are a significant positive effect of the share of socioeconomically disadvantaged population ("scheduled castes" and "scheduled tribes") in a village, on the child sex ratio, in most of our rural subsamples. Scheduled castes and tribal groups, by virtue of their difference from traditional upper-caste Hindu society, suffer less from rigid dowry norms and other rituals limiting women's autonomy (Miller 1981, Agnihotri et al. 2002).

Another interesting finding is the negative effect of female literacy rate on the child sex ratio. The effect, although not very strong, is consistently present in one but all rural subsamples. This is likely the result of a strong inverse association between female literacy and fertility.[26] As women's schooling has expanded, fertility rates have fallen, and the pressure on a couple to have a male child has increased. As *the Economist* magazine noted in a special recent issue on gendercide: "in societies where four or six children were common, a boy would almost certainly come along eventually; son preference did not need to exist at the expense of daughters. But now couples want two children – or, as in China, are allowed only one – they will sacrifice unborn daughters to their pursuit of a son. That is why sex ratios are most distorted in the modern, open parts of China and India."[27] Park and Cho (1995) also associate reduced fertility, and a small-family norm, to the strengthening of son preference in East Asian societies.

Three of the urban subsamples exhibit a significant negative association between female labor force participation rates and the child sex ratio. Again, this likely reflects the fact that

[25] Park and Cho (1995) have argued that similar restrictions on sex-determination tests placed in 1990 in South Korea have been effective. Chung and Das Gupta (2007) discuss the recent improvements in sex ratio in South Korea.

[26] See Sharma and Retherford (1990), Murthi, Guio and Dreze (1995), Parikh and Gupta (2001), Jha et al. (2006a), and Dasgupta and Bhat (1997).

[27]

The War on Baby Girls: Gendercide, *The Economist,* March 4th, 2011, http://www.economist.com/node/15606229 women's participation in the formal work force raises the opportunity cost of a child and lowers fertility. In the face of strong son preference, this induces couples to sex-select their children in favor of boys.

The availability of healthcare and educational infrastructure generally does not have any effect on the child sex ratio, except the occasional significance of the availability of a primary or middle school, paved road, and electricity in a few subsamples, and some additional variables in the fully interacted model. In case of the latter, we find that the presence of a registered medical practitioner (typically a private doctor) or a community health worker in a village is associated with a decline in the child sex ratio ranging from 3-8 points. The availability of a nurse midwife (who can also be the village health worker) or a registered private doctor in a village makes it easier for couples to access prenatal sex determination tests and sex-selective abortion services (Srivastava 1998, Ganatra et al. 2001, Deolalikar et al. 2009), thus skewing the child sex ratio.

6 Conclusion

In this paper we use a policy variation to examine the causal impact of a legislative ban on sex-selective abortions in India on child sex ratios. Using village- and town-level longitudinal data from the 1991 and 2001 censuses, we find a positive and significant causal impact of the 1994 PNDT Act on child sex ratios. Our estimates suggest that, controlling for other factors, the PNDT Act accounts for an increase of 14-26 points in the child sex ratio. Our results are robust to a variety of methodologies and subsamples. While the magnitude of the estimated effect may seem small, our calculations indicate that the PNDT Act may have resulted in at least an additional 106,000 surviving girls aged 0-6 years in the newly-treated rural areas.[28]

Our results are in stark contrast to the common perception in India that the PNDT Act has been a failure. The perception is based on the fact that the child sex ratio in the country has continued to fall even after the passage and implementation of the Act. However, our analysis suggests that in the absence of the PNDT Act, the child sex ratio in the country would have declined even more than it did. Naturally, our results say nothing about the room for improvement in the implementation of the PNDT Act. There is no question that the Act is unevenly and weakly enforced. Encouragingly, however, the Indian government expanded the provisions of the PNDT Act in 2003 and has been strengthening its enforcement.

The PNDT Act is only one of several interventions being used to combat gender imbalance in India. Other interventions include government schemes which attempt to change people's preferences through media campaigns or monetary incentives. For example, the *Balika Samriddhi Yojana*, started in 1997, provides monetary incentives for the education of girls from poor families. Among other noteworthy central programs is the *Dhan Lakshmi Scheme* (2008), along with various state government programs such as in Tamil Nadu (the Cradle Baby Scheme in 1992), Andhra Pradesh (Girl Child Protection Scheme 1996-97), and Karnataka (Bhagyalakshmi Scheme 2006-07) etc. Such schemes are increasing becoming popular (Sekher 2010).

In addition, the government has also been at the forefront of changing inheritance laws with a view to reducing son preference. Until recently, inheritance laws governing the transfer of resources across generations, including the Hindu Succession Act of 1956, were largely discriminatory against women. The Government amended the Succession Act in 2004 to establish equal property rights for male and female children.

[28] We use the population sizes in the age group 0-6 years, across the censuses of 1991 and 2001 in non-Maharashtra states, to covert the estimated difference-in-difference effect size of 13.7 (regression coefficient of PNDT Act in subsample V, fully interacted) to a number of additional female children at just above 81,500 in rural areas. Using the ratio of urban children to rural children (0-4 year age group) in India, which is approximately 0.3 (Census 2001), the total number of urban female fetuses saved is therefore estimated to be 24,500. This extrapolation implicitly uses the same rural regression coefficient of 13.7 (urban subsample IV has a PNDT coefficient of 13.9). Therefore, the conservative estimate of the total number (rural and urban) of female fetuses saved by the PNDT is 106,000.

Finally, the absence of formal social safety nets – particularly pension schemes – reinforces son preference, since the care of elderly parents is typically the responsibility of sons. Direct cash transfer programs, such as the National Old Age Pension Scheme (2007) for the elderly poor, can also reduce the old-age motive to prefer sons over daughters.

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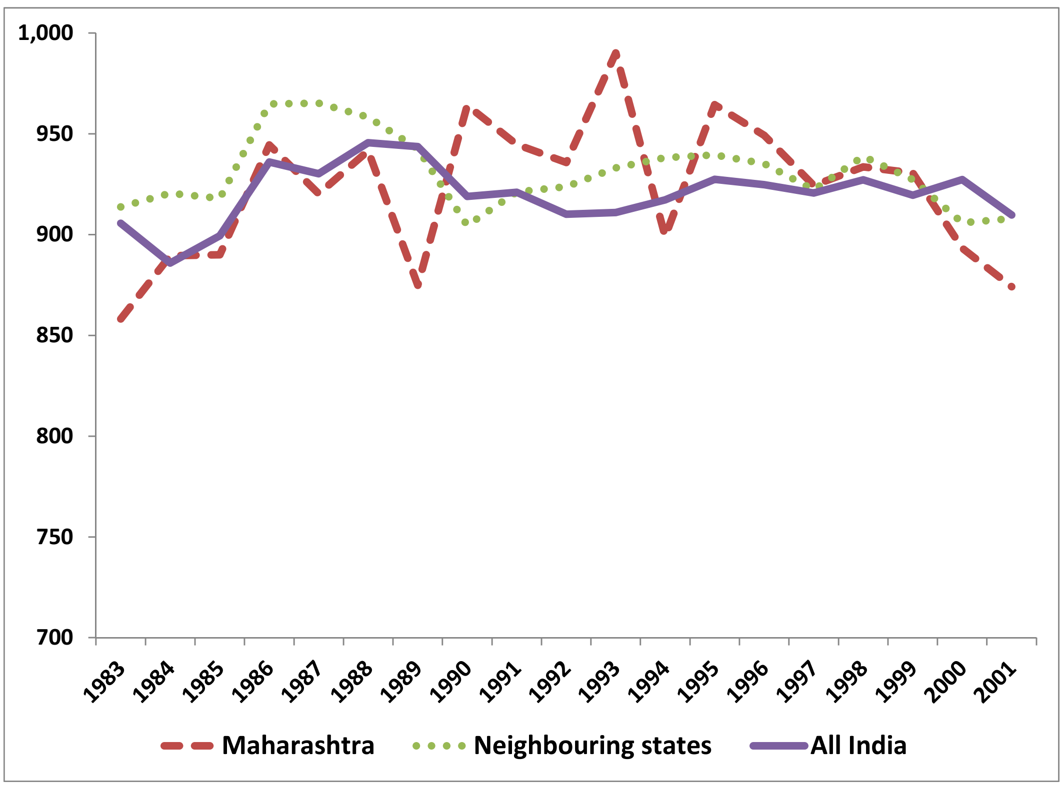
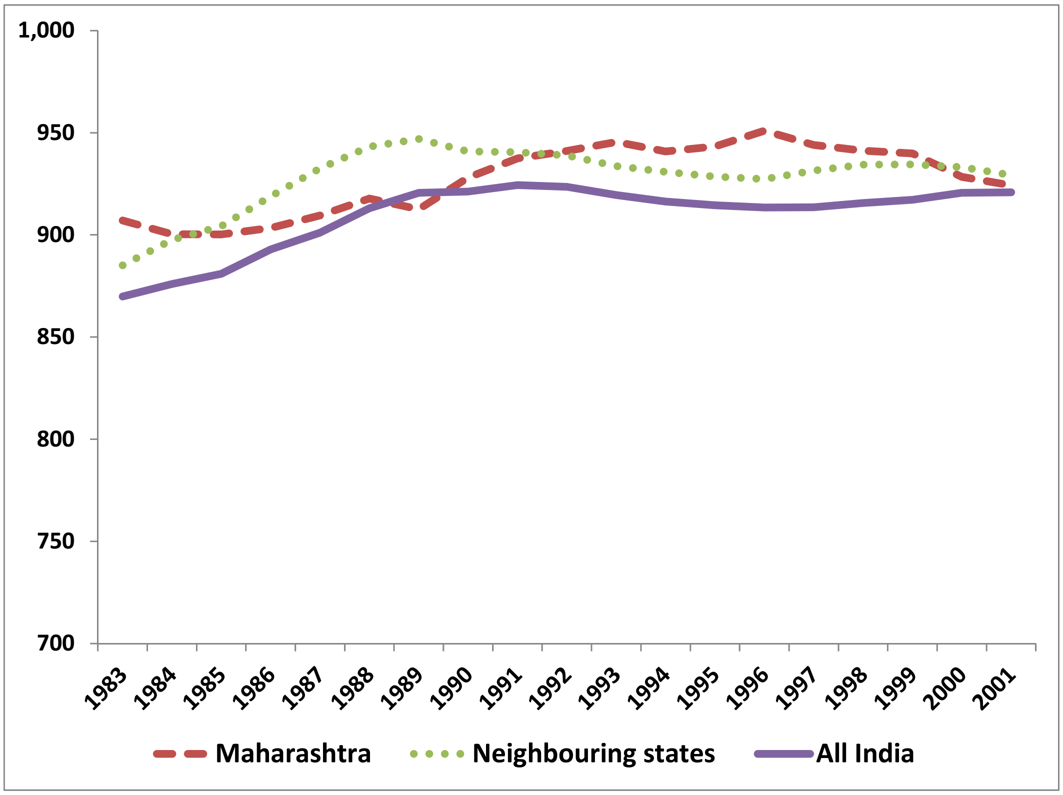
Appendix

Figure A.3: Sex Ratio at Birth by Year in India (1991 to 2001)



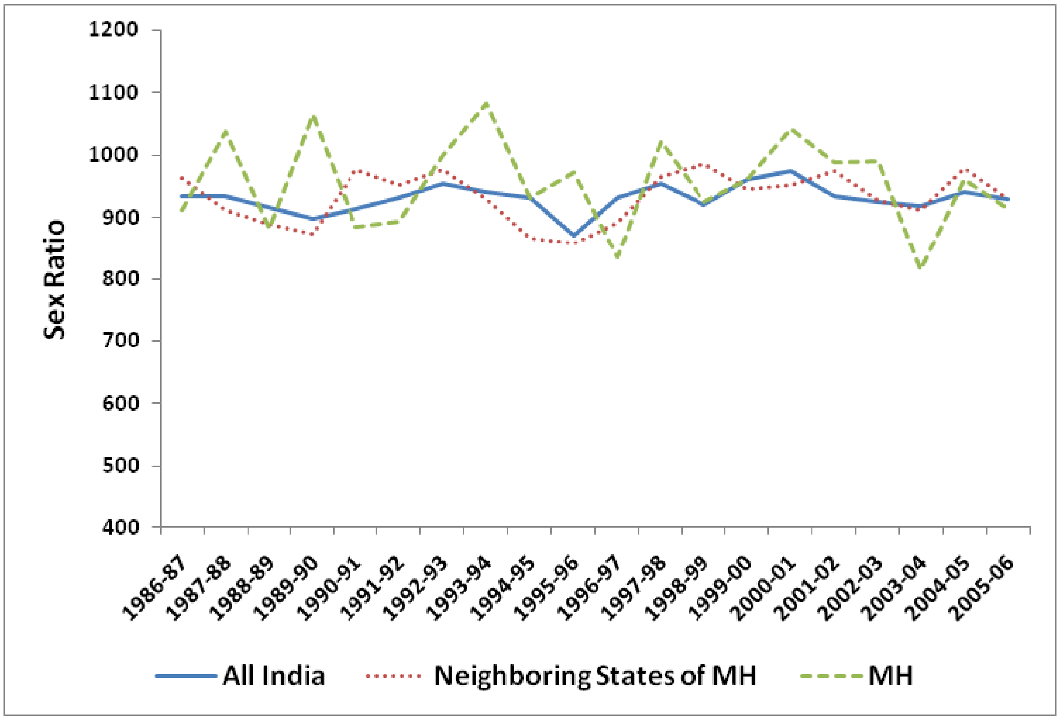
Source: Calculated from the birth history data collected by the DLHS 2002-04. Total number of boys and girls born to all mothers in a region, during each year, are used to compute the sex ratio at birth. Sex ratio is the number of girls per 1000 boys, born during a given year.

Figure A.4: Sex Ratio in the Age Group 0-6 Years, by Year, in India (1983 to 2001)



Source: Calculated from the birth history data collected by the DLHS 2002-04. Sex ratio in the age group 0-6 years is the number of girls per 1000 boys (only for children who were reported still alive in 2002-04).

Figure A.5: Sex Ratio by Year of Birth in India (1986-87 to 2005-06)



Source: Data on household members from the National Family Health Survey of 1992-93, 1998-99 and 2005-06. 'MH' denotes the state of Maharashtra. Due to low sample size at each year, a smoothing technique similar to a three-year moving average has been used to calculate sex ratio at each year. For example, sex ratio at year 2005-06 is the female-to-male sex ratio among children of age 0-2 years, while sex ratio at year 2004-05 is the sex ratio among 1-3 year old children – both calculated from the 2005-06 survey data. Figures for the years 1987-88 to 1992-93 have been generated from 1992-93 NFHS data; those from 1993-94 to 1998-99 have been computed from the 1998-99 NFHS data and the rest come from the 2005-06 NFHS data.

Figure A.6: Change in Rural Child Sex Ratio, 1991-2001 [Subsample (I) - Villages from immediate taluks on both sides of Maharashtra (MH) border]

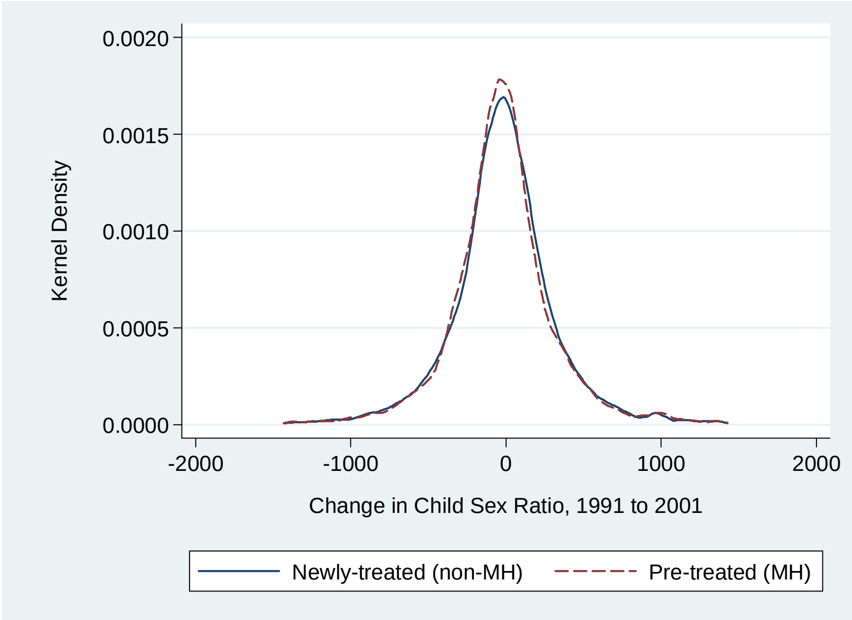


Figure A.7: Change in Rural Child Sex Ratio, 1991-2001 [Subsample (II) - Villages from neighboring districts from both sides of the Maharashtra border, except the immediate neighboring taluks]

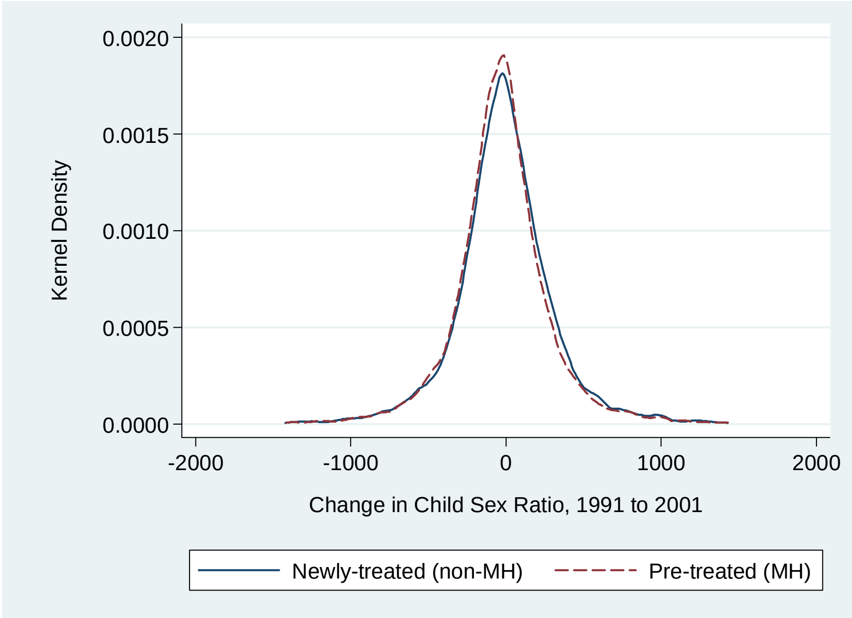


Figure A.8: Change in Rural Child Sex Ratio, 1991-2001 [Subsample (III) - Villages from Maharashtra and neighboring states except from immediate districts on both sides of the MH border]

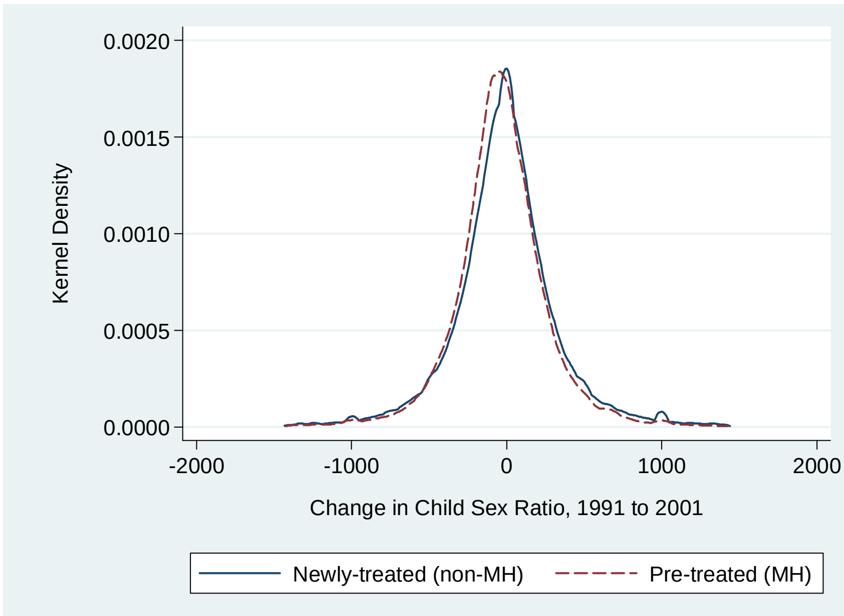


Figure A.9: Change in Rural Child Sex Ratio, 1991-2001 [Subsample (IV) - All villages from Maharashtra and neighboring states]

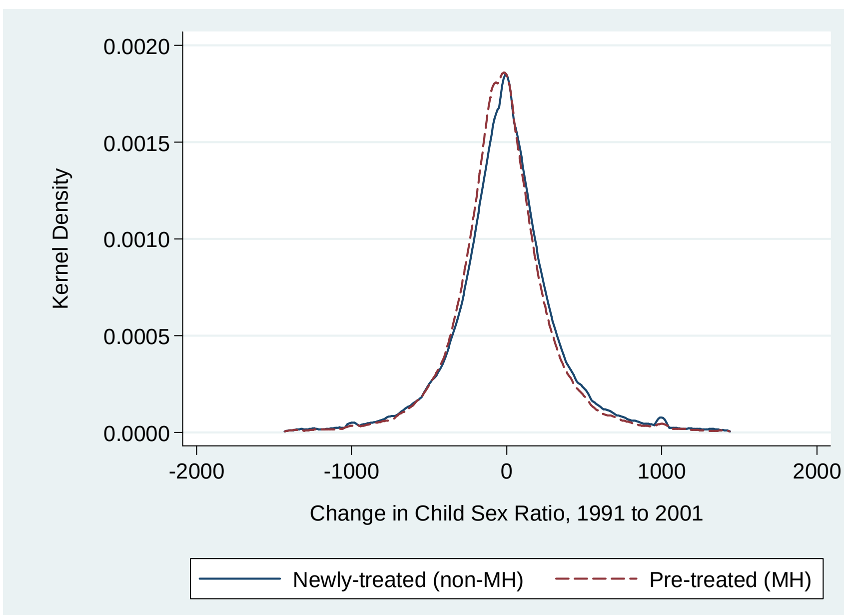


Figure A.10: Change in Rural Child Sex Ratio, 1991-2001 [Subsample (V) - All villages from Maharashtra and other major Indian states]

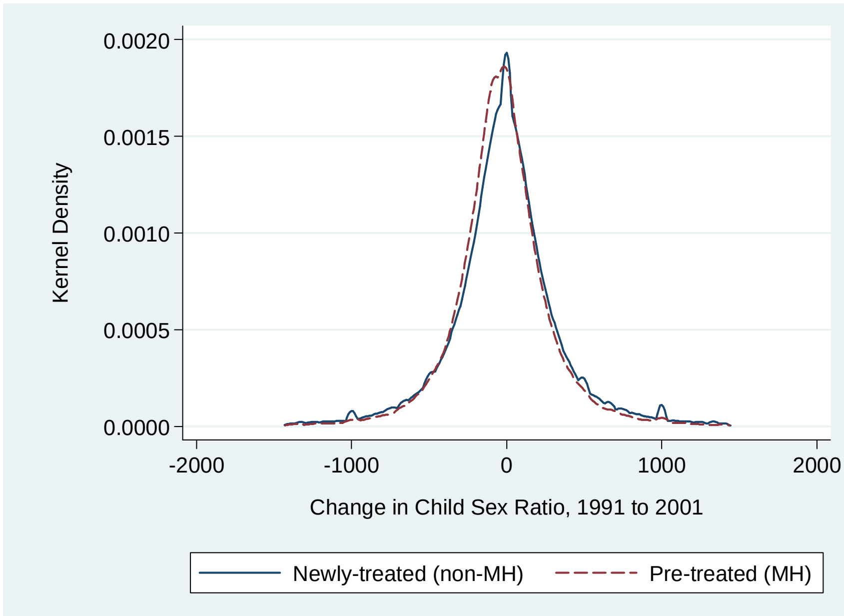


Figure A.11: Change in Urban Child Sex Ratio, 1991-2001 [Subsample (I) - Towns from immediate districts on both sides of Maharashtra (MH) border]

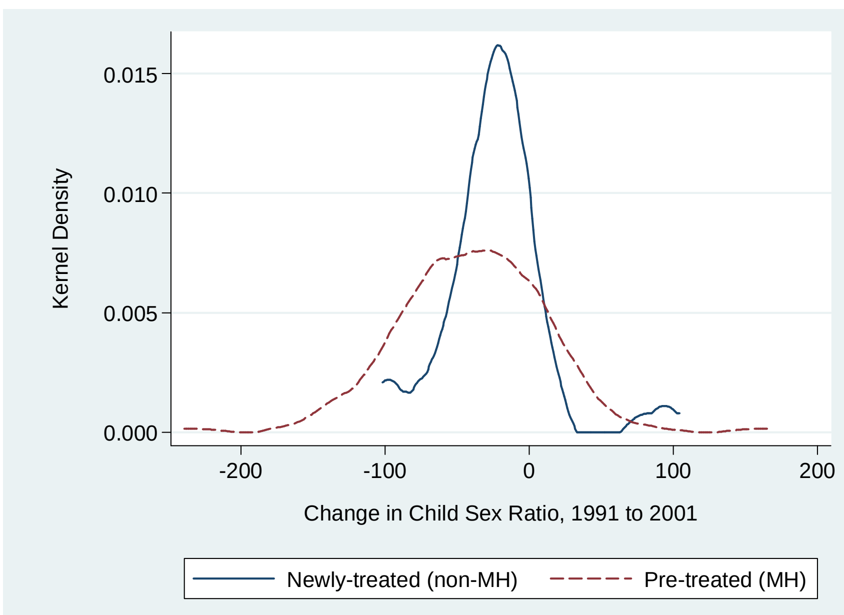


Figure A.12: Change in Urban Child Sex Ratio, 1991-2001 [Subsample (II) - Towns from Maharashtra and neighboring states, except from the immediate districts on both sides of the MH border]

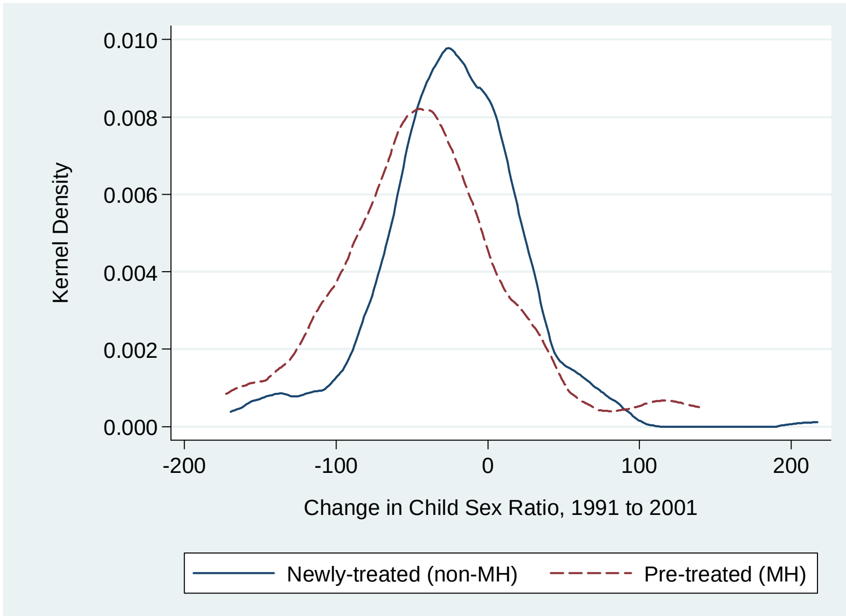


Figure A.13: Change in Urban Child Sex Ratio, 1991-2001 [Subsample (III) - All towns from Maharashtra and neighboring states]

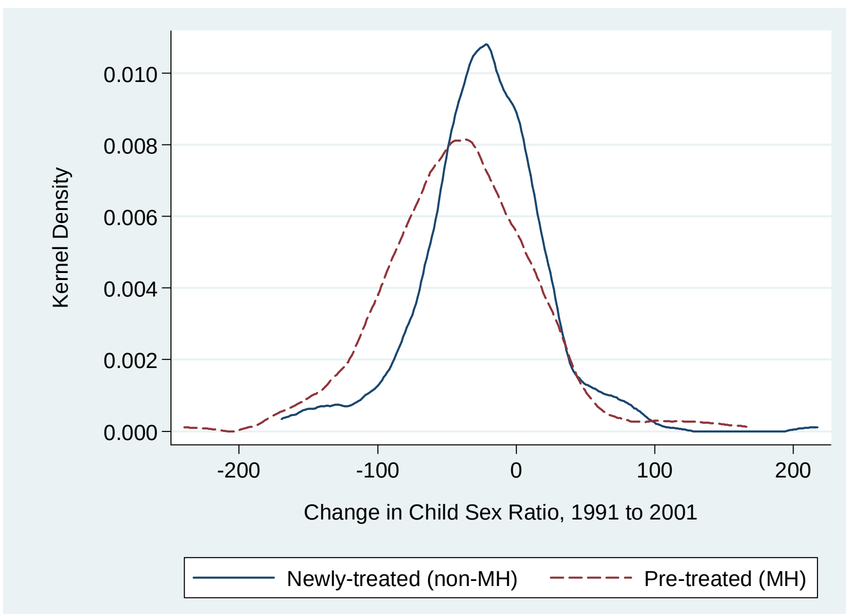
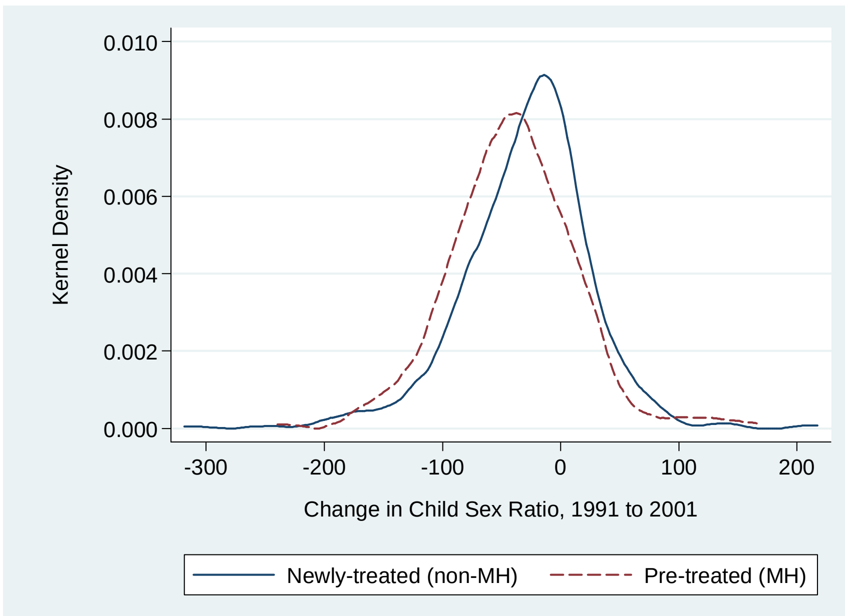


Figure A.14: Change in Urban Child Sex Ratio, 1991-2001 [Subsample (IV) - All towns from Maharashtra and the rest of the country]



Source (Figure A.6 through Figure A.14): Calculated from Census of India, 1991 and 2001 Primary Census Abstract. 'Change' denotes the difference between 1991 and 2001 values.

Table A.5: Village Fixed-effect Regression of Child Sex Ratio

	Subsample (III)	**Subsample (IV)**	**Subsample (V)**	**Subsample (V), Fully Interacted**
First Difference Regression of Child Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	26.44**	21.66**	23.29**	13.71**
Log village population	-3.38	-6.88	0.07	-21.48**
Male literacy rate	0.53*	0.62*	0.29	0.63**
Female literacy rate	-0.25	-0.34	-0.35**	-0.76**
Scheduled Caste (% of population)	0.15	0.20**	0.21**	0.18**
Scheduled Tribe (% of population)	0.34	0.26*	0.25**	0.05**
Acres of cultivable land per cultivator	0.28	0.21	0.10	0.67**
% of irrigated cultivable land	0.02	0.00	0.02	-0.07**
Availability in the village of:				
Primary or Middle School	-8.17**	-5.88	-4.30**	11.04**
High School	2.26	0.62	-0.46	-1.96**
Any public health facility	0.38	0.63	-0.39	0.98*
Maternal/child welfare center	-2.09	-1.07	-0.71	0.38
Registered medical practitioner	-5.09	-5.89	-4.61	-7.95**
Community health worker	1.54**	0.10	0.45	-3.32**
Tap water	0.64	0.05	1.68	-0.24
Paved approach road	-1.90	-0.07	1.41	4.32**
Electricity	0.03	2.81	0.20	-24.85**
At least one telephone	2.00	1.24	-3.08	-5.48**
Intercept term	-46.32**	-40.41**	-36.17**	-27.23**
R^2	0.003	0.003	0.001	0.002
Number of Villages	122,968	170,772	518,446	518,446

Note: Data are from village-level Indian Censuses 1991 and 2001. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . Standard errors are clustered at the state level, and corrected using wild bootsrapping. All regression models are weighted with the 2001 village-level population size in the age group 0-6 years. The last column presents the fully interacted regression model, where interaction terms between the PNDT indicator and all other explanatory variables are also included on the the right hand side of the regression.

Table A.6: Descriptive Statistics of Rural Subsamples: Average Change from 1991 to 2001

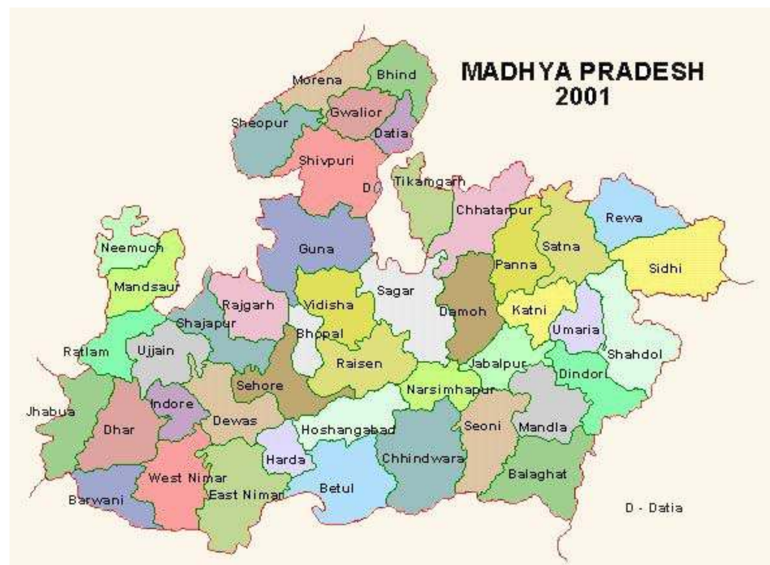
	Subsample (I)		**Subsample (II)**		**Subsample (III)**		**Subsample (IV)**		**Subsample (V)**	
	MH	**Non MH**	**MH**	**Non MH**	**MH**	**Non MH**	**MH**	**Non MH**	**MH**	**Non MH**
First-difference (change from 1991 to 2001)										
Log village population	0.17	0.18	0.14	0.16	0.12	0.18	0.14	0.16	0.14	0.18
Male literacy rate	16.97	19.05	13.46	20.34	13.45	15.36	14.15	19.07	14.15	15.60
Female literacy rate	19.58	20.00	18.23	19.81	19.36	17.59	18.94	20.39	18.94	17.72
Scheduled Caste (% of population)	-0.58	-0.48	-0.55	-0.54	-0.45	0.18	-0.52	-0.06	-0.52	0.14
Scheduled Tribe (% of population)	0.06	0.78	-0.82	0.62	-0.24	0.22	-0.42	0.61	-0.42	0.25
Acres of cultivable land per cultivator	0.60	0.03	0.49	0.04	0.29	0.30	0.43	0.09	0.43	0.28
% of irrigated cultivable land	4.99	9.30	5.07	16.94	4.77	22.79	4.94	17.99	4.94	22.34
Share of villages that have:										
Primary or Middle School	0.06	0.08	0.02	0.08	0.02	0.06	0.03	0.08	0.03	0.06
High School	0.09	0.06	0.10	0.06	0.10	0.03	0.10	0.06	0.10	0.03
Any public health facility	0.08	0.12	0.08	0.14	0.04	0.05	0.06	0.13	0.06	0.05
Maternal/child welfare center	0.02	0.03	0.02	0.05	0.01	0.03	0.02	0.04	0.02	0.03
Registered medical practitioner	0.03	0.07	-0.01	0.11	0.04	0.02	0.02	0.08	0.02	0.03
Community health worker	0.13	0.25	0.18	0.18	0.10	-0.04	0.14	0.11	0.14	-0.03
Tap water	0.19	0.16	0.22	0.20	0.28	0.15	0.23	0.20	0.23	0.15
Paved approach road	0.43	0.12	0.40	0.14	0.39	0.15	0.40	0.13	0.40	0.15
Electricity	-0.01	0.09	0.00	0.09	0.00	0.07	-0.01	0.08	-0.01	0.07
At least one telephone	0.26	0.23	0.39	0.26	0.40	0.28	0.37	0.30	0.37	0.28

Source: Data are from village-level Indian Censuses 1991 and 2001. Maharashtra and non-Maharashtra villages are denoted by 'MH' and 'non-MH', respectively. Subsamples are – (I) Villages from taluks along the administrative border of Maharashtra and its neighboring states, (II) Villages from MH and neighboring state districts along the state border, except the villages from taluks immediately on both sides of the border, (III) All villages from Maharashtra and neighboring states except the ones from immediate districts on both sides of the border, (IV) All villages from Maharashtra and all villages from neighboring states.

Table A.7: Descriptive Statistics of Urban Subsamples: Average Change from 1991 to 2001

	Subsample (i)		**Subsample (ii)**		**Subsample (iii)**		**Subsample (iv)**	
	MH	**Non MH**	**MH**	**Non MH**	**MH**	**Non MH**	**MH**	**Non MH**
First-difference (change from 1991 to 2001)								
Log town population	0.23	0.19	0.25	0.22	0.24	0.21	0.24	0.23
Female literacy rate	10.87	11.45	10.84	10.83	10.86	10.93	10.86	11.22
Scheduled Caste (% of population)	-0.41	0.34	-0.35	0.14	-0.39	0.18	-0.39	0.04
Scheduled Tribe (% of population)	-0.42	0.75	-0.12	0.35	-0.30	0.41	-0.30	0.18
Male work force participation rate	0.51	-0.05	0.25	0.90	0.41	0.74	0.41	-0.11
Female work force participation rate	1.73	2.81	1.21	3.62	1.53	3.48	1.53	4.93

Source: Data are from town-level Indian Censuses 1991 and 2001. Maharashtra and non-Maharashtra towns are denoted by 'MH' and 'non-MH', respectively. Subsamples are – (i) Towns from districts along the administrative border of Maharashtra and its neighboring states, (ii) All towns from MH and neighboring states except the districts along the state border of MH, (iii) All towns from MH and neighboring states, (iv) All towns from MH and the rest of India.



Source: Census of India District Maps, http://www.censusindia.gov.in/maps/State_Maps/maps.htm, accessed October 15, 2012

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