Widening the Gender Gap: The Unintended Consequences of Conditional Cash Transfers in India

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Abstract

This paper investigates the unintended consequences of the introduction of a large conditional cash transfer programme (Janani Suraksha Yojana) aimed at improving maternal and neonatal mortality in India. We concentrate on two outcomes not targeted by the scheme: sex ratios at birth and gender gaps in neonatal survival. We exploit the incremental implementation of the programme using the District Level Household Survey data to estimate these effects in a difference-in-differences framework, which compares districts treated in the first year of the scheme with districts treated in subsequent years. The results suggest that the programme significantly suppressed sex ratios at birth, especially in areas characterised by strong preferences for sons. By contrast, we do not find an impact on gender specific mortality. We also provide evidence that the introduction of the programme increased pregnant women's exposure to ultrasound scans.

JEL Classification: J13, I15, I14

Key words: Sex-ratio, Conditional-Cash-Transfer-programmes, neonatal mortality, India.

1. Introduction

In many countries across Southeast Asia, men outnumber women. This phenomenon – often referred to as "missing women" (Sen, 1992) – is particularly severe for young children in India (Klasen and Wink, 2002). For 0 to 6 year olds, the country's most recent Census (2011) reports a ratio of 914 girls to 1,000 boys,[1] which lies considerably below the natural rate (see Bhaskar and Gupta, 2007; for an overview).[2] Such imbalances have become a matter of concern and have been shown to have profound long run effects on the marriage market (Angrist, 2002), crime (Edlund et al., 2013) and social stratification and welfare more generally (Bhaskar, 2010; Edlund, 1999).

Abnormally low sex ratios typically arise as a consequence of excess female mortality and/or sex selective abortions (Sen, 2003).[3] Whilst gender differences in survival rates of children are a well-known phenomenon in India (see Rose, 1999; for instance), recent technological advances enabling in-utero sex determination[4] have increased the incidence of sex selective abortions (Arnold et al, 2002). Jha et al. (2011), for instance, estimate the number of female foetuses aborted between 2000 and 2010 to lie between 3 and 6 million. Patterns such as these have prompted the introduction of numerous policies aimed specifically at women and children (the Devirupak[5] programme, for instance). Recent findings, however, have raised a concern that such interventions may be ineffective (Anukriti, 2013) or even have unexpected spill-over effects. The legalisation of abortion, for instance, has been shown to have profound effects on sex ratios (Lin et al, 2014) and termination of pregnancies (Valente, 2014).

This paper explores the unintended consequences of the introduction of a large scale conditional cash transfer (CCT henceforth) programme – the Janani Suraksha Yojana scheme (JSY henceforth) – aimed at reducing maternal and neonatal mortality.[6] We estimate the programme's effect on two outcomes not targeted by the scheme: the sex ratio at birth and gender differences in child survival. The programme provides pecuniary assistance for

[1] The Census only provides sex ratios for the age group of 0 to 6 year olds (Indian Census, 2011). The Sample Registration System (2012) reports that the sex ratio at Birth for India increased from 906 in 2009-11 to 908 in 2010-12. Chhattisgarh has reported the highest Sex Ratio at Birth (979); Haryana, the lowest (857). See Figure 1.
[2] We define sex ratio as the ratio of women to men. Low sex ratios thus indicate a deficit of women. Sex ratios at birth are considered to be normal at around 948 women per 1,000 men (Bhaskar and Gupta, 2007).
[3] We do not consider selective outmigration in this context.
[4] Ultrasonography is the most common method for determining the sex of the foetus during pregnancy.
[5] The programme was introduced in 2002 in Haryana. More details under http://hsprodindia.nic.in/listdetails.asp?roid=198
[6] Neonatal mortality rates (NNM) are defined as deaths of children (within the first 28 days after birth) per 1,000 births. India's NNM lie around 32 (Roy et al., 2013). Maternal mortality rates (MMR) are defined as the number of maternal deaths per 100,000 live births due to causes related to pregnancies. India's MMR lie around 178. (SRS Bulletin, Nov 2013).

institutional delivery. Further, the introduction of the scheme was accompanied by a pronounced effort to increase take-up of antenatal care (ANC henceforth) of which ultrasound scans are a standard component. The scheme was announced in 2005 by the central government and incrementally rolled out across all of India's districts.

We use the information from the two rounds of the District Level Household Survey (DLHS 2004, DLHS 2008) to estimate the effect of the introduction of JSY on our outcomes of interest – the sex ratio at birth and neonatal mortality. For this purpose, we first calculate weighted district averages of these two outcomes for each fiscal year over the period 1999 – 2008. We then identify the causal effect of the introduction of the programme using a difference-in-differences methodology. We exploit the incremental implementation of JSY to compare districts treated in 2005 with districts treated between 2006 and 2008. This helps us to address the concern that districts that are treated during the initial rollout years differ in terms of unobserved characteristics compared to those that were treated later.

The results suggest that the introduction of JSY decreased the sex ratio at birth by between 1 and 6 percentage points. The estimates are particularly large for districts identified by the government as areas with high maternal mortality and for districts characterised by strong preferences for sons. The estimates are robust to numerous sensitivity analyses. We also provide evidence in favour of the claim that the introduction of JSY is uncorrelated with pre-existing trends in sex ratios.

In the second part of the paper, we investigate the pathways through which JSY affects the sex ratio at birth. We find that JSY increased demand for ANC services. Women in treated districts report a higher number of ANC visits and health check-ups. Crucially for our reduced form results, we also find that JSY increases pregnant women's exposure to ultrasound technology. Finally, we do not find evidence for a change in gender specific survival rates.

This paper adds to the growing knowledge base on the determinants of sex ratios. Previous work has documented how sex ratios vary with income levels (Burgess and Zhuang, 2001), biological factors (Oster, 2005; Oster and Chen, 2008) and fertility choices (Porter, 2014). Much of this evidence, however, is based on the implicit assumption that the availability of sex detection technologies remains constant. The few studies analysing the role of sex determination technologies rely on variation in sex ratios across children's birth cohorts, which are subsequently attributed to the availability of ultrasonography (see Bhalotra and Cochrane, 2010, for instance). By contrast, the introduction of a specific intervention with a narrow focus on pregnant women provides a plausibly exogenous variation in the exposure of women to ultrasound scans within a very short time period. This enables us to better document the pathways through which sex ratios changed.

The paper unfolds as follows. Section 2 lays out the background information regarding the aspects of JSY and sex selective abortions. Section 3 introduces the data and gives summary statistics. Section 4 lays out the econometric framework, the results of which are discussed in the same section. Section 5 addresses a number of identification concerns and section 6 checks for the robustness of our results. Section 7 investigates the pathways through which JSY affects the sex ratio and Section 8 concludes.

2. Background

2.1. The Janani Surakshya Yojana Programme

The Janani Surakshya Yojana, or safe motherhood, scheme is a conditional cash transfer programme aiming to improve maternal and neonatal survival. The programme integrates pecuniary assistance with institutional delivery as well as antenatal and postnatal care. JSY is one of the largest CCTs in the world. It was launched with a budget of Rs 380 million ($8.7 million) and 740,000 beneficiaries in 2005/06; increasing to Rs 7.5 billion ($170 million) and 7.3 million at the end of the sample period in 2007/08 (United Nations Population Fund, 2009). The breadth of this scheme helps to address concerns regarding the external validity of small scale interventions (Deaton, 2010).

JSY remunerates women, who give birth in a publicly recognised facility after birth. Eligibility and benefits received vary according to women's state of residence, social status[7] and income level and have been evolving over time. In its first year, women classified as living below the poverty line in states with high maternal and neonatal mortality (low performing states[8]), received Rs 700 ($16) in rural and Rs 600 ($14) in urban areas. In states with low maternal and neonatal mortality (high performing states[9]), women classified as below the poverty line received Rs 700 ($16) if they resided in rural areas only (JSY Guidelines for Implementation, 2005). In subsequent years, payments under JSY increased and extended to all women in low performing states and to women aged 19 or above, who are

[7] Scheduled caste and scheduled tribes received special benefits under the scheme.

[8] Low performing states are Assam, Bihar, Chattisgarh, Jharkhand, Madhya Pradesh, Orissa, Rajasthan, Uttar Pradesh, Uttaranchal, and Jammu and Kashmir.

[9] High performing states are Andhra Pradesh, Arunachal Pradesh, Goa, Gujarat, Haryana, Himachal Pradesh, Karnataka, Kerala, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Punjab, Sikkim, Tamil Nadu, Tripura and West Bengal.

classified as below the poverty line or from a disadvantaged background, in high performing states (World Bank, 2009).[10]

The adoption of JSY was compulsory for the whole of India. Individual states, however, were left with the authority to make minor alterations (Ministry of Health and Family Welfare, 2006). The programme was ultimately implemented by India's districts, which constitute the smallest local authority in India.[11] To help to implement JSY, districts in certain areas[12] hired Accredited Social Health Activists (ASHAs). The ASHAs' major responsibilities are the recruitment and registration of pregnant women to JSY. After registration to JSY, ASHAs or equivalent health workers draw up a micro-birth plan for each expecting mother, which details, among other things, the expected dates for antenatal visits, delivery and post-partum care.

As one of the first studies to evaluate JSY, Lim et al. (2010) find an increase in in-facility birth rates and decrease in perinatal and infant mortality rates. Mazumdar et al. (2011), by contrast, report an increase in access to maternity services but no significant effect on neonatal or early neonatal mortality.

2.2. <u>Prenatal Sex Determination</u>

Ultrasonography is a commonly used technique for ascertaining a foetus' sex during pregnancy.[13] Whilst this technology can determine the gender from the 12th week of pregnancy onwards, the predictions often become reliable only from 16 to 18 weeks onwards. Although ultrasound scans for the purpose of determining the gender of a foetus are illegal in India, there are genuine medical reasons to have scans, during which it is not difficult to determine the gender of the foetus. Indeed, ultrasound scans are a standard component of antenatal care visits and in India 89 percent of women have at least one antenatal care visit before pregnancy (Coverage Evaluation Survey, 2009). In India, abortion is legal within the first 20 weeks of pregnancy (Medical Termination of Pregnancy Act, 1972)[14] and two thirds of pregnant women receive their first antenatal care visit during this time (Coverage Evaluation Survey, 2009). Sex selective abortions, by contrast, are illegal (Pre-Conception

[10] Payments increased to Rs 1,400 ($32) in rural and Rs 1,000 ($23) urban areas in low performing states and to Rs 700 ($16) in urban and Rs 600 ($14) in urban areas in high performing states.
[11] In 2005, the number of districts in India was 594.
[12] ASHAs were hired only in low performing states and north-east states and in tribal districts of all states (World Bank, 2009).
[13] The two alternatives Chorionic Villus Sampling and Amniocentesis can determine the gender of the foetus from 10 to 12 and 15 to 18 weeks respectively. These methods are considerably more expensive than ultrasound.
[14] Pregnancies not exceeding 12 weeks may be terminated based on a single opinion formed in good faith. In case of pregnancies exceeding 12 weeks but less than 20 weeks, termination needs opinion of two doctors.

and Pre-Natal Diagnostic Techniques (PCPNDT) Act, 1994). In practice, however, this law has been hard to enforce (Sudha and Rajan, 1999). One reason is that, if the process of determining the gender of the foetus and the abortion are carried out separately, it is hard to convict the interested parties.

The implementation of JSY is likely to increase the exposure of its beneficiaries to ultrasonography for two reasons. First, JSY increased the demand for antenatal care visits, of which ultrasound scans are a standard component. The JSY guidelines explicitly recommend that participants attend at least three ANC visits. Furthermore, one of the ASHAs' duties was to incentivise women to attend antenatal care visits. Because transportation costs have been identified as a major barrier to antenatal care visits (Titaley et al., 2010), ASHAs were supplied with vouchers to cover any logistical expenses for themselves and for the pregnant woman. In some cases, beneficiaries received payments for registering for JSY and for antenatal care visits (Commissioner of Family Welfare, AP, 2010).

Second, the introduction of JSY was accompanied by a supply side intervention aimed at improving health facility infrastructure. As part of the scheme, the central government explicitly undertook efforts to link each habitation (village, or ward in an urban area) to a functional health centre-public or accredited private institution (Government of India, 2005). Further efforts were made to improve the services in hospitals and health centres (NHSRC, 2009). Finally, in many instances, JSY established a partnership with private health centres and hospitals, which would provide obstetric care services to the JSY beneficiaries (JSY FAQ, 2005). We provide evidence on the effect of JSY on antenatal care takeup and ultrasound usage in Section 8.

Both, national (Lim et al, 2010; NHSRC, 2009) and state wide studies (Kumar et al, 2012, Kahn, M. E. 2009; Gopalan and Durairaj, 2012; CORT, 2007) point to a positive effect of JSY on ANC service utilisation.

3. Data, Sample and Measurements

This study employs data drawn from two rounds of the District Level Household Survey (DLHS), which were carried out by the International Institute for Population Sciences, Mumbai (IIPS). The DLHS2 (DLHS3) interviewed 620,107 (720,320) households in 2004 (2009). The sample of each round is representative at the district level, for which, on average 1,000 individuals were interviewed. The surveys collected extensive information on, inter alia, birth histories, pregnancy outcomes and survival status of the child.[15] Further, for the most recent birth within 5 years preceding the survey, the DLHS inquires about a number of ANC aspects, such as, for instance, which tests were carried out and whether the woman received an ultrasound scan during pregnancy. Our units of observation are children born in the 5 years prior to the survey to mothers aged between 18 and 44 years. The final sample consists of 761,474 children born to 559,226 mothers in 480 districts.[16] Column 1 of Table 1 reports the characteristics of mothers interviewed for the DLHS2 and DLHS3, the data used for the most part of our analysis. More than two thirds of women belong to scheduled castes, tribes or backward castes in general. Majority of respondents are Hindus (77%) with the second largest group being Muslims (13%). The educational attainment of respondents is relatively low, only 61% have completed primary education.

3.1. JSY Rollout and definition of treatment

The government of India launched JSY in the financial year 2005 and the programme was rolled out incrementally across the country's districts. It has not been possible to obtain exact information on the precise timing of the programme roll-outs by districts. Instead, we follow the approach of previous studies (Lim et al, 2010; Mazumdar et al., 2011) and define a district as having started the implementation of the program using the self-reported information on JSY receipt regarding the last live birth contained in the DLHS3. The question that is used for the purpose is: *"Did you receive any government financial assistance for delivery care under the Janani Suraksha Yojana or state-specific scheme?"* We detail this next.

For each district and fiscal year, we calculate the weighted[17] proportion of mothers, who reported to have received pecuniary assistance under JSY conditional on having given birth in that year. We then define the start of the programme in that district when this proportion exceeds a pre-determined threshold. Once this critical value is reached, JSY is assumed to be available in that district from that point onwards. This empirical strategy, however, implies that we might be measuring the timing of the implementation wrongly. We should also note that there is some doubt regarding whether some mothers who had reported as having received JSY did actually receive JSY benefits. It is felt that some might have erroneously reported as having received JSY when they had received benefits under the

[15] DLHS data has been used by previous studies evaluating JSY (Lim et al, 2010; Mazumdar et al, 2010; for instance).

[16] The number of districts in DLHS1, 2 and 3 are 504, 593 and 611 respectively. District boundaries changed across surveys. To make observations comparable across years, we have regrouped to take into account the boundary changes. This gave us 480 districts over the sample period 1999-2008.

[17] The weights were provided by the DLHS.

previous programme "National Maternal Benefit Scheme" which JSY replaced in 2005. Due to the arbitrariness of the choice of cut-offs, we carefully evaluate and discuss the implications of this definition in Section 8.

In order to identify the starting year of the programme, we experimented with five different thresholds: 10%, 12.5%, 15%, 17.5% and 20%. As the official figures suggest, JSY was rolled out incrementally over time. Figure 2 reports the percentage of districts treated by year of introduction of JSY; in 2005, between 5% and 15% of districts received the programme. This percentage increases over time and reaches between 25% and 50% in the fiscal year 2008.

Figure 3 shows the geographical distribution of JSY recipients. The map suggests that JSY was rolled out across the entire sub-continent. The largest increases in JSY receipts are in the centre, the north and the east of the country. JSY recipients increased in both low performing states, such as, for instance, Assam, Madhya Pradesh, Orissa, Rajasthan and Uttar Pradesh, and high performing states, such as, for instance, Andhra Pradesh, Gujarat and Himachal Pradesh.

The fact that JSY was rolled out incrementally raises the concern that treated and untreated districts differ in characteristics. Columns 2 and 3 of Table 1 report the summary statistics of respondents interviewed during DHLS2 in 2004, i.e. before the introduction of JSY. The proportion of respondents belonging to scheduled castes is similar across treated and untreated districts. The former group, however, shows a marginally higher percentage of women belonging to backward tribes and other backward castes. In comparison, the differences in religious backgrounds between treated and untreated districts are larger. The former show a higher proportion of Muslims, the latter a higher proportion of Hindus. By contrast, women in both groups show very similar educational attainments. Finally, the standard of living index constructed by the IIPS shows that, in treated districts, a higher proportion of respondents is classified as having a lower standard of living. Akin to above, however, the differences do not appear to be stark.

3.2. <u>Sex Ratios in India</u>

In order to assess the unintended consequences of the introduction of the JSY program on the sex ratio, we model the proportion of female births by year and district. Please note that from now on, we use the word *"sex ratio"* synonymously with *"proportion of female births"*. Figure 4 reports the geographical variation in the proportion of girls born across India for the years 2005 and 2008. Between the two years, the largest decreases in the female births occur in the states of Andhra Pradesh, Orissa and Uttar Pradesh, which lie in the North and East of the country. By contrast, the states of Haryana, Punjab, Jammu and Kashmir and Himachal Pradesh, which lie in the Northwest of India, exhibited the largest increase in this proportion. A comparison to Figure 3 provides first descriptive evidence that the introduction of JSY indeed affected the sex ratio at birth; the states with the largest decreases in the sex ratio also experienced a high increase in JSY coverage.

To provide more detail on the relationship between JSY and the sex ratio in India, we plot the sex ratio at birth for treated and untreated districts by the year of treatment. In figure 5, the year of treatment is denoted as 0, years before treatment as negative and years since treatment as positive integers.[18] For both groups, the sex ratio at birth lies below the natural rate with a mean of around 0.488. The sex ratios of treated districts slightly exceed the ones for untreated ones. In the first year of treatment, the sex ratio drops for the treated whereas it slightly rises for the untreated districts. After two years of treatment, the sex ratio rises again for treated districts whereas it stays relatively constant for untreated ones.

4. Empirical Methodology and Results

We model the sex ratio at birth using the weighted proportion of female births for each district for the fiscal years 1999 to 2008. As discussed earlier, the data come from retrospective birth histories in DLHS2 and DLHS3. Let y_{dt} be the proportion of female births in district d and year t. We first estimate the model without distinguishing the year of introduction:

$$y_{dt} = \alpha_d + \tau_t + \lambda_{st} + \beta_1 D^T_{dt} + \varepsilon_{dt} \tag{1}$$

where D^T_{dt} = 1 for $t>2004$ if district d started implementing the programme in year t and 0 otherwise, essentially, this dummy variable takes the value 1 in the year district d receives JSY; λ_{st}s are state specific time trends and α_d and τ_t are district and year specific unobservable characteristics (so called district or year 'fixed-effects'). The reference group is made up of districts that never implemented JSY.

Table 2 presents the results for five different thresholds that define districts as treated (10%, 12.5%, 15%, 17.5% and 20%) and compares results across specifications. The parameter estimates do not suggest a strong effect of JSY on the sex ratio. For the thresholds 10%, 12.5% and 15% the estimated treatment effects do not differ notably from zero. For the two higher thresholds, 17.5% and 20% the estimates increase in absolute value and become

[18] For untreated districts, the reference year chosen is 2005.

significant. The estimates imply that on average, the introduction of the programme reduced the proportion of female births by about 2 percentage points, ceteris paribus.

As shown in figure 2, not all districts were observed to have introduced JSY by the end of the sample period. This may give rise to the concern that districts treated during the initial rollout years differ in terms of unobserved characteristics from those districts that did not receive treatment.

To address this concern, we estimate the following specification, which compares districts treated in the first year of JSY to those treated in the subsequent two years. The equation estimated is:

$$y_{dt} = \alpha_d + \tau_t + \lambda_{st} + \beta_1 D_{dt}^{T2005} + \beta_2 D_{dt}^{NT2005} + \varepsilon_{dt} \qquad (2)$$

D_{dt}^{T2005}=1 for *t>2004* if district *d* started implementing the program in 2005 and 0 otherwise. This is the usual dummy of treatment group interacted with the post treatment period. D_{dt}^{NT2005}=1 for *t>2004* if district *d* did not start implementing the program during 2005-2008. This is the dummy for districts that were never treated interacted with the post treatment period. The reference group in this specification consists of districts that implemented the program after 2005. Thus, β_1 measures the effect of the implementation of the programme relative to those districts that implemented after 2005.

The results for this specification are provided in Table 3. In contrast to the results of Table 2, the parameter estimates in the first row of Table 3 suggest that JSY had a strong and significant impact on sex ratios at birth in those districts that implemented the program in 2005 relative to districts that implemented in 2006-2008. For all thresholds under consideration, the parameter estimates are negative. For the smallest threshold (10%), the estimate is -0.013. The figures further increase to -0.03, -0.015, -0.038 and -0.06 for the thresholds 12.5%, 15%, 17.5% and 20% respectively. Furthermore, the coefficients for the thresholds 12.5%, 17.5% and 20% are significantly different from zero. The second row of Table 3 compares districts treated in 2006-2008 with districts that were not treated. The results suggest that the treatment had a significant effect of reducing the proportion of female births in those districts that implemented the program in 2005 only relative to those treated later, ceteris paribus.

Back of the envelope calculations suggest that the magnitude of these estimates is considerable. Our preferred specification[19] implies that the introduction of JSY in 2005 decreased the proportion of girls born by around 3 percentage points, which corresponds to a decrease in 59 girls per 1,000 boys. Cross-state differences within India may help to illustrate the size of this magnitude. Our estimated effect is comparable to the difference in sex ratios (for children aged 0 to 6) between the states of Andhra Pradesh, which is often considered a typical state in India, and Rajasthan, a state that shows considerable gender gaps in numerous human development indicators. The sex ratio for 0 to 6 year olds for the former state is 943, for the latter it is 883 (Census of India, 2011).

4.1. <u>Treatment Heterogeneity</u>

The effect of JSY varies considerably across districts. Table 4 reports the estimates for the difference-in-differences specification outlined in equation 2 using the 12.5% threshold.

First, we distinguish high and low performing states. The latter have been identified by the Indian government to have particularly high maternal mortality rates. Districts in these regions also hired large number of ASHAs. One of the roles of ASHAs was to incentivise women to get at least three ANC visits before child birth. This feature of JSY is likely to increase mothers' exposure to ultrasound compared to high performing states and we would thus expect the change in the sex ratio to be particularly marked in these districts. Column 1 of table 4 suggests that the sex ratio declined more in low performing compared to high performing states. The difference is estimated to be around 5 percentage points lower in these districts. The coefficient on the interaction term, however, is not statistically significant.

Second, we single out districts, which exhibit strong preferences for sons. We capture these attitudes using three different measurements. First, we select districts in patrilineal states, where kinship is passed on through the father. These states have been shown to exhibit larger gender gaps in a number of welfare indicators as well as stronger preferences for sons. Second, using the DLHS1, we calculate the sex ratio in 1995 – ten years before the introduction of JSY. Districts with a sex ratio below the national mean are more likely to exhibit preferences for sons. Lastly, we calculate weighted district averages of maternal education. Districts below the national mean are more likely to be characterised by stronger preferences for sons. Columns 2 to 4 of table 4 indicate that the introduction of JSY led to a larger decrease in the sex ratio for districts, which exhibit preferences for sons. The introduction of JSY decreased the sex ratio at birth by 4.5 percentage points more in districts

[19] Our preferred specification uses the treatment threshold of 12.5%.

located in patrilineal states compared to the base category (matrilineal states). Similarly, the impact of JSY's introduction was stronger for districts with a below national average sex ratio at birth in 1995 and with below national average maternal education. The respective parameter estimates are -0.035 and -0.02.

5. Identification

The key identifying assumption of our specification is that – after controlling for district and time unobservable characteristics and state time trends – the placement of JSY is exogenous. We evaluate the plausibility of this assumption in two ways.

First, we investigate the possibility that unobserved characteristics determine both, trends in sex ratios at birth and the introduction of JSY. For this purpose, investigate whether sex ratios at birth in previous years determine the introduction of JSY. We estimate the following equation

$$JSY_{dt} = \beta_0 + \beta_{95} SR_{95} + s_s + \varepsilon_{dt} \quad (3)$$

where JSY_{dt} is a dummy indicating whether district *d* introduced JSY during the period *t* (between 2005 and 2008), SR_{95} the sex ratio of district *d* in 1995, ten years before the announcement of JSY, and s_s a state specific intercept. We also estimate two alternative specifications. First, we investigate the probability that district *d* introduced JSY already in its first year, i.e. in 2005. Second, instead of using the sex ratio at birth in 1995, we employ changes in sex ratios between 1995 and a number of other years. This specification helps us to address the concern underlying trends are reflected in the rates of change in sex ratios at birth rather than in their levels. If unobserved characteristics were driving both, changes in sex ratios over time and the introduction of JSY, we would expect the sex ratio before the implementation of the policy to be correlated with the introduction of JSY. Table 5 reports the parameter estimates of equation 3. Column 1 reports the coefficients of the regression of the introduction of JSY on the sex ratio in 1995. The parameter estimate is very small and not significantly different from zero. Columns 2 to 4 show the effects of the rates of change in sex ratios between the years 1995 and 1996, 1997 and 1998 respectively. As before, all parameter estimates are small in absolute size and not significantly different from zero. Columns 5 to 8 show the parameter estimates for the model estimating the probability that district *d* introduces JSY in 2005. As before, the estimates on the levels as well as on the rates of change in sex ratios are small and not significantly different from zero.

Second, we investigate the exact timing of changes in sex ratios to test whether the decrease we described in section 5 coincided with the years JSY was introduced. For this purpose, we estimate an expanded version of equation 2 as

$$y_{dt} = \alpha_d + \tau_t + \lambda_{st} + \beta_{05} D_{d2005}^{T2005} + \beta_{06} D_{d2006}^{T2005} ... + \beta_{08} D_{d2008}^{T2005} + \beta_{N05} D_{d2005}^{NT2005} + \beta_{N06} D_{d2006}^{NT2005} ... + \beta_{N08} D_{d2008}^{NT2005} + \varepsilon_{dt} \quad (4)$$

where D_{d2005}^{T2005} to D_{d2008}^{T2005} are dummies for the years 2000 to 2008 for districts implementing the programme in 2005 and D_{d2005}^{NT2005} to D_{d2008}^{NT2005} are dummies for the years 2000 to 2008 for districts that did not start implementing the program during 2005-2008. All other variables are defined as in equation 2. If the decrease in sex ratios at birth is as result of the introduction of JSY, we would expect the sex ratios to decrease from the year 2005 onwards. Figure 6 shows the parameter estimates for the coefficients β_0 to β_8 along with their 95% confidence intervals. Although the coefficient estimates for the years prior to the reform exhibit a slight negative trend, the years 2005 and after are characterised by a marked decrease in the sex ratio at birth. This suggests that the introduction of JSY indeed supressed sex ratios at birth in India.

6. <u>Robustness</u>

We test the robustness of our results described in section 5 in three ways. First we address the issue of measurement error, second we investigate whether the standard errors are robust to a different specification of the difference-in-differences framework and third we carry out a number of falsification tests.

First, as explained in section 3, we define districts as treated if the weighted average of mothers reporting JSY receipt passes a pre-determined threshold. One concern with this approach is that the thresholds reported in section 5 appear somewhat arbitrary. Also, by employing only five different thresholds, we do not provide a complete picture of the effect of JSY on sex ratios. To address this issue, we re-estimate the difference-in-differences specification laid out in equation 2 using very small threshold intervals. We start by defining districts as treated if 0.5% of mothers report JSY receipt and subsequently increase the threshold by 0.5 percentage points until we reach 20%. Figure 7 reports the estimated coefficients and confidence intervals using these 40 different thresholds. The estimates suggest that, as the threshold increases, the effect of JSY on sex selective abortions becomes stronger. The absolute magnitudes increase almost monotonically.

Second, we address the concern that difference-in-differences estimates applied to long time series data often result in standard errors, which are too small (Bertrand et al., 2004). The authors suggest to collapse all pre- and post-periods into one observation respectively. The difference-in-differences framework should then be estimated on the two periods only adjusting the standard errors for small sample estimation. Column 1 of table 6 reports the difference-in-differences estimates using only two time periods.[20] The estimate is very similar to the one reported in column 3 of table 3 and the standard errors are hardly affected.

To investigate whether the difference-in-differences estimator outlined in equation 2 captures changes in the sex ratio that coincide with but are uncorrelated to the introduction of JSY, we carry out a number of falsification tests. In these, we randomly allocate treatment status to different states in India and re-estimate equation 2. Table 6 reports the estimates using the 12.5% threshold. Columns 2 to 7 allocate treatment status to the states of Kerala, Uttar Pradesh, Andhra Pradesh Madhya Pradesh, Karnataka and Rajasthan. All estimates for these placebo treatments are very close to zero and none is statistically significantly different form zero.

7. Pathways and Ramifications

In this section, we explore the pathways through which the introduction of JSY may have supressed the sex ratio at birth. In particular, we investigate whether the implementation of the scheme led to an increased exposure to ultrasound scans as well as its effect on gender specific survival.

7.1. Exposure to ultrasound technology

As already mentioned in section 3, previous research has shown that JSY increased ANC take-up (Lim et al, 2010). To explore this issue further, we take advantage of information on self-reported ANC take-up in the DLHS2 and DLHS3.[21] We compare conditional means across these two rounds using the following specification

$$y_{rdi} = \alpha_d + \beta_D DLHS3 + \beta_J JSY + \beta_{DJ} DLHS3 * JSY + x'\beta + \varepsilon_{dri} \qquad (5)$$

where y_{rdi} is the relevant aspect of ANC for mother *i*, residing in district *d* interviewed in round *r*, a_d a district level fixed effect, DLHS3 a dummy for the woman being interviewed in the third round of the DLHS (i.e. in 2008), JSY a dummy for whether the district was treated

[20] The threshold used for this estimation is 12.5%.

[21] For the last birth within 5 years of the interview, each mother is asked a number of questions regarding the ANC, postnatal care and outcome of pregnancy.

in between 2005 and 2008 (using the 12.5% threshold) and x’ a number of socio-economic characteristics of the mother.

Table 7 reports the coefficient estimates based on equation 5. Column 1 indicates that the introduction of JSY led to an increase in institutional deliveries. This finding is in line with previous ones highlighting the impact of the scheme on institutional deliveries (Lim et al, 2011, for instance). Columns 2 to 5 report the results for various aspects of ANC uptake. They suggest that there was an increase of ANC take-up at the intensive margin. Whilst the percentage of women using ANC did not significantly increase (column 2), the number of ANC visits increased significantly due to the introduction of JSY (column 4). Furthermore, mothers were more likely to use public facilities for their ANC visits (column 5).

Columns 6 and 7 of table 7 report the difference-in-differences estimates for self-reported ultrasound usage. Both columns show that ultrasound usage increased conditional (column 6) and unconditional (column 7) on the woman benefitting from ANC services. The estimates suggest that ultrasound scans increased between 13% and 20%. Finally, columns 8 to 10 report the estimates for different components of ANC. The parameter estimates suggest that during ANC visits, more tests were carried out. This points to the fact that JSY increased the quality of ANC services offered in districts that were treated by the scheme.

7.2. <u>Child survival</u>

In this subsection, we investigate the effect of the introduction of JSY on gender specific survival of young children. Whilst Lim et al. (2010) show that JSY improved child survival, the authors do not distinguish mortality rates of boys from the ones of girls. It is, however, likely that a change in sex selective abortions affects the gender specific survival rates. Lin et al. (2014), for instance, show that an increase in sex selective abortions in Taiwan was accompanied by a reduction in gender specific mortality rates of young children.

Ex ante, the effect of JSY on gender specific survival rates is ambiguous. On the one hand, an increase in sex selective abortions changes the composition of young children. Because parents have control over whether or not a girl is born, the probability that a daughter is born into a household that values females increases. This, in turn, is likely to improve the survival rates of young girls. On the other hand, a high incidence of sex selective abortions may reflect strong preferences for sons. In such an environment, parents may be less likely to take full advantage of the postnatal care offered by JSY if they have a daughter; thus increasing mortality rates for girls.

To investigate the effect of the introduction of JSY on gender specific survival rates, we first calculate for each district weighted averages of mortality rates for girls and boys separately. For each variable, we then estimate a difference-in-differences specification similar to the one outlined in equation 2

$$m_{dt} = \alpha_d + \tau_t + \lambda_{st} + \beta_1 D_{dt}^{T2005} + \beta_2 D_{dt}^{NT2005} + \varepsilon_{dt} \qquad (6)$$

where m_{dt} is the weighted average of mortality rates in district *d* in year *t*. The remaining covariates are defined as in equation 2. We estimate equation 6 for boys and girls separately.

Table 8 shows the results based on equation 6; Columns 1 to 3 analyse the effect of JYS on neonatal mortality;[22] columns 4 to 6 the effect on infant mortality.[23] For both genders, the introduction of JSY does not appear to have had a significant impact on child survival, see columns 1 and 4. Similarly, neither the mortality rates for boys (columns 2 and 5) nor for girls (columns 3 and 6) seem to have been affected by the introduction of the scheme.

8. Conclusion

The results of our empirical specification suggest that the introduction of JSY had considerable unintended consequences: it resulted in a marked decrease in sex ratios at birth. Our results should, however, not be interpreted as a critique of the scheme. Although the overall impact of JSY is still debated, there is plenty of evidence pointing to improvements in institutional delivery as well as in mothers' and children's welfare. Instead, our analysis should serve as a word of caution for the future. It is well known that wide parts of India are characterised by strong preferences for sons. Thus, any scheme, which changes the costs and benefits of childbirth, is likely to have wide-reaching ramifications. As far as possible these eventualities should be taken into account. We also provide evidence that the decrease in sex ratios resulted from an increased exposure of women to ultrasound scans. This finding can be seen as further evidence that the legal framework is ineffective in curbing the practice of sex selective abortions, thus highlighting the need for a change in the laws surrounding these practices.

[22] Neonatal mortality is defined as a death during the first 28 days of life.
[23] Infant mortality is defined as a death during the first year of life.

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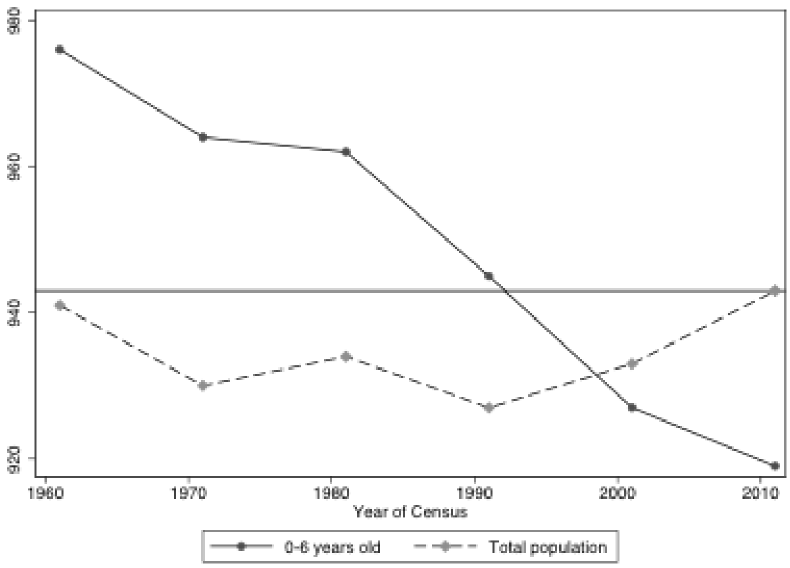
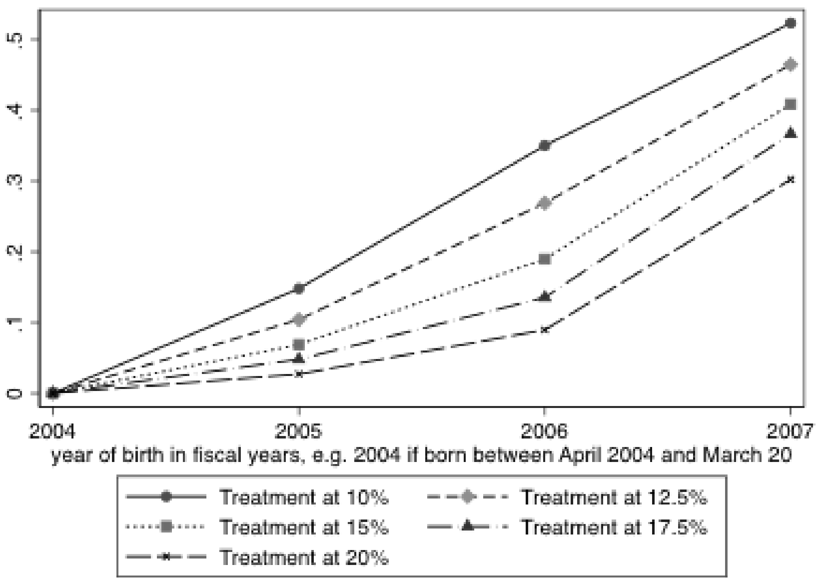
Figures:

Figure 1: Sex Ratios in India



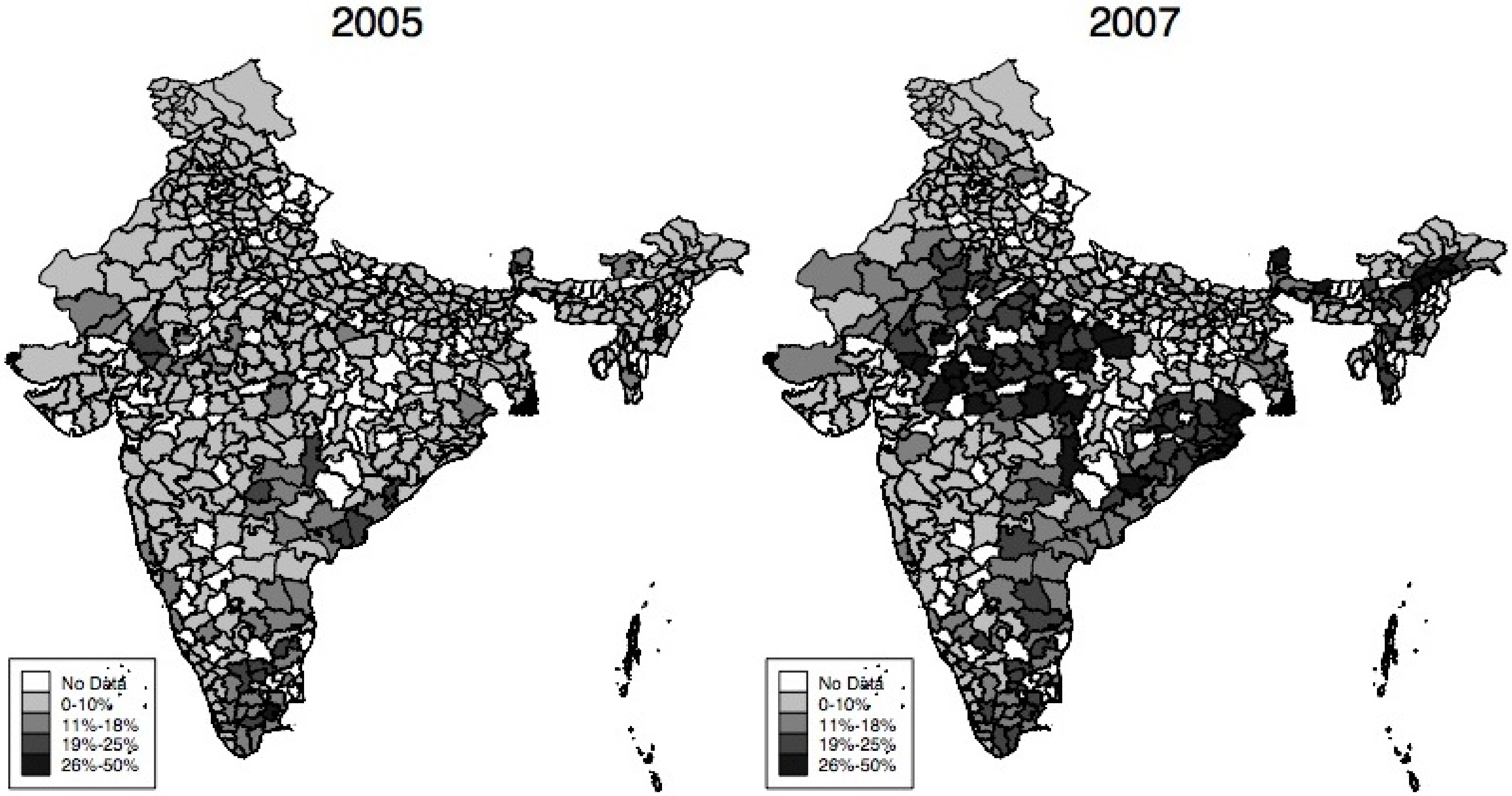
Notes: Sex ratios expressed as number of girls/women per 1,000 boys/men; Source: Indian Census, various years; Horizontal line denotes women per 1,000 men in Germany.

Figure 2: Proportion of districts defined as treated using different treatment variables



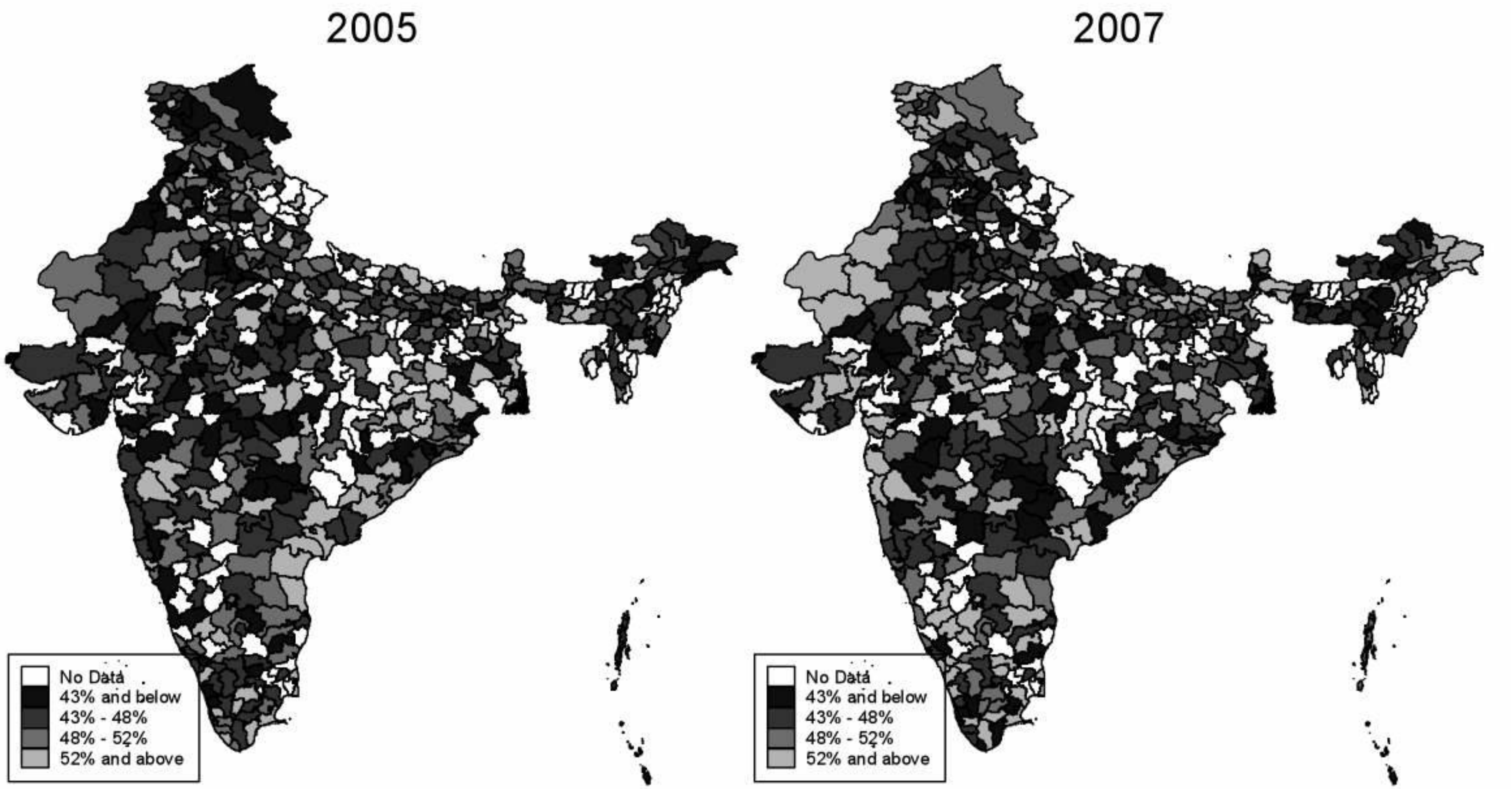
Notes: (i) Sample consists of women aged 18 to 44 drawn from DLHS2 and DLHS3; (ii) Year of birth Y is defined in fiscal years as April Y to March Y+1; (iii) Treatment status is based on self-reported JSY receipt. Treatment at x% implies that at least x% of those women in that district who had given live birth in the fiscal year Y reported as having received JSY for the birth of that child.

Figure 3: JSY Coverage Across India



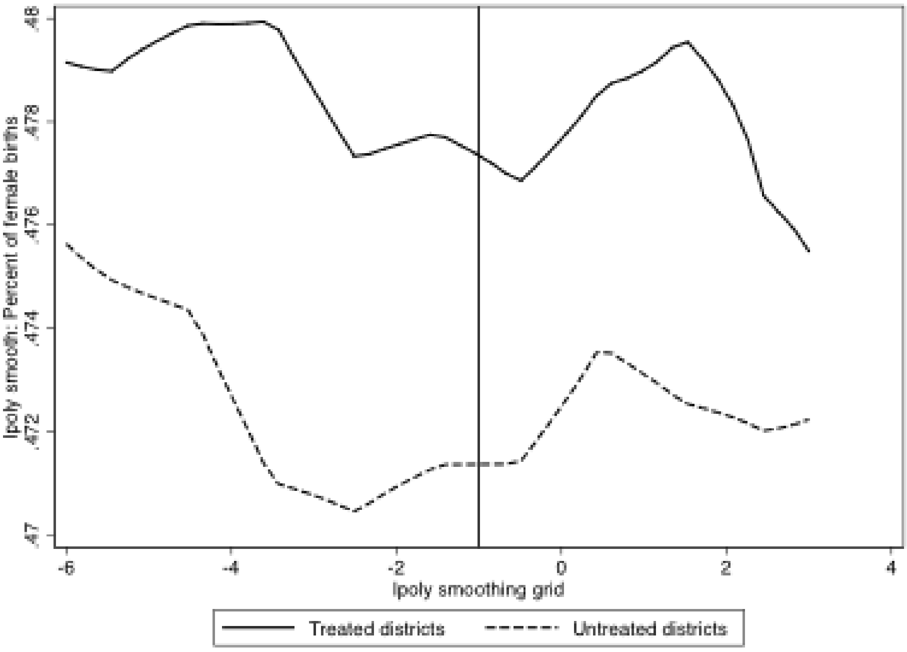
Notes: Sample consists of women aged 18 to 44 drawn from DLHS3; treatment status based on self-reported JSY receipt.

Figure 4: Sex Ratios at birth Across India



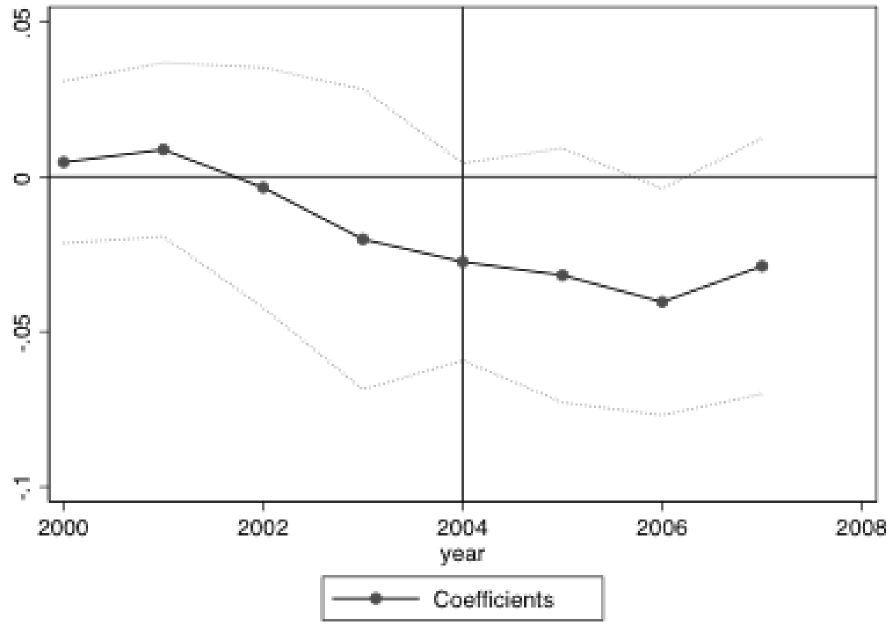
Notes: Sample consists of children born to women aged 18 to 44 drawn from DLHS3; sex ratio at birth defined as proportion of girls born.

Figure 5: Proportion of female births by Treatment Status



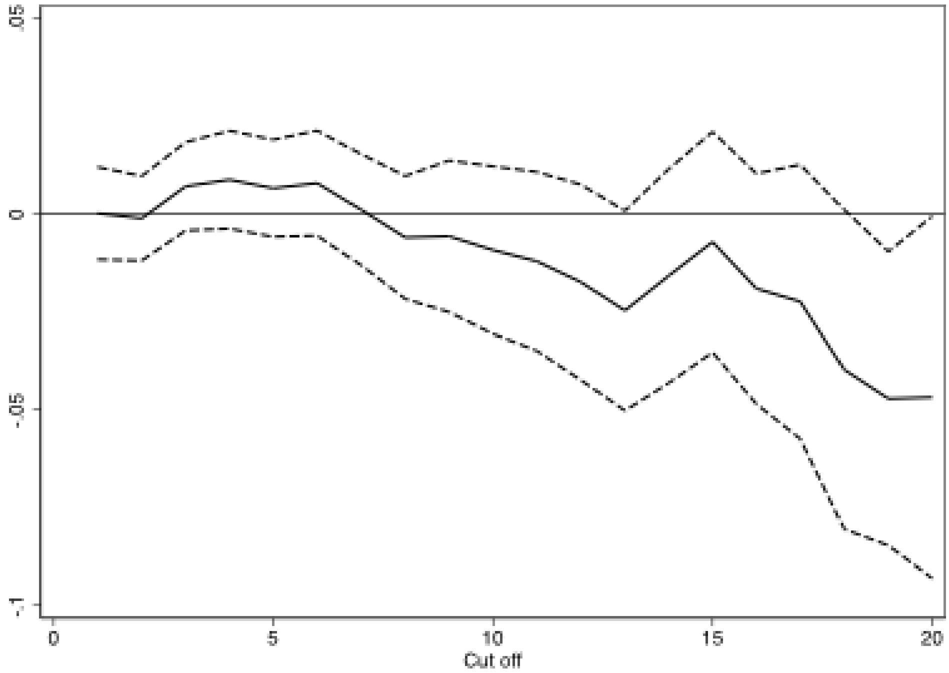
Notes: (i) Sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (ii) Sex ratio at birth defined as proportion of girls born; (iii) Treatment implies that at least 12.5% of those women in that district who had given birth reported as having received JSY for the birth of that child.

Figure 6: Effect of JSY treatment by year – difference-in-differences



Notes: (i) Parameter estimates reported are from difference-in-differences specification; (ii) dependent variable is the proportion of girls born; (iii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iv) dashed line indicates 95% confidence interval; (v) Treatment implies that at least 12.5% of those women in that district who had given birth reported as having received JSY for the birth of that child.

Figure 7: Effect of JSY using different thresholds – difference-in-differences



<u>Notes:</u> (i) Parameter estimates reported are from difference-in-differences specification; (ii) dependent variable is the proportion of girls born; (iii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iv) dashed line indicates 95% confidence interval; (v) Treatment implies that at least 12.5% of those women in that district who had given birth reported as having received JSY for the birth of that child.

Tables:

Table 1: Maternal Characteristics

	[1]	[2]	[3]
	Whole Sample in 2004 and 2008	**Untreated districts before treatment in 2004**	**Treated districts before treatment in 2004**
Belongs to scheduled caste	0.18	0.17	0.18
Belongs to scheduled tribe	0.15	0.13	0.17
Belongs to other backward caste	0.39	0.37	0.39
Hindu religion	0.77	0.73	0.82
Muslim religion	0.13	0.15	0.1
Has completed primary education	0.61	0.62	0.63
1st standard of living tertile	0.43	0.43	0.5
2nd standard of living tertile	0.32	0.32	0.3
3rd standard of living tertile	0.25	0.25	0.2
Number of women	463,737	169,499	152,401

Notes: sample consists of women aged 18 to 44 drawn from DLHS2 and DLHS3; treatment status defined as district having received JSY during sample period; threshold used: 12.5%.

Table 2: Effect of JSY on weighted sex ratio – equation 1

	Dependent variable: proportion of female births				
	Mean of dependent variable: 0.476 **Base category: Never treated**				
	[1]	**[2]**	**[3]**	**[4]**	**[5]**
	Treated at 10%	**Treated at 12.50%**	**Treated at 15%**	**Treated at 17.50%**	**Treated at 20%**
JSY introduction	-0.008	0.001	-0.004	-0.018*	-0.020*
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.476***	0.478***	0.477***	0.475***	0.475***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Within R^2	0.017	0.016	0.016	0.018	0.018

Notes: (i) Parameter estimates reported are within-group estimates; (ii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) number of districts = 480 and number of years = 10 standard errors are reported in parentheses and are clustered at the district level; ***, **, and * indicate significance at the 1%, 5% and 10%.

Table 3: Effect of JSY on weighted sex ratio – equation 2

	Dependent variable: proportion of female births Mean of dependent variable: 0.476 Base category: Treated in 2006 or later				
	[1] Treated at 10%	**[2] Treated at 12.50%**	**[3] Treated at 15%**	**[4] Treated at 17.50%**	**[5] Treated at 20%**
JSY introduction in 2005*Post	-0.013	-0.030**	-0.015	-0.038*	-0.060**
	(0.01)	(0.01)	(0.02)	(0.02)	(0.03)
JSY Not introduced*Post	0.011	0.000	0.004	0.003	0.004
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Constant	0.479***	0.477***	0.479***	0.478***	0.479***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Within R^2	0.018	0.018	0.017	0.018	0.019

Notes: (i) Parameter estimates reported are within-group estimates; (ii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) number of districts = 480 and number of years = 10 standard errors are reported in parentheses and are clustered at the district level; ***, **, and * indicate significance at the 1%, 5% and 10%.

Table 4: Treatment heterogeneity of JSY on sex ratios – difference-in-differences

	Dependent variable: proportion of female births			
	Mean of dependent variable: 0.476 Base category: Treated in 2006 or later			
	[1]	[2]	[3]	[4]
JSY introduction in 2005*Post	-0.015	-0.02	-0.001	-0.01*
	(0.02)	(0.02)	(0.01)	(0.00)
Interaction of JSY introduction in 2005*Post				
Low performing states	-0.054			
	(0.04)			
Patrilineal states		-0.045**		
		(0.02)		
Low Sex Ratio in 1995			-0.035**	
			(0.02)	
Low education				-0.02**
				(0.01)
Constant	0.476***	0.479***	0.477***	0.479***
	(0.01)	(0.01)	(0.01)	(0.01)
Within R^2	0.018	0.018	0.017	0.018

Notes: (i) Parameter estimates reported are within-group estimates; (ii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) number of districts = 480 and number of years = 10 standard errors are reported in parentheses and are clustered at the district level; ***, **, and * indicate significance at the 1%, 5% and 10%.

Table5: Effect of previous sex ratios on introduction of JSY – difference-in-differences

	Dependent Variable: Introduction of JSY				Dependent Variable: JSY introduced in 2005			
	Mean of dependent Variable: 0.51				Mean of dependent Variable: 0.010			
Proportion of female births in 1995	-0.002				-0.004			
	(0.01)				(0.00)			
Difference between								
1996 - 1995		0.003				0.001		
		(0.00)				(0.00)		
1997 - 1995			0.006				0.002	
			(0.00)				(0.00)	
1998 - 1995				-0.000				0.003
				(0.00)				(0.00)
Constant	0.597**	0.505***	0.503***	0.506***	0.388**	0.094***	0.093***	0.092***
	(0.26)	(0.03)	(0.03)	(0.03)	(0.17)	(0.00)	(0.00)	(0.00)
State fixed effects	yes	yes	yes	yes	yes	yes	yes	yes
Districts	243	243	243	243	123	123	123	123
Within R^2	0.001	0.001	0.008	0.000	0.006	0.000	0.005	0.008

Notes: (i) Parameter estimates reported are from ordinary least squares model; (ii) sample consists of women aged 18 to 44 drawn from DLHS1, DLHS2 and DLHS3; (iii) standard errors are reported in parentheses and are clustered at the district level; (iv) ***, **, and * indicate significance at the 1%, 5% and 10%.

Table 6: Robustness of estimates of effect of JSY – placebo treatments

	Dependent variable: proportion of female births						
	Mean of dependent variable: 0.476						
	[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**
JSY introduction in 2005*Post	-0.033**						
	(0.02)						
Different treatment groups							
Kerala*Post		-0.004					
		(0.02)					
UP*Post			0.003				
			(0.01)				
AP*Post				-0.011			
				(0.03)			
MP*Post					-0.008		
					(0.01)		
Karnataka*Post						0.011	
						(0.02)	
Rajasthan*Post							0.002
							(0.01)
Constant	0.484***	0.478***	0.478***	0.478***	0.478***	0.478***	0.478***
	(0.02)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	960	4,582	4,582	4,582	4,582	4,582	4,582
Within R^2	0.068	0.016	0.016	0.016	0.016	0.016	0.016

Notes: (i) Parameter estimates reported are within-group estimates; (ii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) number of districts = 480 and number of years = 10 standard errors are reported in parentheses and are clustered at the district level; ***, **, and * indicate significance at the 1%, 5% and 10%.

Table 7: Pathways of effect of JSY – difference-in-differences

	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]
						Dependent variable:					
	Delivery in hospital	**Received ANC**	**Month of first ANC visit**	**Nr. Of ANC visits**	**ANC in public facility**	**Ultrasound cond. on ANC**	**Ultrasound uncond. on ANC**	**Weight measured**	**Abdominal exam**	**Blood test**	**Urine test**
Mean of dependent variable	0.41	0.69	3.8	3.9	0.56	0.31	0.21	0.61	0.68	0.6	0.62
Treatment	0.006***	0.055***	-0.241***	-0.006	0.098***	0.104***	0.068***	0.045***	-0.091***	-0.024***	0.015***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Post	0.016***	0.048***	-0.073***	0.025	0.002	-0.030***	-0.017***	-0.020***	-0.008**	0.018***	-0.000
	(0.00)	(0.00)	(0.01)	(0.02)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Post*Treatment	0.072***	0.001	0.024**	0.212***	0.062***	0.042***	0.040***	0.063***	0.070***	0.029***	0.050***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Mother covariates	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
District fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Number of women	411,612	411,421	276,858	283,597	307,094	286,749	411,392	286,799	286,784	286,810	286,796
Within R^2	0.311	0.231	0.129	0.382	0.163	0.292	0.328	0.313	0.146	0.297	0.279

Notes: (i) Parameter estimates reported are from ordinary least squares and linear probability models; (ii) sample consists of women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) standard errors are reported in parentheses and are clustered at the district level; (iv) ***, **, and * indicate significance at the 1%, 5% and 10%.

Table 8: Effect of JSY on gender specific child survival – difference-in-differences

	Dependent variable: proportion of female births					
	Coefficient on "JSY introduction*Post"					
	[1]	[2]	[3]	[4]	[5]	[6]
Dependent variable						
Neonatal Mortality - all	0.005					
	(0.00)					
Neonatal Mortality - boys		0.003				
		(0.00)				
Neonatal Mortality - girls			0.009			
			(0.01)			
Infant Mortality - all				0.003		
				(0.00)		
Infant Mortality - boys					0.001	
					(0.01)	
Infant Mortality - girls						0.007
						(0.01)
Constant	0.050***	0.052***	0.047***	0.070***	0.071***	0.069***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Within R^2	0.083	0.071	0.046	0.118	0.089	0.067

Notes: (i) Parameter estimates reported are within-group estimates; (ii) sample consists of children born to women aged 18 to 44 drawn from DLHS2 and DLHS3; (iii) number of districts = 480 and number of years = 10 standard errors are reported in parentheses and are clustered at the district level; ***, **, and * indicate significance at the 1%, 5% and 10%.