Parental Choice and Gender Balance*

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Abstract

We examine the implications of parental choice regarding the gender of their child in a context where boys are valued more than girls. In the absence of a bride price system, parental choice may reduce gender bias, but has an adverse effect on welfare since it results in a sex ratio that is biased against girls. Bride prices can ensure efficient outcomes with a balanced sex ratio if markets are Walrasian. However, if the marriage market is subject to frictions, the equilibrium sex ratio will be unbalanced and inefficient.

Keywords: gender bias, marriage market, ex-ante investments, hold-up problem.

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1 Introduction

In many parts of the world, parents exhibit *gender bias* — i.e. they prefer to have a boy child rather than a girl. This phenomenon is especially prevalent in South Asia. In Northern India, it is common to celebrate the birth of a boy and bemoan the birth of a girl. Indeed, the community of *hijras* (eunuchs), who traditionally make their living by extorting money on joyous occasions, demand substantially larger amounts when a boy is born as compared to when a girl is born. Coupled with gender bias is the relative neglect of girls which leads to higher mortality and a sex ratio that is biased towards males. Parents have also taken more violent methods to dispose of unwanted girls, including infanticide. In Dharmapuri district of Tamil Nadu, infant girls are often fed uncooked rice, as a way of inducing rapid death. In Punjab, the caste of Bedi Sikhs have traditionally been known as *kudi-maar* – "girl-killer" — due to their practice of female infanticide.

Recent developments in medical technology have increased parental choice and reduced the cost of choosing boys. The development of amniocentesis in the 1980s and ultrasound screening subsequently made foetal sex determination possible, thereby permitting selective abortion. Foetal sex determination for selective abortion has been made illegal in India, but the practice flourishes nevertheless. Indeed, since abortion is legal, it is hard to see how a ban on sex-selective abortions can be enforced.

Table 1 **Boys per 100 Girls years 0-6, Selected States**

	1961	1971	1981	1991	2001
Andhra	101.9	100.6	100.6	101.6	102.8
W. Bengal	104.1	97.7	101.4	103.5	104.2
Kerala	103.9	102.5	102.8	104.4	104.1
Tamil Nadu	102.5	100.9	103.7	105.5	106.2
Gujarat	107.1	106.5	104.9	107.8	113.2
Haryana		111.2	111.2	113.8	122.1
Delhi			111.2	109.3	115.2
Punjab	109.2	111.3	109.9	114.3	125.3
Rajasthan	107.8	107.0	105.0	109.1	110.0
India	**105.2**	**99.8**	**103.0**	**105.8**	**107.8**

Table 1 presents evidence on the sex ratio in the age group 0-6 for selected Indian states from the Indian censuses. In the states in the North and West of India, one finds that number of boys per 100 girls has increased quite dramatically. For example, in Haryana, the number has risen by 11 between 1981 (when amniocentesis had just been introduced and was not widespread) and 2001. In Punjab, the increase has been over 15, so that there are over 125 bys per 100 girls. One should also point out that this problem appears specific to certain regions. For example, in the South and the East of India, the increases in the number of boys have been modest and are consistent with the natural rise that can be attributable to reductions in infant mortality coupled with a sex ratio at birth that naturally favours boys slightly (Chahnazarain, 1988) – the medical evidence suggests that boys, who have greater infant mortality than girls, may reduce their disadvantage with reductions in infant and child mortality.

The incidence of sex selective abortions, and more generally, parental choice regarding their child's gender, obtains in other countries as well. The sex ratios in South East Asia – in particular South Korea and China – have shown large increases in the proportion of boys. [1]Indeed, in China, it has been argued that as a consequence of the one-child policy, more than 40 million girls are missing.

Recent developments in medical technology have made sex selection easier and potentially available to a large number of parents, thereby making this question of importance for developed economies as well. Invitro fertilization allows control over the sex of the embryo, thereby reducing the psychological and financial costs of sex selection. It is also clear that parents have preferences regarding the gender of their child. For example, Angrist and Evans (1998) find from the US census that parents who have two children of the same gender are significantly more likely to have a third child as compared to parents whose first two children are of the same gender. This suggests that many parents seek "gender balance" within their families, in the sense that they want at least one child of each sex. Interestingly, parents with two girls were somewhat more likely to have a third child than parents with two boys. Most countries do not allow parental choice in this matter – for example, the British parliament initially suggested allowing this for family balancing reasons, but then withdrew this provision. Nevertheless, it would seem that allowing choice would prima facie improve parental welfare in this dimension, and the question merits exploration.

What are the implications of increased parental choice in a society with widespread gender bias? The standard response, from government agencies, in-

[1] Oster (2005) argues that Hepatitis B can explain a signifiant proportion of the imbalance in East Asia, since the infection biases the sex ratio at birth towards boys. This is less important in India, since Hepatitis B infection is limited.

ternational institutions and non-governmental organizations, is to deplore sexual selection. In this view, gender bias reflects discriminatory preferences, that are based on ignorance and backwardness. Rather than allowing choice based on discriminatory preferences, the state has a duty to educate away such preferences, and in the meantime, constrain how they are exercised. This view is squarely paternalistic, in the sense that policy is not based upon the preferences of the citizens, but rather on those of enlightened agencies.

An alternative view is more "economic" and suggests that allowing parental choice may in fact improve the position of girls. As girls become scarcer, their value will rise, and this will reduce gender bias and improve their position in society. Dharma Kumar (1983) was an early and trenchant expounder of this position.

This paper sets out an economic model of parental choice and its implications for gender bias and for welfare. We show that parental choice reduces gender bias, essentially by increasing the supply of boys and reducing their value to parents, by virtue of the fact that they may not be able to marry or reproduce. Despite this, allowing parental choice in a situation where the matches are random reduces welfare – we adopt a non-paternalistic welfare criterion, where welfare corresponds to the expected utility of the typical household or parent. The essential reason is that parents who choose to exercise choice do not take into account the congestion externality they exert in the marriage market. We also find that technological improvements that permit parental choice at lower cost have a negative consequences for welfare. We show that a bride-price system, where parents of boys offer a bride price can result in an efficient allocation where the sex ratio is balanced. However, this is only possible if the marriage market is Walrasian, with parental choice being determined as part of a rational expectations equilibrium. With a frictional marriage market, a bride price does not ensure efficiency since the sex ratio must still be unbalanced.

2 The Model

The standard biological model of the sex ratio dates back R.A Fisher (1930), following on ideas in Darwin. Fisher's model is one where a parent is concerned only with maximizing reproductive fitness, and this predicts an equilibrium sex ratio which is balanced. In addition, in equilibrium, there is no gender bias –

parents are equally happy when a girl is born as when a boy is. In this paper we modify Fisher's model by allowing parents to be concerned with the "economic value" of an offspring as well, with the value possibly differing between boys and girls. We assume that parental preferences are such that a boy is strictly preferred to a girl, conditional on both having the same marital status. However, a married girl is strictly preferred to a single boy. Without loss of generality, the von-Neumann Morgenstern utilities may be parametrized as follows. Let β be the base payoff to the parents from having a single boy, and let $\beta+\rho_b$ be the total payoff from having a boy who is successful in finding a partner. That is, ρ_b is the additional payoff from successful mating. Similarly, let γ be the payoff to the parents from having a single girl and let ρ_g be the additional payoff in the event that this girl finds a partner. Let r be the ratio of girls to boys in the population. We shall assume that every member of the scarcer sex gets a partner, while every member of the more abundant sex has an equal chance of getting a partner. The expected payoff to the parents from having a boy is given by

$$U(r) = \beta + \min\{r, 1\} \rho_b. \tag{1}$$

While the payoff from having a girl is given by

$$V(r) = \gamma + \min\left\{\frac{1}{r}, 1\right\} \rho_g. \tag{2}$$

Let us now consider parental choice. When the mother has a child, this is a girl or a boy with equal probability. On observing the sex of foetus (or embryo or child) the parents can pay a cost c and exercise the option of trying once again. In this event, they once have an independent draw where the probability of a boy is one-half. Once again, if they are unsatisfied with the outcome of the new draw, they can again pay a cost of c and try again.

Our assumptions on preferences imply that $\beta > \gamma$ and $\beta + \rho_b > \gamma + \rho_g$. The preference for boys may reflect the greater earnings potential of boys or cultural values. Assume further that $\beta < \gamma + \rho_g$, so that reproductive value is sufficiently important that a married girl is preferable to a boy who is doomed to remain single.

Consider first the case where the cost c is large, i.e. $c \geq \frac{\beta+\rho_b-\gamma-\gamma_g}{2}$. In this case, it is easy to see that the equilibrium sex ratio r will be 1, so that there are equal numbers of boys and girls. To verify this, observe that at a balanced sex ratio, both sexes have equal reproductive value, since any individual is matched with probability one. Thus the expected gain in value for a parent who chooses to try again is $\frac{\beta+\rho_b-\gamma-\rho_g}{2}$, which is less than c. Nor can there be any other equilibrium – if $r < 1$, then the gain from having a boy is even smaller, and thus exercising the option to try again cannot be optimal.

Let us now assume $c < \frac{\beta+\rho_b-\gamma-\rho_g}{2}$. In this case it is clear that $r = 1$ cannot be an equilibrium, since the value of trying again is greater than the cost. Let the expected exante utility from a child be denoted by $EU(r)$. At an interior equilibrium (i.e. at $r \in (0, 1)$), it must be the case that a parent is indifferent between accepting a girl child and trying again, i.e.

$$EU(r) - c = V(r). \tag{3}$$

Substituting for $EU(r)$, one gets the basic indifference condition:

$$U(r) - V(r) = 2c. \tag{4}$$

The intuition for this condition is straightforward: by exercising choice when one has a girl, a parent gets a half chance of an improvement in value from $V(r)$ to $U(r)$. Indifference requires that this equals the cost c. By substituting for the values of $U(.)$ and $V(.)$, one gets the equilibrium sex ratio as

$$r^* = 1 - \frac{(\beta + \rho_b - \gamma - \rho_g) - 2c}{\rho_b}. \tag{5}$$

That is, if $c < \frac{\beta+\rho_b-\gamma-\rho_g}{2}$, the equilibrium sex ratio is biased against girls.

Let us now examine the welfare implications of parental choice. We assume a non-paternalistic welfare evaluation. Since all parents are exante identical (before the realization of the sex of their child), we take as our welfare criterion the expected exante utility of a typical parent – this also equals the sum of realized utilities in this society. Note that we do not assume that r now corresponds to an equilibrium. Thus welfare is given by

$$W(r) = \frac{1}{1+r}U(r) + \frac{r}{1+r}V(r) - c\frac{1-r}{1+r}. \tag{6}$$

The first two terms are straightforward – a proportion $\frac{1}{1+r}$ of parents have boys, and get utility $U(r)$, while the remainder have girls and utility $V(r)$. To account for the total cost associated with trying again for a boy, suppose that a fraction λ of parents who have girls after the initial attempt keep trying until they get a girl. The expected cost associated with such a policy is given by the infinite summation $c + \frac{c}{2} + \frac{c}{4} + ..$, yielding $2c$. λ must equal $\frac{1-r}{2(1+r)}$ in order to have the sex ratio r.

We shall henceforth restrict attention to values of r less than 1. The derivative of social welfare with respect to r is given by

$$\frac{\partial W}{\partial r} = \frac{V(r) - U(r) + 2c + (1+r)[U'(r) + rV'(r)]}{(1+r)^2}. \tag{7}$$

At the equilibrium, $V(r^*) - U(r^*) + 2c = 0$, which implies that welfare is increasing in r at r^* (since $V'(r) = 0$ and $U'(r) = \rho_b$). Indeed, weflare is always increasing in r as long as $r < 1$.

$$\frac{\partial W}{\partial r} = \frac{\gamma - \beta + \rho_b + \rho_g + 2c}{(1+r)^2} > 0. \tag{8}$$

Thus the welfare optimal level of r is 1, i.e. when the sexes are balanced. Of course, this cannot be an equilibrium sex ratio – given the economic advantage of boys, parents have an incentive to have more of them. Some intuition for why market equilibrium is not welfare optimal is as follows. Suppose that a small fraction λ of parents who have had girls decide to try again and have boys. This implies that a fraction 2λ of boys will be without a partner – since there is now an excess of boys, and also those boys who would have been partnered by the these girls will also not be partnered. However, this cost is shared amongst all the boys, not just by those of the parents who have exercised choice. That is, there is a congestion externality in the marriage market which is not taken into account by parents who exercise choice.

We have assumed that there is no transferability of utility in the marriage market. If girls are on the short side, then when a girl matches with a boy with a boy who would be otherwise unmatched, she confers on him a payoff gain of ρ_b. Implicit in this the assumption of non-transferable utility – that the girl cannot extract her scarcity value via a payment. We shall relax this assumption shortly. Hoever, note that credit constraints may restrict extraction exante via a bride price, while there maybe an inability to commit to flow payments after marriage. If these constraints are important, then even with a bride price, agents on the long side of the market will get a part of the surplus. This explains several marriage institutions, such as multiple matches across the same pair of extended families. For example, often a brother and sister from one family will be married to a sister and brother from another extended family, allowing a bartering of favours. It also explain the phenomenon of marriage between cousins or between an uncle and neice, that is common both in Pakistan and in Southern India. Although there is a cost associated with marrying a close relative (due to genetic defects), there is a benefit since this increases the reproductive success of a relative.These considerations can arise in small populations even if the expected sex ratio is unbiased. [2]

To summarize: parental choice results in a sex ratio with excessive males if the economic value of males is greater than that of females. Allowing choice reduces gender bias – since there is an excess of males, they now have lower reproductive value. Indeed, if the cost of exercising choice, c, is zero, gender bias is eliminated altogether. However, the exercise of choice reduces aggregate welfare – if society could prevent the exercise of choice, all parents would be better off.

We now consider the implications of changes in c upon welfare. Equation (5) shows that the equilibrium sex ratio, r^*, increases with c. Let $W^*(c)$ denote equilibrium welfare as a function of c, i.e.

$$W^*(c) = W(r^*(c)). \tag{9}$$

Thus the derivative of equilibrium welfare with respect to c is given by

$$\frac{dW^*}{dc} = \left.\frac{\partial W}{\partial r}\right|_{r^*} \frac{\partial r^*}{\partial c} + \left.\frac{\partial W}{\partial c}\right|_{r^*}. \tag{10}$$

Now,

$$\left.\frac{\partial W}{\partial r}\right|_{r^*} = \frac{\rho_b}{1+r}, \tag{11}$$

$$\frac{dW^*}{dc} = \frac{\rho_b}{1+r}\frac{2}{\rho_b} - \frac{1-r}{1+r} = 1. \tag{12}$$

We conclude therefore that an increase in c which makes parental choice harder increases welfare.

[2] Perry et. al . (2006) argue that genetic mixing in order to avoid parasites rather than the need to avoid deleterious mutations is the main reason for sex. A little sex suffices to ensure mixing, and from this point of view, a strategy where one occasionally mates with related individuals, when they are unable to obtain mates, will increase fitness.

To summarize: in this section we have analyzed parental choice under the assumption that there are no transfers (dowry or bride price) in the marriage market. If boys have sufficiently greater value than girls (for economic or cultural reasons), relative to the costs of exercising choice, then the equilibrium sex ratio must be unbalanced, so that the reproductive value of boys is reduced sufficiently. This reduces aggregate welfare; essentially parental choice results in a congestion externality in the marriage market. Technological progress that increases parental choice is also liable to be welfare reducing.

3 A Bride Price System: Walrasian Markets

We have assumed that there are no transfers possible in the marriage market. Suppose that the more abundant sex (boys) compete for the scarcer sex by making transfers, say a bride price. We analyze a bride price system under two possible situations. We first consider a frictionless market, where the ex-post marriage market is Walrasian. Our focus is on a rational expectations equilibrium, where parents make their initial choices (regarding gender) anticpating a bride price, that in turn equals the realized bride price.

Let t denote the transfer from boys to girls, i.e. the bride price. Now in a Walrasian market, one must have $t = \rho_b$ if $r < 1$ and $t = -\rho_g$ if $r > 1$.If $r = 1$, then any $t \in [-\rho_g, \rho_b]$ is a market clearing price. Let us now consider a rational expectations equilibrium, where parents at date 1 (the time the child is born) correctly forecast a t^*, and where the choices they exercise results in a sex ratio r^* such that t^* is a Walrasian price given r^*. We show first that the sex ratio cannot be unbalanced in a rational expectations equilibrium. Suppose that $r^* < 1$, so that $t^* = \rho_b$. In this case, any parent who has a girl strictly prefers not to exercise choice, since we have assumed that $\beta - \gamma < \rho_b$. So r^* cannot be less than one. Similarly, one cannot have $r^* > 1$.

We now show that there is a continuum of rational expectations prices that support a single allocation, the one with a balanced sex ratio, where the equilibrium transfer t^* satisfies

$$\frac{(\beta - \gamma) - 2c}{2} \leq t^* \leq \frac{(\beta - \gamma) + 2c}{2}. \tag{13}$$

To verify that this is indeed an equilibrium, note that the bounds lie within the interval $[-\rho_g, \rho_b]$, so that the equilibrium price is Walrasian. Furthermore, if the inequality is satisfied, a parent who has a girl will not find it optimal to exercise choice, and the same is true for a parent who has a boy.

Notice that a Walrasian equilibrium permits gender bias – t^* may be such that parents are better off with a boy or for that matter, a girl.

To summarize, with a Walrasian marriage market, the unique rational expectations equilibrium allocation is one where no parent exercises choice. This outcome is socially efficient. There is an interval of prices, each one of which supports this allocation.

4 Frictional Matching

The Walrasian model has an unattractive property that the equilibrium price moves discontinuously with the sex ratio r. Marriage markets are hardly centrally organized, and idiosyncratic factors play an important role in partner choice. We therefore consider decentralized matching, with the bride-price being the outcome of bargaining. Let us now consider a frictional matching mode, as in Rubinstein and Wolinsky (1985). Let x denote the measure of the stock of girls in the market and normalize that of boys to 1. Let $\alpha(x)$ be the arrival rate of matches for a girl, where $\alpha'(.) < 0$. Thus the arrival rate of matches for a boy is $x\alpha$, which is assumed to be increasing in x, i.e. $\alpha'(.) > -\alpha/x$. When a match is arranged, there is a bride-price t that is paid from the boy to a girl. Since we are assuming transferable utility, the sum of the reproductive values from a match is all that matters. Let $\rho = \frac{\rho_b+\rho_g}{2}$. Let i denote the interest rate, so that the values of a matched boy and a matched girl are given by

$$U^m = \frac{\beta + \rho - t}{i}, \tag{14}$$

$$V^m = \frac{\gamma + \rho + t}{i}. \tag{15}$$

The value of a single boy is therefore given by

$$U(x,t) = \frac{\beta}{i} + \frac{x\alpha}{x\alpha + i}(\rho - t). \tag{16}$$

While the value of a single girl is given by

$$V(x,t) = \frac{\gamma}{i} + \frac{\alpha}{\alpha + i}(\rho + t). \tag{17}$$

We assume that the bride price is determined by Nash bargaining between the two parties. That is the equilibrium bride price t^* is such that

$$U^m(t^*) - U(.x, t^*) = V^m(t^*) - V(x, t^*). \tag{18}$$

Solving for an equilibrium, one gets

$$t^*(x) = \frac{\rho\alpha(1-x)}{\alpha(1+x)+2i}. \tag{19}$$

This gives the equilibrium values as

$$\tilde{U}(x) = \frac{\beta}{i} + \frac{2\rho\alpha x}{[\alpha(1+x)+2i]i}. \tag{20}$$

$$\tilde{V}(x) = \frac{\gamma}{i} + \frac{2\rho\alpha}{[\alpha(1+x)+2i]i}. \tag{21}$$

With parental choice, has the same equilibrium condition, i.e. the sex ratio (in stocks) x must be such that the difference between $\tilde{U}(x)$ and $\tilde{V}(x)$ equals $2c$. This gives us the equilibrium sex ratio, x^*, which must be less than 1 if $\beta - \gamma > 2c$.

We now turn to the implications for the flow of births. Let us assume that the flow of new births is exogenously given at g, and let θ be the fraction of births that are girls. Let μ be the measure of the stock of boys, and assume that the instantaneous death rate is δ. Thus the steady state flows must satisfy

$$\alpha x\mu + \delta\mu = (1-\theta)g. \tag{22}$$

$$\alpha x\mu + \delta x\mu = \theta g. \tag{23}$$

Solving these equations, we get θ, the proportion of new births that must be boys, as

$$\theta(x) = \frac{g + \delta\alpha(x-1)}{2g}. \tag{24}$$

That is, if x^* is the required sex ratio in the stock of the unmatched, the implied sex ratio in the flow of births is given by $\theta(x^*)$.

Turning to welfare, let us consider the expected welfare of the parent as a function of $x, W(x)$. This is given by

$$W(x) = (1-\theta)\tilde{U}(x) + \theta\tilde{V}(x) - (1-2\theta)c. \tag{25}$$

$$W'(x) = (1-\theta)\tilde{U}'(x) + \theta\tilde{V}'(x) + \theta'(x)[\tilde{V(x)} + 2c - \tilde{U}(x)]. \tag{26}$$

Evaluating this at x^*, the equilibrium sex ratio, $\tilde{U}(x^*) - V(x^*) = 2c$, so one obtains

$$W'(x)|_{x^*} = (1-\theta)U'(x) + \theta V'(x). \tag{27}$$

Now since $\theta^* < 0.5$ and $\tilde{U}$ is increasing in x whereas V is decreasing, a sufficient condition for the positivity of the above expression is that the unweighted sum of utilities, $\tilde{U}(x) + V(x)$, is increasing in x. This sum is given by

$$\tilde{U}(x) + \tilde{V}(x) = \frac{\beta + \gamma}{i} + \frac{2\rho\alpha(1+x)}{[\alpha(1+x) + 2i]i}. \tag{28}$$

This is increasing provided that $\alpha(1+x)$ is increasing in x when $x < 1$. But $\alpha(1+x)$ is simply the sum of the arrival rates of matches for boys and girls, which by assumption is increasing in x as long as $x < 1$. We conclude therefore that welfare is increasing in x at x^*, i.e. the equilibrium proportion of girls is too low from a welfare point of view. Note that with frictional matching it is no longer necessarily true that $x = 1$ is socially poptimal. To summarize: with frictional matching, the equilibrium sex ratio need not be balanced. Also, parental choice results in an inefficient outcome, with too many boys, since parents do not internalize the congestion externality in the marriage market.

5 Conclusions

We have examined the implications of parental choice regarding the sex of their child, in context where boys may be valued more than girls. In the absence of prices, parental choice results in too many boys, and reduces welfare. Bride prices in a Walrasian marriage market can result in an efficient outcome with a balanced sex ratio; however, if matching is subject to frictions, the results are qualitatively similar to the case without prices.

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