WHY ARE SEX RATIOS BEGINNING TO EVEN OUT IN INDIA? A TEST OF SUPPLY- AND DEMAND-SIDE FACTORS INFLUENCING SON PREFERENCE

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ABSTRACT

Evidence from the most recent India census suggests that despite a country-level downward trend in child sex ratios (fewer girls than boys), the states and districts that have in the past had the most imbalanced sex ratios are beginning to show evidence of slowing of decline and even turn-around. This paper explores possible demand- and supply-side factors that could influence son preference and sex-selective behavior. The marriage market, labor market, and social norms are explored as possible demand-side factors, and supply-side factors relating to availability of medical professionals are explored, at varying individual-, community-, and state-levels. A lower community level child sex ratio (fewer girls compared to boys) is not associated with an individual woman having a lower odds of having a boy. When more women were in advanced labor opportunities in the community and more women had access to doctors and nurses, there was a lower odds of having a boy. Community level labor market was also associated with the overall community level child sex. These findings suggest that community factors relating to supply and demand of boys compared to girls may be influencing decision-making. More research on possible mechanisms for equalization in sex ratios is necessary, particularly using data sources that allow for integration of other district-level data.

INTRODUCTION

The most recent Indian census (2011) showed the child sex ratios (the number of girls under age five divided by the number of boys under age five) are more imbalanced to disadvantage girls than in recorded history (Registrar General of India, 2011). However, recent analysis by Diamond-Smith and Bishai (2013) found evidence that child sex ratios in the districts of India that have previously had the most imbalanced sex ratios were beginning to equalize, even though child sex ratios in the country as a whole worsened (Diamond-Smith and Bishai, 2013). This suggests that in districts with a long history of increasingly imbalanced sex ratios, some type of feedback mechanism is at play that is changing behavior so people are discriminating less against female children.

The initial analysis by Diamond-Smith and Bishai used data from 1981-2011 to look at the state-level, and found that this reversal was visible in the states and territories of Haryana, Punjab, Delhi, Chandigarh, and to some extent Gujarat (Diamond-Smith and Bishai, 2012). Using fixed effects models, they found evidence of this trend at a district-level throughout the country as a whole over this time period (Diamond-Smith and Bishai, 2013). Diamond-Smith and Bishai's analysis used census data, so all correlations were at a population level. Therefore, while the trends are suggestive of district-level trends affecting individual behavior, population level analysis cannot make strong claims of this relationship at an individual-level.

If indeed some type of correction mechanism is starting to occur in Indian districts with very imbalanced sex ratios, it is important to explore potential drivers of this reversal. The results of Diamond-Smith and Bishai (2013) suggest that the quantity of sex-selective abortions might be decreasing, because the sex ratio is falling. It is also possible that excess female mortality is declining because people are providing better care for their girls. There are a number of factors that could be leading to these changes, both from the supply- and the demand-side. In this paper we will look at those that can be measured in the National Family Health Survey of India, round 3 (NFHS-3). These data were collected from a representative sample of households in India in 2005-2006.

Possible drivers of equalization in the child sex ratio include tensions in the marriage market, which would make having a male child less attractive; improvements in women's opportunities in the labor market, which would make having a female child more attractive; the success of certain government programs and laws that have been enacted to improve the status of girls and restrict sex selection; among others. On the supply-side, we explore access to sex-selective technology, which could be decreasing due to increased government regulation. On the demand-side, we explore tensions in the marriage market, opportunities in the labor market and social norms, as factors that would make people desire fewer sons, and therefore seeking fewer sex-selective abortions.

I. Theory

There is a plethora of evidence in India for a demand for sons (Pande and Astone, 2007, Diamond-Smith et al., 2008, Arnold et al., 1998, Clark, 2000, Dyson and Moore, 1983). Historically, child sex ratios in India have been slightly imbalanced because people practiced female infanticide (Das Gupta and Bhat, 1997, Dyson and Moore, 1983). However, in the mid 1980s, when ultrasound technology and abortions became widely available in India, there was a method for people to act on their son preference more easily (supply increased to meet demand), and sex ratios became increasingly imbalanced (Das Gupta and Bhat, 1997).

In this paper, we conceptualize the situation of son preference and sex ratios in India in terms of a market. This is a useful way of understanding this phenomenon because it allows us to see how different development might affect the sex ratio in a population. For example, as family planning access expanded, the "price" of controlling fertility declined. As access to abortion and sex-selective technology then expanded, the price of selecting a son also dropped.

Market explanations can be visualized on a supply and demand curve (see below). When the demand curve shifts right, the price goes up, the quantity goes down. When the demand curve shirts left, the price goes down and the quantity goes down. When the supply curve shifts right the price goes down and the quantity goes up, and when the supply curve shifts left, the price goes up and the quantity goes down.

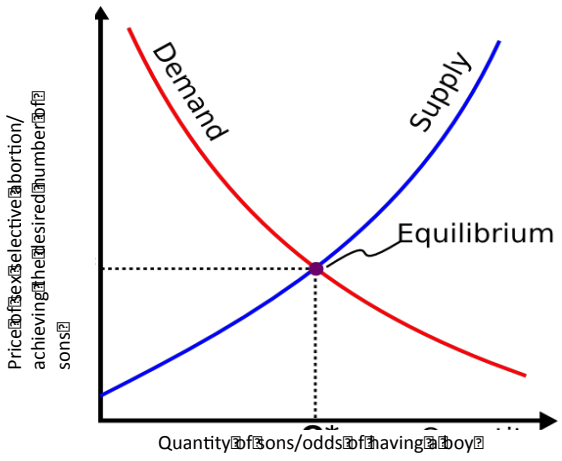

Fig 4.1: Supply and Demand Curve

In this framework, we can think about the various ways that the supply or demand curve might shift. Access to technology or regulation of technology might shift the supply curve right or left. Changes in education level, social contagion, complementarity of the good to other up trending goods, substitutability of the good to other down-trending goods or norm changes might shift the demand curve left or right (among other possibilities).

Before ultrasounds and sex-selective abortion, the cost (emotional, societal) of removing an unwanted female fetus was high, so very few people would use that/demand that, so the quantity was low, and sex ratios at birth were only slightly imbalanced. However, with an increased supply of sex-selective technology, the cost of having a son was lower (less emotional burden, less social stigma, however, an added financial cost). This shifted

the supply-side right. Therefore, the number of sex-selective abortions increased as supply met demand, and the sex ratio became more imbalanced.

The finding by Diamond-Smith and Bishai (2013) that child sex ratios are increasing in some states could suggest that the quantity of sex-selective abortions is decreasing. This could be due to a left shift in demand, or a left shift in supply. There are a number of factors that could be leading to this change, both from the supply- and the demand-side.

i. Demand Shifts

Demand-side shifts in this situation are centered on a parental utility function, where parents derive utility from children based on both their quality and quantity, and often have to make a tradeoff between the two.

U(Quality, Quantity)

In the Indian setting, we propose four main factors affecting child quality. The first is social status enhancement of children, which can be accomplished through the child marrying up, excelling in school or their career, etc. Second, quality rests in old age support, for example, the ability of the child to work in the household or on a family farm, or the child to migrate and send remittances to the parents. Old age support can be either or both financial or emotional. A third measure of quality might be the child's own happiness and health, which would bring the parents happiness. The fourth measure of quality can be through the children providing their parents with grandchildren, thereby maintaining the family and the genetic line.

In India, the ability for a child to be of high quality can be determined by factors in the marriage market, such as marriage squeezes, which will either allow or prohibit children from marrying up or producing grandchildren. Educational or labor opportunities can affect a child's ability to succeed in their career, and be able to provide monetary old age support. Discrimination against girls entering the labor force, or the decline of such discrimination can also affect the potential quality.

ii. Supply Shifts

There are three ways that people can have more boys (increase their odds of having a boy), all of which have become more effective in recent decades. The first is to become pregnant again if the desired number of boys has not been achieved, or to stop having children if the family has enough boys. Family planning options have made this easier than historically. Second, if a woman is already pregnant, she can choose to not abort a boy fetus (or abort a girl fetus and then become pregnant again more quickly with a boy). Access to ultrasounds has made this option more realistic. Finally, if a boy has already been born, a family can work harder to keep him alive, and immunization, better nutrition, and the child survival revolution in general have made this step more effective than before.

In this paper we will look at those that can be measured in the NFHS-3 data. On the supply-side, it is possible that access to sex-selective technology could be decreasing, perhaps due to increased government regulation. On the demand-side, it is possible that people are desiring fewer sons, and therefore seeking fewer sex-selective abortions. Or, people might be demanding more daughters, so once people have a child, they provide

equal quality care to girl and boy children. These changing preferences could be due to changing social norms, changes in the marriage market, the labor market, or some other factors affecting behavior.

II. Demand-side Factors

i. Marriage market

It is safe to assume that most people in India wish to marry someone of the opposite gender, which implies that in the population as a whole it would be beneficial to have an equal number of girls and boys (sex ratios here being seen as a public good). Most societies, including India, often have an age gap between the bride and groom, with the groom being slightly older. In these cases, as long as the population is still growing, even if there are uneven sex ratios, each man will be able to find a wife, because he can seek a wife in the larger pool of women in the cohort below him. In most of India, despite fertility decline, the population is still growing due to population momentum (Bhaskar, 2011).

India (and China) are at the cusp of a huge problem due to uneven sex ratios in their marriage markets as their population pyramids begin to even out. Previously, because of population growth, the size of the cohort below any given cohort was larger, however, in China today and in India in the coming decades, it is predicted that the cohort sizes will have the opposite trend, with larger cohorts above, and smaller cohorts below (see Fig 2).

Projections by Guilmoto (2012) suggest that there will be as many as 40 million men remaining single between 2020-2080 in India, and 32 million in China in that same time period (Guilmoto, 2012). These projections assume that most women will want to marry, however, if India and China follow the trend in other countries during development, and a sub-population of women begin to opt out of marriage, there will be even more bachelors.

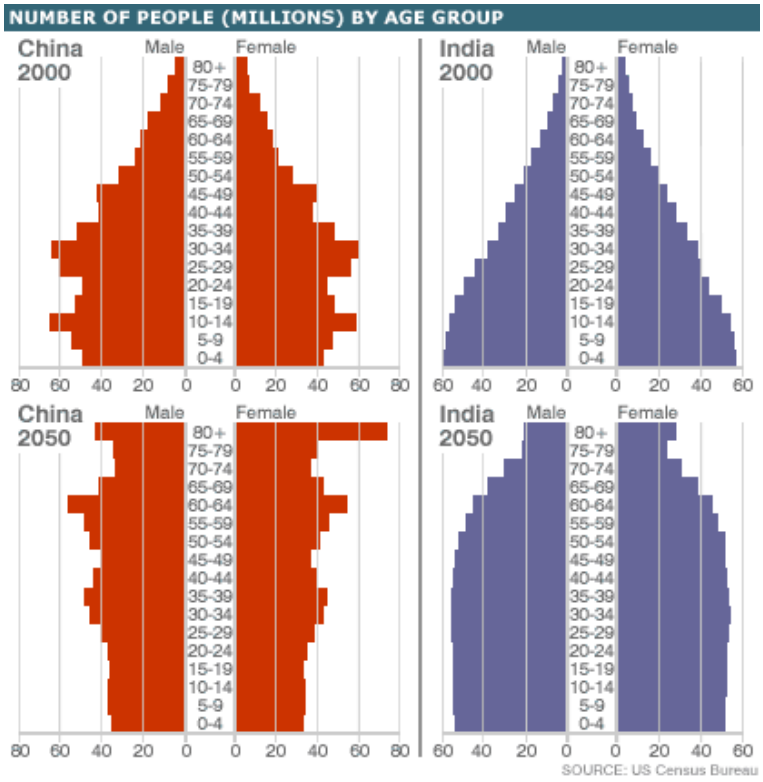

Fig 4.2. Population pyramids of India and China in 2000 and 2050 (Lewis Historial Society, 2012)

It is possible that such large numbers of unmarried men will lead families to revise their preferences for sons. If families derive benefit not just from having a son, but from having a grandchild (via a married son), then there might be an increased utility of having

a daughter. Additionally, not only do married sons provide benefit because they can produce grandchildren, but they may also provide benefit through the additional support that a daughter-in-law provides. For example, evidence from China suggests that not only do sons send money back to support parents in old-age, but daughter-in-laws also contribute a significant proportion of their income to their husband's parents (Bhattacharjya et al., 2008). Therefore, it is possible that an unmarried son could be less valuable if he cannot marry, and parents, and when faced with the option of having a son who might never marry or a daughter who would marry, the family might not prefer the son. For this to be true, parents would have to value having a grandchild above other possible child quality related factors.

Another possibility is that as women become a scarce resource they will be able to compete more on the marriage market, and either demand higher quality husbands, which might have some long-term benefits to parents of daughters, or be required to pay a lower dowry, because men are so desperate for wives that they will not demand as high of a dowry. There has been debate in the literature as to what uneven sex ratios and squeezes in the marriage market will do to dowry. An economic perspective suggests that dowries should fall with increasingly imbalanced sex ratios, however, Bhaskar (2011) has shown that as long as social disparities widen, dowry prices should rise (Bhaskar, 2011). Dowry is the bride's family's opportunity to move upwards, so it can be seen as the cost of a higher-class groom. Therefore, even in a situation with an excess of men, dowries may rise because families still must compete for high-class grooms. Recently dowries have been increasing in India, even in regions that historically did not have a tradition of

dowry. Some have even suggested that the declining position of women in India is due to the marriage squeeze, as states that previously relied on bride price (the grooms family paying the bride's family) have now switched to dowry (Bhat and Halli, 1999).

While the concept of a marriage market is easy to understand, actually measuring the marriage market is more complex. Part of the problem with measuring the marriage market in a place like India, which has a growing population, and a tradition of men being older than their wives, is that even if in a given age group there are more men than women, if men marry younger wives, the pressures on the marriage market will remain low. Other factors that complicate the measurement of the marriage market in India is the tradition of exogamous marriage, which makes defining the potential pool of marriage partners difficult. Some literature has suggested that using larger measures of the marriage market (such as district or state) can help account for marriage migration and provide a reasonable measure of the marriage market (Caldwell et al., 1983).

In theory, when there is a shortage of women in an age group, men will reach farther down into younger age groups to find wives. Therefore, one way of measuring pressures on the marriage market could be through the size of the age gap between husbands and wives. In theory, the more stressed the marriage market is, the larger the marriage gap would be. Edlund (1996) showed how son preference increases the age gap in marriage, and how the lowest ranking males will have the largest age gap in marriage (in other words, a sign of a low-quality marriage is a large age gap) (Edlund, 1999). Cross

sectional data suggest that where there is an excess of men, the marriage gap is bigger (Edlund, 1999).

Tucker and Van Hook (2013) proposed a method for projecting the marriage market in China using data on the sex ratio at birth, the rate of growth, the marriage age gap, and the life expectancy of men and women to the average age at marriage (Tucker and Van Hook, 2013). This model is based purely on demographic information, but provides valuable information about the magnitude of marriage market imbalance in different future population growth or son preference regimes.

ii. Labor Market

When there is a shortage of women it is possible that the lack of sufficient workers to fill occupations where women have higher productivity could change the value of women. This mechanism can only work through occupations that exclude men (in other words, occupations that men can/will not fill when there are not enough women around, even if the wage is high). In this case, labor markets would have to compete more for the smaller pool of women, and therefore wages would rise. If female wages rose faster than male wages, then a family deciding whether to have a boy or a girl might see the potential earnings of a daughter being higher than the earnings were before, and therefore wish to have a daughter. Of course, this would only act in the short run, because if everyone started having girls, and the market was flooded with women, female wages would fall again.

Past research has suggested that in regions of India that are dominated by rice cultivation, instead of wheat, female survival is enhanced (Kishor, 1993). This is thought to be because women are more productive in rice fields than in wheat fields, therefore their economic value is higher. This argument has been used to help explain some of the historical trend of lower son preference in the South (rice producing) states of India. Research by Qian (2008) in China found that holding male income constant, female survival increases when female wages rise, and vice versa (female survival declines when male wages rise, holding female wages constant) (Qian, 2008).

There is mixed evidence about the role of women's wages and labor force participation on sex ratios or other measures of gender preference in India. Cross-sectional data have found that in states where more women work sex ratios are less imbalanced (less disadvantageous for women) (Kishor, 1993). However, others have pointed out that because of the practice of exogamous marriages, the labor market in a specific community should not have much impact on gender preferences or differentials (Foster and Rosenzweig, 2001, Drèze and Sen, 1998). Sophisticated models that take into account marriage migration have suggested that when the destination of marriage migration is to areas where technology changes favor opportunities for women, there is relative preference for girls and improvement in female survival (Foster and Rosenzweig, 2001).

The labor market is changing in India, with an increase in jobs in the global technology

sector. There is evidence that returns to middle and upper schooling for women have increased in the past few decades (although they have not improved for primary schooling) (Duraisamy, 2002). An interesting experiment in New Delhi found more discrimination based on caste than on gender in the hiring market (Banerjee et al., 2008). This suggests that labor market opportunities for women in India may be opening up due to reductions in discrimination against women in general.

iii. Social Norms

It is also possible that sex ratios are equalizing because social norms about preferences for boys or girls are changing. There is no clear evidence as to why norms about gender would be changing now in India, since efforts have been made for many decades by NGOs and the government to improve the status of women. Chung and Das Gupta (2007) have suggested that changes in social norms were responsible for much of the decline in son preference in South Korea, however, why and how social norms changed is not clearly understood (Chung and Das Gupta, 2007). A myriad of programs and schemes have been instituted by the Government of India and various NGOs and other interested organizations across the country, aiming to reduce discrimination against females. It is possible that these programs and schemes have influenced people's views and led to changes in behavior. For example, many states have used conditional cash transfer programs to improve the status of girls, whereby if the family complied with a certain aim (birth registration, immunization, registration in school, or delaying age of marriage), they would receive a financial incentives (Sekher, 2010). Some of these schemes are

supported by the central government, while others either are eventually taken over by states, or initiated by states. Some schemes target the whole state, while others only specific groups, such as those in backwards classes or in the lowest wealth quintiles. Many of the schemes have met with problems in implementation, lack of central/state support and too many restrictions and criteria for membership (Sekher, 2012). A recent report by the National Advisory Council of India stated (p. 7) "There is no field-based impact-assessment of these schemes, in the absence of which there is no evidence regarding the desired objective of reducing sex selection. Clearly, there is a need for a systematic evaluation before these schemes are articulated or promoted as the center-piece of the fight against the declining sex ratio" (Naqvi and Kumar, 2012).

Past research looking at social norms and son preference in India found that religion and caste were associated with son preference, but other measures of social norms, such as territorial and kinship endogamy, were not associated (Pande and Astone, 2007). There are pervasive differences between religious groups in India, with Muslims generally having higher son preference, having higher fertility, and being less likely to use contraception than Hindus (Clark, 2000, Pande and Astone, 2007, Dharmalingam and Morgan, 2004). There are also regional variations in factors related to religion, for example, in some states Muslims and Hindus are equally likely to practice purdah (a certain set of behaviors revolving around women being restricted in their movement), while in other parts of the country Muslims are much more likely to practice purdah than Hindus (Rahman and Rao, 2004). However, this does not necessarily equate to women's

decision-making power, as this same study found Muslim women generally have more decision-making power than Hindu women (Rahman and Rao, 2004).

Analysis of panel data in India found that an individual's exposure to cable TV was associated with a decrease in the acceptability of son preference, in addition to decrease in the acceptability of violence against women (Jensen and Oster, 2009). This suggests that exposure to modern ideas can change people's norms, which can perhaps in turn impact behavior. We were unable to find any papers that looked at the role of community-level norms on son preference or sex ratios in India, but research on other related topics has found that, for example, community-level opinions about the importance of delivering in a facility (the percent of the community who thinks delivering in a facility is important) is related to an individual's probability of facility based delivery (Moyer and Mustafa, 2013). The theory is that women will be influenced by the views of the community around them—these are the norms they are subjected to and which affect their behavior.

III. Supply-side Factors

There has been a proliferation of mobile ultrasound clinics, which offer (and even advertise aggressively) a relatively inexpensive way of finding the sex of a fetus (Retherford and Roy, 2003). Once the sex has been determined, people have little trouble obtaining an abortion (not explicitly for sex selection, but for another reason). Since sex-selective abortion is technically illegal in India since 1994 (although abortion itself has

been legal since the 1970s), there are very few data about exactly how accessible sex-selective abortions are throughout India (Naqvi and Kumar, 2012). Since direct evidence about availability of sex-selective technology is limited, one way to estimate the supply of sex-selective services could be by using the number of clinics or physicians in a community as a proxy. Since sex-selective abortion is illegal, it might be hypothesized that most sex-selective abortions happen in non-formal settings, however, there is evidence of strong sex preference among physicians (stronger even than in the community as a whole), suggesting that physicians might be willing to facilitate or turn a blind eye to sex determination and sex-selective abortions in their clinics (Patel et al., 2013).

Conceptual and Analytical Frameworks

We conceptualize a woman/family's decision-making along the process shown below in Fig 4.3. After a woman becomes pregnant, she and her family can decide whether to test for the sex of the fetus. If they do not test, they can either have an abortion, the baby can die spontaneously, or they can have the baby. If they decide to test for the sex, they can either find out it's a boy or a girl. At this point, regardless of the sex, they can decide to have the baby, they baby can die spontaneously, or they can have an abortion. In the NFSH-3 data, we are able to only measure babies that are born.

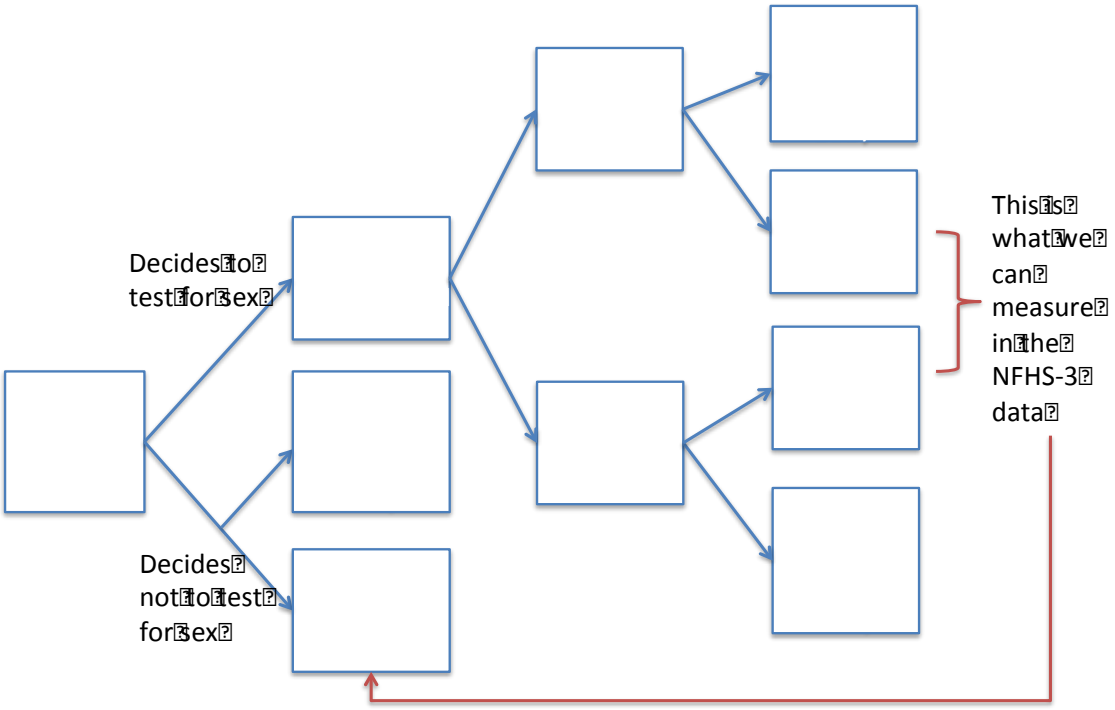

Fig. 4.3: Conceptual framework

We hypothesize that the various community and individual level factors described above influence all stages of this decision making process: from the decision to get pregnant all the way to deciding whether to keep a child of a certain sex or not. The analytical framework below shows how we conceptualize these various factors influencing each other, and how they fit into the two different sets of models (Fig 4.4). We hypothesize that the community level factors are associated with the community level child sex ratio, which we model in Model 2. We hypothesize that both individual and community level factors influence an individual's decision-making process to having a child of a certain sex.

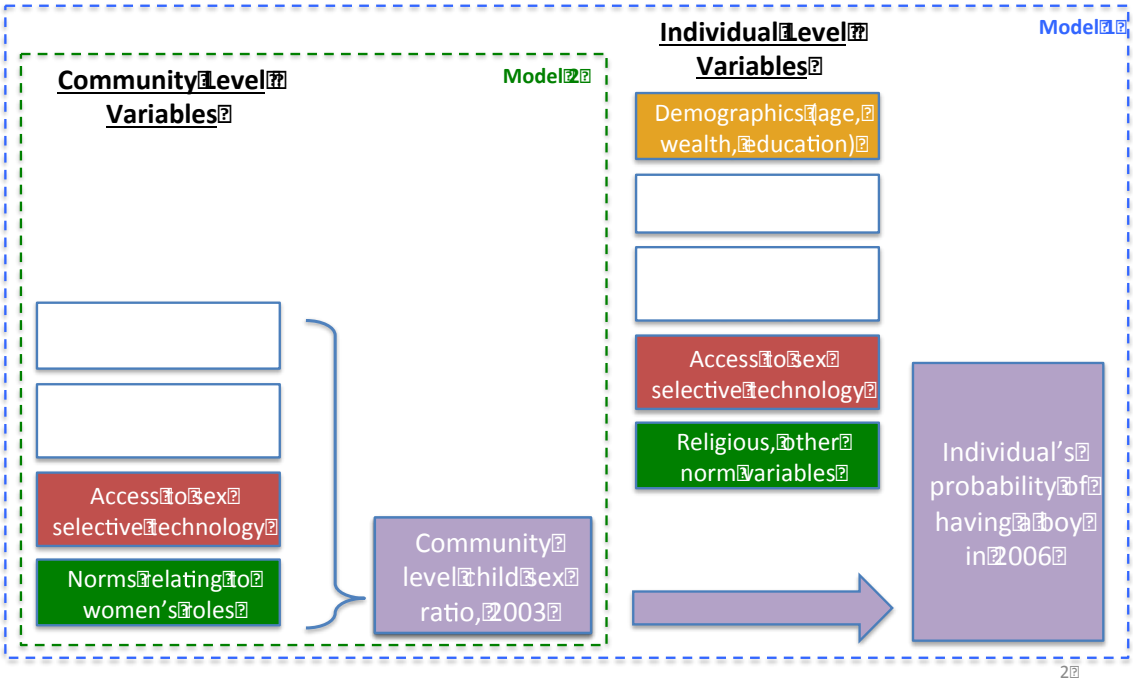

Fig 4.4: Analytical Framework

Specifically, we hypothesize that a marriage market that had too many boys in it would make people desire a boy less. We hypothesize that larger age gaps between spouses indicate a marriage market that is less favorable for boys, and which would make families desire a son less. Either the average community level age gap, or the couple's own age gap might influence this. In terms of the labor market, we hypothesize that where more women are in the labor force, especially in more advanced occupations, families might see daughters as having more earning potential or more potential to increase their social standing through a good job, and therefore desire a son less (this could be either individual labor or community level patterns). Relating to access to providers at ANC or delivery, we hypothesize that in communities where women have more access to providers (either at ANC or delivery) or individual women used these services, women would have more access to a sex selective abortion. Finally, communities were social

norms are more favorable to daughters or less favorable to sex selective abortion, as measured by acceptability of wife beating and access to modern thoughts via TV (which presumably are more gender equitable), we hypothesize would be associated with an individual having a lower probability of having a son (these factors could either act at the individual or community level).

DATA AND METHODS:

I. Data

This analysis uses data from the National Family Health Survey of India, round 3 (NFHS-3), which was carried out in 2005-06 (International Institute for Population Sciences (IIPS) and Macro International, 2007). It collected data from individual women and households in a representative sample around the country. The number of women sampled was based on the size of the state, with some adjustments to take HIV prevalence into account (to sample enough women to obtain data on HIV, which was collected in Round 3 for the first time). Sampling was conducted differently for urban and rural areas, and respondents were sampled based on the population of rural and urban areas in each state. In the rural sample, villages (Primary Sample Units, or PSUs) were selected with probability proportional to size sample (PPS) is the first stage of sampling. Within each PSU, households were randomly selected (second stage). In urban areas, three-stage sampling was used, where wards were selected using PPS first, and then census enumeration blocks were randomly selected, and then within that, households

were randomly selected (International Institute for Population Sciences (IIPS) and Macro International).

The 2001 Census was used as a sampling frame. Stratification of villages was based on geographic area. Villages were then stratified based on village size, percent of males in non-agricultural sector, percent of population of scheduled caste or tribe, and female literacy. Also, since NFHS-3 collected HIV data, high, medium and low HIV prevalence was also used to stratify (International Institute for Population Sciences (IIPS) and Macro International).

For this analysis, we use data from the women's questionnaire. Women were eligible if they were 15-49. NFHS-3 did not publish which district households were living in (due to the HIV data collection), therefore it is not possible to connect these data to other surveys or census data at a district-level. The survey did identify households by "stratum" that was based on geographic areas, and therefore this is used as a proxy for "community" in the creation of community-level variables.

All women who were sterilized more than 2 years before the survey data were collected are removed from the analysis because they were not at risk of having a child (the main outcome of interest in the analysis). we assume that all of the non-sterilized women were at risk of having a child, even if she was using family planning at the time of data collection. For the purpose of this analysis, the sex ratio is calculated as the number of

girls/the number of boys, so a lower value means there are fewer girls, unless otherwise stated.

II. Methods

The first model looks at the impact of various demand-side, supply-side, and demographic variables, on the probability that a woman who had a child in 2005/2006 had a boy, rather than a girl (among women who had a child in those years).

Model 1:

Probability(B|had a birth in 2006)= C+ B1(Stratum-level Child Sex Ratio) + B2(Women's demographic factors) + B3(Stratum-level norm factors) + B4(Stratum-level marriage factors) + B5(State-level marriage factors) + B6(Stratum-level labor factors) + B7(Stratum-level Supply factors) + e

The second model looks at whether the stratum sex ratio of children under 10 was influenced by the stratum- and state-level demand- and supply-side factors.

Model 2:

Stratum-level sex ratio =C+ B1(Stratum-level marriage factors) + B2(State-level marriage factors) + B3(Stratum-level labor factors) + B4(Stratum-level Supply factors) +e

The first model is run using multivariate logistic regression, and the second multivariate linear regression. All models are weighted using svy, and Model 1 is clustered at the stratum-level and Model 2 at the state-level (since the outcome of interest was at the stratum-level). Models are run in a step-wise fashion, where first the bivariate model is run, and then the demographic variables, and various community-level variables (relating to marriage market, labor market, social norms, and access) are each added individually, and then all variables are modeled together.

i. Demographic variables

Woman's age, education, religion (Hindu/other), whether she is currently using family planning, and the household wealth index are included as demographic variables in all models. Additionally, the number of boys and the number of girls in the household are included as measures of parity. Other variables relating to demographics are also included, but they are discussed more below as they relate specifically to the marriage market, labor market, norms, and supply of services.

ii. Marriage market data and variables

The first way that marriage market is measured is by the age gap between the husbands and wives in the analysis. The age gap between husbands and wives is calculated by subtracting the age of the wife at time of marriage from the age of the husband at time of marriage using the NFHS-3 data (since some husbands may have died we use the gap at

time of marriage). A stratum specific average age gap is also calculated by averaging the age gaps in each stratum.

iii. Labor market data and variables

The first set of variables used to measure labor market are based on the NFHS-3 data on women's reported occupations at an individual-level. A variable for any labor force participation and participation in high-level occupations (where the categories of professionals, clerical and sales were coded as higher-level occupations) are included. A stratum-level variable for percent of women in the labor force at and a variable to measure the percent of women in a stratum in higher-level occupations are both created.

iv. Norm data and variables

Three different variables are included in the analysis to measure community-level norms that might be related to changing sex ratios. The NFHS-3 included questions about women's ideal number of girls and boys. Both an individual and community-level (stratum) variable is created that measures the ratio of the average ideal number of boys over the average ideal number of girls. In this case, a higher value means more boys are desired than girls. Jensen and Oster (2009) found that women increasing the amount of TV they watched over time was correlated with a decrease in women's son preference, and in their belief that it is alright for a husband to beat his wife (Jensen and Oster, 2009). Therefore, we include a variable from the NFHS-3 for TV watching, where "more than

once a week" and "at least once a week" was coded as "Frequent TV watching." This is an individual-level variable. Finally, five questions in the NFHS-3 were asked about the acceptability of wife beating under various circumstances. we combined these into a score, where a higher score meant that the respondent said wife beating was acceptable under more circumstances. This is then made into a community-level mean score and also included as an individual-level variable.

v. Supply-side data variables

Due to lack of data about access to sex-selective technology specifically, we use percent of women per stratum who deliver with a doctor or a nurse, and the percent of women who see a doctor or nurse for their Antenatal Care (ANC), as a proxies for access to sex-selective technology. This variable is used to estimate the availability of access to modern technology and providers in a stratum. These variables are also included at the individual-level, and all come from the NFHS-3 data.

IV. Robustness Tests

i. Poisson

We re-ran model 1 as a Poisson model. Since the outcome, an individual having a boy in 2005-06) is a count, it is possible that a Poisson model would be a more appropriate model to run.

ii. Imputations

Since some of the variables differed significantly between the datasets with and without the missing cases which were dropped due to missingness of some variables (namely, women's education, age gap between husbands and wives, and ideal number of boy over girls), we re-ran the models with these values imputed using regression.

RESULTS

I. Description of the data

There were 84,609 women in the 2005-2006 NFHS-3, and 65.5% of them (55,447 women) were not sterilized 2 years before the start of the survey. These women live in 73 strata, which we take as a proxy for "community." Stratum range in size from 169 women to 5,031 women. Table 4.1 shows the characteristics of all women in the sample compared to those who were not sterilized 2 years before the survey and those cases for which there was complete data. The average age of women in the full sample is 33 years, and in the restricted sample it is 31 years old. They have 5.04 and 5.52 mean years of school, and 42.13% of all women, compared to 38.15% of the restricted sample of women, were participating in the labor force at the time of the survey. A larger percentage of the women in the restricted sample gave birth to a boy in the 2 years before the survey (11.83% compared to 7.75% of the full sample). The largest difference between the two samples is in family planning use, which makes sense since the

restricted sample was created by removing all women who were sterilized 2 years before the study.

Stratum- and state-level factors differ little between the two groups. The average stratum-level child sex ratio for children under 10 in 2003 is about 0.70 (ranging from 0.41-1.07). All marriage sex ratios are in the reverse measurement (boys/girls). The stratum estimated marriage sex ratio using the NFHS-3 method is 1.09-1.10 (ranging from 0.74-1.29). The average percent of women in the labor force per stratum is 42 and 41% ranging from 18.69-84.27%), while the percent of women in advanced sectors of the labor force is lower at 6.99 and 7.19% (ranging from 1.17-28.76%).

In terms of norms, the stratum mean ideal number of boys over girls is the same in the two groups, with both groups wanting slightly more boys than girls. Acceptability of wife beating is low, with a mean stratum score of about 1.2 (where a low score represents less acceptability), and the mean stratum percent of frequent TV watchers was about 60%. The non-sterilized women watch TV on average slightly less frequently, and they have slightly lower scores on the acceptability of wife beating scale.

For the supply-side variables, about 34% of women on average per stratum in both samples saw a doctor or nurse for their ANC visits, with this being slightly higher for the smaller sample. Fewer women (about 24% on average per stratum) delivered with a doctor or nurse, and this was slightly lower for the smaller, non-sterilized sample.

There were about 2,748 women who had missing values for one of three variables: women's education, age gap between husbands and wives, and ideal number of boys over girls. When comparing the full non-sterilized sample to the non-sterilized complete sample (no missing data), we can see that these two groups had statistically significantly differed values for some variables. Namely, when women with missing values were removed, the sample was significantly older, poorer, less Hindu, higher stratum level ideal number of boys/girls, less frequent TV watching, fewer women in the labor force, more women seeing a doctor or nurse for both ANC and delivering ($p<0.05$). Additionally, an individual being in the labor force, using family planning and acceptability of wife beating were marginally significantly higher ($p<0.1$).

II. Model 1: Probability of having a boy, given a woman gave birth in 2005-06

In the bivariate model testing the impact of the stratum-level child sex ratio for children under 10 in 2003 on an individual's probability of having a boy, there was no significant relationship (model 1A, Table 4.2). When demographic variables were added to the model (model 1B), using family planning, having a ratio of ideal number boys over girls that favored more boys, having more boys already in the household or fewer girls already in the household were significantly associated with the odds of having a boy ($p<0.001$). The main predictor (stratum-level child sex ratio) was still not associated. Neither the community-level marriage nor labor variables were significantly associated when they were added separately (models 1C and 1D). When the stratum-level norm variables were added (model 1E), a higher the stratum-percent of frequent TV watching was associated

with and increased odds of having a boy ($p<0.05$). Both of the stratum-level access to provider variables were associated with the outcome (1F): access to a provider for ANC decreased the odds of having a boy, and access to provider for delivery increased the odds ($p<0.001$).

In the full model (1G) with all variables included, the higher the stratum-level child sex ratio for children under 10 in 2003 the greater the odds of having a boy ($p<0.1$). This would suggest that when the child sex ratio is lower (fewer girls), women have a greater probability of having a girl. A woman using family planning, having a ratio of ideal number boys over girls that favored more boys, having more boys already in the household, fewer girls already in the household, a lower stratum-level percent of women in advanced labor opportunities, lower stratum-level percent of women who saw a provider for ANC and a higher percent of women who delivered with a doctor/nurse were associated with increased odds of having a boy ($p<0.05$).

III. Model 2: Stratum sex ratio in children under 10 in 2006

The second set of models looks at the predictors of the stratum-level sex ratio in children under 10 in 2006 (Table 4.3). The higher the stratum percent of women in professional occupations, the higher the stratum sex ratio (less imbalanced) ($p<0.01$). Stratum age gap, norm variables and the supply of doctors and nurses, as measured by the stratum percent of women who saw a doctor/nurse for the ANC or delivery, were not associated with the

stratum-level child sex ratio. Additionally, a lower percent of Hindus at the stratum level was associated with a higher stratum child sex ratio.

IV. Robustness Checks:

i. Poisson Model

We re-ran the bivariate 1A and full model 1G as a Poisson model 1J and 1K (Table 4.4). As can be seen, there was little difference in the significance of the variables between the logistic and the Poisson models, although the magnitude of some of the coefficients changed marginally. therefore, we are confident that we are not gaining any additional information by using the logistic model. Additionally, since we are modeling all women who had a birth in 2006 in this analysis, and roughly half of them had a boy, although this is event data or count data, it is not rare, and Poisson models are generally more applicable for rare events.

ii. Imputations

When we imputed the missing values for education, mean ideal number of boys over girls and age gap between husbands and wives, and re-ran the model as model J (Table 4.5), the main predictor was no longer even marginally associated with the odds of having a boy. None of the other variables changed their relationship with the outcome of interest when values were imputed.

DISCUSSION

In the bivariate model for the relationship between the stratum-level child sex ratio for children under 10 in 2003 and an individual woman's odds of having a boy were not associated. Nor were they associated when demographic factors, or stratum-level factors relating to the marriage market, labor market, social norms or access to providers were added to the models separately. Use of family planning, ideal number of boys over girls, and the number of girls and boys in the household were robustly associated with a woman's probability of having a boy. We would expect that families with a higher ideal number of boys compared to girls to have more boys, as we find in this analysis. The number of boys in a household was associated with increased odds of having a boy, while the number of boys in the household was associated with decreased odds. It appears that these variables might be picking up on a family's preference for boys compared to girls—families with many boys want more boys and are more likely to have another boy, whereas families with more girls have less son preference and therefore are less likely to use sex selection to select for a boy.

A greater percent of women in advanced labor in the stratum is associated with a lower probability of having a boy. Also the higher the percent of women in the stratum who watched TV frequently, the higher the odds of an individual having a boy, however, this lost significance in the full model. Past research suggested that TV watching was associated with less son preference, the opposite of what was found here. Perhaps in this case TV is enforcing gender norms and preferences.

When only access related factors were added, a higher stratum percent of women who saw a doctor or nurse for ANC reduced the odds of having a boy, while a higher stratum percent of women who saw a doctor or nurse for delivery increased the odds of having a boy, and this remained true in the full model. Perhaps in communities where more women see highly trained providers for ANC, they are less likely to get information about the sex of their fetus in the ultrasound than in communities where more women see less-well trained/non-professional providers. It is also possible that communities with less son preference or sex-selective abortion are also communities with more use of or access to highly trained providers—we do not know the causality in this relationship. It is surprising that the two access variables seemed to act in opposite directions, as we would expect them to act in the same direction. It is important to note that the individual measures of these two factors were not associated, which suggests that it is not actually an individual woman's access to providers that is associated with the probability of having a boy, but instead the community level access. This suggests that there is something about communities in which more women see providers or there is more access to providers for ANC that is also associated gender preference or the ability to act on that preference.

The second set of models looking at the predictors of the stratum-level sex ratio in children under 10 in 2006 found that in stratum with more women in high professional degrees, the sex ratio is less imbalanced (more girls). Perhaps women in communities where more women have good occupations see more value in having daughters, whereas

any type of labor force opportunity does not have the same effect. There is some evidence that strata that have a higher percent of Hindus have lower sex ratios (more imbalanced, suggesting more son preference), as has been found in other literature (Clark, 2000). Interestingly, the supply of doctors and nurses, as measured by the stratum percent of women who saw a doctor/nurse for the ANC or delivery is not associated with the stratum-level child sex ratio.

I. Limitations

This analysis is limited by the fact that the NFHS-3 does not provide code to link individual women, primary sampling units, or stratum to districts in India, so we are not able to merge in any district-level information on labor market (such as wages or occupational structure) or the marriage market (such as the marriage sex ratio of each district as a whole). District-level data might have been strongly correlated with outcomes, especially since many states in India are incredibly large, populous, and diverse. It would have been especially useful to be able to link the NFHS-3 data to districts in order to look specifically at districts that were identified as experiencing equalization in the 2011 census, and see what mechanisms were at play. Other ways of measuring supply of sex-selective technology, either through merging in more data on health care availability from other sources, or data on laws restricting sex determination and their implementation, would have been useful.

I am also limited in my ability to create community/norm variables that might be associated with changes in preference for boys out of the NFHS data. The same is true for variables measuring the supply of sex-selective technology or access to medical care and health facilities. This is partly due to few questions about these topics in the NFHS-3 and partly due to lack of previous research identifying what types of community-level norms that might be important to consider.

Finally, we are not able to include any data on changes in dowry price or practices that could be important factors, nor are we able to include any variables about programs, laws, education campaigns etc., that might have been influencing behavior. Part of this is due to the issues discussed above about lack of precise geographical information about where the sample was drawn from, but also due to poor data on programs, laws, and schemes and their implementation and success rate.

CONCLUSION

This analysis does not find evidence that the community level child sex ratio lagged to 2003 is associated with an individual; woman's probably of having a child of a certain sex in 2006. Unsurprisingly, people's preferences for boys compared to boys, and they gender make0up of the children already in their household influence decision-making. More women participating in higher level jobs in a community appears to be associated with a lower odds of an individual woman having a boy and the overall community level child sex ratio, suggesting that community level labor force opportunities may be

influencing gender composition decision making at both an individual and community level. Finally, access to providers at the community level also appears to be associated with the sex of child an individual woman has, although the direction and mechanism of this relationship is not clear. More research should focus on labor force and supply side variables for understanding changing patterns of sex preference.

More research is needed on factors associated with changing sex ratios to understand what is occurring now, what might occur in the future, and ideally to determine if there are effective ways to encourage communities or individuals to prefer girls more, rather than waiting for all districts to reach very imbalanced levels of child sex ratios before beginning to equalize. This analysis provides initial evidence that looking at community-level factors is important in understanding these trends. The incorporation of other datasets and types of variables will be key to understanding what other demand- and supply-side factors might be associated with changes in sex ratios. This paper provides some possible paths to explore further, particularly relating to marriage age gaps, women's labor force participation (notably women in higher level, professional occupations), and interaction with trained health professionals.

Table 4.1: Difference between main variables of interest in full NFHS-3 sample and sample used in the analysis

	A: Full Sample (N=84,609)	B: Gave birth in 2005-06 (N= 12,789)	C: Sample with full data (N=10,006)
Individual level Factors	**Mean (range) or % (N)**	**Mean (range) or % (N)**	**Mean (range) or % (N)**
Current Age	33.18 (15-49)	25.21 (15-49)	25.26 (15-29) (ND)
Years of Education	5.04 (0-23)	5.43 (0-22)	5.50 (0-19)***
Average age gap between husbands and wives	5.70 (-36-69)	5.31 (-22-69)	5.29 (-22 – 67) (ND)
Ideal number of boys/girls	1.22 (0-8)	1.22 (0-6)	1.23 (0 -6) (ND)
Number boys in household	1.3 (0-11)	0.06 (0-7)	0.06 (0-6) (ND)
Number girls in household	1.17 (0-10)	0.06 (0-8)	0.06 (0-8) (ND)
In the labor force	42.13 % (35,645)	29.8 % (3,812)	30.8 % (3,085)*
Wealth Index	3.41 (1-5)	3.11 (1-5)	3.01 (1-5)***
Percent of women using family planning at time of survey	61.3% (51,863)	30.43% (3,892)	289.25% (2,927)*
Percent Hindu	73.8% (62,440)	67.7% (8,658)	65.9% (6,595)***
Community level factors (*Stratum)*			
Stratum mean ideal number of boys/ideal number of girls	1.08 (0.96-1.30)	1.09 (0.96-1.30)	1.10 (0.96-1.30) ***
Stratum mean percent of women who watch TV frequently	60.1% (13-95)	55.09% (13-95)	53.4% (13-95) ***
Stratum mean score for acceptability of wife beating	1.21 (.18-2.53)	1.26 (0.18-2.53)	1.27 (0.18-2.53) *
Stratum-level child sex ratio (under 10),	0.71 (0.41-1.07)	0.71 (0.41-1.07)	0.71 (0.41-1.07) (ND)

	Stratum percent of women in labor force	42.13% (18.69-84.27%)	44.25% (18.69-84.27%)	43.3% (18.69-84.27%) ***
	Stratum percent of women in higher level occupations in the labor force	6.99% (1.17-28.76%)	6.79% (1.17-28.76%)	8.15% (1.17-28.76%) (ND)
	Stratum percent who saw a doctor or Nurse for ANC	33.7% (19-50)	33.75% (19-50)	34.39% (19-50) ***
	Stratum percent who delivered with a doctor or Nurse	24.1% (11-45)	22.88% (11-45)	24.69% (11-45)***

*** p<0.01, ** p<0.05, * p<0.1, ND= No significant difference; for difference between columns B and C

Table 4.2: Individual Model: An individual woman's odds of having a boy in 2006, among women who had a baby in 2006

	A: Basic model	B: Demographics	C: Community level Marriage	D: Community level Labor	E: Community level Norms	F: Community level Access	G: Full Model
Stratum level sex ratio in children under 10, 2003	0.891 [-0.860]	1.059 [0.377]	0.949 [-0.404]	0.918 [-0.645]	0.949 [-0.368]	0.869 [-1.140]	1.329* [1.705]
Woman's age		1.006* [1.731]					1.006* [1.867]
Women's education single years		0.998 [-0.382]					1.000 [-0.075]
Women's labor market participation		0.964 [-1.155]					0.951 [-1.457]
Women's advanced labor market participation		0.893 [-0.850]					0.921 [-0.604]
Wealth Index		1.043* [1.926]					1.034 [1.396]
Using Family Planning		1.257*** [4.507]					1.254*** [4.459]
Ideal number boys over girls		1.397*** [7.215]					1.393*** [7.080]
Number of girls in the household, 2005		0.290*** [-8.597]					0.291*** [-8.566]
Number of boys in the household, 2005		4.050*** [8.443]					4.049*** [8.420]
Hindu		0.986 [-0.310]					0.986 [-0.284]
State		1.004* [1.808]					1.002 [0.783]
Age Gap		0.999 [-0.256]					1.000 [-0.055]
Frequent TV watching		0.934 [-1.186]					0.934 [-1.202]
Saw Doctor/Nurse for ANC		0.986 [-0.268]					1.002 [0.038]
Delivered with Doctor/Nurse		1.029 [0.616]					1.011 [0.228]
Stratum level Average Age Gap			0.983 [-1.088]				0.984 [-0.942]
Stratum Percent Women Labor Force				0.913 [-1.023]			1.217 [1.504]
Stratum Percent				0.862			0.230***

Women Advanced Labor				[-0.468]			[-3.520]
Stratum level Mean Beat Wife Score					0.989 [-0.396]		0.970 [-0.906]
Stratum level Mean Ideal Boys Over Girls					1.013 [0.059]		1.195 [0.756]
Stratum Percent of Frequent TV watching					1.168** [2.098]		1.074 [0.490]
Stratum Percent Hindu					1.106 [1.316]		0.876 [-1.511]
Stratum Percent ANC Doc/Nurse						0.451*** [-3.058]	0.492** [-2.392]
Stratum Percent Deliver Doc/Nurse						2.166*** [3.570]	2.770** [2.547]
Constant	1.143 [1.462]	0.448*** [-4.376]	1.206 [1.634]	1.177* [1.700]	0.935 [-0.247]	1.275** [2.138]	0.399** [-2.306]
Observations	12,789	10,005	12,789	12,789	12,789	12,789	10,005

*** p<0.01, ** p<0.05, * p<0.1, Robust t-statistics in brackets

Table 4.3: Community Model: Factors associated with the stratum-level sex ratio in children under 10 in 2006

	A: Stratum Sex Ratio Under 10 in 2006
Stratum Average Age Gap Between Husband and Wife	0.027 [1.460]
Stratum Average Wealth Index	-0.070 [-1.121]
Stratum Percent of Women in Labor Force	-0.139 [-1.085]
Stratum Percent of Women in Advanced Labor	0.920*** [2.927]
Stratum Mean Acceptability of Beating Wife Score	-0.006 [-0.233]
Stratum Mean Ideal Boys Over Girls	0.036 [0.144]
Stratum Percent Watch TV Frequently	0.026 [0.139]
State Dummy	0.004** [2.342]
Stratum Percent Hindu	-0.152** [-2.450]
Stratum Percent ANC with Doctor/Nurse	-0.059 [-0.229]
Stratum Percent Deliver Doctor/Nurse	-0.207 [-0.721]
Constant	0.930* [1.881]
Observations	73
R-squared	0.505

*** p<0.01, ** p<0.05, * p<0.1, Robust t-statistics in brackets

Table 4.4: Model 1: Poisson model of an individual woman's odds of having a boy in 2006 given that she had a child

	A: Basic Model	G: Full Model	H: Basic Model Poisson	I: Full Model Poisson
Stratum level sex ratio in children under 10, 2003	-0.116 [-0.860]	0.285* [1.705]	-0.056 [-0.857]	0.148* [1.778]
Woman's age		0.006* [1.867]		0.003** [2.059]
Women's education single years		-0.000 [-0.075]		-0.000 [-0.081]
Women's labor market participation		-0.050 [-1.457]		-0.030* [-1.666]
Women's advanced labor market participation		-0.082 [-0.604]		-0.035 [-0.506]
Wealth Index		0.033 [1.396]		0.017 [1.474]
Using Family Planning		0.226*** [4.459]		0.109*** [4.420]
Ideal number boys over girls		0.331*** [7.080]		0.154*** [7.350]
Number of girls in the household, 2005		-1.233*** [-8.566]		-0.418*** [-10.291]
Number of boys in the household, 2005		1.399*** [8.420]		0.343*** [14.579]
Hindu		-0.014 [-0.284]		-0.005 [-0.193]
State		0.002 [0.783]		0.001 [0.835]
Age Gap		-0.000 [-0.055]		0.000 [0.047]
Frequent TV watching		-0.068 [-1.202]		-0.033 [-1.189]
Saw Doctor/Nurse for ANC		0.002 [0.038]		-0.002 [-0.080]
Delivered with Doctor/Nurse		0.011 [0.228]		0.005 [0.214]
Stratum level Average Age Gap		-0.016 [-0.942]		-0.008 [-0.957]
Stratum Percent Women Labor Force		0.197 [1.504]		0.112* [1.711]
Stratum Percent Women Advanced Labor		-1.468*** [-3.520]		-0.766*** [-3.550]
Stratum level Mean Beat Wife Score		-0.031 [-0.906]		-0.018 [-1.080]
Stratum level Mean Ideal Boys Over Girls		0.178 [0.756]		0.072 [0.626]
Stratum Percent of Frequent TV watching		0.072 [0.490]		0.034 [0.442]
Stratum Percent Hindu		-0.132 [-1.511]		-0.069 [-1.619]
Stratum Percent ANC Doc/Nurse		-0.710** [-2.392]		-0.352** [-2.307]

Stratum Percent Deliver Doc/Nurse		1.019** [2.547]		0.506** [2.447]
Constant	0.134 [1.462]	-0.918** [-2.306]	-0.628*** [-14.112]	-1.132*** [-5.797]
Observations	12,789	10,005	12,789	10,005

*** p<0.01, ** p<0.05, * p<0.1, Robust t-statistics in brackets

Table 4.5: Model J with imputed missing values for women's education, ideal number of boys/girls and age gap between husband's and wives.

	G: Full Model	J: Full Model with imputations
Stratum level sex ratio in children under 10, 2003	1.329* [1.705]	1.077 [0.524]
Woman's age	1.006* [1.867]	1.002 [0.705]
Women's education single years /Imputed Women's education single years	1.000 [-0.075]	**1.004** **[0.712]**
Women's labor market participation	0.951 [-1.457]	0.952 [-1.546]
Women's advanced labor market participation	0.921 [-0.604]	0.956 [-0.379]
Wealth Index	1.034 [1.396]	1.039* [1.908]
Using Family Planning	1.254*** [4.459]	1.202*** [4.102]
Ideal number boys over girls /Imputed Ideal number boys over girls	1.393*** [7.080]	**1.397***** **[7.281]**
Number of girls in the household, 2005	0.291*** [-8.566]	0.277*** [-9.535]
Number of boys in the household, 2005	4.049*** [8.420]	3.756*** [9.133]
Hindu	0.986 [-0.284]	1.012 [0.261]
State	1.002 [0.783]	1.000 [0.130]
Age Gap /Imputed Age Gap	1.000 [-0.055]	**1.000** **[-0.079]**
Frequent TV watching	0.934 [-1.202]	0.937 [-1.332]
Saw Doctor/Nurse for ANC	1.002 [0.038]	0.992 [-0.159]
Delivered with Doctor/Nurse	1.011 [0.228]	1.083* [1.721]
Stratum level Average Age Gap	0.984 [-0.942]	0.986 [-0.782]
Stratum Percent Women Labor Force	1.217 [1.504]	1.271** [2.033]
Stratum Percent Women Advanced Labor	0.230*** [-3.520]	0.343*** [-2.952]
Stratum level Mean Beat Wife Score	0.970 [-0.906]	0.969 [-1.242]
Stratum level Mean Ideal Boys Over Girls	1.195 [0.756]	0.884 [-0.581]
Stratum Percent of Frequent TV watching	1.074 [0.490]	1.066 [0.500]
Stratum Percent Hindu	0.876 [-1.511]	0.974 [-0.315]
Stratum Percent ANC Doc/Nurse	0.492** [-2.392]	0.522** [-2.265]
Stratum Percent Deliver Doc/Nurse	2.770**	2.137**

	[2.547]	[2.230]
Constant	0.399**	0.668
	[-2.306]	[-1.165]
Observations	10,005	12,789

*** p<0.01, ** p<0.05, * p<0.1

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