Three Empirical Essays in Development Economics in India

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A Dissertation presented to the Graduate Faculty
of the University of Virginia in Candidacy for the Degree of
Doctor of Philosophy

Department of Economics

University of Virginia

May, 2013

UNIVERSITY OF VIRGINIA

Abstract

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This dissertation consists of three chapters on gender issues in India focusing on female health, autonomy, and education.

In Chapter 1, "Improving Maternal Health with Incentives to Mothers vs. Health Workers: Evidence from India", I assess the role of incentives on health care utilization using a unique program, which provided cash incentives to pregnant women and to health workers conditional on child delivery at health facilities. I exploit plausibly exogenous differences in eligibility and transfer size by state, income, and caste. I find that the program increased the probability of a delivery at a health facility by 4 percentage points. It also increased utilization of prenatal and postnatal care. The effect of an additional dollar given to a health worker was substantially larger than that of dollar given to a mother. These results suggest that choosing both the agents to incentivize and their incentive amounts are crucial to efficient delivery of health care services.

In Chapter 2, "The Impact of Household Structure on Female Autonomy in Developing Countries, I estimate the effect of joint households in India on women's autonomy and labor force participation". In joint households several generations co-reside and share resources. I use the death of the patriarch of the joint household as an instrument for household structure and find that women living in nuclear households are up to 18 percentage points to have substantive decision making power and are 9 percentage points more likely to participate in labor market.

In Chapter 3, "School Subsidies for Girls and the Gender Gap in Enrollment", I evaluate the effect of two programs in India which target gender disparity in education. The programs were implemented in Educationally Backward Blocks, determined by a discontinuous assignment rule. I estimate the effect of these programs using a sharp Regression Discontinuity design and find that the programs increased the probability of enrollment for a girl by 3 percentage points while there was no significant effect for boys. The gains in enrollment were almost twice as high for girls belonging to lower castes.

Acknowledgements

Graduate school has helped me to find an area which challenges and engages me. This would not have been possible without guidance, encouragement and support from my mentors, family, and friends.

It is the exposure to economics that I received from Sugato Dasgupta and Arijit Sen at Jawaharlal Nehru University that made me interested in the subject. My advisers at the University of Virginia, Leora Friedberg, Sheetal Sekhri, John Pepper, and Sarah Turner taught me how to address issues as a researcher. I am grateful to them for sharing their wisdom with me.

I would also like to thank my childhood mentors Jiban Krishna Roy and Debashis Mishra as without their teachings I would be less educated.

I feel fortunate to have friends like Xiaohuan Lan and Parth Havnurkar. Their cheerful company has made some of the tough times at graduate school seem much lighter.

My wife's confidence in my abilities has propelled me to come this far. I met her during graduate school and since then her constructive criticisms of my ideas have compelled me to introspect, which helped me sharpen my arguments. It is her constant support that keeps me motivated and committed to my work. My parents provided unabated support for my academic career. My father's dedication to work has been an example to me. But, it is ultimately my mother's faith in me that led me to an academic career. I dedicate this dissertation to her.

Contents

List of Figures

List of Tables

Abbreviations

ANM	Auxiliary Nurse Midwife
ASHA	Accredited Social Health Activist
BPL	Below Poverty Line
CCT	Conditional Cash Transfer
CHC	Community Health Center
DLHS	District Level Household Survey
EBB	Educationally Backward Blocks
HDPI	Human Development Profile of India
ICDS	Integrated Child Development Scheme
IHDS	India Human Development Survey
JSY	*Janani Surakshya Yojana* (Safe Motherhood Scheme)
KGBV	*Kasturba Gandhi Balika Vidyalaya* (Kasturba Gandhi Girls' School)
MO	Medical Officer
NFHS	National Family Health Survey
NPEGL	National Programme for Education of Girls at Elementary Level
OBC	Other Backward Castes
PHC	Primary Health Center
PSU	Primary Sampling Unit
RDD	Regression Discontinuity Design
SC	Scheduled Caste
SSA	*Sarva Sikshya Abhiyaan* (Universal Elementary Education Program)
ST	Scheduled Tribe

For Chotomaa. . .

Chapter 1

Improving Maternal Health with Incentives to Mothers vs. Health Workers: Evidence from India

1.1 Introduction

In 2010 developing countries accounted for 99 percent and 98.5 percent of the total maternal and infant deaths in the world, respectively.[1] Low utilization of health care facilities is often considered one of the main reasons for high maternal and child deaths in these countries (Amin et al., 1989). Even though the government of India provides basic maternal and child health care facilities for free or at minimal cost, either high opportunity costs or low quality of services deter the use of such services in India (Chaudhury et al., 2006).

Cash transfers to low income individuals that are conditional on utilization of particular public services is now a popular tool to increase utilization of health care services. India recently implemented a *Conditional Cash Transfer* (CCT) program designed to increase use of pre and postnatal health services. I estimate the impact of this CCT program, which provided varying cash incentives for both pregnant women and health care workers.

A large body of literature finds that CCT programs raise utilization of health facilities in a variety of countries. These evaluations were mostly done for programs in Latin

[1] See WHO, UNICEF, UNFPA and The World Bank (2011, 2012)

American countries, where facilities are also relatively more developed.[2] A growing body of literature with sound identification strategy finds that incentive programs for public providers can also increase utilization and quality of health care and other public services (Banerjee et al., 2008). Most of those incentive programs make the salaries of public servants a direct function of their effort levels by means of reward, punishment or a combination of both. Yet, uncertainties remain about the design of public service provision incentives. First, incentive amounts may not be sufficient. Second, health workers may have a target income level and may stop working after reaching their monthly target (Fehr and Goette, 2007). Lastly, the incentive scheme may crowd out the intrinsic motivation of health workers (Benabou, 2006).

The *Janani Surakshya Yojana* (JSY, Safe Motherhood Scheme), a CCT program, was launched in India in 2005. The objective of the program was to improve utilization of maternal health care. The program provided cash incentives to pregnant women to give birth in a public or private health facility and to health workers to facilitate this. Eligibility and incentive amounts given to mothers and health workers varied substantially under the program. In ten low performance states (defined as having low rates of institutional births prior to JSY) eligibility for the program was universal and payments were made to both mothers and health care workers, while in high performance states eligibility was restricted to women who were disadvantaged by income or caste, and health care workers received no payments. The incentive amount to mothers and health workers differed by location, with pregnant women and health care workers given Rs. 1400 ($25.50) and Rs.600 ($10.9), respectively, in rural areas and Rs.1000 ($18.2) and Rs.200 ($3.6)in urban areas of low performance states. In high performing states conditional cash assistance to eligible pregnant women was Rs.700 ($12.7) and Rs.600 ($10.9) respectively for rural and urban areas.

I use observational data and difference-in-difference estimation strategies that exploit several of these dimensions of variation in eligibility and incentive size, to find the effect of incentives provided to mothers and health workers on institutional birth, utilization of prenatal care and immunization of the child. I find that the program raised the likelihood of all eligible women delivering in a health facility by 4 percentage points. The effects of the program took some time to emerge, with small effects apparent in the first two years (2005-06) and a 9.1 percentage point increase in institutional delivery in the next two years. These effects are greater in rural areas, where the cash incentive amounts were larger for both mothers and health workers compared to urban areas.

[2]See Lagarde et al. (2007) for a survey of literature assessing the effect of CCTs on utilization of health care facilities.

The program also significantly increased the probability of an eligible woman receiving a pregnancy confirmation test, iron folic acid supplements, prenatal care visits, tetanus injections and of babies receiving a variety of immunizations.

Given the variation in the cash incentives, I also estimate the effects of cash amounts given to mothers or health workers. The estimates suggest that an additional Rs.100 incentive to workers increased the probability of an institutional delivery by 0.6 percentage points for the entire period and 1.2 percentage points in the final two years of my data, with much smaller effects resulting from giving an extra Rs.100 to mothers. The incentive effects for workers continue to be larger for the measures of prenatal care utilization and immunization.

Increase in health care utilization for pregnant women and infants are also likely to reduce maternal and infant mortality. However, the District Level Health Survey - III is not suitable to analyze the effect of the JSY program on maternal mortality.[3] The survey collected data on all pregnancies for women reporting at least one pregnancy since January 2004. Although statistically insignificant, I find that eligibility for the program reduced 1.7 to 3.8 infant deaths by per 1000 live births. I also find that the program significantly reduced early neo-natal mortality whereas there was no significant effect of the program on late neo-natal mortality. These results are consistent with the increase in institutional deliveries as health institutions are more efficient is addressing complications during or immediately after childbirth than births at home.

Most of the existing literature estimates the effect of CCT programs on health and educational outcomes when the incentives are given to the user. Another small body of literature finds the effects of incentives given to health care workers or teachers on utilization of health care facilities and educational outcomes. This paper is the first to compare the effectiveness of incentives for both users and public service workers and finds a much stronger effect of giving incentives to the later. Successful implementation of incentive based program is a challenge in developing countries. This is especially true for programs aimed at government facilities, as public sector employees are organized and politically powerful and often face strict work rules (Duflo et al., 2012). Interestingly,

[3]The District Level Household Survey -III (2007-08) collected information on four most recent deaths in the household since January 2004. This implies that recent maternal deaths are more likely to be reported and therefore the estimated program effects on maternal mortality would be biased. But the survey collected data on the results of all pregnancies reported by 15 to 49 year old women thus making it more suitable to analyze the effect of the program on infant mortality. Note that I do not observe the status of live births for deceased women. Since only 0.06 percent of the interviewed households reported death of a woman either during pregnancy or six weeks after child birth, the bias due to selection, if present, is negligible.

the JSY program circumvented this potential problem by mobilizing temporary workers (Accredited Social Health Associates, ASHA), who are paid on a freelance basis, so effort yielded direct reward, and are less likely to be organized. This paper provides credibility to the strategy of creating an incentive program within a framework which is plagued by absenteeism and politically powerful workers.[4]

The rest of the paper is organized as follows. Section 1.2 discusses the relevant literature. Section 1.3 describes maternal health care in India. The JSY program is described in Section 1.4. Section 1.5 and 1.6 describes the data and the estimation strategy. The results are described in Section 1.7. Section 1.8 discusses robustness of the results and finally Section 1.9 concludes.

1.2 Literature

Income transfers can raise health outcomes if the primary cause of low health is liquidity constraint. However, if poor households are pressed with competing priorities and fail to understand benefits of good health, unconditional transfers may not yield better health outcomes. There is a large body of literature evaluating the impact of unconditional transfers on health outcomes. Duflo (2003) finds that large transfers to grandparents in South Africa improved grandchildren's nutrition and health. However, Behrman and Deolalikar (1987) finds that nutrient elasticity with respect to income in rural south India may be very close to zero. Similarly, in the United States cash transfer does not seem to improve child health (Currie, 1993). Generally, the literature on the effect of cash transfers on health outcomes remains controversial.[5]

Another approach that seeks to improve health outcomes is to make incentives or cash transfers conditional on specific behaviors of the recipient. This approach relaxes the budget of the household but adds additional constraint of utilization of health care or other facilities.[6] Gertler (2004) finds that PROGRESSA, a CCT program in Mexico

[4]Banerjee et al., 2008 finds that an experiment (in Rajasthan, India) which made salaries of government health workers a function of their effort level was initially effective but the gains were lost over time as the local health administration undermined the scheme.

[5]See Alderman (1986), Behrman and Deolalikar (1988), Behrman et al. (1997), Bouis (1994), Bouis and Haddad (1992)

[6]Latin American countries were among the first to adopt such conditional cash transfer programs and transfers were typically linked to attendance for preventive interventions at primary health care facilities and educational enrollment for children.

improved child health.[7] A randomized control trial experiment in India finds that regular immunization camps combined with incentives improves immunization rates (Banerjee et al., 2010).

The CCT programs are often linked to educational outcomes. Baird et al. (2010) finds that a two year CCT program in Malawi decreased the dropout rate for adolescent girls by more than double compared to a unconditional cash transfer program.

Another small yet well identified body of literature finds that improving quality of public services also leads to increase in utilization. Quality of public service can be improved by either incentivizing or punishing providers according to their effort levels. Duflo et al. (2012) finds that monitoring and finacial incentives to teachers reduces teacher absence and increase learning in rural India. A randomized experiment by Banerjee et al. (2008), also in rural India, recorded presence of nurses at government health centers. The most delinquent nurses were punished financially by the government. Monitoring and subsequent punishment for absentee nurses increased their attendance significantly. However, the gains of the program was lost as the local health administration undermined the scheme later.

1.3 Maternal Health Care in India

Family welfare and health services in India are provided by a mix of public and private facilities. In rural areas these services are mainly provided by a large network of health centers established by state and national governments arranged in three tiers. A sub-center is the most peripheral and the first point of contact between a patient and the public health care system.[8] Primary health centers (PHCs), the second tier in the system, serve as the first contact point between a patient and a Medical Officer.[9] Finally,

[7]The PROGRESSA disbursed cash incentives to poor households conditional on engagement in a set of behaviors designed to improve health and nutrition, including prenatal care, well-baby care and immunization, nutrition monitoring and supplementation, preventive checkups, and participation in educational programs regarding health, hygiene, and nutrition.

[8]Each sub-center is staffed by at least one Auxiliary Nurse Midwife (ANM) or a female health worker and a male health worker. Six sub-centers are supervised by a health visitor. The sub-centers provide services related to maternal and child health, family welfare, nutrition, immunization, diarrhoea control and control of communicable diseases. The sub-centers are provided with basic drugs for minor ailments (no antibiotics). There were a total of 1,48,124 functioning sub-centers as of March 2011 (Ministry of Family Health and Welfare, Government of India, 2011).

[9]PHCs are staffed by a Medical Officer supported by 14 paramedical and other staff. It acts as a referral unit for six sub-centers and has four to six beds for patients. The activities of PHCs involve curative, preventive, promotive, and Family Welfare Services. There were 23,887 PHCs functioning in the country as of March 2011 (Ministry of Family Health and Welfare, Government of India, 2011).

community health centers (CHCs) are the apex body of the health system which serves as a referral unit for approximately four PHCs.[10] According to government norms, one sub-center is to be provided per 5000 residents. Similarly, one primary and community health center is to be provided per 20,000 and 80,000 residents respectively. These norms vary for tribal and hilly areas (Ministry of Family Health and Welfare, Government of India, 2011).

Apart from these three types of health facilities, medical colleges, private hospitals and nursing homes also cater to health care needs. Unlike the rural areas, urban areas do not have a well-structured health system. Urban areas are usually catered by a mix of services, consisting of small and large hospitals complemented by outreach services run by the government, civic agencies, private organizations, and NGOs. Most urban slums are covered by the Integrated Child Development Scheme (ICDS) (World Health Organization, 2005).

The majority of these services are provided at the community level through various types of health workers. Auxiliary Nurse Midwives (ANMs) at health sub-centres cater to a group of contiguous villages. *Dais* (midwives) and *Anganwadi* workers present in most of the villages provide advice, information and basic health services for pregnant women, mothers and young children (Shariff and Singh, 2002).[11] Prenatal services are part of the primary health care services for pregnant women. In India prenatal services consist of a set of pregnancy checkups, tetanus and other immunisations, prophylaxis through iron and folic acid tablets, blood pressure check up and advice and information regarding delivery methods and services, nutrition and postnatal care. Although these services are available in the private sector, the government has been the largest (over 90 percent) supplier of prenatal care in rural areas (Shariff and Singh, 2002). Postnatal care needs more of hospital level care relative to prenatal care as complications during delivery requires skilled personnel and hospital facilities. The postnatal services provided at the community level include counseling on family planning, breast feeding practices, nutrition, management of neo-natal hypothermia, early detection of postpartum complications and referral for such problems. The higher-tier health centers are intended to provide these services as well as take care of post delivery complications.

[10] CHCs provide obstetric care and specialist consultations. As on March, 2011, there were 4,809 CHCs functioning in the country (Ministry of Family Health and Welfare, Government of India, 2011).

[11] Anganwadi is a village-level child care center set up under the Integrated Child Development Services program (ICDS). Each Anganwadi covers a population of about a thousand.

1.4 The *Janani Surakshya Yojana* Program

Janani Surakshya Yojana (JSY, Safe Motherhood Scheme) is a conditional cash transfer program launched in India in April 2005. The objective of the program is to improve maternal and neo-natal health by promoting delivery in institutional settings among pregnant women. The program provided cash incentives to pregnant women and health workers to facilitate birth in a public or private health facility. While the JSY program is implemented all over India, it gave special emphasis to ten"low performing states", that had low levels of institutional delivery at the baseline.[12] Figure 1.1 shows the spatial variation in the implementation of JSY. It was mandatory for all the states to implement the program with the same nationally set parameters.[13]

The JSY program mobilized existing Accredited Social Health Activists (ASHAs), a local community health worker, to identify pregnant women and counsel them for institutional delivery.[14] These workers worked on a freelance basis for several government health awareness programs. Any woman between 25 to 45 and with at least eight years of schooling were eligible for the ASHA posts. They are selected by a committee consisting of self-help groups, Block Nodal officer, District Nodal officer, village Health Committee and Gram Sabha (Village council). The selected ASHAs were given a training in basic health care practices. The duration of training period varied by state. The ASHAs received performance based incentives for promoting universal immunization, referral and escort services for Reproductive and Child Health (RCH) and other health care programs, and construction of household toilets. The incentive amounts for ASHA workers varied by state and area of residence only for the JSY program.

[12]The low performing states were Uttar Pradesh, Uttaranchal, Bihar, Jharkhand, Madhya Pradesh, Chhattisgarh, Assam, Rajasthan, Orissa and Jammu and Kashmir (Ministry of Family Health and Welfare, Government of India, 2006).

[13]Unilateral changes in the program by the states might lead to audit objections (Ministry of Family Health and Welfare, Government of India, 2006).

[14]The detailed responsibilities of ASHA workers under the JSY program included:
* Identify pregnant woman as program beneficiary and facilitate registration for pre-natal care
* Assist the pregnant woman to obtain necessary certifications.
* Arrange at least three pre-natal checkups including Tetanus injections, and Iron Folic Acid tablets.
* Identify a Government health center / accredited private health institution for referral and delivery.
* Counsel for institutional delivery.
* Escort the women to the pre-determined health center and stay with her till the woman is discharged.
* Immunize the newborn till the age of 14 weeks
* Inform about the birth or death of the child or mother to the ANM/MO (Assistance Nurse Midwife/Medical Officer).
* Post natal visit within 7 days of delivery to track mother's health.
* Counsel for initiation of breast feeding and family planning.

Each beneficiary of the program were provided a JSY card and Maternal and Child Health (MCH) card, which were used to track prenatal care utilization and immunization of the newborn. It was mandatory to create a micro-birth plan for each beneficiary to help monitoring prenatal check-ups and postnatal care.[15]

The number of beneficiaries increased over time, as reported in Table 1.3, and varied by state. Figure 1.2 plots the number of beneficiaries by low and high performing states. After the year 2006 number of women receiving benefits under the JSY program in low performing states was much higher than that in high performing states.

1.4.1 Eligibility and Cash Incentives

Eligibility for cash assistance varied by state, caste, and economic status of a household. In low performing states all pregnant women delivering in government health centers, Primary Health Centers, Community Health Centers, First Referral Units, or general wards of District hospitals were eligible for the program. However cash assistance under JSY was restricted to women belonging to Below Poverty Line, Scheduled Castes or Scheduled Tribes households if the delivery took place in an accredited private institutions.[16] For high performing states eligibility was restricted to two live births and only women aged 19 or above belonging to BPL, SC, or ST households could claim the benefits. Table 1.1 describes eligibility for the JSY program by low and high performing states.[17]

Scale of cash assistance varied by state as well. In low performing states the cash assistance given to pregnant women were Rs.1400 ($25.5) and Rs.1000 ($18.2) for rural and urban area respectively. In high performing states the cash assistance were Rs.700 ($12.7) and Rs.600 ($10.9) respectively for rural and urban areas. ASHA workers received Rs.600 and Rs.200 in rural and urban area respectively in low performing states.

[15]Micro birth plan is a list of essential services that may be required during pregnancy along with the service provider and an approximate time line.

[16]In 1950 a constitution order in India listed 1,108 castes and 744 tribes which were loosely known as depressed classes earlier, as *Scheduled Castes* (SCs) and *Scheduled Tribe* (STs). Later SCs and STs were given preferential treatment in jobs and higher education. A household is declared *below the poverty line*, if the household income is insufficient to purchase a basket of goods to satisfy its calorific needs. This measure vary by state and is often used by the Indian government to identify households which qualify for government assistance.

[17]According to a study by United Nations Population Fund - India (2009) "Among the mothers who were eligible for receiving the incentives, 93 percent in Rajasthan reported having received the money. Proportion of mothers who who received the money was also high in Orissa (89 percent) and Madhya Pradesh (83 percent)...".

In high performance states the health workers did not receive any cash assistance. Table 1.2 describes the structure of cash assistance given to pregnant women and health workers by states and type of residence.

1.4.2 Timing of Payment

According to the program specifications full cash entitlements for pregnant women delivering at health facilities were to be disbursed at the health institution immediately after arrival and registration (Ministry of Family Health and Welfare, Government of India, 2006). However, timing of receipt of payment varied across states. An assessment of the JSY program by United Nations Population Fund - India (2009) finds that in five low performing states, 63 percent of the beneficiaries reported receiving their entitlement within 2 weeks of discharge from heath center while the rest received their entitlement within 4 weeks.

The cash incentives to ASHA workers were given in two installments. First installment of the payment was made at the health center after registering an expectant mother. While the second installment was to be paid after she has made post natal visit and the child has been immunized for BCG.

1.5 Data

I use household level data on repeated cross-sections from two rounds of the District Level Household Surveys, DLHS-II (2002-04) and DLHS-III (2007-08) to estimate the effect of the JSY program on institutional birth, prenatal care, and immunization.[18] The DLHS is one of the largest demographic health surveys in India, and it was executed by the Indian Institute of Population Sciences. The DLHS primarily collects data on family planning, maternal and child health, and utilization of public health services. Apart from family health information, both rounds of the DLHS also collected data on the demographic composition, human capital, and socioeconomic characteristics of the household including caste, religion, and asset ownership.

The second round of the DLHS (DLHS-II) interviewed 620,107 households (about 1000 in each of 593 districts) in India between 2002 and 2004 using multistage stratified sampling. The third round of the DLHS (DLHS-III) interviewed 720,320 households (1000 to 1500

[18]International Institute for Population Sciences, Ministry of Health and Family Welfare (2006, 2010)

from each of 611 districts) between late 2007 and early 2008 following a multistage stratified sampling method. I use the DLHS-III to find the program effects and the incentive effects by comparing across groups of women that vary by their eligibility and by the cash transfer amount they and the health care workers are eligible for. I use the earlier round of the survey (DLHS-II) primarily to test the robustness of the results using a placebo date for program implementation.

1.5.1 Estimation Sample

The District Level Household Survey III (2007-08) collected data on reproductive health, maternal care, and child health for 15-49 ever married women. The questions on prenatal, natal, and postnatal care were not birth specific, however, but rather were asked for births since January 2004. To merge these questions uniquely with birth history data (date of delivery and child characteristics), I restrict my sample to women who gave birth to a single child between January 2004 and survey date. This restriction raises some issues on the external validity of the empirical results. If women who choose to have a single child in the period January 2004 till the date of interview are different from those who had two or more children, then the empirical results would not be valid for women outside the estimation sample. To test this formally, I estimate the effect of number of children born to a woman since January 2004 on institutional birth using a linear probability model.[19] I found no effect of number of live births since January 2004 on the probability of institutional delivery after controlling for a rich set of regressors.

1.5.2 Summary Statistics

The summary statistics for the dependent variables measuring institutional birth, prenatal care, and immunization are reported in Panel A of Table 1.4. As discussed earlier the sample is restricted to women who gave birth to a single child between January 2004 and the survey date in 2007-08. Columns (1) and (2) report the averages and standard deviations for the births before the JSY program, while the rest of the columns report the same for post JSY births. Except for number of Tetanus injections received by a pregnant woman and number of DPT vaccines received by a child, all dependent variables are binary. Forty percent of births before the JSY program took place in a

[19] Institutional birth is one of the main outcome variable that the program (JSY) was supposed to affect as the cash assistance was conditional on institutional delivery. The results are reported in Appendix A, Table A.1.

health facility, while it increased to 46 percent for post JSY deliveries. Averages for all variables measuring prenatal care increased after the JSY program. However, most of the variables measuring immunization of children decreased on average for births after the JSY program.

Panel B of the same table reports the averages characteristics of women and their spouse (age and years of schooling); indicators for below poverty line status, scheduled castes/scheduled tribes, rural residence, and household assets. All regression results reported later controls for these variables. Women who gave birth after the JSY program are younger on average while they have more years of education compared to the women who gave birth before the JSY program.[20] Their husbands are also younger and have more years of education. For other control variables in Panel B, the averages for births before and after the JSY program are similar.[21]

1.6 Estimation Strategy

The objective of this paper is to estimate the effect of the JSY program on institutional birth, prenatal care utilization, and immunization. To isolate the causal effect of the program, I use a difference-in-difference estimation strategy, and I explore several definitions of treatment and control groups, reflecting the multiple dimensions of eligibility and cash transfer size. The following empirical model is common to all specifications

$$Y_{it} = \alpha_0 + \alpha_E Eligible_i + \alpha_P Post_t + \alpha_{EP}(Eligible_i \times Post_t) + \mathbf{X_i}\alpha' + \epsilon_{it} \qquad (1.1)$$

where Y_{it} is an outcome variable measuring either institutional birth, or prenatal care or immunization of a child born to woman i at time t. $Eligible_i$ is an indicator which takes the value one if the i^{th} woman was eligible to receive any benefit under the JSY program and zero otherwise.[22] The variable $Post_t$ is an indicator which takes the value one if time period t, when the child was born, is after announcement of the JSY program

[20] Since the sample is restricted to women who gave birth to a single child between January 2004 and the date of survey (2008-09), those who gave birth later (after JSY was introduced in April 2005) are more likely to be younger at the time of survery.

[21] I do not report the summary statistics of these variables by eligibility for benefits under the JSY program. On average the variables both in Panel A and B are significantly different for the eligible and non-eligible women as eligibility was determined based on pre program level of deliveries in institutional settings by states, caste, and income.

[22] All women in the low performing states were eligible for the program. In the high performing states only women belonging to Scheduled Castes, Scheduled Tribes, and below poverty line households were eligible for the benefits of the JSY program.

(April, 2005). X_i is a set of characteristics of the i^{th} woman and ϵ_{it} is a random error term. The coefficient α_{EP} on the interaction of $Eligible_i$ and $Post_t$ is the parameter of interest. In some specifications I also estimate the effect of a greater treatment (available in rural areas of low-performing states) to a lesser treatment (available in urban areas of low-performing states).

The amount of the cash incentives to both women and to health care workers also varies across rural and urban areas in low-performing states and for women of different backgrounds in high-performing states. I estimate the effects of these cash incentives (in Rs. 100) for both mothers and ASHA workers, on the same outcome variables using the following empirical model

$$\begin{aligned} Y_{it} =& \beta_0 + \beta_M CCTM_i + \beta_A CCTA_i + \beta_P Post_t + \\ & \beta_{MP}(CCTM_i \times Post_t) + \beta_{AP}(CCTA_i \times Post_t) + \mathbf{X_i}\beta' + \varepsilon_{it} \end{aligned} \tag{1.2}$$

where Y_{it} is an outcome variable as in equation (1.1). $CCTM_i$ and $CCTA_i$ are the cash benefits (in Rs. 100) that the i^{th} woman and the ASHA worker who might have assisted her were supposed to receive given the residence, caste, and income level of the woman. The variable ε_{it} is a random error term. The coefficients β_{AP} and β_{MP} on the interactions of $CCTA_i$ and $CCTM_i$ with $Post_t$ are the parameters of interest.[23]

As mentioned earlier the number of beneficiaries under the JSY program was low in the initial years, but increased in most of the states over time. I estimate the following specifications to estimate time variation in the effect of eligibility and cash incentives under the JSY program.

$$\begin{aligned} Y_{it} =& \gamma_0 + \gamma_E Eligible_i + \sum_{j=1}^{2} \gamma_{Pj} Post_{tj} + \\ & \gamma_{EP1}(Eligible_i \times Post_{t1}) + \gamma_{EP2}(Eligible_i \times Post_{t2}) + \mathbf{X_i}\gamma' + \zeta_{it} \end{aligned} \tag{1.3}$$

$$\begin{aligned} Y_{it} =& \delta_0 + \delta_M CCTM_i + \delta_A CCTA_i + \sum_{j=1}^{2} \delta_{Pj} Post_{tj} \\ & + \delta_{MP1}(CCTM_i \times Post_{t1}) + \delta_{MP2}(CCTM_i \times Post_{t2}) + \delta_{AP1}(CCTA_i \times Post_{t1}) \\ & + \delta_{AP2}(CCTA_i \times Post_{t2}) + \mathbf{X_i}\delta' + \eta_{it} \end{aligned} \tag{1.4}$$

[23] If Y_{ij} is binary then equations (1.1) and (1.2) are reduced to linear probability models. In such situations, as all controls used in estimation are categorical, the linear probability models are saturated. A saturated model is a linear probability model with categorical variables on the right hand side. These models estimate the underlying conditional mean function perfectly and eliminates the need of non-linear specifications (Angrist, 2001).

where $Post_{t1}$ is an indicator which takes the value one if at time period t, when the child was born, is after the announcement of the JSY program but before the year 2007. Similarly, $Post_{t2}$ is an indicator which takes the value one if the child was born after 2007. In equation (1.3), γ_{EP1} and γ_{EP2} are the parameters of interest which estimate the effects of JSY eligibility in the first two years and the second two years of the program, respectively. Similarly, in equation (1.4), δ_{MP1}, δ_{MP2} and δ_{AP1}, δ_{AP2} measures the incentive effects that the i^{th} woman and the ASHA worker was supposed to receive in the first two years and the second two years of the program.

The identification assumption for the estimation strategy described above is that the outcome variables were not evolving differently for eligible and non-eligible group over time. In other words a difference-in-difference estimation strategy yields unbiased estimate of treatment effect if pre-program trends in the outcome variable for eligible and non-eligible groups was parallel. Section 8 discusses validity of this assumption in detail.

1.7 Results

This section presents empirical evidence on the effect of *Janani Surakshya Yojana* (JSY, Safe Motherhood Scheme), a conditional cash transfer program in India, on institutional birth, prenatal care, and immunization. The program provided cash benefits to pregnant women and health workers for delivering at a health facility. I use a difference-in-difference estimation strategy to find the effect of the program and of the size of the cash incentives using the District Level Household Survey-III (2007-08). Eligibility and cash amounts received under the program varied for pregnant women and health workers by state, area of residence, caste, and income level.

1.7.1 Institutional Birth

As mentioned earlier, I restrict the sample to women reporting a single birth since January, 2004. Only for these women I can uniquely match the place of delivery with the date of birth. I use the information on place of delivery to create an indicator for institutional birth and report the effect of eligibility for the JSY program on institutional birth in Table 1.5.[24] Table 1.6 reports the incentive effects of the JSY cash transfer

[24]Institutional birth takes the value one if a child was born in a public (hospital, dispensary, uhc/uh-pc/ufwc, community health center or rural hospital, primary health center, sub center, ayush hospital or clinic) or a private health facility (non-government organization hospital or clinic, private hospital or clinic, private ayush hospital or clinic).

amounts. In both tables Panel A report the effects of the program post JSY, while Panel B report time varying effects of the program.[25]

1.7.1.1 Effects of JSY Eligibility on Institutional Birth

Table 1.5 reports the effect of the JSY program on institutional birth. The outcome variable is binary and takes the value one if the delivery took place in a public or private health facility and zero if the delivery takes place at home, work or other places. The indicator eligibility takes the value one if a woman was eligible for any assistance under the JSY program and zero otherwise.[26] The indicator post takes the value one if a delivery took place after the announcement of JSY (12th April, 2005). All regressions reported in Table 1.5 control for characteristics of a woman and her spouse, indicators for household assets, religion, and district fixed effects.[27] The standard errors are robust and clustered at the primary sampling unit level.[28]

The coefficient on the interaction of eligible and post in Column (1) of Panel A reports the effect of the JSY program on institutional delivery for the full sample. The estimate is positive and highly statistically significant. It suggests that after the JSY program the probability of institutional delivery increased by 3.9 percentage points. Panel B reports the effects for the same sample but broken down into the first two years (2005-06) and the next two years after the program was implemented. This shows that the effect was approximately zero in the first two years but even larger, at 9.1 percentage points, in the second two years. Note that these broad eligibility estimates assume the same treatment effect for women and health care workers who are eligible for payments of different sizes. To make the samples and the treatments more similar, I restrict the samples in the consecutive regressions as described next.

Column (2) reports the effect of eligibility after including only non-disadvantaged households (which do not belong to Scheduled Castes or Scheduled Tribes and are above the poverty line) from the sample, resulting in a comparison of non-disadvantaged women

[25] JSY was announced on 12th April, 2005.

[26] Eligibility was universal in a group of ten states called low performing states. In other states (high performance states) women belonging to Scheduled Castes or Tribes and below the poverty line were eligible for benefits under the program.

[27] Characteristics of a woman and her spouse include age and years of schooling. Indicators for assets include ownership of mattress, cooker, chair, couch, cot or bed, table, electric fan, radio or transistor, television (black and white), television (color), sewing machine, mobile, telephone, computer, refrigerator, washing machine, watch, clock, bicycle, motorcycle or scooter, animal drawn cart, car, tractor, water pump, thresher, and electricity connection at home.

[28] Primary sampling units (PSUs) are either a village, segment of a village, or a census enumeration block. In the DLHS-III, 50 PSUs were randomly selected from each of 611 districts.

who are eligible for payment (along with ASHAs) in low-performing states and who are ineligible in high-performing states.[29] When both mothers and ASHA workers were paid and comparing only non-disadvantaged households, the program increased the probability of institutional delivery by 4.7 percentage points over the entire post-JSY period and by 11 percentage points in 2007-08. The estimates are highly statistically significant and larger than those reported for all of India in Column (1).

Column (3) restricts the sample to the high performing states where no ASHAs were eligible for payments and compares eligible disadvantaged women to ineligible non-disadvantaged women.[30] The program increased the probability of institutional birth in high performing states by an insignificant 1.2 percentage points overall and by a significant 2.9 percentage points in 2007-08, indicating smaller effects which may result from more advanced health facilities or from a smaller payment to women and no payment to ASHAs.

Even though eligibility for the program was universal in low performing states, the financial assistance received by pregnant women and ASHA workers was greater in rural areas, at Rs. 1400 and Rs. 600, respectively, than in urban areas, at Rs. 1000 and Rs. 200. The indicator rural takes the value one if a women resides in a rural area and zero otherwise. The coefficient on the interaction of eligible, rural, and post is statistically significant. The estimate suggests that the effect of the program was significantly higher in rural areas in the low performing states. A pregnant woman in a rural area was 3.6 percentage points more likely to deliver at a health facility due to the program than a woman in an urban area and 7.6 percentage points more likely in the later years of JSY.

The effects of eligibility for the JSY program are thus estimated to be largest in the later years of the program and in low-performing states overall and are estimated to be smallest for disadvantaged households in high-performing states, where the payments were lowest.

1.7.1.2 Incentive Effects of the JSY Transfer Amounts on Institutional Birth

Cash benefits provided under the JSY program to a pregnant woman and an ASHA worker varied by state, area of residence, caste, and level of income.[31] I exploit this

[29] This regression holds constant the type of women who are being compared.
[30] This comparison holds constant the nature of health care facilities in high performing states.
[31] Incentives are measured in Rs. 100 is approximately equal to $2.

variation to estimate the intent to treatment effects of the cash benefits on institutional birth. The variable *mother's incentive* takes the values (in Rs. 100) a pregnant woman was eligible to receive from the government given her caste, residence, and possession of a below poverty line card issued by the local government. Similarly, *ASHA's incentive* takes the values (in Rs. 100) corresponding to a health worker's cash benefits given the characteristics of a pregnant woman. Here, I must assume that the marginal utility of income does not vary with the amount of the transfer. Panel A in Table 1.6 reports the incentive effects post announcement of the JSY program while Panel B reports the time varying incentive effects. All regressions reported in Table 1.6 control for the same characteristics of a woman and her spouse as above, indicators for household assets, religion, and state fixed effects. The standard errors are robust and clustered at primary sampling unit level.

Column (1) in Panel A reports the marginal effects of incentive (in Rs. 100) to mothers and ASHA workers on the probability of institutional delivery. The estimates suggests that an additional Rs. 100 incentive to an ASHA worker increased the probability of institutional delivery by 0.6 percentage points. The estimate is highly statistically significant and substantially greater in the final year of my sample period than in the first three years, as shown in Panel (B), with an estimated marginal effect of Rs.100 of 1.2 percentage points. Payments to ASHAs were Rs.200 in urban areas and Rs.600 in rural areas, only in low-performance states, so the effects are relatively large, at 2.4 percentage points in urban areas and 3.6 percentage points in rural areas. In contrast, the effect of an additional Rs. 100 received by a mother had no significant effect on the probability of institutional delivery. The rest of the columns report estimates for limited sub-samples of the population.

Column (2) in Panel A reports the same estimates for non-disadvantaged households (which do not belong to Scheduled Castes or Scheduled Tribes and are above the poverty line). For this sample only women in low performing states were eligible and the ASHA workers were also paid along with the mothers. The marginal effect of Rs. 100 given to an ASHA worker on the probability of institutional birth is 1.2 percentage points, while the effect of incentive to mothers had no significant effect on institutional birth.

As in the previous table, the sample for the estimates in Column (3) is restricted to the high performing states and compares disadvantaged women and non-disadvantaged women belonging to Scheduled Castes and Scheduled Tribes or households with below poverty line cards were eligible to receive cash benefits while no incentive was provided to ASHA workers. Since there is no variation in the incentives received by ASHA workers,

I report the effect of additional Rs. 100 given to a mother. The estimate is very close to zero at 0.1 percentage points and it is statistically insignificant.

Finally, in Column (4) the sample is restricted to the low performing states, where all women and ASHA workers were eligible to receive cash benefits but in amounts that varied in rural and urban areas. The estimates suggests that an additional Rs. 100 benefit to an ASHA worker increased the probability of delivery at a health facility by 0.7 percentage points (significant at the 10% level) for all post-JSY years and by 1.1 percentage points (significant at the 1% level) in the last two year of my data. The effect of additional Rs. 100 given to a mother is estimated at 0.2 percentage points and is statistically insignificant.

1.7.2 Prenatal Care

The cash payment to an ASHA (Accredited Social Health Activist) worker under the JSY program was conditional on registration of the pregnant woman and helping her to get prenatal care. The survey collected data whether a pregnant woman received a pregnancy confirmation test, iron folic acid supplements, prenatal care visits, and tetanus injections. I use these variables to estimate the effect of the program on prenatal care in Table 1.7. Table 1.8 reports the incentive effect of the cash transfers from the program on prenatal care. In both tables the sample is unrestricted. All regressions control for characteristics of a woman and her spouse, indicators for household assets, religion, and state fixed effects. The standard errors are robust and clustered at the primary sampling unit level.

1.7.2.1 Effect of the JSY Program on Prenatal Care

Columns (1) through (5) in Panel A of Table 1.7 reports the effects of the JSY program on whether a pregnant woman received a pregnancy confirmation test, consumed iron folic acid tablets or syrup, reported having any prenatal care, and received tetanus injection. Most of the outcome variables are binary (except number of tetanus injections received) and take the value one if a woman received that type of care and zero otherwise. The estimated coefficients on the interaction of eligible and post are positive for all the outcome variables implying pre-natal health care utilization (except for pregnancy confirmation test) improved significantly for eligible women after the safe motherhood program was introduced in 2005. A pregnant women was 3.5 percentage points more

likely to receive a tetanus injection if she was eligible after the JSY program. While, she was likely to receive 0.05 more tetanus injections after the JSY program.

Panel B of Table 1.7 reports the time varying effects of the JSY program on utilization of prenatal care. Most of the estimates are positive and strongly statistically significant. For almost all the outcome variables the effect of the program was larger for the births in the year 2007 and 2008.

1.7.2.2 Incentive Effects of the JSY program on Prenatal Care

To find the cash incentive effects of the JSY program on prenatal care utilization, I exploit the variations in the payments received by mothers and ASHA workers. I report the estimated coefficients on the interaction of payments that mothers and ASHA workers were eligible to receive and the indicator for post in Panel A of Table 1.8. The outcome variables measuring utilization of prenatal care remains the same as the previous table. As with the outcome of institutional delivery, the reported results suggests that an additional Rs. 100 given to ASHA workers increased the probability of prenatal care reported by a woman significantly, while the effect was negligible if the amount was given to mothers. For example, an additional Rs. 100 given to an ASHA worker increased the probability that a woman receives any prenatal care by 0.9 percentage points. Similar results are also observed for number of tetanus injections received by a woman. Panel B of Table 1.8 reports the time varying effect of the incentives received by mothers and ASHA workers. As in Panel A, the marginal effect of the incentives are higher for ASHA workers and the incentive effects are larger for the births in the years 2007 and 2008.

1.7.3 Immunization

Apart from ensuring prenatal care received by pregnant women, the incentives received by ASHA workers were also contingent upon immunization of the newborn till the age of 14 weeks. According to recommended immunization schedule in India each newborn is immunized for BCG (Bacillus Calmette Guerin), OPV-0 (Oral Polio Vaccine Zero), and Hepatitis B-1 soon after birth.[32] In Panel A of Table 1.9, I report the effect of the JSY program on immunization for these three vaccines along with other polio vaccines,

[32]Indian Academy of Pediatrics, http://www.iapindia.org/immunisation/immunisation- schedule, accessed on 7/31/2012.

DPT (Diphtheria, Tetanus, Pertussis), and Measles vaccines. Except for number of DPT vaccines, all outcome variables are binary and take the value one if the child received the vaccination and zero otherwise. All regressions control for characteristics of a woman and her spouse, indicators for household assets, religion, and state fixed effects. The standard errors are robust and clustered at primary sampling unit level.

1.7.3.1 Effect of the JSY Program on Immunization

As reported in panel A of Table 1.9 the JSY program increased the probability of immunization significantly (except for any polio vaccine and number of DPT vaccines). The estimated effect of the program was highest for the Measles vaccine and lowest for polio vaccine reported in Columns (7) and (4) respectively. The program increased the probability of Measles vaccination by 5 percentage points. Panel B in the same table reports the time varying effects of the program on immunization. However, unlike institutional delivery and prenatal care, the effect of the program on immunization was larger for the births in the year 2005 and 2006. Even though the overall effect of the program post JSY was positive, children born in the years 2007 and 2008 to eligible mothers were less likely to be immunized. One plausible explanation for this finding could be that these children were too young to be immunized compared to the children born in the 2005 and 2006 cohort.

1.7.3.2 Incentive Effects of the JSY program on Immunization

I use the same set of variables measuring immunization of children to find the incentive effect of the JSY program. Panel A in Table 1.10 reports the incentive effects of the program while Panel B reports the time varying incentive effects. The effect of an additional Rs. 100 given to ASHA workers was significantly positive for all the outcome variables. While the marginal effect of Rs. 100 incentive to mothers had marginally negative or no effect on immunization of their children. There was significant variation in the incentive effects over time. The marginal effects of incentive to ASHA workers were larger for the births in the year 2007 and 2008, whereas the effect of incentives to mothers continue to be marginally negative or insignificant over time.

1.7.4 Infant Mortality

The main objective of the *Janani Surakshya Yojana* was to reduce maternal and infant mortality by increasing health care received by pregnant women and newborns. As reported in Table 1.5, Table 1.7 and Table 1.9, the eligibility for the program significantly increased the probability of institutional birth, utilization of pre-natal care, and immunization of the newborn babies. I report the estimated effects of program eligibility on infant, early and late neo-natal mortality in Table 1.11.[33] The District Level Household Survey - III interviewed all women between 15 to 49 years of age reporting at least one pregnancy since January 2004, and recorded the result of their pregnancy. I restrict the sample to all live births to estimate the effect of the program on infant mortality. As the outcome variables are more likely to take the value zero the fitted values from a linear probability model may lie outside the unit interval.[34] I report the estimated effects of the program using a Probit model in Table 1.11.[35]

Column (1) Panel A in Table 1.11 reports the effect of eligibility for the JSY program on infant mortality. The reported coefficient suggests that the eligibility for the program saved 1.7 infants (per 1000 live births). Similarly, for non-disadvantaged households, as reported in Column (2), the eligibility for the program saved 1.1 infants (per 1000 live births). The program was most effective in high performing states where only pregnant women were incentivized. As reported in Column (3), eligibility for the JSY program in high performing states saved 3.8 infants per 1000 live births. For the low performing states reported in Column (4), where eligibility was universal but the incentive amounts were larger (both for pregnant womean and ASHA workers) in the rural areas, eligibility for the program increased infant mortality by 1.5 deaths per 1000 live births. However, none of the estimated coefficients are statistically significant.

Panel B in Table 1.11 reports the effect of eligibility for the JSY program on early neo-natal mortality. As in Panel A the estimation samples vary by columns. Except

[33]Infant mortality is an indicator which takes the value one if the baby was born alive and died within one year of birth. Early and late neo-natal mortality are also indicators taking the value one if the baby died within 7 and 28 days since birth, respectively.

[34]Before the announcement of the program 35 infants out of 1000 live births died within one year of birth.

[35]There may be some selection issues in the estimates reported in Table 1.11 as I do not observe the status of the children for deceased mothers. If the child of a deceased mother is also more likely to die then these estimates are biased. Since the survey does not collect parents identifiers, it is impossible to track the children of deceased mothers. However, among 720,320 households surveyed only 470 (0.06 %) females between 15 to 49 died either during childbirth or within six weeks of childbirth. The children of these women are excluded from my estimation sample. Since the number of excluded children is very small, it is likely that the bias due to selection, if any, is negligible.

for Column (4) where the sample is restricted to the low performing states eligibility for the program decreased early neo-natal mortality. The effect is largest for the high performing states, reported in Column (2), where early neo-natal mortality decreased by 5.1 and the estimated coefficient is statistically significant.

Panel C in Table 1.11 reports the effect of the program on late neo-natal mortality. The estimated coefficients reported in Columns (1) through (4) are smaller in magnitude and statistically insignificant. These results provide evidence that the eligibility for the JSY program weakly decreased infant mortality by reducing early neo-natal mortality whereas there was no significant effect on late neo-natal mortality.

1.8 Robustness

In this section I address three issues that might cast doubt over the estimated effects of the JSY program. First, difference-in-difference estimation strategy assumes parallel trends in the outcomes of interest for the eligible and non-eligible groups. I test the validity of the parallel trend assumption using data collected before the JSY program and assuming a placebo treatment year. Second, a common practice as a falsification test for difference-in-difference estimates is to use alternative placebo outcomes that the treatment was not supposed to affect. To show this I test if the changes in observables for women who gave birth before and after the JSY program were different. Finally, eligibility for the program was determined based on pre-program levels of outcome variables. Therefore, eligible and non-eligible women are different in levels at the baseline period. In order to make the eligible and non-eligible groups more similar, I restrict the sample to the districts bordering the low and high performers states. Although less significant, the program effects for this restricted sample remains positive.

1.8.1 Placebo Treatment Year

Since eligibility for the program was determined by pre-program outcome levels, differential pre-program trends for eligible and non-eligible women may render the estimated treatment effects biased. Therefore, demonstrating parallel trends for these two groups is important for the credibility of the estimation results. Unfortunately, because I needed to restrict the sample to births after January 2004, the estimation sample has outcome variables for births only one year prior to the treatment.

I use the second round of the District Level Household Survey (DLHS-II, 2002-04) to plot the average rate of institutional births by the low and high performance states in Figure 1.4.[36] The solid (dashed) black line represents average institutional birth in the low (high) performance states. While the levels differ, by definition of low and high performance of these states, a visual inspection of the trends in institutional birth corroborates the assumption of parallel trends prior to JSY.

In order to test the assumption of parallel trends formally, I use a difference-in-difference estimation strategy as specified in equation (1.1) using the earlier wave, DLHS-II. Table 1.12 reports the placebo difference-in-difference estimate of the program. The indicator post takes the value one if the year of birth is after a placebo treatment year (2002 or later).[37] Eligibility is defined as following the eligibility rules of the JSY program.[38] Column (1) in Table 1.12 reports coefficient estimate for the interaction of post and eligible when no additional controls are included.[39] The estimate suggests that for eligible women the probability of institutional birth decreased by one percentage point after the placebo treatment year. The estimate is not statistically significant. The rest of the columns report the same estimates with additional controls for the characteristics of a woman and her spouse, household asset indicators, and religion fixed effects. None of the estimates are significantly different from zero.

1.8.2 Districts Bordering Low and High Performance States

One crucial factor that determined eligibility and incentive amounts for the JSY program is residence in the low performing states. When the sample is restricted to non-disadvantaged households, in other words when eligibility is completely determined by residence in the low performing states, the estimated program and incentive effects are highest. As shown in Figure 1.1, the low and high performing states are geographically clustered. If confounding unobservables evolved differently over time in these two geographical clusters the estimated results may be biased. To test this formally, I use a difference-in-difference estimation strategy specified in equation (1.1) after restricting

[36] As earlier, in order to merge the place of delivery uniquely with date of delivery, the sample is restricted to women who gave birth to a single child since January 1999.

[37] The choice of the placebo treatment year is arbitrary. The results do not change for other placebo program dates and I do not report those results.

[38] 31st December of 2001 is assumed as the placebo treatment date. The indicator eligibility takes the value one if a woman was eligible for any assistance under the JSY program and zero otherwise. The DLHS-II did not collect information on possession of a below poverty line card. Therefore, women belonging to the low performing states and Scheduled Caste or Scheduled Tribe households and above the age of 19 are defined as eligible.

[39] All regressions reported in Table 1.12 control for district fixed effects.

the sample to the districts bordering the low and high performance states. Figure 1.5 shows the districts bordering the low and high performance states.

Table 1.13 reports the effect of eligibility for the JSY program on institutional birth for districts bordering the low and high performance states. The sample is also restricted to non-disadvantaged households so that residence in low performing households alone determines eligibility. Panel A reports the post JSY program effects while Panel B reports the time varying effects of the program. The control set across the columns remain the same as in Table 1.12. As reported in Panel A the effect of the program for the post JSY period is positive but not strongly significant. However, the bottom panel clearly shows that the probability of institutional births increased for eligible women for this restricted sample but the gains were concentrated in the later years.

1.8.3 Effect of JSY on Other Observables

A common falsification test for difference-in-difference estimates is to test if the treatment affected other variables which it was not supposed to. I test if changes in the control variables across the low and high performance states are different for births before and after the JSY program. The results are reported in Appendix A in Table A.2. Columns (1) and (2) report the average differences in control variables for births before and after the JSY program by the low and high performing states respectively. As reported in Column (1), in the low performing states, women giving birth in post JSY period are 2.6 years younger compared to women who delivered before the JSY program. Similarly, in the high performing states the age differential for women giving birth after the JSY program is -2.4 years on average. These differences are statistically significant, however, the difference between these average age differentials is not significantly different from zero. In fact for all the control variables used in the regressions in the Section 7, the average difference for births before and after the JSY program are not different across the low and high performance states.

1.9 Conclusion

This paper provides empirical evidence that the *Janani Surakshya Yojana*, a conditional cash transfer program in India, significantly increased utilization of maternal health care. The program increased the likelihood for an eligible woman delivering at a health facility by four percentage points. It also significantly increased the probability of an

eligible woman to receive a pregnancy confirmation test, iron folic acid supplements, prenatal care visits, and tetanus injections. Babies born to eligible women after the program were also more likely to receive a variety of immunizations. The effects were concentrated for the later years of the program as the number of beneficiaries increased steadily over time.

Apart from eligible pregnant women the program also provided cash incentives to health workers who assisted them to receive pre and postnatal care. I find that an additional Rs. 100 (about $2) incentive to workers increased the probability of institutional delivery by 1.2 percentage points in the last two years of the program, while the same amount of additional incentive to mothers yielded 0.3 percentage points increase in the likelihood. The results are consistent for other prenatal care utilization and immunization of the babies.

FIGURE 1.1: Spatial Variation in Implementation of JSY.

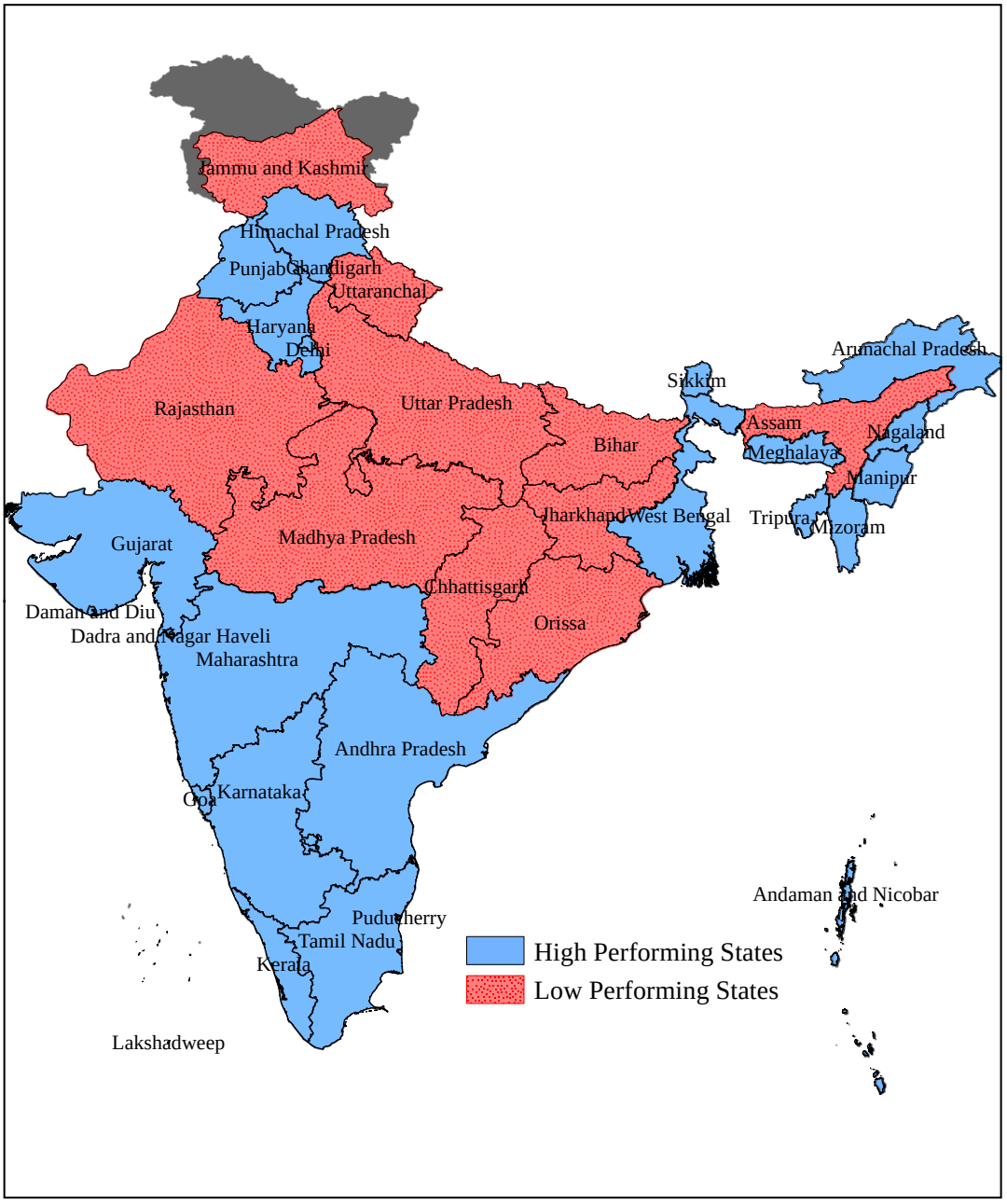
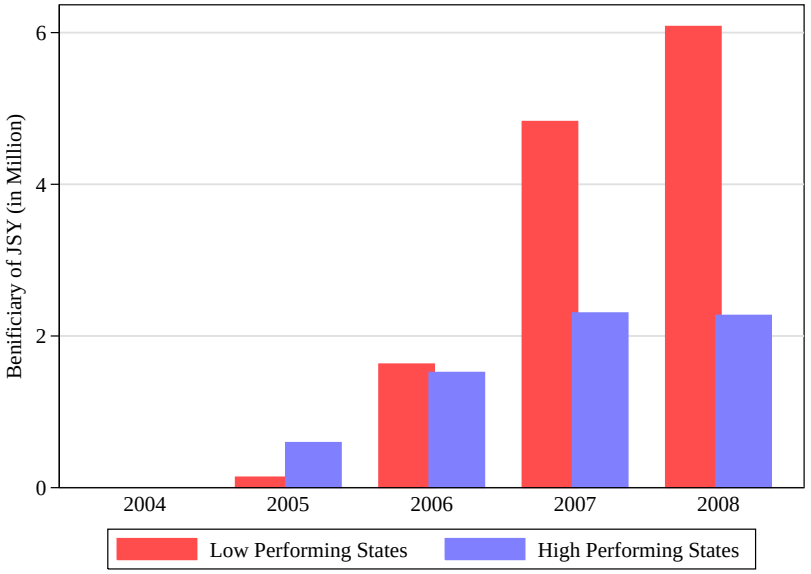
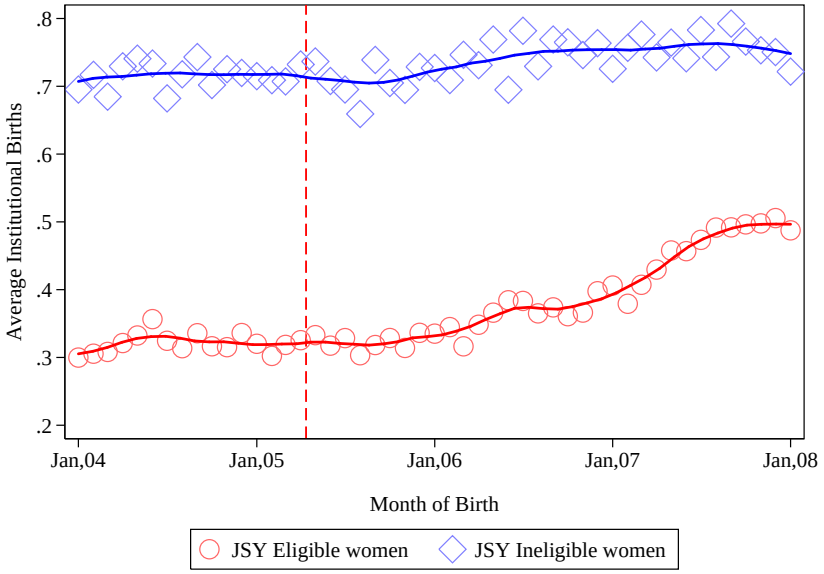


FIGURE 1.2: Beneficiaries of JSY by Year.



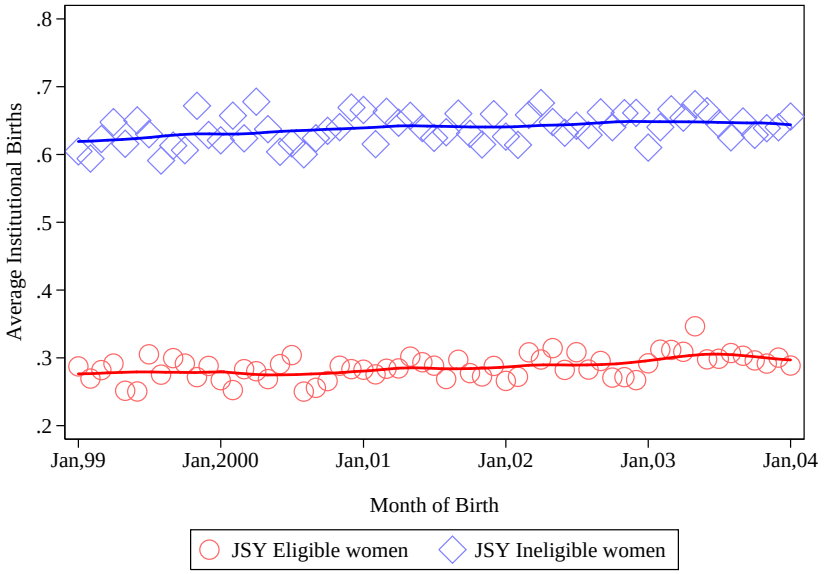
Notes: Data collected from various Statewise NRHM Progress - A Snapshot Reports, Ministry of Health and Family Welfare. Available at http://*www.mohfw.nic.in/NRHM.htm*

FIGURE 1.3: Average Institutional Births over Time (2004 to 2008).



Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women who reported a single birth since January, 2004.

FIGURE 1.4: Average Institutional Births over Time (1999 to 2004).



Notes: Data used from the District Level Household Survey-II (2007-08). The sample is restricted to women who reported a single birth since January, 2004.

FIGURE 1.5: Districts Bordering High and Low Performing States.

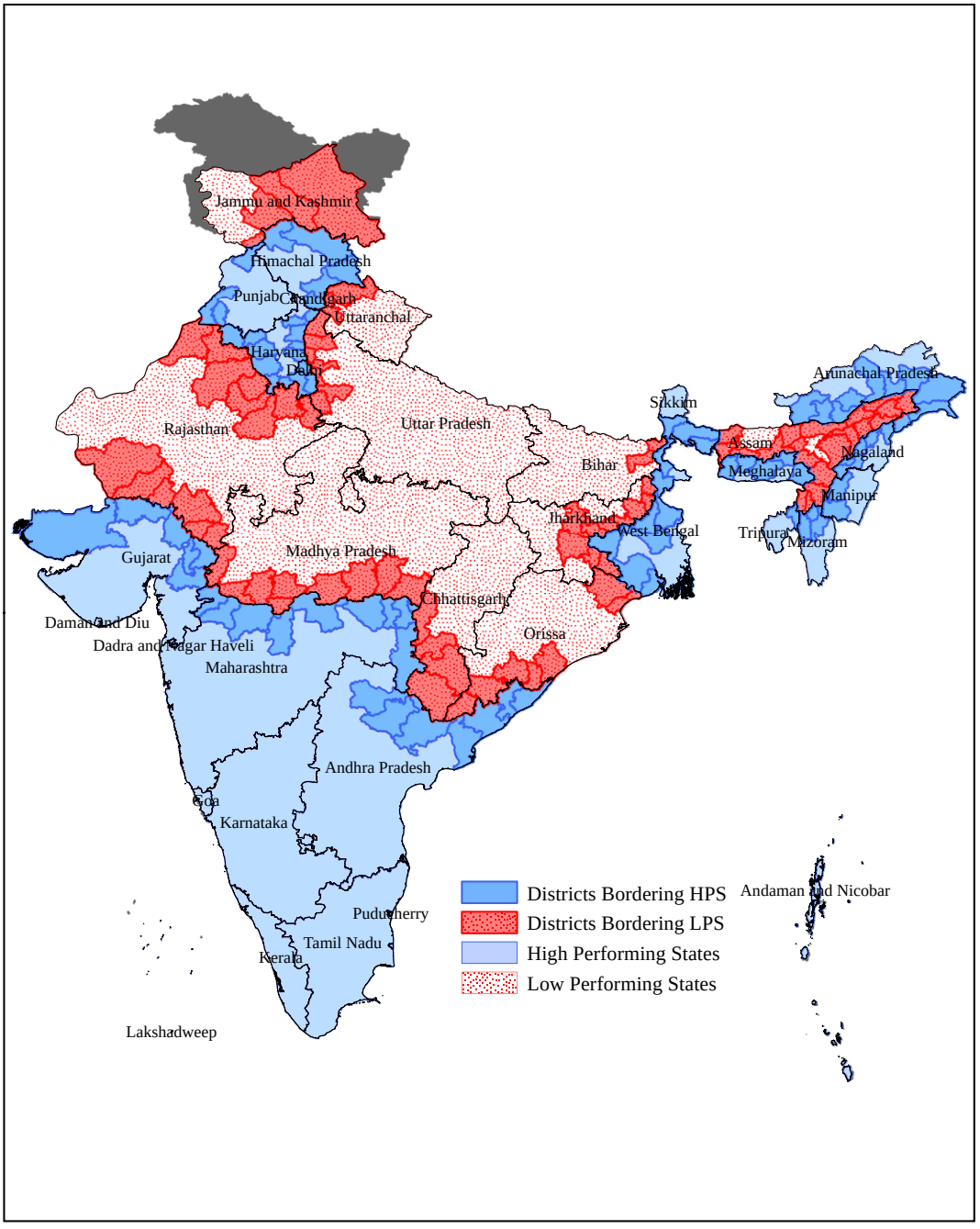


TABLE 1.1: Eligibility for *Jananni Surkshya Yojana*.

States	Disadvantaged Household	Non-disadvantaged Household
Low Performing	Eligible	Eligible
High Performing	Eligible	Non-Eligible

Notes: Households belonging to Scheduled Castes and Scheduled Tribes, or below the poverty line are called disadvantaged. Only women above 19 were eligible and eligibility was limited to two live births.

TABLE 1.2: Incentive Amounts for Mothers and ASHA Workers Under the *Jananni Surkshya Yojana* (Safe Motherhood Scheme).

States	Rural Area		Urban Area	
	Mothers	ASHA Workers	Mothers	ASHA Workers
Low Performing	1400 ($25.5)	600 ($10.9)	1000 ($18.2)	200 ($3.6)
High Performing	700 ($12.7)	-	600 ($10.9)	-

Notes: $ 1 = INR 54.9

TABLE 1.3: Number of Beneficiaries of Safe Motherhood Scheme by State and Year.

States	2005-06	2006-07	2007-08	2008-09
Low Performance States				
Assam	17,523	190,334	304,741	327,894
Bihar		89,839	838,481	1,051,376
Chhattisgarh	3,190	76,677	175,978	225,000
Jammu & Kashmir	2,134	13,127	10,568	7,364
Jharkhand		123,910	251,867	477,890
Madhya Pradesh	68,252	401,184	1,115,941	1,138,000
Orissa	26,407	227,204	490,657	309,000
Uttar Pradesh	12,127	168,613	797,505	1,563,516
Uttarakhand	1,360	23,873	69,679	66,202
Rajasthan	10,085	317,484	774,877	917,000
High Performance States				
Andhra Pradesh	167,000	429,000	563,401	450,000
Arunachal Pradesh	794	1,433	7,689	7,782
Delhi		242	7,238	23,829
Goa	57	483	898	688
Gujarat		121,153	185,956	213,000
Haryana	1,825	23,123	35,441	48,000
Himachal Pradesh	1,585	6,303	10,371	11,323
Karnataka	50,542	233,147	283,000	331,000
Kerala		56,072	162,050	136,000
Maharashtra	5,650	97,390	198,015	224,000
Manipur		7,602	8,664	10,726
Meghalaya	471	4,257	1,003	10,600
Mizoram	1,056	7,462	13,371	14,290
Punjab	11,595	16,079	9,917	68,000
Sikkim	1,128	1,719	1,616	3,161
Tamil Nadu	321,567	288,224	229,609	386,700
Tripura	2,247	3,203	15,547	18,350
West Bengal	31,363	224,863	572,651	317,000

Notes: Data collected from various Statewise *NRHM Progress - A Snapshot* reports, Ministry of Health and Family Welfare. Avaiable at http://www.mohfw.nic.in/NRHM.htm

TABLE 1.4: Summary Statistics by Births Before and After *Janani Surakshya Yojana.*

	Births before JSY		Births after JSY	
	Mean	S.D	Mean	S.D
Variables	(1)	(2)	(3)	(4)
Panel A: Dependent variables				
Institutional Birth	0.40	0.49	0.46	0.50
Pregnancy Confirmation Test	0.50	0.50	0.53	0.50
Had Iron Folic Acid Tablet/Syrup	0.56	0.50	0.57	0.49
Received Any Ante Natal Care	0.71	0.45	0.75	0.43
Received Tetanus Injection	0.70	0.46	0.73	0.44
Number of Tetanus Injections Received	1.52	1.08	1.60	1.04
BCG Vaccine	0.85	0.36	0.85	0.35
Polio `0' Vaccine	0.65	0.48	0.68	0.47
Hepatitis- B Vaccine	0.35	0.48	0.27	0.44
Any Polio Vaccine	0.94	0.24	0.92	0.27
Any DPT Vaccine	0.82	0.39	0.80	0.40
Number of DPT Vaccine	2.56	0.91	2.36	1.03
Measles Vaccine	0.75	0.43	0.58	0.49
Panel B: Control Variables				
Age	28.99	5.43	26.48	5.43
Years of schooling	4.69	4.98	5.00	5.04
Age of husband	34.24	6.43	31.50	6.48
Years of schooling of husband	6.89	5.04	7.03	4.99
Below poverty line (BPL)	0.31	0.46	0.31	0.46
Scheduled Caste/ Scheduled Tribe (SC/ST)	0.35	0.48	0.36	0.48
Rural	0.79	0.41	0.80	0.40
Own electricity	0.64	0.48	0.62	0.48
Own mattress	0.61	0.49	0.62	0.48
Own cooker	0.35	0.48	0.34	0.48
Own chair	0.51	0.50	0.51	0.50
Own sofaset	0.15	0.35	0.15	0.36
Own cot or bed	0.86	0.34	0.87	0.34
Own table	0.40	0.49	0.41	0.49
Own electric fan	0.44	0.50	0.43	0.50
Own radio/transister	0.26	0.44	0.26	0.44
Own tv (b&w)	0.15	0.36	0.14	0.35
Own tv (color)	0.29	0.45	0.28	0.45
Own sewing machine	0.19	0.39	0.19	0.39
Own mobile	0.36	0.48	0.36	0.48
Own any other telephone	0.10	0.30	0.10	0.29
Own computer	0.02	0.15	0.02	0.14
Own refrigerator	0.13	0.33	0.12	0.33
Own washing machine	0.06	0.23	0.06	0.23
Own watch/clock	0.76	0.43	0.76	0.43
Own bicycle	0.50	0.50	0.49	0.50
Own motorcycle or scooter	0.19	0.39	0.18	0.39
Own animal drawn cart	0.06	0.24	0.06	0.24
Own car	0.03	0.17	0.03	0.17
Own tractor	0.03	0.18	0.03	0.17
Own water pump	0.10	0.30	0.09	0.29
Own thresher	0.02	0.14	0.02	0.14

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004.

TABLE 1.5: Effects of the *Janani Surkshya Yojana* Eligibility on Institutional Birth.

Sample:	All India	Non-disadvantaged hh.	High performing states	Low performing states
Who is Eligible:	All women in low performing states, disadvantaged women in high performing states (1)	Women in low performing states (2)	Women in disadvantaged hh. (3)	All women (4)
Baseline Average for Eligible Women	**0.442**	**0.516**	**0.627**	**0.319**
	Panel A: Effects of Post JSY, 2005-08			
Eligible × Post	**0.039*** **	**0.047*** **	**0.012**	-
	(0.006)	(0.007)	(0.008)	
Eligible × Rural × Post	-	-	-	**0.036*** **
				(0.010)
Number of Observations	147139	70453	58866	88273
R-square	0.34	0.35	0.30	0.26
	Panel B: Time Varying Effects of Post JSY			
Eligible × Year 2005-06	**0.004**	**0.009**	**0.005**	-
	(0.004)	(0.006)	(0.007)	
Eligible × Year 2007-08	**0.091*** **	**0.11*** **	**0.029*** **	-
	(0.007)	(0.009)	(0.009)	
Eligible × Rural × Year 2005-06	-	-	-	**0.012**
				(0.010)
Eligible × Rural × Year 2007-08	-	-	-	**0.076*** **
				(0.013)
Number of Observations	147139	70453	58866	88273
R-square	0.34	0.36	0.30	0.27

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004. A household is defined as disadvantaged if it belongs to Scheduled Castes/Scheduled Tribes or is below the poverty line. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.6: Incentive Effects of the *Jananni Surkshya Yojana* Cash Transfer Amounts on Institutional Birth.

Sample:	All India	Non-disadvantaged hh.	High performing states	Low performing states
Who is Eligible:	All women in low performing states, disadvantaged women in high performing states (1)	Women in low performing states (2)	Women in disadvantaged hh. (3)	All women (4)
Baseline Average for Eligible Women	**0.442**	**0.516**	**0.627**	**0.319**
	Panel A: Effects of Post JSY, 2005-08			
Mother's incentive (in 100 Rs.) × Post	**0.001**	**-0.001**	**0.002**	**0.002**
	(0.001)	(0.002)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Post	**0.006*** **	**0.012*** **	**-**	**0.007***
	(0.002)	(0.005)		(0.004)
Number of Observations	147139	70453	58866	88273
R-square	0.31	0.32	0.26	0.23
	Panel B: Time Varying Effects of Post JSY			
Mother's incentive (in 100 Rs.) × Yr. 2005-06	**-0.000**	**-0.000**	**0.000**	**-0.001**
	(0.001)	(0.002)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Yr. 2005-06	**0.002**	**0.004**	**-**	**0.004**
	(0.002)	(0.005)		(0.004)
Mother's incentive (in 100 Rs.) × Yr. 2007-08	**0.003*** **	**-0.002**	**0.004*** **	**0.008*** **
	(0.001)	(0.002)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Yr 2007-08	**0.012*** **	**0.025*** **	**-**	**0.011** **
	(0.003)	(0.006)		(0.005)
Number of Observations	147139	70453	58866	88273
R-square	0.32	0.33	0.26	0.24

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004. A household is defined as disadvantaged if it belongs to Scheduled Castes/Scheduled Tribes or is below the poverty line. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and state fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.7: Effects of the *Jananni Surkshya Yojana* Eligibility on Prenatal Care (Sample is All India).

Dependent variable:	Pregnancy Confirmation Test (1)	Had Iron Folic Acid Tablet/Syrup (2)	Received Any Ante Natal Care (3)	Received Tetanus Injection (4)	Number of Tetanus Injections Received (5)
Baseline Average for Eligible Women	**0.422**	**0.503**	**0.663**	**0.643**	**1.407**
Panel A: Effects of Post JSY, 2005-08					
Eligible × Post	**0.006**	**0.016****	**0.035*****	**0.035*****	**0.054*****
	(0.006)	(0.006)	(0.005)	(0.005)	(0.012)
Number of Observations	142741	147139	142754	142759	139509
R-square	0.39	0.26	0.27	0.27	0.25
Panel B: Time Varying Effects of Post JSY					
Eligible × Year 2005-06	**-0.009**	**0.025*****	**0.021*****	**0.022*****	**0.034*****
	(0.006)	(0.007)	(0.005)	(0.005)	(0.013)
Eligible × Year 2007-08	**0.028*****	**0.004**	**0.055*****	**0.055*****	**0.085*****
	(0.006)	(0.007)	(0.005)	(0.005)	(0.013)
Obs.	142741	147139	142754	142759	139509
R-sq	0.39	0.26	0.27	0.27	0.25

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.8: Incentive Effects of the *Janani Surkshya Yojana* Cash Transfer Amounts on Prenatal Care (Sample is All India).

Dependent variable:	Pregnancy Confirmation Test (1)	Had Iron Folic Acid Tablet/Syrup (2)	Received Any Ante Natal Care (3)	Received Tetanus Injection (4)	Number of Tetanus Injections Received (5)
Baseline Average for Eligible Women	**0.422**	**0.503**	**0.663**	**0.643**	**1.407**
Panel A: Effects of Post JSY, 2005-08					
Mother's incentive (in 100 Rs.) × Post	**-0.002***	**0.000**	**0.000**	**0.000**	**-0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Post	**0.007*****	**0.004****	**0.009*****	**0.009*****	**0.017*****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
Number of Observations	142741	147139	142754	142759	139509
R-square	0.39	0.26	0.27	0.27	0.25
Panel B: Time Varying Effects of Post JSY					
Mother's incentive (in 100 Rs.) × Year 2005-06	**-0.001**	**0.001**	**0.000**	**0.000**	**0.001**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Year 2005-06	**0.004***	**0.002**	**0.006*****	**0.006*****	**0.010****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)
Mother's incentive (in 100 Rs.) × Year 2007-08	**-0.002****	**0.000**	**0.000**	**0.000**	**-0.002**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
ASHA's incentive (in 100 Rs.) × Year 2007-08	**0.011*****	**0.006****	**0.014*****	**0.014*****	**0.026*****
	(0.002)	(0.002)	(0.002)	(0.002)	(0.005)
Obs.	142741	147139	142754	142759	139509
R-sq	0.39	0.26	0.27	0.27	0.25

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.9: Effects of the *Jananni Surkshya Yojana* Eligibility on Immunization (Sample is All India).

Dependent variable:	BCG Vaccine	Polio `0' Vaccine	Hepatitis- B Vaccine	Any Polio Vaccine	Any DPT Vaccine	Number of DPT Vaccine	Measles Vaccine
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Baseline Average for Eligible Women	**0.822**	**0.609**	**0.277**	**0.928**	**0.784**	**2.478**	**0.712**
Panel A: Effects of Post JSY, 2005-08							
Eligible × Post	**0.017*****	**0.024*****	**0.033*****	**0.000**	**0.015*****	**-0.012**	**0.032*****
	(0.004)	(0.006)	(0.007)	(0.003)	(0.004)	(0.012)	(0.006)
Number of Observations	137324	130366	130509	137447	135687	116086	135372
R-square	0.16	0.18	0.35	0.11	0.19	0.22	0.31
Panel B: Time Varying Effects of Post JSY							
Eligible × Year 2005-06	**0.020*****	**0.022*****	**0.038*****	**0.001**	**0.020*****	**0.018**	**0.087*****
	(0.004)	(0.006)	(0.007)	(0.003)	(0.005)	(0.012)	(0.006)
Eligible × Year 2007-08	**0.013*****	**0.027*****	**0.027*****	**-0.003**	**0.007**	**-0.054*****	**-0.043*****
	(0.005)	(0.007)	(0.007)	(0.003)	(0.005)	(0.015)	(0.007)
Obs.	137324	130366	130509	137447	135687	116086	135372
R-sq	0.16	0.18	0.35	0.11	0.19	0.22	0.32

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women reporting a single birth since January, 2004. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.10: Incentive Effects of the *Jananni Surkshya Yojana* Cash Transfer Amounts on Immunization (Sample is All India).

Dependent variable:	BCG Vaccine (1)	Polio `0' Vaccine (2)	Hepatitis- B Vaccine (3)	Any Polio Vaccine (4)	Any DPT Vaccine (5)	Number of DPT Vaccine (6)	Measles Vaccine (7)
Baseline Average for Eligible Women	**0.822**	**0.609**	**0.277**	**0.928**	**0.784**	**2.478**	**0.712**
Panel A: Effects of Post JSY, 2005-08							
Mother's incentive (in 100 Rs.) × Post	**-0.002****	**0.000**	**0.002**	**-0.002*****	**-0.002*****	**-0.006*****	**0.000**
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
ASHA's incentive (in 100 Rs.) × Post	**0.009*****	**0.008*****	**0.003**	**0.005*****	**0.010*****	**0.015*****	**0.008*****
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)	(0.002)
Number of Observations	137324	130366	130509	137447	135687	116086	135372
R-square	0.16	0.18	0.35	0.11	0.19	0.22	0.31
Panel B: Time Varying Effects of Post JSY							
Mother's incentive (in 100 Rs.) × Year 2005-06	**0.000**	**0.000**	**0.003*****	**0.000**	**0.001**	**0.013*****	**0.009*****
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)	(0.001)
ASHA's incentive (in 100 Rs.) × Year 2005-06	**0.008*****	**0.004***	**-0.004***	**0.003****	**0.008*****	**-0.002**	**-0.004****
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.004)	(0.002)
Mother's incentive (in 100 Rs.) × Year 2007-08	**-0.002****	**-0.002***	**0.004*****	**-0.002*****	**-0.001**	**0.002**	**0.010*****
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)
ASHA's incentive (in 100 Rs.) × Year 2007-08	**0.007*****	**0.013*****	**0.007*****	**0.003***	**0.004***	**-0.013****	**-0.004**
	(0.002)	(0.003)	(0.003)	(0.001)	(0.002)	(0.006)	(0.003)
Number of Observations	137324	130366	130509	137447	135687	116086	135372
R-square	0.17	0.19	0.35	0.13	0.23	0.28	0.35

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to women who reported a single birth since January, 2004. All regressions control for characteristics of the woman and her spouse (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling unit are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.11: Effect of the *Janani Surkshya Yojana* Program on Infant Mortality, Early and Late Neo-Natal Mortality (Probit Model).

Sample:	All India	Non-disadvantaged hh.	High performing states	Low performing states
Who is Eligible:	All women in low performing states, disadvantaged women in high performing states	Women in low performing states	Women in disadvantaged hh.	All women
	(1)	(2)	(3)	(4)
Panel A: Dependent Variable: Infant Mortality				
Baseline Average Infant Mortality × 1000	35	32	26	40
Eligible × Post × 1000	**-1.708**	**-1.077**	**-3.821**	
	(2.582)	(2.807)	(2.414)	
Rural × Post × 1000				**1.552**
				(3.607)
Number of observations	270934	121984	101796	169138
Pseudo R-Square	0.080	0.084	0.094	0.068
Panel B: Dependent Variable: Early Neo-Natal Mortality				
Baseline Average Early Neo-Natal Mortality × 1000	18	17	14	21
Eligible × Post × 1000	**-3.252***	**-2.652**	**-5.122****	
	(1.96)	(2.229)	(1.891)	
Rural × Post × 1000				**0.462**
				(2.698)
Number of observations	265110	116138	97012	168098
Pseudo R-Square	0.076	0.077	0.092	0.066
Panel C: Dependent Variable: Late Neo-Natal Mortality				
Baseline Average Late Neo-Natal Mortality × 1000	4	4	3	5
Eligible × Post × 1000	**0.637**	**1.103**	**-0.456**	
	(1.16)	(1.519)	(1.152)	
Rural × Post × 1000				**0.352**
				(1.469)
Number of observations	219885	82441	67845	152040
Pseudo R-Square	0.071	0.070	0.075	0.071

Notes: Data used from the District Level Household Survey-III (2007-08). A household is defined as disadvantaged if it belongs to Scheduled Castes/Scheduled Tribes or is below the poverty line. The sample is restricted to all live births reported by 15-49 year old women since January 2004. All regressions control for number of siblings, indicator for gender of the child, characteristics of the parent (age and years of schooling), indicators for household assets, religion, and district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. Infant mortality is an indicator which takes the value one if the baby was born alive and died within one year of birth. Early and late neo-natal mortality are also indicators taking the value one if the baby died within 7 and 28 days since birth, respectively.

TABLE 1.12: Effects of a Placebo Treatment Year on Institutional Birth using the DLHS-II Data.

Dependent Variable:	If the delivery took place at a (Govt./Private) Hospital			
	(1)	(2)	(3)	(4)
Eligible × Post	**-0.009**	**-0.005**	**-0.006**	**-0.006**
	(0.01)	(0.01)	(0.01)	(0.01)
Women & Spuose Controls	No	Yes	Yes	Yes
Household Asset Indicators	No	No	Yes	Yes
Religion FE	No	No	No	Yes
Number of Observations	115455	115455	115455	115455
R-square	0.24	0.36	0.38	0.38

Notes: Data used from the District Level Household Survey-II (2002-04). The sample is restricted to women reporting a single birth since January, 1999. The variable post is an indicator for birth after the year 2001. All regressions control for district fixed effects. Robust standard errors clustered at primary sampling unit are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE 1.13: Effects of the *Jananni Surkshya Yojana* Eligibility on Institutional Birth (Sample: Districts Bordering Low and High Performing States and Non-disadvantaged Households).

Dependent Variable:	If the delivery took place at a (Govt./Private) Hospital			
	(1)	(2)	(3)	(4)
Panel A: Before and After JSY				
Eligible × Post	**0.021**	**0.029***	**0.029***	**0.029***
	(0.018)	(0.017)	(0.016)	(0.016)
Obs.	16308	16253	16253	16253
R-sq	0.13	0.26	0.28	0.29
Panel B: Time Varying Effects of JSY				
Eligible × Year 2005-06	**-0.013**	**-0.006**	**-0.003**	**-0.002**
	(0.015)	(0.014)	(0.013)	(0.013)
Eligible × Year 2007-08	**0.074*****	**0.080*****	**0.082*****	**0.082*****
	(0.019)	(0.018)	(0.018)	(0.018)
Number of Observations	16308	16253	16253	16253
R-square	0.14	0.27	0.29	0.29
Women & Spuose Controls	No	Yes	Yes	Yes
Household Asset Indicators	No	No	Yes	Yes
Religion FE	No	No	No	Yes

Notes: Data used from the District Level Household Survey-III (2007-08). The sample is restricted to the households residing in the districts bordering the low and high performing states and non-disadvantaged households. A household is defined as disadvantaged if it belongs to Scheduled Castes/Scheduled Tribes or is below the poverty line. All regressions control for characteristics district fixed effects. Robust standard errors clustered at primary sampling units are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

Chapter 2

The Impact of Household Structure on Female Autonomy in Developing Countries

2.1 Introduction

Joint households involving a symbiotic co-residence of three generations under one roof are common in many developing countries.[1] Joint households provide household public goods in terms of time, physical structure, and insurance. But, joint households also give the patriarch, who controls the current resources and allocates bequests to the next generation, the opportunity to exert control and impose his preferences on other members of the households. Understanding the costs and benefits of joint household structure is important as urbanization and development are eroding joint household structure, altering the pooling of resources and the nature of care-giving provided to old and young family members, particularly in developing countries. The percentage of joint households in India decreased from 44 percent in 1992-93 to 34 percent in 2005-06.[2]

The dissolution of a joint households into two or more smaller households is an important economic and social event.[3] Several studies have attempted to explain the determinants

[1] Even though technical definitions vary, a joint household typically comprises of two or more generations of kin related patrilineally or sometime matrilineally who live in close proximity, eat from the same hearth and hold property in common (Caldwell et al., 1982).

[2] Author's calculation using the National Family Health Survey, 1992-93 and 2005-06.

[3] Goode (1963), Cain (1978), Dyson and Moore (1983).

of household partition and I build on those studies by focusing on the death of the patriarch. Meanwhile, the impact of household structure on the welfare of household members has been more difficult to observe and identify.[4] In this paper, I estimate the effect of household structure on autonomy and labor market participation of second generation women (typically, daughter-in-law).

Empowering women has become an increasingly important policy goal, both in its own right, and as a means for achieving other development goals. The literature identifies labor force participation, income, ownership of assets, access to credit for women, and kinship structure as major factors that determine women's autonomy. This paper finds empirical evidence that household structure, among many other factors, is a significant and important determinant of female autonomy and labor market participation. A simple model shows that nuclear households are likely to afford increased bargaining power for women, while also changing access to resources. After partition of a joint household, income and time may no longer be pooled across families, and access to joint household public goods is lost. Losing access to pooled income may induce women in nuclear households to work more, while losing access to pooled time may induce women to work less in order to produce household public goods. Apart from access to resources, change in household structure may also change the bargaining power of a woman and her husband. Therefore, the theoretical effect of household structure on female labor market participation is ambiguous.

The empirical challenge in evaluating the effect of household structure is that female autonomy and household structure might be endogenous. For example, a woman who regards her independence and autonomy highly might marry a husband who is more likely to live in a nuclear family after marriage. In this case, women would get sorted into different family structures according to their preference for autonomy. Even though most marriages in India and other South Asian countries are arranged by parents, where women have very little say in choosing their husbands, the endogeneity of female autonomy and household structure still remains an issue as parents might internalize their daughter's preferences.

Since joint household formation is plausibly endogenous, I use death of the patriarch as an instrument to explain the partition of joint households. The validity of the IV strategy would be undermined if the unobservable in the first stage affect both death

[4] Joshi and Sinha (2003) examines the effect of household partition on children's schooling in Bangladesh. Edlund and Rahman (2005) find that children in nuclear households in Bangladesh have better nutritional and educational outcomes.

of the patriarch and the bargaining power of women. I control for many possible confounding variables arising from geographic variation in access to infrastructure, age of the patriarch and spouse, and pre-partition household wealth. Conditional on this rich set of controls, I assume that death of the patriarch provides exogenous variation in the dissolution of joint households. Using unique longitudinal data from India that includes variables measuring autonomy of married women in the second wave of the survey, I find that living in nuclear households significantly raises women's autonomy and labor supply. I also find that the effects of joint households are heterogeneous by initial household asset. For most of the outcome variables involving decision making, the effect of living in poorer joint households are more negative than the effect of living in richer joint households. Whereas for most of the variables measuring the ability of a woman to leave the household premise without the permission of other household members, the effect of living in richer joint households are more negative than the effect of living in poorer joint households.

This paper makes two main contributions to the literature. First, to the best of my knowledge, this is the first study to evaluate the effect of household structure on female autonomy. Second, most of the studies on female autonomy measure autonomy in terms of indirect measures like expenditure on gender specific consumption goods (for example clothing). The data I use allows me to use more direct measures like women's ability to make decisions about various day-to-day activities and other financial and social matters.

The rest of the paper is organized as follows. Section 2.2 discusses the relevant literature. Section 2.3 provides an outline of joint household structure in India. Section 2.4 spells out a model of household decision making and the effect of household dissolution on female autonomy and labor market participation. Section 2.5 describes the data. The empirical strategy is outlined in Section 2.6, and section 2.7 discusses the results. Section 2.8 checks the robustness of the results. Section 2.9 discusses heterogeneity in the effect of household structure on outcomes for women and Section 2.10 concludes.

2.2 Background

The existing literature identifies several factors such as labor force participation, ownership of assets, access to credit, and exposure to media as determinants of female

autonomy. Numerous studies bolster the view that women's access to employment outside the household increases her decision making power and control over resources.[5] A separate strand of literature argues that female ownership of durable assets may serve as an effective way to enhance female autonomy and control over resources.[6] More recently, Jensen and Oster (2007) find that exposure to mass media is associated with increase in reported autonomy, decrease in reported acceptability of beating, and decrease in fertility.

Empirical studies on the effect of household structure on women's labor market participation are also very scant. Wong and Levine (1992) find that the presence of a 'mother substitute' in the house significantly increases the labor force participation of the mothers in Mexico. Gong and Soest (2002) also find that presence of another woman increases the labor supply of mothers with young children in Mexico. Sasaki (2002) finds that co-residence with in-laws increases labor force participation for Japanese women. He uses sibling characteristics (birth order and numbers of siblings for married women and their spouses) and characteristics of the house as instruments for co-residence.

2.3 Joint Household Structure

The term *"Hindoo Joint Family System"* first appeared in early British Indian legal textbooks in the 1820's and 1830's (Denault, 2009). There are conflicting theories on the origins of the joint family system. The system is considered an ancient institution by one school of historians while others consider it to be have flourished as late as early nineteenth century.[7] A joint household comprises married couples linked by kinship (mostly patrilineal) residing under the same roof or in close proximity and sharing resources

[5] See Acharya and Bennett (1982) for evidence from Nepal, Finaly (1989) for the Dominican Republic, Ecevit (1991) for Turkey, Safa (1992) for the Caribbean, and Kantor (2003) for India. Also see Rahman and Rao (2004), and Anderson and Eswaran (2009) among several others.

[6] See Agarwal (1995), Beegle et al. (2001), Fafchamps and Quisumbing (2005), Panda and Agarwal (2005), Breza (2005), Doss (2006).

[7] "the joint family has endured for as long as any records exist... Neither the Muslim nor the British rule was able to modify the structure of this most ancient institution of India" - Karve (1968). "a process 'Sanskritisation', by which lower-caste people could gain social standing by adopting upper caste norms of behavior and ritual practice...in the late nineteenth and early twentieth century" (Denault, 2009)

under the headship of a patriarch.[8] Sons continue to live within the parental household after marriage, whereas daughters migrate to their husband's family. After several years of co-residence the joint household may break up into two or more households (Joshi and Sinha, 2003).

The effect of partition of joint families is observed in eating arrangements, the family budget, land (if any) and residential arrangements. Change in residential arrangements might imply acquisition of one or more separate houses or the partition of the existing house by an imaginary line or a brick wall. Some agricultural tools may still be shared, and labor may be exchanged, but post-partition some notion of accounting begins to emerge.

Most of the studies confirm that partition of a household occurs sometime between the marriage of the eldest son and the death of the father. There are several explanations offered for household partition. First, the death of the patriarch is one of the proximate causes of household dissolution (Caldwell et al., 1984, Khuda, 1985, Foster, 1993). Caldwell et al. (1984) finds that 31 percent of the households in rural South India report death of the patriarch as the primary reason for household partition. A patriarch might mediate discords among sub-households in a joint family, thus preventing partition. Khuda (1985) finds that discord among the sub-households is another potential reason for partition. Similar observations are also noted by Epstein (1962) and Caldwell et al. (1984) using Indian data. After death, patriarch's properties are divided among the claimants, which may also initiate the partitioning. Second, the timing of the partition may vary depending on the financial status and landholding characteristics of a joint household. Cain (1978) finds that landowning joint households in Bangladesh partitioned later than landless joint households. This could be due to the fact that early separation from the joint family by a son may reduce his land holdings. Khuda (1985) reports that 36 percent of the households consider economic pressure to be the main cause of partition in Bangladesh. It suggests that disproportionate relative contributions versus benefits for sub-households in a joint family may cause the household to break up. This problem could be more severe for poorer joint households, which subsequently makes them prone to partition earlier than the richer joint households. Third,

[8] Caldwell et al. (1984) summarizes different family structures existing in India. A family of a conjugal couple and their unmarried children is called a *nuclear household*. A *stem household* describes two married couples in different generations. A *joint household* refers to married siblings (mostly brothers) living together. A *joint-step household* is a classical full pyramid where more than two generations live together. Generally, such households comprise of older couples and their married sons and grandchildren. In this paper any household which is more complex than a nuclear household will be called a joint household.

crowding, migration for work, and migration for land from wife's natal home could be responsible for joint household dissolution. Apart from the above mentioned factors Foster (1993) finds that in Bangladesh household partition is affected by the sex composition and number of children in the household. Rosenzweig and Wolpin (1985) propose that predominance of extended households in land scarce developing countries is an outcome of an optimal contract between generations which maximizes the gains from farm specific knowledge obtained through experiments over time. Foster and Rosenzweig (2002) find that intra-household inequality in schooling, timing of marriages and *riskiness* increase the probability of partition of a joint household.

2.4 Theory

This section presents a model of resource allocation in a joint household where several related families co-reside. I subsequently add production of a household public good to the basic model in order to find the effect of households structure on the labor force participation of women. For the sake of brevity, neither version examines conditions in which families or households break up endogenously; the possibility that this happens as a function of discord will necessitate the use of an instrument. I derive predictions about the impact of household structure on autonomy and employment of women within the household.

2.4.1 Basic Model

The *collective* model of the household specifies household welfare to be a weighted average of individual (often a *husband* and a *wife*) utilities where the weights are exogenous. Given the complex household structure in developing countries, the model presented in this section adapts and extends the *collective* model to accommodate joint households.

I assume that k families co-reside in a joint household, and each family consists of a husband, wife and an unmarried child.[9] All families in the household pool their resources but do not necessarily behave like a single agent. The utility function of the i^{th} family is given by $u_i = (1-\theta_i)u_{ih} + \theta_i u_{iw}$, where u_{ih} and u_{iw} are the utility functions of the husband and the wife respectively.$\theta_i \in [0,1]$ captures the intra-family bargaining power of the i^{th} *wife*, so as θ_i increases bargaining power of the *wife* increases relative

[9]The model can easily accommodate more than one child without changes to the basic implications.

to the husband.[10] Both the husband and wife are endowed with one unit of time and to simplify the model I assume that both are employed full time with wage w.

To keep the model simple, I assume that both the husband and wife have a common utility function u_{ic}, i.e., $u_i = (1-\theta_i)u_{ic} + \theta_i u_{ic}$, so intra-family bargaining is irrelevant. u_{ic} depends on consumption of a single composite commodity x_{ic}, and the utility function is logarithmic, $u_{ic} = \ln x_{ic}$.

The household maximizes a weighted average of the utility functions of the families. The objective function of the household is given by $\Psi = \sum_{i=1}^{k} \phi_i u_i$, where ϕ_i measures inter-family bargaining power, so as ϕ_i increases, the bargaining power of the i^{th} family increases. In this model I assume that ϕ_i depends on the birth order b_i of the husband in i^{th} family, with $\phi(b_i)$ decreasing in b_i and $\sum_{i=1}^{k} \phi_i = 1$.[11]

The household's problem can be expressed as follows:

$$\max_{x_{ij}} \sum_{i=1}^{k} \phi(b_i) \ln x_{ic} \tag{2.1}$$

$$\text{subject to: } x_{ic} \in \Re_+ \quad \text{and} \quad p.\sum_{i=1}^{k} x_{ic} = 2wk$$

where p is the price of consumption good x. Given the simple assumptions, the household's problem has a closed form solution. The optimal consumption of the child in the i^{th} family is given by $x^*_{ic} = y\phi_i$, where y is total real income ($\frac{2wk}{p}$) of the extended family and the factor of proportion ϕ_i measures his family's bargaining weight in the joint household.

2.4.2 Change in Family Structure

An exogenous change in the structure of a joint household is equivalent to a change in k in the model. If a joint household consisting of two families breaks up into two nuclear families, k changes from 2 to 1. As bargaining power ϕ_i of a family is a function of birth order of the husband in the joint household b_i, ϕ_i also changes after partition and it becomes trivial in the cases I consider, involving the formation of nuclear household.

[10] Since u_i is a convex combination of two strictly concave functions, it is also strictly concave.

[11] b_i takes value 1 if the husband in the i^{th} family is the oldest married man in the joint household. Male siblings in the Indian subcontinent typically get married according to their birth order.

A simple example illustrates the effects when a two-couple extended household breaks up. Let $k = 2$ and $\phi_i = \frac{2(k+1-b_i)}{k(k+1)}$, where b_i is the birth order of the husband in the i^{th} family.[12] If the families split and form two nuclear households, the changes in x^*_{ic} for each family are given by $\Delta x^*_{1c} = -\frac{y}{3}$ and $\Delta x^*_{2c} = \frac{y}{3}$. Consumption of the older couple decrease, while it increases for the younger couple. This is simply because the older couple had higher inter-family bargaining power ϕ_i in the joint household and had gained some resource from the younger couple.

An exogenous change in household structure induces a change in intra-family bargaining. Bargaining power of the wife in the i^{th} family is given by the product of the intra-family and inter-family bargaining power, $\phi_i\theta_i$. I will call this effective bargaining power and denote it by π_i. Changes in effective bargaining power in the above example are given by $\Delta\pi_{1w} = \frac{\theta_1}{3}$ and $\Delta\pi_{2w} = \frac{2\theta_2}{3}$. An exogenous change in household structure increases the bargaining power of wives in both the families, while the increase is higher for the younger wife, since she and her husband had less inter-family bargaining power in the joint household.

2.4.3 Public Good and Female Employment

It is interesting to investigate how women's labor force participation might change due to a change in household structure because, based on the literature cited earlier, higher income for females increases female autonomy and improves child outcomes. Joint households are often characterized by time spent by individual members on home production of a good which is non-rival and non-excludable. For example, cleanliness is enjoyed by every member as a public good in a household. I introduce a public good in the basic model and endogenize the time spent by wives in the labor market, although lacking a good instrument, I continue to assume that bargaining power is independent of labor earning.

I assume that a child's well-being depends not only on the composite commodity x^*_{ic} but also on a public good g, which is produced by the female members of the household.[13] To keep the model simple, I assume the only input required for production of g is time. Female members now can divide their unit time between producing g (e^g_{iw}) and working in the labor market (e^m_{iw}). The male members of the household are employed full time in the labor market.

[12] The assumed functional form of ϕ_i simplifies calculations, $\frac{\partial\phi_i}{\partial b_i} < 0$, and $\sum_{i=1}^{k}\phi_i = 1$.

[13] This assumption follows from the traditional gender roles in developing countries where women are mostly confined to household chores without male involvement.

The utility of each adult member is given by $u_{ij}(x_{ic}, g) = \ln x_{ic} + \gamma g$. The production of the public good is given by $g = \sum_{i=1}^{k} e_{iw}^{g}$. Thus, the marginal utility from g and the marginal product of labor in producing g are constant. The households problem now can be written as follows

$$\max_{x_{ij},\ e_{iw}^{g},\ e_{iw}^{m}} \sum_{i=1}^{k} \phi(b_i) \left(\ln x_{ic} + \gamma g\right) \tag{2.2}$$

$$\text{subject to: } x_{ic}, g \in \Re_{+}; \quad g = \textstyle\sum_{i=1}^{k} e_{iw}^{g}; \quad e_{iw}^{g} + e_{iw}^{m} = 1; \quad \text{and}$$
$$p. \textstyle\sum_{i=1}^{k} x_{ic} = wk + w. \sum_{i=1}^{k} e_{iw}^{m}.$$

The optimal private consumption x_{ic}^{*} is given by $x_{ic}^{*} = \frac{w\phi_i}{\gamma p} = \frac{y\phi_i}{2\gamma k}$, and it falls as preferences for the public good rise and rises as market productivity rises. The optimal amount of public good g that will be produced in the household is given by $(2k - \frac{1}{\gamma})$, so it increases in the number of families k in the household. There is no unique solution for e_{iw}^{m}, but if I assume all wives contribute an equal amount of time in producing g, then $e_{iw}^{m*} = \left(\frac{1}{\gamma k} - 1\right)$.[14] Under the assumption of equal contribution to the public good, if the joint household splits (decrease in k), the amount of the public good produced in the household will decrease, and therefore time spent by females in the labor market will increase unambiguously after partition, as the gain in household utility from public good production has declined.

2.5 Data

2.5.1 Data Sources

I use two sources of data for the empirical analysis: the *Human Development Profile of India* (HDPI) and the *India Human Development Survey* (IHDS). The HDPI was collected in 1993-94 by the National Council for Applied Economic Research (NCAER), focusing on rural areas in 16 states of India and covered 33,230 households. The IHDS was collected in 2005 from 25 states and union territories of India covering 41,554 households.[15] The IHDS 2005 (wave II) attempted to re-interview half of the rural households that had been covered by the HDPI in 1993-94 (wave I). I focus on these re-interview

[14] For an interior solution I need to assume $\frac{1}{2k} \leq \gamma \leq \frac{1}{k}$. If the time contribution of each female is not equal, then splitting the joint household may lead some women to work less and some to work more, just as, above, some families would have gained income and some lost income if the household split.

[15] This data was collected by Desai, Vanneman and NCAER

households (N=13,079) so that I can observe the partition of joint households. Re-interview households were selected randomly within the stratified 1994 sampling design. The survey provides comprehensive data at both the individual and household levels to test the hypotheses of the theoretical model .

In IHDS 2005, ever-married women between the ages of 15 and 49 were asked about their decision-making power regarding cooking, purchase of expensive durable goods, number of children they want to bear, and medical needs of their children. They were also asked if they need permission from their husband or elder members of the household to go to a grocery store or health center or to visit a friend. I use these self-reported indicators to measure female autonomy.

2.5.2 Estimation Sample

The HDPI collected household and individual level data in rural areas from a total of 33,230 households in 1993-94. Among these households, 10,791 were re-interviewed in 2005 as a part of the IHDS. During the eleven year gap between the two surveys, the re-visited households had partitioned into a total of 13,079 households. The working sample consists of the re-interviewed households which initially had a joint household structure in 1993-94, possessed land, and were headed by a male.[16] A household is defined to be joint if there is more than one married male or female in a household. Among the 10,791 households in 1993-94, 3536 were joint, had land, and were headed by a male. As panel B in Table 2.1 reports, by 2005 these households had split into 4873 households. Table 2.1 also shows the relationship between household structure and death of a patriarch. While most households break up, 36.9 percent of households remained joint if the patriarch was still alive, whereas only 16.8 percent households remained joint if the patriarch died between wave I and II.

Table 2.1 reports that almost 63 percent of the joint households split into nuclear households by 2005, despite the patriarch being alive. Although a large percent of joint households broke up endogenously, 2SLS still can identify the Local Average Treatment Effect (LATE) of joint household structure on autonomy and other outcomes for those women who live in nuclear households despite the patriarch being alive and would also

[16]In 1993, 46 percent of the households had a joint household structure, 95 percent were headed by male, and 67 percent of them possessed land. In joint households with land the patriarch is more likely to have greater control over resources as he will bequeath his land later to the second generation. The literature also suggests that households which have land are less likely to break-up for reasons other than patriarch's death.

live in a nuclear household if the patriarch was dead by 2005 (Imbens and Angrist, 1994). In other words, 2SLS estimates identify the effect of household structure for those whose household structure is actually changed by death of the patriarch.

2.5.3 Summary Statistics

The first three columns in Table 2.2 provide summary statistics for the 2847 women between age 15-49 residing in households which were initially joint, headed by a male, and owned land in 1993-94. The 2847 households (in 2005), which constitutes the sample for analyzing women's autonomy, were a total of 2443 households in 1993-94. For these households in 1993-94, the average number of married male, married female, and total members were 2.58, 2.36, and 8.74 respectively. Almost 87 percent of the households had livestock in 1993-94, and only 5 percent of them belonged to higher castes. 87 percent of the households were Hindus. The average age of the patriarch was 51.26 years. In 2005 the average age for the women is 35.54 years and their average years of education is 3.03 years. The average age and years of education for their spouses are 40.26 and 5.89 years, respectively.

Column (iv) to (ix) of Table 2.2 report the summary statistics by the household structure in 2005. These columns compare the 1993-94 household characteristics and women's characteristics in 2005 for women residing in households which were joint in 1993-94 by their household structure in 2005. Except for average land holding, 1993-94 (wave I) household characteristics are almost identical across the joint and nuclear households in 2005. Similarly, the women's characteristics are also almost identical across the two types of household structure in 2005. The summary statistics for the female autonomy variables presented at the bottom of the table shows that women in nuclear families in 2005 consistently have more decision making power, need not get permission for their activities, and participate more in the labor market.

2.6 Estimation Strategy

The objective of this paper is to estimate the effect of household structure on autonomy and labor market participation of females. The model predicts that women in nuclear households will enjoy higher bargaining power as there is no inter-family bargaining and will participate more in the labor market as access to the joint household public good is lost. To measure women's bargaining power, I use her self reported decision making

power over cooking, purchasing expensive items, the number of children to bear, and satisfying medical needs of her child. This section outlines the strategy to estimate the causal impact of household structure on these outcomes.

2.6.1 Female Autonomy and Labor Market Participation

The model unambiguously predicts that women living in nuclear families will have higher effective bargaining power or autonomy than their joint household counterparts. To test this empirically, I use indicators for a woman's decision making power over specific types of actions as measures of her bargaining power in 2005 who lived in a joint household in 1993-94. The empirical model is specified as:

$$A_{ij} = \alpha_0 + \alpha_s S_j + \alpha_h H_j + \alpha_f F_{ij} + \alpha_m M_{ij} + \nu_{ij} \tag{2.3}$$

where A_{ij} is a binary indicator for having decision making power or participating in the labor market for woman i in household j, S_j is a binary indicator for whether the household remains joint (S_j=1) or nuclear (S_j=0) in 2005, and other variables represent characteristics of the household, H_j in 1993, and its individuals, with F_{ij} for the woman's characteristics in 2005, and M_{ij} for the spouse's characteristics in 2005. I use initial-wave rather than later-wave household characteristics H_j, so as to avoid including variables that may be influenced by subsequent changes in family structure.[17] The coefficient α_s on the structure S_j of the household is the parameter of interest.[18]

I rewrite equation (2.3) as follows:

$$A_{ij} = \alpha_0 + \alpha_s S_j + \alpha_v V_{ij} + \nu_{ij} \tag{2.4}$$

where $\alpha_v = (\alpha_h \;\; \alpha_f \;\; \alpha_m)$ and $V_{ij} = [H_j \;\; F_{ij} \;\; M_{ij}]'$.

The main empirical challenge is that household structure may be endogenous. For example, a woman who strongly prefers her independence and autonomy might want to marry a husband who will choose to live in a nuclear family after marriage. The next

[17] Changes in women's and spouses characteristics (F_{ij} and M_{ij}, respectively) after the dissolution of a household in not a concern as years of education and age at first marriage are very unlikely to change.

[18] The indicator A_{ij} takes the value one if a woman can decide over cooking, purchasing, deciding the number and the medical needs of her children and zero otherwise. Labor market participation is also an indicator which takes the value one if a woman participates in the labor market and zero otherwise. Similarly, the set of permission variables are also indicators, they take the value one if a woman do not need permission to go to a grocery store, health center or a friends place. The characteristics of women and her spouse include their age and years of education.

section describes the instrumental variable estimation strategy and the validity of the instrument in detail.

2.6.2 Validity of the Instrument and First-Stage Estimates

As described earlier household structure may be correlated with female autonomy. Therefore, the OLS estimate of the effect of household structure on female autonomy would be biased. To address endogeneity concerns, I use the death of the patriarch (the woman's father-in-law) as an instrument for household structure. Ethnographic studies suggest that death of a patriarch plays an important role in dissolution of a joint household for multiple reasons. First, living in a joint family while the patriarch is alive is a social custom widely practiced in South Asia. Orenstein and Micklin (1966) summarize the norms governing joint families in India: *"following marriage, adult men remain in their father's household until he dies, at his death, each married male establishes their own nuclear household. Each of these nuclear household remain such until its eldest son marries, when it again becomes joint."* Second, the patriarch might act as a mediator to resolve discords among the families living together and can prevent break up. Third, according to the Hindu Succession Act, land and other assets get divided equally among the surviving sons of the patriarch. But, the law can be preempted by a legal declaration by the patriarch. Separation of the son from a joint household while his father is alive might strip him off his claims over the property of the patriarch (Jain, 2010). This incentivizes living in joint households till the patriarch is alive. Therefore, death of a patriarch is a prominent determinant of household partition.[19]

The IV approach involves estimating a two stage model which is specified as follows:

$$First stage : S_j = \gamma_0 + \gamma_z Z_j + \gamma_x X_{ij} + \eta_j \tag{2.5}$$

$$Structural equation : A_{ij} = \alpha_0 + \alpha_s S_j + \alpha_x X_{ij} + \nu_{ij} \tag{2.6}$$

The structure of the household S_j is instrumented by Z_j, whether the patriarch died.

The two requirements for the validity of the instrumental variable is (i) the instrumental variable and the endogenous regressor are strongly correlated, and (ii) the instrumental

[19]The instrument does not deal with the endogenous choice to form a joint household, but this has typically been a cultural norm in rural India (Edlund and Rahman 2004, Foster 1993). Nevertheless, the instrument is only valid for households that choose to form joint households while the patriarch is alive.

variable is orthogonal to the error in the structural equation. The rest of this section discusses the validity of these two assumptions.

I restrict the sample to households that were joint in wave-I in 1993-94 and examine dissolution in 2005. The estimation results for the first stage are presented in Table 2.3. The dependent variable in Table 2.3 is an indicator which takes value one if a woman lives in a joint household. Column (i) in the tables reports the coefficient indicating how the death of the patriarch affects on household structure without any additional controls. Based on the estimated coefficient of -0.24, a woman is 24 percentage points less likely to live in a joint household in wave-II if the patriarch died between waves I and II. The coefficient is highly statistically significant, and the F Statistic is 163.6, eliminating concerns about weak instruments. This shows that the instrument variable satisfies the first condition that it is relevant in the First stage equation.

The literature identifies crowding and number of rooms as one of the potential reasons for household break-up (Joshi and Sinha, 2003). In Column (ii) of Table 2.3, I add household residential characteristics from wave-I as additional controls that may be correlated with household structure in wave-II. These controls include total number of household members, number of married male and female members, and number of rooms in the household in 1994 (wave-I) when all households were joint. The coefficient of death of the patriarch increases marginally in Column (ii) and is still highly significant.

Household wealth may determine survival of a patriarch. Therefore, I control for household wealth as in 1993-94 using education of the patriarch, land (in acres), and an indicator for livestock ownership as additional regressors in column (iii). The specification in column (iii) also controls for age of the patriarch in 1993. The coefficient on death of the patriarch strengthens to -0.33 and continues to be statistically significant.

Individual and husband's characteristics and income may jointly determine the household structure and the outcome variables. A highly educated woman is more likely to prefer autonomous decision making and she may also be more effective in persuading her husband to form a nuclear household. Therefore, in Column (iv) of Table 2.3, I add women's and their spouse's age and years of schooling in 2005 as additional controls. The coefficients on death of the patriarch do not change after controlling for these additional variables.

Both survival of the patriarch and labor force participation (and other outcome variables measuring female autonomy, such as if permission is required to visit health center) may depend crucially on provision of infrastructure such as hospitals, roads etc. Apart from

that, dissolution of a joint household after the death of the patriarch might be more common in certain regions or for certain caste or religious groups. Intra-household bargaining norms in India also vary geographically based on local social customs and traditions. To address these concerns, I include district fixed effects, caste and religion dummies as additional regressors in Column (v). Even controlling for differences across district, caste, and religion, the death of a patriarch continues to have a significant effect on household structure.

The estimated effect of death of the patriarch remains remarkably similar across all the specifications. If any of these variables had strong direct effects on the death of a patriarch, then including them might be expected to change the coefficient estimate of interest, but it does not. Therefore, after adding detailed control for household characteristics and initial family wealth, district, religion and caste fixed effects, variation in death of the patriarch may be considered plausibly exogenous to women's autonomy. All results presented in the subsequent section control for the full set of regressors described above.

2.7 Results

This section presents the empirical evidence on the effects of household structure on female autonomy and on women's labor market participation using a standard two stage least square estimation procedure. I instrument for Wave-II household structure with an indicator for whether the patriarch of the joint household died between Waves I and II. In all the regressions, I include the full detailed set of first-stage controls described above, including Wave-I measures of household wealth and spousal characteristics. Although the first-stage estimate was not sensitive to these controls, they help deal with concerns that the death of the patriarch is directly correlated with second-stage outcomes.

As mentioned earlier, I restrict my sample to ever married women between 15 to 49 years residing in landowning joint households (in 1993-94) headed by males in order to gauge the impact of household structure on female autonomy. In 2005, these women were asked if they can decide independently what to cook on a daily basis, whether to purchase an expensive item, what number of children to bear, and what to do if their children needed medical care. They were also asked if they need permission from their husband or other senior members of the household to go to a grocery store, or health center, or to visit a friend. I use these indicators as measures of women's decision

making power and autonomy respectively, and report the effect of household structure on these outcomes in Table 2.4 and Table 2.5. Tables 2.4 and 5 also report the effect of joint households on labor force participation of women, and if she has disposable cash in hand.

Table 2.4 reports the OLS estimate of household structure on women's decision making power, her autonomy, and labor force participation. All these variables are indicators which take value one if women exhibit more autonomy, i.e., they are able to make decisions, do not need permission to take action, or participate in labor force. All coefficient estimates for the decision making variables reported in Columns (i) to (iv) are negative and statistically significant after controlling for household residential characteristics in 1993, proxies for household wealth in 1993, age and education of the woman and her spouse in 2005, age at marriage, and religion, caste and district fixed effects. Similarly, the OLS estimates of the effect of household structure on women's autonomy (whether women do not need permission for her activities) reported in Columns (v) to (vii) are negative and significant. Column (i) reports the coefficient of joint household structure on the cooking decision. The coefficient of -0.18 on the indicator for being in a joint family in Wave II is highly statistically significant, suggesting that women in joint households are 18 percentage points less likely to decide what to cook on a daily basis, compared to women in nuclear households. The OLS estimates reported in Columns (viii) and (ix) suggest that women living in joint households are 9 percentage points less likely to participate in labor market and are 5 percentage point less likely to have disposable cash in hand.

As the OLS estimates reported in Table 2.4 may suffer from endogeneity, I use the patriarch's death as an instrument for living in a joint household in 2005 and report the results in Table 2.5. Panel A in the table reports the first stage of the regressions. The coefficient on patriarch's death is highly significant and negative, as reported earlier. Death of the patriarch reduces the probability that a woman lives in a joint household by 32 percentage points.[20]

In the 2SLS estimates in Panel B, the effect of joint households on women's autonomy and labor market participation are substantially more negative, compared to the OLS coefficients, for all outcomes. The coefficient for deciding about cooking remains almost the same, but the other coefficients are in the range of -0.11 (for labor force participation) and -0.33 (for visiting grocery store). The estimates imply, for example, that living in a

[20]The first stage regression estimates for the last three Columns is marginally different as the sample size for the outcome variables vary.

joint family reduces the likelihood of being able to decide about the number of children to have by 12 percentage points, about medical care for children by 25 percentage points, and about visiting a friend by 27 percentage points. A woman is also less likely to hold cash in hand by 11 percentage points if she resides in a joint household. As almost all the 2SLS estimates are more negative than the OLS estimates, it suggests that the unobserved characteristics of a woman increase the OLS estimates. For example, in the presence of a suppressive mother-in-law a woman would have less decision making power and she would also be less likely to live in a joint household.

The model in Section 4.3 predicted that under the assumption of equal contribution to joint household public good, labor force participation of females will increase unambiguously after the dissolution of the joint household. Estimates reported in Column (viii) suggests that residing in a joint household because the patriarch remains alive reduces the probability that a woman will participate in labor market by 12 percentage points.

2.8 Robustness

In this section I address two issues that raise concern over the estimated effect of household structure on female autonomy. First, the estimation strategy discussed in Section 6 specifies a linear probability model for both the first stage and the structural equation. As the specified linear probability models are not saturated this section discusses non-linear estimates of the effect of household structure on female autonomy and labor force participation.[21]

Second, a crucial assumption for 2SLS estimates is that the instrument is excluded from the structural equation. However, it may be argued that, given social customs in South Asia, women's autonomy may depend on the presence of the patriarch in the household. Therefore, the death of the patriarch, although used as the instrument, would not be excluded from the structural equation. Even though there is no formal way of testing the exclusion restriction, I provide some circumstantial evidence to support the claim that the instrument is excluded and therefore valid.

[21] A *saturated* model is a linear probability model with dummy variables on the right hand side. A saturated model with only dummy variables on the right hand side is a *general* model and it estimates the underlying conditional mean function perfectly.

2.8.1 Bivariate Probit Estimation

Apart from the issue of the fitted variable being outside the unit interval, the linear probability model also implies that a unit increase in the explanatory variable will always change the probability of the outcome variable by the same amount, ultimately driving predicted probabilities outside the unit interval. The use of a linear probability model is justified if most of the explanatory variables are categorical and in the extreme case when the model is saturated, linear probability model is completely general. Since both the first stage and the structural equation are not saturated, in this section I report the non-linear estimates of the effects of the household structure on female autonomy. I estimate a Bivariate Probit model, which treats the binary measures of female autonomy variables and the indicator for death of the patriarch as latent variables and excludes the indicator for death of the patriarch from the structural equation.

Table 2.6 reports the results from the Bivariate Probit estimation. As in the 2SLS estimates, the sample is restricted to ever married women between 15 to 49 years residing in land owning joint households in 1993 headed by males. The set of controls also remain unchanged.[22] All outcomes variables are binary, which take the value one if women are able to make household decisions, do not need permission to visit a health center, a friend or a grocery store, and participate in labor force. Column (i) reports the Biprobit estimated marginal effect of the effect of joint household structure on whether a woman can decide about cooking on a daily basis. The reported estimate of -.21 is highly significant and implies that the a woman is 21 percentage points less likely to decide about cooking if she resides in a joint household. This estimate is very similar to the 2SLS estimate of -.22 reported in Column (i) of Table 2.4. All estimates of the marginal effect of joint household structure are negative, indicating joint households decrease women's decision making power, permission to visit a health center, a friend, or a grocery store. The estimated marginal effects on labor force participation and the indicator for having disposable cash in hand are also negative, although the estimated effect on labor force participation is imprecise. Also, all the estimated Biprobit effects of joint household are similar to 2SLS estimates, except they all are somewhat less negative for going to friends or a grocery store without requiring permission from other household members. Therefore, the Bivariate Probit estimates corroborate the 2SLS estimates and allay issues related to linear probability model specification.

[22]The control set include household residential characteristics in 1993, proxies for household wealth in 1993, age and education of the woman and her spouse in 2005, age at marriage, and religion, caste and district fixed effects

2.8.2 Exclusion of the Instrument from the Structural Equation

The identification of the structural parameters in the linear instrumental variable framework requires that the instrument should be uncorrelated with the error term in the structural equation. In this section I conduct robustness tests to validate the exclusion restriction assumption.

First, even though I control for a rich set of factors that may affect both female autonomy and death of the patriarch, the presence of a dominant male household head may make women submissive violating the exclusion restriction.[23] I test if the presence of a male household head influences women's autonomy using the second wave of the data (IHDS, 2005). I restrict the sample to households which are joint, posses land, and the head is not the father-in-law of the woman in 2005. I also drop women from the sample if her husband is head of the household. In other words, this sample includes the joint household where the head is either a non-husband male (Brother-in-law, or other male relative of a woman) or female (mother-in-law, or other female relative of a woman). I report the OLS estimates of the effect of a male headed household on the measures of female autonomy and labor force participation in Panel A of Table B.1 in the Appendix B. Out of seven measures of decision making and autonomy for women, only for the indicator whether women can visit a health center without permission, the effects of a male headed household is statistically significant at 90 % level of significance. Panel B of the Table A1, reports the effects of household head by relation of the women to the head on the same outcome variables.[24] The reported estimates do not reveal any significant negative affect of household head being male on women's autonomy and labor force participation.

Second, anthropological studies find that in the Indian sub-continent, there is a discontinuity in the freedom and autonomy a girl enjoys before and after marriage; however, their hierarchical position in the household increases with time. A newly married woman has to practice purdah in front of the males and requires permission from them to leave the household. Her status and voice in from of males increases over time, in particular after she becomes a mother (Das Gupta, 1996). Given the average age of 35.5 and an average age at marriage of 16.5, the women in the sample are married for an average

[23] I cannot separate the effects of living with the patriarch and that of living in a joint household. But the effects of the presence of a male head (not the husband of a woman) on female autonomy can be formally tested.

[24] The excluded category in Panel A are the households where the head is a female. In Panel B the excluded categories are the households where the head is a female or the head is a male and he is either the father or brother of a woman.

of 20 years. Given such a long marital duration and the anthropometric evidence that status of female in the household increases with time, it is plausible to assume that presence of a male household is excluded from the structural equation making death of the patriarch a valid instrument.

2.9 Heterogeneous Effect of Household Structure

This section presents evidence on heterogeneity in the effect of household structure on women's autonomy. The model presented in Section 4 predicts that an exogeneous change in household structure from joint to nuclear will increase bargaining power of all women. The results discussed in Section 7.1 provides empirical evidence supporting this hypothesis. Some joint households may confer more decision making power to women while others may restrict their autonomy. In this section I discuss the heterogeneity in women's outcomes based on the joint household's economic status in wave-I in 1993-94.

2.9.1 Heterogeneity in Outcomes for Women

Recall that the original sample consists of women aged 15-49 who lived in households that were joint in 1993-94, possessed land, and were headed by a male. I divide this group into two sub-samples by the median asset index of the joint household in 1993-94. The asset index for the joint household was created using Principal Component Analysis from the indicators for household assets.[25] Table 9 presents the 2SLS estimates for women who lived in joint households during 1993-94 with values of the household asset index below the median (poorer households) in Panel A and for women with values above the median (richer households) in Panel B. For all the outcome variables involving decision making reported in Columns (i) to (iv), the effect of living in poorer joint households are more negative than the effect of living in richer joint households and for the latter they become statistically insignificant. However, the effect of joint households on whether a women is able to decide on what to be cooked on a daily basis does not vary by the two types of joint household.

Columns (v) to (vii) report the effects on whether women need permission to visit a health center, friends, or a grocery store. Here, the estimates are reversed. The effects

[25] I use indicators for ownership of bicycle, sewing machine, tube well, generator, thresher, winnower, bullock, biogas, rickshaw, bike, car, tractor, radio, tv, vcr, air conditioner, and fan to construct the asset index.

of the joint household for these outcome variables are more negative and significant for the richer households. The coefficient on whether a woman can visit a local health center without permission is almost identical across the panels, but women in richer joint households are 37 and 56 percentage points less likely to visit a friend or a grocery store without permission. The corresponding estimates for the poorer households are 15 and 13 percentage point respectively and are less precise. On other words, women living in richer joint households have more autonomy within the household but less in leaving, and the effects are reversed for the women living in poorer joint households.

Column (viii) and (ix) report estimates for whether a woman participates in the labor market, and has a bank account. The estimates reported in both the panels are negative, but, they are not statistically significant.

2.10 Conclusion

This paper provides empirical evidence that household structure is a significant determinant of female autonomy. Women residing in joint households are less likely to have decision making power and they need permission more often from other household members to execute some routine household activities. Women living in nuclear households are more likely to participate in labor market. I also find that there are heterogeneity in the effects of joint household structure by the economic status of the joint household. Women have less decision making power in a poor joint household while they need more permission to leave in a rich joint household.

Given the benefits of increased female autonomy noted in the development literature, these results suggest that policies and urbanization promoting nuclear households may yield good results in terms of female autonomy. Moreover, policies geared to increase female employment without considering their household structure might not yield desired outcomes. It is also important to note that provision of substitutes for joint household public goods in terms of care for young and old and insurance against shocks may complement the gains in female autonomy arising due to dissolution of a joint household.

TABLE 2.1: Death of Patriarch and Household Structure.

Panel A: Household Structure in 1993-94		
Joint	Nuclear	Total
3536	3317	6853

Panel B: Structure of 3536 joint households from panel A in 2005			
If the Patriarch died between 1993 - 2005	No	Yes	Total
Nuclear Household	2375	924	3299
Joint Household	1388	186	1574
% of Households Which are Joint	**36.89**	**16.76**	32.30
Total	3763	1110	4873

Notes: Data used from HDPI (1993-94) and IHDS (2005). Sample includes households which were headed by male and had land in 1993-94.

TABLE 2.2: Summary Statistics.

Variable	All			Joint households in 2005			Nuclear households in 2005		
	Obs.	Mean	S.D.	Obs.	Mean	S.D.	Obs.	Mean	S.D.
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Wave I covariates, 1993-94									
No. of household members	2847	8.74	3.92	1013	8.83	3.69	1834	8.69	4.05
No. of married female members	2847	2.58	0.97	1013	2.66	0.93	1834	2.54	0.99
No. of married male members	2847	2.36	1	1013	2.46	0.93	1834	2.31	1.04
No. of rooms	2847	2.49	0.86	1013	2.57	0.84	1834	2.44	0.87
Education of the patriarch	2847	1.22	1.57	1013	1.2	1.62	1834	1.23	1.53
Land (in acre)	2847	72.27	169.89	1013	80.41	165.01	1834	67.77	172.41
If household have any livestock	2847	0.87	0.34	1013	0.89	0.31	1834	0.86	0.35
Age of the patriarch	2847	51.26	14.6	1013	52.84	12.82	1834	50.39	15.42
If upper caste	2847	0.05	0.22	1013	0.06	0.25	1834	0.04	0.2
If Hindu	2847	0.87	0.33	1013	0.89	0.31	1834	0.86	0.34
If Muslim	2847	0.06	0.24	1013	0.05	0.22	1834	0.07	0.25
Women's characteristics in 2005									
Age	2847	35.54	5.86	1013	35.18	6.11	1834	35.73	5.72
Education (years)	2832	3.03	3.88	1004	3.33	4	1828	2.87	3.81
Spouse's age	2846	40.26	6.69	1012	39.55	6.97	1834	40.65	6.5
Spouse's education (years)	2842	5.89	4.46	1010	6.55	4.63	1832	5.53	4.32
Age at marriage	2846	16.52	3.17	1013	16.47	3.25	1833	16.56	3.13
Female autonomy in 2005									
Can decide what is to be cooked	2847	0.75	0.44	1013	0.6	0.49	1834	0.83	0.38
Can decide on expensive purchases	2847	0.07	0.26	1013	0.04	0.2	1834	0.09	0.29
Can decide no. of children	2847	0.16	0.36	1013	0.13	0.34	1834	0.17	0.38
Can decide on children's medical needs	2847	0.26	0.44	1013	0.2	0.4	1834	0.3	0.46
No permission required to visit health center	2846	0.2	0.4	1013	0.15	0.36	1833	0.22	0.42
No permission required to visit Friend	2800	0.21	0.41	997	0.17	0.37	1803	0.23	0.42
No permission required to visit Grocery	2308	0.4	0.49	781	0.35	0.48	1527	0.43	0.5
Labor market participation	2847	0.3	0.46	1013	0.22	0.41	1834	0.34	0.47
If have disposable cash	2840	0.83	0.38	1009	0.81	0.39	1831	0.84	0.37

Notes: Data used from HDPI (1993-94) and IHDS (2005). Sample includes women aged 15-49 residing in households which were joint, headed by male and had land in 1993-94.

TABLE 2.3: First-Stage Regressions of Women's Household Structure on Patriarch's Death.

	Dependent variable: If household structure in which a woman resides is joint in 2005				
	(i)	(ii)	(iii)	(iv)	(v)
Patriarch died between 1993 and 2005	-0.24***	-0.26***	-0.33***	-0.33***	-0.32***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Additional control variables included in regression					
Wave I controls					
Household Residence & Members	No	Yes	Yes	Yes	Yes
Household wealth	No	No	Yes	Yes	Yes
Wave II controls	No	No	No	Yes	Yes
District, Caste & Religion FE	No	No	No	No	Yes
N	2847	2847	2847	2832	2832
R-Squared	0.044	0.066	0.092	0.11	0.22
F-Statistics	163.57	175.64	220.6	215.24	192.41

Notes: Data used from HDPI (1993-94) and IHDS (2005). The sample is restricted to households which were joint in structure in wave-I, possessed land and were headed by male. Household Residence & Members controls include total number of household members, number of married male and female residents and number of rooms in the household in wave-I. Household Wealth controls include patriarch's education, land (in acres), age, and indicator for livestock ownership from wave-I. Wave II controls include women's and their spouse's age and years of education. Standard errors are robust and clustered at the village level in all specifications.

TABLE 2.4: OLS Estimates of the Effects of Household Structure on Women's Decision Making Power and Labor Force Participation.

	Whether the respondent decides				If the respondent does not need permission to			If the respondent	
Dependent Variable	what to be cooked on a daily basis?	whether to buy an expensive item?	how many children to have?	what to do if child falls sick?	visit local Health Center?	visit friends or relatives?	go to grocery store?	participate in labor force?	have cash in hand?
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Joint family in 2005	**-0.18*****	**-0.037*****	**-0.028****	**-0.075*****	**-0.049*****	**-0.054*****	**-0.062*****	**-0.091*****	**-0.054*****
	(0.02)	(0.01)	(0.01)	(0.02)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)
N	2831	2831	2831	2831	2830	2784	2296	2831	2825
R Square	0.30	0.14	0.22	0.27	0.28	0.27	0.32	0.40	0.27

Notes: Data used from HDPI (1993-94) and IHDS (2005). The sample is restricted to households which were joint in structure in wave-I, possessed land and were headed by male. All regressions control for total number of household members, number of married male and female residents and number of rooms in the household, patriarch's education, land (in acres), age, indicator for livestock from wave-I and, caste, religion and district fixed effects. The control set also includes women's and their spouse's age and years of education from wave I. Standard errors are robust and clustered at village level in all specifications.

TABLE 2.5: 2SLS Estimates of the Effects of Household Structure on Women's Decision Making Power and Labor Force Participation.

	Panel A: First Stage Estimation								
	Dependent variable: Household Structure in Wave-II is joint								
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Patriarch deceased	**-.32*** **	**-.32*** **	**-.32*** **	**-.32*** **	**-.32*** **	**-.32*** **	**-.29*** **	**-.32*** **	**-.31*** **
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)	(0.02)	(0.02)
N	2831	2831	2831	2831	2830	2784	2296	2831	2825
R Square	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22

	Panel B: Second Stage Estimates								
	Whether the respondent decides				If the respondent does not need permission to			If the respondent	
Dependent Variable	what to be cooked on a daily basis?	whether to buy an expensive item?	how many children to have?	what to do if child falls sick?	visit local Health Center?	visit friends or relatives?	go to grocery store?	participate in labor force?	have cash in hand?
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Joint family in 2005	**-0.22*** **	**-0.13*** **	**-0.12***	**-0.25*** **	**-0.18*** **	**-0.27*** **	**-0.33*** **	**-0.12***	**-0.11*** **
	(0.06)	(0.05)	(0.06)	(0.07)	(0.06)	(0.06)	(0.09)	(0.06)	(0.05)
N	2831	2831	2831	2831	2830	2784	2296	2831	2825
R Square	0.29	0.12	0.21	0.25	0.26	0.22	0.26	0.39	0.27

Notes: Data used from HDPI (1993-94) and IHDS (2005). The sample is restricted to households which were joint in structure in wave-I, possessed land and were headed by male. All regressions control for total number of household members, number of married male and female residents and number of rooms in the household, patriarch's education, land (in acres), age, indicator for livestock from wave-I and, caste, religion and district fixed effects. The control set also includes women's and their spouse's age and years of education from wave I. Standard errors are robust and clustered at village level in all specifications.

TABLE 2.6: Bivariate Probit Estimates of the Effects of Household Structure on Women's Decision Making Power and Labor Force Participation.

Dependent Variable	Whether the respondent decides				If the respondent does not need permission to			If the respondent	
	what to be cooked on a daily basis?	whether to buy an expensive item?	how many children to have?	what to do if child falls sick?	visit local Health Center?	visit friends or relatives?	go to grocery store?	participate in labor force?	have cash in hand?
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Joint family in 2005	**-0.21*** **	**-0.10*** **	**-0.14*** **	**-0.21*** **	**-0.12*** **	**-0.14*** **	**-0.19** **	**-.093**	**-0.15** **
	(0.07)	(0.03)	(0.05)	(0.05)	(0.05)	(0.05)	(0.08)	(0.07)	(0.07)
N	2831	2831	2831	2831	2830	2784	2296	2831	2825
Wald Chi-sq	343.98	362.65	389.92	422.38	336.01	329.03	265.71	506.12	340.89

Notes: Data used from HDPI (1993-94) and IHDS (2005). The sample is restricted to households which were joint in structure in wave-I, possessed land and were headed by male. All regressions control for total number of household members, number of married male and female residents and number of rooms in the household, patriarch's education, land (in acres), age, indicator for livestock from wave-I and, caste, and religion fixed effects. The control set also includes women's and their spouse's age and years of education from wave I. Standard errors are robust and clustered at village level in all specifications.

TABLE 2.7: 2SLS Estimates of the Heterogeneity in the Effects of Household Structure on Women's Decision Making Power and Labor Force Participation.

Dependent Variable	Whether the respondent decides				If the respondent does not need permission to			If the respondent	
	what to be cooked on a daily basis?	whether to buy an expensive item?	how many children to have?	what to do if child falls sick?	visit local Health Center?	visit friends or relatives?	go to grocery store?	participate in labor force?	have cash in hand?
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
Panel A: Sample Restricted to Households with 1993 Asset Index below Median									
Joint family in 2005	**-0.18****	**-0.22*****	**-0.26*****	**-0.29*****	**-0.18****	**-0.15***	**-0.13**	**-0.12**	**-0.12**
	(0.09)	(0.07)	(0.08)	(0.09)	(0.09)	(0.09)	(0.11)	(0.10)	(0.08)
N	1431	1431	1431	1431	1431	1403	1200	1431	1430
R-Squared	0.35	0.11	0.19	0.31	0.31	0.33	0.37	0.46	0.32
Panel B: Sample Restricted to Households with 1993 Asset Index above Median									
Joint family in 2005	**-0.21****	**-0.0033**	**0.02**	**-0.12**	**-0.16****	**-0.37*****	**-0.56*****	**-0.017**	**-0.066**
	(0.09)	-0.06	(0.09)	(0.1)	(0.08)	(0.09)	(0.14)	(0.08)	(0.07)
N	1400	1400	1400	1400	1399	1381	1096	1400	1395
R-Squared	0.33	0.19	0.27	0.33	0.34	0.22	0.19	0.41	0.33

Notes: Data used from HDPI (1993-94) and IHDS (2005). The sample is restricted to households which were joint in structure in wave-I, possessed land and were headed by male. All regressions control for total number of household members, number of married male and female residents and number of rooms in the household, patriarch's education, land (in acres), age, indicator for livestock, asset index from wave-I and, caste, religion and district fixed effects. The control set also includes women's and their spouse's age and years of education. Standard errors are robust and clustered at village level in all specifications.

Chapter 3

School Subsidies for Girls and the Gender Gap in Enrollment

3.1 Introduction

Gender disparity in primary education decreased substantially in South Asian and North African countries in the last two decades.[1] Nevertheless, these and many other developing countries continue to display significant gender disparity in education. The effects of female education on womens productivity, family health, child survival, and child human capital are well documented.[2] Therefore, reducing the gender gap in education is an important policy goal in itself and has the potential to achieve other development goals. In this paper I estimate the effects of two schemes aimed at reducing the gender gap in school enrollment in India.

The National Programme for the Education of Girls at Elementary Level (NPEGEL) was introduced in 2003 in India to increase primary school enrollment of girls. The key strategy of the program was to provide more autonomy to the lower rungs of administration, enabling them to choose policies which suit local conditions in addressing lower enrollment and higher drop out rates of girls in primary education. Another program called *Kasturba Gandhi Balika Vidyalaya* (KGBV, Kasturba Gandhi Girls School) was

[1] The decrease in the gender gap, as measured by the gross intake rate at the last grade of primary education, was the highest for South Asian Countries (decreasing from 19.5 percent in 1991 to 3.1 percent in 2009), followed by North African countries (Nations, 2011).

[2] See McCrary (2011), Strauss and Thomas (1995), Wolfe and Behrman (1987), Chou et al. (2007), Breierova and Duflo (2004), Currie and Moretti (2003), Black et al. (2004) and Len (2006) for evidence on the effect of female education on fertility and child health.

launched in August, 2004. This program built residential schools exclusively for girls belonging to lower caste, minority, and low-income line households.

Both the programs were implemented only in Educationally Backward Blocks (EBB) in India.[3] Educationally Backward Block is defined by the female literacy rate and the gender gap in the literacy rate. If a Block follows below the national average for rural Blocks in both variables, it is an EBB. This discontinuous selection rule makes the program similar to a powerful, quasi experimental design: the regression discontinuity design, introduced by Thistlethwaite and Campbell (1960). I exploit this sharp discontinuous assignment rule to find that the probability of school enrollment for 5 to 13 year girls increased by 3 percentage points in Educationally Backward Blocks, but there was no increase in the probability of school enrollment for boys. I find further that the increase in enrollment for lower caste girls was almost twice as high.

The findings of this paper bolster earlier empirical evidence on the effects of building new schools and of gender specific subsidies in areas with lower enrollment rates for girls in Pakistan (Alderman et al., 2003) and on the effect of "girl friendly" primary schools in Burkina Faso (Kazianga et al., 2012). Meller, 2012 uses aggregate school level data to find that the NPEGEL and KGBV programs in India, which I examine here, increases girls' enrollment ratio more than that of boys. Since I use household level data I can investigate heterogeneity in the effects of the programs by households characteristics. I find that the improvement in school enrollment for girls are heterogeneous by caste. For girls belonging to *Scheduled Caste* (SC) and *Scheduled Tribe* (ST) households the increase in the probability of enrollment was almost twice than that of girls belonging to non-SC/ST households. This finding suggests that the KGBV program, was specifically targeted at SC/ST girls, was particularly effective in bringing down the gender disparity in enrollment.

The rest of the paper is organized as follows. Section 3.2 discusses the relevant literature. Section 3.3 describes the NPEGEL and the KGBV programs. Section 3.4 develops a theoretical model to explain the gender gap in education. Section 3.5 describes the data and Section 3.6 describes the estimation strategy. Section 3.7 validates the identification strategy. The results are described in Section 3.8 and Section 3.9 concludes.

[3]The implementation of the programs were defined at the level of Blocks, an administrative subdivision with an average of 120,000 inhabitants. Blocks with a rural female literacy rate below the national average (46.13%) and a gender gap in literacy rate above the national average (21.59%), were defined as Educationally Backward Blocks (EBB) and were eligible for both the programs.

3.2 Background

Two frequently cited explanations for the gender gap in education are labor market discrimination against women (Kingdon, 1998, Rosenzweig and Schultz, 1982) and discrimination by parents, leading to differential treatment of sons and daughters (Vlassoff, 1990). If the labor market returns for boys are higher than that for girls, this reduces the incentive to invest in girls' education (Kingdon, 1998). Parents may discriminate if they appropriate some or all of the returns to human capital of boys (who often live in the parental household and take care of their parents as adults) but not for girls (who traditionally move to their husband's home). The allocation of resources is further distorted by another societal norm which requires parents to accumulate dowry for the marriage of the daughters, while they receive dowry for their sons. The amount of dowry received is proportional to sons' education, but it is inversely proportional to daughters' education (Dalmia, 2004).

A number of studies have found that cash transfers conditional on enrollment (for girls), state subsidies for girls' education improve the gender gap in enrollment. However, the effect of interventions that delegates the power to choose from a list of measures to improve girls's enrollment to local administration or provides new residential school exclusively for girls are scant.

3.3 The Intervention

The Government of India launched its flagship Universal Elementary Education program, *Sarva Sikshya Abhiyaan* (SSA), in the year 2001-02 after the 86th amendment to the constitution of India made free and compulsory education a fundamental right for 6 to 14 year old children. The Universal Elementary Education program was a lofty goal given the huge gender disparity in education. 35.5 percent of girls and 22.6 percent of boys in the age group of 10 to 14 were not enrolled in school in rural India (Census, 2001). Since SSA had limited provisions for girls education, the National Program for the Education of Girls at Elementary Level (NPEGEL) was introduced in July 2003 as an amendment to SSA, targeting the hardest to reach girls from grade I to VIII (age 5 to 13). Kasturba Gandhi Balika Vidyalaya, KGBV (Kasturba Gandhi Girls School) was launched in August 2004 to set up residential schools at the upper primary level (grade VI to VIII) exclusively for girls belonging to Scheduled Castes (SC), Scheduled Tribes (ST), Other Backward Castes (OBC), and Minorities; Both the programs ran under the

framework of SSA but were implemented only in a subset of rural areas. The objective of the programs were to prevent girls from dropping out of school and to increase access to school.

3.3.1 Eligibility

The implementations of the programs were defined at the level of Blocks, an administrative subdivision with an average of 120,000 inhabitants. Initially, the eligibility criteria for both the programs were very similar. All Educationally Backward Blocks (EBB), Blocks with rural female literacy rate below the national average (46.13%) and gender gap in literacy rate above the national average (21.59%), were eligible for both the programs. Out of the 6,357 Blocks enumerated in 2001 census, 3075 were identified as Educationally Backward. This criterion was announced in early 2003 (Meller, 2012). The eligibility rules for the programs were revised later. The revised guidelines in 2005 stipulated that along with the EBBs, Blocks with at least 5% SC/ST (Scheduled Caste/Scheduled Tribe) population and SC/ST female literacy rate below 10% and selected urban slums would be eligible for the NPEGEL program. Following the new definition, an additional 376 Blocks became eligible for the NPEGEL program. Similarly, for the KGBV program an additional 316 Blocks with rural female literacy below 30% and 94 towns/cities having minority concentration with female literacy rate below the national average (53.67%) were added to the list of eligible Blocks with effect from April, 2008.

3.3.2 National Programme for Education of Girls at Elementary Level

The National Program for Education of Girls at Elementary Level (NPEGEL) was launched in July, 2003 and was developed around the existing schools. The program provided more autonomy to lower levels of administration to adopt policies which will prevent girls from dropping out of school, break the gender stereotypes in rural areas by community mobilization, develop gender sensitive teaching and learning material, etc. There were several components of the NPEGEL program. First, eligible Blocks could develop their own projects based on local circumstances and needs. Blocks were supposed to come up with detailed action plan for the target group of girls and specific strategies were to be adopted with defined and measurable outcomes. Some Blocks, for example, initiated remedial classes and bridge courses for girls who dropped out. Second, about 8 to 10 public schools in each eligible Block were converted to model girl friendly

schools with toilets, an additional classroom, drinking water, and electricity connection. A sum of Rupees 200,000 ($ 4450) was provided to upgrade an existing school into a model school. An additional fund of Rupees 30,000 ($ 670) was provided to each model school to purchase books for library, sports equipment, equipment for vocational training, etc., which could be shared by other local schools. Third, each cluster (a Block is comprised of 8 to 10 clusters) in the eligible Blocks could take up one or more of the following interventions within an annual budget of Rupees 60,000 ($ 1340): recurring grant to model schools; awards to schools/teachers achieving progress in enrollment, retention and success of girl students; student evaluation, remedial teaching, bridge courses, alternative schools aimed at out of school and irregular girl students; waiver of fees and free supplementary materials for female students for courses under open schools; teacher training courses on gender sensitization, and child care centers to relieve girls from sibling care. In addition to these components, girls in eligible Blocks were free to use the entire amount of their textbook grant according to their need.[4] Lastly, as a part of the program local communities were mobilized through formation of Mother Teacher Association and Women Motivator Group to follow up drop out girls, girls attendance and achievement.

3.3.3 Kasturba Gandhi Balika Vidyalaya (Kasturba Gandhi Girls School)

The Kasturba Gandhi Balika Vidyalaya program was initiated in August 2004, shortly after the beginning of 2004-05 school year. Under this program one residential school was to be built per eligible Block for girls belonging to lower caste, minority, and below poverty line households. Each school had to accommodate at least 50 primary or upper primary students. Schools were built following three modules depending on the number students the school can accommodate. For a school accommodating 100 girls, a non-recurring fund of Rupees 4,600,000 ($ 102,230) and a recurring fund of Rupees 3,027,000 ($ 67,270) were provided for the necessary infrastructure and to meet the recurring expenses, respectively. Since this program had the provision of renting of buildings if the school building is under construction, there was considerably less delay in the implementation of the program.[5]

[4]Girls in non-eligible Blocks are supposed to buy only textbooks with their textbook grant of Rupees 150 ($3).

[5]Unavailability of data on actual implementation of the program makes it difficult to disentangle the effects of KGBV from that of NPEGEL.

3.4 Theory

This section presents a two-period unitary household production function to explain the gender gap in education. It is not based on a differential schooling costs or schooling production functions for girls, nor on a direct preference for boys, though these may be present as well. Rather, it builds on the unequal returns to education gained by households who retain access to the income of adult sons but not adult daughters. Subsequently, I add a school subsidy for girls to find its effect on the gender gap in education.

Consider a household with three members, an *adult* (a), a *boy* (b), and a *girl* (g). As the objective of the model is to explain gender gap in education, the children are normalized by their gender. The assumption of a single parent keeps the model simple and can be relaxed easily. The *adult* is the decision maker and his objective is to maximize a two period household utility function given by

$$U = U_1(E_b, E_g, C_1) + \beta U_2(C_2). \tag{3.1}$$

where, U_t is the utility in period t. Utility in period 1 U_1 is obtained from education E_b and E_g of the *boy* and the *girl* respectively and a composite consumption good C_1. Period 2 utility U_2 is obtained by consuming only C_2, a composite consumption good. U_i's are assumed to be continuously differentiable and strictly concave. Furthermore, the period 1 utility function is assumed to have a special form, $U_1(E_b, E_g, C_1) = [f(C_1) + g(E_b) + g(E_g)]^\gamma$, where the functions $f(.)$ and $g(.)$ are strictly positive, increasing, and concave in their respective arguments and $\gamma \in (0, \infty)$.[6] The rate of time preference of the household is given by β. Each of the arguments of the utility functions is assumed to be produced by the household through a combination of market goods ($X_j, j \in \{E_b, E_g, C_1, C_2\}$) and time inputs from some of the members (T_{ijt}).[7] More formally,

$$E_i = \psi(X_{E_i}, T_{iE_i1}) \qquad \forall i \in \{b, g\} \tag{3.2}$$

$$C_t = \phi_t(X_{c_t}) \quad \forall t \in \{1, 2\} \tag{3.3}$$

[6]This functional form is very general. It encompasses commonly used Cobb-Douglas, Stone-Geary and CES utility functions.

[7]T_{ijt} represents time allocated by the i^{th} member of the household to produce the j^{th} commodity in period t, where $i \in \{a, b, g\}, j \in \{E_b, E_g, C_1, C_2\}$, and $t \in \{1, 2\}$

The education production functions are assumed to be the same for the *boy* and the *girl* and they do not require any time input from the *adult*. I further assume that the marginal products of the inputs used for producing education are identical for the *boy* and the *girl*, i.e., $\frac{\partial E_b}{\partial X_{E_b}} = \frac{\partial E_g}{\partial X_{E_g}}$ and $\frac{\partial E_b}{\partial T_{1E_b b}} = \frac{\partial E_g}{\partial T_{1E_g g}}$. This assumption rules out any favoritism for boys in the production of education. The production of the composite consumption goods C_i does not require any time from the household members. This is an innocuous simplifying assumption.

In period 1 all three members can participate in the labor market. The wage rates of the *adult*, the *boy* and the *girl* are given by w_a, w_b, and w_g. I assume that the *adult* supplies all his time in the labor market inelastically. But, in period 2 the *adult* does not participate in the labor market due to old age. In period 2 the girl is married and leaves the household. Any income earned by her accrues to her husbands family. On the other hand, income earned by the *boy* in period 2 continues to accrue to the household, and he supplies all his time in labor market inelastically at the wage rate $w(E_b)$. I assume that $\frac{\partial w(E_b)}{\partial E_b} > 0$, i.e., the wage of the boy in period 2 increases with his education in period 1.

The time allocation constraints, assuming each member is endowed with one unit of time, are the following

$$T_{iE_i1} + T_{im1} = 1 \ \forall i \in \{b, g\};\ T_{am1} = 1;\ T_{bm2} = 1 \tag{3.4}$$

where T_{imt} is the time supplied to the labor market by member i in period t. Assuming V to be the unearned non-labor income of the household in each period, the budget constraint of the household for periods 1 an 2 are, respectively,

$$V + w_a + w_b T_{bm1} + w_b T_{gm1} \geq \sum_{j \in \{E_b, E_g, C_1\}} P_j X_j \tag{3.5}$$

$$V + w(E_b) \geq P_{c_2} X_{C_2} \tag{3.6}$$

where P_j is the price of the market goods X_j used to produce good j ($j \in \{E_b, E_g, C_1\}$). I assume that the prices of X_{E_b} and X_{E_g} are the same, $P_{X_b} = P_{X_g}$. The left hand sides of the equations in (3.5) and (3.6) are the income of the household and the right hand sides are the expenditures incurred to purchase the inputs in each period.

The utility maximization problem subject to the time and the budget constraints yields a set of first order conditions for an interior equilibrium:[8]

$$\frac{\partial U}{\partial X_j} - \lambda_1 \frac{\partial \Pi_1}{\partial X_j} - \beta\lambda_2 \frac{\partial \Pi_2}{\partial X_j} = 0, \quad \forall j \in \{E_b, E_g, C_1, C_2\} \tag{3.7}$$

$$\frac{\partial U}{\partial T_{im1}} - \lambda_1 \frac{\partial \Pi_1}{\partial T_{im1}} - \beta\lambda_2 \frac{\partial \Pi_2}{\partial T_{im1}} = 0, \quad \forall i \in b, g \tag{3.8}$$

3.4.1 Gender Gap in Education as an Optimal Outcome

The utility maximization problem of the household described above would result in a disproportional allocation of resources to produce education would result in a gender disparity in education.

Proposition 1: The optimal choice of the household generates a gender gap in education, $E_b^* > E_g^*$***.***

Using (3.7) and (3.8), the optimum choice of the adult would satisfy the following condition

$$g^{'}(E_g) - g^{'}(E_b) = \frac{\lambda_2 \beta w^{'}(.)}{\gamma[f(c_1) + g(E_b) + g(E_g)]^{\gamma-1}} \tag{3.9}$$

Given the assumption that $g()$ is increasing and concave, (3.9) implies that $E_b^* > E_g^*$. Thus the household in equilibrium would like to consume more of the boys education than that of the girls. This equilibrium gender gap in education is driven by the higher return from boys education gained by the household in the second period; if the daughter's future in-laws could pay the household for her education, the gap could shrink. The gap increases with the time preference rate (β) and the marginal return from boys education ($w^{'}(E_b)$). Also, the equilibrium education gap is independent of the period 1 wage gap between boys and girls ($w_b - w_g$).

3.4.2 Subsidy for Girls' Education

Even though the programs did not provide direct subsidy to the households to enroll girls in school, the objective of the programs was to reduce the cost of education for girls, which can be interpreted as a gender specific school subsidy. In the above set-up a subsidy for *girl's* education can be thought of as a decrease in the input prices of E_g.

[8] $\Pi_1 = V + w_a + w_b + w_g - \sum_{j \in \{E_b, E_g, C_1\}} P_j X_j - w_b T_{1E_b b} - w_g T_{1E_g g}$; $\Pi_2 = V + w(E_b) - P_{c_2} X_{c_2}$ and λ's are the *Lagrange* multipliers

I started with the assumption that $P_{E_b} = P_{E_g}$. A subsidy for *girl's* education will make the input price for *girl's* education less than that of *boy's* education, $P_{E_b} > P_{E_g}$.

Proposition 2: A subsidy to goods used as inputs to produce girls' education will reduce the educational gender gap.

Let the post-subsidy input price for girl's education E_g given by $\widehat{P_{E_g}}$ ($P_{E_b} = P_{E_g} > \widehat{P_{E_g}}$). The equilibrium condition in (3.9) for the inputs X_{E_b} and X_{E_g} change as follows

$$\frac{\partial U}{\partial X_{E_b}} - \lambda_1 P_{E_b} - \beta\lambda_2 \frac{\partial w(E_b)}{\partial X_{E_b}} = 0 \tag{3.10}$$

$$\frac{\partial U}{\partial X_{E_g}} - \lambda_1 \widehat{P_{E_g}} = 0 \tag{3.11}$$

Since ($P_{E_b} > \widehat{P_{E_g}}$), from (3.10)and (3.11)

$$\frac{\partial U}{\partial X_{E_b}} - \frac{\partial U}{\partial X_{E_g}} > \beta\lambda_2 \frac{\partial w(E_b)}{\partial X_{E_b}} \tag{3.12}$$

The optimality condition after subsidy can be further simplified as

$$g^{'}(E_g) - g^{'}(E_b) < \frac{\lambda_2 \beta w^{'}(.)}{\gamma[f(c_1) + g(E_b) + g(E_g)]^{\gamma-1}} \tag{3.13}$$

Comparing (3.9) with (3.13), it is clear that the gender gap in education under the subsidy for girls' education will be lower. However, the model does not quantify the decrease in the gap.

3.5 Data

3.5.1 District Level Household Survey

I use household level data from the third round of District Level Household Survey, 2007-08 (DLHS-III) to find the effect of the NPEGEL program on school enrollment in Educationally Backward Blocks in India. DLHS is one of the largest demographic health surveys in India executed by the Indian Institute of Population Sciences. The DLHS primarily collects data on family planning, maternal and child health, and utilization of public health services. Apart from family health related information, DLHS-III also

collected data on demographic composition of the household; human capital of its members; and socioeconomic characteristics of the household including caste, religion, and asset ownership.

The third round of DLHS interviewed 720,320 households (1000 to 1500 from each of 611 districts) between late 2007 and early 2009 following a multistage stratified sampling method. DLHS data is particularly suitable for this analysis for a number of reasons. First, this is the only large scale survey from India that provides Block location of the surveyed households.[9] Since, the NPEGEL program was implemented at the Block level, this information is crucial to identify the treatment effects. Second, DLHS-III collected data on enrollment status of 5 to 17 year old members of the household. Lastly, DLHS-III was collected four years after the announcement of the program, making it suitable to find the treatment effects. The large sample size of the surveys also helps to implement a Regression Discontinuity Design.

The NPEGEL program was implemented in Educationally Backward Blocks, defined as Community Development Blocks (or Blocks) which had a female literacy rate below the national rural average and a gender gap in literacy above the national average.[10] I use sub-district level literacy rates from the Primary Census Abstract, 2001 (PCA-2001) to identify the NPEGEL eligible Blocks.[11] The administrative subdivision of districts is not the same for all states in India. The subdivision of a district is called Tehsil in North Indian sates, while it is called Taluka and Mandal in some Western and Southern states. In some states these subdivisions are further divided into Blocks.[12]

Therefore, the literacy rate and other demographic information available from PCA-2001 at sub-district levels do not correspond to that of Blocks for the states where sub-districts are further divided into Blocks. To avoid these problems, I restrict my analysis to seven states in India where the subdivisions of the districts are not further sub-divided into Blocks. In other words the geographical boundary of a Block and that of a subdivision of a district are identical in these seven states. Figure 3.1 shows that for Ariyalur district in the state of Tamilnadu, the geographical boundaries of district subdivisions in Panel A (Taluk) are different from that of the Blocks in Panel B.

[9]Districts are sub-divisions of States. Community Development Blocks or Blocks are administrative subdivisions of districts.

[10]Female literacy rate and gender gap in literacy rate for each Block was calculated using the Census 2001 data.

[11]PCA-2001 also provides data on population by gender, caste, literacy, employment, at the sub-district level.

[12]Districts are sub-divisions of States. Community Development Blocks or Blocks are administrative subdivisions of districts.

3.5.2 Estimation Sample

3.5.3 Summary Statistics

Table 3.1 provides a summary statistics for 158,823 children between ages 5 to 13 in seven states in India.[13] The average school enrollment for these children is 88 percent and 49 percent of them are girls. The average age for these children is 8.97 years, 39 percent of them belong to below poverty line households, and only 3 percent of them reside in urban areas. These children are residing in a total of 1473 Blocks. The average female employment rate for these Blocks is 35.59 %. A total of 16.67 % of the population in these Blocks belong to the *Scheduled Castes*. Almost 40.8 % of the households in these Blocks reported cultivation as their main source of livelihood, while 35.3 % and 3.8 % of the households reported agricultural labor and household production respectively.[14]

3.6 Estimation Strategy

I employ a Regression Discontinuity Design (RDD) to estimate the effects of the NPEGEL and KGVB programs on school enrollment of girls in India. The NPEGEL program, begun in 2003, provided autonomy and resources to lower levels of administration to adopt policies to prevent girls from dropping out of school. The KGBV program, begun in 2004, aimed to build one residential girls' school per eligible Block.[15] Only the Educationally Backward Blocks (EBB), with the rural female literacy rate below the national average (46.13%) and the gender gap in literacy rate above the national average (21.59%), were eligible for both the programs. Given the cut-offs for the eligibility of the programs, the effect of the programs can be obtained by comparing girls and boys in EBBs to those in Blocks that have almost the same characteristics but not quite as low a literacy rate and not quite as high a gender gap in literacy.

One of the forcing variables, gender gap in literacy rate, is the difference between male and female literacy rates in a Block. This implies that two Blocks with similar gender gap in literacy rate may not be similar in terms of literacy rates. One may find same

[13]The estimation sample is restricted to the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka. These seven states cover 32% of India in terms of area and about 40.5% of the Indians reside in these states. The sample is further restricted to the Blocks where gender gap in literacy rate is above the national average. Thus female literacy rate alone determines Educationally Backward Block (treatment) status.

[14]Block level data obtained from Primary Census Abstract 2001.

[15]Section 3.3 discusses the programs in greater detail.

gender gap in literacy if looking at two Blocks, one with low male and female literacy rates and another where both the rates are high. Thus in a RDD set up using gender gap in literacy rate as a running variable may not compare the outcome variable across similar Blocks. To address this issue I use only the literacy rate cut-off and not the gender gap in literacy cut-off for identification purpose in my estimation strategy. Thus I restrict the sample to Blocks where the gender gap in literacy rate is above the EBB cut-off and the literacy rate that is just below or just above the EBB cut-off. This refers to the households within the red rectangle in Figure 3.3. This corresponds to a "sharp" RDD with a basic regression specification as follows:

$$Y_{ij} = \alpha \; ebb_j + f(flit_j) + X_{ij}\beta' + \epsilon_{ij} \tag{3.14}$$

where Y_{ij} represents current school enrollment for the i^{th} child residing in the j^{th} Block. X_{ij} represents a set of household characteristics (below poverty line, urban residence) and Block level characteristics.[16] Even though inclusion of these controls has very little effect on the estimates all RDD specifications controls for them. The indicator ebb_j takes the value one if a child resides in an Educationally Backward Block and zero otherwise. The coefficient α is the parameter of interest, and measures the effect of the NPEGEL and KGBV program on child outcomes. Finally, $f(flit_j)$ is a function of female literacy rate ($flit_j$) in Block j. Given the eligibility of the program and restriction on the estimation sample $flit_j$ is the forcing variables in the context of RDD.

The central assumption underlying an RDD is that the forcing variable, which determines the exposure of a Block to the programs, is correctly specified. Therefore, an important issue for implementing the empirical strategy is how to model $f(flit_j)$. I consider both parametric and non parametric functions of $flit_j$. For the parametric specifications I use linear, quadratic, and cubic functions of the running variable. For the non parametric specifications, I follow Hahn et al. (2001), Porter (2003), and more recently Malamud and Pop-Eleches (2011) by estimating local linear regressions to estimate the left and right limits of the discontinuity.[17] I use a triangle kernel which puts more weight on observations closer to the cutoff, and it is boundary optimal (Cheng, 1997).

[16]Block level characteristics include the female employment rate, females per thousand males (sex-ratio), the percentage of workforce reporting cultivation, agriculture labor, and household production as main source of their livelihood, and percentage of Scheduled Caste population.

[17]The non-parametric RDD is implemented in Stata using the rd ado file (Nichols, 2011).

Another important issue for RDD is the choice of the proper bandwidth. Since there is no widely accepted method for selecting the bandwidth, I report the results based on a variety of bandwidth lengths, using 7.5, 10 and 15 and also the Imbens and Kalyanraman optimal bandwidth (Imbens and Kalyanaraman, 2011). The Imbens and Kalyanraman optimal bandwidth is within the range of the bandwidths that I use. All reported standard errors are robust and clustered at the primary sampling unit level.

3.7 Validating the Identification Assumptions

The application of a sharp RDD to measure the effect of schooling subsidy is crucially contingent upon the discontinuity of the treatment assignment. Panel A in Figure 3.3 (based on the data from Primary Census Abstract, India 2001) shows that treatment status is discontinuous with the female literacy rate and the gender gap in the literacy rate of the Blocks at the cutoff. The cut off for assignment variables are shown by a vertical and a horizontal line. The left (right) figure in Panel B shows the treatment status by normalized female (gender gap in) literacy rate after restricting the sample to the Blocks where gender gap in (female) literacy rate is above (below) the national average. Both the figures plot the average treatment status of Blocks by 0.5 point interval of the assignment variable. In Panel B, the average treatment is zero for the Blocks with female literacy rate above the cutoff but it is unity for Blocks below the cutoff (46.13%). Similarly, average treatment is zero below the cutoff but it jumps to unity at the cutoff for gender gap in literacy rate (21.6%).

Another equally important assumption is that households were not able to manipulate the forcing variable. In the context of NPEGEL and KGBV, the implementation of the program makes it almost impossible for the forcing variables to be manipulated. Eligibility for the program was defined at the Block level and did not depend on any value reported by the households. The possibility that an administrative Block may manipulate the forcing variable is not an issue either, as the Block level literacy rate data was used from 2001 Census and were not reported by the Blocks. This can be verified from Panel B of Figure 3.3. As discussed above this figure plots the probability of EBB status of a Block against the forcing variables. The sharp discontinuity in the probability of the EBB status at the cut-offs from 0 to 1 eliminates the concerns regarding Blocks manipulating the forcing variables. Furthermore, the NPEGEL and KGBV programs were implemented in the years 2003 and 2004 while the eligibility criteria was determined based on 2001 Census data. Second, manipulation of the cutoffs

would be an issue if households relocated to Blocks strategically to take advantage of the program. Given the marginal cost and benefit of relocation, this does not seem to be a serious concern. I formally test for the manipulation of the forcing variables following McCrary (2008) and find no evidence of such manipulation (See Figure 3.4). The figures in Panel A and B of Figure 3.4 show that there is no significant jump in the distribution of the forcing variables (female literacy rate in Panel A and gender gap in literacy rates in Panel B) at the cut-off points.

Finally, Figure 3.5 justifies the assumption that households near the cutoff are similar. The figure shows that the Block characteristics do not change discontinuously around the female literacy rate cutoff when the sample is restricted to Blocks where the gender gap in literacy rate is above the average.[18] Figure 3.5 plots the local polynomials for the sex-ratio (number of females per 1000 males), female employment rate, percentage of Scheduled Caste population, share of workers in agriculture labor, household production, and cultivation on both sides of the female literacy rate cutoff. The figures show that there are no significant discontinuous jumps at the cutoff.

3.8 Results

This section discusses the joint effect of the NPEGEL and KGBV programs on school enrollment by gender for 5 to 13 children. I estimate this effect by comparing outcomes in eligible blocks and ineligible blocks but only focus on blocks that are just above or below the cut-off involving the female literacy rate and that are all above the cut-off involving the gender gap in literacy. I report both parametric and non-parametric RDD estimates using three bandwidths (7.5, 10 and 15) and, for non-parametric specifications, the Imbens Kalyanraman optimal bandwidth.[19] All RDD regressions control for age of the children; whether the household is below the poverty line; whether the household resides in urban areas; and block characteristics (average female employment, percentage of households report agricultural labor, household production and cultivation as main source of livelihood, and percentage of Scheduled Caste households). All parametric estimates additionally control for a linear, a quadratic, and a cubic function of the forcing variable, the female literacy rate. Estimated errors are robust and clustered at the Primary Sampling Unit level. The nonparametric estimates use local nonlinear regression of school enrollment on both sides of the female literacy rate cutoff.

[18] I do not show the same figures for the other forcing variable (gender gap in literacy rate) since given the sample restrictions treatment status is completely determined by the female literacy rate of a Block.

[19] These bandwidths are measured in terms of female literacy rate.

3.8.1 Effect on School Enrollment

Before considering the causal estimates using RDD approach, Table 3.2 reports the OLS estimates of the joint effect of the NPEGEL and the KGBV programs on school enrollment for 5 to 13 year old children in seven states in India.[20] Panel A reports the estimated effects on girls while Panel B reports the estimated effects on Boys.

Column (1) in Panel A reports that the probability of current school enrollment increases by 3.7 percentage point for girls if they reside in EBBs. The estimate is highly statistically significant at the 1 % level. Column (1) in Panel B reports that residence in the EBBs increases the probability of current school enrollment for boys by 1.4 percentage points but the estimate is not statistically significant. The estimated effects are not very sensitive to adding control variables. In Column (2) I additionally control for household characteristics; age of the child, indicators of below poverty line household, and urban residence. The estimates in both the panels decrease marginally, but the effect on girls continues to be statistically significant. In Column (3) I additionally control for Block characteristics, and the point estimates diminish slightly.[21] The resulting estimates in Column (3) suggests that the probability of school enrollment for girls increases by 3 percentage points in the EBBs, but does not change significantly for boys. In the rest of the regressions I will continue to control for household and block-level characteristics. However, since assignment of EBBs were non random the estimated treatment effects cannot argued as causal effects.

I report the parametric RD estimates of the programs for 5 to 13 year children in Table 3.3. In Columns (1), (2), and (3) the sample to restricted to a bandwidth of 7.5, 10, and 15 percentage points, respectively, around the female literacy rate cutoff. In Panel A, I report the parametric RD estimates for girls for a linear, quadratic, and cubic function of the running variable. All specifications control for the full set of regressors used in Column (3) of Table 3.2. The reported estimates of the effect of the programs on school enrollment girls vary between 2.6 to 4.1 percentage points. Except the estimate with cubic control function for a 7.5 percent interval around the cutoff all reported estimates are statistically significant. In Panel B I report the parametric RD estimates for boys

[20] The sample is restricted to the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka as the geographical boundaries of Community Development Blocks (administrative unit for implementation of the programs) and sub-district boundaries (District Level Household Survey provides only sub-district identifiers for households) are identical for these states. The sample is further restricted to the Blocks where the gender gap in literacy rate is above the national average.

[21] Block characteristics include sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population.

for a linear, quadratic and cubic function of the running variable. The estimates vary between -0.016 to 0.011 and none of them are statistically significant. The estimates suggest that the programs increased the probability of school enrollment for girls while it did not affect enrollment for boys. Therefore, the programs helped to eliminate gender gap in enrollment.

Table 3.4 reports the non-parametric RD estimates of the effect of the programs on school enrollment. In Columns (1), (2), and (3) the sample to restricted to a bandwidth of 7.5, 10, and 15 percentage points. While Column (4) reports the estimates for Imbens-Kalyanraman (IK) optimal bandwidth. The effect of the program on girls reported in panel A is very similar to the parametric estimates and suggests that the programs increased probability of school enrollment by 3.5 percentage point, whereas, there are no significant effect on boys.

3.8.2 Heterogenous Effects of the Programs

3.8.2.1 Heterogeneity by Caste

Table 3.5 describes the differential effects of the NPEGEL and KGBV programs on school enrollment of 5 to 13 children by caste. Panel A reports the OLS estimates by gender and by caste. Column (1) in Panel A reports that for girls the program increased the probability of enrollment by 3.2 percentage points while Column (2) shows that there was no effect for boys.[22] Column (3) and (4) report the effect on the programs on girls and boys belonging to Scheduled Caste and Scheduled Tribe (SC/ST) households respectively. The effect of the programs were considerably higher for girls belonging to SC/ST households. The programs increased the probability of enrollment for SC/ST girls by 6.4 percentage points while there was no effect for SC/ST boys. The rest of the Columns in Panel A report the effect of the programs for non-SC/ST households. For non-SC/ST households the programs increased the probability of enrollment for girls and boys by 1.8 and 1.3 percentage points respectively. But the estimates are not precise.

Panel B in Table 3.5 reports the parametric RD estimates of the effect of the programs on enrollment by gender. The sample is restricted to Blocks where gender gap in literacy is above the national rural average and female literacy rate is within 15 percentage points

[22]The OLS estimates of the effect of the programs on enrollment in Column (1) and (2) are reproduced from Column (3) of Table 3.2.

of the national rural average. Column (1) and (2) report the effect of the program on girls and boys respectively. The estimates suggests that the programs increased the probability of enrollment for girls by 4 percentage points and for boys by 0.9 percentage points.[23] Column (3) and (4) report the RD estimate of the effect of the programs on enrollment for SC/ST girls and boys respectively. The estimates suggest that the probability of enrollment for girls increased by 5.6 percentage point while for boys the programs decreased the probability of enrollment by 2 percentage points. For non-SC/ST households the probability of enrollment increased by 3 an 2.2 percentage points for girls and boys respectively.

Similarly, Panel C in Table 3.5 reports the non-parametric estimates of the effect of the programs. The estimates indicate that the programs significantly increased the probability of enrollment for SC/ST girls but did not have any effect on enrollment for SC/ST boys. But for non-SC/ST households the programs increased the probability of enrollment both for the girls and boys by 2.8 and 2.2 percentage points respectively.

Estimated parametric and non-parametric effects of the programs on school enrollment indicate that it was more effective in bringing down gender gap in enrollment for SC/ST households. Among the two programs it was the Kasturba Gandhi Balika Vidyalaya (Kasturba Gandhi Girl's School) which specifically targeted the girls belonging to SC/ST households by building new residential schools for them. Therefore, it can be concluded that providing new residential schools exclusively for girls are more effective to bring down the gender gap in enrollment than providing autonomy to lower rungs of administration.

3.8.2.2 Heterogeneity by Income

Table 3.6 reports the heterogenous effect of the NPEGEL and KGBV programs on school enrollment of 5 to 13 year old children by household income. The District Level Household Survey - III collected information on whether a household had a below poverty line (BPL) card.[24] Since these cards are issued to poor households and the KGBV program was targeted to girls belonging to poorer households I estimate the effect of the programs by possession of BPL cards. As in 3.5 Panel A reports the OLS estimates

[23]The RD estimates of the effect of the programs on enrollment in Column (1) and (2) are reproduced from Column (3) of Table 3.2. All specifications control for linear, quadratic, and cubic functions of the assignment variable.

[24]BPL cards are issued to poor households in India which enables them to access several public welfare programs.

by gender and possession of BPL cards. Column (1) and (2) are reproduced from Table 3.5. Column (3) and (4) report the effect on the programs on girls and boys belonging to below poverty line (BPL) households respectively. The estimates suggest that the probability of enrollment for girls increased by 5.6% percentage points while there was no effect for BPL boys. For non-BPL households the programs increased the probability of enrollment for girls and boys by 1.4 and 1 percentage points respectively. But the estimates are not statistically significant.

Panel B in the same table describes the parametric RD estimates of the effect of the programs. The effect of the programs were considerably higher for girls belonging to BPL households. Column (1) and (2) are reproduced from Table 3.5. Column (3) and (4) report the RD estimate of the effect of the programs on enrollment for BPL girls and boys respectively. The estimates suggest that the probability of enrollment increased by 4.7 percentage points but there was no effect of the programs on boys' enrollment. However, the estimates for non-BPL households shows similar pattern. For the non-BPL girls the probability of enrollment increased by 3.2 percentage points but there was little effect of the programs' on boys' enrollment.

Panel C in Table 3.6 reports the non-parametric estimates of the effect of the programs. The estimates suggest that programs significantly increased the probability of enrollment for girls belonging to both BPL and non-BPL households but there was no effect of the programs on boys. The estimates for BPL girls are also higher than that of non-BPL girls.

3.9 Conclusion

This paper analyzes the effect of two gender specific interventions in India on gender bias in school enrollment. One of the programs (National Programme for Education of Girls at Elementary Level) granted autonomy to local administration to adopt policies suitable to local conditions in order to improve school enrollment of girls, while another program (Kasturba Gandhi Balika Vidyalaya) provided new residential schools exclusively for girls belonging to lower caste and below poverty line households. I find that the programs had a positive and significant effect on school enrollment for girls. The programs increased the probability of school enrollment for a 5 to 13 year old girl by 3 to 4 percentage points while there were little effect for boys in the same age category. Moreover, the programs seemed to be more effective at targeting SC/ST girls, leading to a 5 to 6 percentage

point increase in school enrollment for girls. It also appeared to raise school enrollment for non-SC/ST boys by about 2 percentage points.

Since both the programs were implemented almost simultaneously in the same locations it is difficult to identify the effects of the programs separately. It is also not possible to identify the effects of specific actions taken by particular districts under NPEGEL. However, because most of the gains in school enrollment for girls is concentrated for lower caste and below poverty line households it suggests that the provision of new residential schools was particularly effective in bringing down the gender gap in school enrollment.

FIGURE 3.1: Taluk and Block Boundaries for the District of Ariyalur, Tamilnadu

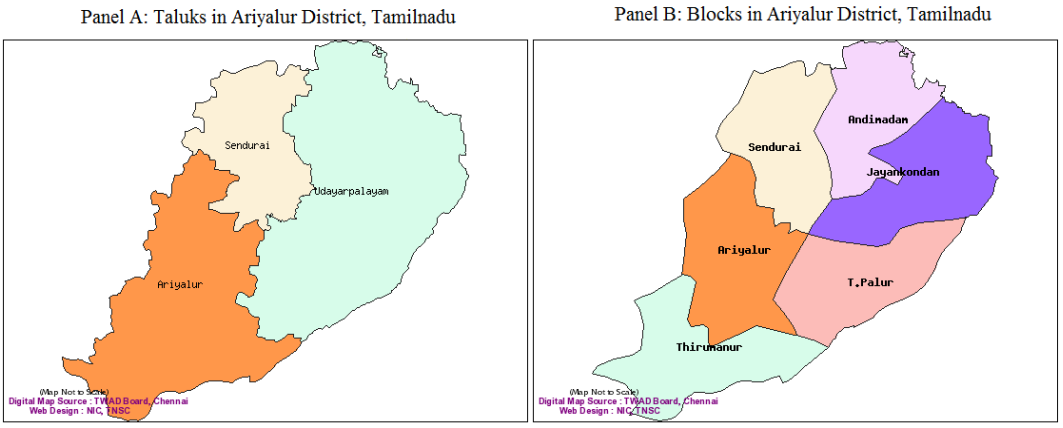
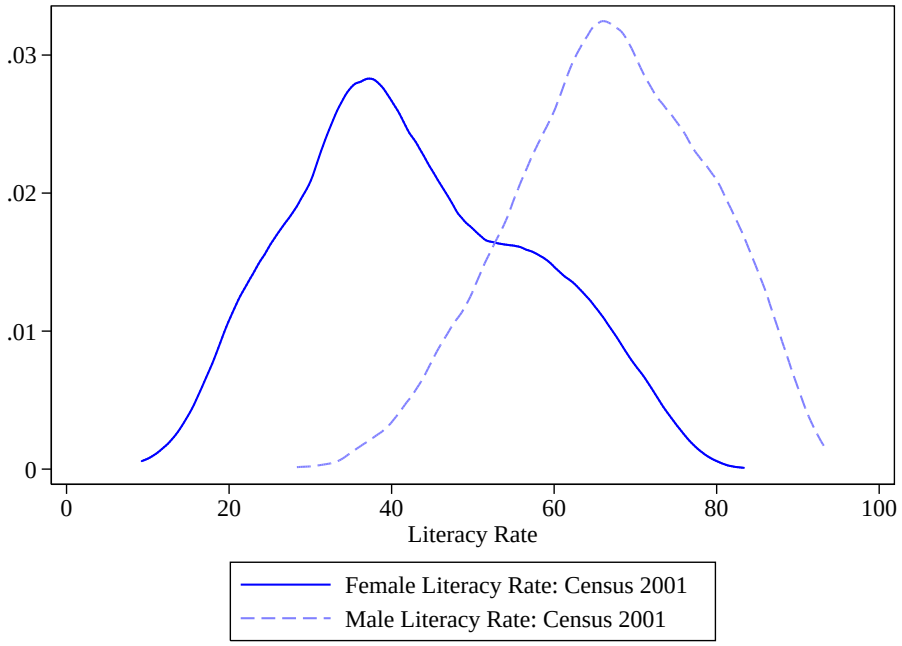
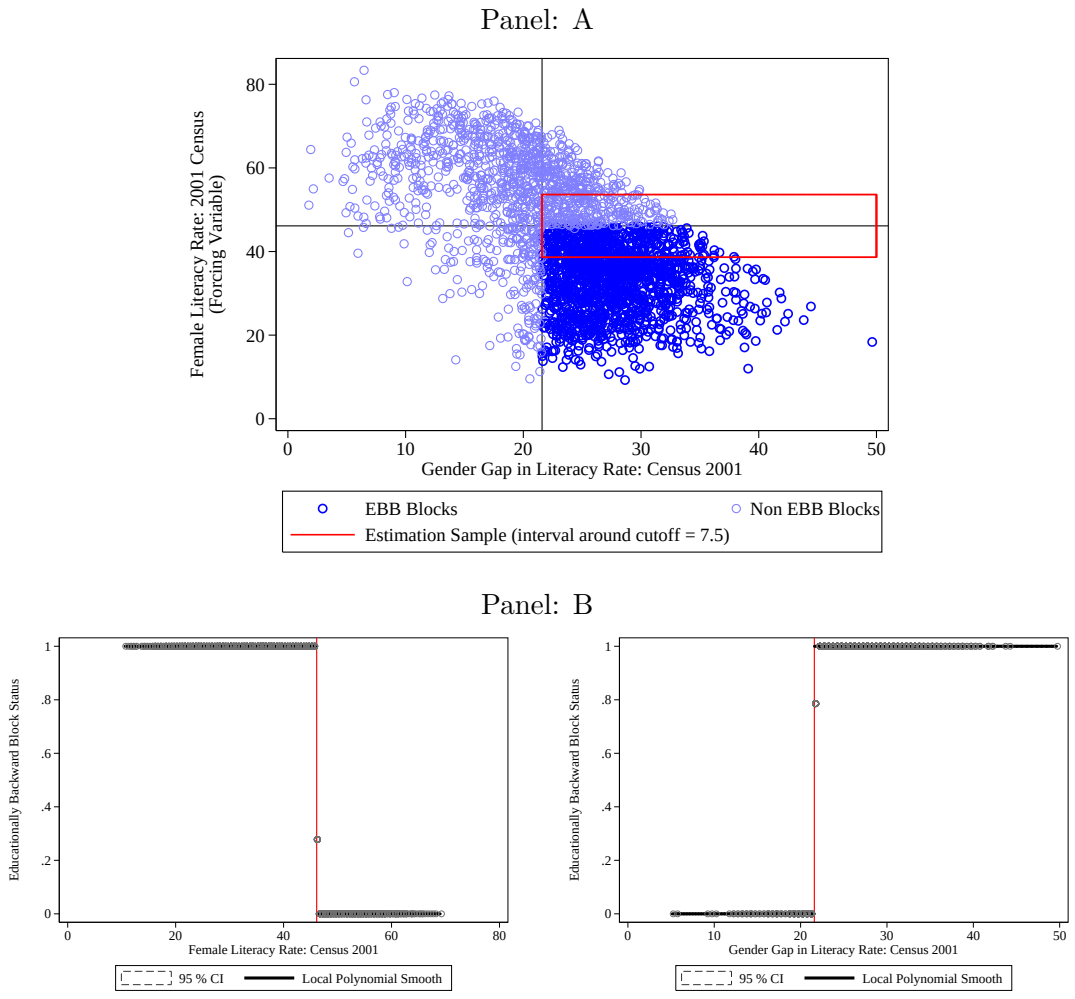


FIGURE 3.2: Distribution of Block Level Literacy Rate by Gender.



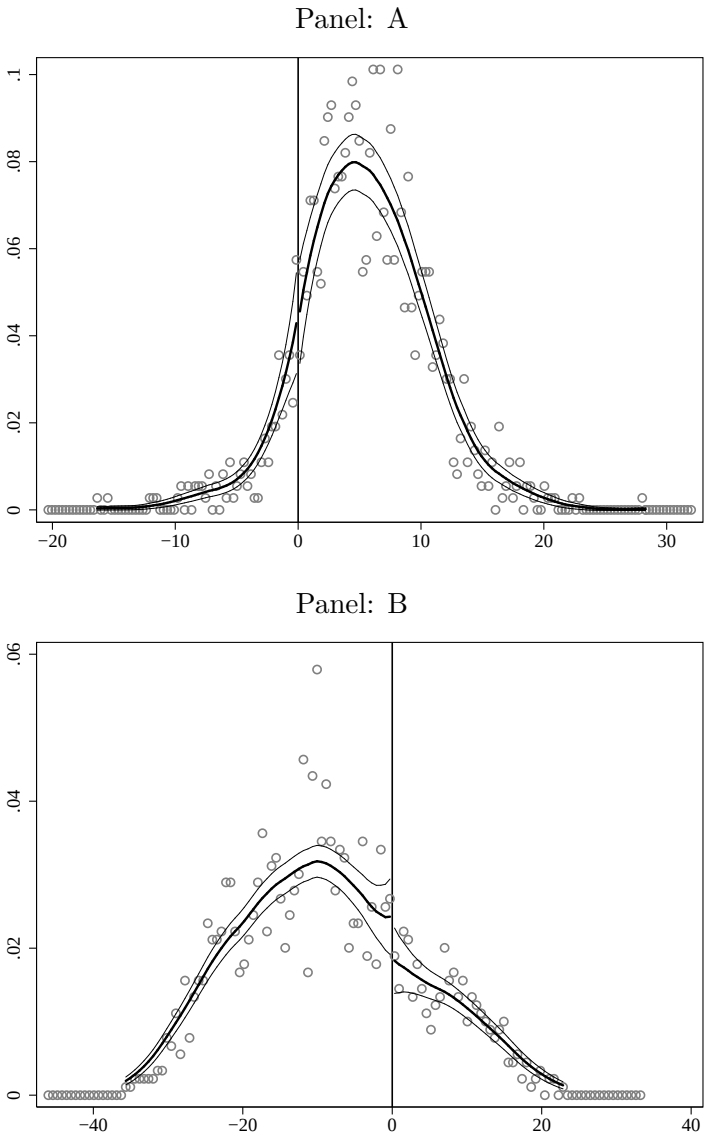
Notes: Data used from Primary Census Abstract (2001) for the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka.

FIGURE 3.3: Educationally Backward Block Status.



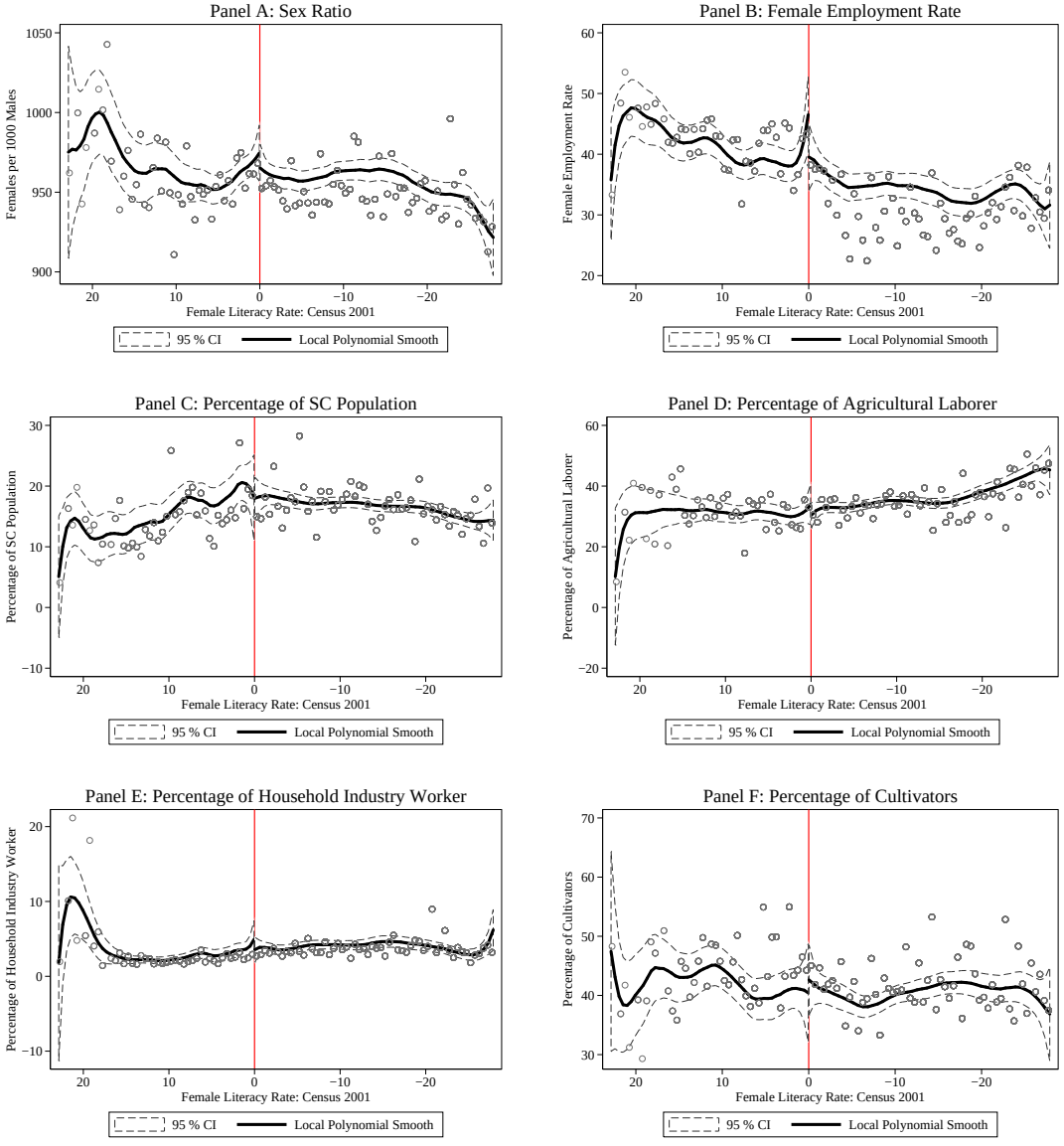
Notes: Data used from Primary Census Abstract (2001) for the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka. The Educationally Backward Blocks are shown at the lower right quadrant in panel A. Figures in Panel B plot the probability of treatment (average Educationally Backward Block status) for 0.5 percentage point bins of the running variables. For the figure in the left the sample the restricted to blocks where gender gap in literacy rate is above the national average, therefore, treatment is solely determined by female literacy rate. Similarly, for the figure in the right the sample is restricted to blocks where female literacy rate is below the national average, therefore, treatment is defined on the basis of gender gap in literacy rate only.

FIGURE 3.4: Continuity of the Running Variables.



Notes: Data used from Primary Census Abstract (2001) for the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka. In Panel A the sample is restricted to the blocks where female literacy rate is below the national average; therefore, treatment (Educationally Backward Block status) is defined on the basis of gender gap in literacy rate only. Similarly, in Panel B the sample is restricted to the blocks where gender gap in literacy rate is above the national average; therefore, treatment is defined on the basis of female literacy rate only. The log difference in heights and their standard errors (discontinuity estimates following McCrary, 2008) are given by -.27 (0.17) and -0.04 (.21) for Panel A and B respectively.

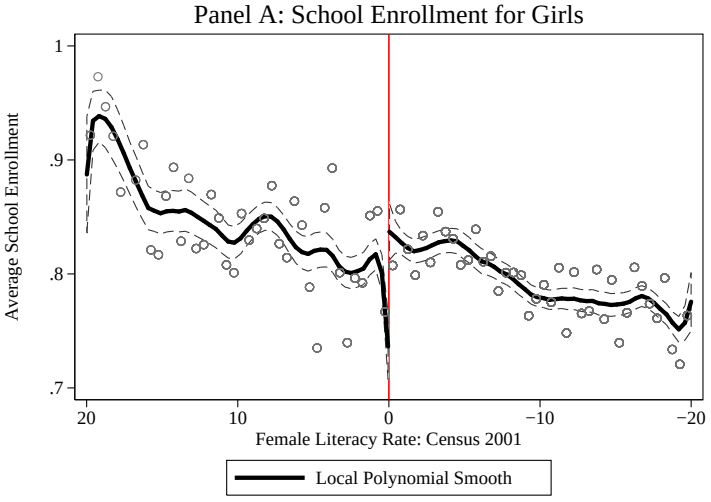
FIGURE 3.5: Block Level Covariates by Female Literacy Rate.



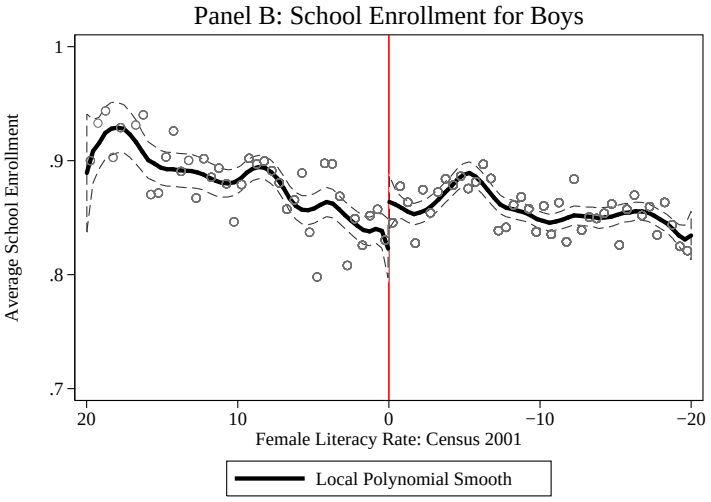
Notes: Data used from Primary Census Abstract (2001) for the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka. The open circles plot the average of the variables for 0.5 percentage point bins of female literacy rate. The solid lines are weighted local polynomial smoothing on both sides of the cut-off. The running variable, female literacy rate has been normalized at the cut-off (46.13 %).

FIGURE 3.6: Current School Enrollment (5 to 13 year).

Panel: A



Panel: B



Notes: Data used from Primary Census Abstract (2001) for the states of Bihar, Tripura, West Bengal, Jharkhand, Maharashtra, Andhra Pradesh, and Karnataka. The open circles plot the average of the indicator for current school enrollment for 0.5 percentage point bins of female literacy rate. The solid lines are weighted local polynomial smoothing on both sides of the cut-off. The running variable, female literacy rate has been normalized at the cut-off (46.13 %).

TABLE 3.1: Summary Statistics.

Variable	All			Girls			Boys		
	Obs	Mean	SD	Obs	Mean	SD	Obs	Mean	SD
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Child Characteristics									
Currently in school	158823	0.88	0.32	78056	0.86	0.35	80767	0.90	0.30
Girl	158823	0.49	0.50	78056	1.00	0.00	80767	0.00	0.00
Age	158823	8.97	2.54	78056	9.01	2.56	80767	8.93	2.52
Below poverty line	157914	0.39	0.49	77607	0.40	0.49	80307	0.39	0.49
Urban	158823	0.03	0.16	78056	0.03	0.16	80767	0.02	0.16
Scheduled Caste / Tribe	157894	0.33	0.47	77590	0.33	0.47	80304	0.33	0.47
BPL and SC/ST	156997	0.17	0.37	77148	0.17	0.37	79849	0.17	0.37
Block Characteristics									
Female employment ratio	1473	35.59	14.12	-	-	-	-	-	-
Sex ratio	1473	957.71	43.51	-	-	-	-	-	-
Workers in agriculture labor	1473	35.32	13.35	-	-	-	-	-	-
Workers in household production	1473	3.79	4.05	-	-	-	-	-	-
Workers in cultivation	1473	40.80	13.23	-	-	-	-	-	-
Scheduled Caste population	1473	16.67	8.87	-	-	-	-	-	-

Notes: Data used from District Lelvel Household Survey (2007-08). The sample is restricted to children in the age group 5 to 13 and the blocks where the gender gap in literacy rate is above the national average. Curerntly in school, Girl, Below poverty line, Urban, Scheduled Caste Tribe are indicator variables.

TABLE 3.2: OLS Estimates of the Effect of Educationally Backward Blocks on Current School Enrollment for 5-13 Children.

Dependent Variable: Current School Enrollment			
	(1)	(2)	(3)
	Panel A: Girls		
Educationally Backward Blocks	**0.037*** **	**0.033*** **	**0.033*** **
	(0.01)	(0.01)	(0.01)
Obs	75369	74494	74494
R-square	0.026	0.062	0.064
	Panel B: Boys		
Educationally Backward Blocks	**0.014**	**0.0097**	**0.0091**
	(0.01)	(0.01)	(0.01)
Obs	78024	77131	77131
R-square	0.0087	0.024	0.026
Household Controls	No	Yes	Yes
Block Controls	No	No	Yes

Notes: Data used from the District Level Household Survey (2007-08). The sample is restricted to children in the age group of 5 to 13 years and the blocks where the gender gap in literacy rate is above the national average, therefore, treatment is based on female literacy rate cutoff only. In Panel A the sample is restricted to girls whereas for Panel B the sample is restricted to boys. Robust standard errors clustered at the village level are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. Household controls include age of the children, indicators for poverty, urban residence of the household. Block controls include sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population at the block level.

TABLE 3.3: Parametric RD Estimates of the Effect of Educationally Backward Blocks on Current School Enrollment for 5-13 Children.

Dependent Variable: Current School Enrollment			
Interval around cutoff (percentage points)	7.5	10	15
	(1)	(2)	(3)
	Panel A: Girls		
Linear control function	**0.038*** **	**0.041*** **	**0.036*** **
	(0.01)	(0.01)	(0.01)
Quadratic control function	**0.038*** **	**0.040*** **	**0.030*** **
	(0.01)	(0.01)	(0.01)
Cubic control function	**0.026**	**0.030***	**0.040*** **
	(0.02)	(0.01)	(0.01)
	Panel B: Boys		
Linear control function	**-0.0016**	**0.0073**	**0.0082**
	(0.01)	(0.01)	(0.01)
Quadratic control function	**0.00081**	**0.0099**	**0.0081**
	(0.01)	(0.01)	(0.01)
Cubic control function	**-0.016**	**-0.011**	**0.0087**
	(0.01)	(0.01)	(0.01)

Notes: Data used from the District Level Household Survey (2007-08). The sample is restricted to children in the age group of 5 to 13 years. The sample is further restricted to the blocks where the gender gap in literacy rate is above the national average, therefore, treatment is based on female literacy rate cutoff only. In Panel A the sample is restricted to girls whereas for Panel B the sample is restricted to boys. Robust standard errors clustered at the village level are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. All regressions include controls for age of the children, indicators for poverty, urban residence of the household. The control set also include the sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population. Number of observations and R-square values are not reported to keep the table clean.

TABLE 3.4: Non-Parametric Estimates of the Effect of Educationally Backward Blocks on Current School Enrollment for 5-13 Children.

Dependent Variable: Current School Enrollment				
Interval around cutoff (percentage points)	7.5	10	15	IK
	(1)	(2)	(3)	(4)
	Panel A: Girls			
Educationally Backward Blocks	**0.032*** **	**0.035*** **	**0.035*** **	**0.036*** **
	(0.01)	(0.01)	(0.01)	(0.01)
Obs	20342	29195	44169	40336
	Panel B: Boys			
Educationally Backward Blocks	**-0.005**	**0.003**	**0.01**	**0.01**
	(0.01)	(0.01)	(0.01)	(0.01)
Obs	20925	30129	45735	41311

Notes: Data used from the District Level Household Survey (2007-08). The sample is restricted to children in the age group of 5 to 13 years. The sample is further restricted to the blocks where the gender gap in literacy rate is above the national average, therefore, treatment is based on female literacy rate cutoff only. In Panel A the sample is restricted to girls whereas for Panel B the sample is restricted to boys. Robust standard errors clustered at the village level are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. All regressions include controls for age of the children, indicators for poverty, urban residence of the household. The control set also include the sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population.

TABLE 3.5: Heterogeneous Effect of Educationally Backward Blocks on Current School Enrollment for 5-13 Children.

Households	Dependent Variable: Current School Enrollment					
	All		SC/ST		Non SC/ST	
	Girls	Boys	Girls	Boys	Girls	Boys
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS Estimates						
Educationally Backward Blocks	**0.032*** **	**0.0088**	**0.064*** **	**0.0028**	**0.018**	**0.013**
	(0.01)	(0.01)	(0.02)	(0.01)	(0.01)	(0.01)
Panel B: Parametric RD Estimates (interval around cutoff: 15, cubic control function)						
Educationally Backward Blocks	**0.040*** **	**0.0087**	**0.056** **	**-0.020**	**0.030***	**0.022***
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Panel C: Non-Parametric Estimates (IK bandwidth)						
Educationally Backward Blocks	**0.036*** **	**0.0089**	**0.053*** **	**-0.017**	**0.028*** **	**0.022** **
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

Notes: Data used from the District Level Household Survey (2007-08). The sample is restricted to children in the age group of 5 to 13 years. The sample is further restricted to the blocks where the gender gap in literacy rate is above the national average, therefore, treatment is based on female literacy rate cutoff only. Robust standard errors clustered at the village level are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. All regressions include controls for age of the children, indicators for poverty, urban residence of the household. The control set also include the sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population.

TABLE 3.6: Heterogeneous Effect of Educationally Backward Blocks on Current School Enrollment for 5-13 Children.

Households	Dependent Variable: Current School Enrollment					
	All		BPL		Non BPL	
	Girls	Boys	Girls	Boys	Girls	Boys
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A: OLS Estimates						
Educationally Backward Blocks	**0.032*** **	**0.0088**	**0.056*** **	**0.0082**	**0.014**	**0.010**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Panel B: Parametric RD Estimates (interval around cutoff: 15, cubic control function)						
Educationally Backward Blocks	**0.040*** **	**0.0087**	**0.047** **	**0.0027**	**0.032** **	**0.012**
	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)
Panel C: Non-Parametric Estimates (IK bandwidth)						
Educationally Backward Blocks	**0.036*** **	**0.0089**	**0.040*** **	**0.0061**	**0.028*** **	**0.012**
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)

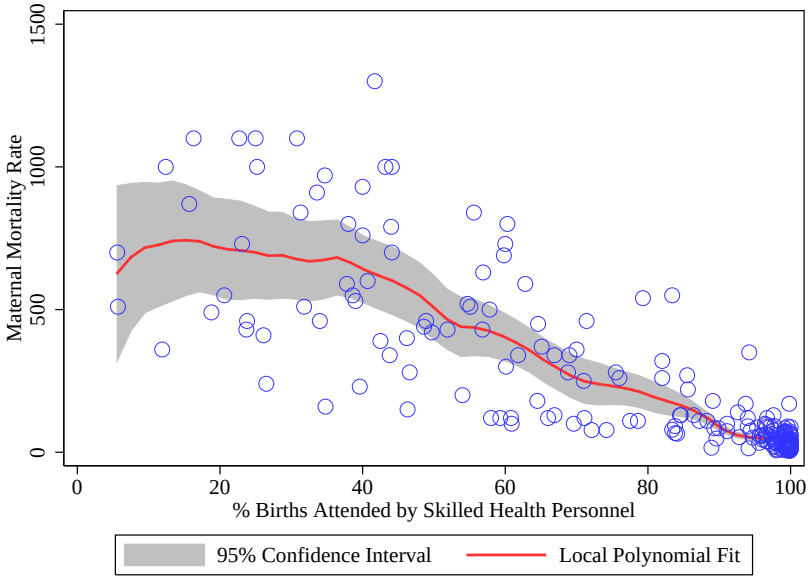
Notes: Data used from the District Level Household Survey (2007-08). The sample is restricted to children in the age group of 5 to 13 years. The sample is further restricted to the blocks where the gender gap in literacy rate is above the national average, therefore, treatment is based on female literacy rate cutoff only. Robust standard errors clustered at the village level are reported in parenthesis. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively. All regressions include controls for age of the children, indicators for poverty, urban residence of the household. The control set also include the sex-ratio, female employment rate, share of workers in agriculture labor, cultivation, and household production, and percentage of Scheduled Caste population.

Appendix A

Chapter 1: Improving Maternal Health with Incentives to Mothers vs. Health Workers: Evidence from India

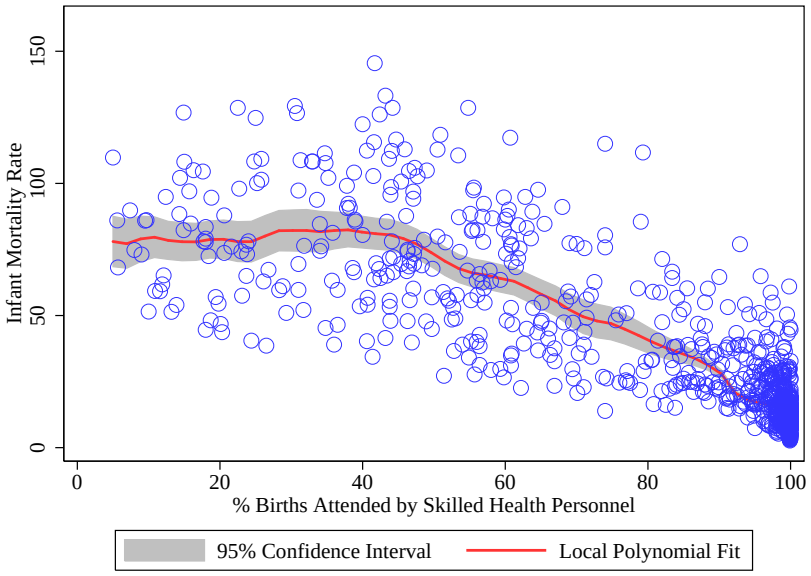
A.1 Maternal and Infant Mortality by Institutional Delivery

FIGURE A.1: Maternal Mortality by Percentage of Births Attended by Health Personnel (Country Level Data: 1990 - 2013)



Source: Millennium Development Goals Indicators, United Nations.

FIGURE A.2: Infant Mortality by Percentage of Births Attended by Health Personnel (Country Level Data: 1990 - 2013)



Source: Millennium Development Goals Indicators, United Nations.

A.2 Selection Issues

TABLE A.1: Effect of Number of Births (Since January 2004) on Institutional Delivery of the Last Birth.

Dependent Variable:	If the delivery took place at a (Govt./Private) Hospital			
	(1)	(2)	(3)	(4)
Panel A: Effect of Number of Births Since 2004 (Linear)				
Number of births since 2004	**0.004**	**0.001**	**0.000**	**0.001**
	(0.00)	(0.00)	(0.00)	(0.00)
Number of Observations	205184	204091	202588	202588
R-square	0.22	0.25	0.26	0.26
Panel B: Effect of Number of Births Since 2004 (Non Linear)				
One birth since 2004	**0.000**	**-0.014**	**-0.019**	**-0.020**
	(0.03)	(0.03)	(0.03)	(0.03)
Two births since 2004	**0.007**	**-0.015**	**-0.018**	**-0.020**
	(0.03)	(0.03)	(0.03)	(0.03)
Three births since 2004	**-0.007**	**-0.019**	**-0.021**	**-0.022**
	(0.03)	(0.03)	(0.03)	(0.03)
Number of Observations	205184	204091	202588	202588
R-square	0.22	0.25	0.26	0.26
Indicators for treatment, household assets, birthyear FE, religion FE	Yes	Yes	Yes	Yes
Age and yrs. of schooling for women and their husbands	No	Yes	Yes	Yes
Indicators for below poverty line and scheduled caste households	No	No	Yes	Yes
Indicators for rural areas	No	No	No	Yes

Notes: Data used from the District Level Household Survey-II (2002-04). The sample is restricted to women reporting at least one birth since January, 1999. All regressions control for district fixed effects. Robust standard errors clustered at primary sampling unit are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

TABLE A.2: Effect of *Jananani Surakshya Yojana* on Other Observables.

	Average Difference, Births before v/s after JSY			
Household variables	Low Performing States	High Performing States	Difference Col.(1) - Col.(2)	t-statistics
	(1)	(2)	(3)	(4)
Age	-2.651	-2.364	-0.287	0.067
Years of schooling	0.360	0.431	-0.071	0.058
Age of husband	-2.741	-2.758	0.017	0.080
Years of schooling of husband	0.033	0.396	-0.363	0.060
Below poverty line (bpl)	-0.006	-0.007	0.002	0.005
Scheduled Caste/ Scheduled Tribe (scst)	0.017	0.004	0.013	0.005
Rural	0.003	-0.003	0.006	0.005
Own electricity	-0.005	0.004	-0.009	0.005
Own mattress	0.001	0.038	-0.037	0.006
Own cooker	-0.003	0.007	-0.011	0.006
Own chair	0.016	0.003	0.013	0.006
Own sofaset	0.007	0.017	-0.010	0.004
Own cot or bed	-0.009	0.023	-0.032	0.004
Own table	0.011	0.013	-0.001	0.006
Own electric fan	-0.007	0.007	-0.014	0.006
Own radio/transister	0.000	0.004	-0.005	0.005
Own tv (b&w)	-0.003	-0.010	0.006	0.004
Own tv (color)	0.003	0.003	-0.001	0.005
Own sewing machine	-0.002	0.002	-0.004	0.005
Own mobile	-0.001	0.009	-0.010	0.006
Own any other telephone	-0.002	0.000	-0.002	0.004
Own computer	-0.001	0.000	-0.002	0.002
Own refrigerator	-0.001	0.007	-0.008	0.004
Own washing machine	0.000	0.005	-0.004	0.003
Own watch/clock	0.001	0.000	0.001	0.005
Own bicycle	-0.014	0.001	-0.015	0.006
Own motorcycle or scooter	-0.007	0.006	-0.013	0.005
Own animal drawn cart	-0.001	0.002	-0.003	0.003
Own car	-0.002	0.001	-0.003	0.002
Own tractor	-0.003	-0.001	-0.002	0.002
Own water pump	-0.009	-0.006	-0.003	0.004
Own thresher	0.000	-0.004	0.003	0.002

Notes: Data used from the District Level Household Survey-II (2002-04). The sample is restricted to women reporting at least one birth since January, 1999. All regressions control for district fixed effects. Robust standard errors clustered at primary sampling unit are reported in parentheses. ***, **, and, * indicate statistical significance at the 1, 5, and, 10 percent level respectively.

Appendix B

Chapter 2: The Impact of Household Structure on Female Autonomy in Developing Countries

TABLE B.1: OLS Estimates of the Effects of Male Household Head on Women's Decision Making Power and Labor Force Participation.

Dependent Variable	Whether the respondent decides				If the respondent does not need permission to			If the respondent	
	what to be cooked on a daily basis?	whether to buy an expensive item?	how many children to have?	what to do if child falls sick?	visit local Health Center?	visit friends or relatives?	go to grocery store?	participate in labor force?	have cash in hand?
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)	(ix)
				Panel A					
Househol Head is Male	**-0.074**	**-0.037**	**0.041**	**0.11**	**-0.14****	**-0.086**	**-0.072**	**-0.067**	**-0.060**
	(0.10)	(0.03)	(0.06)	(0.07)	(0.07)	(0.07)	(0.11)	(0.07)	(0.09)
N	379	379	379	379	379	364	270	379	377
R Square	0.53	0.52	0.52	0.59	0.59	0.63	0.65	0.53	0.54
				Panel B					
Brother-in-Law	**-0.15**	**-0.038**	**0.15***	**0.12**	**-0.10**	**-0.13**	**-0.11**	**-0.081**	**0.036**
	(0.14)	(0.05)	(0.09)	(0.10)	(0.10)	(0.08)	(0.15)	(0.11)	(0.12)
Other Relation	**-0.15**	**0.0032**	**0.040**	**-0.20***	**0.012**	**0.025**	**0.25**	**-0.10**	**-0.041**
	(0.16)	(0.07)	(0.09)	(0.10)	(0.08)	(0.09)	(0.18)	(0.09)	(0.12)
N	379	379	379	379	379	364	270	379	377
R Square	0.53	0.52	0.53	0.60	0.59	0.63	0.66	0.53	0.54

Notes: Data used from IHDS (2005). The sample is restricted to households which are joint in structure in wave-II, possessed land and the household head is not the father-in-law of the woman. All regressions control for total number of household members, number of married male and female residents and number of rooms in the household, land (in acres), indicator for livestock and, caste, religion and district fixed effects. The control set also includes women's and their spouse's age and years of education from. Standard errors are robust and clustered at village level in all specifications.

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