The Demand for Sex Selective Abortion[*]

Claus C Pörtner

Department of Economics

University of Washington[†]

September 2003

[*]Preliminary. Please do not quote without permission from author.

[†]Seattle, WA 98195-3330, cportner@u.washington.edu

Abstract

One of the major changes that have taken place in India over the last two decades is a significant shift in the sex ratio at birth. As in other Asian countries ultrasound and other techniques for prenatal sex determination have become more widely available and affordable in India during this period. There has, however, so far been virtually no analysis of who uses prenatal sex determination to abort female fetuses, despite the obvious major impacts this practice is likely to have in the future. One reason for this it the perceived lack of suitable information. I argue, however, that it is possible to examine the demand for sex selective abortion even in the absence of direct information on its use. I suggest and present results from two different methods. First, the determinants of the probability that a child of a given parity will be a son. Secondly, the determinants of the difference between actual spacing between births when sex selective abortion is available and the predicted spacing based on information from when it was not available. I use the two rounds of the National Family and Health Survey from India to examine the effectiveness of these two methods.

1 Introduction

India has during the last century experienced an almost continuous increase in her sex ratio, measured as the the number of males to females (Dyson 2001). This increase is widely believed to be the result of excess mortality for girls compared to boys, which has been tied to a strong preference for boys in especially the northern states (Murthi, Guio, and Dreze 1995; Arnold, Choe, and Roy 1998). In addition to the increase in the overall sex ratio due to excess mortality of girls, there is evidence that the sex ratio at birth has also been changing over the last two decades due to the spread of sex selective abortion (Das Gupta and Bhat 1997; Sudha and Rajan 1999). India is not alone in showing this pattern of change; in both China and South Korea, ultrasound and other methods for determining the sex of a fetus have become more widely available and affordable and this has led to a significant change in the sex ratio at birth (Zeng, Tu, Gu, Xu, Li, and Li 1993; Park and Cho 1995; Chu 2001).

The change in the sex ratio at birth, combined with the excess mortality of girls and a changing fertility pattern, is likely to have profound effects on virtually every aspect of India's social and economic development. The suggested effects run the gamut from very positive to catastrophic. Among the positive, Goodkind (1996) discusses the possibility that with sex selective abortion female children will be less discriminated against because they are more likely to be wanted. Davies and Zhang (1997) examines a model of parental choice of their children's consumption with and without "gender control" and find that girls' consumption may increase. This positive effect is, however, disputed by Das Gupta and Bhat (1997). Leung (1994) and Seidl (1995) provide discussions of the effect on fertility, arguing that sex selection may or may not decrease overall fertility, depending on the cost of determining the sex of the fetus. Park and Cho (1995) examine various aspects, among those the possibility of a marriage squeeze, with a significant shortage of brides.[1] In India a marriage squeeze may result in the decline of the price of dowry, which have otherwise been increasing according to Rao (1993).[2] Edlund (1999) also discuss the relation between marriage and sex selection and suggests that it may result in the development of a female underclass. The potential marriage squeeze is also responsible for some of the more "colourful" suggestions, with increasing incidences of war, homosexuality and crime a result of a surplus of young males with no mates.

It is, however, very difficult to establish what the effects of the changing sex ratio will be without information on the extent to which sex selective abortion is used and, more importantly, by whom it is used. There has, however, so far been relatively few studies of how much sex selective abortion is being used. Furthermore, there has been virtually no research on who is using it. Chu (2001), who interviewed 820 women in China, is one of the few example, if not the only one, of trying to determine who uses prenatal sex

[1]Park and Cho (1995) note that the possible marriage squeeze in the South Korean case is more a result of fertility decline than sex selection.

[2]There is anecdotal evidence that this might already be happening (Lancaster 2002).

determination.[3] One of the reasons for this lack of research is the perceived lack of surveys, which can inform us about the use of sex determination and selection. As Goodkind (1996) discusses there are not many questionnaires that contain questions specifically about the use of prenatal sex determination and those that do show signs of serious underreporting.[4]

Hence, this paper has two purposes. First, to suggest techniques that can be used to analyse which factors determine the use of sex selective abortion even when there is no direct information on the availability or use of prenatal sex determination techniques. Secondly, to present evidence on use of sex selective abortion in India, focusing on how its use is affected by birth order, sibling composition, the relative return of investing in boys versus girls and the characteristics of the family.

I use the two rounds of the National Family and Health Survey, which are of the Demographic and Health Survey type. The important difference between these and other household surveys is that they contain a detailed fertility history for each family.[5] As I will show there are two ways of indirectly determining the use of sex selective abortion. The first is based on the fact that the types of families who are more likely to use prenatal sex

[3] Ahn (1995) attempts to estimate how much sex selection will be used in Korea, based on data collected in 1980, although this is not the primary purpose of the paper.

[4] Before prenatal sex determination became widely available McClelland (1983), argued that measures based on behaviour, such as parity progression, are insufficient to estimate the potential number of users of sex selective abortion, and consequently calls for more reliance on measures of intent.

[5] The latest round also contains information on still births, spontaneous and induced abortions, although there is no information on the reasons for choosing to end a pregnancy.

determination and selection will also be more likely to have a child of the desired sex (in the case of India, a boy). Hence, provided that the fertility history is correct I can for each parity use the probability that the next child is a boy as a proxy for the demand for sex selective abortions and can therefore estimate the impact of household and local characteristics, such as the different returns to investing in boys and girls, on the demand. The second uses the difference between the observed spacing between birth and the predicted duration based on data from before prenatal sex determination techniques became available. Those families that use sex selective abortion will, *ceteris paribus*, tend to have longer spells between births.

The structure of the paper is as follows. First, I review the literature on the causes and effects of son preferences in India. Section 3 discusses the different biological factors influencing the sex of a fetus and medical technologies available for prenatal sex determination. A dynamic model of fertility decision is presented in Section 4. I discuss the data and preliminary evidence on how the sex ratio has changed over time and between states in Sections 5 and 6. The discussion of the estimation strategy follows in Section 7 and the results in Section 8. Finally, Section 9 concludes with a summary of results and suggestions for future research.

2 Son Preference in India

This section reviews some of the possible reasons for parents wanting more sons than daughters and the effects of these reasons.[6] There are four major factors which are thought to drive the preference for sons in India: The structure of the marriage system, the differences in wage rates between men and women, the need for old age insurance and cultural factors. With respect to the effects of son preferences I look at fertility, mortality, educational investments and others.

The structure of the marriage market in India is possibly one of the main driving forces behind the preference for sons and the discrimination against girls as discussed by Rao (1993) and Foster and Rosenzweig (1999). As in many other societies the tradition is for girls to leave the parental household to join her husband's. Most marriages take place within well-defined social groups or castes and are arranged for both the groom and bride by their parents.[7] An important feature is that dowry, that is a transfer from the bride's parents to the groom's parents, is widespread. According to Rao (1993) and Bloch and Rao (2000) the size of the dowry paid has increased significantly as population growth has created a marriage squeeze with more females than males in the marriageable age groups, even with the higher mortality rates for females.[8] This has happened to the extent that places

[6] See Leung (1991) and Haughton and Haughton (1998) for discussions of different tests for son preference.

[7] On the latter see Rosenzweig and Stark (1989) and Deolalikar and Rao (1998) for discussions.

[8] Bloch and Rao (2000) discuss the use of violence against brides by their husbands to

that before had a bride price now have dowries instead. Furthermore, the size of the dowry is sufficiently large to present a real problem for many households, which may explain why there has not been a large improvement in girls' survival chances. It may also drive the demand for sex selective abortion. This is made clear by the slogan: "Better Rs 500 today than Rs 500,000 tomorrow," which was used to advertise sex determination clinics in the beginning of the 80s. (as quoted in Sudha and Rajan 1999, p. 599).[9]

There are, however, other factors than the size of the dowry, which may affect parents' preference for boys. Rosenzweig and Schultz (1982) suggest that the relative return to investment in boys' versus girls' education is an important determinant of survival probabilities. They show that in areas where relative wages between men and females are more equal there is also less discrimination against girls as measured by their survival chances. It is not immediately clear, however, that this effect is not caused by women gaining more bargaining power within the household when they receive higher relative wages. This would cause the same effect on survival if women had a stronger preference for girls' survival. Unni (1998) documents the differences in how much schooling boys and girls receive [discussion of returns?].

India is, like many other developing countries, characterised by either missing or imperfect capital and insurance markets. In a series of papers Cain (1981, 1983, 1990) discuss the possibility that parents' fertility decisions are

extract more transfer from the bride's family after the dowry has been paid.

[9] In comparison the wage of a skilled agricultural worked was Rs 25 in Punjab and Rs 18 in Haryana according to Sudha and Rajan (1999).

partly driven by the lack of access to insurance. He argues that parents have more children than they would in areas with a well-functioning insurance market, because children can act as an imperfect substitute for insurance against a number of different outcomes. These are not restricted to old age, but can, for example, also include crop loss in the case of flooding. In the latter there is a need for replanting and since other household in the area will also be hit the household stand the best chance if it can command sufficient amount of labour and one way to securing that is by having more children. Given the patrilocal marriage system it is clear that the parents would prefer more boys than girls to help secure their old age. Vlassoff (1990) have, however, argued that even those household that are not in as much need of old age insurance still have a preference for boys [check!!].

[effects on fertility] Larsen, Chung, and Das Gupta (1998), Clark (2000). Dreze and Murthi (2001), Arnold, Choe, and Roy (1998)

[effects on mortality] Arnold, Choe, and Roy (1998) Murthi, Guio, and Dreze (1995) Bourne and Walker (1991) [Bhuiya and Streatfield (1991) on Bangladesh] Das Gupta and Bhat (1997) Rose (1999) Dreze and Murthi (2001)

[intra-household allocation and other effects] Behrman, Pollak, and Taubman (1986); Behrman (1988) Deolalikar and Rose (1998) on effect of sex of birth on savings.

3 The Technology of Sex Determinations and Selection

The "natural" sex ratio, that is the number of boys to one hundred girls without interventions, will be around 105 to 100. Hence, parents can expect a son with a probability of about 0.512. This sections discuss various factors which are thought to affect the sex of a fetus and medical technologies available for prenatal sex determination and their availability in India.

As James (1983) discusses there has been a long standing interest in what determines whether a women will have a boy or a girl and ways of influencing this outcome.

wifes' tales

natural methods

genetic differences?

[maternal dominance hypothesis Grant (1998)]

While there might be an effect of the factors described above, they are likely to be too imprecise for an individual family who has a desire for sons. Hence, an alternative is to use prenatal sex determination techniques and then abort the fetus if the child is not of the desired sex.[10] There are currently three well-developed technologies, which can be used to determine the sex of a fetus: Chorionic villus sampling, amniocentesis and ultrasound. Between them there is a trade-off between reliability, length of gestation necessary

[10]The following relies heavily on Park and Cho (1995) and Sudha and Rajan (1999).

and the cost of the procedure.

Chorionic villus sampling is the method that can be applied after the shortest period of gestation at about eight to twelve weeks. This is the most complicated and reliable technique and have the advantage that a unwanted fetus can be aborted in the first trimester. The main disadvantage is, however, the cost of the procedure; in Korea it can cost USD 625 or more. Even if the cost would be less in India, due to lower labour costs of doctors, it is still likely to be out of reach everybody but the very rich.

Amniocentesis can be performed after fourteen weeks, but requires three to four weeks before the result is available. This means that an abortion cannot be performed until more than midways through the second trimester when using this technique. The technique is very reliable, although there is some discussion about the potential for an increase in the risk of a spontaneous abortion following the procedure.[11] Compared to chorionic villus sampling the cost of amniocentesis appear to be less. In Korea, Park and Cho (1995) quote a price in 1984 of around USD 250 to 375. Amniocentesis has been available in India since 1975, although the cost of it likely have prevented its use in the beginning.

The final procedure is ultrasound, which has the advantages of being noninvasive and relatively cheap. In Korea the cost is around USD 75, while in India it is between Rs 500 to over Rs 1000, which is between USD 11

[11] Park and Cho (1995) states that it is not always safe, but according to Kobrin and Potter (1983, p. 50) this risk is not "noticeably elevated".

and 24. It is not clear how precise this method is in the field, but according to Chu (2001) the sex of a fetus can be determined in the third month of gestation if it is a boy and the fourth month if it a girl. In the fifth month or later it should be almost 100 per cent accurate. As describe in Sudha and Rajan (1999) the first reports of private clinics offering sex determination for a fee came in 1982-83 and mobile clinics, which can reach small towns in remote areas, have been available since the mid-1980 in India.

Abortion itself has been legal in India since 1971 and still is. Since amniocentesis quickly became known as a method of prenatal sex determination, its use for the purpose of abortion became a penal offense. The government of Maharashtra was the first to pass a law on this and in 1994 the Central Government passed a law making determining and communicating the sex of a fetus illegal. According to Sudha and Rajan (1999) there are a substantial amount of leeway in the law, which for all intent and purposes allows private clinics to operate with little risk of legal action. This is partly due to the fact that the law does not cover ultrasound clinics to the same extent that it covers the use of amniocentesis.

4 Model

Although the main purpose of this paper is to estimate the demand for sex selective abortion it is instructive to consider a model of fertility behaviour and ultrasound use. I use the model to examine how the demand for sex selective abortion might change with price, income, preferences and sibling composition. A model will also be able to answer some of the questions about the overall effects of introducing sex selective abortion.

Most models of fertility looks only at the total number of births and ignores both the timing of birth and the effects of that different realisations of child characteristics may have on the demand for children. This is mainly for technical reasons; deriving tractable predictions from and finding closed-form solutions to dynamic model of fertility is generally difficult (See Arroyo and Zhang 1997, for a discussion). The model I describe below suffers from the same problem, but using simulation allows me to examine some of the implications of the model. [review of previous models Leung (1991, 1994)]

Consider a family which is maximising its expected discounted utility over the remaining years of its life $t = \tau, \ldots, T$. Parents derive utility from their consumption C_t and the number of boys B_t and the number of girls G_t they have. The utility in each period is

$$U_t = \ln(C_t) + B_t^{\beta} + G_t^{\gamma}, \tag{1}$$

where $\beta > \gamma$.

Without any type of interventions the probability of having a son is π. In each period the parents are faced with the choices shown in Figure 1. First parents decide on whether to have an additional pregnancy. Provided that they do want an additional pregnancy they are then faced with the choice of whether to have ultrasound scanning or not. There is a cost S associated with ultrasound and hence having an ultrasound scanning only makes sense if the parents want to abort a female fetus.[12] If parents decide not to have a scanning the child is born, its sex observed and their the process begins anew. With a scanning parents abort the fetus if it is a girl and have the child if it is a boy. I assume that there are no risks associated with abortion.[13] In order to simplify parents are assumed to have the following choice set $\{d_n, d_f, d_u\} \in \{0, 1\}$, where they choose one of the three action: No children $d_n = 1$, pregnancy without ultrasound $d_f = 1$ and pregnancy with ultrasound $d_u = 1$.

[Figure 1 about here.]

In each period the household has an income of Y, which for simplicity is assumed constant for all periods. The price of the ultrasound is paid in the period the decision is made. There are costs P and Q of having a boy and a girl, respectively. The child is born the period after the decision is made and the cost is paid for all subsequent periods.

[what should the model be able to predict about: - the probability of having a boy - the probability of having an additional child depending on children]

[12]In this model there are no medical reasons for the use of ultrasound.

[13]This is obvious not the case since there is a possibility of infertility and a higher risk of spontaneous abortion after an induced abortion. These risks increase with repeated abortions. [references] [discussion of potential impact on use of ultrasound - likely will reduce it for lower parity children]

[Show full decision tree based on simulations]

[With development there is an increase in both costs of children and income. The cost of children increasing relatively more than the income. The price of ultrasound does not increase. That makes the differences between low and high income parents. That will likely drive down fertility but increase use of ultrasound (if no changes in sons preference)]

[implications: increase income, increase costs of children, decrease price of ultra sound, "development"]

There are two main implications that can be derived from a model like the one presented above. The first is that the if the optimal strategy is to use ultrasound for the next pregnancy the next *child* can still be a girl. The reason for this is that the optimal strategy changes over time due to the end of the fertile period. Hence, the use of ultrasound increases the chance of having a boy next, but does not guaranty it.[14]

The second is with respect to the spacing between births. Although the model as presented above would not be able to yield predictions about the differential spacing following the birth of a boy versus the birth of a girl, it is clear that those parents who employ sex determination will have an increased waiting period to next child, since half of the fetuses will be aborted and these will have to wait to the next period to have another child. Leung (1991, p. 1082) finds that his model predict a lower probability of a birth if the last

[14] This point is related to the discussion in Kobrin and Potter (1983), who calculate the expected number of pregnancies and abortions it will take to reach different sequential and compositional family goals.

child is a boy than if it is a girl, holding the number of children constant; a lower probability converts into a longer expected period between births.

5 Data

The sources of demographic and household information are the two rounds of the National Family Health Survey (NFHS-1 and NFHS-2). They were collected in 1992-93 and 1998-99, respectively.[15] Both are based on the Demographic and Health Survey Model B, with NFHS-1 using the DHS II questionnaire and NFHS-2 using the DHS III questionnaire. They were collected by the International Institute for Population Sciences in Mumbai and have nationwide coverage.

Both of the two surveys are large. NFHS-1 covered 89,777 ever-married women aged 13-49 from 88,562 households, while NFHS-2 covered 90,303 ever-married women aged 15-49 from 92,486 households. Those women who had no children are not used here. There are 10,427 of those from NFHS-1 and 9,431 from NFHS-2. The final number of births are 275,111 and 268,869 from NFHS-1 and NFHS-2 respectively.

One of the main problems with using DHS style data is the lack of economic variables, especially relating to wages and other income. Especially wage data is of interest since they can be used to calculate the relative return of girls versus boys and to provide a measure of the extent of discrimination

[15] NFHS-2 also has a small number of observation collected in 2000, due to a delay in the survey for Tripura.

against females. A possible source for wage data is the National Sample Survey (NSS). I have, however, not yet been able to obtain district names from Measure DHS+, who are responsible for the distribution of the NFHS and this therefore remains work in progress.

5.1 Recall Error and the Sex Ratio

Before I examine the spatial and temporal patterns of the sex ratio, it is important to consider to what extent the birth histories collected are reliable. There are two reasons for this. First, I need to establish when the use of sex selective abortion became widely available, which can only be done if there is not a significant amount of recall error of children of a specific sex. Secondly, my estimation methods relies heavily on good quality data being present both before and after sex selective abortion was introduced. I shall discuss that potential problem in more detail in Section 7.

Recall error here refers to children who are missed during the collection of a woman's birth history.[16] The main reason for a child not being counted is likely to be that he or she did not survive for long after birth. In the absence of preferences for a specific sex recall error should bias an estimate of the sex ratio towards girls, since boys are more likely than girls to die early and therefore not be counted. In India, however, there are two effects which

[16] In the DHS III schedule, which is used for NFHS-2, the interviewer probes about any missing births if there is four or more years between two births reported as consecutive. This is done ignoring the months of births and the actual spacing may therefore be less than 48 months.

bias the results in the opposite direction. First, as discussed above there is a significantly higher mortality risk for girls than for boys. Hence, even if all births had an equal chance of being remembered this would tend to bias the results toward a higher sex ratio. Secondly, the preference for boys, which leads to the higher mortality for girls, is also likely to lead to more boys than girls being remembered. This would further bias the estimated sex ratio upward.

If recall error increases with the time elapsed since a birth the birth history becomes less and less reliable the further back we look. This makes an analysis of the spread of sex determinations techniques less precise, since there may appear to be little change in the sex ratio over time even though the actual sex ratio has increased. With the high mortality risk for girls we may even find that the pattern is the reverse of the expected.

One possible solution to the problem is to drop observations which are considered too far from the survey. The problem then is to find the ideal trade-off between sample size and the recall error. To determine how important the recall error is I use the fact that there are births from the two surveys which falls in the same periods. As discussed above the earliest reliable method of sex determination of a fetus was amniocentesis and that was not released until 1975. Hence, it is reasonable to assume that sex selective abortion could not have had a significant effect on the sex ratio at birth until the end of that decade. The means for births taking place twenty or more years before the year of interview show no significant difference between the two surveys, although both show a substantial male bias. The two means are 0.5260 and 0.5283 for NFHS-1 and NFHS-2, respectively, which leads to a t-statistics for equality of 0.743.[17] Compare this to the significant difference between the two survey when using births that fall in the period 1972 to 1979. The means are then 0.5147 and 0.5262, which leads to a t-statistics of 3.807.[18] The sex ratio, calculated from NFHS-1, is 106 boys per 100 girls, which is what we would expect without recall error and sex selective abortion, while the sex ratio based on NFHS-2 for exactly the same period is 111 boys per 100 girls. The implication of this is that I discard births which took place more than twenty years before the relevant survey in all of the analyses done below.

6 Spatial and Temporal Patterns in the Sex Ratio

This section looks at how the sex ratios differ between states in India and how it has developed over time. Beside the value of describing the pattern of sex ratios it also serves to focus the empirical analysis. I begin with the geographical differences.

Table 1 presents the estimated sex ratio by state for three decades. Children who were born more than twenty years before the survey were not used

[17]The periods covered are before 1972-73 and 1978-79 and there are 48,925 and 50,780 observations.

[18]There are 72,012 and 43,401 observations, respectively.

in creating Table 1. As discussed above there seems to be generally agreement that the technology for sex selective abortion was not widely available until the mid-eighties. In spite of this and the restriction on the distance between the survey and birth, Table 1 shows higher than natural sex ratios for many states for both the seventies and the eighties.[19] As shown in Tables 2-4 most of these do not, however, exhibit a distribution which is significantly different from the expected 0.512.

Not surprisingly there is little evidence of a masculine sex ratio in the Southern states, while the Northern states have significantly higher sex ratios than the expected of 105-106 boys per 100 girls. The pattern is more mixed in the rest of the states. The three states, Gujarat, Madhya Pradesh and Maharashtra all have significantly higher than expected sex ratios in the eighties, although they are not significant for the nineties. For the Northeast of India the three states of Meghalaya, Arunachal Pradesh and Assam show sex ratios that are significantly higher than 105 boys per 100 girls in either the eighties, nineties or both.

[Table 1 about here.]

[Table 2 about here.]

[Table 3 about here.]

[Table 4 about here.]

[19] Using all available observations tended to distort the sex ratio even further for the seventies. This pattern was even more pronounced for the sixties, which are not shown here.

7 Estimation Strategy

As discussed in Section 4 there are two implications that follows from parents' decision to use sex selective abortion. The first is that parents who use ultrasound will have a higher probability of their next child being a son. The second is that, because there is an approximately fifty per cent chance of the fetus being female, there should be an additional waiting time to next birth compared to what is expected when sex selective abortion is not available. Both of these implications can in principle be tested and used to establish who uses sex selective abortion. This section discusses the econometric specifications and the potential problems.

The first method simply consists of estimating the probability of a family having a boy conditional on a set of explanatory variables. If there is no sex selective abortion this should be a completely random event and hence there should not be any significant parameters. I estimate the probability of having a son for parity one through three, both before and after 1985. The choice of 1985 is based on the discussions in Sudha and Rajan (1999). [This should in principle be done using either logit or probit, but for ease of interpretation I use standard OLS at the moment.]

There are a number of potential estimation issues to consider. First there is the problem of recall error as discussed above. If a family has a preference for boys and therefore a higher mortality for girls, then a girl who dies soon after birth is more likely not be reported and this increases the “probability” of observing a boy instead. Since mortality is likely to be higher among poorer families this will bias upwards the estimated use of sex selective abortion among the poor. One way to assess the extent of recall error and for which types of families it is more likely to be a problem is to use the method described above and estimate what determines the probability of observing a boy for those births that took place twenty or more years ago.

Secondly, as discussed above parents may still end up with a girl as their next child even through they have used sex selective abortion. If this is the case in a substantial number of households then our estimates may only be a lower bound estimate. This is why the second method is also of interest since it relies on the duration between births and therefore should be better at estimating how many abortions there have taken place between two births.

Thirdly, for parity two and above there may be a selection problem. If parents are able to select the sex of their children or at least abort fetuses of an unwanted sex and the composition of older siblings are included as an explanatory variables, this may lead to a bias in the estimates. The same is the case if the samples on which the determinants of the probability of having a boy are estimated are selected on the basis of the family composition. For both cases the problem is the difficulty in finding a identifying variables. All variables that affect the decision on whether to abort a female fetus or not are the same for all parities.

The final problem may be the serious here and that is that of precision and number of data points needed. In a population with 10,000 births we would expect about 5,122 of them to be boys in the absence of sex selective abortion. If the use of sex selective abortion drives the sex ratio up to 110 boys per 100 girls, we would expect 5,238 boys instead. That is only an increase of 116 boys in a population of 10,000. The implication of this is that the data requirements are relatively intensive and it may be difficult to explain much of the variation in the sex of the children. It should still, however, be possible to establish which factors have a significant effect on the probability having a son.

[problems: possibility of genetic differences that affect the likelihood of having a boy; other methods; unobservable factors that might influence fertility and demand for ultrasound (such as low fecundity)]

While the first method is in principle easy to implement it may not provide a very precise estimate of the use of sex selective abortion because it only looks at the birth outcomes. The second method instead uses the increase in spacing between children that is expected if sex selective abortion is used. As described above there is at least a three months period between the beginning of the pregnancy and the time where reliable tests to determine the sex of the fetus can be carried out. Furthermore, in case a pregnancy is terminated the uterus need at least two periods to recover in before conception can be attempted again. Finally, the expected time to conception is about six months. Hence, the use of sex selective abortion is likely to delay the birth of a child by more than a year.

I use the pre-ultrasound data to estimate a predicted spacing based on a set of explanatory variables and this predicted spacing is then subtracted from the observed spacing. The factors that affects the demand for sex selective abortion are then expected to have a significant effect on this difference.

One problem here is that it is likely that the spacing between births changes over time as a result of other factors than the spread of sex selective abortion. One such possibility is improvement in nutrition and general health, maybe combined with better access to maternal health clinics. These improvement would most likely lead to fewer spontaneous abortions and thereby tend to reduce the spacing between births. I would expect an effect like this to mainly affect the lower income households. A second problem is that of censoring. Those families that use sex selective abortion will be more likely to be censored than other families.

[Finally, as mentioned above the NFHS-2 contains information on abortions, both spontaneous and induced, and still births. It should be possible to estimate a lower bound on the number of induced abortions that would have taken place in order to reach the realised sex ratio and then compare that to the abortion data collected.]

8 Estimation Results

For the moment I have chosen the following explanatory variables. For both the mother and the father I have divided their education into five group: No education, which is the excluded variable, 1 to 5 years of education, 6 to 9 years of education, 10 to 14 years of education and finally 15 or more years of education. There are three land variables used. A dummy for whether the household own any agricultural land, which is used for urban households and the number of acres of irrigated and non-irrigated land the household own. The latter two are used for rural households. The predominate religion in India is Hindi, which is the excluded religion variable. There are also dummies for being Muslim, Christian, Sikh and others.

For urban household the place of residence can be located in either a large or capital city, the excluded variable, or in a small city or a town. The geographical dummies follow those used above. The ratio of the mean of women's education over men's education is supposed to measure equality of the sexes until a better variable can be found (see below).

There is three dummies for year of birth: 1985-1989, which is the excluded variable, 1990-1994 and 1995-1999. Furthermore, the variable "No Boys" takes the value one if there are no surviving boys at the time of birth of the child in question. Likewise, "One Boy" take the value one if there is exactly one boy alive at the time of birth of the child. Both of these refer only to older siblings; multiple births have been dropped from the sample.

There are a number of variables that it would be of great interest to include. One is some measure of the relative return to investing in boys versus girls. An example could be the relative wage rate between women and men as used in Rosenzweig and Schultz (1982), although this may actually measure the relative bargaining power of women and not the return to investment.

Another variable is one that can capture the "feedback mechanism" from a changing sex ratio on the use of sex selective abortions. At one point parents must realise that the current dowry system will not continue, which must affect the demand. A possible measure of this could be the ratio of marriage-aged girls to marriage-aged boys [census?]. Furthermore, it may be possible to trace the effect of making the use of ultrasound for sex determination illegal

There are variables which have been excluded even through they seem appropriate at first glance. Chief among these is measures of son preference. I tried two measure: Whether the family wants more boys than girls and whether it wants more than half their children to be boys. The reason for excluding these measures is evidence of a very strong effect from actual sex composition of children to these measures.

Related to this is the exclusion of a number of wealth variables that turned out to be endogenous. An example is livestock, which, if included, is very significant in the 1970-1984 sample of rural households when looking at first borns, while nothing else is. That must be because those household that were "lucky" enough to have a son (as first born) in the period 1970-84 can now cash in on their dowry (which may be in the form of livestock or be converted to livestock). It is an open question whether the land variable suffer from the same problem, but it appears to be of a lesser degree if it does.

8.1 Probability of Having a Boy

Tables 5 and 6 presents the results of the estimation of the effects of the explanatory variables on the probability of having a son. One of the most interesting features of these results is the major difference in which factors and important and which sign they have between first births and subsequent births.

[Table 5 about here.]

[Table 6 about here.]

8.2 Spacing between Births

Tables 7 and 9 show the results for estimating the effects of the factors discussed above on the spacing measured in months between the first and the second birth and the second and the third birth for urban and rural households respectively. As expected the presence of one or more boys lead to a longer period between births. If there are no boys among the two children when looking at the duration between second and third births, there is a very substantial reduction in the expected spell. Tables 8 and 10 show the results for the estimation using the difference between the observed duration between births and the predicted length of time. As discussed above I expect that factors that lead a household to use sex selective abortion should increase the expected duration between births. This is supported by the results on the differences. If there, for example, are no boys presents the actual spacing after 1985 is significantly longer than the predicted using the pre-1985 data, which most likely reflects the increase in spell length between birth that are the result of the use of sex selective abortion.

[Table 7 about here.]

[Table 8 about here.]

[Table 9 about here.]

[Table 10 about here.]

9 Conclusion

[to be added]

References

Ahn, N. (1995): "Measuring the Value of Children by Sex and Age Using a Dynamic Programming," *Review of Economic Studies*, 62(3), 361–79.

Arnold, F., M. K. Choe, and T. K. Roy (1998): "Son Preference, the Family-Building Process and Child Mortality in India," *Population Studies*, 52(3), 301–15.

Arroyo, C. R., and J. Zhang (1997): "Dynamic Microeconomic Models of Fertility Choice: A Survey," *Journal of Population Economics*, 10(1), 23–65.

Behrman, J. R., R. A. Pollak, and P. Taubman (1986): "Do Parents Favor Boys?," *International Economic Review*, 27(1), 33–54.

Behrman, J. R. (1988): "Intrahousehold Allocation of Nutrients in Rural India: Are Boys Favored? Do Parents Exhibit Inequality Aversion?," *Oxford Economic Papers*, 40, 32–54.

Bhuiya, A., and K. Streatfield (1991): "Mothers' Education and Survival of Female Children in a Rural Area of Bangladesh," *Population Studies*, 45(2), 253–64.

Bloch, F., and V. Rao (2000): "Terror as a Bargaining Instrument: A Case Study of Dowry Violence in Rural India," Policy Research Working Paper 2347, World Bank.

Bourne, K. L., and J. Walker, George M. (1991): "The Differential Effect of Mothers' Education on Mortality of Boys and Girls in India," *Population Studies*, 45(2), 203–19.

Cain, M. (1981): "Risk and Insurance: Perspectives on Fertility and Agrarian Change in India and Bangladesh," *Population and Development Review*, 7(3), 435–474.

——— (1983): "Fertility as an Adjustment to Risk," *Population and Development Review*, 9(4), 688–702.

——— (1990): "Risk and Fertility in a Semi-Feudal Context: The Case of Rural Madhya Pradesh," Research Division Working Paper 19, The Population Council.

Chu, J. (2001): "Prenatal Sex Determination and Sex-Selective Abortion in Rural Central China," *Population and Development Review*, 27(2), 259–81.

Clark, S. (2000): "Son Preference and Sex Composition of Children: Evidence from India," *Demography*, 37(1), 95–108.

Das Gupta, M., and P. N. M. Bhat (1997): "Fertility Decline and Increased Manifestation of Sex Bias in India," *Population Studies*, 51(3), 307–15.

Davies, J. B., and J. Zhang (1997): "The Effects of Gender Control on Fertility and Children's Consumption," *Journal of Population Economics*, 10(1), 67–85.

Deolalikar, A. B., and V. Rao (1998): "The Demand for Dowries and Bride Characteristics in Marriage: Empirical Estimates for Rural South-Central India," in *Gender, Population and Development*, ed. by M. Krishnaraj, R. M. Sudarshan, and A. Shariff, pp. 122–140. Oxford University Press, Delhi; Oxford and New York.

Deolalikar, A., and E. Rose (1998): "Gender and Savings in Rural India," *Journal of Population Economics*, 11(4), 453–70.

Dreze, J., and M. Murthi (2001): "Fertility, Education, and Development: Evidence from India," *Population and Development Review*, 27(1), 33–63.

Dyson, T. (2001): "The Preliminary Demography of the 2001 Census of India," *Population and Development Review*, 27(2), 341–56.

Edlund, L. (1999): "Son Preference, Sex Ratios, and Marriage Patterns," *Journal of Political Economy*, 107(6), 1275–1304.

Foster, A. D., and M. R. Rosenzweig (1999): "Missing Women, the Marriage Market and Economic Growth," Manuscript, Brown University.

Goodkind, D. (1996): "On Substituting Sex Preference Strategies in East Asia: Does Prenatal Sex Selection Reduce Postnatal Discrimination," *Population and Development Review*, 22(1), 111–25.

Grant, V. J. (1998): *Maternal Personality, Evolution, and the Sex Ratio: Do Mothers Control the Sex of the Infant?* Routledge, London.

Haughton, J., and D. Haughton (1998): "Are Simple Tests of Son Preference Useful? An Evaluation Using Data from Vietnam," *Journal of Population Economics*, 11(4), 495–516.

James, W. H. (1983): "Timing of Fertilization and the Sex Ratio of Offspring," in *Sex Selection of Children*, ed. by N. G. Bennett, pp. 73–99. Academic Press, New York.

Kobrin, F. E., and J. Potter, Robert G. (1983): "Sex Selection through Amniocentesis and Selective Abortion," in *Sex Selection of Children*, ed. by N. G. Bennett, pp. 47–71. Academic Press, New York.

Lancaster, J. (2002): "The Desperate Bachelors," *The Washington Post*, December 2, A01.

Larsen, U., W. Chung, and M. Das Gupta (1998): "Fertility and Son Preference in Korea," *Population Studies*, 52(3), 317–25.

Leung, S. F. (1991): "A Stochastic Dynamic Analysis of Parental Sex Preferences and Fertility," *Quarterly Journal of Economics*, 106(4), 1063–88.

——— (1994): "Will Sex Selection Reduce Fertility?," *Journal of Population Economics*, 7(4), 379–92.

McClelland, G. H. (1983): "Measuring Sex Preferences and Their Effects on Fertility," in *Sex Selection of Children*, ed. by N. G. Bennett, pp. 13–45. Academic Press, New York.

Murthi, M., A. C. Guio, and J. Dreze (1995): "Mortality, Fertility, and Gender Bias in India: A District-Level Analysis," *Population and Development Review*, 21(4), 745–82.

Park, C. B., and N. H. Cho (1995): "Consequences of Son Preference in a Low-Fertility Society: Imbalance of the Sex Ratio at Birth in Korea," *Population and Development Review*, 21(1), 59–84.

Rao, V. (1993): "The Rising Price of Husbands: A Hedonic Analysis of Dowry Increases in Rural India," *Journal of Political Economy*, 101(4), 666–77.

Rosenzweig, M. R., and T. P. Schultz (1982): "Market Opportunities, Genetic Endowments, and Intrafamily Resource Distribution: Child Survival in Rural India," *American Economic Review*, 72(4), 803–15.

Rosenzweig, M. R., and O. Stark (1989): "Consumption Smoothing, Migration, and Marriage: Evidence from Rural India," *Journal of Political Economy*, 97(4), 905–26.

Rose, E. (1999): "Consumption Smoothing and Excess Female Mortality in Rural India," *Review of Economics and Statistics*, 81(1), 41–49.

Seidl, C. (1995): "The Desire for a Son Is the Father of Many Daughters: A Sex Ratio Paradox," *Journal of Population Economics*, 8(2), 185–203.

Sudha, S., and S. I. Rajan (1999): "Female Demographic Disadvantage in India 1981-1991: Sex Selective Abortions and Female Infanticide," *Development and Change*, 30(3), 585–618.

Unni, J. (1998): "Gender Differentials in Schooling," in *Gender, Population and Development*, ed. by M. Krishnaraj, R. M. Sudarshan, and A. Shariff, pp. 94–121. Oxford University Press, Delhi; Oxford and New York.

Vlassoff, C. (1990): "The Value of Sons in an Indian Village: How Widows see it," *Population Studies*, 44(1), 5–20.

Zeng, Y., P. Tu, B. Gu, Y. Xu, B. Li, and Y. Li (1993): "Causes and Implications of the Recent Increase in the Reported Sex Ratio at Birth in China," *Population and Development Review*, 19(2), 283–302.

Table 1: Estimated Sex Ratios (M/F)

	1970-79	1980-89	1990-00
North / Northwest			
Haryana	107.0	111.4	116.0
Himachal Pradesh	105.3	108.0	114.0
Jammu	109.8	106.3	110.0
Punjab	106.3	117.8	117.1
Rajasthan	112.0	112.0	108.6
Uttar Pradesh	108.4	111.3	105.3
New Delhi	105.2	110.8	114.1
Central			
Bihar	104.5	105.6	106.1
Goa	106.7	100.6	110.1
Gujarat	109.2	108.4	104.6
Madhya Pradesh	107.1	109.1	107.0
Maharashtra	108.1	109.2	106.5
Orissa	104.2	105.9	106.6
East / Northeast			
Assam	104.1	108.3	105.4
Manipur	115.3	102.9	97.9
Meghalaya	113.8	111.6	111.1
Mizoram	108.1	98.8	105.0
Nagaland	95.4	104.0	105.1
Sikkim	91.5	101.3	111.2
West Bengal	100.5	102.3	104.5
Arunachal Pradesh	111.7	106.6	118.2
Tripura	114.8	108.0	102.6
South			
Andhra Pradesh	104.7	103.4	106.4
Karnataka	103.5	105.5	105.3
Kerala	98.2	102.0	107.0
Tamil Nadu	104.6	106.4	101.9

Table 2: Estimated Means and Standard Errors

	1970-79	1980-89	1990-00
	North		
Haryana	0.5169	0.5270***	0.5370***
	(0.0106)	(0.0056)	(0.0071)
Himachal Pradesh	0.5129	0.5193	0.5327***
	(0.0095)	(0.0060)	(0.0078)
Jammu	0.5233	0.5154	0.5239**
	(0.0103)	(0.0058)	(0.0070)
Punjab	0.5152	0.5408***	0.5395***
	(0.0100)	(0.0058)	(0.0076)
Rajasthan	0.5282**	0.5283***	0.5206**
	(0.0075)	(0.0038)	(0.0045)
New Delhi	0.5127	0.5255**	0.5328***
	(0.0105)	(0.0058)	(0.0076)
	West		
Goa	0.5163	0.5015	0.5241
	(0.0096)	(0.0075)	(0.0113)
Gujarat	0.5219	0.5201*	0.5113
	(0.0089)	(0.0051)	(0.0066)
Maharashtra	0.5194	0.5219**	0.5158
	(0.0085)	(0.0047)	(0.0059)
	Central		
Madhya Pradesh	0.5173	0.5218***	0.5170
	(0.0065)	(0.0037)	(0.0045)
Uttar Pradesh	0.5202**	0.5267***	0.5128
	(0.0048)	(0.0028)	(0.0035)
	Northeast		
Assam	0.5101	0.5199*	0.5130
	(0.0095)	(0.0053)	(0.0067)
Manipur	0.5356*	0.5071	0.4946
	(0.0167)	(0.0086)	(0.0098)
Meghalaya	0.5323	0.5274*	0.5264*
	(0.0173)	(0.0093)	(0.0099)
Mizoram	0.5194	0.4970	0.5122
	(0.0169)	(0.0097)	(0.0112)
Nagaland	0.4883	0.5098	0.5124
	(0.0160)	(0.0094)	(0.0110)
Sikkim	0.4778	0.5031	0.5264
	(0.0529)	(0.0132)	(0.0133)
Arunachal Pradesh	0.5277	0.5160	0.5417***
	(0.0205)	(0.0097)	(0.0104)
Tripura	0.5344	0.5193	0.5065
	(0.0177)	(0.0094)	(0.0119)
	East		
Bihar	0.5110	0.5136	0.5147
	(0.0074)	(0.0037)	(0.0043)
Orissa	0.5103	0.5144	0.5159
	(0.0087)	(0.0048)	(0.0060)
West Bengal	0.5013	0.5057	0.5110
	(0.0080)	(0.0048)	(0.0067)
	South		
Andhra Pradesh	0.5115	0.5083	0.5155
	(0.0083)	(0.0052)	(0.0071)
Karnataka	0.5086	0.5133	0.5129
	(0.0082)	(0.0048)	(0.0063)
Kerala	0.4954	0.5049	0.5170
	(0.0087)	(0.0059)	(0.0085)
Tamil Nadu	0.5113	0.5155	0.5047
	(0.0085)	(0.0054)	(0.0069)

NOTE: Children are coded 1 for boys and 0 for girls
Standard errors in parentheses

Table 3: Estimated Means and Standard Errors – Urban

	1970-79	1980-89	1990-00
	North		
Haryana	0.4846	0.5283*	0.5532***
	(0.0183)	(0.0101)	(0.0138)
Himachal Pradesh	0.5342	0.5309*	0.5427**
	(0.0183)	(0.0115)	(0.0157)
Jammu	0.5242	0.5055	0.5428**
	(0.0191)	(0.0114)	(0.0143)
Punjab	0.5038	0.5310**	0.5579***
	(0.0195)	(0.0104)	(0.0143)
Rajasthan	0.5219	0.5425***	0.5210
	(0.0165)	(0.0084)	(0.0104)
New Delhi	0.5123	0.5252**	0.5334***
	(0.0108)	(0.0060)	(0.0080)
	West		
Goa	0.5115	0.5037	0.5396*
	(0.0143)	(0.0111)	(0.0173)
Gujarat	0.5136	0.5297**	0.5293*
	(0.0153)	(0.0086)	(0.0111)
Maharashtra	0.5151	0.5283**	0.5124
	(0.0131)	(0.0069)	(0.0082)
	Central		
Madhya Pradesh	0.5266	0.5250**	0.5212
	(0.0130)	(0.0076)	(0.0097)
Uttar Pradesh	0.5138	0.5251**	0.5115
	(0.0108)	(0.0063)	(0.0086)
	Northeast		
Assam	0.5078	0.5182	0.5004
	(0.0162)	(0.0103)	(0.0150)
Manipur	0.5300	0.5082	0.5099
	(0.0297)	(0.0156)	(0.0182)
Meghalaya	0.4750	0.5025	0.5074
	(0.0396)	(0.0206)	(0.0248)
Mizoram	0.5286	0.4828	0.4981
	(0.0244)	(0.0137)	(0.0156)
Nagaland	0.4764	0.5138	0.5311
	(0.0344)	(0.0208)	(0.0279)
Sikkim	0.6667	0.5486	0.5278
	(0.2108)	(0.0416)	(0.0483)
Arunachal Pradesh	0.5455	0.4985	0.6008***
	(0.0571)	(0.0279)	(0.0305)
Tripura	0.6013**	0.5085	0.4954
	(0.0397)	(0.0231)	(0.0341)
	East		
Bihar	0.5100	0.5180	0.5010
	(0.0158)	(0.0095)	(0.0131)
Orissa	0.5111	0.5138	0.5101
	(0.0167)	(0.0097)	(0.0130)
West Bengal	0.5040	0.5012	0.5022
	(0.0170)	(0.0094)	(0.0124)
	South		
Andhra Pradesh	0.5120	0.5013	0.5243
	(0.0158)	(0.0103)	(0.0140)
Karnataka	0.5042	0.5217	0.5120
	(0.0154)	(0.0087)	(0.0115)
Kerala	0.4995	0.4950	0.5248
	(0.0165)	(0.0115)	(0.0166)
Tamil Nadu	0.5040	0.5328***	0.5164
	(0.0149)	(0.0088)	(0.0107)

NOTE: Children are coded 1 for boys and 0 for girls
Standard errors in parentheses

Table 4: Estimated Means and Standard Errors – Rural

	1970-79	1980-89	1990-00
	North		
Haryana	0.5332*	0.5264**	0.5313**
	(0.0130)	(0.0067)	(0.0082)
Himachal Pradesh	0.5050	0.5150	0.5293**
	(0.0112)	(0.0070)	(0.0091)
Jammu	0.5230	0.5188	0.5180
	(0.0123)	(0.0067)	(0.0080)
Punjab	0.5192	0.5452***	0.5324**
	(0.0116)	(0.0070)	(0.0089)
Rajasthan	0.5299**	0.5246***	0.5205**
	(0.0084)	(0.0043)	(0.0050)
New Delhi	0.5197	0.5293	0.5273
	(0.0445)	(0.0202)	(0.0261)
	West		
Goa	0.5201	0.4996	0.5128
	(0.0128)	(0.0101)	(0.0149)
Gujarat	0.5261	0.5149	0.5012
	(0.0109)	(0.0064)	(0.0083)
Maharashtra	0.5226	0.5162	0.5194
	(0.0113)	(0.0065)	(0.0085)
	Central		
Madhya Pradesh	0.5141	0.5208**	0.5158
	(0.0075)	(0.0042)	(0.0051)
Uttar Pradesh	0.5218**	0.5271***	0.5131
	(0.0054)	(0.0031)	(0.0038)
	Northeast		
Assam	0.5114	0.5205*	0.5162
	(0.0118)	(0.0062)	(0.0075)
Manipur	0.5382*	0.5065	0.4883
	(0.0201)	(0.0103)	(0.0117)
Meghalaya	0.5459**	0.5337**	0.5301*
	(0.0192)	(0.0104)	(0.0109)
Mizoram	0.5110	0.5111	0.5273
	(0.0234)	(0.0136)	(0.0160)
Nagaland	0.4915	0.5088	0.5089
	(0.0181)	(0.0106)	(0.0120)
Sikkim	0.4643	0.4981	0.5263
	(0.0547)	(0.0139)	(0.0139)
Arunachal Pradesh	0.5251	0.5184	0.5341**
	(0.0220)	(0.0103)	(0.0111)
Tripura	0.5186	0.5214	0.5081
	(0.0197)	(0.0102)	(0.0127)
	East		
Bihar	0.5112	0.5128	0.5164
	(0.0084)	(0.0041)	(0.0046)
Orissa	0.5100	0.5146	0.5174
	(0.0102)	(0.0055)	(0.0067)
West Bengal	0.5005	0.5073	0.5147
	(0.0091)	(0.0057)	(0.0080)
	South		
Andhra Pradesh	0.5113	0.5107	0.5124
	(0.0098)	(0.0060)	(0.0082)
Karnataka	0.5103	0.5098	0.5133
	(0.0097)	(0.0057)	(0.0075)
Kerala	0.4938	0.5084	0.5142
	(0.0103)	(0.0069)	(0.0099)
Tamil Nadu	0.5148	0.5052	0.4962
	(0.0103)	(0.0068)	(0.0091)

NOTE: Children are coded 1 for boys and 0 for girls
Standard errors in parentheses

Table 5: Determinants of Having a Son – Urban Households

	1st Born	2nd Born	3rd Born
Father: 1-5 Years Educ.	0.0339*	−0.0181	−0.0286
	(0.0189)	(0.0188)	(0.0201)
Father: 6-9 Years Educ	0.0393**	−0.0235	0.0000
	(0.0170)	(0.0173)	(0.0187)
Father: 10-14 Years Educ.	0.0419**	−0.0388**	−0.0039
	(0.0174)	(0.0177)	(0.0193)
Father: 15+ Years Educ.	0.0556***	−0.0297	−0.0125
	(0.0212)	(0.0221)	(0.0270)
Mother: 1-5 Years Educ.	−0.0247	0.0102	0.0050
	(0.0157)	(0.0157)	(0.0171)
Mother: 6-9 Years Educ.	−0.0169	0.0110	−0.0005
	(0.0145)	(0.0151)	(0.0172)
Mother: 10-14 Years Educ.	−0.0220	0.0267*	0.0422**
	(0.0152)	(0.0159)	(0.0194)
Mother: 15+ Years Educ.	−0.0622***	0.0488**	0.0822**
	(0.0201)	(0.0222)	(0.0340)
Own Agricultural Land	0.0262**	0.0172	0.0057
	(0.0109)	(0.0117)	(0.0140)
Muslim	−0.0175	−0.0270**	−0.0094
	(0.0127)	(0.0132)	(0.0148)
Christian	0.0188	−0.0376	−0.0927*
	(0.0286)	(0.0330)	(0.0505)
Sikh	−0.0132	0.0119	0.0130
	(0.0222)	(0.0229)	(0.0301)
Other Religion	0.0234	0.0534*	0.0176
	(0.0269)	(0.0288)	(0.0364)
Small City	0.0165	0.0017	0.0181
	(0.0119)	(0.0127)	(0.0157)
Town	−0.0014	−0.0119	0.0578***
	(0.0112)	(0.0120)	(0.0151)
Women's to Men's Educ.	−0.0075	−0.0683	0.1527**
	(0.0563)	(0.0595)	(0.0725)
Born 1990-1994	−0.0086	0.0073	−0.0130
	(0.0096)	(0.0103)	(0.0125)
Born 1995-1999	−0.0154	0.0182	−0.0084
	(0.0123)	(0.0131)	(0.0163)
West	−0.0154	0.0064	−0.0193
	(0.0109)	(0.0117)	(0.0147)
Central	−0.0052	−0.0018	−0.0174
	(0.0122)	(0.0130)	(0.0152)
No Boys		0.0338***	0.0622***
		(0.0093)	(0.0164)
One Boy			0.0255*
			(0.0153)
Constant	0.5172***	0.5640***	0.3846***
	(0.0439)	(0.0467)	(0.0573)
Observations	13195	11649	7787
R-squared	0.00	0.00	0.01

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Table 6: Determinants of Having a Son – Rural Households

	1st Born	2nd Born	3rd Born
Father: 1-5 Years Educ.	−0.0074	−0.0192*	−0.0026
	(0.0100)	(0.0100)	(0.0106)
Father: 6-9 Years Educ	0.0071	−0.0164*	−0.0027
	(0.0089)	(0.0092)	(0.0101)
Father: 10-14 Years Educ.	−0.0018	0.0039	−0.0019
	(0.0094)	(0.0098)	(0.0110)
Father: 15+ Years Educ.	0.0120	0.0247	0.0279
	(0.0185)	(0.0200)	(0.0244)
Mother: 1-5 Years Educ.	−0.0038	0.0037	0.0022
	(0.0096)	(0.0099)	(0.0112)
Mother: 6-9 Years Educ.	0.0120	0.0044	0.0138
	(0.0106)	(0.0117)	(0.0142)
Mother: 10-14 Years Educ.	0.0257**	−0.0269*	0.0292
	(0.0130)	(0.0149)	(0.0210)
Mother: 15+ Years Educ.	0.0056	0.0164	0.0727
	(0.0346)	(0.0433)	(0.0796)
Acres of Irrigated Land	0.0003*	0.0000	0.0003
	(0.0002)	(0.0002)	(0.0002)
Acres of Nonirr. Land	0.0001	−0.0002	−0.0003
	(0.0003)	(0.0003)	(0.0004)
Muslim	0.0278**	0.0022	−0.0287**
	(0.0115)	(0.0119)	(0.0126)
Christian	0.0142	−0.0129	−0.0234
	(0.0282)	(0.0322)	(0.0420)
Sikh	−0.0410***	0.0032	−0.0053
	(0.0154)	(0.0163)	(0.0196)
Other Religion	−0.0082	−0.0126	0.0351
	(0.0346)	(0.0374)	(0.0408)
Women's to Men's Educ.	0.0388	0.0267	−0.0025
	(0.0290)	(0.0304)	(0.0346)
Born 1990-1994	0.0077	−0.0118	−0.0014
	(0.0069)	(0.0072)	(0.0080)
Born 1995-1999	0.0055	−0.0066	−0.0042
	(0.0089)	(0.0093)	(0.0103)
West	−0.0175	−0.0172	−0.0363***
	(0.0107)	(0.0111)	(0.0128)
Central	0.0003	−0.0042	−0.0140
	(0.0075)	(0.0078)	(0.0086)
No Boy		0.0108*	0.0253**
		(0.0065)	(0.0107)
One Boy			0.0128
			(0.0101)
Constant	0.4969***	0.5170***	0.5243***
	(0.0128)	(0.0138)	(0.0167)
Observations	25900	23619	19028
R-squared	0.00	0.00	0.00

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Table 7: Determinants of Spacing between Births – Urban Households

	1st to 2nd	2nd to 3rd
Father: 1-5 Years Educ.	−2.5820**	−1.9400
	(1.1987)	(1.9315)
Father: 6-9 Years Educ	−3.0945***	−3.4411*
	(1.1222)	(1.8318)
Father: 10-14 Years Educ.	−0.9787	3.3060*
	(1.1274)	(1.8413)
Father: 15+ Years Educ.	1.2815	8.8317***
	(1.4468)	(2.4103)
Mother: 1-5 Years Educ.	−0.4234	1.2695
	(0.9942)	(1.6178)
Mother: 6-9 Years Educ.	−2.2742**	4.8221***
	(1.0298)	(1.6975)
Mother: 10-14 Years Educ.	−0.2833	24.7817***
	(1.0930)	(1.8139)
Mother: 15+ Years Educ.	4.7312***	56.8025***
	(1.6663)	(2.9276)
Own Agricultural Land	0.8953	−0.5053
	(0.8103)	(1.3430)
Muslim	−3.2836***	−5.6167***
	(0.9344)	(1.5490)
Christian	−0.0190	−3.0959
	(2.1637)	(3.7299)
Sikh	−0.9493	6.7559**
	(1.5609)	(2.6474)
Other Religion	1.1357	−0.4152
	(1.9186)	(3.2377)
Small City	−2.5384***	−5.5136***
	(0.8446)	(1.4058)
Town	−2.2887***	−2.8504**
	(0.8162)	(1.3640)
Women's to Men's Educ.	−3.7754	34.2459***
	(3.8802)	(6.4251)
Age of Mother	−0.3002***	−0.0749
	(0.0604)	(0.1136)
Age of Mother Squared	0.0008***	0.0005***
	(0.0001)	(0.0002)
West	4.8402***	5.5893***
	(0.7994)	(1.3367)
Central	0.6061	−4.7269***
	(0.8695)	(1.4280)
Boy	3.7008***	
	(0.6260)	
No Boys		−24.4397***
		(1.4655)
One Boy		−7.5427***
		(1.2794)
Constant	65.0988***	14.8062
	(8.1897)	(16.4989)
Observations	13501	11188
R-squared	0.04	0.20

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Table 8: Determinants of Difference between Actual and Predicted Spacing – Urban Households

	1st to 2nd	2nd to 3rd
Father: 1-5 Years Educ.	2.2575***	2.0475*
	(0.8082)	(1.1287)
Father: 6-9 Years Educ	3.4001***	3.9121***
	(0.7287)	(1.0378)
Father: 10-14 Years Educ.	2.0739***	−0.8954
	(0.7475)	(1.0605)
Father: 15+ Years Educ.	4.2905***	1.5656
	(0.9095)	(1.3261)
Mother: 1-5 Years Educ.	0.5344	0.8058
	(0.6713)	(0.9440)
Mother: 6-9 Years Educ.	2.2671***	−0.0735
	(0.6265)	(0.9103)
Mother: 10-14 Years Educ.	0.7184	−15.7966***
	(0.6699)	(0.9791)
Mother: 15+ Years Educ.	−0.6595	−39.8656***
	(0.9032)	(1.3840)
Own Agricultural Land	−1.1521**	0.7576
	(0.4669)	(0.6998)
Muslim	2.1306***	4.5536***
	(0.5441)	(0.7939)
Christian	−1.2267	4.4910**
	(1.2372)	(1.9909)
Sikh	1.0951	−5.0426***
	(0.9524)	(1.3759)
Other Religion	−0.4287	0.5728
	(1.1542)	(1.7242)
Small City	0.1722	2.9162***
	(0.5113)	(0.7630)
Town	1.6552***	4.6686***
	(0.4822)	(0.7207)
Women's to Men's Educ.	17.0251***	8.7459**
	(2.4220)	(3.5783)
Age of Mother	0.1108***	0.2274***
	(0.0323)	(0.0500)
Age of Mother Squared	−0.0004***	−0.0007***
	(0.0001)	(0.0001)
West	−2.1590***	−2.9945***
	(0.4682)	(0.7055)
Central	0.1803	4.2080***
	(0.5250)	(0.7814)
Born 1990-1994	−8.3608***	−16.8124***
	(0.4137)	(0.6172)
Born 1995-1999	−17.7583***	−33.8263***
	(0.5284)	(0.7853)
Boy	−1.4668***	
	(0.3732)	
No Boys		14.0462***
		(0.7998)
One Boy		5.2547***
		(0.6818)
Constant	−19.3666***	−26.8875***
	(4.7914)	(7.9794)
Observations	13195	11649
R-squared	0.13	0.42

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Table 9: Determinants of Spacing between Births – Rural Households

	1st to 2nd	2nd to 3rd
Father: 1-5 Years Educ.	0.1337	0.6347
	(0.5525)	(0.8155)
Father: 6-9 Years Educ	−0.9872*	−0.6537
	(0.5611)	(0.8423)
Father: 10-14 Years Educ.	0.1904	3.6764***
	(0.6072)	(0.9126)
Father: 15+ Years Educ.	−1.5532	6.4121***
	(1.3445)	(2.1284)
Mother: 1-5 Years Educ.	−0.7698	1.7677*
	(0.6216)	(0.9398)
Mother: 6-9 Years Educ.	−1.9079**	2.8209**
	(0.8491)	(1.3244)
Mother: 10-14 Years Educ.	0.4292	15.2183***
	(1.1789)	(1.9058)
Mother: 15+ Years Educ.	1.4415	59.3354***
	(4.0602)	(7.3007)
Acres of Irrigated Land	−0.0064	0.0098
	(0.0088)	(0.0125)
Acres of Nonirr. Land	−0.0264	−0.0507*
	(0.0201)	(0.0285)
Muslim	−0.9671	−4.2139***
	(0.7436)	(1.1262)
Christian	1.4039	2.3889
	(1.7625)	(2.6695)
Sikh	−2.1773**	2.5905*
	(0.9901)	(1.4704)
Other Religion	0.9536	−1.3258
	(2.0124)	(2.9488)
Women's to Men's Educ.	−0.8174	17.2698***
	(1.8235)	(2.7165)
Age of Mother	−0.3893***	−0.1699**
	(0.0413)	(0.0664)
Age of Mother Squared	0.0010***	0.0006***
	(0.0001)	(0.0001)
West	3.2012***	3.5150***
	(0.6685)	(1.0013)
Central	1.6608***	−0.1390
	(0.4839)	(0.7243)
Boy	2.5334***	
	(0.3914)	
No Boys		−15.6793***
		(0.8254)
One Boy		−9.0535***
		(0.7257)
Constant	70.6350***	47.6191***
	(5.0783)	(9.0243)
Observations	24956	21177
R-squared	0.02	0.06

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Table 10: Determinants of Difference between Actual and Predicted Spacing – Rural Households

	1st to 2nd	2nd to 3rd
Father: 1-5 Years Educ.	0.1644	0.3896
	(0.3466)	(0.4798)
Father: 6-9 Years Educ	0.5915*	1.5260***
	(0.3098)	(0.4417)
Father: 10-14 Years Educ.	−0.5336	−2.0865***
	(0.3272)	(0.4714)
Father: 15+ Years Educ.	3.8237***	0.2455
	(0.6444)	(0.9558)
Mother: 1-5 Years Educ.	0.6723**	0.2689
	(0.3327)	(0.4746)
Mother: 6-9 Years Educ.	1.6159***	0.1543
	(0.3713)	(0.5611)
Mother: 10-14 Years Educ.	−0.0617	−10.8607***
	(0.4591)	(0.7203)
Mother: 15+ Years Educ.	4.0870***	−54.2781***
	(1.2138)	(2.0850)
Acres of Irrigated Land	0.0079	−0.0031
	(0.0064)	(0.0088)
Acres of Nonirr. Land	0.0338***	0.0259**
	(0.0090)	(0.0128)
Muslim	1.0674***	2.0497***
	(0.4001)	(0.5690)
Christian	2.5208**	−2.1648
	(0.9916)	(1.5533)
Sikh	−0.0907	−4.8647***
	(0.5356)	(0.7792)
Other Religion	−0.2813	1.2570
	(1.2038)	(1.7900)
Women's to Men's Educ.	6.4094***	2.8638**
	(1.0121)	(1.4566)
Age of Mother	0.2306***	0.0357
	(0.0206)	(0.0302)
Age of Mother Squared	−0.0006***	−0.0002***
	(0.0000)	(0.0001)
West	−3.4291***	−5.6445***
	(0.3752)	(0.5328)
Central	−0.6395**	−0.4867
	(0.2619)	(0.3768)
Born 1990-1994	−6.9764***	−9.8331***
	(0.2393)	(0.3447)
Born 1995-1999	−13.0785***	−20.2990***
	(0.3102)	(0.4430)
Boy	−1.9209***	
	(0.2160)	
No Boys		6.0690***
		(0.4442)
One Boy		3.2063***
		(0.3903)
Constant	−22.6829***	1.7570
	(2.6581)	(4.3053)
Observations	25900	23619
R-squared	0.12	0.19

NOTE: * significant at 10%; ** significant at 5%; *** significant at 1%
Standard errors in parentheses

Figure 1: The Decision Tree