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The empowerment of women, fertility, and child mortality: Towards a theoretical analysis

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Abstract. This paper examines one avenue through which female autonomy impinges on fertility and child mortality in developing countries. A simple model is set out in which couples are motivated to have children for old age security purposes. The decisions of a couple regarding fertility and allocation of resources for the healthcare of their children are made within a bargaining framework. An increase in female autonomy translating into an increase in the relative bargaining power or the threat point utility of mothers is shown to reduce fertility and also to reduce child mortality rates. Paradoxically, the increase in female autonomy within a household may increase the disadvantage suffered by female children in that household with respect to survival.

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1. Introduction

It is becoming increasingly clear that fertility and child mortality in developing countries are causally related to the autonomy of women inside and outside

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their homes. In a district-wise analysis of the 1981 Census data of India, Murthi et al. (1995) found that the variables pertaining to women's agency (female literacy and female labour force participation, in particular) significantly explained variations in child mortality, fertility, and gender inequality in child mortality. Dyson and Moore (1983) have proposed that female autonomy is a key factor in explaining some important differences in the recent demographics between the northern and southern states of India. Compared to the southern states of India, the northern states are characterized by relatively high fertility rates, child mortality rates, and male-to-female sex ratios. Dyson and Moore have forcibly argued that these differences may have a great deal to do with the fact that northern Indian women enjoy considerably less autonomy than their southern counterparts, and that this stems from the different kinship systems prevailing in the north and the south. This view on the role of kinship has been persuasively corroborated by the statistical analysis of Kishor (1993). Based on the existing evidence, in a recent essay Sen (1997) has argued that the emancipation of women in developing countries would be a better route to fertility reduction than would placing authoritarian limits on family size. Mason (1993) has outlined the various hypotheses linking female autonomy to fertility and child mortality, and has also surveyed the available evidence in support of these hypotheses.[1]

This paper attempts to formally model some aspects of the empowerment of women within the household in a developing country and to investigate how changes in the bargaining power of women might impinge on a couple's fertility and the incidence of child mortality. It is presumed that couples are motivated to have children for security in old age. A bargaining framework is set out in which the decisions regarding a couple's fertility and its allocation of resources towards the healthcare of children are determined by the relative bargaining powers of the mother and the father. It is argued here that the costs associated with having children are distributed disproportionately between mothers and fathers, with mothers bearing a larger share of the burden. It is demonstrated that an increase in female autonomy, by bringing in its wake decision-making more in line with the preferences of women, is accompanied by a decline in fertility. Furthermore, there is a simultaneous reduction in child mortality due to an increase in the allocation of resources for children's health. It is also shown that the reduction in fertility and child mortality accompanying the increase in female autonomy are interrelated: they are both aspects of the optimal provision of old age security from the mothers' perspective. Thus the empowerment of women is seen to be a potentially important factor in hastening the demographic transition from high to low fertility rates in developing countries.

There are many avenues through which female autonomy may impinge on fertility and child mortality (Mason 1993). This paper, however, takes a rather modest approach: in attempting to provide a theoretical link between female autonomy, fertility and child mortality it singles out for analysis only one such avenue, namely, the differential costs of fertility borne by mothers and fathers.

As mentioned above, it is assumed here that fertility is motivated by old age security concerns, as is the case in many present-day developing countries (Cain 1981, 1983).[2] This is particularly true of countries in south Asia. In the relative absence of capital markets, children are viewed as the best form of saving for old age (Neher 1971, Zhang and Nishimura 1993). Even when

avenues for saving are available, children are not entirely dispensable since there are countless contingencies in which adult children can be of assistance to their aged parents. The number of children (and, indeed, their sex-composition) is an important component of the family-building strategy in developing countries for securing a comfortable old age.

The probability of the death of a child is not unalterably fixed; greater expenditure on the food and the healthcare of children will lower child mortality. This, no doubt, is part of the reason why child mortality rates are lower among the affluent than among the poor (World Development Report 1993). Even when incomes are low, however, there is considerable discretion parents can exercise in the allocation of resources between their own consumption and their children's consumption and healthcare. In other words, parents have some control over the mortality rates of their children through expenditures on mortality-reducing healthcare, as has been recognized and formally modelled by Cigno (1998).

The allocation of expenditures deemed optimal by parents between their own consumption and those of their children will differ for fathers and mothers. The reason has to do with the fact that, while the benefits of old age security from surviving children are more or less shared equally by fathers and mothers, the costs of childbearing are borne largely by mothers. There is clearly an income loss to mothers during the period they are unavailable for work due to pregnancy, childbirth and childrearing. It is assumed here (as is frequently true in developing countries) that the income of the mother is pooled with that of the father; so that the cost of income foregone by the mother due to childbearing and childrearing is equally shared by the father and mother. Dropping this assumption would only reinforce the results of this paper. There is, however, a more important cost of family-building to the mother which is not shared by the father. This is the damage to health incurred by the mother – especially in developing countries – in childbearing.

The health problems associated with childbearing reduce the quality of life of mothers. The most extreme form of the ill-effects of childbirth is, of course, maternal mortality. In developing countries, maternal mortality rates are often an order of magnitude higher than those in the developed countries. For example, in India the maternal mortality rate has been estimated to be 555 per 100,000 births (Mari Bhat et al. 1995). Furthermore, for every Indian woman who succumbs to maternal mortality there are about 20 women whose health is impaired due to pregnancy-related causes (Jejeebhoy and Rao 1995). Some of the conditions contributing to maternal mortality and morbidity are sepsis, anaemia, haemorrhage, toxaemea, pelvic inflammatory diseases, gynaecological disorders and infections (Jejeebhoy and Rao 1995).

In patriarchal developing societies, men exercise a disproportionate degree of control over family decisions relative to the extent to which they bear the costs of these decisions. There is, thus, within the family a fundamental externality which renders fertility and child mortality excessive relative to what would be deemed optimal when the interests of the mother and the father are weighted equally. Since the father bears a negligible share of the cost of bearing children and only a small share in raising them, he would prefer to have more children than would the mother. Furthermore, he would prefer to allocate less resources than the mother would for the healthcare of these children because the costs of higher fertility in anticipation of child mortality are largely borne by the mother. Mothers would prefer to have fewer children but

of better health (higher "quality") than would fathers. Thus, an increase in the bargaining power of the mother within the household, *ceteris paribus*, would result in a decline in fertility and in the child mortality rate. This effect will be reinforced, when the child mortality rate falls, by a further reduction in fertility induced by a decline in the need of risk-averse parents to "hoard" children.[3]

The result described above offers an independent explanation for the inverse correlation that is frequently found between fertility and child mortality during the demographic transitions of developing countries. In this explanation, it is not a reduction in child mortality *per se* which generates a decline in fertility; rather, both these reductions are aspects of the optimal strategy of the more empowered women to provide old age security for themselves and their spouses.

It is argued here that, if the possibility of investment in the education of children is allowed for, children are more likely to be educated when the bargaining power of mothers relative to that of their fathers is high than when it is low. The reason has to do with the fact that the survival probability of children is higher (and therefore the investments in children's education are better protected) in the former case, thereby providing a greater incentive to invest in the education of children.[4] Indeed, one would expect to observe a complementarity between the incentives to invest in children's health and in their education. On the one hand, better health would invite greater educational investments in children since the expected return to education would be higher. On the other, better education would invite greater protection of this investment through higher expenditures on healthcare. While this would be true irrespective of whether it is the mother or the father who dictated fertility and healthcare decisions, the effect would be stronger when it is the mother who dictates these choices. Thus greater female autonomy is likely to result in a virtuous circle leading to greater investments in the human capital (health and education) of children. The essential reason is that greater empowerment of women transfers control over the decision-making into the hands of those who bear the greater costs of having children.

In societies where old age security is provided mostly by sons and rarely by daughters (as in south Asia) or sons are at a premium for cultural reasons (as in east Asia), female children are discriminated against in terms of healthcare expenditures. This is an important reason why the sex ratio in many developing countries is highly skewed in favour of males. Parental preferences regarding the sexual composition of children and their attempts to implement these preferences by deciding when to cease from having more children cannot influence the sex ratio (see for example, Seidl (1995)). To explain the observed sex ratios in many developing countries, one has to acknowledge that daughters are discriminated against in favour of sons in terms of the allocation of nutrition, healthcare expenditures, sex-selective abortions, and infanticide. For the empowerment of women to have entirely benign effects in these circumstances, however, it is important that female autonomy must extend beyond the household: it must enable daughters to be of assistance to their aged parents or militate against the cultural preference for sons. In the absence of this, it is argued here on the basis of the results of the model that increases in female autonomy may not always have entirely benign effects. In particular, an increase in the bargaining power of the mother, *ceteris paribus*, may increase the healthcare expenditures on sons at the expense of those on

daughters. In other words, the disadvantage faced by daughters in their chances of survival may be exacerbated when the autonomy of mothers increases.

The outcome alluded to above is consistent with the empirical findings of Das Gupta (1987), who found in the district of Ludhiana in Punjab, India, that the education of women reduced child mortality rates but increased the disparity between the mortality rates of female children of high order and the remaining children. The argument is also consistent with the more recent evidence Das Gupta and Mari Bhat (1997) have presented: in India (1981–1991), the ratio of male births to female births has increased despite a reduction in fertility rates. The phenomenon of an increase in the sex-ratio in favour of male children accompanying a decline in fertility is also observed in South Korea (Park and Cho 1995) and China (Hull 1990; Zeng et al. 1993).

In the next section, a simple model is laid out in which a couple's fertility and allocation of resources for their children's healthcare are determined within a bargaining framework. The consequences for fertility and child mortality of increases in the mother's bargaining power are analyzed. The implications of the model for the education of children and for gender-based differences in child mortality are discussed in Sect. 3. The conclusions of the paper are presented in Sect. 4.

2. A simple model and some results

Each individual is assumed to live for a maximum of three periods. In the first period, the person is a child and in the second the person is an adult. All adults are assumed to marry. Each adult earns an income and, if female, is fertile. In the third period, the person is retired and lives off the income transferred from his/her children.

In the adult phase of their lives, couples are confronted with the decision of how many children to have for the purpose of old age support. The possibility of child mortality will importantly impinge on this decision, since only surviving children will be of such use in the old age of parents. The only mortality considered here is child mortality, namely, the event where a person does not go on to live in period 2 of his/her life. It is child and young-adult mortality rather than infant mortality that is relevant here. More precisely, the emphasis here is on children who survive early childhood but fail to survive long enough to provide old-age security to their parents. To maintain this focus, infant fatalities are assumed to be negligible.

It is possible to obtain a rough idea of the magnitude of the relevant probability for developing countries. Using mortality tables, Murray et al. (1992, Tables 2–6) have computed that for India over the period 1970–1983, the proportion of fifteen year old males (females) who failed to survive till they were sixty was 32.8% (29.4%).[5] In other words, during 1970–1983 approximately one out of every three male children in India who lived long enough to be able to go through school died before providing old-age security for his parents for the entire length of their retirement.[6] The above source also reveals considerable variation in these proportions across the Indian states: the above proportion for males (females) goes from a maximum of 39.0% in the state of Orissa (37.4% also in Orissa) to a minimum of 20.7% in the state of Punjab (16.4% in Kerala). These are state-wide averages, covering urban

and rural areas. One would expect the relevant proportions for rural areas to be higher than these averages because of the limited availability of rural healthcare facilities.

For an individual couple, the probability of child survival has exogenous and endogenous components. The exogenous component will depend on the natural resilience of the body and on the extent of public provision of healthcare services. The endogenous component will depend on the expenditure on food and private healthcare services, h, devoted by the parents to each child. Thus the survival probability of a child, q, will be an increasing but strictly concave function $q(h)$ of the healthcare expenditure per child. The strict concavity of $q(h)$ reflects the fact that additional amounts of healthcare expenditures exhibit diminishing returns. Let n denote the number of children the couple has. We shall take n to be a continuous variable, as in Cigno (1998). If the survival of children are independent events, as is assumed here, the number surviving to adulthood, m, can taken to be given with certainty by $m = nq(h)$.[7]

Let $u^W(c)$ and $u^H(c)$ denote the utility derived by the wife and the husband, respectively, in a period in which their own joint consumption is c. It is assumed here for convenience that the consumptions of the wife and husband are nonrivalrous.[8] Let y denote the joint income, assumed exogenous, of each couple. We shall take it that family, social, and cultural conventions dictate that a fraction α of this income is transferred to one's parents for old age support. It is assumed here that all surviving children contribute to their parents' upkeep, not just survivors of a given sex.[9] Let b denote the exogenous (non-discretionary) cost per child that needs to be incurred by a couple on each child. This cost would include expenditures on necessities, and can also include the income foregone by the mother during childbirth.[10]

The assumption that children (who may be selfish) transfer a proportion of their incomes as adults without fail to their parents is invoked for tractability but warrants comment. To address the issue of empowerment of women, the focus of attention is on the interaction between husband and wife, and the interaction between children and parents is sidelined. In other words, the modeling of gaming within a generation comes at the expense of gaming across generations. However, this assumption can be justified by appealing to the work of Cigno (1993). He demonstrates that intergenerational transfers can be rendered incentive compatible by 'family rules' that prescribe the obligations of the adults of each generation: the amount of resources to spend on children and to transfer to parents. If adults default on their obligations, their children are required by the family rule to default on their obligations to their parents. Cigno (1993) argues that such an arrangement generates self-enforcing equilibria. In the context of this paper, we could say that the extended family rule specifies that adults transfer a fraction α of their income to parents, or else their children are required to default, too. The family rule serves here as a credible vehicle for implementing sanctions against bad behaviour. This is a particularly plausible scenario in the absence of capital markets or state-sponsored pension plans. (This, of course, is precisely the scenario in which the old age security motive for children is relevant.)

If a couple has n children and incurs a discretionary expenditure on (food and) healthcare expenditures of h on each child, the expected utilities $U^W(n,h)$ of the wife/mother and $U^H(n,h)$ of the husband/father, respectively, are given by:[11]

$$U^W(n,h) = u^W[(1-2\alpha)y - n(b+h)] + u^W(\alpha ynq(h)), \tag{1a}$$

$$U^H(n,h) = u^H[(1-2\alpha)y - n(b+h)] + u^H(\alpha ynq(h)). \tag{1b}$$

The first term on the right hand sides of each of the above expressions represent the utilities of the respective parent in the current period. This depends on their consumption, which is determined by the income left over after they meet the obligations towards their parents and after they incur the expenses of bearing and raising their children. The second term represents the (expected) utility in old age.[12] Since the consumption of fathers and mothers are taken to be non-rivalrous, they share equally the old age benefits offered by their children.[13] The event that no child survives to adulthood is deemed an extremely unpalatable prospect to parents in many developing countries, since it normally means either dependence on distant relatives or working when one is aged.[14]

It is a premise of this paper that women bear a greater cost than men in arranging for old age security through children. The income loss to women during the period when they are bearing and rearing children has already been captured through the cost parameter b. This loss of income is shared by the father as well, since it is assumed here that husbands and wives pool their incomes. As argued in the Introduction, a far greater personal cost to the mother of childbearing is the attendant loss of health. The higher a woman's fertility the greater is the damage to her health. A simple way to analytically capture the attenuation of the mother's physical well-being with fertility is to introduce in her utility function a multiplicative term which decreases with her fertility. In the absence of such an effect, it may have been reasonably assumed that $u^W(c) = u^H(c)$ so as to facilitate a natural comparison between the levels of well-being of the father and the mother. To explicitly capture this "maternal depletion" effect, it is assumed here that

$$u^W(c) = D(n)u^H(c), \quad \text{where } D(0) = 1,$$

$$D(n) > 0 \text{ and } D'(n) < 0 \text{ for all } n. \tag{2}$$

The multiplicative factor $D(n)$ captures the extent to which the mother's well-being is eroded relative to the father's by repeated childbirth. For a wife who never bore any children, the utility is identical to the husband's for same consumption levels. This equality pivots the analysis by facilitating the isolation of the effect of childbirth on the mother's relative well-being.

In order to ensure the optimal old age support for themselves, in the working period of their lives couples have not only to choose their fertility but also to decide on how much healthcare expenditure to incur on each child. In view of the differential costs borne by them, the optimal number of children and the optimal healthcare expenditure per child will differ for the father and the mother. If all the decision-making power were vested with the mother/father, she/he would choose the fertility and the healthcare expenditure per child so as to maximize (1a)/(1b). The following result can be derived for these extreme scenarios:

Proposition 1.

(a) *For a given fertility, the optimal expenditures on a child's healthcare are the same from the mother's and the father's perspectives.*

(b) *At the optimum of either parent, fertility and healthcare expenditure per child are perceived as substitutes.*
(c) *The optimal fertility (healthcare expenditure per child) from the mother's perspective is less than (greater than) that from the father's.*

Proof. See Appendix.

Higher expenditure on a child's healthcare will curtail the couple's present consumption but increase their future utility by enhancing their children's chances of survival to adulthood. If fertility is given, the optimal expenditure on a child's healthcare will be determined by the tradeoff between the decision-making parent's present consumption and future consumption obtained through the surviving children. Since the mother's utility is taken to be an attenuated version of the father's as in (2), this tradeoff between present and future consumption is the same for the mother and the father, explaining part (a) of Proposition 1. This result implies that if mothers and fathers end up with different healthcare expenditures per child, it is not because they *a priori* put different weights on the survival of children.

An increase in fertility at current levels of healthcare expenditure per child will increase the couple's future consumption by increasing the expected number of survivors, thereby lowering the marginal utility of future consumption. Since healthcare expenditures safeguard future consumption at the expense of present consumption, fertility increase lowers the marginal worth of healthcare expenditure. In other words, fertility and healthcare expenditures per child are perceived by parents as (imperfect) substitutes in the provision of a more secure future: if one is parametrically increased, the other decreases. This explains part (b) of Proposition 1. This result is reminiscent of that derived by Cigno (1998), where he demonstrates that, when parents can improve the survival chances of their children by spending more money on their health, nutrition, etc., there can be a positive correlation between the number of births and infant mortality. Part (c) of the proposition follows immediately from the fact that, while the benefits to higher fertility are equally shared by both parents, the costs to the mother increase disproportionately.

It is only in extreme scenarios that one of the partners unilaterally makes the decisions for the couple. It is important to accommodate the possibility that the decision-making is shared, although the partners may carry different weights in the process. Let the relative bargaining power of the wife be denoted by the parameter γ $(0 \leq \gamma \leq 1)$ and that of the husband by $(1 - \gamma)$. When $\gamma = 0$ $(\gamma = 1)$, all the decision-making power is vested with the husband (wife). Kinship systems that undermine the social and economic roles that women could play – in the manner discussed by Dyson and Moore (1983), for example – would result in low values of γ, whereas those that allow women greater autonomy would result in higher values of γ. It may be noted that, in societies with the kinship systems of the type that prevail in South Asia, $(1 - \gamma)$ may be interpreted as the relative bargaining power of the entire natal family of the husband since the wife is frequently vying with her mother-in-law for control over decisions (see Basu 1995).

When the relevant decisions are made unilaterally by one member of the couple (that is, when γ takes on a value at either extreme of its range), the choices made maximize the utility of the decision-maker. It will be assumed here that for intermediate values of γ the decisions are the outcome of bar-

gaining between the husband and the wife and that this outcome is given by the solution to the Nash Bargaining problem, in the tradition of household bargaining models (Manser and Brown 1980; McElroy and Horney 1981; Lundberg and Pollak 1993). It is convenient, however, to adopt the asymmetric Nash bargaining solution here.[15] The fertility and the healthcare expenditure per child, then, is determined as those which solve:

$$\max_{n,h}[U^W(n,h) - \overline{U}^W]^{\gamma}[U^H(n,h) - \overline{U}^H]^{1-\gamma}, \tag{3}$$

where $\overline{U}^W$ and $\overline{U}^H$ denote the threat points of the father and mother, respectively. These threat point utilities represent the utilities of the mother and father in the scenario where bargaining breaks down between them and the outcome that obtains is a noncooperative one. Education of women and/or their participation in the labour force is likely their threat point.

In the case of marriage, it is not immediately clear what the noncooperative outcome is.[16] Divorce is one possibility, and this is the interpretation of Manser and Brown (1980) and of McElroy and Horney (1981). It is also possible that, when bargaining breaks down, the noncooperative equilibrium is one in which there is no divorce but the husband and wife provide their inputs noncooperatively. This is the interpretation favoured by Lundberg and Pollak (1993). In developing countries, where divorce is rare, the latter may be the more appropriate interpretation. In any case, modeling either of these scenarios would warrant considerations that are beyond the scope of this paper. Consequently, these threat points are taken to be parametric here.

It is clear that the solution to (3) is also the solution to the maximization of the logarithm of the objective function in (3):

$$\max_{n,h} \gamma\tilde{U}^W(n,h) + (1-\gamma)\tilde{U}^H(n,h),$$

$$\text{where } \tilde{U}^W(n,h) \equiv \ln[U^W(n,h) - \overline{U}^W],$$

$$\tilde{U}^H(n,h) \equiv \ln[U^H(n,h) - \overline{U}^H]. \tag{4}$$

In (4), $\tilde{U}^W(n,h)$ and $\tilde{U}^H(n,h)$ are redefined utility functions of the mother and father, respectively, given by the logarithms – which are monotone transformations – of the excess of the original expected utilities over their fallback utilities. It is apparent from (4) that the asymmetric Nash Bargaining solution maximizes the weighted average of the (redefined) utilities of the mother and father, with weights given by γ and $(1-\gamma)$, respectively. The optimal fertility and healthcare expenditure per child, therefore, will in general depend non-trivially on the relative bargaining powers of the mother and the father. Let $\{n^*(\gamma, \overline{U}^W), q^*(\gamma, \overline{U}^W)\}$ denote the solution to the above bargaining game. (Dependence on the husband's threat point has been suppressed, for brevity.)

Given its broad and pervasive nature, empowerment is a concept that does not lend itself to a unique characterization. On the one hand, an increase in the parameter γ (which would be associated with a cultural shift to more favourable kinship systems) can certainly be construed as empowering women. On the other, so can an increase in the wife's threat point utility, $\overline{U}^W$ (which would be associated with greater education, labour market participation,

ownership of assets, etc.). While it is not realistic to expect governments to be able to change kinship systems, changing the threat point utility of women is certainly within reach. The following result records the comparative static effect on the couple's choices of a change in either of these parameters.

Proposition 2. *The couple's fertility decreases, and expenditure on the healthcare per child increases, when*

(a) *the relative bargaining power of the mother within the household increases, and*
(b) *the threat point utility of the mother increases.*

Proof. See Appendix.

The above proposition demonstrates that, irrespective of whether empowerment of women is interpreted as an increase in the mother's bargaining power or as an increase in her threat point utility, the outcomes are the same. This proposition sharply brings out the differences in the strategies that are optimal for mothers and fathers in arranging for their old age security. Mothers, who bear a disproportionately high share of the costs of childbearing, tend to prefer relatively few children but would opt to allocate a substantial amount of resources to ensuring high survival probabilities for these children. Fathers, who bear a small share of the cost of childbearing, would prefer to have many children and to have less resources allocated to the healthcare of each child. If children with better health are deemed to be of 'higher quality', then it may be said that mothers and fathers prefer to trade off quantity versus quality differently: mothers put more emphasis on quality, and fathers more on quantity. This result formally establishes the claim that the empowerment of women is a factor that could hasten the demographic transition in developing countries. An immediate policy implication for developing countries with the problem of rapid population growth is that raising the threat point utility of women – a legitimate goal in its own right – would confer the benefit of alleviating the problem.

The results in Proposition 2 are consistent with the contrasting empirical regularities observed by Dyson and Moore (1983) between the northern and southern states of India: fertility rates and child mortality rates are significantly higher in the north than in the south. They have argued that kinship systems in northern India tend to circumscribe the autonomy of women, while those in the southern states are less constraining. The role of kinship has been further corroborated by Kishor (1993) in an empirical analysis of 1981 data from 355 districts in India. She found that patrilocal exogamy – the practice of forming marital alliances with spouses outside one's native village and the migration of brides to the residence of their in-laws – exhibited positive Pearson coefficents for correlations with male and female child mortality rates. It is reasonable to posit that, by separating brides from their natal families, patrilocal exogamy undermines the bargaining power of women. This practice is more prevalent in the northern rather than the southern states of India. Kishor also found a positive Pearson correlation coefficient between patrilocal exagamy and child-to-woman ratio (a measure of fertility).

The results in Proposition 2 are also consistent with the household expenditure study of Hoddinott and Haddad (1995) in which they identify how the

budget shares on various aggregates vary with the identity of the income earner. Using 1986–1987 data from Côte d'Ivorie, they find that an increase in the wife's share of cash income significantly increases the budget share of food and reduces the budget shares of alcohol and cigarettes. Using Brazilian data for 1974–1975, Thomas (1990) studied the effects of the identity of the owner of unearned income within the household on the family's health status. He found that unearned income accruing to the mother has a far greater effect on the family's health than that accruing to the father; the effect on child survival probabilities is 20 times larger.

There are many avenues through which the bargaining power of women may be improved. Education is a natural one. It is well-known that in the Third World, women's educational accomplishments are much lower than men's. Greater labour force participation by women is also likely to give them greater bargaining power within the household. Murthi et al. (1995) have recently shown in a district wise study done on India using the 1981 census data that an increase in the educational levels and the labour force participation of women have strong negative effects on fertility and child mortality. While there may be more than one reason why such correlations may be empirically observed, this evidence is consistent with the claims of Proposition 2.

Another important avenue through which women's bargaining power may be improved is by facilitating their ownership of assets like land (see, for example, Schultz 1997). In South Asia, particularly, any land owned by a family is usually held in the husband's name. Enabling wives to become asset owners would give them access to credit for production purposes, making them less economically dependent on their husbands. The remarkable performance of the southern Indian state of Kerala in the realm of fertility and child mortality reduction in recent decades (see Zachariah 1984) affords persuasive evidence in favour of this view. Kerala is unique in that it has had a history of matriliny and matriarchy among a substantial proportion of its population (Unny 1994). Even today, Keralite society is also matrilocal to a significant extent.[17] Furthermore, in sharp contrast to the strongly patriarchal societies of the rest of India (especially in the north) where women are excluded from the line of inheritance, women in Kerala tend to inherit and hold land and other assets. In 1991, the female literacy rate in Kerala was 86.9% (as opposed to an all-India average of 39.4%). One would expect that, in such a society, the bargaining power of the wife relative to the husband would be considerable. Thus, in 1991, the sex ratio (females to males) in Kerala was 1.040 whereas the national average for India was 0.929; the respective population rates of growth over the period 1981–1991 were 1.39% and 2.03% per annum; the infant mortality rates in 1989 were, respectively, 22 and 91 per 1000 (Bose 1991).

3. Implications for education and gender-based child mortality

In many developing countries, education is not compulsory – and even if it were made mandatory the law would be unenforceable. (See Weiner (1990) for an interesting and comprehensive discussion of the status of compulsory education in India.) Hence, for any couple, the number of children to be educated (if any) is in reality a matter of parental choice. In the simple model set out here, the possibility of educating children was assumed away. The conse-

quences of allowing for this possibility, however, may be easily discerned in the light of the above results. From the old age security perspective, the advantage to parents of educating a child is that the child will earn a higher income as an adult and hence will be able to provide more generous old age benefits. Educating children would normally increase the costs to parents of raising children. However, even in the extreme scenario where education is completely subsidized by the State, in many developing countries there is an opportunity cost to parents of educating their children, namely, the foregone income from child labour.[18] Parents could well expect higher expected returns from educated children than from uneducated ones, but because of child mortality they will perceive educated children to be riskier. In general, couples will opt for a mix of educated and uneducated children in view of this risk-return trade off.[19]

It has been seen above that mothers would prefer to have fewer children with high survival probabilities than many with poor survival chances. As a result, investments in the education of children are better protected when mothers' rather than fathers' preferences dictate fertility and children's healthcare expenditures. Since the expected returns to children's education are higher when the bargaining power of mothers is high relative to that of fathers, it follows that children are more likely to be educated in the former scenario. An increase in female autonomy, *ceteris paribus*, would therefore not only improve the health of children but would also increase their level of education. Indeed, there will be a complementarity between investments in the education and investments in the health of children: not only will parents perceive healthier children to be more profitable vehicles of educational human capital but, conversely, parents will also invest more in the health of their educated children in order to protect their higher earning potential. This positive feedback, however, would be stronger when the mother rather than the father makes the choices regarding fertility and the healthcare expenditures on the children since survival probabilities are higher in the former case for reasons that are independent of the incentives to educate. Thus, the differences in the perceptions of mothers and fathers regarding the trade-off between the quality and quantity of children have important implications for those societies in the Third World with low skill levels and high populations rates of growth.

The model presented above has so far assumed that *all* the surviving children of a couple will provide old age support and that parents have no preference for children of a given sex. In the developing countries of south Asia, in particular, this assumption is violated: old age security is expected mostly from sons. More generally, parents tend to have a strong preference for male children in many Asian societies, e.g., China, South Korea, Taiwan (see Schultz 1997 for a discussion on this). The consequences of relaxing the assumption invoked here that there is no preference over the sex of children, however, are plain enough. Formally, this amounts to making the parameter α of the model dependent on the sex of the child, and setting $\alpha = 0$ for daughters. If children are valued by parents only as pension plans and if daughters are of no perceived use in this regard, parents will tend to invest nothing in the health (and education) of daughters. It is well-known that female children are discriminated against on both these counts in south Asia. The higher child mortality rates and lower school enrollment rates for female children in these societies bear testimony to this discrimination. (See Kishor

(1995) for a comprehensive survey of the empirical evidence on gender differentials in child mortality in India.) (The fact that parents undertake some amount of investment in their daughters' health and education is due, of course, to the fact that old age security is the not the sole concern of parents in reality.)

It is interesting to inquire how the disadvantage faced by female children relative to male children in terms of survival will change when the bargaining power shifts from fathers to mothers. Following Murthi et al. (1995), female disadvantage may be defined as the excess of female child mortality over male child mortality, expressed as a fraction of female child mortality. (Thus defined, female disadvantage is a relative measure of the disadvantage faced by female children.) If children are valued only as vehicles of old age security, all of the expenditures allocated by a couple to healthcare will be directed to their male children. From Proposition 2, it follows that as the bargaining power of the mother increases, the healthcare expenditure on each male child will increase while that on each female child will remain at zero (in this model). Thus, as the bargaining power of the mother increases, the mortality rate of male children will decrease while that of female children will be constant at $q(0)$.[20] From this the following result immediately obtains:

Proposition 3. *When the relative bargaining power or the threat point utility of the mother increases relative to that of the father within the household*, ceteris paribus, *female disadvantage increases.*

The intuition for the above strong implication of the model is straightforward. If female children are perceived to bestow no benefits on their retired parents, they will receive no resources to enhance their survival chances whereas male children will. Since fertility declines when the mother's bargaining power increases, it is now seen to be even more important for parents to ensure the survival of the (fewer) male children. Hence, the relative disadvantage of female children increases.

The assumption that female children provide no old age support at all to their parents is, of course, extremely stark. More realistically, suppose that daughters are perceived by parents to be potentially of some assistance in old age but not as much as sons. Then in this model parents would expend discretionary resources even on daughters to enhance their survival prospects, but not as much as they would on sons.[21] An increase in the relative bargaining power or the threat point utility of mothers, *ceteris paribus*, would result in a decrease in fertility and certainly in an increase in the healthcare expenditure on each son. However, it could potentially also *decrease* that expended on each daughter so that these resources could be diverted to sons. When there are fewer children, the couple will perceive it to be more important to ensure the survival of the children who are deemed better assets. In this case, an increase in the bargaining power of mothers, *ceteris paribus*, could not only increase the relative disadvantage of female children but also their absolute disadvantage.

The implications of Proposition 3 and the argument made above are very strong, and for this reason the *ceteris paribus* qualification is extremely important. In the theoretical exercise conducted here, only the relative bargaining power or threat point utility of the mother *within the household* is increased; the socioeconomic position of women in society is presumed to be unaltered. In particular, what may be deemed the absolute status of women

in society is held constant here. If this were to improve significantly – to the extent that they can help their aged parents – daughters would begin to be increasingly seen as important economic assets by parents. The result of Proposition 3 will then not necessarily hold. Thus, an absolute increase in women's bargaining power in society can well be expected to decrease female disadvantage in both the absolute and the relative senses. This can be seen in the findings of Kishor (1993). She found that patrilocal exogamy was positively correlated with a measure of the survival disadvantage of female children relative to that of male children. In contrast, in their analysis of district-level census data for 1961 and a household survey data in 1971 for India, Rosenzweig and Schultz (1982) found that households allocated more resources to female children in regions with higher female employment.

Despite the above important caveat, however, Proposition 3 and the argument following it are not without empirical relevance. In her study of discrimination between children by sex and birth order in the district of Ludhiana in Punjab, India, Das Gupta (1987) found that while child mortality rates decreased with the education of the mother, the mortality rates of female children born to mothers who already have female children increased with the education of the mother. More recently, Das Gupta and Mari Bhat (1997) have shown that, associated with fertility declines in India over the period 1981–1991, child mortality rates have gone against girls in favour of boys. They separate two different effects, which operate on mortality rates in opposite directions. On the one hand, a reduction in fertility without a commensurate reduction in the desired number of male children intensifies the discrimination against female children. On the other hand, discrimination against female children is more manifest in girls of higher order (parity) births. When fertility declines, there are fewer children of higher parity, and hence observed mortality rates would tend to decline on this account. Das Gupta and Mari Bhat (1997) show that the intensification effect has been so powerful as to overwhelm the parity effect in China, South Korea and India and has resulted in an observed increase in the ratio of male to female children at birth. (For analyses of trends in sex-ratios in China, see Hull 1990 and Zeng et al. 1993; for South Korea, see Park and Cho 1995.)

If the education of mothers is presumed to increase their bargaining power, the model presented in this paper demonstrates how such an intensification may arise endogenously. Educated women will exercise their greater bargaining power to lower their fertility but render more secure the survival of their male children by concentrating resources on them. This argument does not constitute, by any means, a case against educating women in developing countries. Rather, along with the evidence in Das Gupta (1987) and Das Gupta and Mari Bhat (1997), it shows that anything that brings about a reduction in fertility without also altering preferences for sons could have untoward consequences for daughters.

Additional, but weaker, support for the result in Proposition 3 comes from a study done by Haddad and Hoddinott (1994) using anthropometric data for 1986–1987 data from Côte d'Ivorie. They find that an increase in the cash income share of wives is not gender-neutral in its effect on children's health: it increases the height-for-age measure of boys relative to girls. One reason, the authors suggest, might stem from the well-documented fact that boys in Côte d'Ivorie have poorer health than girls. So mothers, motivated by equity considerations, may be attempting to remedy this unequal health endowment

when it is feasible for them to. The authors suggest that the reason might also stem from old age security considerations: Ivorian society being virilocal, mothers typically spend their old age with one of their sons.

The drawing of a distinction between an increase in an individual woman's bargaining power within her household and an increase in female autonomy in society at large may reconcile apparently contradictory findings reported in the empirical literature. For example, an increase in a woman's bargaining power relative to her husband's (say, due to education) may not necessarily translate into greater valuation of female children in a particular community, since that community may still preclude women from providing old age security to their parents. (For interesting discussions of whether education can be construed as increasing female autonomy, see Basu 1996 and Jeffery and Basu 1996.) In other communities, increases in female education may accurately reflect an increase in their autonomy. Similarly, an increase in labour force participation at large may reflect greater female autonomy and freedom of married women from their in-laws' control. Thus an increase in female education in some scenarios may well result in an increase in female disadvantage (Das Gupta 1987; Das Gupta and Mari Bhat 1997), whereas in other scenarios an increase in education and in labour force participation may both show up as contributing to a reduction in female disadvantage (Rosenzweig and Schultz 1982; Murthi et al. 1995).

4. Conclusions

This paper is premised on the assumption that, in the provision of adequate support for their old age through children, the women of developing countries bear a greater share of the cost than do their spouses. It has been shown here, using an asymmetric Nash Bargaining framework, that the empowerment of women – which increases the bargaining power of wives relative to their husbands – results in a decline in fertility and in the mortality rate of children.

It has been argued here that empowerment of women bestows the further benefit to society of increasing the incentives of parents to educate their children. The return on the education of children clearly increases with their survival probability, and this probability is higher when women are more empowered to make decisions within the household. To protect their greater investment in the education of their children, parents would be induced to invest even more in the healthcare of the children. This decline in the mortality rate of children would lead parents to curtail that part of their fertility which is meant for insurance purposes. Thus the empowerment of women emerges as potentially a very strong factor in hastening the demographic transition of a developing country.

It has also been argued here that, for the empowerment of women to have entirely benign effects in developing countries, it must enable daughters also to provide old age assistance to parents, that is, daughters too must be rendered economically valuable to parents. If not, the fertility decline brought about by the greater bargaining power of women within the household may induce a greater discrimination in terms of healthcare expenditures against daughters – thereby trading off the survival prospects of daughters in favour of those of sons. This argument is consistent with the empirical findings of Das Gupta (1987) in the district of Ludhiana, Punjab (India) and with evidence presented by Das Gupta and Mari Bhat (1997) for India (1981–1991). More generally,

wherever there is a strong preference for children of one sex – for whatever reason – a decline in fertility could be accompanied by a reduction in the birth and survival probabilities of children of the other sex. China (Hull 1990), Taiwan and South Korea (Park and Cho 1995) in the mid-eighties are cases in point.

Appendix

Proof of Proposition 1:

(a) For a given fertility level, the optimal healthcare expenditure per child from the husband's perspective solves

$$\frac{\partial}{\partial h} U^H(n,h) = 0, \tag{A.1}$$

where $U^H(n,h)$ is defined in (1b) of the text. The relevant second order condition is necessarily satisfied at the solution, $h^*(n)$, of the first order condition because of the assumed curvature properties of $u(.)$ and $q(.)$. This condition is:

$$\frac{\partial^2}{\partial h^2} U^H(n,h^*(n)) < 0. \tag{A.2}$$

For a given fertility level, the optimal healthcare expenditure per child from the wife's perspective solves

$$\frac{\partial}{\partial h} U^W(n,h) = 0,$$

where $U^W(n,h)$ is defined in (1a) of the text. Substituting (2) of the text into (1a), the above first order condition reduces to

$$D(n)\frac{\partial}{\partial h} U^H(n,h) = 0. \tag{A.3}$$

Since $D(n) \neq 0$, it follows that, for given n, the optimal healthcare expenditure from the wife's perspective is identical to that from the husband's.

(b) Totally differentiating with respect to n the first order condition (A.1) (which is common to the husband and wife), one obtains

$$\frac{\partial^2}{\partial h^2} U^H(n,h^*(n))\frac{d}{dn}h^*(n) + \frac{\partial^2}{\partial n \partial h} U^H(n,h^*(n)) = 0. \tag{A.4}$$

Differentiating (1b) partially with respect to h and n, and then evaluating the result at $h = h^*(n)$, we obtain

$$\begin{aligned}\frac{\partial^2}{\partial n \partial h} U^H(n,h^*(n)) = {} & \{u''[(1-2\alpha)y - (b+h^*(n))n]n(b+h^*(n)) \\ & + u''[\alpha y n q(h^*(n))]\alpha^2 n y^2 q(h^*(n))q'(h^*(n))\} \\ & + \{-u'[(1-2\alpha)y - (b+h^*(n))n] \\ & + u'[\alpha y n q(h^*(n))]\alpha y q'(h^*(n))\}.\end{aligned}$$

The term in the second pair of curly braces on the right hand side can be shown to be equal to $(1/n)\dfrac{\partial}{\partial h}U^H(n,h)$ evaluated at $h = h^*(n)$, which vanishes at the optimum by (A.1). The term in the first pair of curly braces on the right hand side is clearly negative. Thus we have

$$\frac{\partial^2}{\partial n \partial h}U^H(n,h^*(n)) < 0. \tag{A.5}$$

This result says that the marginal utility of healthcare expenditure declines with fertility. In effect, fertility and expenditure per child are perceived as substitutes at the optimum. Using (A.5) and the second order condition (A.2) in (A.4), it follows that

$$\frac{d}{dn}h^*(n) < 0. \tag{A.6}$$

In other words, if the fertility is parametric, the optimal healthcare expenditure per child decreases with fertility.

(c) For a given fertility, the maximized utility of the wife is given by (2) of the text and part (a) above as $D(n)U^H(n,h^*(n)) \equiv \hat{U}^W(n)$. Using the Envelope Theorem, the derivative of this function may be written as

$$D(n)\frac{\partial}{\partial n}U^H(n,h^*(n)) + U^H(n,h^*(n))D'(n). \tag{A.7}$$

Let n_W and n_H be the optimal fertility from the point of view of the wife and husband, respectively. On evaluating expression (A.7) at n_H, the first term drops out since n_H is optimal for the husband. The remaining second term is negative, since $D(n)$ is decreasing in its argument. Assuming $\hat{U}^W(n)$ to be strictly concave in n, it follows that $n_W < n_H$. It follows from (A.6) that $h^*(n_W) > h^*(n_H)$. □

Proof of Proposition 2:

(a) As in Proposition 1, it is convenient to do the optmization over n and h in two stages: first, we maximize the objective function with respect to h for given n, and then we choose the optimal n. For a given level of fertility, the first order condition with respect to h associated with the maximization in (4) of the text is

$$\gamma\frac{\dfrac{\partial}{\partial h}U^W(n,h)}{U^W(n,h) - \bar{U}^W} + (1-\gamma)\frac{\dfrac{\partial}{\partial h}U^H(n,h)}{U^H(n,h) - \bar{U}^H} = 0. \tag{A.8}$$

Using (2) of the text, the above first order condition reduces to

$$\left\{\gamma\frac{D(n)}{U^W(n,h) - \bar{U}^W} + (1-\gamma)\frac{1}{U^H(n,h) - \bar{U}^H}\right\}\frac{\partial}{\partial h}U^H(n,h) = 0.$$

Since the term in the braces is positive, it follows that the optimal expenditure on the healthcare of each child coincides with the solution to (A.1) and is therefore given by $h^*(n)$ – which, note, is independent of γ and the threat points, $\overline{U}^W$ and $\overline{U}^H$.

The first order condition for n in the maximization of the second stage objective function (that obtains after h has been "maximized out") is

$$\gamma \frac{\frac{\partial}{\partial n}\hat{U}^W(n)}{\hat{U}^W(n) - \overline{U}^W} + (1-\gamma)\frac{\frac{\partial}{\partial n}\hat{U}^H(n)}{\hat{U}^H(n) - \overline{U}^H} = 0, \tag{A.9}$$

where

$$\hat{U}^W(n) \equiv D(n)U^W(n, h^*(n)); \quad \hat{U}^H(n) \equiv U^H(n, h^*(n)).$$

Let $n^*(\gamma, \overline{U}^W)$ be the solution to (A.9). Clearly, at $n^*(\gamma, \overline{U}^W)$, the derivative $\frac{\partial}{\partial n}\hat{U}^W(n)$ has to be negative, while $\frac{\partial}{\partial n}\hat{U}^H(n)$ has to be positive if the two terms on the left hand side of (A.9) are to sum to zero.

If the second order derivative of the second stage objective function with respect to n is denoted by $SOT(n)$, the second order condition for a maximum at $n^*(\gamma, \overline{U}^W)$, assumed to be satisfied, is

$$SOT(n^*) < 0. \tag{A.10}$$

Totally differentiating the first order condition (A.9) with respect to γ, we obtain:

$$SOT(n^*)\frac{d}{d\gamma}n^*(\gamma, \overline{U}^W) + \left\{ \frac{\frac{\partial}{\partial n}\hat{U}^W(n^*)}{\hat{U}^W(n^*) - \overline{U}^W} - \frac{\frac{\partial}{\partial n}\hat{U}^H(n^*)}{\hat{U}^H(n^*) - \overline{U}^H} \right\} = 0. \tag{A.11}$$

By the argument made below (A.9) on the signs of the derivatives of $\hat{U}^W(n)$ and $\hat{U}^H(n)$ at $n^*(\gamma, \overline{U}^W)$, it follows that the term in the braces is negative. Using (A.10) in (A.11) then yields

$$\frac{d}{d\gamma}n^*(\gamma, \overline{U}^W) < 0. \tag{A.12}$$

Using (A.6), (A.12), and the chain rule, it follows that

$$\frac{d}{d\gamma}h^*(n^*(\gamma, \overline{U}^W)) = \frac{d}{dn}h^*(n)\frac{d}{d\gamma}n^*(\gamma, \overline{U}^W) > 0. \tag{A.13}$$

(b) Taking the derivative of (A.9) with respect to the mother's threat point, $\overline{U}^W$, we obtain an expression analogous to (A.11):

$$SOT(n)\frac{d}{d\overline{U}^W}n^*(\gamma, \overline{U}^W) + \frac{\frac{\partial}{\partial n}\hat{U}^W(n^*)}{(\hat{U}^W(n^*) - \overline{U}^W)^2} = 0. \tag{A.14}$$

An argument identical to that made above implies that

$$\frac{d}{d\overline{U}^W}n^*(\gamma, \overline{U}^W) < 0, \tag{A.15}$$

and

$$\frac{d}{d\overline{U}^W}h^*(n^*(\gamma, \overline{U}^W)) > 0. \quad \square \tag{A.16}$$

Endnotes

[1] As expected, the evidence tends to be indirect since female autonomy is a concept that is not easily operationalized. Mason (1993) concludes that there is strong evidence that greater female autonomy reduces child mortality; the evidence on the relationship between female autonomy and fertility is less clear cut.

[2] Evidence drawn from developing countries for the old age security hypothesis is provided in Nugent and Gillaspy (1983), Entwisle and Winegarden (1984), and Jensen (1990). Nugent (1985) surveys the theoretical foundations and the empirical evidence for this hypothesis.

[3] In order to protect themselves against the extremely unpleasant prospect of being left childless in retirement, parents will tend to "hoard" children in excess of the fertility required to generate a given *expected* number of survivors. This is shown in Sah (1991), who also provides a review and critique of earlier attempts at demonstrating this by Ben-Porath (1976), and O'Hara (1975). The consequences of this effect for a demographic transition are worked out in Eswaran (1998).

[4] Summers (1991) alludes to this as one of the benefits of educating women in developing countries. But the point is more general: an increase in women's bargaining power within the household will generate this outcome. Erlich and Liu (1991) have developed a stylized model of economic growth in which investment in education increases for similar reasons when expected lifetimes increase.

[5] The corresponding proportion for a developed country is considerably lower; e.g., for Canada in the period 1983–1987, it was 14.3% (7.7%) (Tables 2–4, *ibid.*). Note, furthermore, that the pension motive is irrelevant to the determination of fertility in the developed countries.

[6] The same source computes the probability that a fifteen year old male (female) in India will not survive until age forty to be 8% (10%).

[7] To see this, note that if n were a discrete variable (which increased in steps of 1) and survival of the children are independent events, the distribution of m would be given by a binomial distribution with mean $nq(h)$. To derive the corresponding distribution for a continuous version of fertility, now suppose that n is taken as the measure of fertility, m the measure of the number of survivors, and Δ the measure of one child, so that the actual number of births is (n/Δ) and the number of survivors is (m/Δ). Taking the limit as Δ goes to zero (to obtain the continuous approximation), we can verify that the binomial probability distribution for m becomes degenerate at $nq(h)$, that is, it becomes infinitely peaked at the mean and exhibits zero variance. (This is essentially the law of large numbers at work.)

[8] This expedient obviates the need to model how the resources available for the couple's own consumption is split between the husband and the wife.

[9] This abstracts from the fact that in some developing countries, like those in south Asia, old age security is expected only from sons. This assumption will be relaxed later in the paper.

[10] There is certainly a discretionary element in these expenditures, but they are taken as exogenous here for simplicity.
[11] The assumption that the health care expenditure on all children is the same is made here for analytic tractability but is violated in reality. This issue is discussed later in the paper.
[12] As pointed out in an earlier endnote, since n is taken to be a continuous variable here, there is no aggregate randomness in the number of survivors: precisely $nq(h)$ children survive to adulthood.
[13] The qualitative results of this paper would remain unchanged if we permitted the consumptions of husbands and wives to differ and allowed, as Mason (1993) argues, husbands to benefit more from the old age security offered by children than do wives.
[14] See Cain (1986) for a discussion, in the south Asian context, of the adversities confronting elderly people who have no surviving children, especially sons.
[15] See Harsanyi and Selten (1972) or Roth (1979) for an axiomatic treatment of the asymmetric Nash bargaining problem.
[16] For a lucid discussion of the various scenarios that are possible, see Lundberg and Pollak (1996).
[17] In matriliny the line of descent is based on kinship with the mother, and in matrilocality the husband goes to live with the wife's family.
[18] Weiner (1990) gives a comprehensive account of the pervasiveness of child labour in India and also discusses the extent to which this institution prevailed in the now-developed countries. For an analysis of the effects of the institution of child labour on fertility in developing countries, see Eswaran (2000).
[19] In the rural areas of developing countries, not all children within a family are necessarily educated. As discussed below, where female children are discriminated against they typically are not given much education. But even the male children within the same family are often not all sent to school – consistent with the explanation given here.
[20] Due to the natural resilience of the body, children have a positive probability of surviving to adulthood even if nothing is spent on their health care, that is, $q(0) > 0$.
[21] The same outcome would obtain if children are perceived to have some intrinsic worth, apart from the old age security they may provide.

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