Religion, Literacy, and the Female-to-Male Ratio in India

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Abstract

This paper proposes a new explanation for religious differences in fertility in India by incorporating the issue of gender bias into the debate. It reports the results from an econometric investigation of the factors influencing the sex ratio at birth and among currently living children, by religion and by caste, for a sample of over 10,000 women in India. The investigation paid particular attention to religion and caste by subdividing the sample into Hindu, Muslim and Dalit women who had all terminated their fertility. It enquired whether the effect of different variables on the sex ratio varied according to the religion and caste of the women. The econometric analysis found that a husband being literate served to raise the sex ratio - both at birth and of currently living children - but that the effect of husbands' literacy was stronger for Muslims and Dalits than it was for Hindus. In other words, while the illiteracy of husbands exacerbated 'son preference' (and its obverse, 'daughter aversion') the preference for sons (and the aversion to daughters) exercised a stronger hold on Hindu families than it did on Muslim and Dalit families.

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Introduction

There are two demographic features about India that have elicited particular interest. The first is the small number of females compared to males. The number of females per 1,000 males – hereafter referred to as the *sex ratio* - is 933 in India, as reported in the 2001 Census, compared to a figure of 1,050 for Europe and North America and 1,022 for sub-Saharan Africa (Sen, 2001). Dreze and Sen (1996) have termed the low sex ratio in India as a 'missing women' phenomenon: on the basis of sub-Saharan ratios, the number of missing women in India is estimated to be between 35 and 37 million (Dreze and Sen, 1996; Klasen, 1994). A second feature about India is differences in the growth of population sub-groups by religion: the proportion of Muslims in India's population has grown from 9.9 per cent in 1951 to 13.4 per cent in 2001 while the Hindu share of the population has fallen from 85 per cent to 80.5 per cent.

Analysis and debate of these two issues proceed independently of each other. The sex ratio is discussed almost entirely in geographical terms, the emphasis being on identifying areas of India - regions, states and districts - where females are particularly at risk and then enquiring about the processes through which females in general, and girls in particular, are placed in jeopardy (Agnihotri, 2003; Sudha and Rajan, 2003).[1] Sen (2001) refers to the preference that many South (and East) Asian families have for sons over daughters ('son preference'), and others have analysed the impact of such preference on the marriage market (Edlund, 1999) and fertility (Bhat and Zavier, 2003).

The Muslim issue, on the other hand, is discussed entirely in terms of the number of children to Muslim, compared to Hindu, families, without any reference to the gender of the children. At its most shrill, the faster growth rate of the Muslim part of the Indian population is blamed on Indian Muslims for obeying the tenets of Islam in rejecting family planning and embracing polygyny[2]. Indeed, Basu (1997) refers to the

[1] For example, this research examines to what extent the adverse sex ratio may be attributed to selective abortions of the female foetus or due to the neglect of girls after birth.
[2] See Basu (2004), Borooah (2004), Iyer (2002), Jeffery and Jeffery (2000), Hendre (1971) and Prakash (1979) for a discussion of the relation between religion and fertility in India.

‘politicisation of fertility’ whereby demographic accusations, of the type described above, are levelled against Muslims in order to achieve non-demographic interventions in Muslim lives.[3]

Against this background, the purpose of this paper is to propose a new idea: to show that, far from being independent of each other, the sex ratio and family size by religion are highly related. At its plainest, girls in India may be *least at risk* with Muslim parents and *most at risk* with parents who are caste Hindus. Or, to put it differently, one of the reasons that Muslims have a larger number of children than Hindus may be due to the fact that they do not regard the birth of a girl with the same degree of trepidation as Hindus. In this paper we develop this idea by extending the notion of ‘son preference’ to the *complementary* concept of ‘daughter aversion’. This concept, developed more fully below, argues that just as sons bring ‘benefits’ to their parents, daughters impose ‘costs’. Consequently, complementing a desire *to have* sons is a desire *not to have* daughters. The desire for sons tends to increase family size while the fear of daughters limits it.

From this we argue that a reason why Muslims have larger families than Hindus is that, firstly, they may not desire sons as much as Hindus[4] and, secondly, they are less apprehensive, compared to Hindus, of having daughters. In consequence, not only do Muslims have larger families than Hindus but they *also* have relatively more daughters than sons.

2. Son Preference, Daughter Aversion, and the Demand for Children

Let S, D and $N = S + D$ represent, respectively, the number of sons, daughters and children to a family. The family gets positive utility from sons and negative utility from daughters – hereafter, the positive utility associated with sons is referred to as the benefit from sons and the negative utility associated with daughters is referred to as the cost of daughters. Let $B(S)$ and $C(D)$ represent the benefit and cost functions associated with, respectively, S sons and D daughters where:

[3] The most important of such interventions is the desire to impose a uniform civil code on all sections of the Indian population. This proposed uniformity extends well beyond the Muslim right to polygyny to embrace issues of *inter alia* grounds for divorce and women’s rights to alimony payments.

$$\partial B / \partial S > 0,\ \partial C / \partial D > 0$$
$$\partial^2 B / \partial S^2 < 0,\ \partial^2 C / \partial D^2 > 0 \qquad (1)$$

A family with S sons and D daughters will decide in favour of (against) having another child if the marginal expected utility (EU) associated with another child is positive (negative) where:

$$EU = \pi B'(S) + (1-\pi)C'(D) \qquad (2)$$

If it is assumed, for the moment, that π, the probability of having a son, is a half, then the family will decide to have another child if, and only if, $B'(S) > C'(D)$ - the marginal benefit of a son outweighs the marginal cost of a daughter - and will decide against another child if, and only if, $B'(S) < C'(D)$ - the marginal benefit of a son is outweighed by the marginal cost of a daughter. An equilibrium number of children is one to which the family does not wish to add.

Figure 1 illustrates the falling marginal benefit (MB) curve for sons and the rising marginal cost (MC) curve for daughters. A horizontal line, across the diagram, represents an equilibrium number of sons and daughters at the points where it, respectively, cuts the MB and MC curves: at these points, the marginal benefit of a son is exactly outweighed by the marginal cost of a daughter. From the set of equilibrium son-daughter configurations two special cases may be distinguished. First, the point X in the diagram represents a *no son equilibrium*: a family with no sons and D_X daughters will not want to increase its family size, in the hope of a son, because the marginal cost, in the event of a daughter, would exceed the marginal benefit from a son. Second, the point Z in the diagram represents a *parity equilibrium*: a family with an equal number of sons and daughters (S_Z=D_Z) will not want to increase its family size. By contrast, all other equilibrium points - a family of S_Y sons and D_Y daughters (S_Y< D_Y), or S_W sons and D_W daughters (S_W> D_W) - represent *non-parity equilibrium*.

Two concepts may be defined: *son preference* and *daughter aversion*. In Figure 2, the marginal cost curve OH represents a higher degree of daughter aversion than the curve OM since, for a given number of daughters, the marginal cost of daughters is

[4] In this context, Bhat and Zavier (2003) have commented that Hindus show greater son-preference than Muslims.

higher for OH than for OM. Then the "no son" equilibrium will be greater with a lower (OM) than with a higher (OH) degree of daughter aversion: $D_M > D_H$. Equally, the parity equilibrium will be greater with a higher degree of daughter aversion: $D^*_M > D^*_H$. Lastly, with a given number of sons in the family, S^{**}, the equilibrium number of daughters will be greater with a lower degree of daughter aversion: $D^{**}_M > D^{**}_H$.

In Figure 3, the marginal benefit curve BH represents a higher degree of son preference than the curve BM since, for a given number of sons, the marginal benefit of sons is higher for OH than for OM. The no son equilibrium is the same with a lower (BM) than with a higher (BH) degree of son preference: $D_M = D_H$. However, the parity equilibrium will be greater with a higher than with a lower degree of son preference: $S^*_H > S^*_M$. Lastly, with a given number of daughters in the family, D^{**}, the equilibrium number of sons will be greater with a higher degree of son preference: $S^{**}_H > S^{**}_M$.

Suppose now that there are two groups, Hindus and Muslims, such that Muslims have the same degree of son preference as Hindus, but a lower degree of daughter aversion. Then by Figure 2, Muslims will always have an equilibrium family size larger than that of Hindus. On the other hand, if Muslims have the same degree of daughter aversion as Hindus, but a lower degree of son preference then, by Figure 3, Muslims will always have an equilibrium family size smaller than that of Hindus.

The line HH′ in Figure 4 represents the *equilibrium locus*: all points on HH' represent son-daughter combinations at which the family is in equilibrium (in the sense of not seeking an increase in its size). The equilibrium locus slopes downwards reflecting the fact that, as the number of sons increases, the marginal utility of sons falls; to be in equilibrium the marginal cost of daughters must also fall for which a smaller number of daughters is required. The "no son" equilibrium is attained with OH daughters and the parity equilibrium is attained at X where the equilibrium locus intersects the 45^0 line through the origin. "No daughter" equilibrium is attained with OH' sons: the family does not seek an increase in its size even though it has only sons because the marginal utility of sons has fallen to zero.

Suppose HH′ represents the equilibrium locus for Hindus. Suppose that Muslims have the same degree of son preference, but a lower degree of daughter aversion, than Hindus. Then, as Figure 2 shows, Muslims will have a *larger* “no son”, and a *larger* parity, equilibrium than Hindus; but, because Muslims have the same degree of son preference, they will have the *same* “no daughter” equilibrium as Hindus. Consequently, the Muslim equilibrium locus will be represented by MH′ in Figure 4 and, in equilibrium, Muslims will have *larger* families than Hindus.

On the other hand, suppose that Muslims have the same degree of daughter aversion, but a lower degree of son preference than Hindus. Then, as Figure 3 shows, Muslims will have a *smaller* “no daughter”, and a *smaller* parity, equilibrium than Hindus; but, because Muslims have the same degree of daughter aversion, they will have the *same* “no son” equilibrium as Hindus. Consequently, the Muslim equilibrium locus will be represented by HM’ in Figure 4 and, in equilibrium, Muslims will have *smaller* families than Hindus.

3. The Data

The results reported in this paper are based on an analysis of unit record data from the Human Development Survey of India, for 10,548 currently married women *who had terminated their fertility* by adopting a terminal method of contraception and who, therefore, at the time of the survey, were - in terms of family size and composition - in equilibrium. Data on these women were culled from a larger survey of 33,230 rural households - encompassing over 195,000 individuals - spread over 1,765 villages, in 195 districts, in 16 states of India. This survey - commissioned by the Indian Planning Commission and funded by a consortium of United Nations agencies – was carried out by the National Council of Applied Economic Research (NCAER) over January-June 1994 and most of the data from the survey pertain to the year prior to the survey, i.e. to 1993-94. Details of this survey - hereafter referred to as the NCAER Survey - are to be found in Shariff (1999). These 10,548 women were subdivided according as to whether they were Hindu, Muslim or Dalit (i.e. Scheduled Caste or Tribe[5]). Tables 1 and 2 show, respectively, the number of living sons and daughters to these women:

4.6 per cent of Hindu, compared to 5.1 per cent of Muslim women terminated their fertility without having any sons; on the other hand, 19.6 per cent of Hindu women, compared to 13.4 per cent of Muslim, women terminated their fertility without any daughters.

Given the desire for sons that exists in South Asian societies, it is reasonable to assume that, in Indian families, the decision whether or not to have a (or another) child is based upon comparing the marginal utility from a male birth with the marginal disutility from a female birth. A plausible measure of the degree of 'son preference' is 1 – the proportion of women who terminated their fertility without any sons; and the corresponding measure of the degree of 'daughter aversion' is the proportion of women who terminated their fertility without any daughters. On these measures, as Table 1 shows, the degree of son preference was lower for Muslims (0.949) than for Hindus (0.954): however, this difference was not statistically significant[6]. On the other hand, the degree of daughter aversion was greater for Hindus (0.196) than for Muslims (0.134) and this difference was statistically significant. Consequently, one may conclude from Table 1 that Muslims had statistically the same degree of son preference as Hindus but a significantly lower degree of daughter aversion. These facts may be sufficient to result in a larger average equilibrium family size for Muslims than for Hindus.

Table 4 shows the sex ratios of children to the women in the sample who had terminated their fertility. The sex ratio at birth was computed by calculating, for each of the women, the number of female live births per male live birth, multiplying by 1,000 and averaging over the Hindu, Muslim and Dalit groups[7]. This shows that the sex ratio at birth was lowest for Hindus (976 per 1,000 male births) and highest for Muslims (1,026 per 1,000 male live births). The sex ratios of currently living children to Hindu and Datlit women were 948 and 963, respectively, that is, 28 and 30 points *lower* than the sex ratios at birth. On the other hand, the sex ratio of currently living children to Muslim women was 1,047, that is, 21 points *higher* than the sex ratio at birth. These findings are consistent with figures from the 2001 Census which show

[5] 'Hindu' refers specifically to non-Scheduled Caste or Scheduled Tribe Hindus.
[6] Z-value of 0.53
[7] Note that his ratio was defined only for those women who had had at least one male live birth.

that the juvenile sex ratio (the number of females per 1,000 males in the 0-6 age group) was 950 for Muslims compared to 925 for Hindus (Basu, 2004).

It is reasonable to suppose that if Muslim parents are less averse to daughters than Hindus, then we would expect female infant mortality rates to be lower for Muslim than for Hindu families. A demographic feature in India, that has drawn little comment, is that infant mortality among Muslims, at 59 per 1000, is much lower than that among Hindus, at 77 per 1000.[8] Similarly child mortality, which is 83 per 1000 for Muslims, is substantially lower than child mortality among Hindus, at 107 per 1000 (IIPS and ORC Macro International 2000). This feature is explored further by estimating separate equations for 'explaining' male and female infant deaths and drawing attention to the importance of the religious background of parents - even after controlling for non-religious factors - in determining these numbers. Table 5 shows the infant mortality rates (defined as the number of infant deaths as a percentage of live births) for Hindu, Muslim and Dalit women. Infant mortality rates were highest for Dalit women and lowest for Muslim women. For both Hindu and Dalit women, male infant mortality rates were considerably lower than female rates; for Muslims, however, male and female infant mortality rates were almost identical.

4. Econometric Analysis

Explaining the Number of Living Sons and Daughters

The thrust of these econometric equations was to explain the number of living sons, S_i, and daughters, D_i, to the 10,548 currently married women who had terminated their fertility (indexed by *i*) in terms of their personal and household characteristics. Since the two dependent variables (S_i and D_i) are 'count' variables, in that they assume nonnegative integer values, an appropriate estimation method is the *Poisson Regression Model* (PRM). The PRM assumes that each observation on the dependent variable (say, s_i) is drawn from a Poisson distribution with parameter λ_i, where this parameter is related to a vector of regressors, $\mathbf{x_i}$.

[8] This point was first brought to Iyer's attention in a piece written by C. Rammanohar Reddy in *The Hindu* newspaper, which is gratefully acknowledged.

The PRM estimates for the number of sons and daughters, to women who had terminated their fertility, are shown in Table 6. Also shown in Table 6, alongside the column of coefficient estimates, are the associated *marginal effects*. These effects show the increase or decrease in the expected number of sons ('sons' equation) or daughters ('daughters' equation) when the value of the relevant variable is increased by one unit, *the values of all the other variables being set to their, respective, means*. Since, all the variables (except for the 'age at marriage' variable) were binary variables, taking 0/1 values, a unit increase in a variable implied a shift from one category to another. Thus, Table 6, shows that, *in equilibrium*, Muslim woman would, on average, have 0.27 more sons and 0.34 more daughters; while Dalit women would have 0.08 more sons and 0.07 more daughters than Hindu women *ceteris paribus*. Similarly, women who are literate would, in equilibrium, have 0.22 fewer sons and 0.11 fewer daughters than women who, along with their husbands, are illiterate.

In addition to the influence of literacy and community, the number of sons and daughters to women who had terminated their fertility, also depended on the region in which the women lived and on the occupation in which they were employed. Living in the South, the East and the West resulted in a smaller number of sons than living in the North (the default region) or in the Central region. Women who worked as labourers or as cultivators had, in equilibrium, a smaller number of sons, but a larger number of daughters, than women who worked in non-manual occupations or women who did not work.

Explaining the Number of Male and Female Infant Deaths

Another clue to differences between Hindus and Muslims in their differing degrees of son preference and daughter aversion is provided by infant mortality rates (Table 7). The male infant mortality rate (male infant deaths as a proportion of male live births) was not very different between Hindus (4.5%) and Muslims (4.7%) who had terminated their fertility and, indeed, the difference between the Hindu and Muslim male infant mortality rates was not statistically significant. However, the female infant mortality rate (female infant deaths as a proportion of female live births) was considerably higher for Hindu (6.3%) than for Muslim (4.6%) mothers and this difference was statistically significant. Indeed, there was hardly any gender difference in Muslim infant mortality rates but there was a considerable gender gap in the Hindu infant mortality rates.

Table 8 shows the PRM estimates (along with the marginal effects) for the number of male and female infant deaths to all currently married women, whether or not they had terminated their fertility. The important point to emerge from these results is that, after controlling for other factors, Muslim women had a smaller number of both male and female infant deaths compared to Hindus. *Ceteris paribus* being Muslim reduces the number of male deaths per woman by 0.038, a reduction of 23% from the mean number of male infant deaths per woman (computed over all 25,796 currently married women who had had male live births) of 0.168: as a consequence, the male mortality rate falls from its observed value of 6.8% to its 'all Muslim' value of 4.4%. By similar token, being Muslim, instead of Hindu, reduces the number of female infant deaths per woman by 0.017, a reduction of 10% from the mean number of female infant deaths per woman (computed over all 23,646 currently married women who had had female live births) of 0.171: as a consequence, the female mortality rate falls from its observed value of 7.4% to its 'all Muslim' value of 6.2%.

The number of male and female infant deaths was significantly affected by village-level infrastructure: safe drinking water[9] in villages was predicted to reduce the average number of male and female infant deaths per woman by, respectively, 4% and 8% and the presence of *anganwadis*[10] in villages was predicted to reduce the mean number of male and female infant deaths by, respectively, 5% and 7%. The number of male and female infant deaths was also affected by the quality of housing conditions and by the occupation of the mother: poor housing conditions[11] were

[9] The NCAER Survey gave details of the main source of drinking water for each of the 1,758 villages covered. The water supply of a village was defined as being 'safe' if the main source was one of: protected wells; tanker truck; piped water; hand pump. It was defined as being 'unsafe' if the main source was one of: ponds; dug wells; running streams/canals. It must be emphasised that the terms 'safe' and 'unsafe' are defined entirely in terms of the source of drinking water and not in terms of any inherent standard of purity.

[10] *Anganwadis* are village-based early childhood development centres. They were devised in the early 1970s as a baseline village health centre, their role being to: provide government-funded food supplements to pregnant women and children under five; work as an immunisation outreach agent; provide information about nutrition and balanced feeding and provide vitamin supplements; run adolescent girls' and women's groups; and monitor the growth, and promote the educational development of children in a village.

[11] These were described in this study as 'poor' if there was: (a) no ventilation; *and* (b) no separate kitchen; *and* (c) food was cooked on a charcoal-fired stove (*chula*).

predicted to increase the mean number of male and female infant deaths by, respectively, 7% and 15%, while women who worked as labourers were predicted to have, on average, 15% more male infant deaths and 9% more female deaths than the sample averages.

Overarching these factors was the importance of mothers' (and, to a lesser extent, fathers') literacy in reducing the number of male and female infant deaths. Literate mothers were predicted to have, on average, 17% fewer male infant deaths and 23% fewer female infant deaths than the sample means; by contrast, paternal literacy (in the face of maternal illiteracy) would lead to reductions of only 4% and 7%, respectively, in the average number of male and female infant deaths.

Explaining the Sex Ratio

Table 9 shows the OLS estimates for the equations pertaining to the sex ratio for women who had terminated their fertility. In equation 1, the dependent variable is the sex ratio at birth while, in equation 2, it is the sex ratio of currently living children. A positive (negative) coefficient estimate implies that the sex ratio increases (decreases) with an increase in the value of the associated variable. The sex ratio equations are estimated as reduced form equations underpinned by the structural equations (Table 6) relating to the number of male and female children.

The specification shown in Table 9 takes account of: the *literacy status* of the women and their husbands; the *region* of residence[12]; the *occupations* of the women and their husbands[13]; the level of *village development*[14]; and the *prosperity* of the households in which the women lived. The coefficient on each of these variables was allowed to vary according as to the *community* to which the women belonged (Muslim, Dalit, Hindu[15]). Consequently, if X_i represents the value of an explanatory variable for woman *i*, the equation was specified as:

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[12] The Survey contained information for each of sixteen states. In this study, the states were aggregated to form five regions: the *Central* region consisting of Bihar, Madhya Pradesh, Rajasthan and Uttar Pradesh; the *South* consisting of Andhra Pradesh, Karnataka, Kerala and Tamilnadu; the *West* consisting of Maharashtra and Gujarat; the *East* consisting of Assam, Bengal and Orissa; and the *North* consisting of Haryana, Himachal Pradesh and Punjab.

[13] The residual occupations for men and women were, respectively, 'non-manual' and 'unoccupied'.

[14] On the basis of their general level of facilities, the 1,758 villages in the NCAER Survey were classified as (a) low-development villages; (b) medium-development villages; (c) high-development villages.

[15] Hindus being the residual category.

$$(sex\ ratio)_i = \alpha X_i + \beta(X_i \times ms_i) + \gamma(X_i \times dl_i) + \varepsilon_i$$

where: $ms_i=1$, if the woman is a Muslim and $dl_i=1$, if the woman is a Dalit. The α coefficient in the above equation represents the 'Hindu coefficient' ($ms_i= dl_i=0$) and the β and γ coefficients represent the *additional effects* (of the explanatory variable) stemming from the women being Muslim ($ms_i=1$) or Dalit ($dl_i=1$), respectively.

The specification shown in Table 9 pertains to the one obtained when variables whose associated coefficients had *t*-values less than unity (i.e. those which did not make a positive contribution to the explanatory power of the equation) were dropped from the estimated equation. The χ^2 values at the foot of Table 9 report the likelihood ratio results from testing the joint hypothesis that the coefficients on the excluded variables take the value zero.

Prosperity Effects

Household prosperity was measured by the logarithm of per-capita household income (i.e. total household income divided by the number of persons in the household). The square of the log of per-capita household income was also included to incorporate non-linear effects. There were no differences between Hindus, Muslims and Dalits in the effects of prosperity upon the sex ratio. If ϕ and φ are the coefficients on these variables then, for woman i:

$$\frac{\partial sexratio_i}{\partial \log\ (income_i)} = \phi + 2\varphi \log(income_i)$$

The fact that the coefficient estimates associated with household, and the square of household, income are, respectively, negative and positive (Table 9, equations 1 and 2) implies that the sex ratio – both at birth and for currently living children – falls as household prosperity increases, but at a diminishing rate.

If one abstracted from income inequality - by setting each woman's income to the mean household per capita income (computed over all the women under analysis) of Rs. 4,910 per year - the sex ratio *at birth* was predicted to fall from its observed (sample) value of 984 to 949 and the sex ratio *of currently living children* was predicted to fall from its observed (sample) value of 958 to 920. The fact that income was unequally distributed - with some women living in households whose incomes were above, and others living in households whose incomes were below mean income - added, therefore, around 35 points to both the sex ratios.

Literacy, Occupation, and Regional Effects

In addition to household prosperity, the sex ratio to the women was influenced by whether their husbands were literate. *Ceteris paribus* the sex ratio at birth was higher by 47 points, and the sex ratio of currently living children was higher by 32 points, for Hindu women with literate husbands compared to Hindu women with illiterate husbands[16]. It should be emphasised that, after the literacy of the husbands had been controlled for, the literacy of the women had no effect on the sex ratios.

In addition to literacy, the sex ratio was influenced by the occupations of the parents. Families in which the husband worked as a labourer had *ceteris paribus* a lower sex ratio (by 72 points at birth and 103 points for currently living children) than families in which the father worked in a non-labouring occupation. On the other hand, families in which the mother worked - either as a cultivator or as a labourer - had a higher sex ratio than women who were unoccupied[17]. Some of these occupational effects were significantly different across the two equations[18]: the null hypothesis that the husband being a labourer - compared to being in a non-labouring occupation - reduced the sex ratio at birth by as much as it did the sex ratio of currently living children was not accepted ($\chi^2(1)=5.74$). However, the null hypotheses that the woman being a cultivator or a labourer - compared to being unoccupied - raised the sex ratio at birth by as much as it did the sex ratio of currently living children could not be rejected[19]. Similarly, the null hypothesis that the positive effects on the sex

[16] For the effects on Muslim and Dalit women see the subsequent discussion on community effects.
[17] On the basis of the results of Table 6, the sex ratio at birth was higher by 64 points and the sex ratio of currently living children was higher 80 points for women cultivators. For women labourers, the corresponding figures were 77 and 67 points.
[18] The cross-equation hypotheses were tested by estimating the equations as Zellner's (1962) Seemingly Unrelated Regression Equations (SURE). Although the Breusch-Pagan test statistic (Breusch and Pagan, 1980) decisively rejected the null hypothesis that the error terms associated with the two sex ratio equations were independently distributed, the OLS and the SURE estimates were very similar and, hence, the latter estimates are not reported.
[19] $\chi^2(1)=0.96$ for cultivators and $\chi^2(1)=0.14$ for labourers.

ratio (at birth and of currently living children) were the same for women who were cultivators and labourers could not be rejected.

The observed sex ratios at birth for the different regions were: 1,014 for the South; 1,002 for the East; 976 for the West; 968 for the Central region; and 957 for the North. Some of these differences were undoubtedly due to inter-regional differences in prosperity. For example, the mean annual per-capita household income of women in the North was Rs. 5,140 compared to Rs. 3,387 of women in the East and this would go some way towards explaining - in the context of the earlier discussion on 'prosperity effects' - why the sex ratio was lower in the North than in the East. If one abstracted from differences in prosperity between the regions by setting every region's mean household per-capita income to the all-India mean value[20], then the predicted (at birth) sex ratios were: 1,018 for the South; 990 for the West; 975 for the East; 960 for the North; and 958 for the Central region.

Similarly, the observed sex ratios for currently living children for the different regions were: 1,005 for the East; 997 for the South; 959 for the West; 930 for the North; and 916 for the Central region. If, as before, one abstracted from differences in prosperity between the regions by setting every region's mean household per-capita income to the all-India mean value then the predicted (currently living) sex ratios were: 1,000 for the South; 976 for the East; 973 for the West; 933 for the North; and 907 for the Central region.

5. Community Effects and Their Decomposition

Table 9 shows that the community to which a woman belonged exerted its influence on the sex ratio of her children (at birth or of living children) through a single channel: the effect of the husband's literacy status on the sex ratios of their children depended upon whether the family was Hindu, Muslim or Dalit. Although the fact of a husband being literate served to lift the sex ratio (both at birth and of currently living children) for all the women, this effect was smallest for Hindus, larger for Dalits, and largest for Muslims. A Hindu husband being literate added 47 points to the sex ratio at birth and 32 points to the sex ratio of living children; by contrast, the corresponding increments for Muslim husbands were 131 and 121 points, respectively.

These observations raise the question of how much of the difference between Muslim and Dalit women on the one hand, and Hindu women on the other, in the sex ratios of their children - at birth and currently living - is due to differences in religion or caste, and how much is due to differences between them in the values of their other socio-economic attributes?

In order to answer this question, the difference between the Muslim and Hindu sex ratios ($SR_M - SR_H$) - and between the Dalit and Hindu sex ratios ($SR_D - SR_H$) - was decomposed, using the methodology of Blinder (1973) and Oaxaca (1973), as:

$$SR_M - SR_H = (SR_M - SR_M^H) + (SR_M^H - SR_H) \qquad (3)$$

and

$$SR_D - SR_H = (SR_D - SR_D^H) + (SR_D^H - SR_H) \qquad (4)$$

where: SR_M^H and SR_D^H are what the Muslim and Dalit sex ratios *would have been* if their respective attributes had been evaluated using Hindu coefficients.

The first term in equation (1) and equation (2) represents the ‘religion effect’. In equation (1), the first term is the difference between the observed Muslim sex ratio and the Muslim sex ratio arising from Muslim attributes being evaluated using Hindu coefficients; in equation (2), the first term is the is the difference between the observed Dalit sex ratio and the Dalit sex ratio arising from Dalit attributes being evaluated using Hindu coefficients. The second term in equation (1) and equation (2) represents the ‘attributes effect’. In equation (1), the second term is the difference between the sex ratios when Muslim and Hindu attributes are evaluated using Hindu coefficients while, in equation (2), the second term is the is the difference between the sex ratios when Dalit and Hindu attributes are evaluated using Hindu coefficients. In each equation, the sum of the first and second terms equals the difference in the observed sex ratios between Hindus and Muslims and Hindus and Dalits.

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[20] The incomes of every household in a region were scaled by the factor: all-India mean income /

Table 10 shows that, of the total difference of 51 points between the Muslim and Hindu (at birth) sex ratios, 71 per cent (36 points out of 51) could be attributed to differences in community and 29 per cent (15 points out of 51) could be attributed to differences in attributes between the communities. On the other hand, of the total difference of 99 points between the Muslim and Hindu (currently living children) sex ratios, only 46 per cent (46 points out of 99) could be attributed to differences in community and 54 per cent (53 points out of 51) could be attributed to differences in attributes between the communities. The difference between the sex ratios to Hindu and Dalit women was considerably smaller than that to Hindu and Muslim women: the difference between the sex ratios at birth was only 17 points and the difference between the sex ratios of currently living children was only 15 points. A little over half of the difference Dalit and Hindu women in their at birth sex ratios was due to the effect of community while the effect of community explained nearly three-fourths of the difference between them in the sex ratios of currently living children.

6. Conclusion

This paper has undertaken an econometric investigation of the factors influencing the sex ratio - at birth and of currently living children - to a sample of over 10,000 women who had terminated their fertility. The investigation paid particular attention to the religion and caste of the women by subdividing the sample into Hindu, Muslim and Dalit women and enquired whether the effect of the different variables on the sex ratio varied according to the religion and caste of the women. The econometric analysis found that a husband being literate served to raise the sex ratio - both at birth and of currently living children - but that the effect of husband's literacy was stronger for Muslims and Dalits than it was for Hindus. In other words, while the illiteracy of husbands exacerbated 'son preference' (and its obverse, 'daughter aversion') the preference for sons (and the aversion to daughters) exercised a stronger hold on Hindu families than it did on Muslim and on Dalit families.

Several other variables - most notably the prosperity of the household and the occupations of the parents - also exercised a significant influence but their influence

regional mean income.

on the sex ratio did not vary either by religion or caste. Taken collectively, 71 per cent of the difference between Hindus and Muslims in the sex ratio at birth could be explained by differences in religion, the remainder being due to differences between the communities in their attributes; on the other hand, when it came to the sex ratio of currently living children, less than half the difference between Hindus and Muslims could be ascribed to religion, the major explanation of the difference being inter-community differences in attributes.

So, in the recurring academic and policy discussions that occur about the determinants of Muslim fertility in India, we think it apposite to inform the discussion by pointing out that in the specific case of India, higher Muslim fertility may well be the consequence of lower daughter aversion in this community, reflected both in an analysis of infant deaths and the sex ratio. Moreover, many of the observed effects are mediated by economic characteristics such as literacy. We believe therefore that more research is needed on the complex interactions between religion, reproduction, and gender bias in India.

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Table 1
Number of Living Sons of Currently Married Women
Who Have Terminated Their Fertility

Sons	*Hindus (%)*	*Muslims (%)*	*Dalits (%)*
0	4.6	5.1	4.5
1	29.3	25.4	27.1
2	45.9	40.4	42.1
3	14.9	19.5	19.2
4+	5.3	9.6	7.1
Mean	1.9	2.1	2.0
Median	2	2	2

6,523 Hindu, 549 Muslim and 3,476 Dalit women
Source: NCAER Survey

Table 2
Number of Living Daughters of Currently Married Women
Who Have Terminated Their Fertility

Daughters	*Hindus (%)*	*Muslims (%)*	*Dalits (%)*
0	19.6	13.4	17.4
1	39.1	35.8	38.5
2	25.1	25.6	26.2
3	11.0	15.8	12.2
4+	5.2	9.4	5.7
Mean	1.4	1.8	1.5
Median	1	2	1

6,523 Hindu, 549 Muslim and 3,476 Dalit women
Source: NCAER Survey

Table 3
Number of Living Children of Currently Married Women
Who Have Their Terminated Fertility

Children	*Hindus (%)*	*Muslims (%)*	*Dalits (%)*
0	0.6	0.8	0.8
1	2.2	1.8	2.6
2	23.4	13.8	18.9
3	35.1	32.1	31.4
4	22.3	25.4	26.1
5+	16.4	26.1	20.2
Mean	3.3	3.8	3.5
Median	3	4	3

6,523 Hindu, 549 Muslim and 3,476 Dalit women
Source: NCAER Survey

Table 4
Sex Ratios of Children to Currently Married Women Who Have Terminated Their Fertility

	Currently Married Women Who Have Terminated Their Fertility		
	Hindu	Muslim	Dalit
Sex Ratio at birth	976	1026	993
Sex Ratio of currently living children	948	1047	963

Sex Ratio: number of girls per 1,000 boys
Source: NCAER Survey

Table 5
Infant Mortality Rates to Currently Married Women Who Have Terminated Their Fertility

	Currently Married Women Who Have Terminated Their Fertility		
	Hindu	Muslim	Dalit
Infant mortality rate (IMR)	5.1	4.5	6.1
Male IMR	4.5	4.6	5.4
Female IMR	6.2	4.5	7.6

Infant: under one year old.
Mortality rates: deaths as a percentage of live births
Source: NCAER Survey

Table 6
Poisson Regression Model Estimates for the Number of Sons and Daughters to Currently Married Women Who Terminated Their Fertility

	Equation for Sons		***Equation for Daughters***	
Variable	**Coefficient**	***Marginal Effects***	***Coefficient***	***Marginal Effects***
Age of woman at marriage	-0.028 (7.4)	-0.053 (0.01)	-0.029 (6.9)	-0.043 (0.01)
Muslim	0.134 (4.3)	0.271 (0.07)	0.207 (6.1)	0.335 (0.06)
Dalit	0.043 (2.7)	0.083 (0.03)	0.046 (2.5)	0.068 (0.03)
Central region	0.039 (1.7)	0.075 (0.04)	-	-
Southern region	-0.167 (6.8)	-0.307 (0.04)	-	-
Western region	-0.032 (1.28)	-0.061 (0.05)	-0.027 (1.3)	-0.040 (0.03)
Eastern region	-0.061 (2.1)	-0.113 (0.05)	0.037 (1.4)	0.055 (0.04)
Woman literate	-0.119 (6.3)	-0.223 (0.03)	-0.076 (4.1)	-0.111 (0.03)
Woman illiterate/husband literate	-0.034 (2.0)	-0.065 (0.03)	-	-
Woman works as labourer	-0.051 (2.3)	-0.095 (0.04)	0.050 (2.1)	0.076 (0.04)
Woman works as cultivator	-0.053 (2.1)	-0.099 (0.05)	0.052 (1.9)	0.079 (0.04)
Woman works in non-manual occupation	-	-	-	-
Husband works as labourer	-0.052 (2.7)	-0.098 (0.036)	-0.09 (4.2)	-0.130 (0.03)
Husband works as cultivator	-	-	-	-

Notes to Table 6:
The equations were estimated on observations for 10,548 currently married women (6,523 Hindus; 549 Muslims; and 3,476 Dalits) who had terminated their fertility by adopting termination methods of contraception.
Figures in parentheses under column 'coefficient' are z-values and under column 'marginal effects' are standard errors.
The marginal effects show the increase/decrease in the expected number of sons/daughters for a unit change in the relevant variables, the values of all other variables being set to their respective mean values.
The LR test statistics for imposing zero restrictions on some of the coefficients were: $\chi^{2(}(2)=0.79$, for the 'sons equation' and $\chi^{2(}(5)=2.4$, for the 'daughters equation'.

Table 7
Average Number of Infant Deaths and Infant Mortality Rates to Currently Married Women

	Hindus	*Muslims*	*Dalits*
Male Infant Deaths	0.132	0.136	0.170
Female Infant Deaths	0.156	0.164	0.194
Total Infant Deaths	0.253	0.229	0.315
Male Infant Deaths as a Percentage of Male Live Births	4.5	4.6	5.4
Female Infant Deaths as a Percentage of Female Live Births	6.2	4.5	7.6
Total Infant Deaths as a Percentage of Total Live Births	5.1	4.5	6.1

Notes to Table 7:
Mean Infant Deaths and Infant Mortality Rates were computed over currently married women *who had had at least one live birth*: and who had terminated their fertility: 6,505 Hindu, 545 Muslim and 3,469 Dalit women
Mean *Male* Infant Deaths and Male Infant Mortality Rates were computed over currently married women *who had had at least one male live birth* and who had terminated their fertility: 6,295 Hindu, 523 Muslim and 3,365 Dalit women
Mean *Female* Infant Deaths and Female Infant Mortality Rates were computed over currently married women *who had had at least one female live birth* and who had terminated their fertility: 5,422 Hindu, 489 Muslim and 3,009 Dalit women.

Table 8
Poisson Regression Model Estimates for the Number of Male and Female Infant Deaths to Currently Married Women

	Equation for Male Infant Deaths		***Equation for Female Infant Deaths***	
Variable	Coefficient	*Marginal Effects*	*Coefficient*	*Marginal Effects*
Male live births	0.577 (64.6)	0.069 (0.001)	-	-
Female live births	-	-	0.488 (56.6)	0.062 (0.001)
Age of woman at marriage	-0.031 (3.5)	-0.004 (0.001)	-0.040 (4.4)	-0.005 (0.001)
Muslim	-0.371 (6.9)	-0.038 (0.005)	-0.145 (2.7)	-0.017 (0.006)
Dalit	-	-	-	-
Safe water in village	-0.052 (1.6)	-0.006 (0.004)	-0.115 (3.4)	-0.014 (0.004)
Anganwadi in village	-0.066 (2.1)	-0.008 (0.004)	-0.096 (2.9)	-0.012 (0.004)
Hospital within 5km of village	0.052 (1.6)	0.006 (0.004)	-0.103 (3.1)	-0.0133 (0.004)
Midwife in village	0.076 (2.3)	0.009 (0.004)	-	-
Poor housing conditions	0.101 (3.1)	0.012 (0.004)	0.193 (5.7)	0.025 (0.004)
Household assets	-0.036 (5.0)	-0.012 (0.004)	-0.019 (2.6)	-0.002 (0.001)
Woman literate	-0.259 (5.5)	-0.029 (0.005)	-0.336 (6.9)	-0.040 (0.005)
Woman illiterate/husband literate	-0.053 (1.5)	-0.006 (0.004)	-0.099 (2.8)	-0.012 (0.004)
Woman works as labourer	0.194 (4.8)	0.025 (0.006)	0.123 (2.9)	0.016 (0.008)
Woman works as cultivator	-	-	-	-

Notes to Table 8:
The male infant deaths equation was estimated on observations for the 25,796 currently married women who had had male live births; the female infant deaths equation was estimated on observations for the 23,646 currently married women who had had female live births.
Figures in parentheses under column 'coefficient' are z-values and under column 'marginal effects' are standard errors.
The marginal effects show the increase/decrease in the expected number of male/female infant deaths for a unit change in the relevant variables, the values of all other variables being set to their respective mean values.
The LR test statistics for imposing zero restrictions on some of the coefficients were: $\chi^{2(}(2)=2.2$, for the male infant deaths equation and $\chi^{2(}(3)=2.4$ for the female infant deaths equation.

Table 9
Regression Estimates for the Sex Ratio to Women who have Terminated Their Fertility

	Equation 1 ***Sex Ratio at Birth***	*Equation 2* Sex Ratio of Currently Living Children
Muslim	dropped	dropped
Dalit	dropped	dropped
Wife literate	dropped	dropped
Husband literate	46.58	32.22
	(2.05	(1.41)
Muslim × husband literate	83.99	89.85
	(1.45)	(1.46)
Dalit × husband literate	51.71	54.53
	(1.76)	(1.85)
Log of household income	-338.99	-404.49
per person	(2.43)	(2.88)
(Log of household income	16.49	20.34
per person)^2	(1.93)	(2.37)
South	2573.62	2881.54
	(4.50)	(5.01)
East	2562.56	2883.71
	(4.49)	(5.02)
West	2535.43	2844.75
	(4.33)	(4.94)
Central	2551.73	2810.48
	(4.46)	(4.88)
North	2547.74	2842.88
	(4.45)	(4.93)
Husband cultivator	Dropped	Dropped
Husband labourer	-72.46	-103.00
	(2.71)	(3.74)
Mother cultivator	64.17	79.93
	(1.91)	(2.37)
Mother labourer	76.77	67.33
	(2.55)	(2.22)
Mother in non-manual occupation	Dropped	Dropped
Level of village	42.96	Dropped
development: medium	(1.60)	
Level of village	69.21	32.73
Development: high	(2.35)	(1.52)

Notes to Table 9:

1. The dependent variable in Equation 1 is the sex ratio (number of females per 1,000 males) *at birth* to women who have terminated their fertility (mean=984.4): 10,176 observations
2. The dependent variable in Equation 2 is the sex ratio (number of females per 1,000 males) of *currently living children* to women who have terminated their fertility (mean=957.97): 10,044 observations
3. LR test of zero restrictions in Equation 1 (on dropped variables): $\chi^2(23)=26.0$; $Pr>\chi^2=0.30$
4. LR test of zero restrictions in Equation 2 (on dropped variables): $\chi^2(24)=26.8$; $Pr>\chi^2=0.32$
5. Figures in parentheses are t-values
6. Equation 1: $\bar{R}^2 = 0.508$; F-test that all the coefficients are zero: F(15,10161)=700.8
7. Equation 2: $\bar{R}^2 = 0.495$; F-test that all the coefficients are zero: F(15,10029)=658.1
8. The following interaction terms were dropped from the specification because their associated coefficients had t-values less than unity: Muslim × log(income); Dalit × log(income); Muslim × [log(income)]^2; Dalit × [log(income)]^2; Muslim × (Region); Dalit × (Region); Muslim × (Father's/Mother's Occupation); Dalit × (Father's/Mother's Occupation).

Table 10
The Decomposition of Muslim-Hindu and Dalit-Hindu Differences in the Sex Ratio at Birth and of Currently Living Children

Sex Ratio at Birth						
Sample Average	***Muslim Attributes Evaluated Using Hindu Coefficients***			***Sample Average***	***Dalit Attributes Evaluated Using Hindu Coefficients***	
$SR_M - SR_H$	$SR_M - SR_M^H$	$SR_M^H - S_H$		$SR_D - SR_H$	$SR_D - SR_D^H$	$SR_D^H - S_H$
1027-976=51	**1027-991=36**	**991-976=15**		**993-976=17**	**993-985=8**	**985-976=9**
Sex Ratio of Currently Living Children						
Sample Average	***Muslim Attributes Evaluated Using Hindu Coefficients***			***Sample Average***	***Dalit Attributes Evaluated Using Hindu Coefficients***	
$SR_M - SR_H$	$SR_M - SR_M^H$	$SR_M^H - S_H$		$SR_D - SR_H$	$SR_D - SR_D^H$	$SR_D^H - S_H$
1047-948=99	**1047-1001=46**	**1001-948=53**		**963-948=15**	**963-952=11**	**952-948=4**

Notes to Table 10:

SR_M SR_D SR_H are the sex ratios for, respectively, Muslim, Dalit and Hindu women

SR_M^H is the what the Muslim sex ratio *would have been* if Muslim attributes were evaluated using Hindu coefficients

SR_D^H is the what the Dalit sex ratio *would have been* if Dalit attributes were evaluated using Hindu coefficients

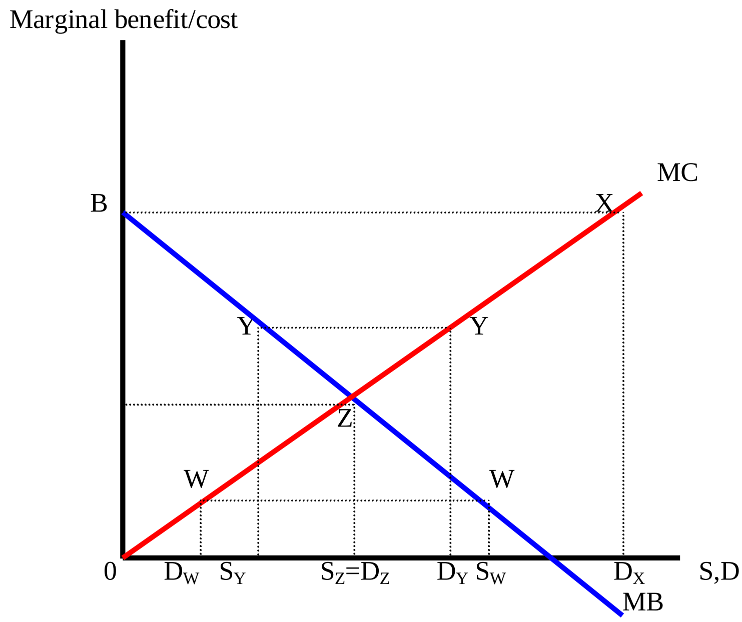

Figure 1

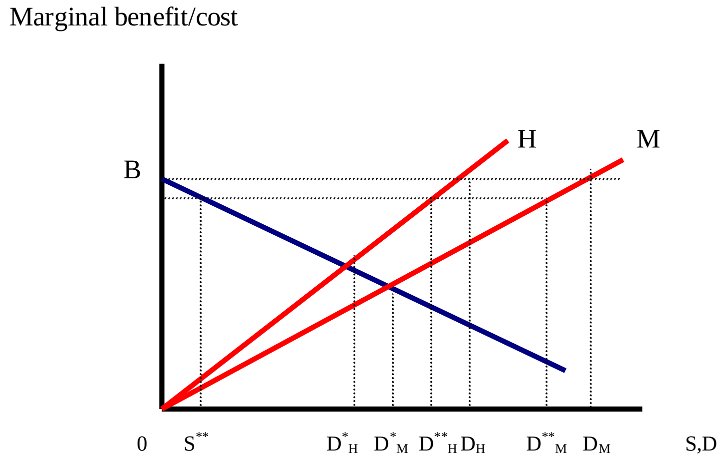

Figure 2

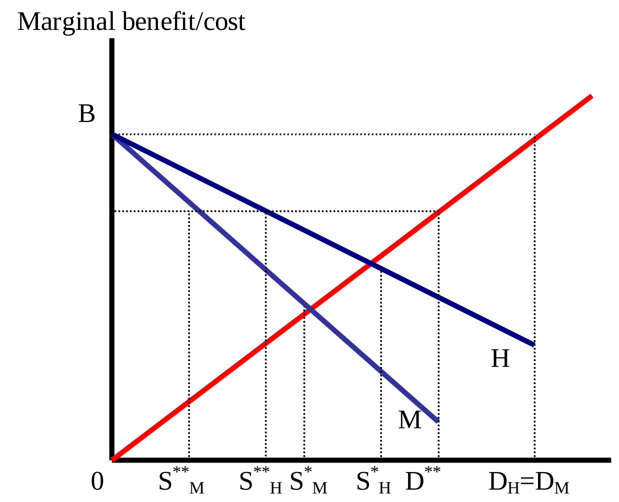

Figure 3

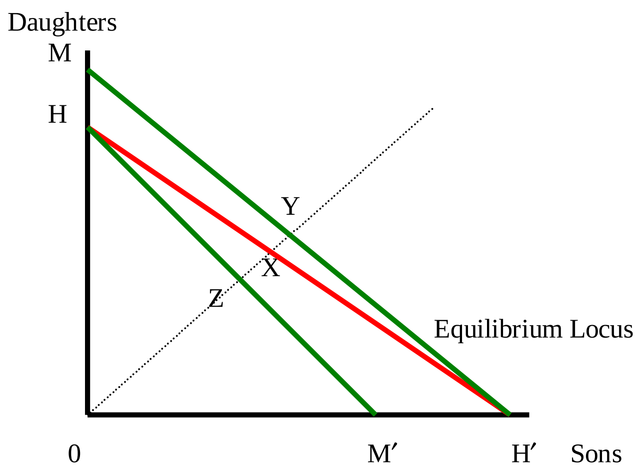

Figure 4