Bare branches and drifting kites: Tackling female infanticide and foeticide in Tamil Nadu

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Accepted on November 17, 2012

I. Introduction

A well-known feature of demographic trends in several East and South Asian countries is the continuing decline in the proportion of females to males, which is evocatively captured in the phrase 'missing' women as coined by Sen (1990).[1] In contrast to the female-male population ratio in Europe and the United States which is about one, and the sex ratio at birth which typically lies between 944 and 962 females per 1000 males, unusually low female-male population and sex ratios at birth have been recorded in Bangladesh, China, India, Nepal, Pakistan and South Korea (United Nations 2004).

In terms of temporal patterns, for a large part of the previous century India has witnessed a steady decline in its population sex ratio, reaching its lowest ever recorded ratio of 927 females per 1000 males in 1991. While the 2001 Census points to a slight improvement in the overall population sex ratio, the proportion of girls to boys or the sex ratio for the 0-6 age group continues to decline. This ratio has fallen from 976 in 1961 to 927 in 2001 (see Table 1). The sex ratio at birth has also declined sharply; estimates show that this ratio has fallen from

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[1] Using the prevailing sex ratio in Sub-Saharan Africa, where females outnumbered males by about 2 percent, as the expected sex ratio, Sen (1992) showed that in South Asia, China, the Middle East, and North Africa, the number of "missing women" was close to 100 million.

943 in the 1980s to 876 in the current decade (see Table 2). A substantial proportion of these declines may be attributed to sex selective abortion, female infanticide and neglect of girls.

Similar declines in sex ratios have been observed in China, where there were 901 girls born for every 1000 male births in 1985 while the corresponding numbers in 1995 and 2005 were 806 and 826 (Westley and Choe 2007). South Korea has also witnessed a decline in sex ratio at birth from 914 in 1985 to 865 in 1994 (KNSO 2004). While the decline in sex ratios has attracted scrutiny in these three countries and other parts of the Indian sub-continent, concerns about the decline in the number of females is emerging in other Asian countries, such as Vietnam, and also within countries.[2]

For example, early work on sex ratios in India pointed out a sharp regional dichotomy with masculine sex ratios in the north and the west and less adverse female to male sex ratios in the south and the east, that is, a diagonal divide (for example, Sopher 1980, pp. 294--6; Miller 1981, pp. 71--4; Dyson and Moore 1983; Sen 2001). However, more recent analyses based on the 2001 census (Agnihotri 2003; Srinivasan and Bedi 2009) shows that this diagonal divide is no longer valid (see Figure 1).

It is often argued that a shortage of women may have positive consequences for them (e.g., Samuelson 1985; Park and Cho 1995); however, empirical evidence on this issue is scarce. Indeed, contrary to such expectations, the shortage of women in the North Indian states of Haryana and Punjab is reported to have led to a rise in marriage migration, abduction and kidnapping of girls and forced polyandry (Aravamudan 2007; Hivos 2005; Kaur 2004).

While recognition of the negative effects of daughter elimination as suggested by legislative measures taken to prevent infanticide and control marriage expenses date to 1731,

[2] Based on data from Vietnam's 1999 Population Census, Truong (2006) points out that the sex ratio at birth in almost all the provinces of Red River Delta is unusually low, ranging from 909 in Ha Noi to 833 in Thai Binh.

systematic efforts to tackle daughter elimination has for the most part been restricted to certain geographical areas and specific time periods. The clearest examples of such instances, and to which this paper pays attention, are the range of policy measures used to tackle infanticide in the North-western province of British India between 1870 and 1906 and the South Indian state of Tamil Nadu between 1992 and 2003.

The next section of this paper provides a brief historical account of female infanticide and then provides a contemporary account of the extent of daughter deficit in India. In similar fashion, Section III begins by providing a historical account of interventions used to prevent infanticide and then focuses on the range and effectiveness of interventions used in Tamil Nadu to prevent daughter elimination. The final section speculates on future patterns of daughter elimination.

II. The extent of daughter deficit

II.1 Early assessments of infanticide[3]

While the origins of female infanticide in India are not clear and the exact configuration of circumstances which result in the practice varies across the country and across various socio-economic characteristics, what is clear is that the practice did not (and does not) enjoy any religious sanction, that it was usually carried out in a clandestine manner (unlike other acts of female elimination such as *jauhar* and *sati*) which in turn impeded its official "discovery" till well into the 18th century.

In 1789, Jonathan Duncan, the British Resident at Benares, was the first to record widespread instances of infanticide amongst the Rajputs of Jaunpur (located in the North-western province of British India). Thereafter, reports of the practice amongst Rajputs living in

[3] This sub-section (*II.1*) draws mainly from Panigrahi (1972) which in turn is based on an exhaustive study of archival material of the colonial period. Other sources, on which this section is based, include Oldenburg (2002), Anagol (2002), and Vishwanath (1998).

other parts of the state came in from Azamgarh (adjacent to Jaunpur) in 1835 and Mainpuri in 1843. While there were instances of poorer families resorting to infanticide, in general the practice as noted by these British administrators took place amongst clans of "superior blood and family".

Motivated by persistent reports of the practice, British administrators took several censuses amongst Rajput families in suspected villages in the North-western provinces. For instance, in 1855, based on a census of Rajput families living in 332 villages of the province, a special commissioner confirmed the prevalence of infanticide in 308 of these villages, while in 62 villages the commissioner did not find a single girl below the age of six (for details, see Panigrahi 1972).

Qualitative investigations (key informant interviews) conducted between 1808 and 1836 revealed that the practice was not confined to North-western province.[4] In 1846 John Lawrence, a Commissioner of a division (Jullunder Doab) in the Punjab, noted that there was not a single girl amongst 2,000 Bedi families in the division. Soon after (in 1851 and 1853), statistical investigations revealed that the practice occurred amongst a large number of castes and clans.

II.2 Contemporary patterns of daughter deficit

While these early analyses confirmed the widespread existence of infanticide in Northern and Western India and its prevalence mainly amongst upper class families, the composition of a nation-wide picture of daughter deficits requires a leap of about 120 years to 1981.[5]

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[4] As far as South India is concerned, Miller (1981) observes that there are few ethnographic studies done in British Madras and Andhra Pradesh and it is possible that the practice was not common in this region as may be inferred from the 1872 juvenile sex ratio of 962 for Madras presidency as opposed to a ratio of 833 for the North-west Provinces.

[5] The choice of this year is pragmatic as it was only in 1981 that nation-wide sex-disaggregated data on infant and child mortality became available.

Before turning to the details, let us define daughter deficit. Daughter deficit is the gap between the number of daughters that may be expected and the number of daughters born or alive in a certain age group. The deficit may occur before birth, within a year after birth (early post-birth deficit) or beyond age one (late post-birth deficit). Given the scope of this paper, we focus mainly on deficit that arises before birth, within a year after birth and in the age group 1 to 5 years.

To detect the extent of daughter deficit we need to establish benchmarks against which the prevailing ratios may be compared. That is, what is the sex ratio at birth and the rate of female infant (0-1) and child mortality (1-5) that would prevail in India in the absence of interference? While details are discussed elsewhere (Bedi and Srinivasan 2008), a widely used and accepted benchmark is a sex ratio at birth of about 952 females per 1000 males. As far as mortality is concerned, analysis of data from countries without a record of interference displays that female mortality (both infant and child) is lower than male mortality and that female infant and child mortality may be pegged at about 80 percent of male infant/child mortality. Based on these benchmarks and the information presented in Tables 3 and 4, in 1981, the daughter deficit rate was about 40 females per 1000 male live births or to put it in a starker manner, about four girls were sacrificed for every 100 male live births. In 1991 the sacrifice rate increased to about five, and in 2001, a little more than six daughters were sacrificed for every 100 sons. In absolute terms, in 2001 this translates into a daughter deficit of about 650,000 daughters for the country. Besides the increase in the rate of sacrifice, the other notable feature is the changing source of the deficit. In 1981, the bulk of the deficit arose in the age group 1-5, while by 2001, consistent with the country-wide spread and easy access to sex-determination technology, more than 75 percent of the deficit arises before birth.

Table 5 provides a disaggregated state-level picture of the extent of the deficit. Consistent with the long history of the practice, the North-western states continue to experience the highest deficit rates, with Haryana and Punjab topping this league of infamy with sacrifice rates of close to 20 girls per 100 boys. These two states are followed by Gujarat, Rajasthan, parts of Uttar Pradesh and Delhi. While the situation in the North-west may be expected, the numbers show that there is a deficit in 22 out of 31 states and while there are sharp differences in the extent of the deficit, it would appear that (i) no region of India is immune to daughter deficit and (ii) across most states daughter deficit arises mainly before birth.

Given the dominance of pre-birth deficit, Table 6 provides information on the link between sex ratio at birth and various characteristics. As shown in the table, daughter deficit does not differ across rural and urban regions. In terms of religion and caste, the practice is less likely to occur among scheduled castes and tribes as compared to others, and while there are deficits across almost all religious groups they are highest amongst Sikhs and Jains (sex ratio at birth of 770 and 847). There appears to be a clear relationship between maternal education and deficits with the most educated mothers recording much higher deficits (876) as compared to illiterate mothers (920).

II.3 Deficit versus elimination[6]

So far the discussion has been couched in terms of daughter deficit, with a distinction drawn between daughter deficit (a shortage of daughters) and deliberate action being taken to eliminate (in the form of feticide, infanticide and neglect) daughters. A pertinent question is

[6] This sub-section draws on Srinivasan and Bedi (2008), which contains additional discussion of the issues raised here.

whether the entire deficit may be attributed to elimination or whether there are other factors that exert a bearing on the deficit.[7]

In the Indian context, two recent papers have argued that, in part, the unexpectedly masculine SRB (sex ratio at birth) may be driven by the incidence of Hepatitis B virus infection (Oster 2005) and improvement in women's health status which may reduce (male) foetal wastage and in turn lead to masculine SRB (Jayaraj and Subramanian 2004).

Let us briefly consider these two explanations. According to the Hepatitis B virus hypothesis, women who are carriers of the virus give birth to a higher ratio of boys to girls than non-carriers. While the prevalence of the Hepatitis B virus may indeed be responsible for a SRB that is lower than the expected ratio of 952, unless there has been an increase in the prevalence of Heptatis B carriers over time, this explanation cannot be responsible for the continued decline in the SRB in India. Also, if a Hepatitis B virus based explanation had a large bearing on the masculinization of the SRB then the SRB should not display much variation across birth order and should not be affected by the sex of previous children.

Better nutrition of women and the subsequent reduction in foetal wastage is consistent with the observed masculinization of SRB over time. While part of the temporal decline in the SRB may be driven by reduced foetal wastage, it is not clear why this ratio should become less than the SRB observed in healthy populations in developed countries. According to this hypothesis, due to the effects of repeated child bearing on a woman's health, the SRB should become more feminine at higher birth orders and the ratio should not be influenced by the sex of previous children.

[7] Various factors other than pre-birth interference may have an effect on the sex ratio at birth. These include maternal calorie intake and nutrition (Williams and Gloster 1992; Goodkind 1996; Jayaraj and Subramaniam 2004), Hepatitis-B virus infection (Drew et al. 1986; Oster 2005), parental hormonal levels at the time of conception (James 1996) father's occupation (Dickinson and Parker, 1997), father's presence at home (Norberg, 2003), maternal dominance (Grant and Yang 2003), smoking (Fukuda et al. 2002), and time taken to conceive (Smits et al. 2005).

However, we observe clear patterns in the SRB across birth order with the sex of the previous child/children exerting a strong influence on the SRB of higher order births (see Table 7). Second order births are only more feminine if the first child is male, while they are extremely masculine if the first child is female (see Table 7). As shown in Table 7, if the first child is male then the sex ratio at birth is 923 females per 1000 males while if the first child is female the SRB is 817. The difference is clearer for higher order births with a ratio of 1025 for women who have had two boys while it is 718 for women who have had two girls.

While these alternate explanations may be responsible for some of the observed deficit, it seems unlikely that they play a large role in influencing daughter deficit. Given the numbers and the issue under scrutiny, a reasonable and cautious approach would be to treat the entire deficit as a consequence of deliberate action.

III. Prevention

III.1 Preventing infanticide in British India[8]

According to British records the earliest regulations attempting to prevent female infanticide were issued in 1731 and 1752 by two Rajput kings of Western India. On their part, soon after the discovery of female infanticide in 1789, British administrators began developing region-specific programs to prevent female infanticide which culminated in the Infanticide Act of 1870.

Based on a benchmark of 666 girls to 1000 boys and the canvassing of a census, the first stage in the implementation of the Act called for the public proclamation of guilty clans and villages, which were then to be subjected to (i) increased statistical scrutiny which included the filing of quarterly data on pregnancies, births, deaths, marriages and on the movement of pregnant women from proclaimed to unproclaimed villages (ii) increased police scrutiny and inquests in case of infant deaths, which were to be followed by appropriate legal action. In terms of an information system, at the village level midwives were responsible for reporting pregnancies, births and especially deaths to the *chowkidar* (watchman) and he in turn was to report to the police station.

The administration swung into action in villages that were especially guilty and subjected them to intensive statistical and police scrutiny. Inquests and post-mortem examinations became common occurrences in the proclaimed villages. In cases where there was adequate proof of infanticide, charges were framed and legal action followed. Police reports show that in the 1880s and 1890s more than 1800 inquests were conducted per year and at least 80 (males) heads of families were punished each year.

The interventions yielded rapid results and between 1875 and 1881, the ratio of girls to boys under age 12 in the proclaimed villages rose from 30.2 percent to 38.6 or an increase in the child sex ratio from 433 to 629 (see Table 8). Gradually it was felt that the provisions of the 1870 Act were no longer necessary and that ordinary law was adequate to prevent infanticide and in 1906, the Act was withdrawn.

It is of course possible that some of the figures were politically inspired. Furthermore, the rapid withdrawal of the Act raises suspicion. However, if we distance ourselves from such concerns for a while, what is clear is that the implementation of the Act provides the first example of the application of a modern, multi-pronged approach to tackling infanticide. Rapid and continuous data gathering supported policy implementation and the interaction between public proclamation and disgrace, intensive statistical monitoring and the credible threat of police and legal action were reported to have led to a sharp drop in female infanticide.

Today, a little over 100 years since the withdrawal of the infanticide Act of 1870, there

[8] This sub-section (*III.1*) is based on Panigrahi (1972) and Oldenburg (2002).

is widespread prevalence and recognition of daughter elimination in India. However, programs to prevent infanticide and the relatively new challenge of foeticide are not available at an all-India level. While laws [The Pre-conception and Pre-natal Diagnostic Techniques (Prohibition of Sex Selection) Act, 1994 (2003)] prohibiting sex-detection are in place, the only example of a comprehensive set of policies involving iterations between data collection and policy-making comes from the south Indian state of Tamil Nadu.[9] In the remainder of this section we provide an account of the measures taken and the causal effect of these measures on daughter elimination in Tamil Nadu. A notable aspect is the striking similarity between some of the measures adopted in Tamil Nadu in the 1990s and the measures that were adopted in the 1870s.

III.2 Preventing daughter elimination in Tamil Nadu[10]

Female infanticide first came to light in Tamil Nadu in 1985 and was estimated to lie in the range of about 3000 deaths a year (Chunkath and Athreya 1997). Initially the practice was considered to be limited to certain groups and certain geographical areas but subsequently several researchers (George et al. 1992; Venkatachalam and Srinivasan 1993; Srinivasan and Bedi 2008) have shown that the practice was widespread.

In 1992, prompted by sustained NGO and media attention and academic reports, the state government introduced several schemes and initiatives to tackle female infanticide. These included the Cradle Baby Scheme (CBS), legal action against perpetrators of infanticide and the Girl Child Protection Scheme (GCPS). In addition, a systematic data collection system was

[9] While civil society mobilisation against sex selection has been witnessed in Delhi and Maharashtra since the 1970s and in 1988, Maharashtra was the first state to legislate against sex selection (Mazumdar 1992; Ravindra 1993), a comprehensive approach which involves periodic data collection and a range of schemes to prevent daughter elimination is restricted to Tamil Nadu.

[10] This sub-section *(III.2)* draws on Bedi and Srinivasan (2008), which contains additional details on the interventions and the estimates discussed here.

launched to track vital events on a more regular basis and to generate district-level information for the purpose of planning and implementation. These Vital Event Surveys are unique to the State and gather information among others, on the number of male and female live births and infant deaths during the year preceding the survey. Each of the surveys is based on a sample of about nine million individuals (in 2001, the state's population was estimated to be about 62 million) and 174,000 births.

The policy interventions used in the state may be divided into two distinct phases, a first phase spanning the years 1992 to 2000 and a second phase which started in 2001. The overall period is marked by several changes in policy intensity as well as differences in terms of policy interventions across districts. This spatial and temporal variation in policy intensity provides an opportunity to identify the causal effect of the interventions on daughter deficits. However, before moving on to the effect of these interventions, we provide a brief sketch of the interventions.

The CBS provides a more humane option to murder. Instead of resorting to infanticide, parents unwilling to raise female babies could place them in government-supported cradles. Subsequently, orphanages offer the cradle babies for adoption. Between 1992 and 1996, 140 babies were placed in government cradles (*The Hindu* 25 June 2001 "Fancy schemes won't work: NGOs"). The scheme had a short life and following elections and a change of government in 1996 it was shelved (see Table 9).

In 1992-93 the government decided to pursue legal action against those who committed or attempted female infanticide. According to police records, the first arrests for female infanticide were made in Salem district in December 1992. In July 1995, the arrested parents were convicted to life imprisonment with the father receiving life imprisonment while the mother received five years rigorous imprisonment. Between 1992 and 2000 there appear to have been at least seven cases of police and legal action.

The GCPS was launched in 1992 with the aim of changing attitudes towards girl children. Among others, the aim of the scheme was to enhance the image of the girl child as well as her economic value by providing financial support for her education and marriage, and to discourage parental preferences for sons. The scheme was targeted at families below the poverty line with daughters in the age group 0-4 and *no* son. For every eligible girl child, Rs.2000 was to be deposited in an interest-bearing special public fund maintained by the government. Money from this fund was to be paid out to families and on attaining 20 years of age a lump sum of Rs.10,000 is to be provided which may be used to pursue higher education or meet marriage expenses. A sum of Rs. 40 million per year was allocated for the scheme (Krishnakumar 2002). Program uptake was limited, and between 1992 and 1997, 2,039 families had benefited from the scheme (Social Welfare Department, Government of Tamil Nadu, Personal Discussions in 2002). Following elections and a change of government in 1996, the scheme was placed on the backburner.

In addition to these three government-led interventions, several initiatives were located in specific pockets in the three districts of Madurai (including Theni), Salem (including Namakkal) and Dharmapuri. While details of the approach used by NGOs operating in each and within district vary, broadly the strategy consisted of three aspects (for details see George 1997; Srinivasan 2006). First, formation of women's self-help groups (SHG) for savings and income generation and to explicitly tackle female infanticide. Group members were provided with training and other inputs on various aspects of gender discrimination including female infanticide and every member took a vow that she would not practice or let others practice female infanticide. Second, at the village level, NGOs with or at times without the support of members of the self-help group identified, monitored and counseled high risk pregnant women (those with more than one daughter and no son) and their families on the value of girl children and against any attempt at female infanticide. Along with counseling, the threat of police and legal action was invoked and members of the self-help groups/NGO staff were encouraged to report specific cases of female infanticide to the police. Third, the NGO guided and encouraged eligible families to access the GCPS, and in some cases provided economic support to families with girl children. If none of these steps appeared to be successful in preventing daughter elimination, the CBS was suggested as a last resort.

The only large scale activity during this period, led by project administrators under the aegis of a Tamil Nadu Area Health Care Project, was a behavioral change communication campaign conducted in Dharmapuri district. The project implementation team addressed female infanticide through a process of social mobilization. A strong communications program with *kalaipayanams* (itinerant street theatre) at its centerpiece was used to sensitize and mobilize the population against female infanticide.[11] According to Athreya and Chunkath (2000), the direct and indirect reach of the program was universal and "every one either knew of it beforehand or came to know of it afterward". The entire period of this intervention, from initial preparatory work to the panchayat commitment covered the years 1997 to 1999.

Although interventions continued in certain districts throughout the 1990s, in general the period 1996 to 2000 was characterized by a reduction in government efforts to tackle daughter deficits. In May 2001, following a change of government, there was a sharp renewal in government action against daughter elimination and the post-2001 period may be treated as the second phase of interventions against daughter elimination.

[11] Performing troupes, typically consisting of eight men and eight women were trained in each of the 18 blocks of the district for about 40 days. Then between April 26 and June 6 1998, these troupes covered their respective blocks and delivered about 3,000 performances which were watched by about a third of the district's population.

In May 2001, the Cradle Baby Scheme was revived and extended to all the state's districts. Additional resources were provided, numerous cradle points were opened and frequent public announcements popularized the scheme. Between May 2001 and November 2007 the scheme received 2410 baby girls (see Table 9).

Police and legal action against infanticide registered an increase especially in Salem and Theni districts. Ten cases of police and legal action were recorded between in 2001 and 2003 as compared to seven cases between 1992 and 2000.

In 2001-02 the GCPS was restructured to confer increased financial benefits. The amount of money granted to eligible one-girl families was increased from Rs. 2000 to Rs. 22,000. The sum was placed in a government corporation and interest accruing from this deposit was paid out on a monthly basis. The scheme envisages a final payment, at age 20, of Rs.80,000. The scheme has witnessed a 50-fold increase in the number of beneficiaries and according to policy note 2006-2007 prepared by the Corporation, a sum of about Rs.1750 million benefiting 115,171 children has been received under the scheme[12].

In addition to the revival of these schemes, the government placed pressure on district administrations to prevent female infanticide and sex selective abortion in five high-prevalence districts, namely Dharmapuri, Madurai, Salem, Theni and Namakkal.[13] The case of Salem, the district with the lowest 0-6 ratio in South India, is illustrative. Between June 2001 and July 2003 the Salem district administration worked closely with NGOs and took several measures to prevent female infanticide and sex selective abortion.

[12] http://www.tntdpc.com/government/energy.pdf, accessed on 2 October 2007

[13] These districts were targeted through the Cradle Baby Scheme (Policy Notes, Government of Tamil Nadu, 2001-02 at http://www.tn.gov.in/policynotes/archives/), they were amongst the seven districts that received funding to conduct behavioural change campaigns against infanticide and foeticide (Policy Notes, Government of Tamil Nadu, 2003-04 at http://www.tn.gov.in/policynotes/archives/) and the two districts, Madurai and Theni were targeted as part of the government's reproductive and child health project, through which the districts received funding to conduct communication and awareness campaigns to tackle infanticide (details are at http://www.tnhealth.org/externallyaidedprojects.htm).

The NGO model of monitoring and counselling high-risk pregnant women through the active role of women's self-help groups and provision of economic support was scaled up. Village-level committees to monitor pregnant women were set up in 385 of the district's 557 villages. At least six cases of police and legal action were initiated during this period as compared to one during 1992-2000. A dedicated 24 hour toll-free phone number with direct access to the collector's bungalow was set up to report female infanticide and sex selective abortion. A death audit was started and any infant death—male or female—was investigated (if need be, bodies were exhumed). These activities were conducted in a high profile manner and district officials utilized every opportunity to condemn infanticide and foeticide.

What was the impact of all these measures? While this is usually a difficult task, in the current context the sharp variations in policy interventions before and after 2001 and the spatial variations in policy intensity across districts may be exploited to isolate the causal impact of the interventions. Specifically, after controlling for a number of other variables which may influence outcomes, changes in daughter deficit over time and across "heavily-treated", "lightly-treated" and "minimally-treated" districts are examined. To elaborate, the first set consists of five districts that have been heavily targeted by state and NGO-led interventions, they account for a majority of legal actions initiated against infanticide and have access to the GCPS and CBS. This set of districts may be characterized as "heavily treated districts". The second set consists of six districts where legal actions have been initiated and these districts have access to GCPS and CBS but there are no widespread NGO-led interventions. These districts may be characterized as "lightly treated" districts. The third set consists of districts where *no* legal action has taken place, these districts (not shown in table) have access to GCPS and CBS but again there are no widespread NGO-led interventions. These districts may be described as "minimally treated" districts (see Table 10).

Based on the benchmark of expected female infant mortality at 80 percent of male infant mortality, over the period 1996-1999, post-birth deficit (estimate of female infanticide) may be pegged at 4,485 girls. In terms of a district-specific distribution, a little more than 50 percent of the deficit may be attributed to just two districts. Dharmapuri accounts for 26.5 percent of the deficit while Salem accounts for 24 percent of the deficit. Post-birth deficit figures for 2003 display a sharp decline of a little more than 2,000 girls, which translates into a decline of 46 percent between the two reference periods. The decline is dominated by Dharmapuri and Salem which together account for 85 percent of the decline. Post-birth daughter deficit in Dharmapuri declines from 1,189 to 219 or a reduction of about 82 percent while the corresponding decline in Salem is 73 percent (from 1067 to 283). Other districts which displayed strong evidence of post-birth daughter deficit in 1996-1999 present a mixed picture, with some showing signs of a larger deficit. However, the main picture emerging from the analysis is that post-birth daughter deficit experiences a spectacular decline between 1996-1999 and 2003. In terms of attribution, the econometric analysis (Table 12) shows that the decline may be attributed entirely to the heavily treated districts and that the interventions are responsible for about 80 percent of the total decline in daughter deficits.

Turning to pre-birth deficit, based on the gap between the expected and actual sex ratio at birth over the period 1996-1999, female pre-birth deficit may be pegged at about 6,244 females (see Tables 13 and 14). Most of this shortfall emanates from the rural areas of the state and is once again dominated by Salem (27 percent of the deficit) followed by Dharmapuri (12 percent). Between 1996-1999 and 2003 the shortfall declines slightly from 6,244 to 5,294 (6,244 - 950) with rural Salem accounting for a large percentage of the decline in the deficit (increase in SRB from 843 to 893) and the sex ratio at birth increases from 935 to 944. In terms of attribution, the econometric analysis (not reported in paper, see Bedi and Srinivasan 2008) shows that there is no association between treatment and a reduction in pre-birth daughter deficit, suggesting that the decline in pre-birth deficit may not be attributed to the set of policy interventions. While the decline in pre-birth deficit is not as spectacular as the decline in post-birth deficit, and the declines that do exist may not be attributed to the policy interventions, the analysis shows that the policy-induced decline in post-birth deficit has not come at the cost of a policy-induced increase in pre-birth deficit.

The pattern of results and the differences across heavily and lightly treated districts provides valuable clues on how daughter deficits may be tackled. First, they suggest the importance of large scale district-wide interventions mobilized by the district administration, as opposed to interventions in limited geographical areas. Second, the district-wide monitoring and counseling of high-risk mothers at the grassroots (by NGOs/women's self-help groups/village health nurses), linked to the credible threat of police and legal action and the possibility of economic support via schemes such as the GCPS comprise an intervention model which may be used in other parts of the country. While the manner in which the various programs interact to reduce daughter deficit needs to be explored more fully, clearly, on their own, police and legal action and schemes such as the CBS and GCPS are unlikely to lead to a reduction in daughter deficit.

While the effect of these interventions is clear, there are a number of details that have been brushed under the carpet. The Cradle Baby Scheme has been criticized for absolving families of the responsibility of caring for their daughters and promoting son preference as well as feeding into an adoption racket (Krishnakumar 2005; CASSA 2007). The Girl Child Protection Schemes targets families below the poverty line, while the data show that daughter elimination is more likely to occur in better-off families. More importantly, have these policies delivered sustainable effects and altered preferences or are these short-term gains? The three interventions mainly aimed at preventing female infanticide and although the PCPNDT Act has seen some activity in the state, efforts to tackle sex selection are limited. Nevertheless, the analysis shows that, as in the past, daughter elimination is amenable to public policy, and that a combination of legal action, economic support and intensive household level counseling and monitoring can prevent daughter elimination.

IV. Looking ahead

While measures to prevent daughter elimination have yielded striking results in Tamil Nadu, and the state's example can and should be emulated in other parts of the country, there is a need to think ahead and devise pre-emptive prevention strategies.

At the moment the most widely available technology for eliminating daughters is the use of ultrasound scan followed by abortion. Sex detection using ultrasound is usually possible about 14 to 16 weeks into a pregnancy and both detection and abortion are undertaken by medical professionals. The Medical Termination of Pregnancy (MTP) Act 1971 permits abortion, with minimum controls up to 12 weeks into a pregnancy, and with stricter controls between 12 and 20 weeks.

Given these hurdles, the demand for early sex detection "is increasing everyday" (Bedi 2008). While technologies offering sperm separation and subsequent insemination make it possible to select the sex of a child before conception, they still call for medical intervention. A bigger threat to programs that attempt to prevent daughter elimination may come from the recent availability of DNA "sexing" kits which are sold over the internet (at a price of $200) and which claim that it is possible to identify the sex of a child from foetal DNA found in a mother's blood stream. The company marketing these kits[14] claims 95 percent "sexing" accuracy as early as seven weeks into a pregnancy. According to Aravamudan (2007), in 2006 such sexing kits, known as "*jantar mantar*" (literally a calculation instrument or a magical calculation instrument), were widely available in Punjab and Haryana. The possibility of early sex detection using such kits and methods of drug-induced abortion may reduce the need for medical intervention and may lie within the purview of the law.[15]

It is not uncommon for some academics and activists to dismiss such technologies as the stuff of fantasy and to point out that these are still not widely available in India and that the focus of intervention efforts should remain on monitoring the use of ultrasound machines. Our view is that such a singular focus which underestimates the potential effect of such new technologies is foolhardy and unreasonable. While the historical and contemporary policy experiences discussed here are inspiring examples of how daughter elimination can be reduced in a short time-span, it is all too likely that the availability of the next generation of sex-detection technology will exacerbate daughter elimination.

[14] http://www.tellmepinkorblue.com

[15] Systematic work on the extent to which such new technologies are being used for sex selection, their costs, and the strategies being used by companies marketing these technologies is limited and calls for further research.

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Table 1
Population and 0-6 sex ratio in India

Year	1901	1911	1921	1931	1941	1951	1961	1971	1981	1991	2001
Population Sex Ratio in India	972	964	955	950	945	946	941	930	934	927	933
0-6 Sex Ratio in India	.	.	.	.	.	.	976	964	962	945	927
0-6 Sex Ratio in Urban India	.	.	.	.	.	.	.	.	.	935	903
0-6 Sex Ratio in Rural India	.	.	.	.	.	.	.	.	.	948	934

Notes: The ratios are defined as the number of females per 1000 males. ***Sources:*** All figures are based on census data.

Table 2
Sex ratio at birth in India

Period/Statistic	Source	SRB India	SRB India Urban	SRB India Rural
Row 1: 1978-92	NFHS-1	943	.	.
Row 2: 1984-98	NFHS-2	926	.	.
Row 3: 1981-90	SRS	909	.	.
Row 4: 1996-98	SRS	901	.	.
Row 5: 1997	SFMS	899	878	903
Row 6: 2001	Census	905	904	906
Row 7: 2001-2003	SRS	876	860	882

Notes: The SRB is defined as the number of female live births per 1000 male live births. ***Sources:*** (a) Figures in row 1 to row 4 are from Retherford and Roy (2003). (b) Figures in row 5 are from Jha *et al.* (2006) and are based on their analysis of the Special Fertility and Mortality Survey (SFMS) conducted by the Office of the Registrar General, India. (c) Figures in row 6 are based on Census 2001, Table F-9. (d) Figures in row 7 are based on the Sample Registration Survey and are from the Baseline Survey Report (2004) issued by the Office of the Registrar General, India.

Table 3
Development of sex ratios

Year	SRB	Male IMR	Female IMR	0-1 Sex Ratio	Under 5 Male MR	Under 5 Female MR	0-6 Sex Ratio
Row 1: 1981	968	122	108	979	147	157	962
Row 2: 1991	925	74	79	914	91	101	945
Row 3: 2001	905	64	68	894	.	.	927

Notes: The SRB is defined as the number of female live births per 1000 male live births. Infant mortality rate (IMR) is defined as the number of infant deaths (0-365 days) per 1000 live births. Under five mortality rate (MR) is defined as the number of deaths in the age group 0-5 per 1000 live births. ***Sources:*** (a) SRB figures in row 1 and row 2 are census based estimates reported in National Human Development Report 2001, Planning Commission, Government of India (2002). The SRB figures are population weighted (urban population share was 23.34 percent in 1981 and 25.72 in 1991) averages of the rural and urban SRB. (b) SRB figures in row 3 are based on Census 2001, Table F-9 while IMR figures in row 3 are from SRS bulletins, Vol. 37, No.1.

Table 4
Female sacrifice rate (*deficit per 1000 male live births*) and sources of female deficit

Year	Before birth 952-SRB	Between 0-1	Between 1-5	Total deficit
Row 1: 1981	0	10.1	28.1	38.2
Row 2: 1991	27	18.37	7.77	53.1
Row 3: 2001	47	15.2	.	62.2
Row 4: 2001 Female deficit in absolute terms	485,780	158,762		644,542

Notes: The figures in the table have been computed on the basis of the information provided in Table 3 and an expected SRB of 952 females per 1000 males and an expected female (infant and 0-5) mortality of 80 percent of male mortality in the absence of interference.

Table 5

State-specific female sacrifice rate (*deficit per 100 male live births*) and sources of female deficit

State / UT	Sex ratio at birth (1)	Pre-birth deficit (2)	Pre-birth deficit rate/per 100 live male births (3)	Post-birth deficit (4)	Post-birth deficit rate/per 100 live male births (5)	Total deficit (6)	Total deficit rate/per 100 live male births (7)	Share of pre-birth deficit to total deficit (8)
India	**905**	**485,780**	**4.65**	158,762	1.52	644,542	6.18	75.37
North-west								
Jammu & Kashmir	**951**	59	**0.07**	131	0.15	191	0.22	31.14
Himachal Pradesh	**845**	6,410	**10.74**	-121	-0.20	6,289	10.54	101.92
Punjab	**787**	32,459	**16.48**	4436	2.25	36,894	18.73	87.98
Haryana	**786**	39,693	**16.62**	3678	1.54	43,371	18.16	91.52
Chandigarh	**850**	827	**10.24**	-129	-1.60	698	8.64	118.48
Delhi	**852**	13,241	**9.96**	159	0.12	13,399	10.08	98.82
North-central								
Rajasthan	**864**	71,287	**8.80**	13722	1.69	85,010	10.49	83.86
Uttar Pradesh	**901**	95,771	**5.11**	31048	1.66	126,820	6.77	75.52
Madhya Pradesh	**903**	36,993	**4.94**	15290	2.04	52,283	6.98	70.76
Bihar	**917**	32,003	**3.54**	18583	2.05	50,586	5.59	63.26
Chhattisgarh	**928**	6,039	**2.40**	4764	1.89	10,802	4.29	55.90
Jharkhand	**907**	13,538	**4.50**	6662	2.21	20,199	6.71	67.02
Uttaranchal	**853**	9,867	**9.92**	679	0.68	10,546	10.60	93.56
East								
Arunachal Pradesh	**997**	-575	**-4.47**	38	0.30	-536	-4.17	107.18
Assam	**948**	1,178	**0.43**	6430	2.35	7,608	2.78	15.49
Manipur	**976**	-444	**-2.40**	101	0.55	-342	-1.85	129.55
Meghalaya	**958**	-215	**-0.63**	274	0.80	59	0.17	-365.96
Mizoram	**994**	-420	**-4.18**	0	0.00	-420	-4.18	100.00
Nagaland	**984**	-504	**-3.17**	0	0.00	-504	-3.17	100.00
Orissa	**928**	8,642	**2.35**	7155	1.95	15,797	4.30	54.71
Tripura	**973**	-555	**-2.11**	-5	-0.02	-560	-2.13	99.08
West Bengal	**975**	-16,893	**-2.32**	4686	0.64	-12,207	-1.68	138.39
Sikkim	**937**	94	**1.52**	29	0.47	124	1.99	76.41
West								
Goa	**921**	315	**3.07**	77	0.76	392	3.83	80.27
Gujarat	**834**	59,494	**11.80**	4709	0.93	64,203	12.73	92.67
Maharashtra	**877**	67,397	**7.46**	10774	1.19	78,171	8.66	86.22
South								
Karnataka	**936**	6,487	**1.56**	4198	1.01	10,685	2.57	60.71
Kerala	**969**	-4,585	**-1.67**	-584	-0.21	-5,169	-1.89	88.71
Pondicherry	**989**	-299	**-3.74**	-30	-0.38	-329	-4.11	90.86
Tamil Nadu	**935**	7,703	**1.66**	7793	1.68	15,495	3.35	49.71
Andhra Pradesh	**951**	733	**0.11**	9831	1.52	10,564	1.63	6.94

Notes: The pre-birth deficit has been computed on the basis of information on SRB from census 2001 (column 1) and an expected SRB of 952 females per 1000 males. The post-birth deficit is based on IMR data from SRS bulletin 2001 and an expected female (infant and 0-5) mortality of 80 percent of male mortality in the absence of interference.

Table 6
SRB and salient characteristics

Characteristics	Sex ratio at birth
Residence	
Rural	906
Urban	904
Religion	
Hindu	902
Muslim	931
Christian	963
Sikh	770
Buddhist	923
Jain	847
Other religious communities	939
Caste/tribe	
Scheduled tribe	940
Scheduled caste	921
Mother's education level	
Illiterate	920
Literate but less than primary	909
Primary	894
Middle	885
Secondary	867
Graduate and above	876

Source: Census of India, 2001

Table 7
Sex Ratio by Birth Order and Sex of Previous Children

Order	Sex of Previous Child	Overall	Urban	Rural
1	.	900	895	902
2	Male	923	916	926
	Female	817	796	826
3	Both Male	1025	1005	1031
	Both Female	718	627	751
	One Male, one Female	852	816	863

Notes: The figures in the table are based on the Sample Registration Survey for the time period 2001-2003 and are from the SRS Baseline Survey Report 2004 issued by the Office of the Registrar General, India.

Table 8
Child (under 12) sex-ratio, North-western province

Year	Proclaimed Population	Percentage of Girls to Boys	Ratio of Girls to Boys
1875	389,697	30.2	433
1876	364,678	30.0	429
1877	352,308	31.6	462
1878	346,683	33.5	504
1879	333,727	34.6	529
1880	303,131	36.4	572
1881	285,860	38.6	629
1887*	.	47.5	905

Notes: The figures in the table are from Panigrahi (1972). * Under age 6.

Table 9
Babies received in the Cradle Baby Scheme

	Male	Female
Phase 1: 1992-13.05.2001		
Salem	0	150
Phase 2: 14.05.2001-30.11.2007		
Salem	57	665
Madurai	30	109
Theni	20	146
Dharmapuri	40	965
Dindigul	12	38
Other districts	231	487
Total	390	2410

Source: Directorate of Social Welfare, Government of Tamil Nadu.

Table 10
Intervention intensity, Tamil Nadu 2001

District	**Treatment status**
Dharmapuri	**Heavily treated**
Dindigul	Lightly treated
Erode	Lightly treated
Madurai	**Heavily treated**
Namakkal [a]	**Heavily treated**
Nilgiris	Lightly treated
Perambalur	Lightly treated
Salem	**Heavily treated**
Theni [a]	**Heavily treated**
Thiruvannamalai	Lightly treated
Virudhunagar	Lightly treated

Notes: [a] Till January 1997, Namakkal was part of Salem district and Theni was part of Madurai district. The remaining 18 districts are classified as minimally treated districts.

Table 11
Post-Birth Daughter Deficit

	Overall Deficit 1996-1999 (1)	Overall Deficit 2003 (2)	Overall Change in deficit 1996-1999 to 2003 (3)
Tamil Nadu [a]	*4485*	*1829*	*2070*
Chennai	0	2	-2
Coimbatore	0	11	-11†
Cuddalore	85*	98	-13
Dharmapuri	1189*	219*	970†
Dindigul	222*	289*	-67†
Erode	89*	0	89†
Kancheepuram	24	58	-34†
Kanyakumari	28	.	.
Karur	38*	41	-3
Madurai	311*	230*	81†
Nagapattinam	45*	40	5
Namakkal	135*	4	131†
Nilgiris	7	12	-5
Perambalur	52*	49*	3
Pudukottai	66*	92*	-26†
Ramanathapuram	28	36	-8
Salem	1067*	283*	784†
Sivaganga	45*	0	45†
Thanjavur	0	0	0
Theni	227*	88*	139†
Thirunelveli	101*	59	42†
Thiruvallur	48	35	13
Thiruvannamalai	110*	82	28
Thiruvarur	0	0	0
Thuthukudi	24	37	-13
Tiruchirapalli	98 *	230*	-132†
Vellore	395*	349*	46
Villupuram	113*	143	-30
Virudhunagar	96*	37	59†

Notes: [a]The total for the state is based on districts where the estimated FIMR is statistically greater than the expected FIMR * indicates that the estimated FIMR is greater than the expected FIMR at at least the 5% level of significance. † indicates that the temporal change in difference between estimated female IMR and expected female is statistically different from zero at at least the 5% level of significance.

Table 12
Post-Birth Daughter Deficit and Interventions
Difference-in-differences estimates

Variable	1	2	3	4	5	6
2003	0.623	0.623	-17.35	-18.62	-18.00	-10.71
	(2.56)	(1.78)	(12.21)	(12.38)	(12.49)	(16.75)
Treated*2003	-12.55*	.	.	.	.	.
	(4.08)					
Heavily treated*2003	.	-25.58**	-20.54**	-22.19**	-23.08**	-22.64**
		(3.73)	(4.07)	(4.53)	(4.68)	(4.80)
Lightly treated*2003	.	-1.69	2.03	1.091	0.128	-0.407
		(3.48)	(3.70)	(3.890)	(4.079)	(4.221)
Female work participation rate	.	.	1.28	1.101	1.255	1.478
			(0.778)	(0.813)	(0.839)	(0.916)
Male work participation rate	.	.	-0.429	-0.344	-0.722	-0.997
			(1.66)	(1.679)	(1.749)	(1.824)
Male literacy	.	.	4.493*	4.249*	4.718*	4.314*
			(1.889)	(1.923)	(2.015)	(2.135)
Female literacy	.	.	-5.073*	-4.785*	-4.941*	-4.927*
			(1.84)	(1.890)	(1.913)	(1.943)
Per capita income	.	.	-0.0003	-0.0007	-0.0003	0.0002
			(0.001)	(0.001)	(0.001)	(0.001)
Rainfall	.	.	.	-0.008	-0.008	-0.008
				(0.009)	(0.010)	(0.010)
Number of self-help groups	.	.	.	.	-0.0014	-0.0016
					(0.0016)	(0.002)
Number of registered scan centres						-0.029
						(0.044)
N	56	56	56	56	56	56
R^2 *(within)*	0.351	0.699	0.789	0.796	0.804	0.809

Notes: Standard errors in parentheses; + significant at 10%; * significant at 5%; ** significant at 1%.

Table 13
Sex Ratio at Birth in India and Tamil Nadu

Birth Year/Statistic	Source	SRB Tamil Nadu	SRB Urban Tamil Nadu	SRB Rural Tamil Nadu
1996-1999	VES[a]	935	943	932
(95% Confidence Interval)		(931-939)	(935-951)	(926-937)
Number of births – female/male		*335,712/358,893*	*100,380/106,406*	*235,332/252,487*
2001	Census[b]	935	960	919
Number of births – female/male		*432,923/462,842*	*177,230/184,609*	*255,693/278,233*
2003	VES[a]	944	954	939
(95% Confidence Interval)		(935-953)	(937-971)	(929-951)
Number of births – female/male		*80,771/85,539*	*24,290/25,466*	*57,245/60,872*
SRB change, 1996-1999 to 2003		9	11	7
(p-value) [c]		*(0.092)*	*(0.262)*	*(0.175)*

Notes: The sex ratio at birth is defined as the number of female live births per 1000 male live births. [a] Our calculations based on the Vital Events Surveys 1996-1999 and 2003. [b] Based on data from Census 2001, Table F-9 [c] H_0: SRB in 1996-1999 is equal to the SRB in 2002.

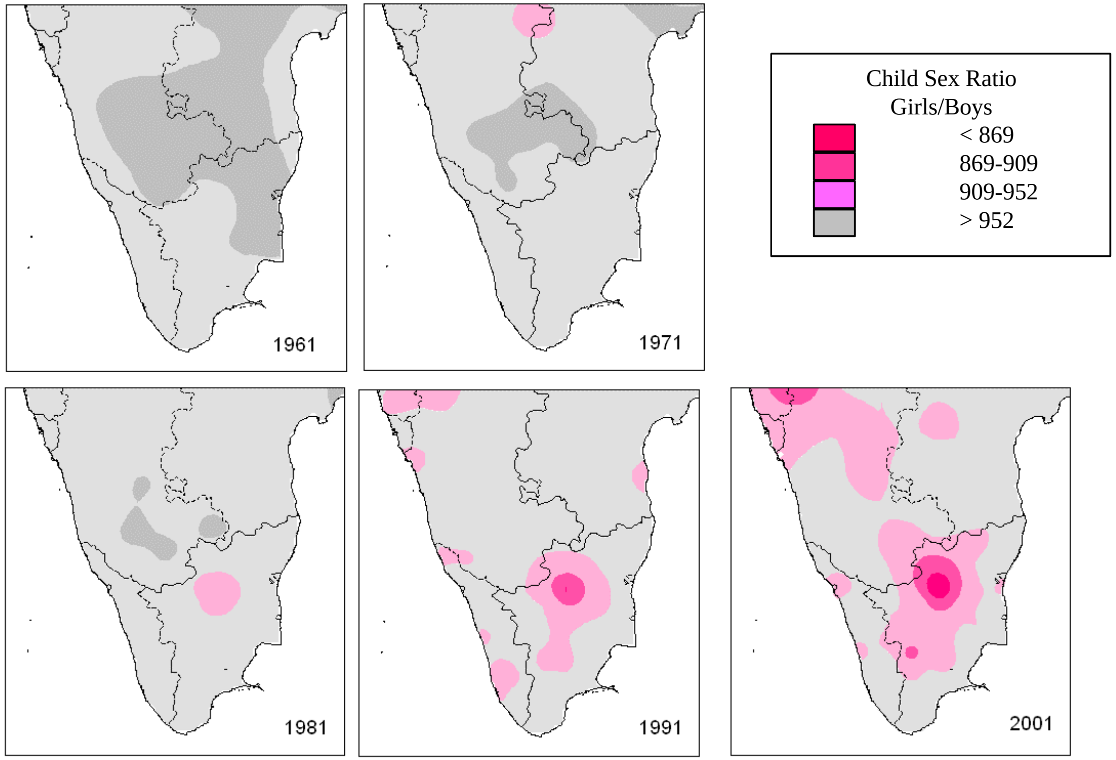
Table 14

Pre-Birth Daughter Deficit

District	**Overall**		
	1996-1999 VES (1)	**2003** VES (2)	**Change 1996-1999 to 2003** VES (p-value) (3)
Tamil Nadu [a]	*6244*	*1563*	*950*
Chennai	124	0	124 (0.453)
Coimbatore	53	665	-612 (0.390)
Cuddalore	108	0	108 (0.789)
Dharmapuri	756*	534	222(0.711)
Dindigul	407*	31	376(0.312)
Erode	380**	162	218(0.635)
Kancheepuram	126	449	-323(0.529)
Kanyakumari	48	.	.
Karur	422*	165	257(0.206)
Madurai	529*	567	-38(0.934)
Nagapattinam	301**	0	301(0.034) †
Namakkal	368*	448*	-80(0.771)
Nilgiris	0	0	-0(0.909)
Perambalur	81	37	44(0.740)
Pudukottai	63	332	-269 (0.411)
Ramanathapuram	30	315	-285(0.322)
Salem	1682*	1115*	567 (0.338)
Sivaganga	149	0	149 (0.133)
Thanjavur	224	0	224 (0.131)
Theni	150**	0	150 (0.295)
Thirunelveli	600*	281	319 (0.597)
Thiruvallur	151	0	151 (0.241)
Thiruvannamalai	0	479	-479 (0.233)
Thiruvarur	0	162	-162 (0.367)
Thuthukudi	0	0	0 (0.059)
Tiruchirapalli	125	374	-249 (0.624)
Vellore	0	796	-796 (0.267)
Villupuram	0	117	-117 (0.670)
Virudhunagar	649*	0	649 (0.077) †

Notes: [a]The total for the state is based on districts where the difference between the estimated and expected SRB is statistically different.*, ** indicate that the SRB is statistically different from the expected SRB of 952, at the 5% and 10% level of significance, respectively.[†] Indicates that the temporal change in SRB is statistically different from zero at at least the 10% level of significance.

Figure 1
Declining child (0-6) sex ratio, South India



Notes: The maps are based on census data and are from Guilmoto (2007).