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Essays in Human Development and Public Policy

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Acknowledgments

Now I somewhat know how Carl Sagan felt. In his famous *"pale blue dot"* speech, Sagan presents the grand scheme of life on this planet and the accumulation of ideas over hundreds of year. For me, it is an incredibly humbling experience to simply be a part of, and be able to contribute the tiniest of the tiny bits to this ethereal world of human knowledge. At the same time, the past five years have been a tremendous journey, one that now culminates into the biggest scholastic achievement of my life so far. It would not have been possible for me to conceive the ideas and write this dissertation without the grace of God, and the guidance and support of several people.

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Dedicated to my late father. He would have been so happy to see me receiving a Ph.D.

ABSTRACT OF DISSERTATION

Essays in Human Development and Public Policy

by

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Dr. Anil Deolalikar and Dr. Aman Ullah, Chairpersons

Despite strong recent economic growth, gender inequality remains a major concern for India. This dissertation examines the effectiveness of public policy in improving some important human development outcomes, with a focus on gender issues. The national Pre-Conception and Pre-Natal Diagnostics Techniques (PNDT) Act of 1994, implemented in 1996, banned sex-selective abortions in the Indian states which hitherto had not legislated such a policy. Using village-level and town-level longitudinal data from the 1991 and 2001 censuses, along with household survey data from other sources, the first essay finds a significantly positive impact of the PNDT Act on the female-to-male juvenile sex ratio (number of females per 1000 males below the age of 6 years). Although researchers frequently mention the futility of the Act, this study is among the first to use a treatment-effect type analysis of the pre-ban and post-ban periods to show that the law hindered any further worsening of the gender imbalance in India. I find that in the possible absence of the PNDT Act, juvenile sex ratio would have declined by another 13-20 points on average. A second study evaluates the 'unintended consequences' of the PNDT Act on child quality. Using household survey data from two time periods, and exploiting a natural experiment framework originating from the timing of the PNDT Act, I find a mixed impact of the law on gender-relative child quality outcomes. Since the PNDT Act partially improved the sex ratio but did not uniformly worsen the nutritional and immunization status of girls, it could be regarded as a truly welfare enhancing public policy. Finally, a third study examines the effectiveness of the Indian school feeding program in improving the nutritional and learning outcomes of children. Using a household fixed-effect and a propensity score matching framework, the outcomes of children receiving school meals are compared with that of similar children who are not covered under the program. The results show that the school meal program generally does not have any significant effect on the child nutrition nor learning outcomes, neither does it have any impact on the relative outcomes of the girl children.

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Chapter 1

Introduction

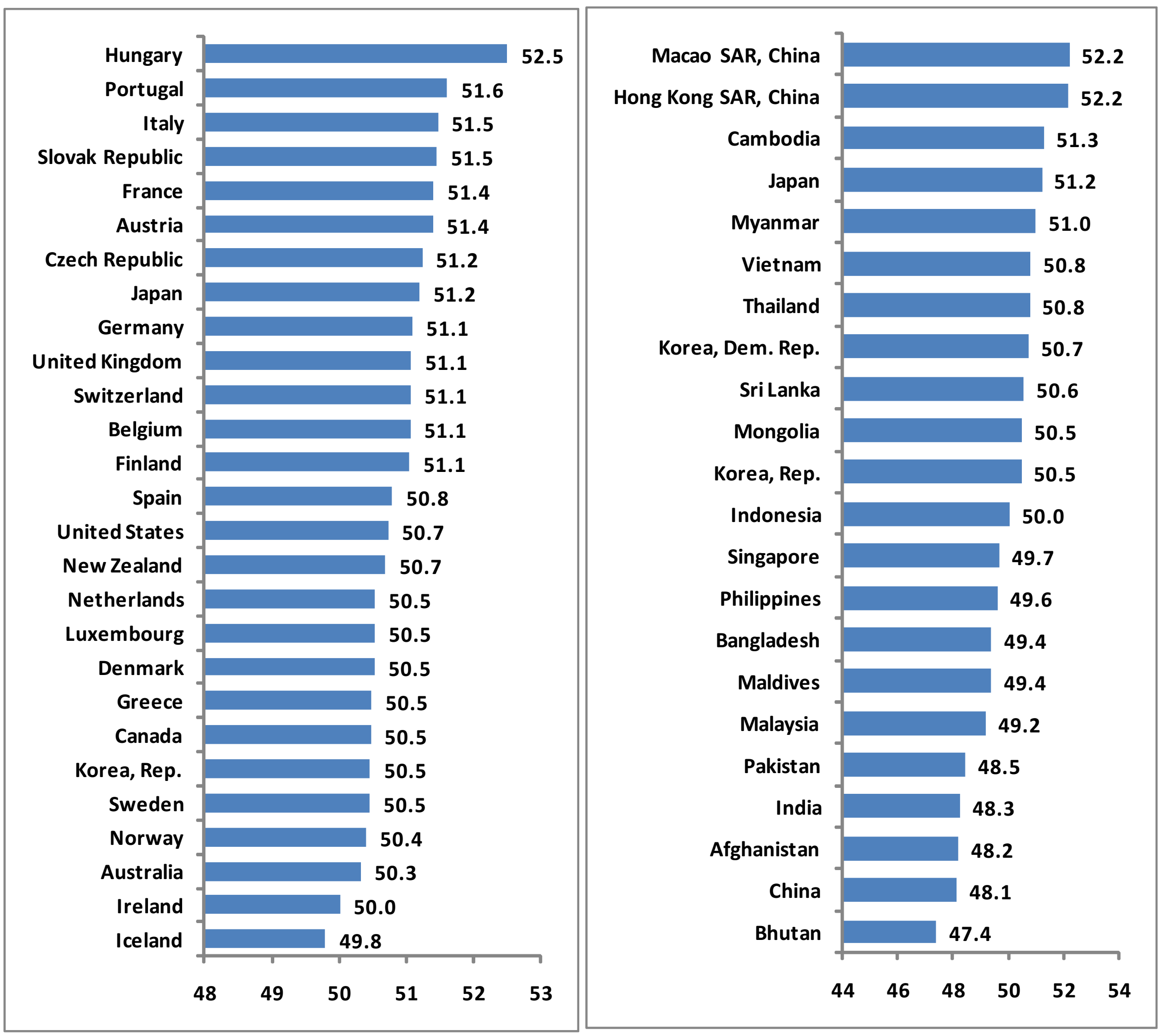
Male-biased population sex ratios in India and a few countries in Asia and North Africa have become a matter of much discourse during the recent decades[1]. Contemporary research has long established the association between a preference for sons over daughters and the skewed sex ratio in these socities. The causal relationship has been found not only at the levels, but also to explain how the strengthening of the former has worsened the later over time. Delving deeper, researchers have also recognized the socioeconomic and cultural factors that lead to the son-preference in these parts of the world.

The normalized human sex ratio at birth is often considered to be about 105 boys for every 100 girls (United Nations 2004, Davis et al. 2007). However, the mortality rates of young boys have been historically higher, especially in the developed world. In high-income countries, although the mortality rates of both boys and girls have declined consistently over the last century, girls have gained an advantage in survival

[1] Messner and Sampson (1991), Das Gupta and Shuzhuo (1999), Angrist (2002), Hudson and Den Boer (2002, 2004), Edlund et al. (2007), Francis (2009), Hesketh (2009) discuss the possible adverse socioeconomic impacts of gender imbalance.

rates (Wingard 1984, Waldron 1993, Vaupel et al. 1998, Rigby and Dorling 2007). Thus, the overall population sex ratios in many countries exhibit a surplus of women.

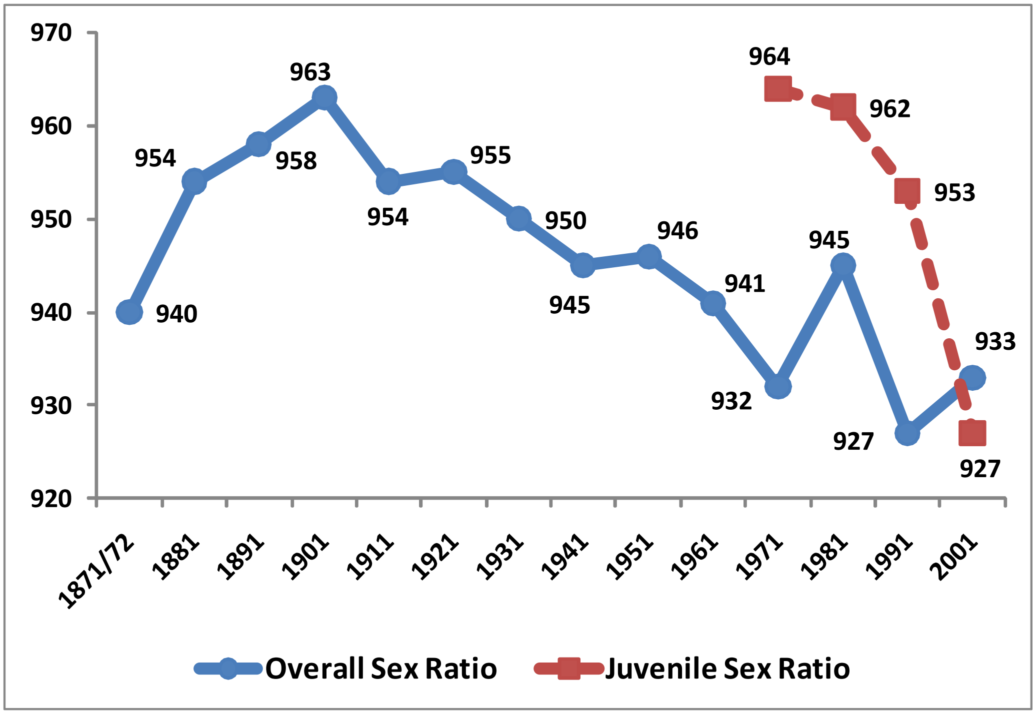
Figure 1.1: Percentage of Women in Overall Population - OECD Countries and Asian Countries



Source: World Bank World Development Indicators 2005. The bars represent the percentage of women in total population. OECD countries are presented in the left panel and Asian countries are shown in the right panel.

Figure 1.1 shows the percentage of women in the total population among the richer OECD countries. Juxtaposed are the Asian countries, some of which are known for a preference for sons. The later group exhibits a more masculine sex ratio - and

Figure 1.2: Overall Sex Ratio and Juvenile Sex Ratio in India, 1871-2001



Source: Hatti and Sekhar (2004), Census of India 1991 and 2001. Sex ratio is the number of women for every 1000 men. Juvenile sex ratio is the sex ratio of children less than 6 years old. Only the Old British Provinces and former Princely State of Mysore were covered under the Census of 1871/72.

a worsening of the same over time, not show here - defying the general worldwide pattern. This phenomenon has prompted a discussion on the so called 'missing girls' in India, China and other Asian countries. Sen (1990) estimated more than 100 million unborn or missing girls worldwide. This estimate has since been revisited and others provided (Coale 1991, Klasen 1994, Klasen and Wink 2002, Sen 2003). However, most researchers still agree that a considerably large percentage of these missing girls are from India.

Historical sex ratios from the Indian censuses are presented in Figure 1.2. The graph shows a consistent decline of the overall female-to-male sex ratio (measured as the number of women for every 1000 men) over most of the twentieth century, except for a small rise in 1981. Even more striking is the rapid decline in the number of young girls compared to boys (in the age group less than 6 year old) - a foreboding of the worsening of overall population gender imbalance in foreseeable future[2].

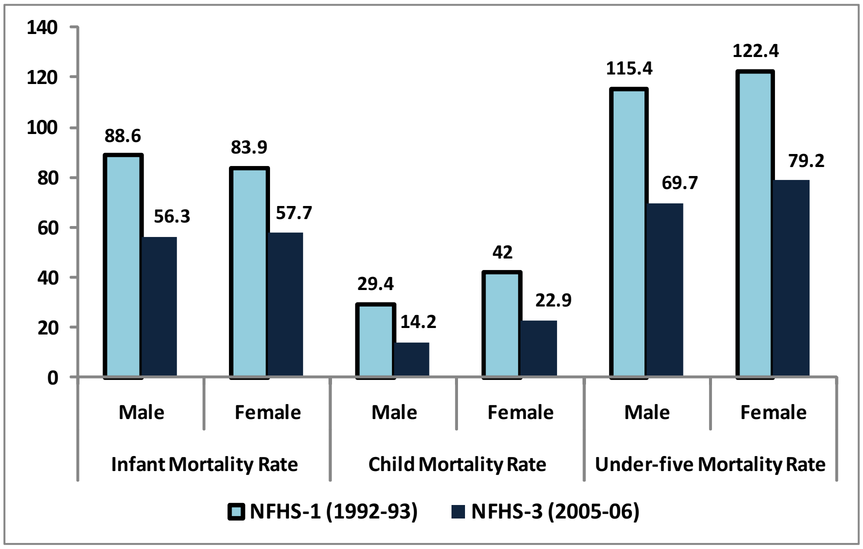
The gender imbalance in India has been repeatedly attributed to the discrimination against girls - both postnatal, which leads to a lower survival rate of girls, and prenatal, which results in fewer girl child births. Sons are viewed as the potential substitute for a nonexistent social safety net during old age. This, along with several other socioeconomic factors such as the caste and dowry systems, exogamy of daughters and a strong patrilineal family structure have historically induced parents to perceive a higher worth of investing more in sons.

Girls are often provided with less resources when it comes to nutrition, healthcare, immunization and education. This has been studied in India and other Asian countries by Miller (1981), Chen et al. (1981), Caldwell et al. (1983), Taylor et al. (1983), Das Gupta (1987), Basu(1989, 1992), Drèze and Sen (1995), Caldwell et al. (1982), Koenig and D'Souza (1986), Muhuri and Preston (1991), Pebley and Amin (1991), Arnold et al. (1998), Pande (2003), Borooah (2004), Mishra et al. (2004), Jayachandran and Kuziemko (2009), and Oster (2009). One possible extreme outcome of the postnatal discrimination of girls, although much less reported during the recent decades, is female infanticide. More common are the excess female child mortality rates in India, resulting from the continual neglect of healthcare and nutrition of girls. Even if the young girls survive, the inadequate investment in nutrition and education translates to poor long term health and labor market outcomes for women.

Figures 1.3 and 1.4 provide an example of the gender disparity in child outcomes in

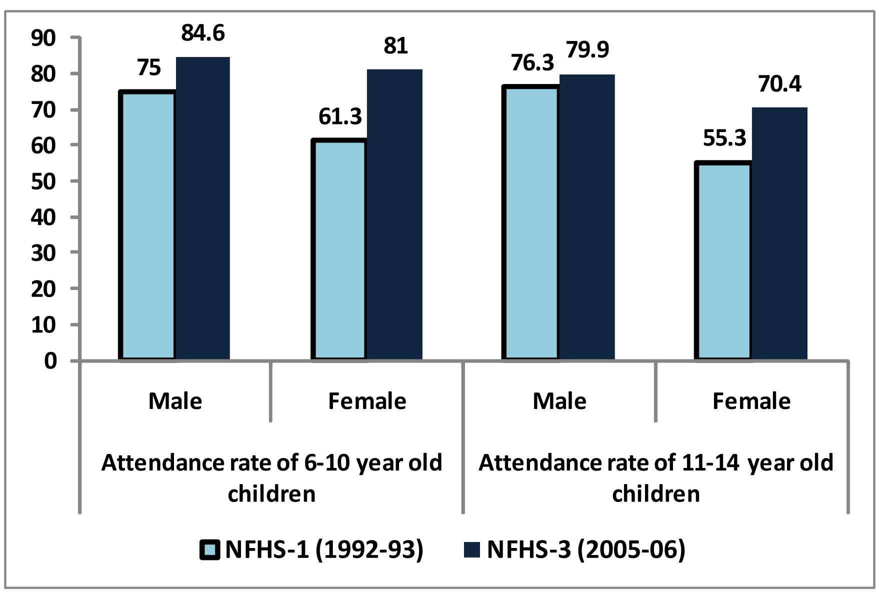
[2]However, some studies such as Chung and Das Gupta (2007), Das Gupta et al. (2009) argue that there is recent evidence of the son-preference reaching a peak in some socities, followed by an improvement in the female-to-male sex ratio.

Figure 1.3: Mortality Rates of Indian Children by Gender, 1992-93 and 2005-06



Source: Published reports of NFHS-1 and NFHS-3. All mortality rates are calculated for every 1,000 live births. Infant mortality is the probability of dying before the first birthday, child mortality is the probability of dying between the first and fifth birthdays, and under-five mortality is the probability of dying before the fifth birthday.

Figure 1.4: School Attendance Rates of Indian Children by Gender, 1992-93 and 2005-06



Source: Published reports of NFHS-1 and NFHS-3. Attendance rates are based on household roster data.

India during the last decade or so. The former shows a large decline in mortality rates over time for both boys and girls. However, the mortality rates of girls have remained higher, and in fact the infant mortality rate shows a reversal of the gender gap over time against the girls. School attendance rates of boys and girls are presented in the latter graph. We observe that although the attendance rates of girls have improved at a faster pace over time, the gender gap is yet to be eliminated.

Among the methods of prenatal discrimination, the so called “stopping rule” mechanism (Coombs 1979, McClelland 1979, Gadalla et al. 1985, Oyeka 1989, Mutharayappa et al. 1997, Arnold et al. 2002, Clark 2000) is worth mentioning. Families with a preference for boys may choose to “stop”, i.e. prevent further fertility after the desired number of sons are born. In addition to resulting in a skewed sex ratio, this practice often worsens the neglect of girls since they generally grow up in a larger sibship size with reduced per capita availability of resources.

With the advent of fetal sex determination and safe abortion techniques during 1980s in many of these societies including India, the selective abortion of female fetuses rapidly became the prevalent method of prenatal discrimination (Wertz and Fletcher 1993, Zeng Yi et al. 1993, Menon 1996, George and Dahiya 1998, Sudha and Rajan 1999, Arnold et al. 2002, UNFPA 2001 , Chu 2001, Ganatra et al. 2001, George 2002, Retherford and Roy 2003, Sahni et al. 2008, Guilmoto et al. 2009). Sen (1992) first estimated the number of unborn girls in India to be about 37 million. Other researchers (Jayaraman 1994, Arnold et al. 2002, Jha et al. 2006a) propose a wide range for the estimated number of female feticides - between 50,000 and 540,000 every year during recent decades.

In response to the growing campaigns against sex-selective abortions by NGOs and other interest groups (Gangoli 1998, Joseph 2007), Maharashtra was the first Indian state to institute a ban on the use of fetal sex determination techniques (to prevent sex-selective abortions) in 1988. A similar ban, the Pre-Conception and Pre-Natal Diagnostics Techniques (Prohibition of Sex Selection) Act was implemented by the Indian federal government in 1994 (Ministry of Health and Family Welfare 2007). This law, called the PNDT Act, came into effect across the entire country at the beginning of 1996.

Although the gender imbalance in India has been studied well by economists and demographers, very little research has been directed toward sex-selective abortions and related legislature. Internationally, the impact of demographic policies (e.g. the "One Child Policy" in China) on population sex ratios and child outcomes have been studied by Park and Cho (1995), Hesketh and Zhu (1997), Das Gupta (2005), Hesketh et al. (2005), Chung and Das Gupta (2007), Lin et al. (2008), Qian (2009), Subramanian and Selvaraj (2009), Zhu et al. (2009), Ebenstein (2010).

This dissertation contributes to this much needed body of research, in the context of India. In a series of three related essays, I explore the impact of public policy on gender-relative human development outcomes in India. In particular, two different public policies are studied - the ban on sex-selective abortions (PNDT Act) and the Indian school feeding program (*Mid-day Meal Scheme*).

The first essay evaluates the impact of the PNDT Act on the juvenile sex ratio (number of girls for every 1000 boys in the age group less than 6 years old). Although researchers generally argue that the Indian PNDT Act did not have any impact on the gender imbalance problem, most studies in this area are based on suggestive evidence on sex-elective abortions and lack a comprehensive treatment-effect type analysis. The main problem with a comparison between the pre-ban and post-ban environments (either sex ratios or the actual incidence of sex-selective abortions) across the entire country - the method which most studies follow - is that it is impossible to distinguish between the confounding effects from several other socioeconomic factors including a general improvement in income and standard of living, public awareness campaigns and other state-specific demographic policies.

This problem is overcome through my use of a natural experiment framework, in which I exploit the difference in timing of the PNDT Act between Maharashtra and the rest of the country. Using village-level and town-level longitudinal data from the Indian censuses of 1991 and 2001, along with household level data from two consecutive National Family and Health Surveys (1992-93 and 1998-99), I compare the sex ratios of young children between Maharashtra (pre-treated group, which was always under the purview of the law) and the rest of India (newly-treated group, which came under the law only during the second period in my study).

The results indicate a significantly positive impact of the PNDT Act on the juvenile sex ratio in India. Since the observed sex ratio declined across the board over my study period, one could interpret the the positive effect of the law as a marginal impact, i.e. in the absence of the law, the gender imbalance would have worsened further. The results appear to be robust among various subsamples of communities in the rural and urban data. In addition, preliminary analysis using quantile regression method suggests different levels of impact of the policy among households with various degrees of son-preference.

With the partial success of the PNDT Act, relatively more girls will be born and the parents may substitute prenatal discrimination of girls (i.e. selective abortion) with postnatal neglect. Therefore, an 'unintended consequence' of a successful PNDT Act may be a reduced investment in the quality of female children - if the girls are unwanted in a household, the parents will allocate fewer resources for their heathcare, nutrition and education. A secondary negative effect on girl child outcomes may originate from the 'quantity-quality tradeoff'. If the households use the "stopping rule" method instead of selective abortions, girls are likely to grow up in larger families. This may further reduce the resources available for each child. The tradeoff between sibship size and the quality of children has been studied by Rosenzweig and Wolpin (1980), Mueller (1984), Gomes (1984), Stafford (1987), Behrman and Taubman (1986), Hanushek (1992), Guo and VanWey (1999), Lloyd (1994), Campbell et al. (2002), Angrist et al. (2005, 2006), Li et al. (2007), Lee (2007), Rosenzweig and Zhang (2009), Qian (2009).

The second essay in this dissertation examines the possible 'unintended consequence' of the PNDT Act on the relative outcomes of boys and girls. Exploiting the natural experiment framework of the law mentioned earlier, and using child level data from two National Family Health Surveys, I find that the PNDT Act did not have any gender-relative impact on child immunization and nutritional outcomes. Thus, one can argue that with a positive impact on gender imbalance, and no negative impact on child outcomes, the PNDT Act may have been a true welfare-enhancing public policy.

The third essay of this dissertation evaluates the impact of the Indian school feeding program (*Mid-day Meal Scheme*) on child nutrition and learning outcomes. The school feeding program is among the largest in the world, covering 120 million children in public schools, with an annual budget of more than $1 billion (Kingdon 2007 and Government of India). Several studies have evaluated the impact of the program on the school enrollment and attendance rates of young children - Drèze and Kingdon(1999) , Khera (2006), Drèze and Goyal (2003) , Jayaraman (2008), Afridi (2010) in the context of India, and Ravallion and Wodon (2000), Ahmed (2004), Vermeersch and Kremer (2004), Alderman et al. (2008) in the context of other developing countries.

Although school feeding programs worldwide have shown mixed effect on nutritional and educational outcomes of children (Jacoby et al. 1996, Tan et al. 1999, Gundersen et al. 2000, Jacoby 2002, Gleason and Suitor 2003, Ahmed 2004, Vermeersch and Kremer 2004, Afridi 2005, Adelman et al. 2008a, Islam and Hoddinott 2009), very few studies have analyzed the Indian case. Using a household fixed-effect framework and a propensity score matching method on child level data from the Indian Human Development Survey (2005), I evaluate the effect of the provision of cooked school meals on child nutrition (anthropometric z-scores) and learning outcomes (test scores of reading, writing and mathematics). The results generally indicate no significant impact of the school feeding program on child outcomes. Furthermore, I do not find any evidence of a gender-relative effect of school meals on children.

This dissertation is organized in the form of three separate essays, revolving around a primary theme of the gender-relative impact of public policy in India. The essays follow a generally uniform structure with the following sections - introduction, literature review, analytical framework, discussion on data and descriptive statistics, an empirical framework describing the regression models, a section on results and a conclusion. Additional materials are provided in the appendix at the end of each essay. Finally, a fifth chapter discusses the conclusion of the entire dissertation.

Chapter 2

The Impact of a Ban on Sex-selective Abortion on the Juvenile Sex Ratio in India: Evidence from a Policy Change

2.1 Introduction

India's robust economic growth in recent decades has been associated with improvements in virtually every measure of human development. The steadily increasing UNDP Human Development Index for India, from 0.42 in 1975 to 0.62 in 2005, provides a snapshot of the nation's advancement. However, contrary to the dynamic achievements, acute gender inequality has remained a major concern. Although sweeping socioeconomic and cultural changes have brought better education, healthcare and labor market opportunities for women, the imbalance in the female-male sex ratio and its consistent decline overshadows much of the progress. The problem is particularly severe among the younger population – the national juvenile sex ratio (number of girls per 1000 boys in the age group 0-6 years) has declined from 964 in 1971 to 927 in 2001[1]. Sex-selective abortions and sex-selective neglect of young girl children, stemming from a strong preference for sons over daughters, have been repeatedly cited as predominant causes of low female-to-male sex ratio in India and other East Asian countries[2]. Studies have estimated the number of unborn women in India to be about 37 million (Sen 2003), with approximately 20 million girl fetuses who have been aborted over the last two decades (Jha et al. 2006a).

The socioeconomic consequences of the gender imbalance are truly multidimensional. First, the sex-selective abortion or neglect of girls violates basic human rights. In addition, the absence of girls may have adverse long run sociological impacts through a marriage market squeeze[3]. Several state and central government policies have been geared toward the reduction of gender inequality in India. In this

[1]The overall sex ratio (for the entire population) in India has declined from 941 (women per 1000 men) in 1961 to 933 in 2001. In comparison, for example, the gender ratio (number of living women per 100 men) in US has increased from 101.02 in 1970 to 102.22 in 2000 (Source: World Bank - World Development Indicators 2002).

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

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

study I examine the effectiveness of one such demographic policy – a ban on prenatal sex-determination (to prevent the sex-selective abortion of girl fetuses).

I use a natural experiment in the form of a policy change. The Indian government banned the use of prenatal sex-determination techniques through the passage of the Pre-Conception and Pre-Natal Diagnostics Techniques (Prohibition of Sex Selection) Act of 1994. The Act, dubbed PNDT, was effective from 1996. The law, which was mandated for all states, was non-binding for the western Indian state of Maharashtra. Since Maharashtra already had had its own PNDT-type law in place (enacted in 1988), the central government enactment of PNDT in 1996 provides us with a variation in the policy. I exploit this variation across states to analyze the impact of the law on gender imbalance, i.e. sex-ratio related outcome variables.

My main outcome variable of interest, the juvenile sex ratio (number of girls per 1000 boys of age below 6 years), depends on two factors – the sex ratio at birth and the gender-relative mortality rates among living children. Preventing the abortion of girl fetuses will directly reduce the masculinity of sex ratio at birth. However, the law may induce an additional behavioral shift among households. Unwanted girl fetuses, if not aborted by virtue of the PNDT Act, grow up as unwanted children in the household. The severe marginalization of the unwanted girls with respect to resource allocation within the household may result in higher female child mortality. Thus, juvenile sex ratio, instead of sex ratio at birth, is capable of measuring that the effect of the PNDT Act both on the newborns as well as other young children[4].

This study contributes to the existing literature on sex-selective abortions and gen-

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

der inequality in numerous ways. Although researchers have comprehensively studied the juvenile sex ratio in India, sex-selective abortions and the related legislature remains an area less explored. Using data typically from the census or the National Family Health Survey (NFHS), most recent studies attempt to provide contemporary evidence on the incidence of sex-selective abortions. Even if many suggest the ineffectiveness of the 1996 PNDT Act, very few actually offer an evaluation of the impact of the law[5]. Moreover, none of the evaluative studies employ a comparative general equilibrium type analysis of the pre-ban and post-ban periods[6]. I address this crucial shortcoming of the present literature by using a rigorous treatment-effect analysis framework. In addition, I attempt to provide a new direction by deviating from the popular North-South dichotomy approach of juvenile sex ratios, particularly through the use of more recent data for the entire country.

I use data from three different sources. My primary focus is on results obtained from a panel dataset of more than 500,000 Indian villages from 1991 and 2001 census. In addition, results from two other data sources are reported – first, a town-level census panel dataset of roughly 1,500 Indian towns and secondly, a household-level pooled dataset of approximately 90,000 households from the National Family Health

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[5] For example, Arnold et al. (2002) use NFHS 1998-99 data to link the prenatal use of ultrasound and amniocentesis by pregnant women with sex-selective abortions and the sex ratio at birth. Visaria (2007) uses primary data from the states of Gujarat and Haryana to find evidence of sex-selective abortions, particularly for higher birth orders. Patel (2007 ed.) provides a comprehensive overview of sex-selective abortions in India.

[6] One contemporary study that employs a logistic regression approach to analyze the odds of the birth of a boy child between the pre-ban and post-ban periods is Subramanian and Selvaraj (2009). Using National Sample Survey (NSS) data from five different time periods, they find no significant difference in the odds of a boy-birth before and after the 1996 PNDT.

Surveys (NFHS) of 1992-93 and 1998-99[7]. To examine the robustness of my results I employ several subsamples from these data, starting from a comparison between Maharashtra and non-Maharashtra communities in close geographical proximity.

I estimate community fixed-effect regressions which yield a significantly positive marginal impact of the PNDT Act on the juvenile sex ratio. The magnitude of the impact varies across census subsamples and the NFHS data exhibit somewhat weaker results. The positive impact of PNDT, *prima facie*, appears to be contradictory to the ineffectiveness of the law suggested by the current Indian literature on sex-selective abortions. However, given the observed decline of the juvenile sex ratio over my study period, the results only indicate a marginal effectiveness of the policy. Thus, I argue that the gender imbalance in India would have worsened in the possible absence of the PNDT Act.

The overall dynamics of a ban on sex-selective abortions depends on the response of various segments of the society. Communities with different degrees of preference for sons over daughters may respond differently to the ban. To better understand the heterogeneous nature of the impact among rural communities, I evaluate the effectiveness of the policy along different quantiles of the conditional juvenile sex ratio distribution. I assume that the observed change in the juvenile sex ratio over the study period is directly linked to the degree of son preference in a community. The results are revealing – I find that villages with a weaker son preference tend to comply with the ban, which is demonstrated by a stronger positive impact of the PNDT Act at the higher quantiles of the distribution. Contrarily, communities at lower quantiles of the distribution, i.e. those with a stronger son preference, are likely

[7]Due to the different nature of the NFHS data, I use the household level percentage of girls among children in the age group 0-4 years as my outcome variable for gender imbalance (instead of juvenile sex ratio).

to see almost no impact (or in some cases, an adverse impact) of the policy.

My research provides a silver lining to the generally bleak overview of a failed 1996 PNDT Act. The marginally positive effect of the PNDT implies that a properly implemented ban on sex-selective abortions could potentially increase (and not just partially 'improve') the female-male sex ratio. The Indian government, thus, has taken a step in the right direction by expanding the provisions of the PNDT Act (2003) and by improving the enforcement of the law.

2.2 Sex-selective Abortion in India: Debates and Public Policy

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

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

Although data paucity prevents us from obtaining dependable statistics on sex-selective abortions in India, several studies have attempted to estimate the number of unborn girl fetuses from secondary sources. The results, though marked by wide variation, provide a glimpse of the severe crisis. Jayaraman (1994) and Arnold et al. (2002) estimate the number of aborted girl fetuses to be between 50,000 and 100,000 every year. Other studies suggest that the incidence rate could be even higher – e.g. using data from the Special Fertility and Mortality Survey (1998) of 1.1 million Indian households, Jha et al. (2006a) estimate that between 450,000 to 540,000 sex-selective abortions take place in India each year[8].

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

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

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

[10]Source: "Handbook on Pre-Conception & Pre-Natal Diagnostic Techniques Act, 1994 and Rules with Amendments", 2006, Ministry of Health and Family Welfare, Government of India

from 1996).

There is a general consensus (Luthra 1994, Jha et al. 2006a, Hatti and Sekhar 2004, Arnold et al. 2002, Visaria 2007) that these bans have not been very effective. The continued practice of sex-selective abortions was indicated by a worsened juvenile sex ratio in the 2001 demographic census. Despite the ban on these abortions, the Indian juvenile sex ratio has steadily declined from 964 in 1971 to 945 in 1991, and then 927 in 2001. In the wake of these recent findings, huge public outcry once again forced the government of India to amend the PNDT Act (2003) and enhance the campaign against sex-selective abortions.

My objective is to evaluate the effectiveness of the 1996 enactment of the nationwide PNDT. Unlike previous studies, I use the chronological difference in the implementation of the law between Maharashtra and the rest of India as my identification strategy. The national PNDT Act (effective 1996) was very similar to the Maharashtra Act (1988) and thus non-binding to Maharashtra by virtue of its pre-existence. This provides us with an important inter-state variation in program placement – compared to Maharashtra, other states experienced a policy intervention mandated later by the central government.

2.3 Theoretical Framework: Modeling the Parental Demand for Boys versus Girls

This section presents a simple microeconomic model outlining the parental preference of the gender composition of children. I consider a unitary household model in the spirit of Becker (1975). The household is a decision maker which maximizes its utility by allocating resources on the optimum number of boys and girls, along with a composite consumption good. I choose a static framework as described below[11]:

$$U(\bar{b}, \bar{g}, x) = W(\bar{b}, \bar{g}) + V(x) \tag{2.1}$$

In the above additive household utility function, the consumption good is represented by x and the number of alive boys and girls are denoted respectively by $\bar{b}$ and $\bar{g}$. The total number of girl fetuses aborted is denoted by $\underline{g}$. Also, $\bar{g} = (g - \underline{g})$, where g is the number of potentially born girls, i.e. the number of conceptions.

The household's preference for boys over girls may be manifested through its use of one or more sex selection techniques. One basic preconception sex selection technique is the differential use of contraceptives based on the gender mix among the existing children in the household. This is the so called "stopping rule" as discussed in Coombs (1979), McClelland (1979), Gadalla et al. (1985), Oyeka (1989), Mutharayappa et al. (1997), Clark (2000), Arnold et al. (2002). Parents abstain from the use of contraceptives until the desired number of male children is born. Using NFHS (1998-99) data, Arnold et al. (2002) show that girls typically grow up in larger families due to the delayed contraceptive choice of the parents.

Girl children are also subjected to postnatal discrimination in the household. More household resources are allocated to boys and the nutrition and education of girls are neglected, leading to excess female infant and child mortality (Miller 1981, Caldwell et al. 1983, Taylor et al. 1983, Das Gupta 1987, Basu 1989, Basu 1992, Drèze and Sen 1995, Pande 2003, Borooah 2004, Oster 2009). Preconception sex-selection often exacerbates this problem as larger families typically have more girl children, thereby

[11] A dynamic analysis involving the household's choice between sex-selective abortion related expenses at the current period and the future cost of raising a girl (dowry etc.) may be more appropriate. However, for simplicity, I adhere to a basic static framework.

reducing the resources allocated to girls even more (Arnold et al. 2002).

The utility function captures the household's son preference in two ways – first, abortion of male fetuses is ruled out. Secondly, for any two integers k, l denoting the number children of two genders, $k > l \Rightarrow W(k,l) > W(l,k)$. For simplicity I assume that the usual first and second order properties hold, i.e. $W'_{\overline{b}}, W'_{\overline{g}}, F', V' > 0$ and $W''_{\overline{b}}, W''_{\overline{g}}, F'', V'' < 0$[12].

The costs of raising boys and girls are p_b and p_g respectively, which depend upon exogenously fixed household income and the cost of inputs such as the healthcare and schooling of the children. Following Becker and Tomes (1976), I assume that richer households invest more in the quality of their children. The healthcare and schooling cost is assumed to be exogenously fixed and amenable to public policy, particularly through the provision of subsidized public goods. The household budget constraint is given by:

$$y = p_b\overline{b} + p_g\overline{g} + p_x x + p_a\underline{g} \tag{2.2}$$

The cost associated to the sex-determination test and the abortion of a girl fetus is p_a. In the presence of cheap and easily available prenatal sex determination and abortion services, p_a is low and consequentially $\underline{g}$ will be high. The higher incidence of abortion of the girl fetuses will materialize in an observed masculine sex ratio at birth. The ban on these sex-selection services in the form of the PNDT Act will raise p_a. A fully successful ban will increase p_a to an infinite (or a very high) level, eliminating all sex-selective abortions.

On the other hand, a partially successful enforcement will likely push the sex-

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[12]For households with a very strong preference for boys over girls, one may observe $W'_{\overline{g}} < 0$. Such possibilities are ruled out by my simplifying assumption.

selection service network underground and raise the price of the test to some extent (Wertz and Fletcher 1993, Luthra 1994). The rise in the transaction cost (monetary and non-monetary) associated with the test will reduce $\underline{g}$. Thus, a PNDT Act, even with its legal loopholes and incomplete implementation, is likely to dissuade couples, especially those among poorer households, from purchasing these services.

A household's choice of the gender composition of children is also affected by the provision of public goods. I consider three types of public goods. First, community level non-exclusionary public goods, such as better roads and drainage system, enhance the overall standard of living of all households. Secondly, household level non-exclusionary public goods, such as clean drinking water and better sanitation, will improve the quality of life of all family members. As a result, the gender gap in the resource allocated to the children, particularly among the households with a strong son preference, will narrow.

A third type of public good is the provision of schooling and healthcare. Cheap and easily available public facilities may relatively benefit the girl children. If the households with a strong son preference have a price-inelastic demand for these inputs for the boys, the income effect generated from a reduction in the cost will induce the parents to access these services for the girls.

These different kinds of public goods serve one common purpose – they diminish the discriminatory allocation of resources between the boys and girls in the household. In addition to the direct healthcare related public goods, community level government programs such as *Anganwadi* (child development), or schooling inputs such as the national school meal (*Mid-day meal*) program may have positive health impacts on children[13]. These, in turn, reduce the female child mortality and improve the juvenile sex ratio.

My objective is to analyze the effectiveness of the PNDT Act in India. Ideally, one would like to use the observed number of sex-selective abortions as an outcome of interest. However, there is no reliable source for nationally representative information on these abortions. Some secondary sources, such as the National Family Health Survey of 1998-99, collect self-reported information on the use of amniocentesis and ultrasound as part of the antenatal checkups by pregnant women. Given the outlawed status of sex-determination tests, these estimates are likely plagued by underreporting. Secondly, self-reported data make it difficult to link the mere use of antenatal services to actual sex-selective abortions performed.

My main outcome of interest in this study is the juvenile sex ratio (females per 1000 males in the 0-6 year age group). Two factors that determine the juvenile sex ratio are the sex ratio at birth and the gender-relative child mortality rates. A successful PNDT implementation will improve the former by preventing the abortion of girl fetuses. On contrary, PNDT may also induce a greater neglect of the living young girls who were born primarily because the law had prevented the abortion of the fetuses. This may result in a higher mortality of young girls compared to boys. Finally, a counteracting force in the form of expansion of public goods may help reduce the relative female child mortality.

[13] The national school meal program provides cooked lunch to children (5-14 year old) in public schools.

2.4 Data

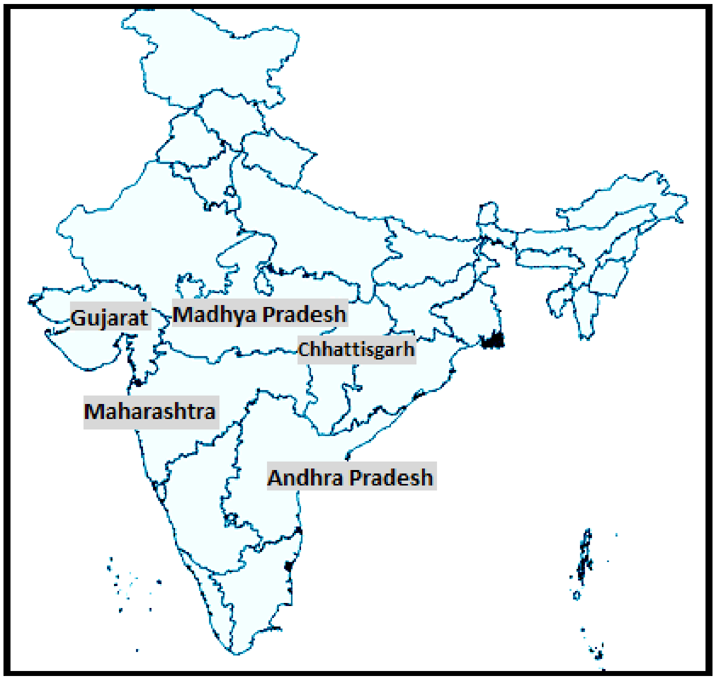
I use data from a wide array of secondary sources, namely rural and urban data from two different decennial Indian censuses, 1991 and 2001; and rural data from two National Family Health Surveys, 1992-93 (NFHS-1) and 1998-99 (NFHS-2). In my analysis of the NFHS data, I also use some additional information from two concurrent National Sample Surveys (NSS).

My main study area is the western state of Maharashtra (MH) and its neighboring states of Gujarat, Andhra Pradesh, Karnataka, Madhya Pradesh and Chhattisgarh. The state of Chhattisgarh was created from Madhya Pradesh in 2000. However, the census data allow us to exactly map villages and towns in the states that were divided in between the two time periods, thus avoiding any complications arising from the bifurcation. The control group is Maharashtra which did not have a PNDT policy intervention during my study period 1991 to 2001 (or NFHS-1 and NFHS-2). The state implemented its own PNDT-type act in 1988. To avoid any conceptual conflict with the conventional practice of referring the group *without* any treatment as a 'control group', I will hereafter refer to Maharashtra as the 'pre-treated' group. The treatment (or the 'newly treated') group consists of the neighbors of Maharashtra, states which had a centrally mandated PNDT (effective 1996) intervention during the study period.

Assuming that the passage of PNDT in 1996 did not have any effect on the pre-treated group, I can attribute any improvements in the juvenile sex ratio of the newly-treated group to the 1996 PNDT Act, *ceteris paribus*. Even if I assume that the 1996 law did affect the pre-treated group (by improving the enforcement, for example), it will only dampen the observed impact on the newly-treated group.

Again, the 4-6 year old children in the pre-treated group in 1991 were truly never

Figure 2.1: States of India (2001)

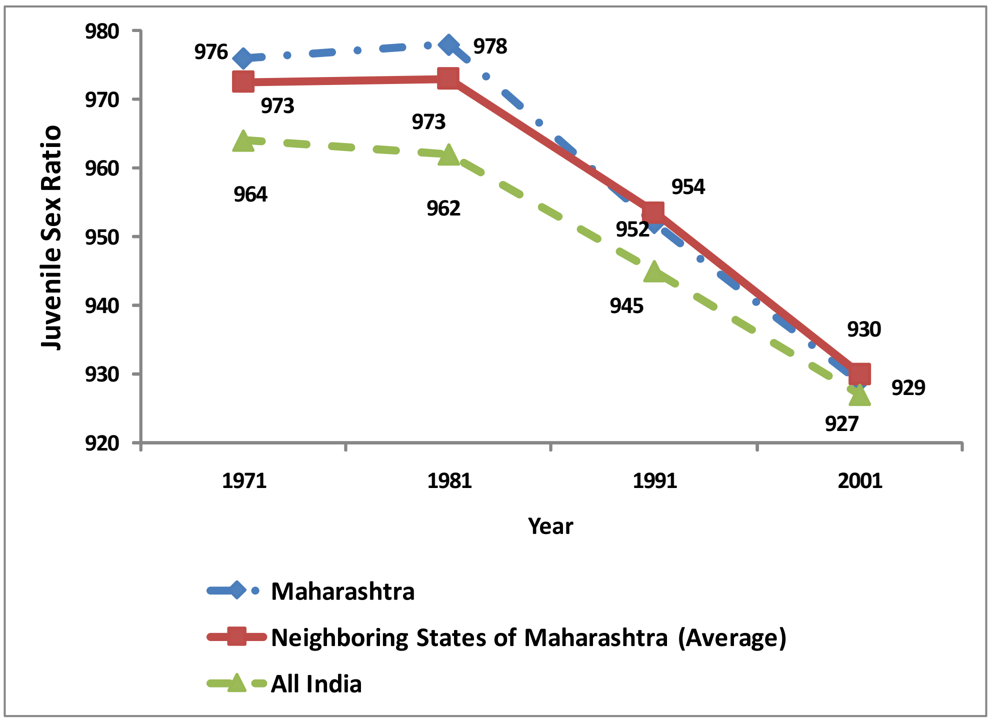


Source: Census of India 2001. Map is for illustration purpose only and may not depict correct political boundaries. Only states belonging to my main study area are shown due to space consideration.

exposed to the treatment as they were born before 1988. This population subgroup, which may have experienced sex-selective abortions, will diminish the observed effect of the PNDT on the newly-treated group. Fortunately, this attenuation bias also works in my favor – the juvenile sex ratio in Maharashtra will presumably improve by some extent between 1991 and 2001 because of the 1988 PNDT Act. Any improvement in the juvenile sex ratio that I may find among the newly-treated group (non-Maharashtra) would be incremental in comparison.

Figure 2.2 presents the decadal juvenile sex ratio from recent Indian censuses. The juvenile sex ratio has been steadily declining across the board over the last three decades. However, Maharashtra and its neighboring states have always fared better that the national average in level, although Maharashtra experienced a very steep decline from 978 in 1981 to 929 in 2001. One important aspect of a treatment-effect

Figure 2.2: Juvenile Sex Ratio in Indian States, 1971-2001 (Females per 1000 Males in the 0-6 year Age Group)



Source: Census of India, 1971, 1981, 1991, 2001 analysis is the validity of so-called parallel trends assumption. For my study, this implies that the juvenile sex ratio in the pre-treated and newly-treated groups should follow a parallel time-path in the absence of a PNDT policy. Alternatively, there should not be any systematic difference between the two groups. Using data from three consecutive NFHS surveys (1992-93, 1998-99 and 2005-06)), Figure A.2.3 in appendix attempts to provide time-trend information on female-to-male sex ratio by year of birth. However, the evidence is clearly inconclusive due to the inconsistent movement of the time series, presumably resulting from different mortality rates affecting each age group. Thus, none of my data sources provides reliable information on juvenile sex ratio for a suitable parallel-trends analysis.

2.4.1 Census Rural Data

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

One common problem of a multi-state treatment-effect analysis is the heterogeneity of the pre-treated and newly-treated groups. The states in my study area are dissimilar in some aspects. For example, the main language spoken across the states are all different from each other. A two-period panel data study takes care of the heterogeneity; it generally produces unbiased estimates by removing the individual village specific traits. However, it fails to eliminate any heterogeneity arising from differential changes over time. This dynamic difference between the pre-treated and newly-treated groups may be particularly relevant for distant time periods such as the Indian censuses.

I employ an empirical strategy to address this second type of heterogeneity. My basic assumption is that pre-treated and newly-treated communities in close proximity share similar socioeconomic, cultural and linguistic characteristics; and, they also experience similar changes in these traits over time. I start by restricting my study area to the villages along the administrative border of Maharashtra and its neighboring states (subsample i)[14]. Thus, approximately 7,800 villages from the border taluks (sub-district) inside Maharashtra constitute my pre-treated group. The newly-treated group contains 9,200 villages from other-state taluks that are just outside Maharashtra border[15].

One downside of this approach is that my study area is susceptible to spillover effects. In the absence of any cross-border migration restriction, pre-treated couples seeking sex-selective abortion could travel to a non-Maharashtra clinic (until the national PNDT Act of 1996) and purchase the services. If I consider the case of a complete contamination, whereby people from pre-treated area continue to obtain tests across the border until a nationwide ban in the form of the 1996 PNDT Act, we

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

[15] District and taluk level administrative maps from Census 2001 were used to identify pre-treated and newly-treated villages in various subsamples. District level census maps have been presented in the appendix.

will see no relative improvement in the juvenile sex ratio in the newly-treated areas compared to the pre-treated. A partial spillover, on the other hand, will work as an attenuation bias to only dampen the perceived impact of PNDT on the newly-treated group.

Table 2.1: Juvenile Sex Ratio in Rural India, 1991 and 2001

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

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

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

To check the robustness of my results and for the sake of comparison, two additional subsamples are used – (iii) All villages from Maharashtra and neighboring states except the ones from immediate districts on both sides of the border. This subsample contains 15,640 pre-treated and 113,900 newly treated villages, (iv) All villages from Maharashtra and all villages from neighboring states. There are 39,711 villages in Maharashtra and 140,622 villages in all the neighboring states.

Given the importance of public policy in reducing the gender inequality, one would naturally be interested in the effectiveness of PNDT across the entire country. Hence, I analyze a final subsample consisting of all villages in the country[16] - (v) all villages from Maharashtra are considered as pre-treated and the villages from other major states are considered as newly-treated. The pre-treated group includes all 39,711 villages from Maharashtra while the newly-treated group consists of 502,462 villages from the rest of the country[17].

Table 2.1 presents the mean juvenile sex ratios across various rural census subsamples. Figures A.2.4 through Figure A.2.12 in appendix provide a snapshot of changes in the juvenile sex ratio over my study period across the rural subsamples. The Kernel density plots show that the pre-treated and newly-treated villages experienced very

[16] I include Maharashtra and 18 other major states in my sample. Smaller north-eastern states (except Assam), Goa, Delhi and union territories have been excluded.

[17] Brief descriptive statistics on the characteristics of all five rural subsamples are presented in Appendix Table A.2.13.

similar changes in the juvenile sex ratio between 1991 and 2001. The distribution of the change in juvenile sex ratio in the newly-treated villages, however, appears marginally to the right of its counterpart.

2.4.2 Census Urban Data

A second set of models are estimated using the Primary Census Abstract (PCA) data on towns from the 1991 and 2001 censuses. The town PCA data provide information on population, age, caste, employment, and education in the urban centers. Towns across the two census periods have been matched to create a panel dataset at the town level.

Unlike the village data, the census town data did not collect information on the availability of facilities and amenities in one of the study periods, presumably due to the ubiquity of these basic infrastructure and services in urban areas. Consequently, I construct a framework that evaluates the impact of the PNDT Act on the juvenile sex ratio, controlling for the PCA information, but leaving out the less significant amenities data.

I analyze four different subsamples – first, a pre-treated group of 144 towns that belong to the districts along the state border inside Maharashtra and 49 newly-treated towns from districts just outside the Maharashtra border (subsample i)[18] [19]. A second subsample covers all pre-treated Maharashtra towns and all newly-treated neighboring state towns, leaving out the districts along both sides of Maharashtra border

[18]The administrative stricture of urban India is as follows – states are divided into districts. Each district is divided into many taluks. Towns typically serve as taluk headquarters, districts headquarters or state capitals. Towns from all Indian states are included in my analysis.

[19]To preserve sample size, I do not disaggregate my analysis further to the taluk level.

Table 2.2: Juvenile Sex Ratio in Urban India, 1991 and 2001

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

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

(subsample ii). There are 90 pre-treated towns and 252 newly-treated towns in this subsample. The observations included in the third subsample are all towns in Maharashtra and its neighboring states, i.e. 234 pre-treated towns and 301 newly-treated towns (subsample iii). Finally, the fourth subsample employs all 234 towns in Maharashtra as pre-treated and all 1,213 towns from the rest of the country as newly-treated (subsample iv).

Table 2.2 presents mean juvenile sex ratios across the urban census subsamples. Kernel density plots of the change in juvenile sex ratio (1991 to 2001) for the town subsamples are presented in Figure 7 through Figure 10 in appendix. The distributions are generally less smooth than their rural counterparts, mainly due to the smaller sample size. However, the distributions of the pre-treated and newly-treated are distinctively different – in most subsamples the pre-treated group shows a stronger worsening of the juvenile sex ratio.

2.4.3 National Family Health Survey (NFHS) Data

Juvenile sex ratio is an aggregate measure, suitable for a community level analysis using the village and town census data. However, it is important to incorporate the intra-household dynamics generated by the PNDT policy and the improved access to affordable public goods. To this end, I estimate a final set of models using data from two large household surveys – NFHS-1 (1992-93) and NFHS-2 (1998-99).

The NFHS covers approximately 90,000 Indian households, more than 65% of which are from rural areas[20]. The two rounds of survey, conducted on different year-specific nationally representative samples, provide general information on household demographics, caste, and asset ownership. A special health questionnaire administered to the ever-married women of reproductive age collects a wide range of specific information related to maternal and child health, and access to healthcare facilities. Moreover, a community level questionnaire used for the rural sample gathers information on the availability of infrastructure and amenities, including healthcare and educational facilities, in the village.

I use the rural NFHS sample for this study because of the availability of additional information on amenities – rural households from Maharashtra are in the pre-treated group while their counterparts from the neighboring states are in the newly-treated group. Since individual households cannot be matched across the two survey rounds,

[20]Surveyed households are selected from all households with at least one ever-married woman in the age group 15-49 years.

I create a household level pooled dataset from NFHS-1 and NFHS-2. My sample consists of approximately 5,400 and 4,900 newly-treated households from NFHS-1 and NFHS-2, respectively. The pre-treated group contains about 900 and 800 households from the two respective survey rounds.

I extend the analysis to a second subsample, one that considers all rural Maharashtra households as pre-treated and rural households from the rest of the country as newly-treated. The larger pre-treated group includes roughly 25,000 households from each time period. I choose the household level ratio of girls to all children in the age group 0-4 years as my outcome of interest. This peculiar choice affects my analysis in the following way – with the Maharashtra PNDT coming into effect in 1988, all children in the pre-treated group were born under the purview of the law. On contrary, the implementation of the national PNDT in 1996 implies that the 3-4 year old children in the newly-treated group were never exposed to the treatment. This will generate an attenuation bias, which once again conforms to my analysis since it will only dampen the desired effect of the PNDT Act on the newly-treated group.

Table 2.3 shows the mean values of the NFHS outcome variable across the two time periods and subgroups of households. Both pre-treated and newly-treated groups experience a decline in the girls-to-children percentage across the two subsamples. The pre-treated Maharashtra households exhibit a stronger worsening of the gender imbalance.

Table 2.3: Household Level Girls-to-Children Percentage in the Age Group 0-4 Years

	Mean Juvenile Sex Ratio (Females per 1000 Males in 0-6 year Age Group)		
	Census 1991	**Census 2001**	**Change**
Subsample (i)			
Pre-treated households from Maharashtra	48.5 (43.5)	46.2 (44.4)	- 2.3
Newly-treated households from neighboring states	48.6 (44.1)	47.9 (44.1)	- 0.7
Subsample (ii)			
Pre-treated households from Maharashtra	48.5 (43.5)	46.2 (44.4)	- 2.3
Newly-treated households from the rest of India	48.2 (44.1)	47.2 (44.2)	- 1.0

Source: National Family Health Survey (NFHS) 1992-93 and 1998-99. Standard deviations are in the parenthesis. 'Change' represents the difference between NFHS-1 and NFHS-2 values.

2.5 Empirical Strategy

2.5.1 Census Data Linear Fixed-effect Regression

On the basis of the underlying data, I use different model specifications to examine the effectiveness of the national PNDT Act. The basic linear model for the rural census data is:

$$y_{jt} = \tau Law_{jt} + \alpha_j + \beta_t + \gamma INF_{jt} + \delta X_{jt} + \epsilon_{jt} \qquad (2.3)$$

where y_{jt} is the juvenile sex ratio (number of females per 1000 males in the age group 0-6 years) in the $j-th$ village at time $t = 1, 2$ (corresponding to year 1991 and 2001 respectively). On the right hand side, my main variable of interest is the treatment (PNDT implementation) status indicator Law_{jt}. For pre-treated Maharashtra villages, $Law_{jt} = 1 \forall t$, while for newly-treated non-Maharashtra villages, $Law_{j1} = 0$

and $Law_{j2} = 1$.

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

A vector of village level demographic characteristics is represented by the time-varying vector $\boldsymbol{X}$. It includes factors that may affect the extent of son preference. Adult education is measured by female and male literacy rates. Several studies suggest that some ethnic groups place higher value on women, typically exhibited by higher female work force participation. I include the percentages of scheduled caste (SC) and scheduled tribe (ST) population[21] to accommodate this type of effects. Village prosperity is captured by the amount of cultivated land per capita cultivator and the percentage of cultivable land that is irrigated. The total log population of the village is also included in $\boldsymbol{X}$.

The village specific unobserved heterogeneity is denoted by α_j. It captures the socioeconomic and cultural differences across villages – time-invariant factors that may differentially affect the parental preference of sons over daughters. β_t denotes a time-varying intercept and ϵ_{jt} is an *iid* error term. Taking the first-difference of

[21]SC and ST subpopulations are socioeconomically backward groups designated by the government of India.

equation (2.3), I obtain:

$$\triangle y_{jt} = \tau \triangle Law_{jt} + \lambda_t + \gamma \triangle INF_{jt} + \delta \triangle X_{jt} + \triangle \epsilon_{jt} \tag{2.4}$$

The time effect is $\lambda_t = (\beta_t - \beta_{t-1})$, and τ is the difference-in-difference marginal effect of PNDT. The first difference operator is $\triangle$, i.e. $\triangle y_{jt} = (y_{jt} - y_{jt-1})$ etc. The estimation results are reported for five different subsamples, as mentioned previously.

Another set of models similar to equation (2.4) are estimated for the census town level panel data:

$$\triangle y_{kt} = \tau \triangle Law_{kt} + \lambda_t + \delta \triangle X_{kt} + \triangle \epsilon_{kt} \tag{2.5}$$

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

2.5.2 NFHS Data Linear District Fixed-effect regression

For the pooled household level NFHS dataset, I use a district fixed-effect specification as below:

$$y_{imt} = \tau Law_{mt} + \alpha + \beta INF_{imt} + \gamma X_{imt} + \sum_m \delta_m D_m + \epsilon_{imt} \tag{2.6}$$

where the subscript i is for individual household; m denotes the $m-th$ district and$t = 1, 2$ represents time (for 1992-93 and 1998-99 respectively). The outcome variable y_{imt} is the percentage of girls among all children in the age group 0-4 years in the household[22]. $\boldsymbol{X}$ is a vector of household characteristics. It contains the size of the household along with several variables for age and gender composition of the household members. Also included are the characteristics of the household head such as caste (SC/ST), religion (using an indicator for Muslim), age, sex and educational attainment.

Since NFHS only collects information on household assets, but neither income nor expenditure, I use additional information from two concurrent NSS rounds to predict household expenditure[23]. For NFHS-1, the NSS 50th round (1993-94) data were used to estimate a model of log household per capita expenditure on several household characteristics. The explanatory variables in the estimated regression were then replaced by variables from the NFHS-1 data to obtain predicted log per capita household expenditure. For NFHS-2, this was done using the NSS 55th round (1999-2000) data. The predicted expenditure is included in $\boldsymbol{X}$.

PNDT treatment status Law_{mt} is defined the same way as in the census data models. Households in Maharashtra are in the pre-treated group while their counterparts from neighboring states are in the newly-treated group. Village level availability of healthcare, educational and other infrastructure are denoted by the time-varying vector $\boldsymbol{INF}$. Among healthcare inputs, I include the presence of a primary health center, a primary health sub-center, a village health guide (same as a community health worker in census data), a trained birth attendant (nurse midwife) and a mobile health unit. Additionally, I include the availability of primary and secondary

[22]Given the fewer number of children in a household, juvenile sex ratio is not an appropriate choice for an outcome variable.

[23]Household assets are an indicator of permanent income, whereas access to healthcare and educational facilities will depend more on the flow of income. Using predicted household consumption expenditure in the context of DHS data has become a popular practice (e.g. see Stifel and Alderman 2006).

schools and paved roads in the village.

I use a set of district dummy variables (denoted by D_m) to control for district fixed-effects. The estimated coefficients of these dummy variables will not be measured accurately due to low sample size at the district level. However, the estimates will be unbiased. Furthermore, they do not pose a threat to my analysis as I am interested in the effect of PNDT at the state level and do not report the results at the district level.

Equation (2.6) is estimated by pooling the data from two NFHS sources and including a time-dummy on the right hand side. The coefficient τ is essentially a difference-in-difference estimator of the marginal effect of PNDT. I report the results for two different subsamples of households.

2.5.3 Heterogeneous Treatment Effect: Village Fixed-effect Quantile Regression Estimates

All the census and NFHS data models mentioned in the previous section are linear – they capture the mean effect of PNDT policy and expansion of public goods. However, different communities exhibit different magnitudes of son preference and their response to public policies will vary. For example, communities with a weaker son preference may respond better to a PNDT while those with a strong son preference may be more amenable to an expansionary public goods policy. The idiosyncratic nature of the impact of the policy intervention can be tested on the conditional distribution of the juvenile sex ratio, which, a mean-model will surely ignore.

One way to capture the heterogeneous effect of the treatment and the access to public goods is the use of quantile regression models, which help us estimate the effect at different percentiles of the conditional distribution of juvenile sex ratio[24]. I estimate the census data model in equation (2.4) at the 10th, 25th, 50th (median), 75th and the 90th percentiles of the conditional distribution of the first difference of juvenile sex ratio for all five rural subsamples.

2.6 Results

2.6.1 Census Data Linear Regression Results

The basic results from the first-difference village-fixed effect models estimated using the first two rural subsamples are presented in Table 2.4. Results from rural subsamples (iii), (iv), and (v) serve as robustness checks. These results are presented in appendix Table A.2.7 and mentioned, whenever relevant, in our current discussion. All the census and NFHS regression models correct for heteroskedasticity by employing Huber-White robust standard errors. Results are robust to clustering at state, districts and taluks for the census data, and districts for the NFHS data[25].

The first row in Table 2.4 presents the coefficient estimates associated with the treatment. Results from the first subsample – pre-treated and newly-treated villages from immediate taluks on both sides of Maharashtra border – do not show any significant impact of the PNDT. Given that these geographically close communities are the most vulnerable to spillover effects, a ban on sex-selective abortion is expected to be ineffective for this subsample. In contrast, the second subsample which is fairly ho-

[24]Koenker and Bassett (1978).

[25]In case of a few first-difference subsamples, the covariate coefficients are not stable across the two time periods (i.e. the intensity of covariate effect changes over time). The estimated impact of the PNDT Act is generally robust among additional regression models that incorporte the time-varying coeffecients.

mogeneous and has a lower risk of spillovers – villages from neighboring districts from both sides of Maharashtra border without the immediate taluks – shows a 16.6 point improvement in the juvenile sex ratio as a consequence of the PNDT Act. Among the rest of the rural subsamples, the positive impact of the PNDT indicator ranges between 13.1 and 21.1 points, all statistically significant.

Table 2.5 presents the results from the urban census data. All four subsamples of census towns exhibit similar positive effects of the PNDT Act. The predicted rise in juvenile sex ratio associated to the policy intervention varies from 19 points to 20.6 points.

One may be tempted to interpret these results as markedly different from the ineffectiveness of the PNDT Act as suggested by the existing literature. Some recent studies such as Jha et al. (2006a) and Arnold et al. (2002) have focused on the continued practice of sex-selective abortions in India[26]. The 2001 census, which revealed severely masculine sex ratios in many states, further supports the hypothesis of a failed PNDT Act. Alarmed by the census outcomes, the Medical Council of India and the Indian Medical Association issued directives urging the doctors to immediately stop all sex-selective abortion services (Arnold et al. 2002). In response to the growing campaign against sex-selective abortion, the government of India expanded the provisions of the PNDT Act through an amendment in 2003.

My results do not contradict previous Indian findings. In general, there is little doubt that the PNDT Act has not been as effective as desired. However, the existing

[26]Ineffectiveness of similar policies has been studied in other Asian countries. Many studies have documented strong son preference among the parents in China and South Korea. Concerned by the low female-male sex ratio at birth, the Chinese government banned prenatal sex determination (except for the diagnosis of hereditary diseases in the fetus) in 1986. However, Zeng Yi et al. (1993) and Chu (2001) point out the wide availability of these services and the sustained prevalence of sex-selective abortion well after they were outlawed in China. In South Korea, similar restrictions on sex-determination placed in 1990 have arguably been effective (Park and Cho 1995).

Table 2.4: Census Data Village Fixed-effect Regression of Juvenile Sex Ratio

	Village Fixed-effect Regressions			
	Subsample (i)		**Subsample (ii)**	
	No INF Variables	**With INF Variables**	**No INF Variables**	**With INF Variables**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	3.44	3.68	16.33**	16.56**
Log village population	38.37**	14.85	-2.31	-8.73
Male literacy rate	0.88**	0.82**	0.92**	0.73**
Female literacy rate	-1.13**	-0.95**	-0.77**	-0.72**
Scheduled Caste (% of population)	1.25*	1.11*	-0.14	-0.04
Scheduled Tribe (% of population)	1.90*	0.52	0.03	0.02
Acres of cultivable land per cultivator	-0.99	-1.32	1.03	0.90
% of irrigated cultivable land	0.00	0.01	-0.03	0.00
Availability in the village of:				
Primary or Middle School		4.11		9.06
High School		-5.45		0.91
Any public health facility		7.08		0.11
Maternal/child welfare center		-0.87		-3.99
Registered medical practitioner		-6.50		-8.23**
Community health worker		-3.72		-5.64*
Tap water		-0.86		-1.32
Paved approach road		-4.14		2.20
Electricity		14.62		13.10
At least one telephone		-5.53		-4.01
Intercept term	-22.63**	-19.16**	-30.15**	-25.11**
F Statistic	3.18	1.72	7.39	3.99
R^2	0.006	0.003	0.002	0.003
Number of Villages	16,565	15,380	32,898	32,450

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used in all estimated models. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . Standard errors are clustered at the taluk level.

Table 2.5: Census Data Town Fixed-effect Regression of Juvenile Sex Ratio

	Town Fixed-effect Regression Models			
	Subsample (i)	**Subsample (ii)**	**Subsample (iii)**	**Subsample (iv)**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	20.62**	20.40**	18.99**	20.00**
Schedule Caste (% of population)	0.11	0.23	-0.11	-0.34
Schedule Tribe (% of population)	-0.43	6.05**	1.85	0.54
Female literacy rate	2.40*	1.44*	1.73**	1.20**
Male work force participation rate	4.33**	-0.13	1.58	2.99**
Female work force participation rate	-1.75	-2.08**	-1.83**	-2.02**
Log town population	15.82	2.17	10.76	-0.44
Constant	-69.09**	-54.85**	-59.52**	-51.90**
F Statistic	1.9	3.64	4.49	10.07
R^2	0.1	0.08	0.07	0.06
Number of Towns	193	342	535	1,447

Note: Data are from town-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used in all estimated models. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** .

literature lacks any scientific treatment-effect analysis and my study overcomes this fundamental inadequacy – I use a comparison (pre-treated) group to judge the effectiveness of the central government implementation of PNDT on the newly-treated group. My results indicate that the 1996 PNDT was far from an utter failure. The partial effect of the Act, controlling for other factors, was an 'improved' juvenile sex ratio over my study period. Although the observed juvenile sex ratio decreased almost across the board, the marginal effect of PNDT was positive, i.e. in the absence of this Act, the juvenile sex ratio would have declined further.

Socioeconomically backward scheduled caste and tribe groups are known for less discrimination and neglect of women. These groups, by virtue of their difference from traditional upper-caste Hindu society, suffer less from rigid dowry norms and other rituals limiting women's autonomy (Miller 1981, Agnihotri et al. 2002). I find a weak but significant positive effect of the percentage of backward population in the village on the juvenile sex ratio – particularly for scheduled tribes – in most of my rural subsamples and one urban subsample. My regional results echo Deolalikar et al. (2009), a concurrent study of the effect of access to public goods on juvenile sex ratio among major Indian states. Another interesting finding is the negative effect of female literacy rate on juvenile sex ratio. The effect, although not very strong, is consistent across all rural subsamples. My results are not unique[27] – researchers have long found a negative link between female literacy and fertility rates in India. Using 1981 census data, Sharma and Retherford (1990) and Murthi et al. (1995) find significant negative impact of female literacy rates on total fertility rates. Parikh and Gupta (2001) and Jha et al. (2006a) have shown similar association between

[27] Again, Deolalikar et al. (2009) discovers similar effects for all India. Jayachandran and Kuziemko 2009 find that girls are weaned from breastfeeding sooner than boys by mothers, resulting in excess female child mortality.

women's education and fertility. On the other hand, several studies have attributed the decline in juvenile sex ratio in India and other Asian societies to fall in fertility rates. For instance, Das Gupta and Bhat (1997) argue that recent decline in fertility in India has been marked by a greater fall in the demand for total number of children compared to the demand for boys[28].

Two of the urban subsamples exhibit a similar weak negative association between female labor force participation and juvenile sex ratio. With women's participation in work force, the opportunity cost of having children rises. As a consequence, fertility declines and son preference induces couples to sex-select their children in favor of boys. On contrary, the male literacy rate in all rural regressions and the male labor force participation rate in one urban model exhibit a significant positive effect[29]. This positive association of literacy and juvenile sex ratio could be explained by the possible 'income effect' as mentioned in Deolalikar et al. (2009). A rise in male employment rate and wages may increase fertility demand, improving the juvenile sex ratio.

I find no or almost negligible effect of the availability healthcare and educational infrastructure on the rural juvenile sex ratio[30]. This finding is similar to Oster (2009) who argue that increased access to healthcare does not monotonically transfer to reduction in gender inequality. One surprising outcome, though, is the significant negative impact of the presence of a registered private doctor in the village. Villages with a doctor are likely to experience a decline in the juvenile sex ratio ranging from

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[28] Park and Cho (1995) associate reduced fertility and 'small-family norm' to the strengthening of son preference in East Asian societies.

[29] Other studies such as Borooah and Iyer (2005) have shown similar positive effect of male literacy on sex ratio in India.

[30] Deolalikar et al. (2009) suggest that the expansion of these public goods may suffer from endogeneity, i.e. communities with stronger son preference tend to have better access to these infrastructure facilities.

6 points to 8.23 points. Similar but weaker negative effect of the availability of a maternal or child welfare center can be seen in one subsample.

The maternal and child welfare centers in rural India are often staffed with a trained or untrained nurse midwife (Robinson 1956). From the discussions in Shrivastava (1998), Ganatra et al. (2001) and Deolalikar et al. (2009) one can argue that the availability of a nurse midwife (or a *dai*, i.e. a traditional birth attendant) or a registered private doctor often makes it easier for couples to access illegal prenatal sex determination and sex-selective abortion services. Thus the presence of these services in the village could have an adverse effect on the juvenile sex ratio.

2.6.2 NFHS Data Regression

Results from the household-level rural NFHS data regressions are presented in Table 2.6. The district fixed-effect model of the first subsample finds a marginally significant positive association between the PNDT Act and the outcome variable – the predicted percentage of girls among children is approximately 4 points higher in the newly-treated group. The second model of all households in the country, however, fails to discover any significant association between the law and the outcome.

My results present a few intriguing insights into the household decision making process. The gender composition among the existing children in the household shows an obvious effect on the sex-relative fertility choice of the couples. The number of boys in the age group 5-14 years has a significantly negative impact on the girls-to-kids percentage in the 0-4 year age group. Similar negative impact of the presence of girls is also observed in the second subsample. These negative effects could be explained by two factors. First, strong unobserved son preference will induce households to have more sons in both the 0-4 year and 5-14 year age groups. Secondly, the "stopping rule"

Table 2.6: Pooled NFHS Data Linear Regression of Girls-to-Children (0-4 Yrs) Percentage

	Households from Maharashtra and Neighbors		**Households from Maharashtra and rest of India**	
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	4.02*	4.43*	2.34	2.19
Number of 5-14 year old boys in the household	-2.15**	-2.09**	-1.49**	-1.52**
Number of 5-14 year old girls in the household	-0.54	-0.53	-1.00**	-1.10**
Percent of household members who are:				
15-24 year old men	-0.12	-0.11	-0.13**	-0.13**
15-24 year old women	-0.03	-0.03	-0.09**	-0.08**
25-44 year old men	-0.01	0.00	-0.11**	-0.11**
25-44 year old women	0.02	0.04	-0.05	-0.05
45-59 year old men	-0.05	-0.05	-0.10**	-0.09**
45-59 year old women	-0.07	-0.06	-0.11**	-0.11**
60 and above year old men	-0.10	-0.09	-0.07	-0.08
60 and above year old women	-0.05	-0.04	-0.15**	-0.15**
Schedule Caste household	-3.13**	-3.14**	-0.31	-0.21
Schedule Tribe household	-0.83	-1.29	-0.22	-0.58
Muslim household	2.22	2.37	0.74	0.80
Household size	-0.02	-0.03	0.39**	0.38**
Whether head is female	-0.37	-0.49	1.66*	1.43
Age of head (years)	-0.02	-0.03	-0.03**	-0.03**
Head completed primary schooling	0.35	-0.02	0.15	0.08
Head completed secondary schooling	3.83**	3.84**	-0.05	-0.01
Head completed higher schooling	1.60	1.86	-1.58	-1.41
Predicted log MPCE (from NSS data)	-13.31**	-13.94**	-3.39**	-4.17**
Availability in the village of:				
Primary school		0.34		0.98
Secondary school		-0.75		0.34
Child welfare (Anganwadi) center		1.38		0.45
Primary health center		0.31		0.62
Primary health sub-center		-1.10		-0.56
Village health guide		0.77		0.38
Trained Birth attendant (Dai)		0.08		0.34
Mobile health unit		0.00		-0.12
Paved road		1.77**		0.19
Time Dummy for NFHS 1998-99	5.15	4.55	3.76	4.07
Intercept	124.67**	127.01**	67.82**	71.08**
F Statistic	2.64	2.7	4.57	3.74
Adjusted R^2	0.005	0.005	0.002	0.002
Sample Size	12,028	11,670	51,634	49,536

Note: Data are from NFHS 1992-93 and 1998-99 rural samples. Robust standard errors have been used. Each regression includes district dummies. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . 'MPCE' denotes monthly per capita expenditure mechanism implies that households with an adequate number of girls in the higher age group are likely to have fewer girls in the 0-5 year age group.

Some characteristics of the head of the household have a significant influence, although inconsistent across two subsamples, on the outcome variable. For example, in a dynamic society, older household heads are likely to have a stronger son preference and thus, an adverse effect on the regression outcome. Again, education of the household head may capture a positive 'income effect', and increased demand for children, improving the girls-to-children ratio in the household.

However, another conflicting force could outweigh this 'income effect'. In communities where the association between a rise in household income and increase in fertility demand is weak, the prevalence of a strong son preference could worsen the female-male sex ratio. With rise in income, households will be able to afford the sex determination and sex-selective abortion services. Indeed, both my models exhibit a significant decline in girls-to-kids percentage as a result of a rise in the predicted log per capita expenditure.

A finding similar to the census data is the general ineffectiveness of healthcare and education infrastructure. None of the health care inputs – such as the availability of a primary health center, a sub-center, a community health worker (or village health guide) etc. – appear to have any significant impact on the girls-kids percentage. The availability of a paved road, on the other hand, positively affects the outcome variable in one subsample.

2.6.3 Rural Census Data Quantile Regression Results

The PNDT Act and the availability of infrastructure and services may affect different communities differently. This heterogeneity in the treatment effect arising from different degree of son preference across population subgroups is captured by the quantile regression results presented in Table A.2.8 through Table A.2.12 in the appendix.

Quantile regressions from all five rural subsamples demonstrate a common pattern. The generally positive effect of the treatment exhibited by the linear mean models is also reflected by the quantile regression models of the 25th percentile and beyond. In a striking juxtaposition, around the left tail (10th percentile) of the conditional distribution of juvenile sex ratio, the implementation of PNDT has no significant impact or, in case of the first and fifth subsamples, a significant negative impact.

Communities at the lower end of the conditional distribution have a stronger son preference, as revealed by their worse-than-average decline in the juvenile sex ratio over my study period. The sheer magnitude of the son preference, a trait shared by both pre-treated and newly-treated villages around the 10th percentile, will undermine a PNDT-type effort. Assuming that there is no impact of the 1996 law on the pre-treated villages, the newly treated communities will seek to continue their sex-selection practices, often at a higher pecuniary cost after the implementation of PNDT Act. This will result in a redistribution of resources in the household, exacerbating the neglect of the girl children. Thus the PNDT Act may initially have a negative impact on these communities. However, one must note that a successful implementation of the law will eventually curb the practice of sex-selective abortions by pushing the costs of an abortion beyond the purchasing power of households, even at the left end of the juvenile sex ratio distribution.

Higher quantiles of the conditional distribution correspond to better changes in the juvenile sex ratio over time – an indication of the weakening son preference among these communities. The positive effect of PNDT typically intensifies at the higher quantiles of the juvenile sex ratio distribution, which conforms to the notion that communities with a weaker son preference respond better to the ban on sex-selective abortion.

The impact of the availability of health and educational infrastructure follows a pattern opposite to that of the PNDT Act. At the lower end of the conditional juvenile sex ratio distribution, healthcare facilities typically have a strong positive effect on the outcome variable. On contrary, the availability of healthcare facilities has a negative impact at higher quantiles of the distribution. It is worth mentioning that the availability of power supply is an exception – I find a negative impact at lower quantiles and a positive impact at higher quantiles. This is possibly indicative of the access to electricity as an aid to sex-selective abortion services in communities with stronger preference for boys over girls. These results are similar across the rural subsamples and echo the findings of Deolalikar et al. (2009).

One must note the factors that can possibly mire my findings. First, similar to many treatment-effect studies, I have no way to capture the regional or temporal variation in the enforcement of the PNDT Act. It is possible for a part or all of the positive impact of the PNDT to originate from differences in enforcement between the pre-treated and newly treated communities. However, given the robustness of the results across various rural and urban subsamples it is safe to assume the absence of such an overarching problem. Also, I cannot I incorporate any time-varying difference in the quality, and not the simple availability, of the amenities and infrastructural facilities and note that the mere availability of a public good may not be equivalent to the actual use of the facility.

Secondly, my fixed-effect estimates ignore other time-varying changes in socioeconomic and cultural factors that may differentially affect the pre-treated and newly-treated communities. This concern can somewhat be mitigated by the use of several subsamples, but these unobserved changes could still alter the magnitude of the impact of public policies.

2.7 Conclusion

In this study I use a policy variation to examine the effectiveness of a ban on sex selective abortions in India. Using village and town level longitudinal data from 1991 and 2001 census, I find a positive marginal impact of the 1996 PNDT Act on juvenile sex ratio. The results obtained from NFHS surveys, however, are similar but much weaker. The positive impact of the Act may appear to be in contradiction with the existing literature. Researchers have repeatedly suggested the ineffectiveness of the 1996 law. I generally agree with the failure of the law in 'increasing' the juvenile sex ratio over my study period. My results indicate that the PNDT Act has partially 'improved' the outcome, i.e. the juvenile sex ratio would have worsened further in the possible absence of the PNDT Act.

My basic census models estimate first-difference regressions, thus eliminating any village or town specific time-invariant heterogeneity. I employ various subsamples of the census data, which serve us two purposes. First, some of the subsamples help us avoid any unobserved time-varying heterogeneity among sample observations. Secondly, the comparison between different subsamples provides a robustness check for my results.

Different communities exhibit different degrees of preference of sons over daughters, both in the level and in terms of change over time. I attempt to capture this inter-community variation through quantile regressions at various points along the conditional distribution of the rural juvenile sex ratio. The results show that the 1996 PNDT Act has been most effective among communities with the weakest son preference. I find no impact (or a negative impact) of the law around the left tail of the distribution, i.e. among villages that exhibit the strongest form of son preference. The existing literature on gender imbalance in India primarily focuses on the north-south dichotomy, i.e. the northern and western states demonstrate a worse than average recent decline in the juvenile sex ratio, something that has been attributed to the stronger son preference in those states. My results align with these findings. The Indian government, thus, has taken a step in the right direction by expanding the provisions of the PNDT Act (2003) and by strengthening its enforcement.

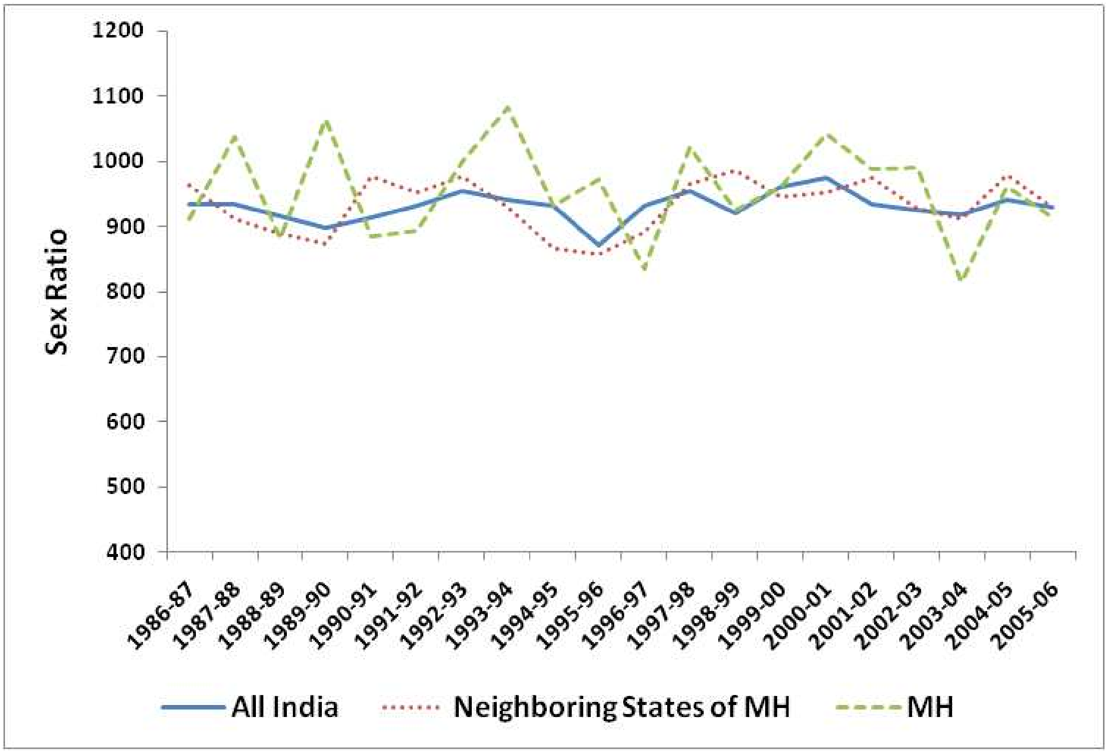
My rural data linear models point toward an overall ineffectiveness of the access to public goods. However, quantile regression results indicate that public goods, particularly the provision of healthcare facilities are effective where needed; communities located on the lower half of the conditional juvenile sex ratio distribution are the most amenable to this type of intervention.

The PNDT Act and the provision of public goods are among a myriad of recent Indian public policies that may potentially affect the gender imbalance. Some of these policies are worth mentioning in the present context. Along with a national population policy (2000), some individual states such as Tamil Nadu, Orissa, Andhra Pradesh and Rajasthan have implemented their own policies to reduce fertility rates. A decline in fertility often leads to a heightened preference for sons over daughters in some communities. For example, in China, Ebenstein (2010) finds a positive causal association between the "One Child" fertility control policy and sex selective abortions. Thus, an effective population control policy may worsen the juvenile sex ratio. In contrast, the central government introduced a direct policy aimed at reducing the neglect of girls – the *Balika Samriddhi Yojana* (1997) provides monetary incentives for the education of girls from poor families. Similar policies were adopted in Tamil Nadu (Cradle Baby Scheme 1992), Andhra Pradesh (Girl Child Protection Scheme 1996-97) and a few other states.

Until recently, inheritance laws governing the transfer of resources between generations had had different implications for boys and girls. These property rights, often determined by local cultural norms along with the Hindu Succession Act (1956), were largely discriminatory against women. The central amendment of the Succession Act (2004), lead by a few individual state laws such as in Kerala (1975), have established equal property rights for men and women. Finally, the absence of a strong social safety net induces parents to perceive their sons as future source of monetary and other support. Direct cash transfer programs such as the National Old Age Pension Scheme (2007) for the poor elderly, and indirect policies aiding the expansion of private and public old-age insurance providers, will thereby help reduce the discrimination of girl children. This study focuses on one of these above policies, the PNDT Act, and opens up several areas of possible future research. Gender imbalance is a severe crisis in India, and designing effective public policies to battle this situation, through a comprehensive evaluation of the existing ones, is of utmost importance.

Appendix

Figure A.2.3: Sex Ratio by Year of Birth in India (1986-87 to 2005-06)



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

Figure A.2.4: Change in Rural Juvenile Sex Ratio, 1991-2001 [Subsample (i) - Villages from immediate taluks on both sides of Maharashtra (MH) border]

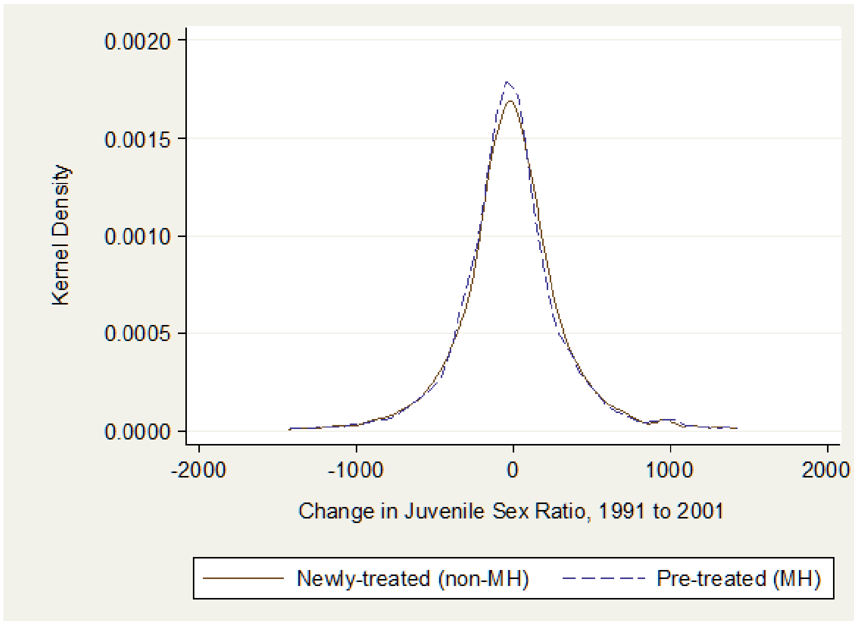


Figure A.2.5: Change in Rural Juvenile Sex Ratio, 1991-2001 [Subsample (ii) - Villages from neighboring districts from both sides of the Maharashtra border, except the immediate neighboring taluks]

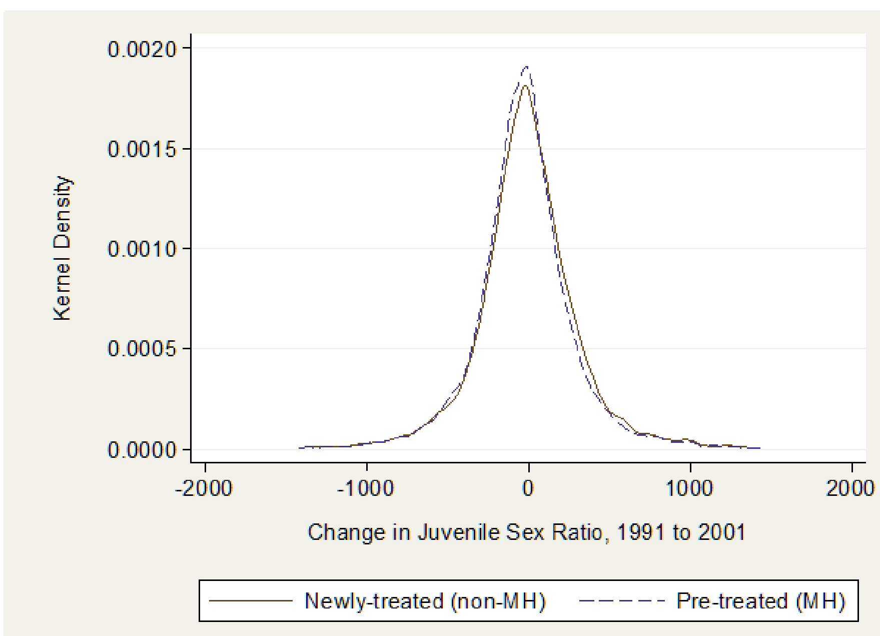


Figure A.2.6: Change in Rural Juvenile Sex Ratio, 1991-2001 [Subsample (iii) - Villages from Maharashtra and neighboring states except from immediate districts on both sides of the MH border]

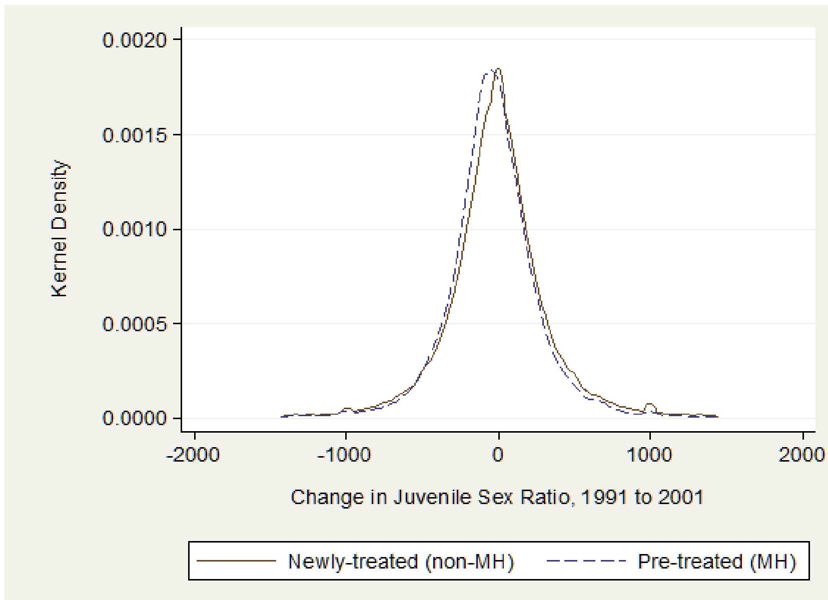


Figure A.2.7: Change in Rural Juvenile Sex Ratio, 1991-2001 [Subsample (iv) - All villages from Maharashtra and neighboring states]

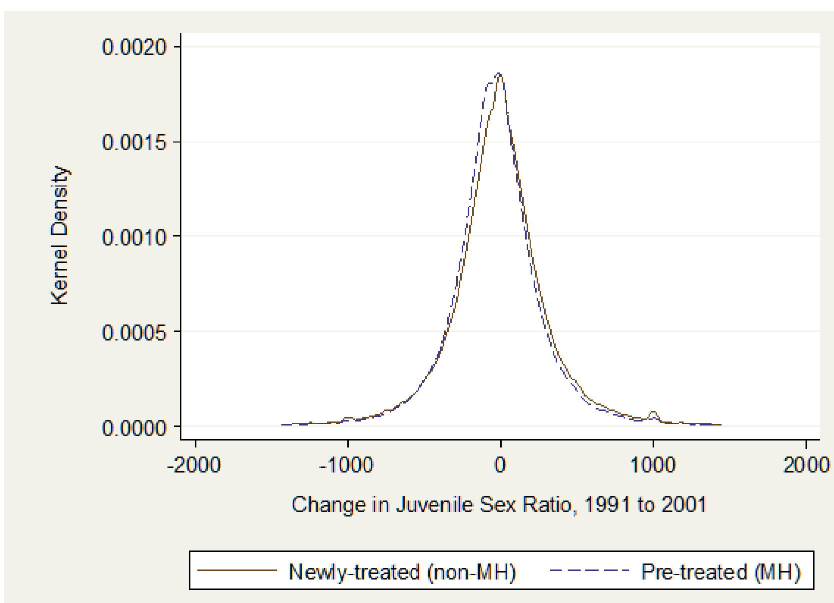


Figure A.2.8: Change in Rural Juvenile Sex Ratio, 1991-2001 [Subsample (v) - All villages from Maharashtra and other major Indian states]

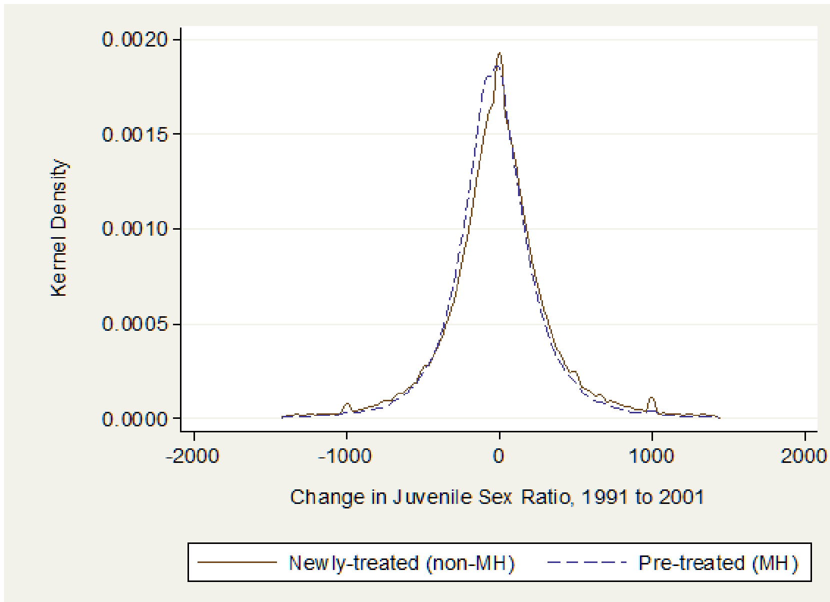


Figure A.2.9: Change in Urban Juvenile Sex Ratio, 1991-2001 [Subsample (i) - Towns from immediate districts on both sides of Maharashtra (MH) border]

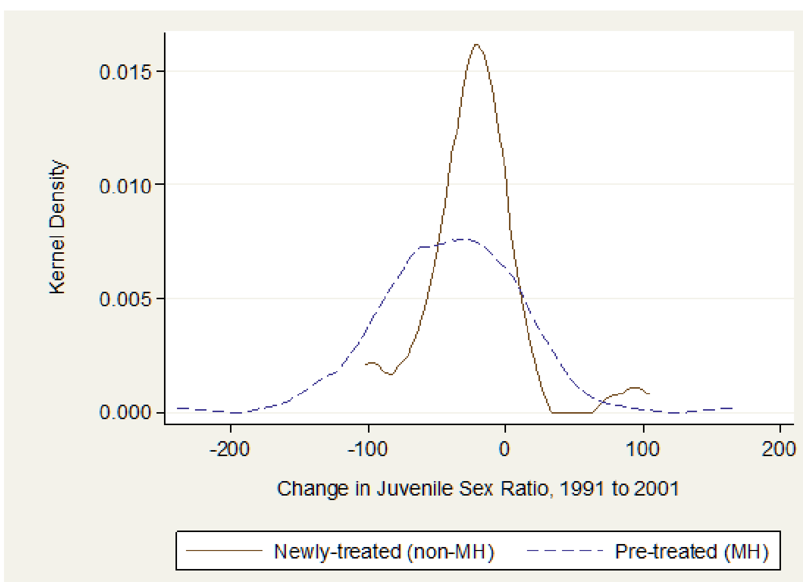


Figure A.2.10: Change in Urban Juvenile Sex Ratio, 1991-2001 [Subsample (ii) - Towns from Maharashtra and neighboring states, except from the immediate districts on both sides of the MH border]

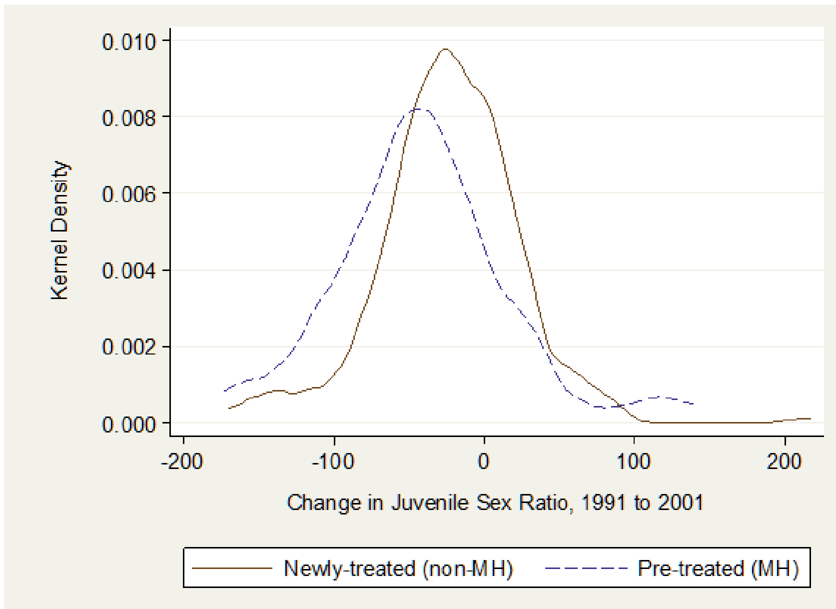


Figure A.2.11: Change in Urban Juvenile Sex Ratio, 1991-2001 [Subsample (iii) - All towns from Maharashtra and neighboring states]

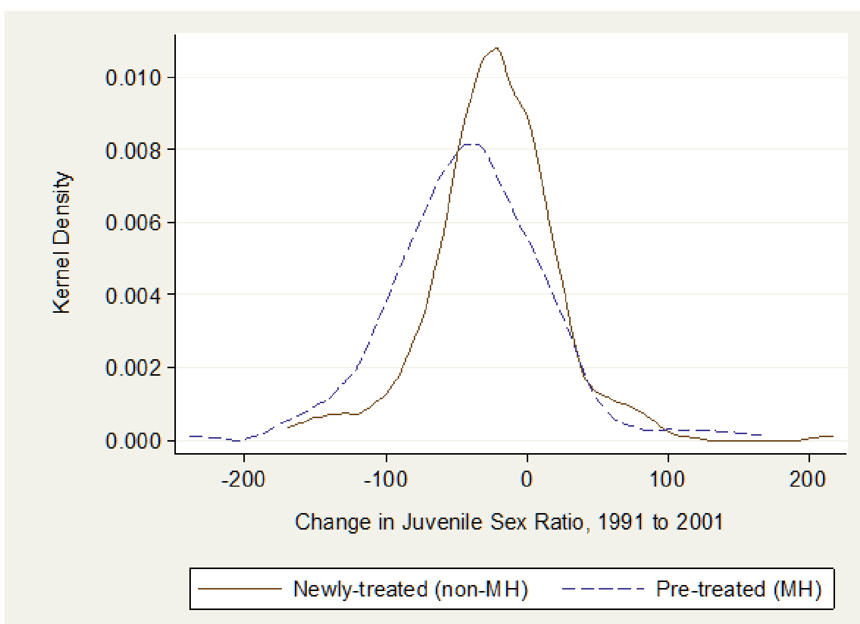
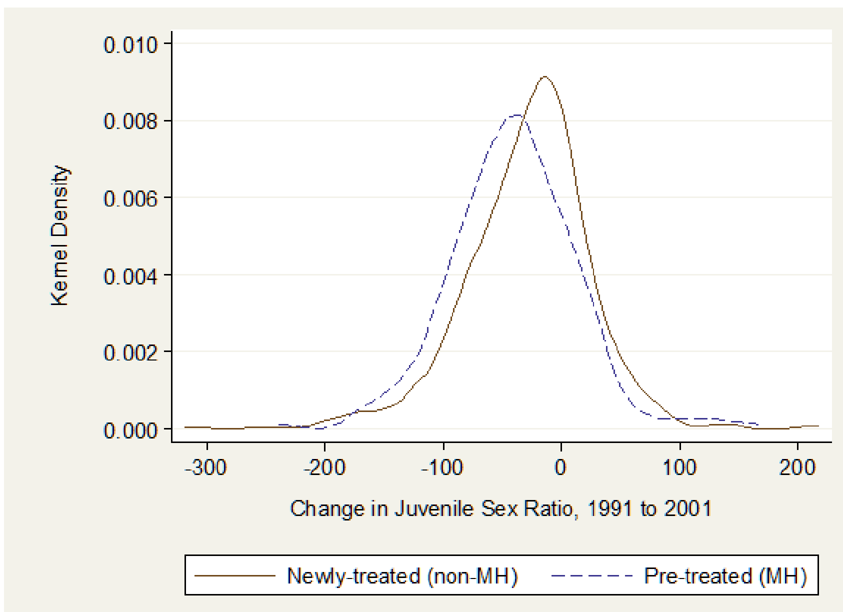


Figure A.2.12: Change in Urban Juvenile Sex Ratio, 1991-2001 [Subsample (iv) - All towns from Maharashtra and the rest of the country]



Source (Figure A.2.4 through Figure A.2.12): Calculated from Census of India, 1991 and 2001 Primary Census Abstract

Table A.2.7: Census Data Village Fixed-effect Regression of Juvenile Sex Ratio

	Village Fixed-effect Regressions		
	Subsample (iii)	**Subsample (iv)**	**Subsample (v)**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	21.05**	16.81**	13.08**
Log village population	44.75**	33.23**	50.79**
Male literacy rate	0.77**	0.79**	0.56**
Female literacy rate	-0.82**	-0.83**	-0.81**
Scheduled Caste (% of population)	-0.09	0.00	0.27**
Scheduled Tribe (% of population)	0.34**	0.29**	0.29**
Acres of cultivable land per cultivator	0.68	0.55	0.14
% of irrigated cultivable land	0.02	0.02	0.03**
Availability in the village of:			
Primary or Middle School	-4.75	-2.43	-4.27**
High School	0.63	-0.20	-0.42
Any public health facility	0.43	1.04	2.52**
Maternal/child welfare center	-3.42	-3.37	-2.21*
Registered medical practitioner	-6.00**	-6.65**	-6.61**
Community health worker	0.63	-1.21	0.06
Tap water	0.87	-0.02	2.29**
Paved approach road	0.04	0.08	1.90**
Electricity	-2.06	1.42	1.84
At least one telephone	0.71	-0.70	-7.85**
Intercept term	-38.95	-32.95**	-30.92**
F Statistic	13.34	17.03	52.3
R^2	0.003	0.002	0.003
Number of Villages	123,107	170,937	519,502

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used in all estimated models. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with ** . Standard errors are clustered at the taluk level.

Table A.2.8: Village Fixed-effect Quantile Regression of Juvenile Sex Ratio [Rural Subsample (i) - Villages from immediate taluks on both sides of Maharashtra (MH) border]

	Village Fixed-effect Regressions				
	0.10 Quantile	**0.25 Quantile**	**0.50 Quantile**	**0.75 Quantile**	**0.90 Quantile**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-31.53**	-3.03	10.10*	32.38**	23.97**
Log village population	2.16	2.20	3.52	10.88	50.51**
Male literacy rate	-0.01	0.73**	1.18**	1.35**	0.66
Female literacy rate	-0.85	-1.23**	-1.08**	-0.52*	-0.33
Scheduled Caste (% of population)	1.06	0.89	0.88*	0.52	2.29**
Scheduled Tribe (% of population)	-0.17	-0.16	0.26	0.65**	1.39**
Acres of cultivable land per cultivator	-4.97**	-3.54**	-1.83*	0.71	1.68
% of irrigated cultivable land	0.27	0.07	-0.10	-0.23	0.28
Availability in the village of:					
Primary or Middle School	-149.38**	-69.33**	20.75*	80.06**	148.84**
High School	60.49**	23.98**	-4.19	-36.25**	-88.32**
Any public health facility	87.54**	40.45**	5.06	-22.85**	-65.83**
Maternal/child welfare center	29.47	18.17**	0.70	-20.13*	-27.71*
Registered medical practitioner	25.60*	4.56	-7.17	-22.76**	-38.69**
Community health worker	21.94**	13.72**	-2.34	-16.19**	-30.96**
Tap water	43.01**	17.06**	-2.86	-18.43**	-39.56**
Paved approach road	-16.56*	-8.48	3.80	5.72	4.48
Electricity	4.79	-0.12	4.85	-8.00	30.36*
At least one telephone	40.34**	15.44**	0.94	-14.98**	-56.96**
Intercept term	-361.98**	-182.50**	-29.33**	117.18**	329.45**
Pseudo R^2	0.0306	0.0092	0.0022	0.0153	0.0377
Number of Villages	15,380	15,380	15,380	15,380	15,380

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with **

Table A.2.9: Village Fixed-effect Quantile Regression of Juvenile Sex Ratio [Rural Subsample (ii) - Villages from neighboring districts from both sides of the Maharashtra border, except the immediate neighboring taluks]

	Village Fixed-effect Regressions				
	0.10 Quantile	**0.25 Quantile**	**0.50 Quantile**	**0.75 Quantile**	**0.90 Quantile**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	10.66	7.30*	15.29**	24.96**	28.53**
Log village population	-24.12	10.82	5.49	-17.52**	-1.34
Male literacy rate	-0.23	0.39*	0.79**	1.52**	1.81**
Female literacy rate	-0.36	-0.60**	-0.89**	-0.98**	-1.20**
Scheduled Caste (% of population)	0.69	-0.03	-0.03	0.00	-0.69
Scheduled Tribe (% of population)	0.85**	0.18	0.17	-0.15	-0.78**
Acres of cultivable land per cultivator	-1.89	-0.10	0.65	2.66**	2.95**
% of irrigated cultivable land	0.58**	0.19**	-0.02	-0.23**	-0.48**
Availability in the village of:					
Primary or Middle School	-166.90**	-59.45**	15.17**	90.46**	172.64**
High School	66.94**	22.84**	5.22	-29.45**	-57.95**
Any public health facility	57.50**	22.81**	-0.20	-17.70**	-61.34**
Maternal/child welfare center	31.87**	23.53**	-2.45	-28.24**	-39.04**
Registered medical practitioner	10.69	-2.93	-6.91	-15.45**	-37.53**
Community health worker	24.25**	10.99**	-9.43**	-15.07**	-32.07**
Tap water	21.32**	11.40**	-1.25	-10.77**	-21.09**
Paved approach road	-7.47	-4.23	3.05	7.37**	8.16
Electricity	-25.37*	-4.64	8.43	29.31**	45.75**
At least one telephone	18.71**	4.56	-6.38*	-14.26**	-25.39**
Intercept term	-362.51**	-185.50**	-26.16**	129.30**	312.96**
Pseudo R^2	0.022	0.0046	0.0018	0.0128	0.0306
Number of Villages	32,450	32,450	32,450	32,450	32,450

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with **

Table A.2.10: Table 7: Village Fixed-effect Quantile Regression of Juvenile Sex Ratio [Rural Subsample (iii) - Villages from Maharashtra and neighboring states except from immediate districts on both sides of the Maharashtra border]

	Village Fixed-effect Regressions				
	0.10 Quantile	**0.25 Quantile**	**0.50 Quantile**	**0.75 Quantile**	**0.90 Quantile**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-0.91	11.95**	26.38**	25.56**	35.64**
Log village population	46.54**	39.49**	25.79**	31.91**	46.19**
Male literacy rate	0.12	0.34**	0.60**	1.30**	1.53**
Female literacy rate	-0.69**	-0.75**	-0.44**	-0.69**	-1.10**
Scheduled Caste (% of population)	0.12	0.28	0.05	0.06	-0.20
Scheduled Tribe (% of population)	0.23	0.27*	0.27**	0.47**	0.37
Acres of cultivable land per cultivator	0.15	0.27	0.65**	0.91**	2.04**
% of irrigated cultivable land	0.32**	0.17**	0.02	-0.10**	-0.23**
Availability in the village of:					
Primary or Middle School	-102.22**	-62.37**	-6.10**	49.15**	86.60**
High School	72.96**	32.78**	0.23	-33.57**	-70.61**
Any public health facility	79.43**	34.29**	-1.34	-33.32**	-80.69**
Maternal/child welfare center	30.98**	11.99**	-1.14	-23.59**	-42.21**
Registered medical practitioner	60.47**	22.34**	-6.92**	-29.95**	-69.16**
Community health worker	13.61**	2.77	2.63	-1.48	-10.77**
Tap water	25.36**	10.78**	-0.17	-8.98**	-17.54**
Paved approach road	2.98	-2.36	-3.48**	-2.09	-5.27
Electricity	-90.17**	-40.71**	-0.43	40.62**	76.01**
At least one telephone	11.69**	2.18	2.25	-1.74	-14.77**
Intercept term	-382.96**	-194.10**	-43.92**	118.51**	311.56**
Pseudo R^2	0.0242	0.0076	0.0014	0.0099	0.0268
Number of Villages	123,107	123,107	123,107	123,107	123,107

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with **

Table A.2.11: Table 7: Village Fixed-effect Quantile Regression of Juvenile Sex Ratio [Rural Subsample (iv) - All villages from Maharashtra and neighboring states]

	Village Fixed-effect Regressions				
	0.10 Quantile	**0.25 Quantile**	**0.50 Quantile**	**0.75 Quantile**	**0.90 Quantile**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-2.72	7.50**	21.00**	26.98**	33.85**
Log village population	29.72**	27.58**	20.19**	20.60**	38.52**
Male literacy rate	0.12	0.45**	0.66**	1.33**	1.54**
Female literacy rate	-0.70**	-0.84**	-0.55**	-0.73**	-1.04**
Scheduled Caste (% of population)	0.11	0.31**	0.07	0.08	-0.07
Scheduled Tribe (% of population)	0.21	0.22*	0.25**	0.32**	0.18
Acres of cultivable land per cultivator	-0.78	-0.17	0.51**	1.24**	2.10**
% of irrigated cultivable land	0.35**	0.18**	0.02	-0.13**	-0.26**
Availability in the village of:					
Primary or Middle School	-110.89**	-61.83**	-1.79	55.74**	99.49**
High School	71.50**	30.04**	0.18	-32.81**	-67.51**
Any public health facility	78.09**	32.46**	-0.94	-29.64**	-78.79**
Maternal/child welfare center	29.36**	15.17**	-1.51	-25.05**	-43.00**
Registered medical practitioner	48.09**	15.78**	-7.42**	-26.21**	-59.68**
Community health worker	16.63**	5.66**	-0.41	-6.55**	-17.58**
Tap water	25.86**	11.11**	-1.15	-11.10**	-22.01**
Paved approach road	-0.52	-3.29*	-1.75	0.72	-1.27
Electricity	-76.82**	-32.31**	0.62	35.90**	67.21**
At least one telephone	15.96**	3.36*	0.58	-5.51**	-19.00**
Intercept term	-377.75**	-187.88**	-36.95**	120.22**	313.55**
Pseudo R^2	0.0232	0.0067	0.0014	0.0105	0.0274
Number of Villages	170,937	170,937	170,937	170,937	170,937

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with **

Table A.2.12: Table 7: Village Fixed-effect Quantile Regression of Juvenile Sex Ratio [Rural Subsample (v) - All villages from Maharashtra and other major Indian states]

	Village Fixed-effect Regressions				
	0.10 Quantile	**0.25 Quantile**	**0.50 Quantile**	**0.75 Quantile**	**0.90 Quantile**
First Difference Regression of Juvenile Sex Ratio	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-29.47**	1.54	19.53**	27.32**	50.13**
Log village population	64.95**	56.73**	36.95**	40.86**	50.36**
Male literacy rate	0.40**	0.40**	0.48**	0.88**	0.81**
Female literacy rate	-0.52**	-0.72**	-0.60**	-0.84**	-1.20**
Scheduled Caste (% of population)	0.46**	0.33**	0.24**	0.27**	0.02
Scheduled Tribe (% of population)	0.60**	0.30**	0.19**	0.16**	0.25
Acres of cultivable land per cultivator	-3.58**	-1.65**	0.07	1.83**	3.92**
% of irrigated cultivable land	0.76**	0.33**	0.02**	-0.24**	-0.69**
Availability in the village of:					
Primary or Middle School	-54.22**	-29.50**	-2.66**	24.99**	42.96**
High School	63.14**	21.75**	-1.14	-24.20**	-58.78**
Any public health facility	52.31**	18.66**	0.35	-14.51**	-46.13**
Maternal/child welfare center	43.50**	17.31**	-1.27	-19.93**	-49.12**
Registered medical practitioner	19.81**	2.52*	-6.49**	-15.35**	-35.71**
Community health worker	18.29**	8.54**	-0.61	-7.94**	-14.11**
Tap water	35.37**	13.89**	0.95	-10.66**	-27.50**
Paved approach road	9.76**	4.17**	1.62**	-0.46	-7.19**
Electricity	-29.83**	-13.60**	1.70	15.47**	32.68**
At least one telephone	46.80**	12.68**	-5.99**	-26.08**	-65.62**
Intercept term	-406.15**	-198.65**	-34.96**	132.45**	343.82**
Pseudo R^2	0.0144	0.0045	0.0013	0.0059	0.017
Number of Villages	519,502	519,502	519,502	519,502	519,502

Note: Data are from village-level Indian Censuses 1991 and 2001. Huber-White robust standard errors have been used. Coefficients which are statistically significant at 10% level have been marked with * and those which are significant at 5% or below have been marked with **

Table A.2.13: Descriptive Statistics of Census Rural Subsamples: Average Change from 1991 to 2001

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

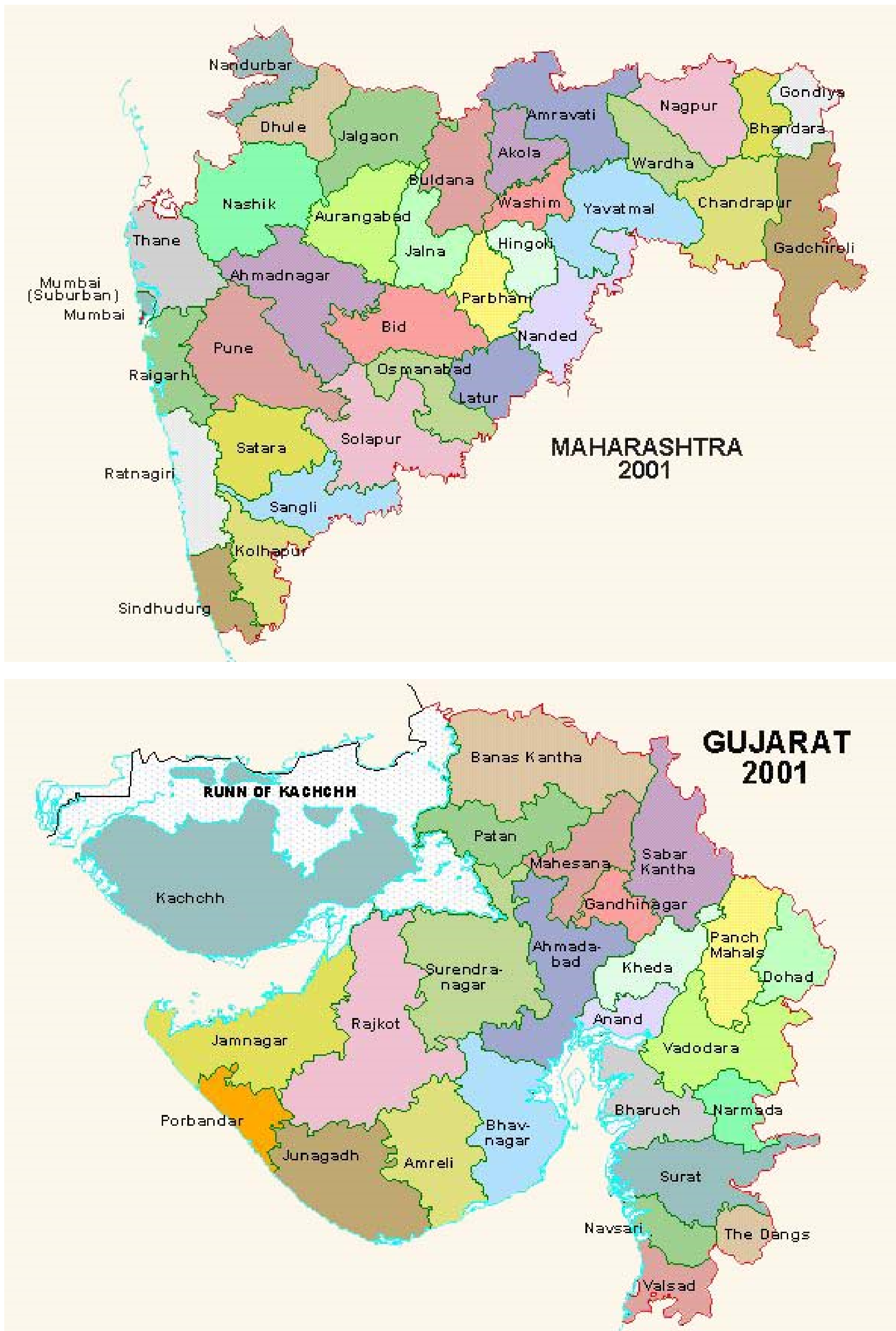
Source: Data are from village-level Indian Censuses 1991 and 2001. Maharashtra and non-Maharashtra villages are denoted by 'MH' and 'non-MH', respectively. Subsamples are – (i) Villages from taluks along the administrative border of Maharashtra and its neighboring states, (ii) Villages from MH and neighboring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

Table A.2.14: Descriptive Statistics of Census Urban Subsamples: Average Change from 1991 to 2001

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

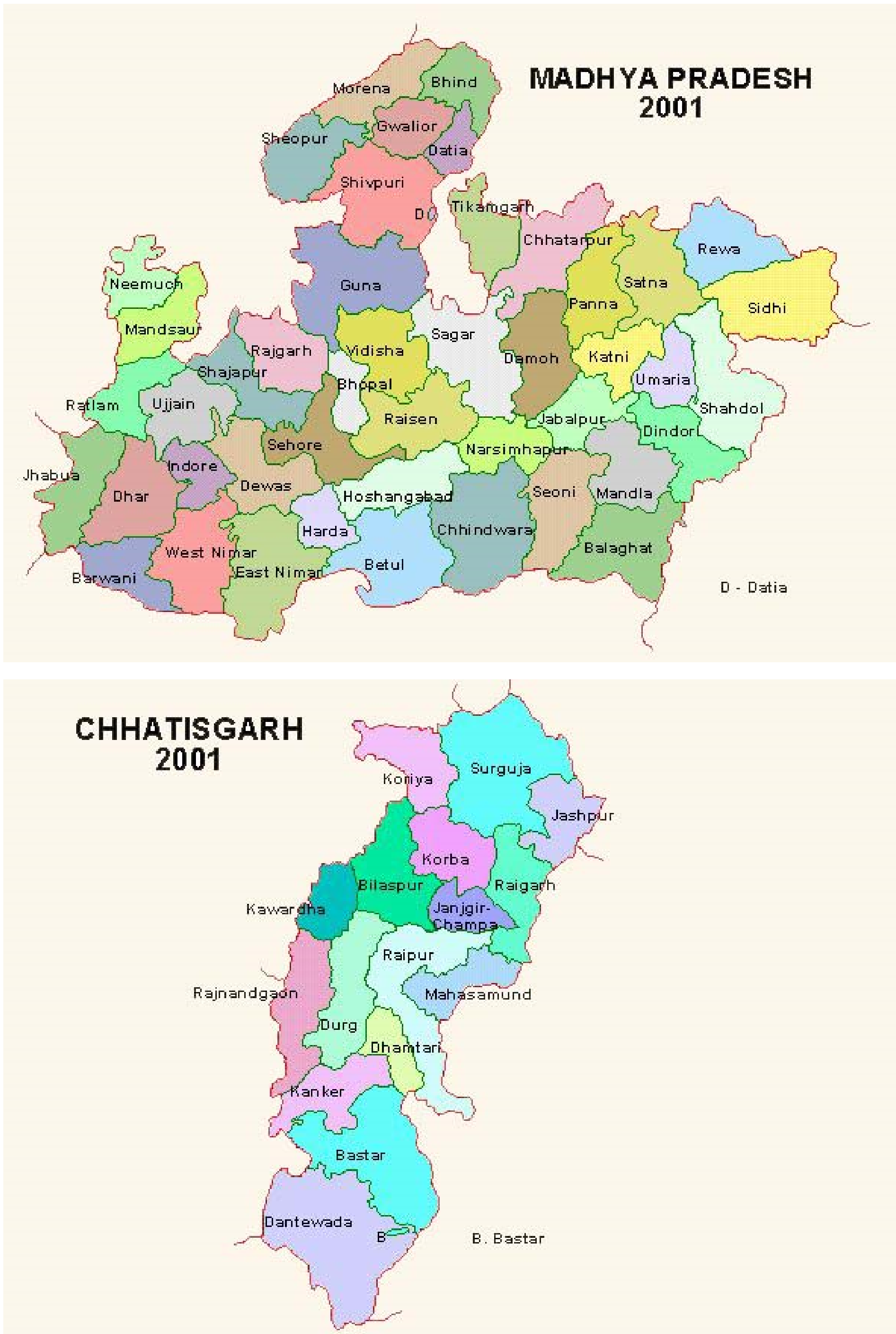
Source: Data are from town-level Indian Censuses 1991 and 2001. Maharashtra and non-Maharashtra towns are denoted by 'MH' and 'non-MH', respectively. Subsamples are – (i) Towns from districts along the administrative border of Maharashtra and its neighboring states, (ii) All towns from MH and neighboring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

Figure A.2.13: District Maps of Maharashtra and Gujarat



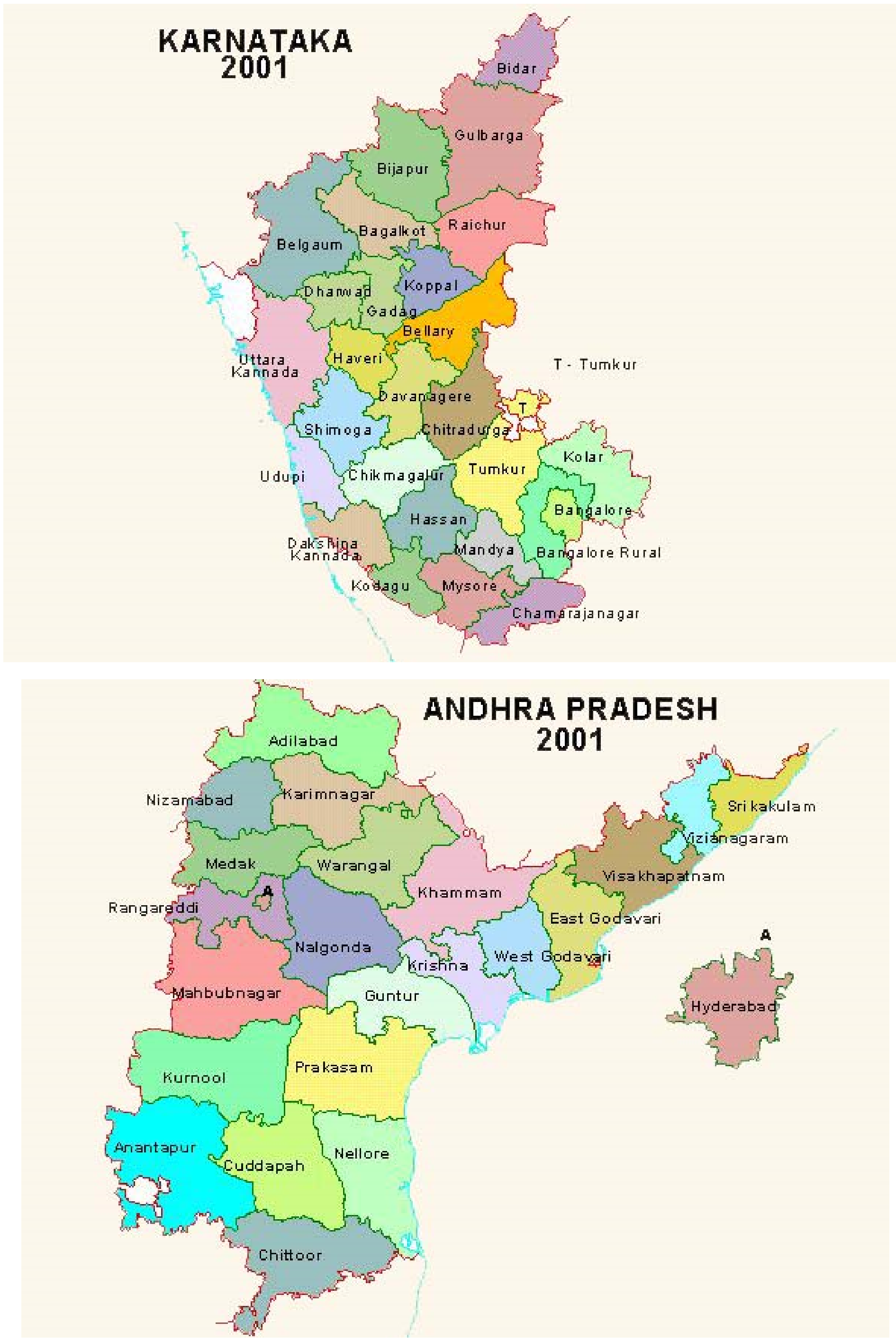
Source: Census of India. On the web at
http://censusindia.gov.in/maps/State_Maps/maps.htm

Figure A.2.14: District Maps of Madhya Pradesh and Chhattisgarh



Source: Census of India. On the web at
http://censusindia.gov.in/maps/State_Maps/maps.htm

Figure A.2.15: District Maps of Karnataka and Andhra Pradesh



Source: Census of India. On the web at
http://censusindia.gov.in/maps/State_Maps/maps.htm

Chapter 3

The Unintended Consequence of a Ban on Sex-Selective Abortion: Does the Indian PNDT Act Increase the Neglect of the Female Child?

3.1 Introduction

Sex imbalance remains a persistent problem for many rapidly developing societies including India and other East Asian countries. As Sen (2003) points out, there are 100 million *missing girls* worldwide, of which 37 million are from India. As the recent Indian censuses reveal, in 2001 there were just 933 women for every 1000 men in the overall population, down from 941 in 1961. In comparison, the number of women for every 1000 men has increased from approximately 1010 to 1022 during 1970-

2000 in the US[1]. As Qian (2008) mentions, the share of women in the population of western Europe is currently 50.1%, while it is only 48.4% in countries such as India, China and Albania.. In 1971, the Indian census started collecting information on the sex composition of children below the age of 6 years. Since then, there has been a significant drop in the number of young girls (964 in 1971 to 927 in 2001) for every 1000 boys. This implies that the gender imbalance in overall population is only going to worsen in the foreseeable future.

Social science researchers and demographers have comprehensively studied four major dimesions of the sex imbalance problem. A detailed discussion of these studies follows in section 3.2. To motivate the discussion and to enunciate the contribution of the current study, a broad overview is provided here. First, a sizable literature is devoted to exploring the socioeconomic and cultural roots of the gender imbalance. These studies recognize that the masculinization of the population composition is the direct consequence of a strong preference for sons over daughters in these societies. Researchers have attempted to explain the degree of son-preference with various socioeconomic factors including education, the income and relative social status (e.g. caste) of a household and the status of the adult women in the family, to name a few[2].

A second group of studies examines the various ways through which a household manifests its preference for sons. Across different societies, researchers have found that households practice prenatal and postnatal sex-selection in favor of boys. For example, girls are often prevented from being born through a selective use of contraceptives by

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[1] WDI Indicators 2002

[2] Some studies, as we will discuss in section 3.2, have argued that biological factors, rather than socioeconomic ones, may be responsible for the sex imbalance.

the parents, or sometimes the female fetuses are selectively aborted. Otherwise, after birth, the nutrition and healthcare of girls are neglected, resulting in a higher female child mortality rate.

Although the acute sex imbalance is a relatively recent phenomenon in developing countries, a third group of studies analyze its possible long term effects including a marriage market squeeze, change in women's status and increased crime rates. Similar studies conducted in developed countries, using past data, can also be included in this group.

Faced with growing concern over the high population growth and sex imbalance during the recent decades, the governments in many Asian economies have actively engaged in demographic policymaking. The intended and unintended consequences of these policies, such as the prominent "One Child Policy" in China, have been evaluated by a fourth group of studies.

This chapter contributes to this final direction in the literature. Although the causes and the manifestation of the sex imbalance problem have been extensively studied, very few researchers have analyzed the public policy dimension. Advocates of proactive public policy argue that strict bans on the selective abortion of girls could improve a country's sex ratio. For example, successful interest group campaigns in India brought about the implementation of the 1994 PNDT Act. Similar bans were instituted in China (1986) and South Korea (1990). There is a consensus that the Indian PNDT Act was generally ineffective in preventing female feticides. However, existing studies are mostly based on descriptive analysis and lack a the use of rigorous pre- and post-ban treatment-effect framework. The previous chapter uses a natural experiment framework to find that the PNDT Act was marginally successful in improving the juvenile sex ratio in India.

Some studies look into the so called 'unintended consequences' of demographic policies. For example, a ban on female feticide, such as the PNDT Act in India, will likely lead to more female child births. However, if the girls are still unwanted, the household may invest less in their nutrition, healthcare and education. This, in turn, will reduce the survival rates of the young girls and result in worse educational and labor market outcomes for the surviving ones in future. However, as I will discuss in section 3.3, a counteracting force may partially improve the well-being of girls in larger families (through economies of scale) at the same time.

This chapter attempts to evaluate some of the 'unintended consequences' of the Indian PNDT Act. Using a natural experiment which exploits the different placement times across states, I examine the effect of the law on investments in child quality by the households. Households in Maharashtra are considered in my pre-treated group - those who were under the PNDT Act in both time periods of my study. Newly treated households from the rest of country were not under the purview of the law during the first period but were under the 1996 implementation of the act. My outcome variables of interest are the indicators of child nutrition (total duration of breastfeeding and WHO Z-scores for anthropometric measures) and immunization (vaccination for polio, BCG, DPT and measles). In specific, my objective is to examine if the PNDT Act creates (or worsens any existing) gender-gap against the girls in one or more child outcomes.

I use data from two consecutive National Family Health Surveys of India, 1992-93 (NFHS-1) and 1998-99 (NFHS-2). The NFHS surveys cover a cross-sectional sample of approximately 90,000 households during each round. To incorporate the community level infrastructural factors in the analysis, this chapter mainly focuses on the rural NFHS sample (more than 65% of the total sample). However, results from the urban sample are also presented.

The state of Maharashtra passed the PNDT Act in 1988 while the rest of the country implemented the same in 1996. From NFHS-1, children who are less that 3 years old (i.e. born between 1989-90 and 1992-93) are included in the analysis. From NFHS-2, children who are less than two years old (i.e. born netween 1996-97 and 1998-89) are selected. Therefore all children in NFHS-2 were born under the national PNDT law while only the children from Maharashtra were under the purview of the law in NFHS-1. To mitigate the unobserved heterogeneity among the pre-treated and newly-treated groups, my analysis starts with households only from Maharashtra and its neighboring states, and then expands to a comparison between Maharashtra and the rest of the country.

I use a pooled child level cross sectional dataset from the two NFHS rounds. District fixed-effect or state fixed-effect models are estimated for the various subsamples of the data as mentioned above. The rural sample results from Maharashtra and neighboring states show that the PNDT Act does not have any significant gender-relative impact on most child outcomes. Similar ineffectiveness of the law is also seen in the expanded sample of Maharashtra and the rest of the country, as well as the urban subsample. Depending upon the choice of sample and child outcome, however, the PNDT Act seems to have a significant positive or negative effect on the gender gap in a few cases.

Therefore, one can argue that the PNDT Act may have been a truly welfare enhancing public policy tool. The analysis in chapter 2 shows that the PNDT Act had a marginal positive effect on the female-to-male sex ratio in India. One may expect that a reduction in prenatal sex selection (female feticide) may induce the households with a strong son-preference to practice more postnatal sex selection. However, my results suggest that the PNDT Act does not significantly change the household's discrimination behavior, i.e. girls are generally not treated any different than previously.

These results could be explained by one or more factors related to the strength of a household's preference for boys. First, households with a stronger son-preference may respond to the PNDT through worsened neglect of girls. However, at the same time if the law increases the family size, larger families may experience a lower upbringing cost per child (economies of scale). This could relatively benefit the girls. Secondly, households with a weaker son-preference may respond weakly to the PNDT Act by not changing their discrimination behavior. An economies-of-scale effect in those households may result in a net positive benefit for girls. Finally, the PNDT Act may additionally serve as an awareness tool for some households. This is particularly relevant in the context of the large nationwide campaigns that immediately preceded the passage of the law. Households formerly practicing postnatal discrimination and not sex-selective abortions might reduce the neglect of girls even if they are not directly affected by the PNDT Act. What I observe from the framework presented in this chapter is the net gender-relative effect of the law. Unfortunately, individual identification of the counteracting effects discussed above is beyond the scope of this study.

This chapter is organized in the following way. Section 3.2 reviews the relevant literature. It provides a discussion on the four broad groups of sex imbalance related studies mentioned earlier, with a focus on the public policy dimension of the prevention of sex selection. A simple conceptual framework - which analyzes a household's response to the PNDT Act - is presented in section 3.3. Discussion on the data and the empirical methodology are presented respectively in sections 3.4 and 3.5. Section 3.6 presents the results and section 3.7 concludes.

3.2 Literature Review

This section discusses the four broad groups of sex-selection related studies briefly introduced in the previous section. The discussion largely focuses on India, with the appropriate mention of relevant international literature.

In the context of India, researchers have linked several socioeconomic and cultural factors with the preference for sons over daughters and the gender difference in child outcomes. Among the important factors are the indicators of the socioeconomic status of adult women in the household, as studied by Miller (1981, 1982), Rosenzweig and Schultz (1982), Gupta (1987), Kishor (1993), Murthi et al. (1995), Foster and Rosenzweig (1999), Clark (2000). Similar studies have been conducted in the context of other countries by Thomas et al. (1991), Thomas (1994), Das Gupta et al. (2003), Burgess and Zhuang (2000), Qian (2008). The Indian studies generally find a North-South dichotomy in the female work force participation and the status of women. The southern states of India are characterized by a greater autonomy of women, a higher female labor force participation and relatively higher female-to-male sex ratios. On contrary, the northern states have more rigid social norms and a lower sex ratio (Dyson and Moore 1983). Some researchers have attempted to explain the dichotomy with regional differences in agricultural cultivation patterns but the evidence is inconclusive.

The education level of adult women is another factor that may affect the sex preference of children. Sharma and Retherford (1990), Murthi et al. (1995), Drèze and Murthi (2001), Parikh and Gupta (2001) find a negative association between women's education and fertility rates. Again, Das Gupta and Bhat (1997), Park and Cho (1995) argue that a decline in fertility rates is responsible for a strengthening of the son-preference among households - with fewer child births, parents generally want more boys.

With a rise in household income, the demand for fertility increases. With higher fertility, one may expect the relative demand for girls to rise. However, empirical evidence on the effect of household income on child sex preference is mixed, both in India and worldwide (Rosenzweig and Schultz 1982, Gu and Roy 1995, Kanbur and Haddad 1994, Edlund 1999). With respect to social and cultural norms, Miller (1981), Basu (1990), and Agnihotri et al. (2002) find that the socially backward groups (*Scheduled Caste* and *Scheduled Tribe*) in India often treat women in a relatively egalitarian way compared to the upper caste Hindu households. While Miller (1981), Bhat and Zavier (2003) note that the upper caste Hindus practice gender discrimination more compared to Muslims and Christians, Wertz and Fletcher (1993) do not find any association between religion and sex selection. Finally, other socioeconomic factors such as the dowry system, the perception of sons as 'old age support' in the context of a joint family structure, exogamy (i.e. women living in the in-law household after marriage) have been linked with the son-preference in India (Dyson and Moore 1983, Kishor 1993, Rao 1993, Das Gupta et al. 2003, Caldwell and Caldwell 2005).

The preference for sons over daughters is manifested through the household's prenatal and postnatal sex selection practices. As mentioned in the previous chapter, households may selectively use contraceptives to reach a chosen gender mix of children - couples may decide to prevent any further births after the desired number of boys are born (McClelland 1979, Mutharayappa et al. 1997, Arnold et al. 2002). Since the advent of fetal sex determination techniques during the 1980s, this preconception sex selection technique has been complemented with female feticides. As Sudha and Rajan (1999), George and Dahiya (1998), George (2002), Ganatra et al. (2001), Arnold et al. (2002), Jha et al. (2006a) discuss in the context of India, Zeng Yi et al. (1993), Chu (2001) in the context of China, and Guilmoto et al. (2009) in the context of Vietnam, sex-selective abortions became rapidly prevalent due to the wide availability of the sex determination tests. For example, as Luthra (1994) mentions, the city of Bombay in Maharashtra had approximately 200 sex determination clinics in 1988 and almost half of all abortions performed in the state were female feticides. Finally, the most recent technological advancement in the form of in-vitro fertilization may allow couples to pre-select the gender of the child without the need for an abortion (Bhaskar and Gupta 2007). However, so far there has been no evidence of widespread use of this technique in India.

Households which do not use prenatal sex-selection techniques may neglect the girl children after they are born. The discretionary allocation of nutrition and healthcare resources against the girls reduces their probability of survival. Even if the daughters survive, the gender gap in the health and education investment results in poor educational attainment and labor market outcomes for the girls in the long run. This has been observed in India and other Asian countries by Chen et al. (1981), Caldwell et al. (1982), Koenig and D'Souza (1986), Das Gupta (1987), Muhuri and Preston (1991), Pebley and Amin (1991), Arnold et al. (1998), Pande (2003), and Mishra et al. (2004). Oster (2009) argues that the excess female child mortality responsible for sex imbalance among the children of less than 5 years of age can also explain the gender imbalance in the entire Indian population.

One should also mention that a few studies (Drew et al. 1986, Norberg 2004, Oster 2005and Lin and Luoh 2008) attempt to examine the impact of non-economic factors such as single parenthood, and the incidence of Hepatitis B on population sex ratios.

The third direction in the literature, a relatively young area of research, focuses on the long term impacts of the population sex imbalance. Messner and Sampson (1991) were among the first studies to associate masculine sex ratios with violent crime rates in US. Angrist (2002) evaluates the marriage market outcomes of immigrant populations in US. Francis (2009) examines the impact of marriage market sex ratios on bride prices and child outcomes in Taiwan. Edlund et al. (2007) link male-biased sex ratios with a rise in violent crimes in China.

Finally, with India and other East Asian countries implementing new demographic policies during the recent decades, a growing body of research has been focused on the evaluation of these policies. For example, several studies including Hesketh and Zhu (1997), Das Gupta (2005), Hesketh et al. (2005), Qian (2009), Zhu et al. (2009), Ebenstein (2010) find that the 'unintended consequence' of the Chinese "One Child Policy" was a strengthening of the preference for sons and therefore, a male-biased sex ratio. Park and Cho (1995) mention that strict regulations to prevent doctors from performing sex-selective abortions - imposed in South Korea in 1990 - may have improved the sex ratio at birth in favor of girls. Subramanian and Selvaraj (2009) argue that the Indian PNDT Act did not have any impact on the odds-ratio of a boy birth. Lin et al. (2008) examine the impact of the legalization of abortion in Taiwan. They find that after abortion was legalized in 1985-86, there was a significant rise in the share of male births. However, the neglect of living young girls also declined substantially, as exhibited by a 25% reduction in excess female child mortality.

3.3 Conceptual Framework

This section presents a discussion on the household's behavior related to the discrimination against girls, and its response to public policy. To the independent observer, the selective neglect of girls is similar to an 'externality' problem, one which originates from a conflict of interest between the individual household and the society. An individual household gains higher utility from the birth of a boy compared to a girl. In the Indian context, researchers have attempted to explain this strong preference for sons through various socioeconomic factors. After briefly mentioning some of these factors below, I will come back to the present discussion on the externality problem.

The Indian society, especially its traditional rural counterpart, has always been characterized by the absence of an effective social safety net. A joint family structure - in which different generations of adult household members share the same pool of resources, including the physical household infrastructure - is also prevalent. Under these socioeconomic conditions, a household specific safety net is created by the intergenerational transfer of resources – one where the parents invest in their children during the current period and receive returns in the form of old-age support from them, both financially and otherwise, in future. Sons are considered to be potentially better earners partly due to the societal norms governing the lives of men and women. As Hatti and Sekhar (2004) point out, male and female children are indeed brought up differently in the household. For example, the difference in the perceived 'worth' of boys versus girls may induce households to provide schooling resources only to the boys.

The upbringing of a daughter poses yet another financial hardship for the family in the form of dowry payments. This is particularly relevant in the case of hypergamous marriages, where a girl's family seeks to establish ties with another socially or financially, or both, superior counterpart. The resulting marriage market squeeze often raises the dowry payments (Das Gupta 1987, Drèze and Sen 1995). In a predominantly Hindu society, marriages are influenced by the economic and cultural factors that determine the societal status of a family. Marriages are generally considered to be a bond between families; and they are typically patrilocal, i.e. women live with their husband's family after marriage. In rural areas, village exogamy is common, thus severing all but social ties between women and their natal families after marriage. This provides little incentive for the parents to invest in their daughters beyond a certain threshold of perceived marriage-market characteristics.

The son-preference of a household is manifested through prenatal and postnatal discrimination of girls, both of which result in a low female-to-male sex ratio among the children in the household, and in the overall population. This presents a conflict of the interest with the society (or the planner) who prefers a more balanced sex ratio. One potential solution to this 'externality' problem is a ban on selective abortion, such as the Indian PNDT Act. As discussed in chapter 2, even if the ban is not fully implemented and the sex-selective abortions are not completely eliminated, a rise in the transaction cost associated with such abortions will reduce the household's demand for boys and move it closer to the social demand.

However, the situation is more complex than it seems. A successful PNDT Act will only reduce the prenatal discrimination of girls by preventing female feticides. Contemporary research in India and other countries does not provide a clear evidence on the possible 'unintended consequences', i.e. the impact of such female feticide bans on the postnatal neglect of girls. Without any change in the preference for sons, if households are prevented from aborting female fetuses, the prenatal sex selection may simply be substituted by postnatal discrimination, and in the extreme case, female infanticide. Furthermore, the ban on female feticides will not affect prenatal sex selection practices other than abortions, such as the selective use of contraceptives. Couples may continue the practice of having children until a desired number of boys are born. As Arnold et al. (2002) point out, girls in India tend to grow up in larger families as a consequence of this "stopping rule" mechanism.

A related factor that contributes to the worsening of the neglect of living girls can be explained by borrowing from a large literature on the 'quantity-quality tradeoff' of children. Several studies have examined the relationship between household size and the quality of children. Following Becker and Lewis (1973), Becker and Tomes (1976), some economists argue that family size may have a negative impact on child quality investments - with fixed resources, an increase in the number of children reduces the per capita availability of resources[3]. A successful ban on sex-selective abortions may increase the sibship size, which in turn will reduce the per capita resource for every child. If there is no change in the household's preference for boys, the resources allocated to girls may further reduce through a redistribution in favor of the boys. However, the international evidence on the quantity-quality tradeoff is mixed. For example, Rosenzweig and Wolpin (1980), Stafford (1987), Behrman and Taubman (1986), Hanushek (1992), Li et al. (2007), Rosenzweig and Zhang (2009) find a negative association between the household size and child quality. Angrist et al. (2005, 2006) do not find any evidence of the quantity-quality tradeoff in Israel, and Lee (2007) finds the tradeoff to be weak in South Korea. Guo and VanWey (1999) show that the negative association between family size and the intellectual development of children in China disappears when factors that are shared across siblings are incorporated. Qian (2009) finds a positive impact of the relaxation of the Chinese "One Child Policy" and increase in sibship size on child schooling.

A positive association between family size and child outcomes could be explained by an 'economies of scale' effect within the household. The marginal cost of raising children reduces with more children. For example, children may share certain resources including clothes, textbooks and toys. Also, younger children may receive financial support from their older siblings (Gomes 1984). Therefore, among households with a weaker preference for sons over daughters, an increase in family size may

[3]However, the tradeoff between quantity and quality may be determined by unobserved parental preference, rather than household size. Parents may like to have fewer children and invest more on each child.

relatively benefit the daughters.

It is worth mentioning that family size may not have a linear effect on child outcomes. The birth order of a child may be an important determinant of quality. Indeed, Das Gupta (1987) finds that first-born girls in India have a much lower mortality rate compared to girls with older sisters. Pande (2003), in the context of India, shows that the presence of multiple elder siblings of same sex worsens the outcomes of children of both gender. Similar negative outcomes for higher-order-born girls have been reported by Mishra et al. (2004), Chamarbagwala (2010) for India, and by Muhuri and Preston (1991) for Bangladesh. For Norway, Black et al. (2005) show that the quantity-quality tradeoff disappears when controls for child birth order are included.

Thus, the net impact of the PNDT Act on child quality may be positive, negative or neutral depending upon the strength of the these factors described above. Unfortunately, due to the lack of appropriate data, it is beyond the scope of this chapter to individually identify any of the sub-effects.

3.4 Data and Descriptive Statistics

I use individual child data from two consecutive rounds of the Indian National Family and Health Surveys, 1992-93 (NFHS-1) and 1998-99 (NFHS-2). The NFHS survey covers approximately 90,000 households; separate nationally representative cross sectional samples were surveyed during each round and over 65% of the households were from rural areas. The survey gathered detailed information on general and reproductive health of the 15-49 year old ever married women in the household. In addition, a wide range of data on household and individual characteristics such as demographics, assets, education, employment and health was collected. For the NFHS rural sample, a supplementary module collected information on the village level availability of infrastructure and amenities such as healthcare and educational facilities, roads, power, telephone etc.

A special children questionnaire asked child health related questions to the mothers of young children. It also gathered anthropometric data (e.g. weight and height) on those children. All children born during the last 4 years preceding NFHS-1 (i.e. less than 48 months old at the time of the survey) and those born during the last 3 years preceding NFHS-2 were covered by the questionnaire. Since the PNDT Act was passed in Maharashtra in 1988 and in the rest of the country in 1996, my analysis only includes children who were less than 3 years old in NFHS-1 and those who were less than 2 years old in NFHS-2. A pooled child level dataset was created which includes information on the child, mother, household characteristics and community characteristics. To incorporate the additional information on village infrastructure availability, the primary focus of this study is on the rural NFHS sample. However, results from the urban sample are also reported.

Households from Maharashtra are considered as the pre-treated group. Children from these households were born under the purview of the PNDT Act during both rounds of the NFHS. Children from the the four neighboring states of Maharashtra - Gujarat, Madhya Pradesh, Karnataka and Andhra Pradesh are considered in the newly-treated group[4]. The newly-treated states experienced a change in public policy when the PNDT Act was implemented in 1996. My rural sample contains approximately 5,000 and 3,000 newly-treated children from NFHS-1 and NFHS-2 respectively. The pre-treated group contains approximately 900 and 490 children respectively from the two surveys. There is a considerable regional variation in economic indicators

[4]The state of Madhya Pradesh was bifurcated into Madhya Pradesh and Chhattisgarh in 2000. Observations from the entire undivided state are used in NFHS-1 and NFHS-2

and socio-cultural factors across India. Some of these factors are directly captured in my analysis but the unobserved factors may still affect a household's son preference. The choice of Maharashtra and its neighboring states as the primary area of analysis assumes that the geographic proximity of these two groups would result in similar unobserved factors and their time paths. A second extended sample contains children from Maharashtra in the pre-treated group and children from the rest of the country in the newly treated group.

Two types of child investment variables are examined - four indicators of child nutrition and four indicators of immunization. The indicators of child nutrition are standardized z-score measures of the weight-for-age, height-for-age and weight-for-height. A fourth variable is the duration of breastfeeding (in months) of the child. The standardized z-scores are calculated on the basis of a reference international population from the World Health Organization[5]. The weight measures are an indicator of a child's short term nutrition while height-for-age is a measure of the longer term nutritional status. Information on breastfeeding was collected from each mother by the surveys. For each child, the total duration of breastfeeding (in months) is reported. The children from NFHS-2 in my regression sample have a maximum reported breastfeeding time of 23 months. For the sake of comparability betwen the two survey rounds, the values for children from NFHS-1 are top-coded at 23 months (i.e. breastfeeding values higher than 23 are replaced with 23).

The indicators of immunization are based on three polio vaccines, one vaccine each for diphtheria, pertussis (whooping cough) and tetanus (known together as DPT), one tuberculosis vaccine (BCG) and a measles vaccine. I use four binary variables created

[5] As the NFHS-2 report (2000) mentions, the WHO reference population is appropriate for use in the context of India.

from the above - one each for polio (if all 3 were administered), DPT (if all 3 were administered), BCG and measles. The information on vaccines is collected from the mother of each child (either verbally reported to the interviewer or shown marked on a vaccination card).

Tables A.3.3 through A.3.10 in appendix present the raw difference-in-difference estimators of changes in child outcomes - separately for boys and girls - associated with the implementation of the PNDT Act. A quadruple-difference estimator measures the change in gender gap (between boys and girls) in child outcomes. Estimates are reported only for my focus sample, i.e. rural children from Maharashtra and neighboring states. Among the child immunization indicators, I find that the gender gap narrows for all vaccines, except for DPT which exhibits a widening of the gap. For the nutritional outcomes, the gender gap increases for the weight-for-age and height-for-age measures, and reduces for the weight-for-height and duration of breastfeeding measures. The distributions of the child nutritional outcomes are presented in appendix figures A.3.1 through A.3.8. The graphs show that the distribution of the outcome among the newly-treated children generally rests toward the right of the distribution for the pre-treated group, both for NFHS-1 and NFHS-2.

3.5 Empirical Framework: Region Fixed-effect Regression

The basic empirical model is a region fixed-effect (state or district) model that is estimated using the child level dataset pooled from the two NFHS rounds. For the immunization-related outcome variables, binary choice models are used, while OLS is used for the nutritional outcome indicators. The probit regression framework is presented below:

$$Y^*_{ikt} = \alpha + \tau Law_{kt} + \beta F_{ikt} + \gamma Law_{kt} \times F_{ikt} + \delta X_{ikt} + \theta I_{ikt} + \sum_k \eta_k D_k + \epsilon_{ikt} \quad (3.1)$$

where i represents the $i-th$ child, k denotes the $k-th$ state; $t = 0, 1$ for NFHS-1 and NFHS-2, respectively. Y^* is unobserved, and we only observe the state of immunization of a child, denoted by Y :

$$Y_{ikt} = \begin{cases} 1 & if \quad Y^*_{ikt} > 0 \\ 0 & otherwise \end{cases}$$

In the present context, Y_{ikt} is the binary immunization outcome for the the $i-th$ child in the $k-th$ state at time t. $Y_{ikt} = 1$ if the child has received the vaccine, and 0 otherwise. As mentioned earlier, separate pooled probit regressions are estimated for the four vaccines - polio, DPT, BCG and measles. The PNDT status indicator is Law_{kt}. For the pre-treated group (Maharashtra), $Law_{kt} = 1 \forall t$. For the newly-treated group (other states), $Law_{k0} = 0$ and $Law_{k1} = 1$. The error term of the regression is $\epsilon_{ikt} \sim N(0, 1)$.

The pooled OLS model used for the child nutrition regressions is written as:

$$Z_{imt} = \alpha + \tau Law_{mt} + \beta F_{imt} + \gamma Law_{mt} \times F_{imt} + \delta X_{imt} + \theta I_{imt} + \sum_m \eta_m D_m + \epsilon_{imt} \quad (3.2)$$

where Z_{ikt} is the child nutrition outcome for the $i-th$ child in the $m-th$ district at time t. I estimate separate regressions for four nutrition outcomes - the WHO z-scores for weight-for-age, height-for-age and weight-for-height, and the total duration of breastfeeding (months). Outlier values of z-scores have been dropped by considering only the values $-6 < z < 6$ for the height-for-age and weight-for-age measures, and $-5 < z < 5$ for the weight-for-height measure. The values of breastfeeding higher than 23 months in NFHS-1 have been replaced with 23 for the sake of comparability between the two rounds of survey.

F_{ikt} is a binary variable for the gender of the child - it takes a value 1 for the girls and 0 for the boys. The coefficient τ captures the difference-in-difference impact of the PNDT Act on child investment. If the ban on sex-selective abortion results in larger a family size and thereby reduced per capita investment in child quality - as discussed in section 3.3 - one may expect the estimated τ to be negative.

My main variable of interest on the right hand side is the interaction between the PNDT indicator and the female child dummy, $Law_{kt} \times F_{ikt}$. It captures the differential impact of the PNDT Act on the outcomes of newly-treated girls. For example, if the PNDT Act results in extra female child births, households with a strong son-preference may exhibit a negative value of the estimated γ. While a bigger family size may reduce the per capita allocation of resources, preference for boys may further worsen the outcomes of the young girls.

$\boldsymbol{X}$ is a vector of characteristics of the child, the child's mother, the household and the head of household. Included in $\boldsymbol{X}$ are child's age and birth order, mother's age and educational attainment, and household head's gender, age, and education. In addition, family size, indicators for caste and religion, and several variables for the household's demographic composition are also included. Finally, log monthly per capita expenditure is included in $\boldsymbol{X}$ as an indicator of the household income. Since NFHS only collects information on durable assets of the household but not income, I use household expenditure which is predicted by using additional information from two concurrent National Sample Survey (NSS) rounds. For NFHS-1, I estimate a regression of the log household per capita expenditure on several household characteristics using the NSS 50th round (1993-94) data. The explanatory variables in the estimated regression are then replaced by similar variables from the NFHS-1 data, to obtain the predicted log per capita household expenditure. For NFHS-2, this is done using the NSS 55th round (1999-2000) data.

As discussed in the previous chapter, most child outcomes related to immunization and nutrition could be amenable to public policy. For example, the Universal Immunization Programme (UIP), introduced in 1985-86 by the Indian government, was designed to immune at least 85% of the country's infant population against six diseases - polio, diphtheria, pertussis, tetanus, tuberculosis and measles - by 1990 (NFHS 2000). The scheme was supplemented with the Pulse Polio Vaccination scheme, an aggressive nationwide oral polio vaccination campaign, in 1995. Therefore, the availability of a healthcare center inside a community may greatly facilitate the immunization of children. Additionally, it may reduce the relative neglect of girls by providing free (or highly subsidized) immunization and healthcare services to the families. Otherwise, when the services are not available close by, or are expensive, households with a strong son-preference may only purchase them for the boys and neglect the girls.

Maternal and child care centers (*Anganwadi*) were introduced in Indian villages during mid-1970s. These centers are staffed with trained health workers who provide day care services and nutritional supplements to the newborn children and their mothers. These workers are also directly involved with immunization services and the dissemination of health and hygiene information. Similar activities are carried out by mobile health workers - known as village health guides - who provide first-aid and outreach services (Datar et al. 2007). Finally, mobile health units provide healthcare services in rural India, particularly in remote areas.

The availability of the healthcare inputs mentioned above are captured through the inclusion of several infrastructure indicators in the regression. The vector $\boldsymbol{I}$ includes time-varying dummy variables for the availability of at least one primary health care center, a primary health sub-center, a village health guide, a trained birth attendant (*dai*), a mobile health unit, and an *Anganwadi* center. The availability of paved roads and schools are also included.

An appropriate number of regional dummies denoted by D_k and D_m are included in equations (3.1) and (3.2), respectively. Also included is a time dummy where $t = 1$ is for NFHS-2 and $t = 0$ is for NFHS-1. To avoid any dimensionality problem arising from the small sample size at the district level, state fixed-effect probit models are estimated. For the district fixed-effect models of child nutrition outcomes, the coefficients of district dummies will not be estimated with precision because of the small sample size. However, this does not pose a threat to this analysis as these coefficients are not reported nor used anywhere in the discussion. Furthermore, I find that the results are comparable to similar state fixed-effects models of the nutrition regression. The results for main rural sample (Maharashtra and neighboring states) are presented in the next section. Additional regression tables are provided in the appendix.

3.6 Results

The main results from the rural sample of Maharashtra and its neighboring states are presented in tables A.3.1 and A.3.2. These are also presented in detail in appendix tables A.3.11 and A.3.12. Results from additional samples (urban sample, and rural Maharashtra with the rest of India) are provided in appendix tables A.3.13 through A.3.16. Heteroskedasticity-robust standard errors are used in all regression models and the errors are clustered at the household level. Results are robust to clustering at the district and state levels. The results from district fixed-effect models are also robust to state fixed-effect specifications.

I begin the discussion with a focus on three explanatory variables of interest - the indicator variables for the PNDT Act, a female child and the interaction between these two. The impact of all three variables is generally mixed and depends upon the choice of the outcome variable. In the main rural sample, the PNDT Act has a negative impact on the incidence of measles vaccine and a positive impact on the BCG and weight-for-age measure of newly-treated children. Similar positive impact on height-for-age and weight-for-age, and a negative impact on BCG and DPT are seen in the urban sample (appendix tables A.3.13 and A.3.14). In the expanded rural sample (Maharashtra and the rest of India), PNDT is generally ineffective (appendix tables A.3.15 and A.3.16). A significant negative coefficient for the PNDT Act indicator may imply that the per child investment generally reduces, even after controlling for subsidized public goods. On the other hand, PNDT may have a positive impact on child outcomes because of the 'economies of scale' effect.

The main rural and urban samples do not exhibit any gender gap in child outcomes, except for a disadvantage for the girls with respect to measles and breastfeeding. In the expanded rural sample, girls are around 11% less likely to have received every individual vaccines. Although they are also weaned from breastfeeding earlier, girls exhibit better weight-for-age and weight-for-height outcomes compared to boys.

Finally, the interaction between the PNDT Act and the female child indicators present the differential impact of the PNDT Act on the gender gap in the newly-treated group. I find that in general the law did not have any such differential impact. However, the main rural sample shows that in the context of DPT, newly-treated girls are a weakly significant 11.1% less likely to receive the vaccine. Again, the gender gap in breastfeeding exhibits a weakly significant reduction by 0.26 months. The urban sample also demonstrates no significant differential impact of the PNDT while the expanded rural sample shows significant positive effect only in the context of the measles vaccine and breastfeeding.

One could draw upon the international evidence related to demographic policies to explain these findings. As noted in section 3.3, a ban on sex-selective abortions may have an impact on the investment in the quality of girls in two ways. First, a successful (or even partially successful) implementation of the ban will likely result in more female child births. The larger family size, in turn, may reduce the investment in quality of each child (Becker and Lewis (1973), Blake (1981)). Secondly, with the rise in family size, there may be another reduction in the resources allocated to girls in households with strong son-preference.

However, several studies in the context of societies with known preference for boys find weak or no evidence of the quantity-quality tradeoff (Guo and VanWey 1999, Lloyd 1994, Lee 2007). In fact, family size and child quality may be positively associated, since a rise in income will result in both higher fertility and more investment in children (Mueller 1984, Campbell et al. 2002). In Kenya, Gomes (1984) finds that an increase in family size improves the schooling outcomes as the children are able to receive remittances from elder siblings to support their own education.

Among my main rural and urban samples (Maharashtra and neighboring states), there is little evidence of a gender gap in child outcomes. Along with this, if the quantity-quality tradeoff is weak or nonexistence, the PNDT Act may have little or no differential effect on the gender gap in child outcomes. However, one must note the average effect of the law could be the consequence of one or more counteracting factors. Following the discussion in chapter 2, I find that households with a weak preference for boys over girls are more likely to comply with the PNDT Act. These households may practice more postnatal discrimination of girls after the implementation of the

Table A.3.1: Pooled Probit Regression of Immunization of Children (less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Polio	**BCG**	**DPT**	**Measles**
Probit Regression of Immunization	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.044	0.250**	-0.059	-0.165*
	(0.094)	(0.101)	(0.094)	(0.094)
Female child	-0.043	-0.048	-0.022	-0.051
	(0.040)	(0.040)	(0.041)	(0.043)
PNDT Act × Female child	-0.017	-0.044	-0.111*	0.052
	(0.059)	(0.059)	(0.060)	(0.063)
Age of child (months)	0.209**	0.120**	0.210**	0.252**
	(0.006)	(0.005)	(0.006)	(0.008)
Age squared	-0.005**	-0.003**	-0.005**	-0.005**
	(0.000)	(0.000)	(0.000)	(0.000)
Birth order of child	-0.073**	-0.077**	-0.086**	-0.085**
	(0.014)	(0.013)	(0.014)	(0.014)
Time dummy	-0.420*	0.114	-0.363*	-0.086
	(0.216)	(0.217)	(0.219)	(0.225)
Village infrastructure indicators	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Constant	-5.956**	-3.763**	-5.901**	-6.241**
	(0.609)	(0.603)	(0.615)	(0.618)
Pseudo R^2	0.231	0.164	0.258	0.275
Sample Size	9,006	9,006	9,006	9,006

Note: Data are from NFHS-1 and NFHS-2. Sample includes children from Maharashtra and its neighboring states. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

Table A.3.2: Pooled Linear Regression of Child Nutrition Indicators (for children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Height for Age	**Weight for Age**	**Weight for Height**	**Breastfeeding**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.214	0.177*	-0.004	-0.267
	(0.137)	(0.100)	(0.104)	(0.226)
Female child	-0.024	0.022	0.043	-0.286**
	(0.077)	(0.041)	(0.059)	(0.116)
PNDT Act × Female child	-0.013	-0.097	-0.024	0.266*
	(0.094)	(0.060)	(0.071)	(0.149)
Birth order of child	0.025	0.028*	-0.003	0.074**
	(0.023)	(0.014)	(0.015)	(0.037)
Time dummy	0.368	0.273	0.018	-1.469**
	(0.267)	(0.214)	(0.195)	(0.413)
Age of child (months)	-	-	-0.105**	1.407**
	-	-	(0.007)	(0.014)
Age squared	-	-	0.003**	-0.025**
	-	-	(0.000)	(0.001)
Village infrastructure indicators	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes
Constant	-4.795**	-4.445**	-1.410**	0.481
	(0.870)	(0.575)	(0.641)	(1.611)
Adjusted R^2	0.036	0.077	0.116	0.746
Sample Size	5,119	7,601	5,163	8,964
F Statistic	4.46	9.86	11.92	848.96

Note: Data are from NFHS-1 and NFHS-2. Sample includes children from Maharashtra and its neighboring states. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

law. Again, communities with a very strong preference for sons exhibit no impact (or even a negative impact) of the PNDT Act on the female-to-male juvenile sex ratio. This implies that these communities continue to practice sex-selective abortion of girls. Therefore, the existence of girls in these households are more likely to be a gender-specific fertility 'choice' rather than an 'accident'. In such a case, we are less likely to observe a postnatal discrimination of girls or its change due to the PNDT Act. Finally, another contributing factor in the form of 'economies of scale' may improve the child outcomes in larger families.

The regression results present a net effect of the PNDT Act, one which determined by the relative strength of the various factors discussed above. It is beyond the scope of this study to identify the individual factors. However, if the net impact of the PNDT Act is of interest, as it might be with the policymakers, I observe that the law did not have any uniform effect on the relative wellbeing of girls. The general absence of a negative impact on female child quality, along with the positive impact on sex ratio implies that the Indian PNDT Act has been a truly welfare enhancing public policy.

Before moving onto a discussion about the effects of other covariates, I must mention the possible factors that may mire the above findings. First, in the absence of time series information on child outcomes in the pre-treated and newly-treated areas, it is not possible to verify the so called 'parallel trends assumption', i.e. the two groups should exhibit homogeneity in the levels, and changes over time, of child outcomes. Secondly, as is true with many public policies, there is no way to measure the degree of enforcement of the PNDT Act across different regions and over time. Although there is evidence that the PNDT Act had some impact of the network of sex-selective abortion providers (Wertz and Fletcher 1993, Luthra 1994), an unobserved regional difference in the enforcement could be affect the regression results. Finally, unobserved parental preference may play an important role in determining a household's response to the PNDT Act. For example, the implementation of the law may serve an additional role of a public awareness campaign for some households. If successful, it may change the household's behavior toward a more egalitarian treatment of girls, in addition to resulting in more female child births.

Among other covariates, the regression results indicate that older children are significantly more likely to receive all vaccination. They are also likely to to be breastfed for a longer duration but have worse weight-for-height outcomes compared to their younger siblings. Children of higher birth order have a statistically significant, although small in magnitude, lower probability of receiving vaccines. The relatively worse outcomes of higher birth order children have been well documented in India and other Asian countries (Das Gupta 1987, Muhuri and Preston 1991, Pande 2003, Mishra et al. 2004, Chamarbagwala 2010).

Mother's education appears to have a positive impact on all child outcomes, except for breastfeeding which shows a negative association. Most child outcomes used in this study are determined by household level decisions. For example, wealthier households are likely to have more educated parents and better child outcomes. However, breastfeeding a child is more likely to be an individual decision by a mother. Education could act as a proxy for a range of characteristics of the mother, such as fertility and labor force participation. Therefore, a negative impact of education on breastfeeding is possible.

On the other hand, education of the household head generally has no effect on child outcomes, except for a significant positive association between the outcomes and household heads with primary education. The positive impact could be the result of an 'income effect' which induces the household heads with more education (and higher income) to invest more in child quality. Socioeconomically backward households, particularly *scheduled tribe* households exhibit worse child outcomes in some cases. This, once again, is expected since these backward groups are known to have lower income and poorer human development outcomes. Finally, the income and wealth of a hosehold, captured by the log predicted per capita expenditure, generally shows a significant positive impact on child outcomes.

Among the village level infrastructure indicators, the presence of a trained birth attendant and a mobile health unit both exhibit a significantly positive effect on the immunization outcomes of children. Similar positive impact is also seen for the availability of a paved road. As Datar et al. (2007) and Oster (2009) point out, most of the vaccines are delivered to the children through health and welfare camps, and outreach workers. Therefore, infrastructure factors that reduce the physical distance between the children and vaccines are likely to have a positive impact on the immunization rates. Again, similar to the findings in Deolalikar et al. (2009) and Oster (2009), my results show that the subsidized healthcare inputs have little or no impact on child nutrition outcomes.

3.7 Conclusion

This chapter uses a policy variation to examine the 'unintended consequences' of a ban on sex-selective abortion in India. The PNDT Act, implemented in the state of Maharashtra in 1988 and the rest of the country in 1996, was intended to prevent the the selective abortion of girls. In the previous chapter, I find that the law was marginally effective in improving the female-to-male juvenile sex ratio in India. Although the observed sex ratio declined even after the implementation of the law, my results indicate that the sex ratio would have become more masculine in the possible absence of the law.

With more female child births and an improvement in the sex ratio, one may expect the households to substitute the prenatal discrimination of girls with postnatal discrimination. Therefore, as an 'unintended consequence' of the PNDT Act, the relative nutritional and immunization status of young girls may worsen. Using child level data from the two consecutive National Family Health Surveys (1992-93 and 1998-99) in India, I examine the impact of the law on the relative outcomes of girls.

Using state and district fixed-effect models, I evaluate the law's effect on four vaccination outcomes and four nutritional status outcomes. The main area of focus consists of the rural households of Maharashtra and its neighboring states. Results are also reported for additional urban and nationwide samples. My results indicate that the PNDT Act did not uniformly worsen or improve the relative outcomes of girls. Depending upon the choice of the outcome variable and the sample, the law exhibits a positive or negative effect in a few cases. For the rest, the law did not have any significant impact.

It is important to distinguish between the two major types of outcome variables chosen for this study. The immunization outcomes of children could be highly dependent on the availability of subsidized healthcare inputs inside a community. The Indian government launched the Universal Immunization Programme (UIP) in 1985-86. Under this scheme, a network of public healthcare providers consisting of the *Anganwadi* and outreach workers, and health and family welfare camps are responsible for providing free or highly subsidized vaccines to children. The vaccination schemes are often very proactive, with large scale awareness campaigns (e.g. the Pulse Polio campaign) and home visits by health workers. On the other hand, nutritional outcomes are relatively less amenable to public policy - cheap and easy access to healthcare facilities may not transfer to the actual use of these services. Thus, depending upon a household's preference for sons, access to subsidized healthcare may or may not improve the relative outcomes of girls.

After incorporating the availability of these healthcare inputs, I find mixed evidence on the impact of the PNDT Act. However, one reassuring fact is that the law, despite improving sex ratios, did not uniformly induce all households to practice more postnatal discrimination of girls. Therefore, one can argue that a ban on sex-selective abortions could be a truly welfare enhancing public policy which marginally reduces the population gender imbalance and at the same time does not worsen the neglect of living girls.

This study contributes to a relatively young and little-researched area of demographic policies and their impact, particularly in societies with a known preference for sons over daughters. There are several confounding effects of the ban on sex-selective abortion on a household's behavior. The present framework does not allow me to study the individual effects and instead estimates the net impact of the policy. Future research could focus on the identification of these independent factors for a more comprehensive evaluation of demographic policies in India ranging from the PNDT Act to fertility control policies.

Appendix

Table A.3.3: Share of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children Who Received Polio Vaccines, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	0.468	0.466	-0.002
	(0.011)	(0.014)	
Pre-treated Boys	0.648	0.620	-0.028
	(0.022)	(0.031)	
Difference between New and Pre	-0.18	-0.154	0.026
Newly-treated Girls	0.458	0.457	-0.001
	(0.011)	(0.014)	
Pre-treated Girls	0.647	0.633	-0.014
	(0.023)	(0.031)	
Difference between New and Pre	-0.189	-0.176	0.013
Gender gap in Newly-treated Group	0.01	0.009	-0.001
Gender gap in Pre-treated Group	0.001	-0.013	-0.014
Difference between New and Pre	-0.009	-0.022	-0.013

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The share of children who received all three Polio vaccines are presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.4: Share of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children Who Received DPT Vaccines, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	0.449	0.439	-0.01
	(0.011)	(0.014)	
Pre-treated Boys	0.661	0.657	-0.004
	(0.022)	(0.030)	
Difference between New and Pre	-0.212	-0.218	-0.006
Newly-treated Girls	0.439	0.404	-0.035
	(0.011)	(0.014)	
Pre-treated Girls	0.656	0.637	-0.019
	(0.023)	(0.031)	
Difference between New and Pre	-0.217	-0.233	-0.016
Gender gap in Newly-treated Group	0.01	0.035	0.025
Gender gap in Pre-treated Group	0.005	0.02	0.015
Difference between New and Pre	0.005	0.015	0.01

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The share of children who received all three DPT vaccines are presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.5: Share of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children Who Received BCG Vaccine, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	0.606	0.707	0.101
	(0.011)	(0.012)	
Pre-treated Boys	0.792	0.840	0.048
	(0.019)	(0.024)	
Difference between New and Pre	-0.186	-0.133	0.053
Newly-treated Girls	0.589	0.684	0.095
	(0.011)	(0.013)	
Pre-treated Girls	0.772	0.758	-0.014
	(0.020)	(0.028)	
Difference between New and Pre	-0.183	-0.074	0.109
Gender gap in Newly-treated Group	0.017	0.023	0.006
Gender gap in Pre-treated Group	0.02	0.082	0.062
Difference between New and Pre	-0.003	-0.059	-0.056

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The share of children who received a BCG vaccine are presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.6: Share of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children Who Received Measles Vaccine, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	0.348	0.287	-0.061
	(0.011)	(0.013)	
Pre-treated Boys	0.508	0.489	-0.019
	(0.023)	(0.032)	
Difference between New and Pre	-0.16	-0.202	-0.042
Newly-treated Girls	0.325	0.298	-0.027
	(0.010)	(0.013)	
Pre-treated Girls	0.523	0.513	-0.01
	(0.024)	(0.032)	
Difference between New and Pre	-0.198	-0.215	-0.017
Gender gap in Newly-treated Group	0.023	-0.011	-0.034
Gender gap in Pre-treated Group	-0.015	-0.024	-0.009
Difference between New and Pre	0.038	0.013	-0.025

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The share of children who received a Measles vaccine are presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.7: Weight-for-age WHO Z-score of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	-2.099	-1.673	0.426
	(0.031)	(0.039)	
Pre-treated Boys	-2.031	-1.754	0.277
	(0.070)	(0.084)	
Difference between New and Pre	-0.068	0.081	0.149
Newly-treated Girls	-2.101	-1.775	0.326
	(0.034)	(0.040)	
Pre-treated Girls	-2.145	-1.853	0.292
	(0.068)	(0.083)	
Difference between New and Pre	0.044	0.078	0.034
Gender gap in Newly-treated Group	0.002	0.102	0.1
Gender gap in Pre-treated Group	0.114	0.099	-0.015
Difference between New and Pre	-0.112	0.003	0.115

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The average value of the WHO Z-score is presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.8: Height-for-age WHO Z-score of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	-1.808	-1.585	0.223
	(0.052)	(0.048)	
Pre-treated Boys	-1.725	-1.491	0.234
	(0.089)	(0.091)	
Difference between New and Pre	-0.083	-0.094	-0.011
Newly-treated Girls	-1.786	-1.648	0.138
	(0.055)	(0.049)	
Pre-treated Girls	-1.915	-1.481	0.434
	(0.087)	(0.090)	
Difference between New and Pre	0.129	-0.167	-0.296
Gender gap in Newly-treated Group	-0.022	0.063	0.085
Gender gap in Pre-treated Group	0.19	-0.01	-0.2
Difference between New and Pre	-0.212	0.073	0.285

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The average value of the WHO Z-score is presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.9: Weight-for-Height WHO Z-score of Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	-1.101	-0.887	0.214
	(0.042)	(0.037)	
Pre-treated Boys	-1.302	-1.103	0.199
	(0.059)	(0.079)	
Difference between New and Pre	0.201	0.216	0.015
Newly-treated Girls	-1.067	-0.915	0.152
	(0.040)	(0.037)	
Pre-treated Girls	-1.266	-1.197	0.069
	(0.060)	(0.076)	
Difference between New and Pre	0.199	0.282	0.083
Gender gap in Newly-treated Group	-0.034	0.028	0.062
Gender gap in Pre-treated Group	-0.036	0.094	0.13
Difference between New and Pre	0.002	-0.066	-0.068

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The average value of the WHO Z-score is presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Table A.3.10: Breastfeeding Duration (in Months) for Pre-treated (Maharashtra) and Newly-treated (Neighboring States) Rural Children, NFHS-1 and NFHS-2

	NFHS-1	**NFHS-2**	**Difference between NFHS-2 and NFHS-1**
Newly-treated Boys	12.745	9.993	-2.752
	(0.162)	(0.175)	
Pre-treated Boys	12.991	10.641	-2.35
	(0.333)	(0.421)	
Difference between New and Pre	-0.246	-0.648	-0.402
Newly-treated Girls	12.541	10.519	-2.022
	(0.160)	(0.181)	
Pre-treated Girls	13.206	10.755	-2.451
	(0.350)	(0.414)	
Difference between New and Pre	-0.665	-0.236	0.429
Gender gap in Newly-treated Group	0.204	-0.526	-0.73
Gender gap in Pre-treated Group	-0.215	-0.114	0.101
Difference between New and Pre	0.419	-0.412	-0.831

Note: Rural children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2 are considered. Sample includes children from Maharashtra (pre-treated) and its four neighboring states (newly treated). The average number of months that children are breastfed is presented in each cell. Standard errors are in parentheses. Gender gap is the difference between the outcomes of boys and girls.

Figure A.3.1: Distribution of Weight-for-Age WHO Z-scores of Children from NFHS-1

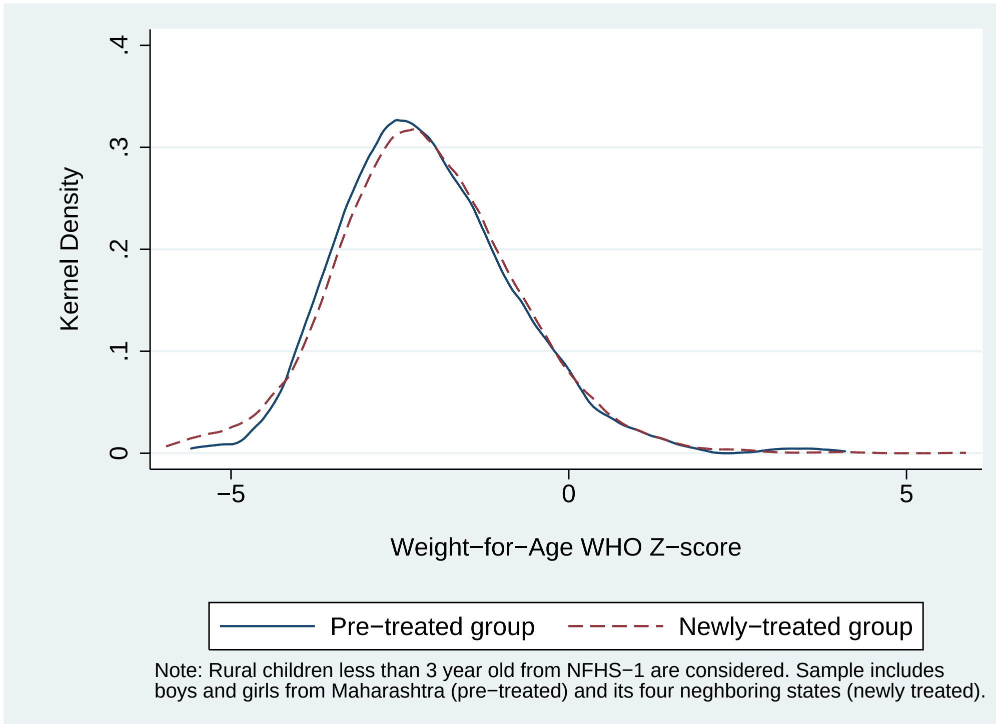

Figure A.3.2: Distribution of Weight-for-Age WHO Z-scores of Children from NFHS-2

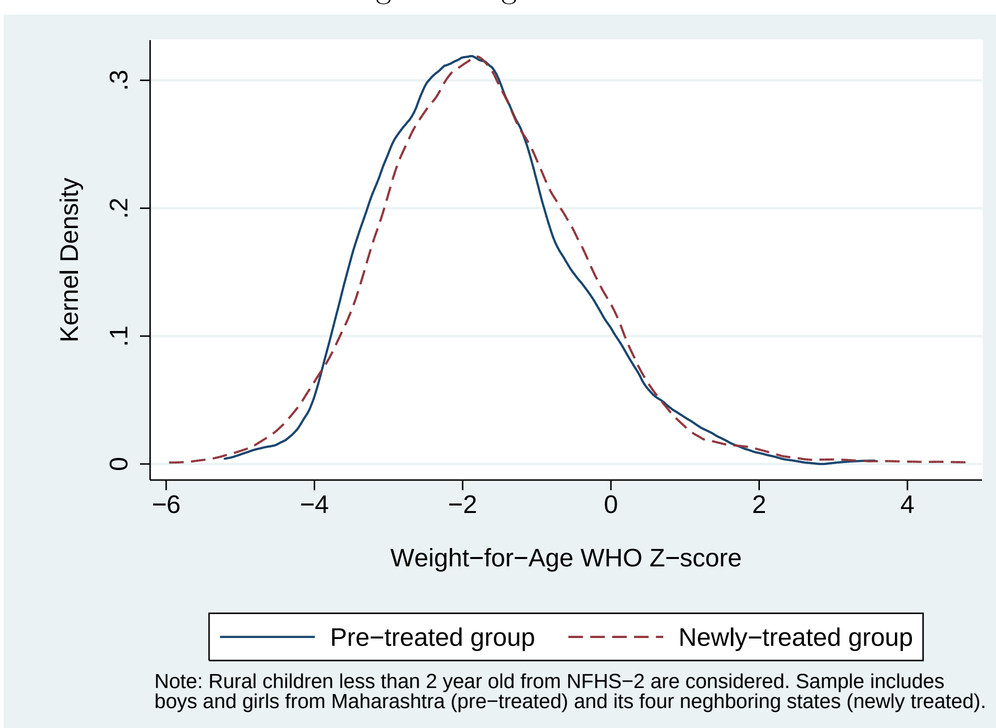

Figure A.3.3: Distribution of Height-for-Age WHO Z-scores of Children from NFHS-1

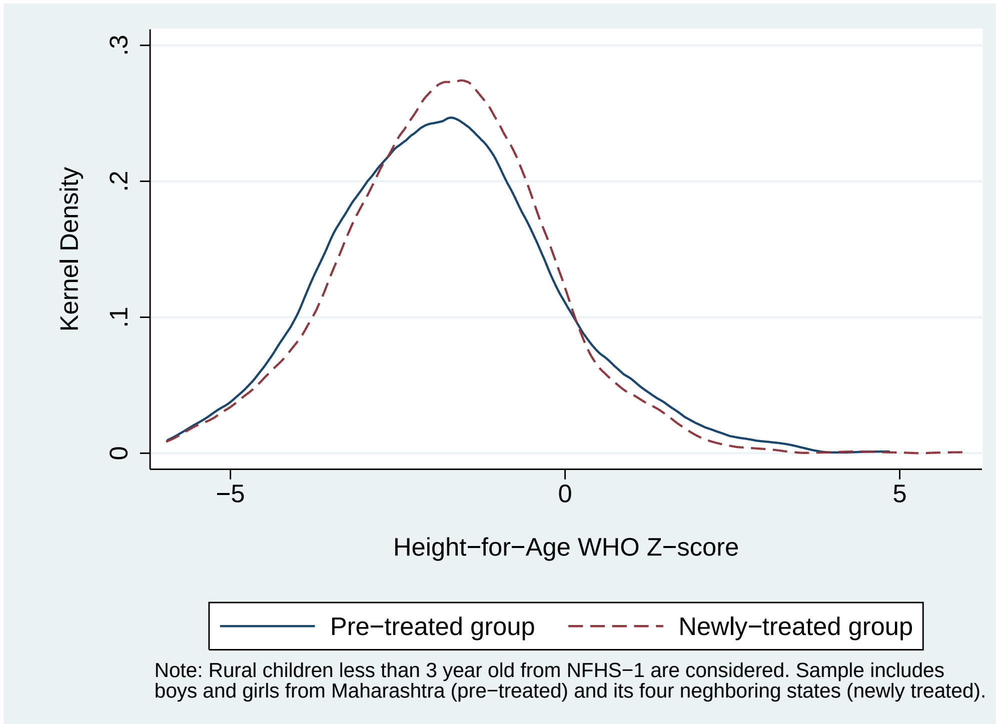

Figure A.3.4: Distribution of Height-for-Age WHO Z-scores of Children from NFHS-2

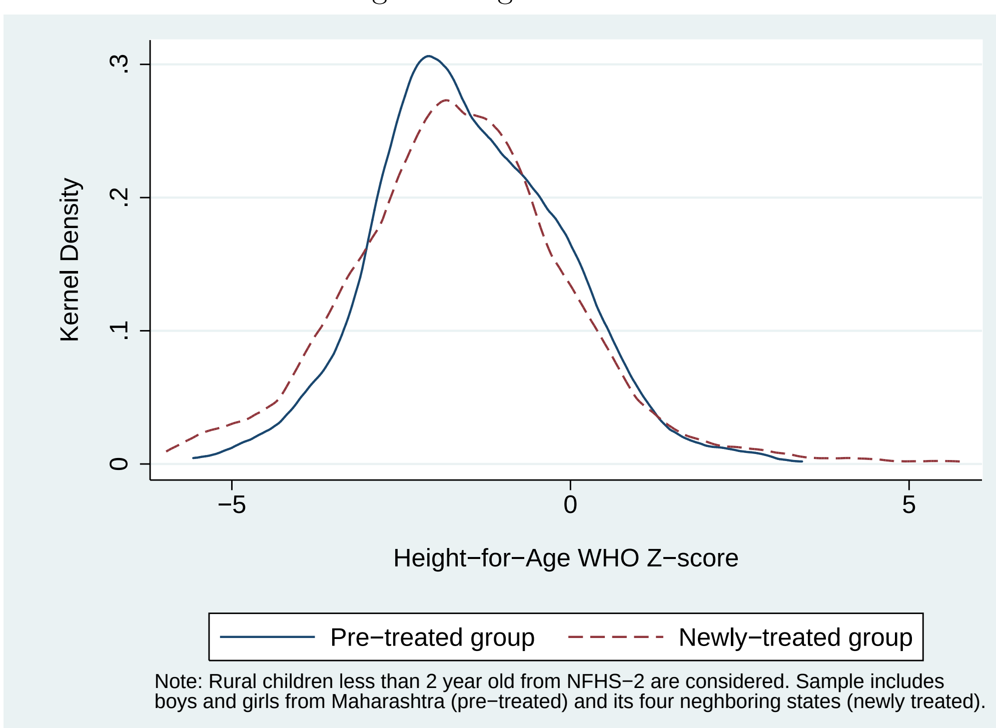

Figure A.3.5: Distribution of Weight-for-Height WHO Z-scores of Children, NFHS-1

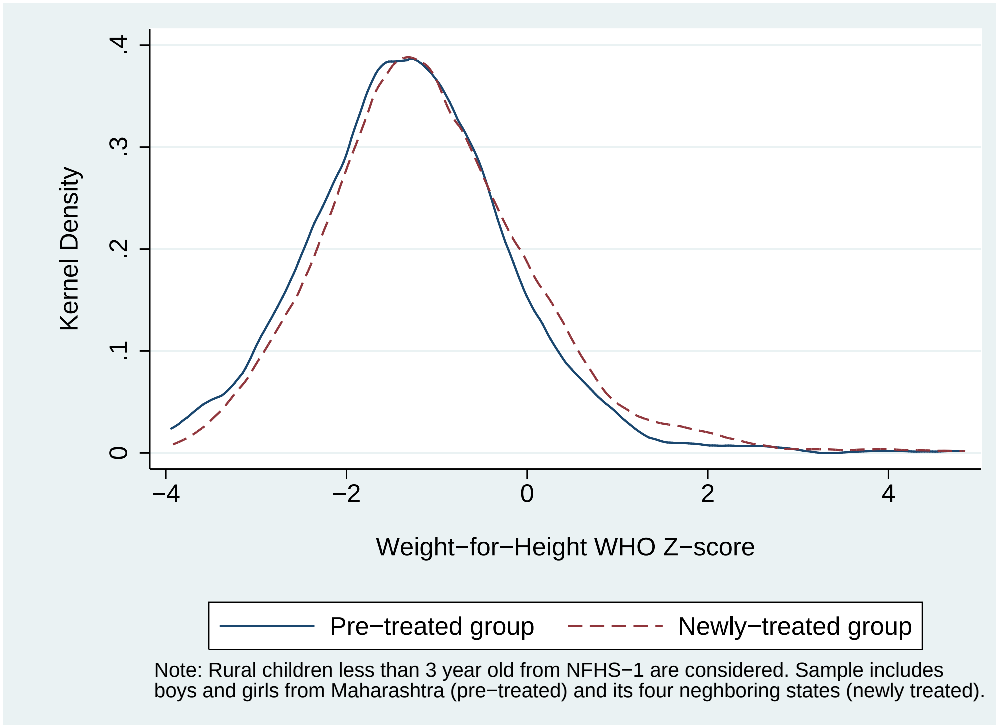

Figure A.3.6: Distribution of Weight-for-Height WHO Z-scores of Children, NFHS-2

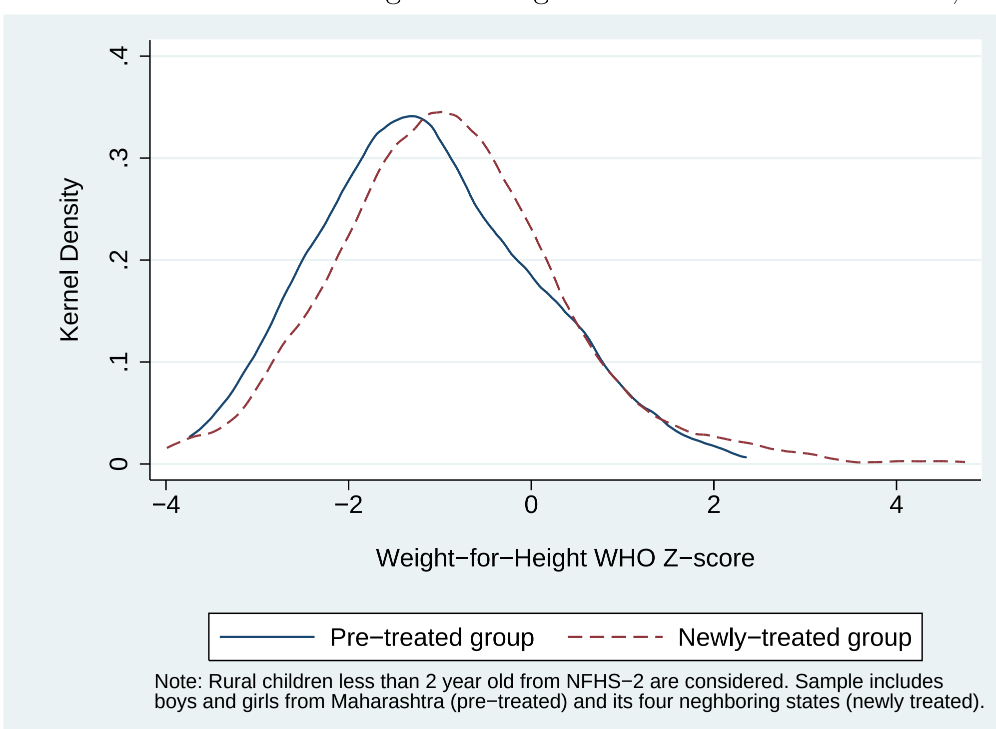

Figure A.3.7: Distribution of the Duration of Breastfeeding (months) of Children, NFHS-1

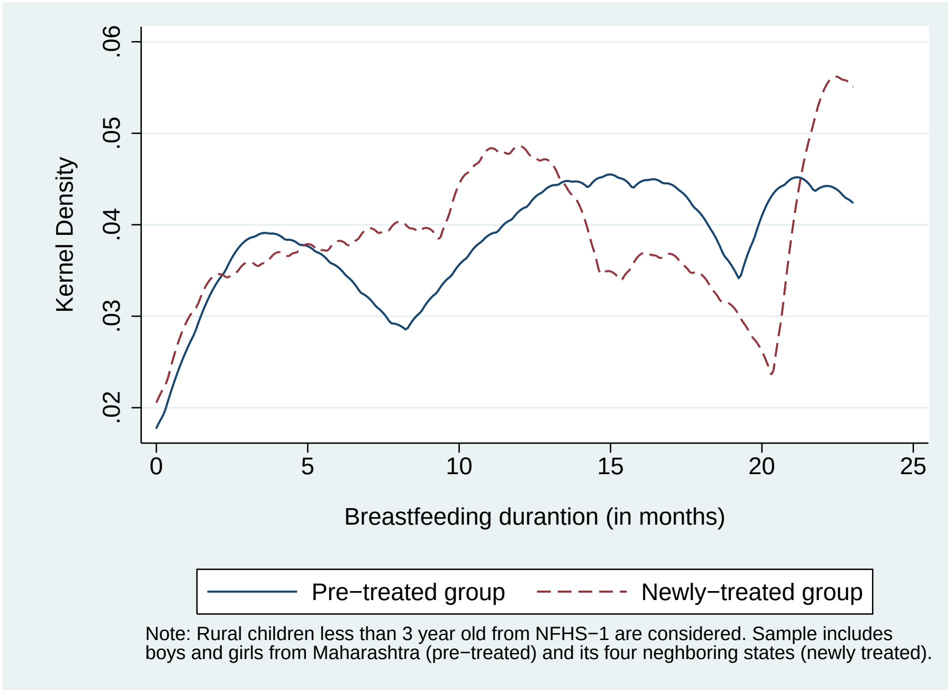

Figure A.3.8: Distribution of the Duration of Breastfeeding (months) of Children, NFHS-2

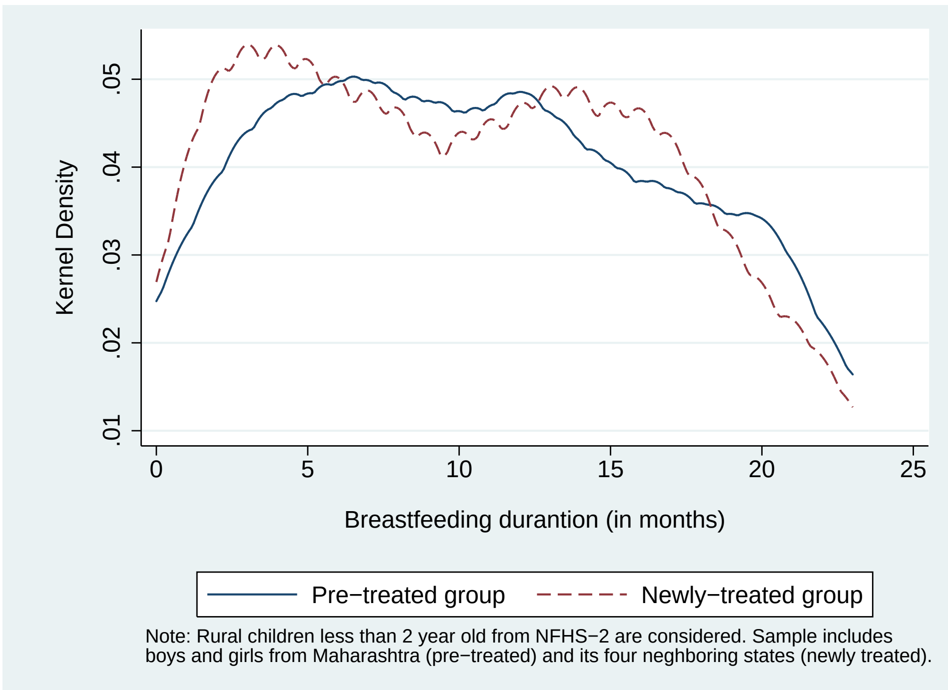

Table A.3.11: Pooled Probit Regression of Immunization of Rural Children (less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Polio	**BCG**	**DPT**	**Measles**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.044	0.250**	-0.059	-0.165*
Female child	-0.043	-0.048	-0.022	-0.051
PNDT Act × Female Child	-0.017	-0.044	-0.111*	0.052
Age of child (months)	0.209**	0.120**	0.210**	0.252**
Age squared	-0.005**	-0.003**	-0.005**	-0.005**
Birth order number	-0.073**	-0.077**	-0.086**	-0.085**
Time Dummy	-0.420*	0.114	-0.363*	-0.086
Mother's age (years)	0.018**	0.024**	0.022**	0.020**
Mother's education:				
Incomplete primary	0.237**	0.205**	0.227**	0.175**
Complete primary	0.335**	0.279**	0.317**	0.231**
Incomplete secondary	0.343**	0.518**	0.450**	0.394**
Complete secondary	0.226*	0.581**	0.393**	0.283**
Higher	0.396**	0.759**	0.697**	0.432**
Scheduled Caste household	-0.022	0.014	-0.048	-0.003
Scheduled Tribe household	-0.018	-0.053	-0.122**	-0.086*
Muslim household	-0.073	-0.170**	-0.036	0.039
Family size	0.006	0.006	0.010	0.012*
Female household head	0.021	0.034	0.001	-0.012
Age of household head	0.001	0.002	0.002	-0.000
Household head's education:				
Primary	0.131**	0.134**	0.115**	0.080*
Secondary	0.054	0.105*	0.049	0.049
Higher	0.025	0.039	0.127	-0.169
Predicted log of MPCE	0.653**	0.480**	0.620**	0.541**

Village infrastructure:				
Primary school	0.292**	0.118	0.368**	0.171*
Secondary school	0.010	0.050	-0.035	0.005
Anganwadi center	0.074**	0.054	0.044	0.054
Primary health center	0.089	0.061	-0.004	0.041
Primary health sub-center	-0.011	0.034	0.014	0.013
Village health guide	-0.049	-0.108**	-0.064*	-0.094**
Trained birth attendant	0.090**	0.118**	0.127**	0.140**
Mobile health unit	0.081*	0.080*	0.099**	0.034
Paved road	0.136**	0.114**	0.177**	0.055
Constant	-5.956**	-3.763**	-5.901**	-6.241**
Pseudo R^2	0.231	0.164	0.258	0.275
Sample Size	9,006	9,006	9,006	9,006

Note: Data are from NFHS-1 and NFHS-2. Sample includes rural children from Maharashtra and its neighboring states. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are the household's demographic composition and state dummy variables.

Table A.3.12: Pooled Linear Regression of Child Nutrition Indicators (for Rural Children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Height for Age	**Weight for Age**	**Weight for Height**	**Breast -feeding**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.214	0.177*	-0.004	-0.267
Female child	-0.024	0.022	0.043	-0.286**
PNDT Act × Female Child	-0.013	-0.097	-0.024	0.266*

Age of child (months)	-	-	-0.105**	1.407**
Age squared	-	-	0.003**	-0.025**
Birth order number	0.025	0.028*	-0.003	0.074**
Time Dummy	0.368	0.273	0.018	-1.469**
Mother's age (years)	-0.009	-0.017**	-0.001	0.032**
Mother's education:				
Incomplete primary	0.132*	0.158**	0.033	-0.223*
Complete primary	0.100	0.193**	0.203**	-0.576**
Incomplete secondary	0.242**	0.313**	0.183**	-0.676**
Complete secondary	0.396**	0.492**	0.268**	-0.863**
Higher	0.430**	0.529**	0.237**	-1.027**
Scheduled Caste household	-0.061	-0.068	-0.036	-0.141
Scheduled Tribe household	-0.026	-0.047	-0.035	-0.132
Muslim household	-0.038	0.055	0.057	-0.573**
Family size	0.029**	0.023**	0.010*	-0.055**
Female household head	0.167	-0.013	-0.060	-0.025
Age of household head	0.000	0.001	0.002*	0.000
Household head's education:				
Primary	0.095	0.003	-0.025	-0.033
Secondary	0.025	0.046	0.088	-0.317**
Higher	-0.016	0.004	0.101	-0.257
Predicted log of MPCE	0.509**	0.423**	0.161	-0.231
Village infrastructure:				
Primary school	-0.148	0.084	0.053	-0.445**
Secondary school	-0.042	-0.010	-0.018	-0.125
Anganwadi center	0.089	0.034	0.038	-0.159
Primary health center	0.020	-0.035	0.097*	-0.025
Primary health sub-center	-0.019	-0.051	-0.029	0.051
Village health guide	0.007	-0.041	-0.076*	0.079
Trained birth attendant	-0.064	-0.021	-0.042	0.099
Mobile health unit	-0.009	-0.072	-0.039	0.007
Paved road	0.060	0.086**	0.055	0.070

Constant	-4.795**	-4.445**	-1.410**	0.481
Adjusted R^2	0.036	0.077	0.116	0.746
Sample Size	5,119	7,601	5,163	8,964
F Statistic	4.458	9.859	11.919	848.956

Note: Data are from NFHS-1 and NFHS-2. Sample includes rural children from Maharashtra and its neighboring states. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are the household's demographic composition and district dummy variables.

Table A.3.13: Pooled Probit Regression of Immunization of Urban Children (less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Polio	**BCG**	**DPT**	**Measles**
Probit Regression of Immunization	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-0.148	-0.238*	-0.347**	-0.044
	(0.116)	(0.134)	(0.120)	(0.117)
Female child	-0.092	-0.040	-0.077	-0.146*
	(0.069)	(0.072)	(0.071)	(0.075)
PNDT Act × Female child	0.095	-0.065	0.084	0.113
	(0.093)	(0.101)	(0.096)	(0.098)
Age of child (months)	0.227**	0.129**	0.258**	0.317**
	(0.009)	(0.010)	(0.009)	(0.013)
Age squared	-0.005**	-0.003**	-0.006**	-0.006**
	(0.000)	(0.000)	(0.000)	(0.000)
Birth order of child	-0.092**	-0.078**	-0.097**	-0.124**
	(0.022)	(0.024)	(0.023)	(0.024)
Time dummy	-0.254	0.330	-0.146	-0.174
	(0.302)	(0.351)	(0.323)	(0.322)
Infrastructure indicators	No	No	No	No
State dummies	Yes	Yes	Yes	Yes
Constant	-8.790**	-7.804**	-8.895**	-9.477**
	(0.873)	(0.953)	(0.910)	(0.894)
Pseudo R^2	0.278	0.229	0.327	0.357
Sample Size	4,115	4,115	4,115	4,115

Note: Data are from NFHS-1 and NFHS-2. Sample includes children from Maharashtra and its neighboring states. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

Table A.3.14: Pooled Linear Regression of Child Nutrition Indicators (for Urban Children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Height for Age	**Weight for Age**	**Weight for Height**	**Breastfeeding**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.398**	0.327**	0.008	-0.063
	(0.170)	(0.111)	(0.120)	(0.354)
Female child	0.030	0.057	0.006	-0.096
	(0.117)	(0.062)	(0.086)	(0.221)
PNDT Act × Female child	-0.009	-0.058	0.016	0.008
	(0.134)	(0.082)	(0.099)	(0.268)
Birth order of child	0.029	0.017	-0.007	0.204**
	(0.033)	(0.020)	(0.022)	(0.065)
Time dummy	-0.392	-0.469*	-0.232	-1.580**
	(0.343)	(0.277)	(0.257)	(0.727)
Age of child (months)			-0.074**	1.300**
			(0.008)	(0.024)
Age squared			0.002**	-0.024**
			(0.000)	(0.001)
Infrastructure indicators	No	No	No	No
District dummies	Yes	Yes	Yes	Yes
Constant	-8.209**	-8.140**	-3.669**	6.011**
	(1.181)	(0.738)	(0.831)	(2.443)
Adjusted R^2	0.076	0.110	0.080	0.628
Sample Size	2,719	3,534	2,734	4,096
F Statistic	4.92	10.25	4.78	281.17

Note: Data are from NFHS-1 and NFHS-2. Sample includes children from Maharashtra and its neighboring states. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

Table A.3.15: Pooled Probit Regression of Immunization of All Rural Children (less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Polio	**BCG**	**DPT**	**Measles**
Probit Regression of Immunization	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	0.136	0.242**	0.044	-0.123
	(0.083)	(0.092)	(0.082)	(0.081)
Female child	-0.106**	-0.118**	-0.109**	-0.114**
	(0.019)	(0.019)	(0.020)	(0.021)
PNDT Act × Female child	0.050	0.030	0.004	0.068**
	(0.031)	(0.030)	(0.031)	(0.034)
Age of child (months)	0.201**	0.120**	0.195**	0.246**
	(0.003)	(0.003)	(0.003)	(0.004)
Age squared	-0.004**	-0.003**	-0.004**	-0.005**
	(0.000)	(0.000)	(0.000)	(0.000)
Birth order of child	-0.056**	-0.063**	-0.068**	-0.071**
	(0.007)	(0.007)	(0.007)	(0.007)
Time dummy	-0.080	-0.143	-0.197	0.009
	(0.127)	(0.130)	(0.127)	(0.133)
Village infrastructure indicators	Yes	Yes	Yes	Yes
State dummies	Yes	Yes	Yes	Yes
Constant	-4.862**	-3.396**	-4.559**	-5.764**
	(0.269)	(0.266)	(0.273)	(0.291)
Pseudo R^2	0.261	0.230	0.279	0.303
Sample Size	36,668	36,668	36,668	36,668

Note: Data are from NFHS-1 and NFHS-2. Sample includes rural children from Maharashtra and the rest of India. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

Table A.3.16: Pooled Linear Regression of Child Nutrition Indicators (for All Rural Children less than 3 year old from NFHS-1 and less than 2 year old from NFHS-2)

	Height for Age	**Weight for Age**	**Weight for Height**	**Breastfeeding**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**
PNDT Act	-0.048	0.075	0.028	-0.188
	(0.107)	(0.090)	(0.076)	(0.198)
Female child	0.049	0.055**	0.083**	-0.181**
	(0.030)	(0.020)	(0.021)	(0.056)
PNDT Act × Female child	0.005	-0.030	-0.038	0.148**
	(0.042)	(0.031)	(0.030)	(0.072)
Birth order of child	0.010	0.009	-0.014**	0.086**
	(0.010)	(0.007)	(0.007)	(0.017)
Time dummy	0.421**	0.251*	-0.088	-0.821**
	(0.157)	(0.132)	(0.116)	(0.268)
Age of child (months)	-	-	-0.101**	1.392**
	-	-	(0.003)	(0.007)
Age squared	-	-	0.002**	-0.024**
	-	-	(0.000)	(0.000)
Village infrastructure indicators	Yes	Yes	Yes	Yes
District dummies	Yes	Yes	Yes	Yes
Constant	-3.406**	-4.072**	-1.724**	1.535**
	(0.373)	(0.273)	(0.272)	(0.720)
Adjusted R^2	0.074	0.107	0.132	0.748
Sample Size	25,218	30,090	25,290	36,502
F Statistic	14.57	28.00	45.59	3418.12

Note: Data are from NFHS-1 and NFHS-2. Sample includes rural children from Maharashtra and the rest of India. Robust standard errors are reported in parentheses. * and ** respectively denote significance at 10% and 5% levels. Standard errors are clustered at the household level. Among explanatory variables, also included are mother's age and education, family head's age, gender and education, and the characteristics of the household (size, caste, religion, demographic composition, log monthly per capita expenditure).

Chapter 4

The Impact of the Indian School Meal Program on the Learning Outcomes and Nutritional Status of Children

4.1 Introduction

School feeding programs, currently operating in many countries worldwide, have long been established as a popular form of in-kind government transfer program. In the context of developing countries, school meal programs are often motivated by the need to improve upon the school participation rates of children, leading to the achievement of the UN Millennium Development Goal (MDG) of universal primary education. School meals provide a strong incentive for the households, especially the poor, to send their children to schools. An increase in school participation and educational attainment plays a crucial role in initiating the long term human capital accumulation and economic growth of a country.

However, school meal programs can also directly address, at least partially, two other MDGs - eradication of hunger and gender inequality. An adequate meal at the school would enhance the immediate cognitive ability of a child by reducing 'classroom hunger', and hunger during the day in general. In addition, school meals are likely to improve the nutritional status and overall health of children. Finally, many developing countries are characterized by an acute gender gap in educational outcomes - households often invest more on the human capital development of the boys. Free school meals provide an incentive to send children of both genders to schools, thereby reducing the discrimination against girls.

This chapter evaluates the effect of the Indian school meal program, the *Midday Meal Scheme (MDMS),* on the nutritional and learning outcomes of children. One of the leading developing countries in terms of a recent economic growth and improved human development, India still lags severely in universalizing its primary education and eliminating the malnourishment of children. According to the Indian National Family Health Survey (NFHS-3) of 2005-06, only 72% of primary-school-age (6-10 years) children attend schools[1]. Among children who should attend middle, secondary or higher secondary schools, 43% of boys and 54% girls do not attend schools. High dropout rates, along with the lack of universal initial enrollment, have historically affected the educational attainment rates in India. NFHS-3 finds that among men of age 6 years and above, 22% have never received any formal schooling. For women of this age group, the corresponding figure is an astoundingly high 42%. The median years of schooling completed by these women is a mere 2 years, while men have completed a median of 5 years of education. For both school attendance and

[1]The net attendance rate of 6-10 year old boys is 73.2% and girls is 70.5%

educational attainment, there also exists a sharp rural-urban divide with the rural areas performing far worse compared to urban India.

The nutritional status of young children, although improved over the last decade, remains far below acceptable levels. Among children under the age of 3 years, NFHS-3 finds that 45% are considered 'stunted'[2], while 40% are 'underweight'[3]. These levels indicate a slow progress over the corresponding figures of 51% and 43%, from the NFHS-2 survey of 1998-99. On contrary, the percentage of children who are considered 'wasted' (i.e. weight-for-height Z-score is less than -2 SD from the reference population median) has actually increased from 20% in NFHS-2 to 23% in NFHS-3. Although NFHS-3 finds that urban children generally have better nutritional status compared to their rural counterparts, no significant gender gap seems to exist.

The worldwide evidence on the impact of school feeding programs on the nutritional and learning outcomes of children is mixed. Most studies, particularly those in the context of India, have found a positive impact of the program in increasing enrollment and reducing dropout rates. Some studies have also linked school feeding programs with immediate nutritional gains of children. However, the ultimate objective of a school feeding program is the cognitive development of children and an imrpovement in educational attainment. Cognitive achievement of children in developing countries has remained a less explored area mostly due to the lack of proper data on learning outcomes.

The Indian school feeding program was mandated by the central government in 1995 through the National Program of Nutritional Support to Primary Education.

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[2]Children with height-for-age anthropometric Z-score below negative two standard deviations (-2 SD) from the reference population median are considered 'stunted'

[3]Children with weight-for-age anthropometric Z-score below negative two standard deviations (-2 SD) from the reference population median are considered 'underweight'

Reinvigorated by a Supreme Court ruling in 2001, the MDMS is currently among the largest school meal programs in the world, covering 120 million children in public primary schools with a federal annual budget of over $1 billion [4]. This chapter contributes to the existing literature on evaluation of school feeding programs in several ways. First, this study is the first to analyze the impact of the Indian MDMS program on the learning outcomes of children (8-11 year old) at a nationally representative level. In addition, I explore the possible nutritional effects (improvements in the anthropometric z-score measures) of the school meal on these children. Finally, my study sheds some light on the impact of school meals in relatively benefiting female learning outcomes and reducing the gender gap in Indian schools.

I use data from the Indian Human Development Survey (IHDS) of 2005, a nationally representative socioeconomic survey of approximately 41,500 Indian households. Information on schoolgoing children in the household is supplemented with matched school level information. My outcome variables of interest are the standardized test scores of reading, writing and mathematics skills, collected for school going children in the age group 8-11 years. Furthermore, I evaluate the impact of the school meals on long term nutritional status indicators such as the WHO anthropometric Z-scores for weight-for-age and height-for-age of these children.

Program evaluation studies often face a serious concern over the possible endogeneity in program placement - a central planning authority may choose certain subpopulations as program areas based on characteristics that are unknown to the researcher. The choice may be motivated by a variety of reasons including the urge to relatively improve the well-being of a poor subpopulation (Rosenzweig and Wolpin

[4] Kingdon (2007), Department of Education and Literacy of the Government of India http://education.nic.in/mdm/mdm.asp

1986). Economists use randomized evaluations, whenever possible, to eliminate the endogeneity arising out of a targeted program placement. In the absence of a suitable randomized evaluation or a natural experiment framework[5], I use a household level fixed effect model to mitigate this endogeneity. The decision to implement the MDMS program is typically taken at the community level[6]. Therefore a household fixed effect model will bypass the selection bias in program placement. Inside each household, outcomes of children who receive meals from the school are compared to other children who go to similar schools but do not receive meals. Finally, propensity score matching methods are employed to derive the average treatment effect on children receiving school meals, without any sample restriction at the community or household levels.

My results indicate that the school meals do not have a significant impact on learning outcomes; neither does it have any effect on the nutritional status of school going children. These results are robust across different alternative fixed effect model specifications as well the propensity score framework. Additionally, depending upon the regression framework, I find a mixed evidence on gender gap in learning outcomes and the gender-relative impact of school meals. There could be several possible competing (or even complementing) explanations behind the general ineffectiveness of the MDMS found in this study.

Several studies have pointed out the surge in primary school enrollment as a positive outcome of the MDMS program in India. With rise in enrollment, classroom congestion and lack of other schooling inputs could result in a reduction in the quality

[5]Glewwe and Kremer (2005) provide a review of randomized and natural experiments in the context of schooling policies.

[6]See Afridi (2010) for a discussion on the implementation of the school meal program in India.

of education, thereby 'crowding out' any cognitive benefits of a school meal. Unfortunately, analysis of such a longitudinal effect is beyond the scope of the cross sectional framework used it this study. The implementation of the MDMS program at a particular school could be correlated with the characteristics of the school. Unobserved school characteristics, along with unobserved cognitive properties of a child may also induce parents to selectively match their children with certain schools. Although the use of school characteristics covariates from the matched child-school IHDS data in my analysis diminishes either form of selection problem to some extent, some unobserved bias may still remain.

Nevertheless, given the sheer magnitude of the coverage and the public expenditure associated with the school meal program in India, this study paves an important path for future research. Much of the existing literature focuses on the impact of school meals on enrollment and only a few address the nutritional benefits. Even fewer studies have analyzed the educational attainment and cognitive development aspects of the MDMS program in India. Although universal primary education seems to be an immediate goal for many developing countries, educational transfer programs such as school meals are ultimately aimed towards the enhancement of quality of education and long term human capital formation.

This chapter is organized in the following way - section 4.2 discusses the existing literature on the impact of school meal programs in India and worldwide. A description of the Indian MDMS program along with a brief analytical framework based on the unitary household model are presented in section 4.3. Section 4.4 and section 4.5 respectively explain the data and the empirical framework. Results from the fixed effect regression models and the propensity score matching method are discussed in section 4.6. Section 4.7 concludes.

4.2 Literature Review

Until recently, studies evaluating the impact of school meals in India have largely focused on school participation rates. These studies have shown that in addition to improving overall school enrollment and attendance rates, school meals have also reduced the gender gap in primary education by relatively increasing the schooling opportunities for girls.

For example, using survey data from four major Indian states, Drèze and Kingdon(1999) find a strong positive impact of the meal program on the school participation of female children. Khera (2006), Drèze and Goyal (2003) estimate that the introduction of school meals have increased primary school enrollment by 11% to as much as 23% in the Indian states of Chhattisgarh, Karnataka and Rajasthan. Afridi (2010) finds no overall enrollment impact of school meals in India but finds a more than 12 percentage point increase in the attendance rate of girls in grade-1. Jayaraman (2008) estimates a 25% overall increase in grade-1 enrollment after the introduction of school meals in selected southern Indian districts. However, she does not find any impact on gender disparity or the enrollment gap between different socioeconomic groups.

Internationally, Vermeersch and Kremer (2004) use a randomized evaluation to find a 30% enrollment gain among Kenyan preschoolers receiving school meals. Alderman et al. (2008) show that although the school feeding program (SFP) and the take home ration (THR) programs in Northern Uganda did not have any effect on school enrollment rates, both programs significantly increased the attendance rates for boys and girls. Ravallion and Wodon (2000), Ahmed (2004) find positive enrollment impact of school meals in Bangladesh[7].

Researchers examining the impact of school meals on the cognitive development and learning outcomes of children have found mixed evidence. School lunches are thought to enhance the learning capabilities of students by reducing the distraction from 'classroom hunger'. Continuous administering of meals are likely to enhance long term nutritional status of children, leading to better educational outcomes. Tan et al. (1999) find a positive impact of the school feeding program only on language test scores in Philippines while Ahmed (2004) find similar impact only on mathematics scores in Bangladesh. Adelman et al. (2008a) do not find any impact of the SFP or the THR programs on the test scores of 6-14 year old Ugandan children. However, they find a positive effect of the THR program on the test scores 11-14 year old children. Both programs are also found to improve cognitive abilities of children to certain extent. Vermeersch and Kremer (2004) find that the meal program in Kenya increased test scores by 0.4 of a standard deviation only in preschools with higher quality teachers. Singh (2008) indicate a gain in Peabody vocabulary test scores of children as a result of the introduction of school meals in the Indian state of Andhra Pradesh[8].

A third group of studies have focused on the impact of school meals on the nutritional status of children. The bulk of the research in this area is concentrated on the short term impact of feeding programs. Jacoby et al. (1996) in the context of Peru,

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[7] A broader group of studies focus on the impact of conditional cash or in-kind transfer programs on school enrollment and attendance. For example, Kremer et al. (2002) evaluate the impact of school infrastructure and other inputs on dropout rates. Schultz (2004), Dearden et al. (2005) analyze the effect of conditional cash transfer programs on schooling in Mexico and UK, respectively.

[8] Some studies have investigated the effect of similar child health programs, other than school meals, on the learning outcomes of children. For example, Barham(2008) finds that public health program interventions at early childhood increases the cognitive development of adolescent children in Bangladesh.

Jacoby (2002) in the context of Philippines, and Afridi (2005) in India find evidence of the so called "flypaper effect" whereby nutrition provided through supplementary feeding programs "sticks" to a child in the short-run and the benefits are not nullified through a resdistribution of resources among household members. Islam and Hoddinott (2009) find similar positive impact of a village level protein supplement program on child calorie intake in rural Guatemala. In the context of US, Gleason and Suitor (2003) show that school lunches provided by the National School Lunch Program increase the daily intake of nutrients and dietary fiber by the children. However, on contrary, studies evaluating the fluid milk distribution program in Mexico (Gundersen et al. 2000) and the "glass of milk" program in Peru (Stifel and Alderman 2006) do not find any significant impact of these supplementary feeding programs on child nutrition. Hinrichs (2010) do not find any long-term health impacts of the school lunch program in US, although he argues that the program substantially improves long-term educational attainment.

School feeding programs are relatively young in many developing countries and the current literature on their effectiveness is severely limited. This chapter attempts to address this shortfall in the Indian context by evaluating the impact of the MDMS program on the learning outcomes and nutritional status of children.

4.3 Conceptual Framework

This section provides an overview of the Mid-day meal program in India. Also, I present a simple theoretical framework to analyze the impact of public policy, such as in-kind transfers, on household behavior. Using a unitary household model similar to the one used in section 2.3 of chapter 2, I attempt to explain how a school meal program could also reduce the gender gap in learning and nutritional status of children.

4.3.1 The *Mid-day Meal Scheme* in India

Although some Indian states such as Tamilnadu had been running successful school meal programs for a long time, the central government nationally introduced school meals through the National Programme of Nutritional Support to Primary Education, 1995. Public primary schools were mandated to serve cooked lunches to children attending grades 1 through 5. Each meal was supposed to contain a nutritional value of over 400 kcal with approximately 8 grams of protein (Afridi 2010). Under a responsibility sharing agreement, states governments were supposed to receive free raw grains from the federal government and they, in turn, would arrange for the in-state schools to serve cooked meals. During the implementation phase of next two years, schools were allowed to distribute raw foodgrains to students (Drèze and Goyal 2003).

However, most states failed to introduce cooked lunches well into early the 2000's. The Supreme Court of India issued a landmark judgment in 2001, directing all public primary schools to provide cooked meals within a period of six months. Since then, The *Mid-day Meal Scheme* has been extended to cover approximately 84.1 million primary and 33.6 million upper-primary school children in public schools nationwide during 2009-10[9]. However, the coverage area was continually being expanded through the end of last decade as some states (e.g. Uttar Pradesh, one of the biggest and poorest states) started implementing the program as late as 2004 - providing me with enough variation in coverage in the IHDS 2005 data used for this study.

[9] Department of Education and Literacy, Government of India http://education.nic.in/mdm/mdm.asp

4.3.2 Theoretical Model

Following Becker (1975), I consider a unitary household model with one child of each gender along with parents. This framework can be easily extended to consider more children of each gender. For simplicity, the consumption of goods and services by the boy and the girl are denoted respectively by C_b and C_g. A subset of these consumption vectors include goods and services that are amenable to public policy intervention (i. e. can be subsidized). The vector X denotes all other goods and services consumed by the parents. The consumption of children and parents depend on the characteristics of individual household members such as age, calorie demand according to health status etc. They also depend on household characteristics such as the household size and composition, wealth, caste, religion; and community characteristics such as the location and the availability of infrastructure, power, roads etc. Together, these characteristics are denoted by the vector Φ. Thus, the household's utility function is given as -

$$U = U(C_b, C_g, X; \Phi) \tag{4.1}$$

Considering an additive utility function, the above can be written as -

$$U = W(C_b, C_g; \Phi) + V(X; \Phi) \tag{4.2}$$

If the household has a strong preference for boys over girls, it may gain higher utility by investing more in the nutrition and human capital of the boys. This phenomenon, as discussed in the context of India by Caldwell et al. (1983), Gupta (1987), Drèze and Sen (1995), Arnold et al. (2002), would impose the following condition on the household utility function - for two quantities of consumption, n_1 and n_2, if

$n_1 > n_2$, then $W(n_1, n_2; \Phi) > W(n_2, n_1; \Phi)$. The usual first-order and second-order conditions are assumed to hold for the utility functions and subfunctions.

The cost of child investment C_b and C_g are respectively denoted by p_b and p_g. Following Becker and Tomes (1976), I assume that these prices are functions of the household wealth and income. The price of vector X is denoted by p_X and Y represents the household income. Therefore, the household maximizes the utility function in equation (4.2) subject to the budget constraint below -

$$Y = p_b C_b + p_g C_g + p_X X \tag{4.3}$$

Subsidized public goods such as a free cooked school meal will reduce both p_b and p_g, and therefore increase the consumption by children of both gender. Adelman et al. (2008b) explain the mechanism through which school meals could affect attendance, nutrition and ultimately the cognitive development of children. First, depending upon the opportunity cost of school attendance, a school meal subsidizes the cost of attendance and induces the parents to send their children to school. In addition, the redistribution of the gains from a reduction in total food expenditure (since the children now receive food from the school) provides a secondary incentive for the household.

Secondly, as Simeon and Grantham-McGregor (1989) note, school meals improve learning abilities because the children are not hungry during school and they are able to concentrate better. Furthermore, in the short run, the "flypaper effect" (as discussed in section 4.2) will enhance the nutrition of children. Thirdly, studies such as Mendez and Adair (1999), Currie and Thomas (1999), Case and Paxson (2008) have emphasized the impact of early nutrition and well-being on later life outcomes including educational attainment and employment. Thus, the school meal program could potentially yield long term benefits for the treated children. Finally, depending upon the level of son-preference at the household, the provision of school meals could reduce the gender gap by relatively benefitting the girls[10].

4.4 Data and Descriptive Statistics

I use data from the Human Development Survey of India (IHDS, 2005), a cross-sectional socioeconomic survey of approximately 41,500 households (both urban and rural) from 33 Indian states and union territories (except Andaman Nicobar and Lakshadweep). The survey collected a variety of household and individual information such as household demographics, caste, religion, employment, health, education etc.

A special questionnaire was administered to school going children of age group 8-11 years in each household. This module gathered anthropometric data (height and weight) of the interviewed children. In addition, one simple test each of reading comprehension, writing ability and mathematics was conducted for about 72% of the selected children. All the tests were translated into several Indian languages and the child was given a choice of language during the interview. The reading scores range from 0 to 4, in ascending order of a child's performance. Similarly, mathematics scores were graded on a scale of 0-3 and writing ability was graded on a binary scale (can write/cannot write)[11].

A community level questionnaire collected information on the availability of infrastructure facilities and services such as power, roads, hospitals, along with data on

[10]For a discussion on the relative impact of public goods on girls in India, see Deolalikar et al. (2009) and Oster (2009)

[11]For a detailed description of the tests and survey instruments, see Desai et al. (2008)

local market conditions. Finally, a school level questionnaire collected schooling input information (e.g. infrastructure, teachers) for one public and one private primary school in the village (or urban block)[12].

Information on the coverage of the school meal program can be obtained from two alternative sources - a child level question asks if the child receives cooked meals (or raw grains to take home) regularly from the school. Another school level question collects this information from the school authority. Cooked meals could either be simple *dalia* (rice and lentil porridge) or include a variety of prepared food items. Since only one public school in each community was surveyed, the use of self-reported information to examine the impact of school meals in the household fixed-effect framework gives us a greater coverage. The propensity score matching framework uses the school level meal information to compare the treatment and control children across all public schools in the survey.

To avoid the problem of quality difference between private and public schools, and any household-level selection of children arising out of that, I restrict my analysis only to the 8-11 year old students enrolled in public (and government aided) primary schools. This subsample contains approximately 10,700 children. The survey reveals that 52.4% of children in this group report regularly receiving any kind of cooked school meal and 20.4% report receiving raw foodgrains. No significant gender gap seems to exist in the coverage of cooked meals or raw grains. Figures A.4.1 and A.4.2 in the appendix provide a quick overview of the nutritional status of the treatment (children receiving cooked meals) and control (children not receiving cooked meals. i.e. either receiving raw grains or nothing at all) groups. Similarly, appendix tables A.4.4,

[12] In case a school was not found inside the village, another nearest facility was chosen. The first two children from the special module on 8-11 year old kids can be matched with their schools from the school questionnaire.

A.4.5 and A.4.6 compare the average learning outcome scores of children in these two groups. The fact that the children in the treatment group exhibit overall worse nutritional and learning outcomes indicate a selective program placement - poorer subpopulations with worse health and education status are covered first under the program. Alternatively, the unobserved 'crowding out' effect may also be responsible for reducing the quality of education in some areas.

4.5 Empirical Framework

4.5.1 Household Fixed-effect Regression Model

As the descriptive statistics discussed in the previous section suggest, there may exist systematic differences between the treatment and control groups. In the case of targeted program placement, OLS estimates will be highly biased and likely yield negative treatment impact on the outcome variables. For example, Afridi (2010) finds that the elected village administrative body, the *gram panchayat* (which typically controls two to three villages), has the responsibility of administering the school meal program in rural India. The state government may decide to choose certain *gram panchayats* first, and those *panchayats*, in turn, may choose certain schools, over others, to introduce the treatment. In the absence of a randomized evaluation framework or a natural experiment framework capable of eliminating the program placement bias, I use a cross-sectional framework where treatment and control children inside each household are compared. Separate regression models are estimated for each of the five outcome variables - two nutritional status indicators and three learning outcomes. The basic regression structure is presented below -

$$Score_i = \alpha + \beta Meal_i + \gamma Female_i + \delta Meal_i \times Female_i + \tau X_i + \epsilon_i \quad (4.4)$$

where $Score_i$ denotes the value of the outcome variable for the $i-th$ child. Weight-for-age and height-for-age z-scores are used as nutritional status outcomes[13]. These z-scores are derived by standardization on the basis of an international reference population provided by the World Health Organization[14]. Observations with extreme values of z-scores ($z < -6$ or $z > 6$) have been excluded from the analysis.

Test scores of reading, writing and mathematics are used as the learning outcomes of children. However, to maintain comparability across different age groups, these scores have been standardized to a scale of 0-1 before using them as the dependent variable in equation (4.4). The nationwide average test score for each age (in year) has been used as the reference mean for the standardization process.

Among the explanatory variables, the main variable of interest is the binary $Meal_i$ which takes a value 1 if the child receives a cooked school meal (self-reported). Binary $Female_i$ assumes a value 1 if the child is female. The interaction term ($Meal_i \times Female_i$) capture the possible impact of the school meal in reducing the gender gap in the outcome variable ($\delta > 0$ implies a marginal benefit for girls). X_i includes one or more variables that could capture child characteristics such as age, initial health status, and indicators of ability (e.g. age at first schooling). However, for the sake

[13]Changes in the weight-for-age are generally accepted as a measure of changes in nutrition in the short run while height-for-age is considered as a measure of long-term nutrition. See Svedberg (2000) for a detailed discussion.

[14]I used STATA modules provided by the WHO to calculate the Z-scores. See WHO (2006) and http://www.who.int/childgrowth/software/en/

simplicity and to avoid any reverse causality problem arising out of the inclusion of similar variables on both sides of the regression, I only use the age-related variables for the child as X_i. The *iid* error term of the regression is denoted by ϵ_i.

Equation (4.4) is estimated as a household fixed-effect model by including an appropriate number of household dummy variables on the right hand side. All children in the age group 8-11 years who are enrolled in public or government-aided primary schools are considered in the regression sample. The regression results are presented in section 4.6.

4.5.2 Propensity Score Matching Method

The household fixed-effect model assumes that all children in the household equally share the same observable and unobservable household-level traits. If the household level characteristics - particularly the unobservable ones - are not similar between the treatment and control children, the treatment effect estimated from equation (4.4) may be biased. This is generally true if the household selectively sends different children to different schools, based on child characteristics such as gender, age, a child's nutritional needs and initial cognitive capability.

One popular econometric technique that attempts to mitigate the differences between the treatment and control observations is the so called propensity score matching framework. Following Rosenbaum and Rubin (1983), Heckman et al. (1997) and Dehejia and Wahba (1999), the methodology is briefly described below.

Let Y_{i1} and Y_{i0} denote the outcomes of observation i under treatmet and control, respectively. The treatment status is denoted by a binary variable T, where $T = 1$ for the group which receives the treatment. The treatment effect of interest of a particular obsertaion is denoted by $\tau_i = (Y_{i1} - Y_{i0})$. The estimated average treatement effect on the treated (ATT) is given as:

$$\tau \mid_{T=1} = E(\tau_i \mid T = 1) = E(Y_{i1} \mid T = 1) - E(Y_{i0} \mid T = 1) \quad (4.5)$$

Since a particular sample observation cannot exhibit Y_{i1} and Y_{i0} both at the same time (the "missing data" problem), simple mean-difference estimation of the treatment effect suffers from bias due to the differences in characteristics between the two groups. Let X denote a vector of covariates (characteristics of sample observations). Then the *unconfoundedness* assumption states that the outcome is independent of the treatment status conditional upon the set of covariates, written as -

$$(Y_{i1}, Y_{i0}) \perp T \mid X \quad (4.6)$$

This implies that:

$$E(Y_{ij} \mid X_i, T_i = 1) = E(Y_{ij} \mid X_i, T_i = 0)$$

Therefore,

$$\tau \mid_{T=1} = E[E(Y_i \mid X_i, T_i = 1) - E(Y_i \mid X_i, T_i = 0) \mid T_i = 1] \quad (4.7)$$

weher the outer expectation is over the distribution of $X_i \mid T_i = 1$.

Matching estimators compare the outcomes of the treatment and control observations that possess similar X covariate values. In case of a large number of covariates, the likelihood of finding matched treatment and control observations belonging to each data cell becomes very low ("dimensionality problem"). Estimated propensity scores provide a way of reducing the comparison to a single dimension. Let us suppose that $\pi(X) = P(T = 1|X)$ denotes the probability of treatment conditional on the covariates (i.e. the propensity score). Following Rosenbaum and Rubin (1983), the *unconfoundedness* assumption (4.6) along with the assumption $0 < \pi(X) < 1 \, \forall X$ imply that the outcomes are orthogonal to the treatment not only conditional on the set X, but also conditional on the estimated propensity score -

$$(Y_{i1}, Y_{i0}) \perp T \mid \pi(X)$$

$$or, \qquad E(Y_1 - Y_0 \mid T = 1, \pi(X)) = E(Y_1 - Y_0 \mid \pi(X)) \tag{4.8}$$

Therefore a matching estimator of the average treatment effect on the treated (ATT) can be written as -

$$ATT = \tau \mid_{T=1} = E[E(Y_i \mid \pi(X_i), T_i = 1) - E(Y_i \mid \pi(X_i), T_i = 0) \mid T_i = 1] \tag{4.9}$$

The outer expectation is over the distribution of $\pi(X_i) \mid T_i = 1$. The second term $E[E(Y_i \mid \pi(X_i), T_i = 0) \mid T_i = 1]$ denotes the mean outcome from a matched comparison group. Under propensity score matching method, treatment observations are matched with corresponding control observations on the basis of the estimated probability of treatment.

Using this framework, I evaluate the impact of the school-level treatment indicator (provision of cooked meals) on child outcomes. While examining the impact of school meals on the learning outcomes, one would ideally like to control for schooling inputs (e.g. student teacher ratio, classroom infrastructure). For example, introduction of the meal program at a particular school may depend upon the existing infrastructure. However, data limitation (only one public school surveyed in each village/urban block) do not allow such an analysis in the context of a household fixed-effect model. In the present context, these schooling inputs, along with child and household characteristics, are included among the explanatory variables in the propensity score estimation equation. To provide an overview of any gender-relative effects of the school meal, propensity score ATT are estimated separately for boys an girls. Treatment group observations of each gender are compared with matched counterparts of the same gender. The results are reported in the next section and the first-stage propensity score regressions are presented in the appendix.

4.6 Results

Table 4.1 presents the results from the household fixed-effect regression models evaluating the impact of cooked school meals. The sample includes all children in the age group 8-11 years who attend a government or government-aided primary school. Huber-White robust standard errors are used in each regression; results are robust to clustering at the household level. Similar regression models where the treatment indicator includes any kind of school meal (cooked meal or take-home raw grains) are presented in appendix Table A.4.7.

The results indicate that school meals are generally ineffective in changing the nutritional status or learning outcomes of children. Also, the results do not seem to depend upon the type of the treatment - both "cooked meals" and "cooked meals or raw grains" do not affect the outcome variables. The coefficient of the gender dummy variable exhibits no gender bias in most child outcomes, except for mathematics test score which shows a significant advantage for boys. Similarly, the interaction term shows that school meals do not have any gender-relative impact on the child outcomes.

The main results from the propensity score matching framework are presented in

Table 4.1: Household Fixed-effect Regression of Nutritional and Learning Outcomes of Children

	Weight for Age Regression	**Height for Age Regression**	**Reading Score Regression**	**Writing Score Regression**	**Math Score Regression**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
Cooked meal †	-0.181	-0.109	-0.123	0.073	-0.186
	(0.306)	(0.202)	(0.177)	(0.166)	(0.168)
Female Child †	-0.036	-0.069	-0.012	-0.005	-0.200**
	(0.140)	(0.113)	(0.096)	(0.101)	(0.092)
Cooked meal × Female Child †	0.036	-0.150	-0.055	-0.018	0.106
	(0.193)	(0.159)	(0.130)	(0.143)	(0.124)
Age (in years)	-0.777	0.016	0.129	-0.072	-0.065
	(2.509)	(0.593)	(0.503)	(0.569)	(0.497)
Age squared	0.043	-0.004	-0.004	0.007	0.006
	(0.139)	(0.031)	(0.027)	(0.030)	(0.027)
Constant	1.845	-1.425	-0.838	-0.094	0.096
	(11.198)	(2.762)	(2.318)	(2.627)	(2.284)
Adjusted R^2	0.662	0.669	0.543	0.451	0.548
Number of Children	7,055	8,426	8,356	8,287	8,335
Number of Households	6,061	6,837	6,897	6,844	6,871

Note: Data are from IHDS 2005. Regression sample includes all children in the age group 8-11 years who attend government and government-aided primary schools. Robust standard errors are in parentheses. * and ** respectively denote significance at 10% and 5% levels. † indicates binary variable. Treatment indicator (child receives a cooked meal at school) is self-reported. Test scores are standardized to a scale of 0-1 within each age (year) group.

Table 4.2. Estimates are also reported separately for boys and girls. The treatment indicator captures the availability of cooked meals at the school level (from the school authority questionnaire). All children (8-11 year old), enrolled in government or government-aided primray schools that report serving cooked meals, are considered in the treatment group. Children who go to schools which are similar but do not provide meals, are considered in the control group. The average treatment effect on the treated (ATT) results from the overall sample indicate that cooked school meals only have a statistically significant positive impact on the height-for-age z-score and a weak negative impact on the mathematics score. For boys, there is a weak positive impact on the reading score in addition to height-for-age. For girls, cooked meals do not exhibit any significant effect.

These results could be explained in a few alternative ways. First, the evidence on the impact of school feeding programs in developing countries is mixed. Tan et al. (1999) evaluate the impact of the school feeding program in Philippines on mathematics, Filipino and English test scores of children. The authors find positive impact of the feeding program only on languages test scores. Ahmed (2004) finds a significant positive impact of 0.62 points on the body mass index (BMI) of children under the school feeding program in Bangladesh. He also finds a strong positive impact on the mathematics test score and a similar but weak impact on English scores of the children. Adelman et al. (2008a) do not find any impact of the school meal programs in Northern Uganda on the mathematics and literacy test scores of 6-14 year old children. After segmenting the sample, they find a positive impact of the program on all the test scores of children in the age group 11-14 years, while they find a negative impact on the literacy test scores of 6-10 year old children. Vermeersch and Kremer (2004) find a positive impact of the feeding program on test scores of students in Kenyan preschools only with highly trained teachers.

Table 4.2: Propensity Score Matching Impact of Cooked School Meals on the Nutritional and Learning Outcomes of Children

		Overall Impact	**Impact on Boys**	**Impact on Girls**
Weight for Age Z-score	*ATE*	-0.069	-0.100	-0.147
	Matched *ATT*	-0.081	-0.106	-0.183
Height for Age Z-score	*ATE*	0.120	0.298***	-0.174*
	Matched *ATT*	0.186**	0.290**	-0.163
Reading Score	*ATE*	0.001	0.125**	-0.019
	Matched *ATT*	-0.021	0.139*	-0.070
Writing Score	*ATE*	-0.053	0.017	0.010
	Matched *ATT*	-0.094	0.001	-0.021
Math Score	*ATE*	-0.044	0.021	0.059
	Matched *ATT*	-0.103*	-0.001	0.027

Note: Data are from IHDS 2005. Regression sample includes all children in the age group 8-11 years who attend government and government-aided primary schools. * , ** and *** respectively denote significance at 10%, 5% and 1% levels. Treatment indicator (child receives a cooked meal at school) is reported by the school authority. *ATE* denotes Average Treatment Effect and *ATT* denotes Average Treatment Effect on the Treated. Single nearest neighbor matching method has been used. Results are robust to other methods of matching. Standard errors are bootstrapped. Test scores are standardized to a scale of 0-1 within the age (year) group.

Another group of studies such as Jacoby et al. (1996), Jacoby (2002), and Afridi (2005) show a positive impact of school feeding programs on the short-term nutritional status of children in developing countries. However, studies evaluating milk distribution programs in Mexican and Peruvian schools do not find any impact on child health, as discussed in section 4.2. Although there is evidence of the "flypaper effect" (i.e. the nutrition from school meals would stick with the child), school meals could spur a redistribution of resources among household members whereby the household can afford better nutrition for the control group children. This phenomenon will effectively eliminate any relative benefits from the school meal for the treatment group children.

Secondly, the school meal program in India has been repeatedly associated with an increase in school enrollment and attendance. Drèze and Kingdon (1999) , Khera (2006), Drèze and Goyal (2003), Jayaraman (2008) estimate a positive impact of the *Mid-day Meal Scheme* on enrollment ranging from 11% to 25%. Afridi (2010) finds a positive effect on attendance but not on the enrollment of the children. A surge in school enrollment and attendance may, however, have a negative "crowding out" effect on the quality of education. For example, Vermeersch and Kremer (2004) find that feeding program in Kenyan preschools resulted in higher student-teacher ratio and did not reduce teacher absenteeism. In addition, the entire process of serving meals interfered with the regular education schedule at schools.

Similar arguments have been made by Drèze and Goyal (2003) who find that when school meals are introduced to schools with inadequate infrastructure in India, they could seriously disrupt the schooling process. Often teachers are found to participate in cooking and serving of meals instead of teaching, and sometimes even students are used as the helping hands. The authors also suggest that improper quality control of the school meals could pose a potential health hazard for the children, instead of improving their nutritional status. The data used in the study show that during the 12 months preceding the survey, at least 10% of the students felt sick after eating the school meal one or more times. Therefore, given the large coverage of the program, along with significant regional variation in the type of cooked items served across India, the provision of supplementary school infrastructure and regular monitoring of the program are indeed very important. Otherwise, the adverse impact of the school meals on the quality of education may outweight any possible benefits, to exhibit a negative net impact (for example, the weakly negative ATT on the mathematics score in Table 4.2).

In the context of the household fixed-effect framework, the potential health and educational benefits of school meals may be eliminated if the household selectively matches schools with the children on the basis of their unobserved characteristics. In particular, with the introduction of healthy cooked meals at a nearby school, parents may choose to send one or more relatively malnourished child to school. Similarly, faced with constrained resources for schooling, households may originally choose to send only the more cognitively capable children to school.

Also, if the household has a strong preference for sons over daughters, the parents may initially only send the boys to the school, irrespective of the unobserved cognitive characteristics of girls. After the advent of school meals, however, the less intellectually capable (or less preferred) children may also start attending schools. These actions by parents may result in a downward bias in the observed impact of the school feeding program on the nutrition and education of the children. The bias could be strong enough to completely cancel or even outweigh any positive benefits from the treatment.

Finally, one must note that the household regression model may not fully resolve a bias in program placement. Although the decision to implement the meal program at a particular school is made by the local government (Afridi 2010), some communities, especially in rural areas, often have fewer public schools. A household's transaction costs associated with a child switching from a non-meal-serving school to a meal-serving school could be high enough to prevent any change in the household behavior. Therefore, if lesser quality schools are covered under the school meal programs first and the households do not change their existing child-school match in response to the program, the impact of the treatment will be biased downward, even in a household fixed-effect model[15].

4.7 Conclusion

This chapter evaluates the impact of the Indian school meal program on the nutritional and learning outcomes of school going children. The Indian *Mid-day Meal Scheme*, which covers more than 120 million children, is among the largest school feeding programs in the world. Irrespective of the slow expansion of the coverage and wide variation in the quality of cooked meals across different regions, the extremely low cost-per-child nature of the program makes it highly efficient. As Jayaraman (2008) points out, the per-child per-day cost of school meals is just Rs. 2.21[16] which is much lower compared to the cost of increasing other schooling inputs, such as hiring new teachers. However, what really makes the school feeding program a potentially superior tool compared to other schooling inputs is that it can achieve multiple nutritional and educational objectives. Cooked school meals can bring short term

[15] Appendix Table A.4.9 provides a comparison of public schools that serve cooked lunches with those which do not.

[16] Approximately US$0.05 at the time of writing this chapter.

nutritional benefits, particularly to the malnourished children. In addition, the provision of cooked meals reduces the children's distraction from the 'classroom hunger' and they are able to concentrate better during the school. In the long run, continued nutrition gain through the meals may improve overall health status and cognitive capabilities of children, resulting in higher educational attainment.

From the macroeconomic point of view of the policymaker, this highly cost-effective program could help achieve the goal of the universalization of primary education by improving school enrollment and attendance. The early childhood nutrition could help build a healthy workforce with a higher human capital investment in future, which is essential for the country's long term growth and development.

Most existing studies which evaluate the school meal program in India focus on its positive effect on enrollment and attendance; only a handful of studies have examined the impact on nutrition and learning outcomes. Considering the importance of the short and long term benefits of the school feeding program at a low cost, this study is among the first to contribute to this much needed body of research. Using a household fixed-effect model, I compare the learning and nutrition outcomes of the treatment and control group children within the household. Children receiving a cooked meal at school (self-reported) are considered to be in the treatment group. An alternative specification also includes children receiving raw foodgrains in the treatment group. The results indicate that the school meal program generally does not have any overall impact on the child outcomes, neither does it exhibit any gender-relative impact. The use of propensity score matching technique yields a overall positive impact on the height-for-age indicator and a weak negative effect on the mathematics test score (also, a weak positive impact on the reading score for boys).

However, one should treat the results with due caution. A cross-sectional framework such as the present one may fail to capture many unobserved factors including targeted program placement and the intra-household selection of children. For example, when school meals only reach certain children in a household, there could be unobserved secondary benefits for the rest through a reallocation of resources in their favor. In case of raw foodgrain rations, all members of the household may equally benefit from the greater availability of food. Again, the sudden rise in school enrollment without any additional capacity building exercise may reduce the quality of education in the short run. This will counteract with any potential gains in learning outcomes of children. None of these factors could be captured without the use of an appropriate longitudinal framework, which, unfortunately is not available yet.

The Indian school feeding program, in addition to its desired effect on school enrollments, can be a powerful tool for narrowing social barriers between the two genders, and different religious and caste groups. The program may also contribute to the country's long-term growth by creating a healthier and more educated workforce. The coexistence of the school meal program with other government policies geared towards poverty alleviation, reduction of gender discrimination, and improvement in health and education, creates a complex socioeconomic structure. At the current stage, with the relatively young age of the program, researchers have very few diagnostic tools available to comprehensively study many of the impacts of school meals. Therefore, this study opens up several avenues of research as the program expands through the various strata of the society and more information becomes available in future.

Appendix

Figure A.4.1: Distribution of Weight-for-age WHO Z-scores of Treatment and Control Group Children (8-11 year old), All India

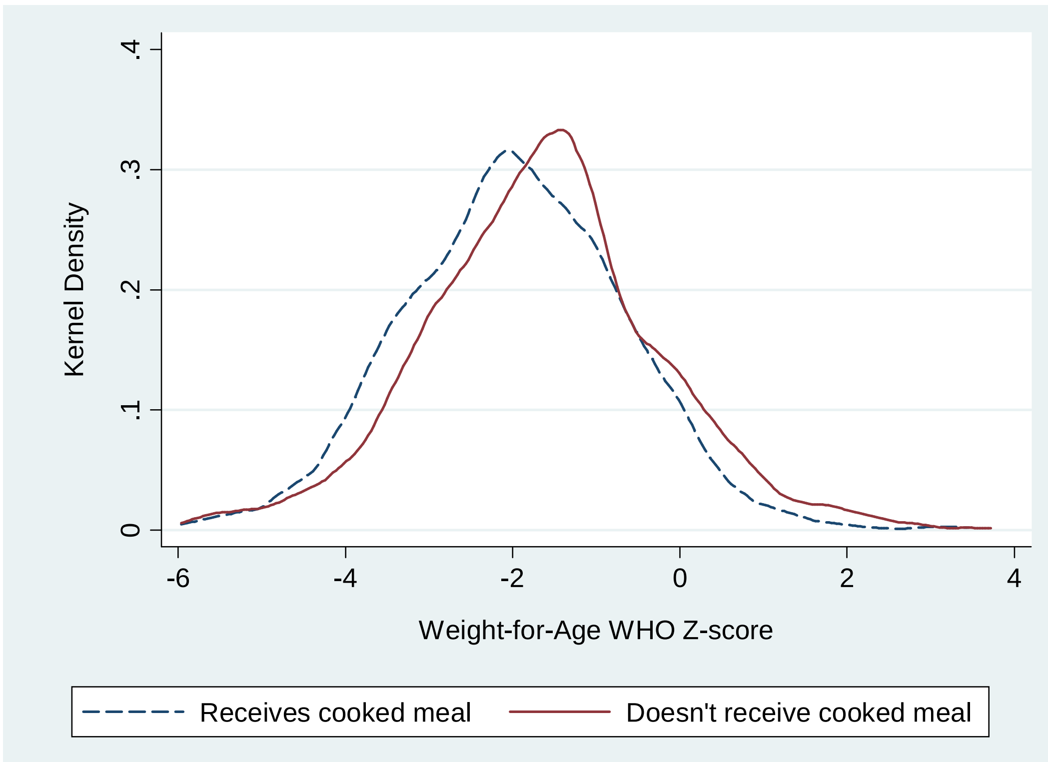

Table A.4.3: Propensity Score Estimation Probit Regression of Cooked School Meal

	Overall Sample Regression	Boys Regression	Girls Regression
	Coeff.	Coeff.	Coeff.
Age (in years)	-0.191	-0.640	0.147
Age squared	0.011	0.034	-0.007
Female Child †	0.014	-	-
Rural Dummy †	0.363**	0.249**	0.483**

Other Backward Class †	-0.064	-0.019	-0.119
Scheduled Caste †	0.051	0.145*	-0.053
Scheduled Tribe †	-0.178**	-0.129	-0.233**
Hindu †	-0.264**	-0.198	-0.330**
Muslim †	-0.392**	-0.401**	-0.396**
Christian †	-0.906**	-0.761**	-1.030**
Agricultural Cultivator HH †	-0.070	0.041	-0.178**
Agri. Labor HH †	0.078	0.123	0.030
Non-Agri. Labor HH †	0.116**	0.170**	0.065
Household Owns Land †	0.109**	0.098	0.119*
Female HH Head †	0.013	0.036	0.004
HH Head's Education	-0.010**	-0.010	-0.012*
Log MPCE	0.065*	0.045	0.090
School Infrastructure:			
Students per Room	0.001	0.002**	0.000
Student-Teacher Ratio	0.007**	0.006**	0.007**
More than One Grades per Classroom †	0.028*	0.022	0.031
Availability of toilet †	-0.181**	-0.162**	-0.206**
Availability of library †	0.033	0.004	0.072
Constant	0.591	3.098	-1.354
State Dummies	Yes	Yes	Yes
Pseudo R^2	0.229	0.213	0.209
Sample Size	8241	4039	4117

Note: Data are from IHDS 2005. Regression sample includes all children in the age group 8-11 years who attend government and government-aided primary schools. * and ** respectively denote significance at 10% and 5% levels. The dependent variable (child receives a cooked meal at school) is reported by the school authority. † denotes binary variable.

Figure A.4.2: Distribution of Height-for-age WHO Z-scores of Treatment and Control Group Children (8-11 year old), All India

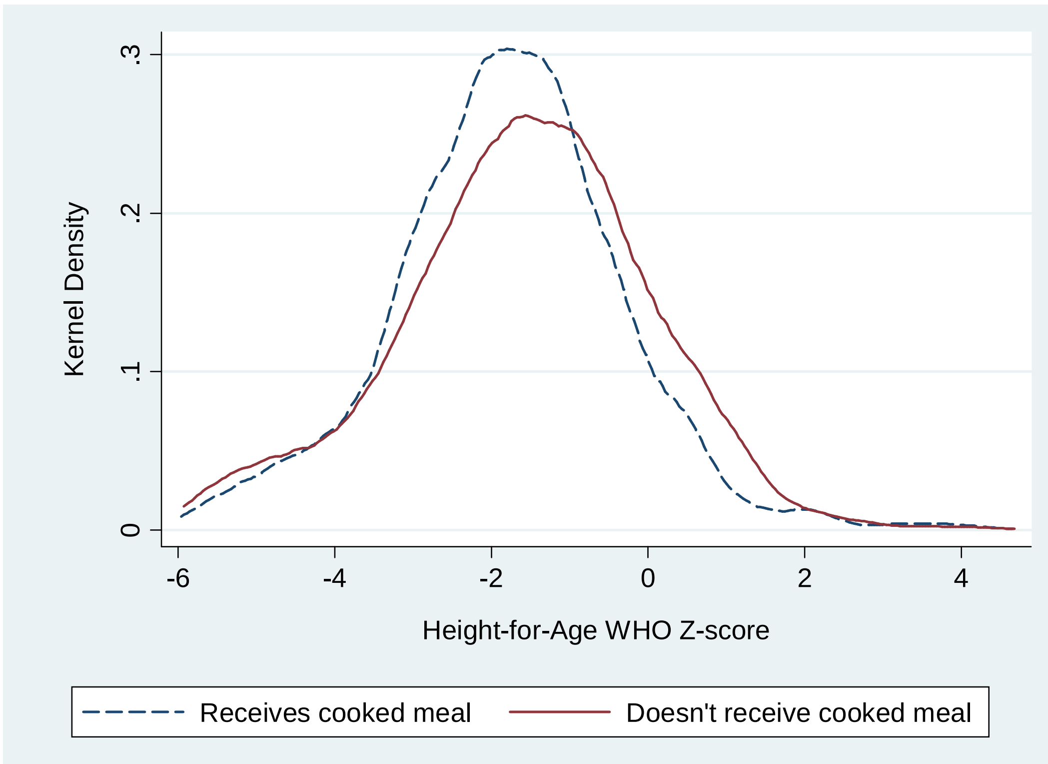

Table A.4.4: Raw Average Test Scores of Treatment and Control Group Children (8-11 year old), All India

	Reading Score (on a scale of 0-4)	**Writing Score (on a scale of 0-1)**	**Mathematics Score (on a scale of 0-3)**
Control Group	2.6	0.68	1.56
(Doesn't receive cooked meal)	(1.33)	(0.47)	(1.04)
Treatment Group	2.33	0.6	1.28
(Receives cooked meal)	(1.33)	(0.49)	(0.96)

Source: Calculated from IHDS 2005 data. Standard deviations are in parentheses. Only the children attending government and government-aided primary schools are considered.

Table A.4.5: Raw Average Test Scores of Treatment and Control Group Boys (8-11 year old), All India

	Reading Score (on a scale of 0-4)	**Writing Score (on a scale of 0-1)**	**Mathematics Score (on a scale of 0-3)**
Control Group	2.65	0.69	1.63
(Doesn't receive cooked meal)	(1.30)	(0.46)	(1.02)
Treatment Group	2.30	0.62	1.37
(Receives cooked meal)	(1.29)	(0.48)	(0.96)

Source: Calculated from IHDS 2005 data. Standard deviations are in parentheses. Only the boys attending government and government-aided primary schools are considered.

Table A.4.6: Raw Average Test Scores of Treatment and Control Group Girls (8-11 year old), All India

	Reading Score (on a scale of 0-4)	**Writing Score (on a scale of 0-1)**	**Mathematics Score (on a scale of 0-3)**
Control Group	2.56	0.66	1.47
(Doesn't receive cooked meal)	(1.35)	(0.47)	(1.06)
Treatment Group	2.16	0.59	1.18
(Receives cooked meal)	(1.36)	(0.49)	(0.95)

Source: Calculated from IHDS 2005 data. Standard deviations are in parentheses. Only the girls attending government and government-aided primary schools are considered.

Table A.4.7: Household Fixed-effect Regression of Nutritional and Learning Outcomes of Children

	Weight for Age	**Height for Age**	**Reading Score**	**Writing Score**	**Math Score**
	Coeff.	**Coeff.**	**Coeff.**	**Coeff.**	**Coeff.**
Cooked meal/Grains	-0.167	-0.163	-0.129	-0.017	-0.161
	(0.303)	(0.188)	(0.148)	(0.146)	(0.143)
Female Child	0.014	-0.040	-0.092	-0.026	-0.259**
	(0.191)	(0.163)	(0.133)	(0.126)	(0.129)
Meal or Grains × Female	-0.043	-0.137	0.071	0.016	0.154
	(0.220)	(0.187)	(0.151)	(0.148)	(0.146)
Age (in years)	-0.578	0.063	0.136	-0.039	-0.062
	(2.513)	(0.594)	(0.500)	(0.570)	(0.496)
Age squared	0.032	-0.006	-0.005	0.005	0.006
	(0.139)	(0.031)	(0.027)	(0.030)	(0.027)
Constant	1.003	-1.550	-0.837	-0.184	0.108
	(11.193)	(2.765)	(2.305)	(2.627)	(2.277)
Adjusted R^2	0.662	0.669	0.543	0.451	0.549
Number of Children	7,055	8,426	8,356	8,287	8,335
Number of Households	6,061	6,837	6,897	6,844	6,871

Note: Data are from IHDS 2005. Regression sample includes all children in the age group 8-11 years who attend government and government-aided primary schools. Robust standard errors are in parentheses. * and ** respectively denote significance at 10% and 5% levels. Treatment indicator (child receives a cooked meal or raw grains at school) is self-reported.

Table A.4.8: Descriptive Statistics of Treatment and Control Groups - Average Characteristics

	Treatment Group		**Control Group**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Age of child (years)	9.395	1.045	9.631	1.088
Female child dummy	0.484	0.500	0.477	0.500
Household characteristics:				
Rural household	0.865	0.342	0.823	0.382
Other Backward Caste	0.430	0.495	0.415	0.493
Scheduled Caste	0.284	0.451	0.238	0.426
Scheduled Tribe	0.076	0.265	0.079	0.271
Hindu	0.858	0.349	0.812	0.391
Muslim	0.110	0.313	0.129	0.335
Christian	0.011	0.104	0.022	0.146
Cultivator	0.338	0.473	0.286	0.452
Agricultural labor	0.204	0.403	0.173	0.379
Non-agricultural labor	0.217	0.413	0.190	0.393
Owns land?	0.531	0.499	0.478	0.500
Family head is female	0.074	0.262	0.086	0.280
Family head's education (years)	3.888	4.164	4.581	4.437
Log MPCE	6.148	0.525	6.271	0.578

Note: Data are from IHDS 2005. Sample includes all children in the age group 8-11 years who attend government and government-aided primary schools. Treatment indicator (child receives a cooked meal at school) is self-reported. MPCE denotes monthly per capita expenditure.

Table A.4.9: Descriptive Statistics of Public Schools

	Public Schools that Serve Cooked Meal		**Public Schools that Don't Serve Cooked Meal**	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**
Number of students/room	60.360	55.558	67.211	63.985
Number of teachers	5.063	3.625	4.908	3.763
Student-teacher ratio	52.874	38.229	59.418	43.661
Mixed-grade classrooms are held?†	0.905	1.139	0.952	1.208
Electricity available at school†	1.710	2.485	1.426	2.381
School has a toilet inside?†	0.587	0.492	0.540	0.499
School has drinking water inside?†	0.721	0.448	0.667	0.472
Availability of chairs†	0.201	0.400	0.357	0.479
Availability of mats†	0.684	0.465	0.553	0.497
School has a library?†	0.418	0.493	0.292	0.455
Availability of fans†	0.234	0.423	0.242	0.428
School has a playground?†	0.684	0.465	0.608	0.488
Teacher evaluation is conducted?†	0.685	0.465	0.700	0.458

Note: Data are from IHDS 2005. Sample includes all government and government-aided schools. † denotes binary variable. Information on the provision of cooked meals and other schooling inputs is collected from the school authority.

Chapter 5

Conclusion

Despite India's strong economic growth and improvement in human development during recent decades, there is a serious lack of gender equality. A strong preference for sons over daughter, and as argued by some researchers - a strengthening of that preference over time, have led to an increased masculinization of the population sex ratio over the last half a century. Women are discriminated both prenatally and postnatally - leading to fewer female births and higher female child mortality rates. The surviving girls suffer from parental neglect through childhood and early adulthood, leading to worse health, human capital, and labor market outcomes in later life.

The Indian federal government and individual state governments have recently undertaken numerous public policies, some of which are generally targeted toward poverty alleviation and human development. Many of these policies, in addition to serving their intended purpose, could potentially reduce the son-preference of households and the discrimination of girls. The school feeding program discussed in this dissertation is an example of such a policy. Secondly, demographic policies aimed at fertility control and a reduction in population growth rate have been implemented nationally and by some individual states. These policies may affect the degree of son-preference among households and arguably increase the neglect of girls[1]. Finally, a third group of policies attempt to reduce the discrimination of girls through direct intervention. The PNDT Act belongs to this group, along with several conditional government transfer programs which promote better care of young girls, inheritance laws that encourage gender equality, and public awareness campaigns which discuss gender issues through media and other outlets.

It is appropriate to conclude this dissertation with a broad overview of these above mentioned public policies and their possible gender-relative socioeconomic impact. But first, I will summarize the findings of my analysis of the PNDT Act and the *Mid-day Meal Scheme*. A discussion on other relevant public policies will follow.

The state government of Maharashtra, motivated by interest group campaigns against sex-selective abortions, implemented the PNDT Act in 1988. The Act banned the use of fetal sex determination techniques such as ultrasound, amniocentesis and chorionic villus sampling. Abortion itself has never been outlawed in India, although it is a restricted practice. Therefore, the PNDT Act was designed to prevent female feticides by prohibiting heathcare providers from divulging information on the gender of the fetus. The central government of India instituted the law in 1994 (effective from 1996). The difference in timing between Maharashtra and the rest of the country provides me with a natural experiment framework which is used in chapters 2 and 3 to evaluate the impact of the Act on child outcomes.

Chapter 2 examines the impact of the ban on the sex ratio of young children. Using village and town level longitudinal data from the Indian censuses of 1991 and 2001, I estimate the difference-in-difference impact of the law on newly-treated com-

[1] For example, in China, Hesketh and Zhu (1997), Das Gupta (2005), Hesketh et al. (2005), Qian (2009), Zhu et al. (2009), and Ebenstein (2010) argue that the "One Child Policy" has strengthened the preference for sons.

munities (i.e. communities from states other than Maharashtra). The comparison group (pre-treated) consists of the communities in Maharashtra. Different segments of the society, depending upon their socioeconomic characteristics, exhibit different levels of preference for sons. To eliminate any community specific time-invariant heterogeneity, first difference regression models of villages and towns have been used. Again, communities may also be heterogeneous with respect to the changes in their characteristics over time. To mitigate this time-varying heterogeneity between the pre-treated and newly-treated group, I begin my analysis with communities from the two groups that are in close geographic proximity. However, for concerns related to possible spillovers, i.e. diffusion of the treatment across the geographic threshold, I employ several other subsamples which are located gradually distant from each other.

Additional analysis using household level data from the National Family Health Surveys have been conducted. Also, to better understand the dynamics of the law across different sections of the society, I perform some preliminary analysis using quantile regression models. I assume that the quantiles of the conditional distribution of the juvenile sex ratio correspond to the level of son preference in a community.

The census linear regression results show a significant positive impact of the PNDT Act on the juvenile sex ratio (number of girls per 1000 boys among less than 6 year old children). The NFHS regression models exhibit similar but weaker effects. Given that the observed sex ratio declined across the entire country during my study period, the positive effect of the law is considered to be a marginal impact, i.e. the gender imbalance would have worsened in the possible absence of the law. Finally, quantile regression models show a stronger impact of the ban on communities in higher quantiles of the conditional sex ratio distribution, i.e. those with a weaker preference for sons over daughters.

Chapter 3 uses the natural experiment framework once more, to evaluate the effects of the PNDT Act on gender-relative child quality investments. With the marginal success of the PNDT Act in reducing the gender imbalance (i.e. resulting in more female child births), the neglect of young girls may rise. If the law increases the sibship size in a household, the per capita allocation of resources will reduce for all children, boys and girls alike. The resources for girls may further reduce if the boys are favored by the parents. Thus, the PNDT Act may increase the neglect of girls. However, there may be an opposite 'economies of scale' effect from the PNDT Act, whereby larger families experience lower per-child cost.

The child outcomes analyzed in this study are various indicators of vaccination and child nutrition. Using child level NFHS data from 1992-93 and 1998-99, I estimate the differential impact of the law on the gender gap in child outcomes. The results are mixed - I find that the law was mostly ineffective but depending upon the choice of sample and child outcome, it exhibits a positive or negative impact in a few cases. However, the law did not uniformly worsen the relative outcomes of girls. Therefore, the PNDT Act may have resulted in a net improvement in social welfare - it was partially successful in reducing gender imbalance, and it did not have any negative 'unintended consequence' on young girls.

Chapter 4 is a study of the school feeding program in India. With a coverage of more than 120 million children in public schools, the Indian school meal program has been found to improve school enrollment and participation rates of children. My study is among the first to evaluate the impact of the program on learning outcomes and nutritional status of all children in general, and to examine any relative benefits for the girls in particular. Using child data from the Indian Human Development Survey (2005), I estimate household fixed-effect models and propensity score matching outcomes to evaluate the impact of cooked school meals on children's anthropometric weight and height indicators, and standardized test scores of reading, writing and mathematics. I find that the school feeding program does not have any significant effect on the outcomes of 8-11 year old children, nor does it have any additional impact on girls.

Now we come to a discussion on the Indian public policies mentioned earlier in this section. The first broad group of public policies generally consists of government programs that provide access to free or highly subsidized public goods. One of the root causes of the discrimination of girls within a household is the scarcity of resources. With limited resources, parents with a strong preference for sons often choose to purchase healthcare, nutrition and education only for the boys. With greater availability of public heathcare and educational infrastructure, such as primary health care centers, *Anganwadis*, and government schools, parents may decide to access these free or cheap services also for the girls. Therefore, many public goods programs may potentially bring relative benefits for the girls. However, as Deolalikar et al. (2009) and Oster (2009) argue, public health interventions do not seem to have any overall gender-relative effect, since simply providing access may not translate into the actual use of these facilities, or the facilities may themselves be placed inside target populations. Future research in this area will likely analyze the possible gender benefits of more public policies and identify the ones which can successfully reduce the neglect of girls.

To control population growth, the federal government of India instituted the National Population Policy in 2000. The goals of the policy were divided into three groups - immediate, medium term and long term. Among the immediate objectives was the provision of basic reproductive and child care services across the entire nation. The medium term goal was to reduce the total fertility rate to replacement levels by 2010 and the long term objective was to bring population stability by 2045. In addition to the national policy, many state governments have adopted their own fertility control policies, such as Orissa (1994), Andhra Pradesh (1997), Rajasthan (1999), Madhya Pradesh (2000) and Uttar Pradseh (2000). Furthermore, there are several localized family planning programs operated by rural governments and NGOs. The Jamkhed Project in Maharashtra, which provides reproductive and general health services to women in 175 villages, and the Karnataka Project for Community Action in Family Planning, which successfully achieved various maternal health and family planning objectives in 154 villages, are two examples of such community level efforts (Wolfson and Fincancioglu 1987). A reduction in fertility rates and the "small family norm" may, however, strengthen the preference for sons (Das Gupta and Bhat 1997, Park and Cho 1995, Mallik 2002). This particular aspect of the population control policies in India lacks comprehensive analysis, and thus belongs to my future research agenda.

Finally, there are several public policies that directly address the problem of son-preference in India. A first subgroup of these policies include conditional cash transfer programs such as the *Balika Samridhi Yojana* (Girl Child Empowerment Scheme, 1997) of the federal government. For families living below the poverty line, this program provides a one-time monetary incentive of INR 500 for every female child birth. In addition, annual scholarships ranging from INR 300 to INR 1000 are provided after the completion of grades 1 through 10 in school by the child. Parts of the birth-grant and the annual scholarship are deposited in a special insurance scheme in the name of the girl child, known as the *Bhagyashri Balika Kalyan Bima Yojna*. On achieving adulthood, unmarried girls are allowed to withdraw the entire amount with accrued interest from the deposit.

Another conditional cash transfer scheme, *Dhanalakshmi*, was introduced as a pilot project by the central government in seven Indian States in 2008. The program, similar to the *Balika Samridhi Yojana* in operation, covered approximately 80,000 girls during 2008-09. The state governments of Haryana and Delhi implemented the *Laadli* scheme in 2008 - a program that provides a birth-incentive of INR 10,000 for every girl, and annual incentives of INR 5,000 during certain educational years of the child. Similar cash incentive programs have been launched by the state governments of Andhra Pradesh (Girl Child Protection Scheme, 1996-97) and once again Haryana (*Apni Beti Apna Dhan*, 1994). The *Kishori Shakti Yojana* or the Adolescent Girls Scheme (2007) is another federal program that provides supplementary nutrition and vocational training, and raises awareness about health and hygiene among 11-18 year old girls. The program covers adolescent girls in 6,118 blocks across the country.

NGOs and other interest groups have long been conducting public awareness campaigns against the neglect of girls in India (for example, see Joseph and CYDA 2007). In addition to proactive public policies in the form of the PNDT Act and conditional transfer programs, some state government have started their own awareness campaigns. For example, the *Beti Bachao Abhiyan* (Save the Daughter Campaign, 2005) of Gujarat actively engages various stakeholders of the society and raises awareness through public discourse.

A third and final subgroup of public policies directed toward the preference for sons include the family inheritance laws. Given the patrilineal family structure in India, the Hindu Succession Act (1956) - the main law governing property inheritance practices - was largely in favor of sons. Households assets are generally transferred to the men of next generation; and the practice of exogamy implies that the daughters typically live with the in-laws after marriage and do not receive any parental assets. In an attempt to reduce the discrimination against women, the central amendment of the Succession Act (2004) have established equal property rights for men and women.

As discussed in this section, the current socioeconomic environment in India is characterized by a complex maze of public policies which may positively or negatively affect the preference for sons over daughters. As Chung and Das Gupta (2007) suggest, economic growth and development along with active policymaking may indeed reduce the the extent of son preference in India and China, something which has already been experienced in Korea. Given the existence of a very comprehensive literature on the socioeconomic roots of gender imbalance, and the gender-discriminatory practices of households, the impact evaluation of various proactive public policies discussed in this section seems to be the appropriate way forward for the future researcher.

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