The Burden of Choice: Mother's Education and Prenatal Sex Selection

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Abstract

The paper isolates precise channels through which mother's education influences propensity for prenatal sex selection of children in societies with strong son preference. This is done by creating a detailed theoretical model and testing it using data from Demographic and Health Survey of India, 1998-99. We find that the relationship between mother's education and pre-natal sex selection is complicated and governed by threshold effects. Econometric analysis shows that sex selection is usually carried out with the second conception and is a common part of the family building strategy for women with some education. Our regressions show that on the whole at the second parity, increasing education implies increased use of sex selective technologies for balancing household sex composition, i.e. giving birth to one boy and one girl. However, we also find evidence that suggests that once certain education thresholds are met, the propensity to selectively abort female children increases. We find that other variables of female agency like women's autonomy and working status do not appear to be systematically related to propensity of sex selection. In this scenario, pre-natal survival of girls can be improved only if households with high maternal education are also exposed to information and public awareness campaigns to decrease levels of son preference.

JEL codes: I 12, I 20, J 13, J 16

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1 Introduction

In recent years fetal sex determination technologies like ultrasound and amniocentesis have enabled couples to identify the sex of the fetus early on in the pregnancy. By aborting pregnancies of the unwanted sex, they can now control sex composition of their families to a much larger extent. In regions like East and South Asia where populations exhibit strong son preference, the availability of sex selection technology has had far reaching demographic and sociological implications. This paper attempts to delineate socio-economic variables that are important predictors of use of sex selective technologies, with a special emphasis on variables relating to maternal education and agency. To do this we use Demographic and Health Survey Data from India (1998-99), which is also known as National Family and Health Survey Data (NFHS).

Procedures for the determination of the sex of the fetus became available in India in the 1970s. This technology was aimed at detecting genetic abnormalities in the fetus but soon began to be misused for the purposes of sex selection. Government of India banned the use of tests for the purpose of determining the sex of the fetus as early as 1976 (Arnold, Kishor and Roy, 2002). Many studies claim that sex selective abortion was not common in India before the early 1990s owing to the late introduction of that technology and its slow spread across the country (DasGupta and Bhat 1995; Nair 1996).

Since sex selective abortion is mostly illegal, there is very little direct data on its incidence and prevalence. However, it is possible to infer the magnitude of this phenomenon by looking at statistics for sex ratio at birth. Sociological and anthropological work in India suggests that the phenomenon of female infanticide has been virtually eradicated from the country. Therefore the highly skewed sex ratios at birth found in certain parts of India can safely be attributed to the practice of female feticide (see Table 1). It has been contended that in the absence of outside interference, sex ratio at birth for populations is usually stable around the figure of 106 males per 100 females

(Johansson and Nygren 1991). Conclusive evidence of the increasing prevalence of sex selective abortion in India comes from the very high SRB seen in some subsets of Indian population. Although SRB for the country as a whole is 106.9, this number masks significant regional variations. The average SRB in states with high son preference (North Indian states) is as high as 111.6, with Delhi showing the highest SRB of 120.8 (NFHS 1, NFHS 2). This is clearly an alarmingly skewed figure, indicating a rapid masculinization of population in certain areas of the country.

Despite these trends, not much work has been done to identify important agents of change for use of sex selective abortion among populations with high son preference, particularly in mainstream economics. This has partly been due to significant data constraints. The Government of India has banned the use of pre-natal tests for the purpose of determining the sex of the fetus. It is therefore very difficult to come across any direct data on sex-selection within households, even though the phenomenon is clearly not uncommon. Even further, reliable data on abortion itself is most often not forthcoming. In the somewhat conservative social climate of India, women do not feel comfortable discussing aborted pregnancies. Also, as a response to strong public policy rhetoric against sex selection, households feel hesitant to admitting to induced abortions at all. Hence very often, women are likely to either not mention induced abortions at all, or mislabel induced abortions as spontaneous abortions.

This paper attempts to study the impact of increasing female education on rates of sex-selective abortions of female children in India. Female education has long been recognized as an important predictor of fertility behavior within the household. Although increased female education is linked with lower fertility (Martin 1995), its relation to propensity of sex selection is likely to be more complicated and has not been studied in great detail. To do this, a theoretical model is proposed. This model studies various channels through which an increase in woman's education could influence her likelihood of engaging in sex-selective abortion. These include monetary and psychic costs of abortion, psychic cost of sex selection and cost of trying to conceive again. Then, this theory is confronted with data and empirical evidence of the relationship between woman's education and sex-selection is sought. By using data from DHS surveys in India

(1998-99), indirect proxies for sex-selection are constructed and used for empirical estimation.

Because of the lack of direct evidence on sex selective abortion, a possible route to analyzing its correlates is to look at some of the practices that accompany sex selective abortions. Recent surveys in India include questions on number of induced and spontaneous abortions and this data can be taken as representing a lower bound to abortions taking place in India (NFHS 1, NFHS 2). Some researchers have attempted to approximate the level of sex selective abortions from this data by comparing the sex composition of families wherein couples admit to having an induced abortion or spontaneous abortions. Even an analysis of the sex composition of those families getting ultrasound and amniocentesis can throw some light on this subject (Arnold, Kishor and Roy, 2002). Another proposed measure is the sex ratio at birth for births occurring immediately after an aborted pregnancy (Arnold, Kishor and Roy, 2002).

2. Women's Education as an Agent of Change

The existence and persistence of son preference in certain societies has been explained by using both cultural and economic rationales. In India, society tends to be organized along strictly patriarchal lines. In their paper on this subject Das Gupta et al (2002) consider the rigidity of the patrilineal and patrilocal norms as being the most important explanations for son preference. They even go as far as to argue that the economic reasons for son preference are mostly culturally induced. Another persuasive argument for the existence of son preference is the role of sons in providing old age security to parents (Cain 1981; Rahman, Foster and Menken 1992). In the more underdeveloped, rural and agrarian areas of India there is an absence of any formal system of social security and parents rely on their sons to take care of them in their old age. This makes them more valuable than daughters since daughters lose contact with their natal kin, owing to the predominantly exogamous nature of marriages in India (Foster and Rosenzwieg 2001). The other major factors influencing this relationship in India are the practice of dowry (Kishor 1995) and low participation of females in the 'formal' labor force with paid work (Rosenzweig and Schultz 1982). Aside from the more obvious economic reasons, it is also seen that having sons adds to the prestige and status of a family (Caldwell, Reddy and Caldwell 1989, Dyson and Moore 1983; Karve 1965).

In India both fertility preferences and degree of son preference varies considerably according to region. Although son preference is found in nearly all states of the country it tends to be markedly higher in the Northern part of the country compared to the Southern regions. It is most pronounced in the North and central Indian states of Uttar Pradesh, Rajasthan, Bihar, Haryana and Madhya Pradesh. It is lowest in the eastern states of Meghalaya and Mizoram and the Southern states of Tamil Nadu, Kerala and Karnataka. The proportion of women who want more sons than daughters ranges from 10% in Tamil Nadu to 53% in Uttar Pradesh.

In this context, increasing female education has long been considered a good proxy for the change in the status of women in society (Jeffery and Basu 1996; Basu 1992) and thereby their fertility preferences and sexual and reproductive freedoms. Education is seen as a powerful and positive force bringing with it information, knowledge, skills and particularly for women: freedom, empowerment and numerous capabilities. Also, education is believed to improve women's access to information and also their ability to process acquired information (Caldwell 1979, Murthi et al 1995). Education is proven to enhance women's exposure to mass media and that can be an important mediating pathway towards increased use of sex selection.

Although education is a powerful predictor of women's role and status and agency within the household, it is by no means their only relevant attribute that can potentially influence fertility decision-making within the household. Increasingly, women's economic participation outside the household and autonomy within the household are being recognized as powerful predictors of fertility outcomes. All these variables either directly or indirectly affect fertility preferences, costs and prices. Where women's opportunities outside the home are severely constrained, their rights and responsibilities tend to be concentrated inwards on family and children. In such a situation, the degree of autonomy a woman enjoys within the household can be a significant predictor of her fertility preferences. In situations of severely restricted autonomy, a woman might look upon having sons as a means of improving her welfare and her relative status within the household. For women with greater autonomy however, the incentives for having sons are comparatively lower.

While women's education and working status are easy to quantify, female autonomy has traditionally been hard to capture. In recent years attempts have been made to usefully quantify autonomy using survey questions. The DHS surveys are designed to capture some of the more critical dimensions of autonomy in a married woman's life. These reflect to some extent the degree to which a married woman can expect to exercise choice and manipulate her external environment. In the cultural context of India, females have been constrained in terms of their physical mobility, their decision making domains and their sexual and reproductive freedoms. It therefore becomes meaningful in this thesis to interpret autonomy in these terms. In Table 4 below, the important dimensions of female autonomy are summarized using survey data.

Constraints on physical mobility of women are captured by considering their freedom of movement with respect to visiting the market and visiting family and friends. For each of these, women were asked if they are allowed to visit and if they need to seek permission to visit. A very large proportion of women report that they need to seek permission from either their husband or someone else in order to be allowed to visit the market (62%) or to visit family and friends (72%). Autonomy in terms of household decision making is evaluated by considering women's role in household decisions regarding healthcare and also their freedom to save money for personal use. Here we find that woman have relatively more freedom, although in many cases decision making is done entirely by the husband or others. Other dimensions of female autonomy relate to their relationship with natal kin and their exposure to physical intimidation. In all respects it is seen that women exercise only limited and in some dimensions freedoms are more restricted than others.

An *autonomy index* for mothers is created based on the survey responses to questions outlines in Table 4. Scores are rescaled so that questions in each dimension have equal weight. After rescaling and aggregating, I obtain a final *autonomy index* for each observation and this index ranges from 0 to 6. The national mean for the autonomy index is 3.43 which seems to suggest that most women have limited autonomy. This autonomy index is used as an explanatory variable in analysis that follows.

3 Theoretical Model

The theoretical model in this paper attempts to capture mechanisms through which a woman's education might affect her more immediate incentives for sex selection. The relationship between price of abortion, the price of sex selection and mother's education is likely to be complicated. The theoretical model described in this section attempts to capture the cost-benefit analysis that couples face while considering a sex selective abortion of the female fetus. By doing this, we hope to clarify some of the pathways through which a woman's education might affect the decision making process for pre-natal discrimination against girls.

Consider a microeconomic household model of couples planning the overall sex-composition of children during a pregnancy. Specifically, couples who want to have another child need to decide whether they should undergo a sex selective abortion, if a daughter is conceived. For making this decision, they would have to compare the costs and benefits of having a sex selective abortion. The model captures these costs and benefits and shows how woman's education would alter them.

The cost of getting an abortion in case a girl child is conceived would include the monetary cost of abortion (T) and the psychic cost of sex-selective abortion (P). The psychic cost of sex selection is hypothesized to have two dimensions. One is the psychic cost of abortion itself (P_a) and the other is the psychic cost of sex-selection (P_s) i.e. the cost associated with discriminating against a child of a specific gender. In this simplistic framework, we can denote total the psychic cost of sex selection as a sum of P_a and P_s.

Given that sex selection decisions apply to couples who *want* to have another child (at the moment ignoring couples with unplanned pregnancies), we have to take into account the costs these couple face in trying to conceive again after the abortion. I denote these costs as X. Hence, a couple who have conceived a girl child face the following costs of sex selection; the cost of an abortion, followed by the cost of trying to conceive again, followed by the probability that they might conceive a girl child again and hence a repetition of the cycle. Since the probability of conceiving a girl child is 0.5 during each pregnancy and independent of previous births, we can describe the *cost of getting sex selective abortions till a male child is conceived*, given that the couple desires one more child, as follows:

$$\mathbf{C} = (T+P) + 0.5(X) + 0.5(T + P + 0.5(X) + 0.5(T+P+0.5(X)+0.5(\ldots)\ldots)),$$
$$\text{where,}\ \ P = P_a + P_s$$

T+P indicate the cost of abortion of the current pregnancy. However, once the couple conceives again (with a cost of X) they might have a son with a probability of 0.5 or might conceive a daughter again with the probability of 0.5 and so on. The formula above can be simplified to:

$$\mathbf{C} = 2\ (T + P + 0.5\ (X))$$

In the model described above, the cost of sex selective abortions till a male child is conceived is an increasing function of monetary and psychic costs of abortion and an increasing function of the cost of trying to conceive again. Both the monetary and psychic costs of abortion depend on certain characteristics of the woman, the household and the community. In particular, both are functions of woman's education (among other factors). It is interesting to see how these costs for couples change as women become more educated. Monetary costs of abortion are expected to decrease as women become more educated. Educated women have access to more fertility and health related information. For the purpose of sex-selection, they would be more aware of the availability of health services in their area and because of this information have greater capacity to secure reasonably priced abortion. They are also less likely to undergo low quality abortions and consequently, face less health related risks of abortion. These benefits decline with increasing levels of education. If we denote, women's education by ME, we have:

$$\frac{\partial T}{\partial ME} < 0 \text{ and } \frac{\partial^2 T}{\partial ME^2} > 0$$

Psychic costs of sex-selective abortions depend on how well women are able to justify these abortions to themselves, on the attitude of spouse, family and community and also on the prevailing cultural and social norms. Psychic costs associated with sex selective abortions would change with the changing circumstances of women, in particular with their educational attainments. The psychic cost of abortion (P_a) is expected to decline with increasing education of women. This is because, for the more educated women, their self worth and family position is less tied up with their fertility levels and child rearing. Also, for these women, the opportunity cost of time is higher; hence there is greater justification for abortion. On the whole, more educated women would find it easier to defend their decision to abort and because of greater autonomy, would face less censure from family and community on their decision. Consequently, we have:

$$\frac{\partial P_a}{\partial ME} < 0 \text{ and } \frac{\partial^2 P_a}{\partial ME^2} > 0$$

On the other hand, the psychic cost of sex-selection is likely to increase with greater education. This is because more educated women are more likely to espouse the more liberal ideologies of equality of the sexes. As mentioned above, their personal achievements and successes are not solely dependent on their reproductive careers. Hence, there is lesser justification for sex-selection. In addition, these women are likely to have more enlightened spouses, relatives and friends, and are more likely to come under censure for sex-selection.

$$\frac{\partial P_s}{\partial ME} > 0 \text{ and } \frac{\partial^2 P_s}{\partial ME^2} > 0$$

On the other hand, couples consider sex-selection because there are certain benefits associated with it. In countries like India, sons are valued above daughters partly because parents expect to receive greater income transfers from their sons than daughters. This is because, first the expected earnings of sons (R_m) is greater than the expected earnings of daughters (R_f), due to a variety of reasons. Secondly, the sons are expected to contribute to their families over a longer period compared to daughters, who lose contact with their natal kin on marriage. Let, the period for which sons and daughters transfer money to their parents be denoted by λ_m and λ_f respectively, the benefit of sex-selection can be denoted as follows:

$$\mathbf{B} = \lambda_m R_m - \lambda_f R_f$$

The benefits of sex-selection are expected to decrease with increasing woman's education. Educated women are more likely to have educated daughters and hence the earning differential between their sons and daughters is likely to be lower. As a result we see that

$$\frac{\partial B}{\partial ME} < 0$$

Figure 2 summarizes the major pathways through which women's education is expected to influence the costs and benefits of using sex selective abortions as a part of family building strategy.

On the whole, the net benefits of sex selection (NB) can be written as follows:

$$\mathbf{NB} = \mathbf{B\text{-}C} = \lambda_m R_m - \lambda_f R_f - 2\,(T + P + 0.5\,(X))$$

In this model, we can study the impact of women's education on incentives for sex selective abortion by looking at the change in net benefit of sex selection with a change in women's education (ME), hence we are interested in the overall sign of $\partial NB/\partial ME$.

$$\frac{\partial NB}{\partial ME} = \frac{\partial B}{\partial ME} - \frac{\partial C}{\partial ME} =$$

$$\lambda_m \frac{\partial R_m}{\partial ME} - \lambda_f \frac{\partial R_f}{\partial ME} - 2\left[\frac{\partial T}{\partial ME} + \frac{\partial P_a}{\partial ME} + \frac{\partial P_s}{\partial ME} + 0.5\frac{\partial X}{\partial ME}\right]$$

Let us assume that increasing women's education has no impact on the cost of conceiving again. From the model we see that the effect of increasing women's education on net benefits of sex-selection is ambiguous. This is because, although benefits of sex-selection decline with increasing education, the net impact on costs of sex-selection is uncertain. On the one hand, increase in women's education is likely to lead to a decrease in the monetary and psychic cost of abortion; but at the same time it is likely to lead to an increase in psychic cost of sex-selection. Hence, one the whole, the impact of increasing women's education on net benefits of sex-selection would depend on the relative weight of different components.

It is expected that, in the *short run*, as cultural norms associated with son preference persist and the female disadvantage is perpetuated, $\partial T/\partial ME$ and $\partial P_a/\partial ME$ would overwhelm $\partial P_s/\partial ME$. In the short run therefore, we expect to see an increase in levels of sex selective abortion with increasing female education. In the *long run* however the situation is likely to be different. Increasing levels of female education on the whole would imply increased female autonomy and empowerment thereby substantially decreasing the net benefits of sex selection. Also, with increased emancipation of women, the psychic cost of sex selection is likely to become very high in the long run. All these factors, would suggest that in the long run levels of sex selective abortion are likely to decline with increasing female education.

4 Econometric Analysis of Sex Selective Abortions in India

Since data on induced abortions for the purpose of sex selection is not directly available, we propose two ways to proceed. One is to look at a broader set of couples who have exhibited any of the behaviors involved in the whole process of sex selection. The process of sex selection starts with some form of sex-determination, either through ultrasound or amniocentesis. These tests are part of antenatal checkups and in India more educated women are much more likely to receive such care than their less educated counterparts. This is clearly shown by Table 3 in the appendix. We also focus on women who admit to having had an induced abortion. Since, both sex determination and abortion are integral steps involved in the process of sex selective abortions, focusing on women who have had either of these, would enable us to look at a broad set of women *could have had a sex-selective abortion* as distinct from women who *could not have had sex selective abortions*. This process does not allow us to unequivocally identify women who have undertaken sex-selection, but does bring us closer to identifying them.

Another method is to look at the actual birth history of households and determine if there are variables that strongly predict the sex composition of children. Given that sex of each child is an independent random event, if use of sex selection is uncommon or arbitrary we would expect to find no relationship between household's socio-economic variables and sex composition. If however, sex selection is a part of specific family building strategies, certain relationships could emerge. For instance we could discern a relationship between the sex of the first child and the sex of the second child. We might also be able to find certain variables that predict sex of children by birth order etc.

Following the above hypothesis, we propose the following econometric framework to isolate correlates of sex selective abortion. The analytical sample consists of ever married women, ages 15-49. The first analysis is of women who have had an ultrasound or abortion and the second looks at the sex of the second child in the household[1]. Both these set of variables are used as proxies for sex selection by applying the following model:

$$SS_i = \alpha_0 + \alpha_1 A_i + \alpha_2 B_i + \alpha_3 C_i + e_{1i}$$

SS_i is a proxy for sex-selection within the household i. A_i is a vector of woman's characteristics, B_i a vector of husband's characteristics and C_i a vector of household characteristics that influence propensity for sex selection. Given the theoretical model presented above, one characteristic of women that influences their incentives for sex selection very strongly is their education level. Beside this I also include other socio-economic variables relating to the woman such as her age and her autonomy levels within the household and her working status. Husband's characteristics included in this regression are his education level. Household level variables include religion, caste and asset index. Since we use village fixed effects in the model, we do not include region specific variables (r.g. rural / urban, north/south etc.) which would be cancelled out in the regression.

As mentioned above, sex ratios in India are found to be much more masculine in the Northern part of the country as compared to the South. These regional patterns of sex ratios are consistent with what is known of the character of gender relations in different parts of the country. The North-Western states for instance are notorious for highly unequal gender relations (Dyson and Moore 1983) , some symptoms of which include the continued practice of female seclusion, very low female labor force participation rates and large gender gap in literacy rates. In all these respects, the social standing of women is somewhat better in South India. Keeping this in mind we carry out separate regressions for All India, North India and South India.

Table 5 describes the analytical sample for our regressions. On the whole, average education for women is quite low at 3.8 years. Average education for the husband is

[1] A separate analysis of carried out for the sex of the first child and it showed that this variable is not systematically related to the socio-economic variables of the household, thereby implying that sex selection is not a common phenomenon for first births.

relatively much higher at 6.4 years on average, but not very high in absolute terms. Women also appear to have limited autonomy based on the autonomy index described in section 2 above.

4.1: Correlates of Abortion and Ultrasound

Table 6 shows results for the analysis of abortion and ultrasound among 15-49 year old women in India. For the abortion regressions, the dependent variable is the number of induced abortions a woman has had. In the ultrasound regression the dependent variable is a dummy indicating whether the woman had ultrasound test for her previous birth. For the ultrasound variable we have a much smaller sample due to a high number of missing observations. For these regressions, only women who have ever been pregnant are included. As mentioned above, separate regressions are carried out for All India, North and South India. For each regression data is adjusted by individual sampling weights (based on sample selection probability) and village level fixed effects are used to control for unobserved community level variables. Marginal effects for these regressions are shown in Table 6a.

In these regressions we find that women's education emerges as an important predictor of both undergoing an abortion and receiving an ultrasound at the national level (marginal effects are also significant) and also separately for the North and South Indian states. The relationship between women's autonomy and probability of sex selection appears to be more complicated. Autonomy levels are negatively and significantly linked to abortion at the All India level and the marginal effect is significant at the 5% level. However, this relationship disappears in the smaller samples of North and South Indian states. Autonomy is positively and significantly linked to probability of getting an ultrasound at the country and regional levels. Women's working status does not appear to be linked to probability of abortion or ultrasound on the whole. However, somewhat surprisingly, for South India, working women are less likely to receive an ultrasound.

Husband's education increases the likelihood of abortion and ultrasound at the country level and for North India, but only of ultrasound in the context of South India. Religion effects are mixed. Not surprisingly, women belonging to richer households are more likely to get ultrasound. Belonging to a scheduled caste or scheduled tribe decreases the likelihood of receiving an ultrasound or abortion. The regressions highlight the importance of parental education in increasing the likelihood of either having an ultrasound or an induced abortion, both of which are central to any study of pre-natal discrimination.

4.2: Likelihood of sex selection based on birth history

An alternative method for analyzing sex selective abortions in India is to look at actual birth histories within the household. If we examine the sex of the second child in the household as conditional upon sex of the first child, patterns of sex selection become evident. Given that the sex of a child is a random event, in the absence of pre birth interventions we should find that sex of the second child is unrelated to the sex of the first child and any other variable introduced in the regressions. We undertake this analysis separately for All India, North India and South India. For these regressions we concentrate on households with two children in order to make the sample more comparable. A Village Fixed Effects Logit regression is used with the sex of the second child (0 if son, 1 if daughter) as the dependent variable.

In families with only two children, dummy variables indicating the sex of the first and second child (0 if son, 1 if daughter) are created. In the empirical analysis discussed below (Tables 7 and 7a) the sex of the first child is an explanatory variable. Woman's education is used as an independent variable. An interaction term based on the sex of the first child and mother's education is also introduced. This interaction term tests whether the impact of a woman's education on the sex of her second child is contingent upon the sex of her first child and is crucial for determining whether more educated women are more likely to indulge in sex selection. Other independent variables in the regression include woman's age, woman's autonomy index, father's education, religion and caste.

For each regression data is adjusted by individual sampling weights (based on sample selection probability). Descriptive statistics for the analytical sample and results of the regression are given below.

These regressions (Tables 7 and 7a) show clear evidence of sex selection. In all regressions, having a daughter as the first child greatly reduces the likelihood of having a daughter as the second child and relationship is significant at the 1% level for both All India and North India, this result holds less strongly for South India. In terms of marginal effects (at mean level) the first child being female reduces the probability of the second child being female by 3.23 % in the All India regression (significant at the 1% level). Since the sex of each child is an independent random event, these numbers clearly show the prevalence of sex selection as a part of family building strategy in India.

The interaction variable between sex of the first child and mother's education is also negative and significant (at the 1% level) for All India and North India. On calculating marginal effects for All India regression, we find that if the first child is female then an additional year of mother's education decreases the probability of the second child being female by 0.06% (significant at the 1% level). This shows that higher education for women is linked with lower probabilities that their second child is female given that their first child is female for India as a whole and for North India. On the other hand in these regressions, mother's education is positive and significant implying that higher education for women is linked with higher probabilities that their second child is female given that their first child is male. The marginal effect of an additional year of mother's schooling on the probability of the second child being female given that first child is male is 0.04% (significant at the 1% level). Taken together, these results show that more educated women are more likely to engage in sex selection but not necessarily in pre-natal discrimination. If anything, women with two children appear to be showing a preference for balanced sex ratios in their families.

Predictably, since son preference is not very strong in South India, not many variables are linked systematically to the sex of the second child. However, other correlates of sex selection emerge for the All India and North India regressions. Hindu households appear to be significantly more likely to indulge in sex selective behaviors when compared to Muslim and Christian households, but less likely when compared to Sikh households. , Richer households also exhibit stronger probabilities of sex selection. Interestingly, other correlates of female agency like women's autonomy and working status are not important in predicting probability of sex selection. Also, husband's education and caste are both unrelated to the sex of the second child.

Given the results shown above, it would be interesting to learn if there are any threshold effects governing the relationship between women's education and patterns of sex selection. For this we carry out separate regressions using dummy variables indicating the level of women's education (primary, secondary etc.) instead of the continuous variable for years of education used above. The regression results in Table 8 show some interesting patterns. Dummy variables are introduced for less than primary education, primary education, less than secondary education and secondary education. We use a Village Fixed Effects Logit model and for each regression data is adjusted by individual sampling weights (based on sample selection probability).

One of the most striking results of these regressions is that women in North India who have completed at least secondary education are significantly (at the 1% level) more likely to give birth to a son as their second child, irrespective of the sex of their first child. This is also true in the country level regression but not in the South India regression. These results reflect two things, one that in North India, higher education with women increases the probability that they will resort to sex selective abortions of the female fetus and second that there are important *threshold effects* associated with increasing education. Impact of mother's education on the probability of pre-natal discrimination is not apparent until they attain at least secondary levels of education.

These results are intuitively persuasive in the Indian context and correspond well with the theoretical model presented above. Mother's education does bring about a change in the cost benefit analysis of undergoing a sex selective abortion. However it is only at relatively high levels of education (i.e. secondary education) that a perceptible effect appears.

5 Conclusion

There exists a large amount of inconvertible evidence suggesting strong links between mother's education and fertility. But in most of this research, dimensions of family size are stressed while dimensions of family sex composition are almost always overlooked. As women become more and more educated in a country like India with its legacy of son preference and daughter neglect, what can we say about the pre-natal survival probabilities of girls?

The chapter above shows some strong evidence indicating that as women become more educated they are more likely to use sex selective abortions as a strategy to achieve desired sex composition of their children. If son preference remains strong, this would imply that more educated women would be more likely to abort female fetus and thereby negatively impact the relative survival probabilities of girls after conception. However, we also see that at the second parity level more educated women are more likely to strive for a balanced sex ratio in their families than their less educated counterparts. Other regressions indicate however that when analyzing women at second parity, secondary education is linked with higher probability of their second child being male, irrespective of the sex of the first child. Therefore, while it is apparent that women's education is linked with higher use of sex selection, the relationship between women's education and pre-natal discrimination against girls is not so straightforward. It is likely that the latter is mediated through important threshold effects that dictate how women's education, their son preference and their likelihood of restoring to pre-natal discrimination against girls interact.

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Table 1: Sex Ratio at Birth in North India (number of boys per 100 girls)

State	1992-93	1998-99
India	105.1	106.9
Delhi	108	120.8
Haryana	113.5	117.8
Himachal Pradesh	112.3	112.6
Punjab	114.1	116.2
Bihar	96.8	106.7
Madhya Pradesh	108.1	104.1
Rajasthan	110.8	108.8
Uttar Pradesh	105.4	103.6

Source: NFHS 1 (1992-93); NFHS 2 (1998-99)

Table 2: Sex Ratio at Birth of children whose mother received ultrasound or amniocentesis as a part of antenatal checkup

State	Ultrasound	Ultrasound or Aminocentesi	Neither
Gujarat	123.1	122	101.9
Haryana	183.8	186.3	117
Punjab	116.7	118.1	104.6
India	112.4	112.3	107.1

Source: NFHS 2 (1998-99)

Table 3: Antenatal Checkup by Selected Socio Economic Characteristics

Background Characteristic	% of women with no ante natal checkup
Residence	
Rural	39.8
Urban	13.6
Mother's Education	
Illiterate	48.4
Less than Middle school complete	19.3
Middle school complete	13.5
High school complete and above	5.8

Source: Author's Calculations. NFHS 2(1998-99)

Table 4: Key Dimensions of Women's Autonomy in India

Survey Question (n = 90303)	% women
Physical Mobility	
Not allowed to go to market	4.7
Can go to market but only with permission from husband/others	62
Can go to market without permission	33.3
Not allowed to visit relatives/ friends	1.3
Can visit relatives/friends but only with permission from husband/others	72.2
Can visit relatives/friends without permission	26.4
Decision-Making Domain	
Husband/Others make decision on obtaining healthcare	45.7
Decision to obtain health care taken jointly with Husband/Others	25.6
Respondent herself makes decision on obtaining healthcare	28.7
Not allowed to have money set aside	38.3
Allowed to have money set aside	61.4
Relationship with Natal Kin	
Husband/others decide if respondent can stay with family	48.5
Decision to stay with family taken jointly with husband/others	37.9
Respondent herself decides if she can stay with	13.6
Exposure to Physical Violence	
Has been beaten since she turned 15	19.4
Has not been beaten since she turned 15	80.6

Source: Author's Calculations, NFHS 1998-99

Table 5: Analytical Sample for Analysis (All India)

Variable	Mean	Std. Dev.	Min	Max
Woman's Age	32.34	8.35	15	49
Woman's Education (in number of years)	3.79	4.68	0	22
Husband's Education	6.38	5.08	0	30
Muslim	0.12	0.32	0	1
Christian	0.06	0.23	0	1
Sikh	0.02	0.15	0	1
Asset Index	1.96	0.72	1	3
Scheduled Caste	0.17	0.37	0	1
Scheduled Tribe	0.12	0.33	0	1
Autonomy Index	3.46	1.25	0	6
Number of induced abortions	0.07	0.33	0	8

Table 6: Women aged 15-49 who could have had a sex selective abortion.

Village Fixed Effects	All India		North India		South India	
	abortion	ultrasound	abortion	ultrasound	abortion	ultrasound
Woman's Age	0.002***	0.006	0.001***	0.003	0.002***	0.017*
	0.000	(0.005)	0.000	(0.006)	0.000	(0.010)
Woman's Education	0.004***	0.095***	0.005***	0.086***	0.002*	0.087***
	0.000	(0.006)	0.000	(0.008)	(0.001)	(0.013)
Husband's Education	0.001***	0.034***	0.001**	0.050***	0.001	0.037***
	0.000	(0.007)	0.000	(0.009)	(0.001)	(0.013)
Muslim	0.000	0.065	0.012***	0.029	-0.016	0.229*
	(0.004)	(0.067)	(0.004)	(0.089)	(0.010)	(0.129)
Christian	-0.001	0.398***	0.049***	0.51	0.015	0.334*
	(0.006)	(0.102)	(0.016)	(0.319)	(0.012)	(0.171)
Sikh	0.042***	0.092	0.046***	0.302**	0.660***	
	(0.008)	(0.139)	(0.008)	(0.147)	(0.150)	
Asset Index	0.011***	0.647***	0.015***	0.714***	0.025***	0.501***
	(0.002)	(0.042)	(0.002)	(0.057)	(0.005)	(0.081)
SC	-0.006*	-0.390***	-0.003	-0.368***	-0.001	-0.413***
	(0.003)	(0.070)	(0.004)	(0.091)	(0.008)	(0.135)
ST	-0.012***	-1.190***	-0.011**	-0.310**	0.041**	-0.398
	(0.004)	(0.107)	(0.005)	(0.150)	(0.017)	(0.339)
Autonomy Index	-0.002**	0.178***	-0.002	0.172***	0.002	0.089**
	(0.001)	(0.021)	(0.001)	(0.028)	(0.002)	(0.040)
Mother Working	0.002	-0.089	0.000	-0.104	0.003	-0.285**
	(0.003)	(0.058)	(0.003)	(0.080)	(0.007)	(0.112)
Observations	79614	17769	54572	11074	14157	3352
R-squared	0.04	0.27	0.04	0.29	0.29	0.08

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Excluded religion is Hindu

Table 6a: Marginal Effects of Selected Variables in Ultrasound & Abortion Regressions (All India)

Variable	dy/dx	Std. Err.	z	P>|z|	Level
Abortion Regression					
Marginal effects after regress (y= number of induced abortions= 0.0702)					
Woman's Education (in number of years)	0.004	0.000	12.07	0.000	3.79
Autonomy Index	-0.002	0.001	-2.00	0.045	3.46
Woman Working [a]	0.002	0.003	0.64	0.524	0.36
Ultrasound Regression					
Marginal effects after logit (y= had an ultrasound in last pregnancy= 0.1387)					
Woman's Education (in number of years)	0.011	0.001	14.76	0.013	5.26
Autonomy Index	0.021	0.003	8.51	0.026	3.32
Woman Working [a]	-0.010	0.007	-1.56	0.003	0.26

(a) dy/dx is for discrete change of dummy variable from 0 to 1

Table 7: Estimated parameters for Logit Regression for sex of second child among women with two children

Village Fixed Effects	Sex of second child. male=0/ female=1		
	All India	North India	South India
Sex of first child (Male=0/Female=1)	-0.132*** (0.042)	-0.145*** (0.051)	-0.160* (0.093)
Sex of first child* Woman's Education	-0.026*** (0.006)	-0.034*** (0.007)	-0.013 (0.012)
Woman's Education	0.014*** (0.005)	0.023*** (0.006)	0.003 (0.011)
Woman's Age	-0.011*** (0.002)	-0.016*** (0.003)	-0.009** (0.004)
Husband's Education	-0.002 (0.004)	0.001 (0.005)	0.004 (0.009)
Muslim	0.160*** (0.053)	0.281*** (0.069)	0.032 (0.110)
Christian	0.170** (0.067)	0.25 (0.188)	-0.049 (0.116)
Sikh	-0.244*** (0.093)	-0.154 (0.097)	-0.279 (1.248)
Asset Index	-0.102*** (0.027)	-0.142*** (0.035)	0.017 (0.057)
Scheduled Caste	-0.027 (0.044)	0.023 (0.054)	-0.013 (0.090)
Scheduled Tribe	-0.001 (0.054)	0.087 (0.075)	-0.361* (0.201)
Autonomy Index	0.013 (0.013)	0.009 (0.017)	0.021 (0.026)
Mother Currently Working	0.026 (0.032)	0.028 (0.042)	0.045 (0.067)
Observations	21263	13701	4936

Standard errors in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%
Note: Excluded religion is Hindu

Table 7a: Marginal Effects of selected variables in Logit Regression for sex of second child among women with two children (All India)

Marginal Effects after logit (y=Probability of second child being female = 0.4325)					
Variable	dy/dx	Std. Err.	z	P>|z|	Level
Sex of first child[a]	-0.032	0.010	-3.17	0.002	0.44
Sex of first child* Woman's Education	-0.006	0.001	-4.60	0.000	2.36
Woman's Education (in number of years)	0.004	0.001	2.91	0.004	5.28
Autonomy Index	0.003	0.003	1.05	0.294	3.58
Mother Working[a]	0.006	0.008	0.79	0.429	0.34

(a) dy/dx is for discrete change of dummy variable from 0 to 1

Table 8: Estimated parameters for Logit Regression for sex of second child among women with two children - Treshold Effects

Village Fixed Effects	Sex of second child. male=0/ female=1		
	All India	North	South
Sex of first child (sex) (Male=0/Female=1)	-0.179*** (0.040)	-0.215*** (0.048)	-0.196** (0.091)
Mother's Education - less than primary (edu1)	-0.010 (0.068)	-0.053 (0.095)	0.093 (0.137)
sex*edu1	-0.006 (0.073)	-0.058 (0.091)	0.076 (0.156)
Mother's Education - primary complete (edu2)	0.036 (0.051)	0.087 (0.067)	0.007 (0.105)
sex*edu2	0.114* (0.065)	0.148* (0.080)	0.055 (0.132)
Mother's Education - less than secondary (edu3)	-0.048 (0.102)	0.169 (0.142)	-0.203 (0.199)
sex*edu3	-0.061 (0.113)	-0.124 (0.144)	0.02 (0.225)
Mother's Education - secondary complete & above (edu4)	-0.255*** (0.076)	-0.326*** (0.102)	-0.126 (0.151)
sex*edu4	-0.276*** (0.096)	-0.490*** (0.124)	0.117 (0.188)
Woman's Age	-0.012*** (0.002)	-0.016*** (0.003)	-0.010** (0.004)
Husband's Education	0.000 (0.004)	0.005 (0.005)	0.002 (0.008)
Muslim	0.156*** (0.053)	0.265*** (0.069)	0.04 (0.110)
Christian	0.181*** (0.067)	0.238 (0.188)	-0.046 (0.115)
Sikh	-0.243*** (0.093)	-0.135 (0.097)	-0.294 (1.252)
Asset Index	-0.097*** (0.026)	-0.125*** (0.034)	0.007 (0.055)
Scheduled Caste	-0.031 (0.044)	0.014 (0.054)	-0.007 (0.090)
Scheduled Tribe	-0.004 (0.054)	0.079 (0.075)	-0.349* (0.202)
Autonomy Index	0.014 (0.013)	0.012 (0.016)	0.017 (0.026)
Mother Working	0.016 (0.033)	0.017 (0.043)	0.048 (0.069)
Observations	21272	13709	4936

Standard errors in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Note: Excluded religion is Hindu

Figure 1: Sex Ratio at Birth in Selected North Indian States

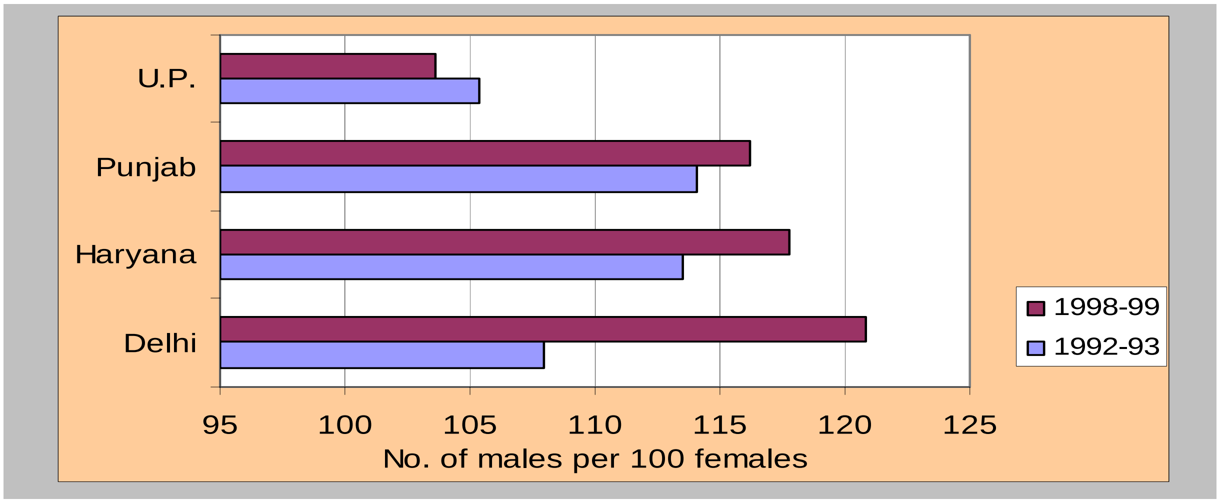
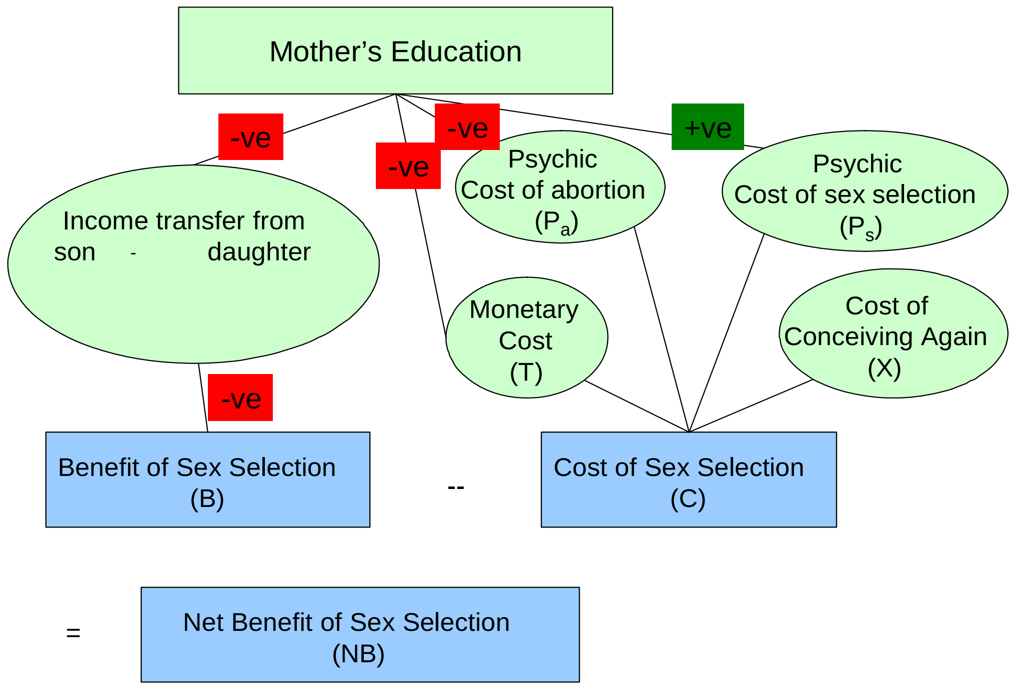


Figure 2: Modeling Sex-Selection as a Household Choice Variable



A Model for Cost Benefit Analysis of Sex Selective Abortion