### Health and Education

There is substantial evidence that children from large families have lower educational attainment and reduced levels of health, in developed as well as developing countries.[1] Though many studies have inadequate controls for parents' income and education, there is some evidence that the negative association is greater at lower levels of family income, and pertains especially after four children.[2] Since families in poor countries have on average lower income and higher family size than families in rich countries, in poor countries the negative association of large family size and reduced health and education of children, will have greater weight in the population as a whole.

However, the strong cross-section association should not be interpreted necessarily as a causal one—of family size on health and education. It is possible that parents decide jointly and simultaneously on both the number of children to have and the size of their parental investment in child health and education. Low income, low returns to education and health investments, and reasonable concern about their own long-term security could lead parents to choose simultaneously both large numbers of children and low investments per child. Thus, an exogenous shock which reduced the number of children—for example the unexpected death of a child—would not necessarily raise parental investments in the health and education of remaining children, in the absence of other changes in the family's environment.

The question thus arises whether parents consciously trade off more children against higher inputs per child, deciding jointly on the quantity and "quality" of children and viewing these as substitutes, or whether they invest in children taking the number as given. The question is an important one for policy. If there is a quantity–quality tradeoff, and parents are not "altruistic" toward their children, that is they do not incorporate into their own utility that of their children, then the negative relation of large families with children's health and education may signal a negative intertemporal externality (arising perhaps because parents do not believe they can capture the returns on investing in their children's health and education)—a market failure which could justify public intervention to discourage high fertility. But if parents are altruistic, then efforts to force parents into higher investments in child health and education through certain kinds of interventions, such as quantitative restrictions on numbers of children or imposition of mandatory school attendance, could simply reduce overall family welfare.[3] From a welfare point of view it is reasonable to assume, except in the case of "unwanted" children, that parents have another child only when they feel that the benefits of an additional child to the family as a whole, including to the children already born, exceed the costs.

Governments have generally taken the view that parents are altruistic (or at least that if they are not, they still retain total rights over their own reproductive lives), and that the decision regarding family size should be left to parents. The most widespread form of population policy is public support for family planning programs, justified as a means to assist parents avoid unwanted children for whom the private costs would add to any social costs of additional births. If some children are unwanted, then even altruistic parents must in effect take the number of children as given, and are forced into sequential decision-making and possibly lower investments in child health and education than they would otherwise have made. In a few countries, especially in Asia (where governments view the social costs of high fertility as substantially above the private costs), government spending on family planning is also justified to provide information and "education" to parents about the likely effects of their own high fertility on the health and education of their own children.

The best evidence that unwanted births do reduce parental investments in children is from a study of the effects of twins on children's school enrollment in India. Rosenzweig and Wolpin (1980) posit that the birth of twins is likely in at least some cases to constitute the exogenous imposition of an "unwanted" child; they report that children from families in which the most recent birth

*From Nancy Birdsall, "Economic Approaches to Population Growth," in Hollis Chenery and T. N. Srinivasan, eds., *Handbook of Development Economics, Volume I* (Amsterdam: North-Holland, 1988), 497–499, 514–521. Reprinted by permission.

[1]Work on the consequences of high fertility for child health and development has been largely the domain of psychologists, public health specialists and demographers. See Blake (1983) and Maine and McNamara (1985). For an economic view, see Birdsall and Griffin (1988).

[2]Birdsall (1980) See also studies cited in Birdsall (1977).

[3]A whole range of pricing policies could distort parental demand for the number and "quality" of children.



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was of twins were significantly less likely to be in school. Here the causal link—from an exogeneously-imposed extra birth to less child schooling—can easily be inferred. The implication is that the elimination of unwanted births, through for example a reduction in the cost of family planning, would raise average education levels among children. . . .

### Female Education, Labor Force Participation, and Wages

There is some evidence that at low levels of education (e.g. between zero and three or four years), education's effect on fertility is positive [Cochrane (1979)]. This may be due to an increase in fecundity (supply of children) as education increases from very low levels in populations in which fertility is initially below desired fertility, as posited in the synthesis model. It may be that more education is associated with higher income (a variable often missing from studies Cochrane cites), and that the higher income is having a positive effect on fertility (by increasing fecundity or increasing the demand for children), without any offsetting change in a woman's shadow price of time (especially in the largely illiterate populations where this positive effect tends to obtain).

Female education above about four years, however, bears one of the strongest and most consistent negative relationships to fertility. Its negative effect is consistent with the price of time effect postulated in the household model, with a "taste" effect of education on a desire for fewer, more educated children postulated in the synthesis model, and with an efficiency effect, operating through a woman's improved efficiency in the use of contraception. Female education is also associated with a higher age at marriage, and may well have some intangible effect on a woman's ability to plan and on her taste for non-familial activities.

Distinguishing empirically among the postulated mechanisms by which education reduces fertility is difficult. For women who work, the wage rate in theory represents the price of time; but labor supply is endogenous to the fertility decision, and high labor supply and low fertility could result from the taste effect as well as the price of time effect of education. Using U.S. data, Rosenzweig and Seiver (1982) and Rosenzweig and Schultz (1985) have shown that at least part of the education effect operates through greater efficiency in contraceptive use. Rosenzweig and Schultz demonstrate that the efficiency effect operates through more effective use by educated women of relatively ineffective methods (and their greater ability to decipher information about their own fecundity). Since education's effect is partly one of information-processing, schooling and birth control information programs are substitutes as public programs to encourage low fertility (and both are substitutes for birth control services). (No comparable studies using developing country data are known to this author. Insofar as birth control information is less available in developing countries, the efficiency effect of education may well be critical.)

Female education is also associated with entry by women into the formal market, especially into jobs in the modern sector. Participation in the labor market is negatively associated with fertility only for women in relatively high-wage modern sector jobs. Though there may be a causal effect of work in the formal labor market on fertility, virtually no studies in developing countries have allowed for the simultaneity of the fertility and labor supply decisions—for example, the possibility that women who have few children due to low fecundity decide to work more.[4] The identification problem in a simultaneous model is severe, since most factors that influence labor supply would also influence fertility.[5] Jobs outside the modern sector—in agriculture, cottage industry and so on—which do not take women far from the household and allow flexible hours, do not increase the time cost of raising children and are not associated with low fertility.[6]

As female education and female wages rise, the differential between female and child wages widens. This in itself tends to reduce fertility, since it means that the family's loss of the mother's income when children are young is not easily and quickly made up by children's work.

### Child Schooling (the "Quality" of Children)

Though the effect of changing prices for child quality on quantity of children is a fundamental idea in the household demand model, only a few

[4]But see McCabe and Rosenzweig (1976).

[5]Fertility but not labor supply would be affected by the price of contraceptives. As Rosenzweig and Wolpin (1980) point out, in estimating a labor supply equation, if the only source of variation in fertility not due to preferences is the price of contraceptives, two-stage least squares in a simultaneous equations model is redundant. The contraceptive price variable should simply be included in a reduced-form labor supply equation.

[6]See Standing (1983) for a review of the literature on fertility and female labor force participation.

studies have rigorously explored this cross-price effect, i.e. the hypothesis that a decline in the price of child schooling (or child health) will reduce fertility. . . . Rosenzweig and Wolpin (1982) show that in India, households in villages with a school have, all other things the same, lower fertility than households in villages without a school. (They also confirm the converse cross-price effect.) Their study is a classic in its demonstration of the use of simple reduced-form ordinary least squares regressions to test the effects of various governmental interventions (more schools, more family planning) on various outcomes—direct own-price effects and indirect cross-price effects. In a subsequent study using the same Indian data, Rosenzweig (1982) shows that farm households more intensively exposed to (exogenous) new agricultural technologies have lower fertility and higher child schooling, similarly implying an alteration in the household's allocation of resources between child quantity and quality in the face of exogenous price changes.

### Family Income and Income Distribution

In studies controlling for parents' education and taking into account the endogeneity of family income [e.g. Kelley (1980)], income has a positive effect on fertility.[7] This positive effect is consistent with the pure income effect of the household demand model,[8] and with the increased fecundity or supply of births postulated when income rises in low income households in the synthesis model. Within the same socioeconomic group, e.g. among small farmers, higher income parents also tend to have more children,[9] and in industrial countries, income growth in the short run is associated with higher fertility (e.g. in the United States in the 1950s). In the long run, however, income growth tends to be offset by social changes that reduce fertility—such as rising education, so that people with more income want and have fewer children.

As a result, the association of income and fertility tends to vary according to absolute levels of income. Below some minimum income, increases in income are associated with higher fertility. In the poorest countries of Africa and South Asia, many families are below that threshold. Above that threshold, further increases in income are associated with lower fertility—for a given increase in income, the reduction is greater for low-income groups. Raising the incomes of the rich (be it of rich countries or of rich groups within countries) reduces fertility less than does raising the incomes of the poor. There is, however, no good evidence that the distribution of income has an independent effect on fertility; it is influential only to the extent that poor households usually have higher absolute incomes if their share of the total is higher.

### Markets and Old-Age Security

An important feature of development is that markets enlarge and diversify. Contacts and kin begin to matter less as guarantors of jobs and help with the harvest; children begin to matter less as a form of old-age security. Children's greater geographical mobility in an expanding labor market makes them less dependable as a form of old-age support; at the same time, an expanding capital market means other instruments for old-age security, including private savings and social insurance, emerge.

The household and synthesis models of fertility emphasize the importance to fertility decline of increases in the relative costs of children, especially the time costs as women's education and wages increase and as the market for women's labor expands [see also Lindert (1980, 1983)]. Cain (1981, 1983), however, has criticized the failure of empirical studies based on these models to take into account the pension value of children as security in old age in societies where land and capital markets are poor and means of accumulation other than children are limited.[10] He examines, for example, the near-total reliance of women in societies such as Bangladesh on their sons' support should they be widowed, as an explanation of persistent high fertility that pertains irrespective of the rearing costs of children.

Williamson (1985) incorporates the effect of a poor capital market and an expanding labor market in a study of fertility decline in nineteenth-century England. He notes the importance of "default risk," i.e. the probability that adult children will emigrate from rural areas, and thus leave the par-

[7]Kelley shows that use of ordinary least squares, rather than two-stage least squares with income endogenous, produces a non-significant coefficient on income in a fertility regression.

[8]For a full discussion see Simon (1977).

[9]World Bank (1984, p. 108).

[10]Rosenzweig and Wolpin (1985) argue that Cain's approach requires an assumption of a poor capital and land market, but that in fact, the apparent absence of such markets (e.g. of land sales) may itself be simply a manifestation of an optimal implicit contract across generations which maximizes the gains from farm-specific knowledge; older people in effect trade information they have on own-farm characteristics, for support from children.

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ents' household just as they become a net economic benefit at the margin, both to the net cost of a child and to a child's pension value.[11] Using data from nineteenth-century England on rural emigration rates, he shows that rising rates throughout the period reduced the present value of rural male children to parents (but not female children) by about 18 percent of farm wages (using a 5 percent discount rate).[12] The emigration rate matters only if remittances from absent children to parents were small; Williamson notes there is little evidence of remittances, and that capital markets that might have eased transfers were poor. His emphasis on the importance of rural emigration in explaining fertility decline thus relies on the combined assumptions of an increasingly integrated labor market and a poor capital market—a combination of assumptions that has not been explored in developing country settings.

Hammer (1986) has proposed that improvements in capital markets should lower fertility (and increase savings; he argues that increased savings per se are not the cause of lower fertility), and Nugent et al. (1983), using household data from India, show in a fully specified structural model that a weak local capital market is positively associated with higher fertility in nuclear households (and not in extended households, which presumably have greater access to capital through family networks).

### Infant Mortality and Fertility

The demographic transition idea posits that a decline in infant mortality brings about a compensating decline in fertility. The exact nature of any causal link is not well understood, however. At the aggregate level, declines in fertility have tended to lag behind declines in mortality, producing in the 1950s through the early 1970s rapid rates of population growth. The real issue, however, is the effect of declining mortality at the individual and family level. At this level, several problems complicate empirical analyses of the effect of infant mortality on fertility behavior. First, at the family level, high mortality and high fertility may be jointly determined, so that ordinary least squares estimates will be biased. Only recently have analysts attempted to isolate the family-specific exogenous component of life expectancy, in order to analyze the effect on fertility of exogenous changes in mortality; these effects appear much smaller than the endogenous mortality component [Olsen and Wolpin (1983)]. The problem of bias due to simultaneity can also occur because high fertility may cause high mortality, rather than vice versa, for example when the birth of a new child leads to rapid weaning (and poor nutritional status, diarrhea and death) of the preceding child.

Second, there is a biological as well as a behavioral effect of mortality on fertility, for example when with the death of a child a woman ceases breastfeeding, and is then more likely to become pregnant. To predict the long-run effects of declines in mortality on fertility, isolation of the behavioral effect is critical.

Schultz (1981, pp. 131–132) notes that knowledge that some fraction of children is likely to die has two offsetting effects on parents: it increases the cost per surviving child, and increases the number of births required to obtain a survivor. The effect on fertility of declines in the probability that children will die depends on the price elasticity of parental demand for surviving children; if demand is elastic, a reduction in the cost or "price" of births with a decline in (exogenous) mortality should increase the demand for children and raise fertility. If demand is inelastic, mortality decline should reduce fertility. The latter is likely if an exogenous reduction in mortality, by lowering the price of child "quality," encourages investment in child quality, i.e. in schooling and health, as allowed for in the quantity–quality model outlined above.

Finally, once a behavioral response to mortality decline is established, an additional question arises: whether the effect represents a reduction in "replacement" behavior (individual couples replacing lost children) or in "insurance" or "hoarding" behavior (couples having more births than they might otherwise have in order to insure against the possibility of loss). Replacement behavior is purported to be more prominent in populations at the highest and lowest levels of development, such as the industrial economies on the one hand, Bangladesh on the other [Preston (1975)]; for a country like Malaysia, replacement effects appear small [Wolpin (1984), Olsen (1983)].

On average, the evidence is that families do not completely replace a lost child, so that in the short run infant mortality reduces overall population growth, all other things the same. However, the indirect and long-run effect of reduced mortality is probably to reduce fertility in a more than compen-

[11] Caldwell's (1976, 1978) restatement of demographic transition theory emphasizes the shift from child-to-parent "wealth" transfers to parent-to-child transfers in explaining fertility decline, but does not refer explicitly to the "default risk" issue.

[12] The lower the discount rate the greater the relative effect of the default (or emigration rate) on the present value of children. Cain's view that the pension motive affects fertility in effect favors a low discount rate.

sating amount—as, with greater certainty about child survival, parents reduce "insurance" births and shift toward child "quality" investments. The need for hoarding or insurance births would appear limited, given the sequential nature of childbearing (which allows replacement); however, it is likely that in high mortality environments, couples begin childbearing earlier (which increases aggregate population growth), and have children more rapidly. Thus, hoarding effects appear to be greater than replacement effects [e.g. Olsen (1983)]. However, the likely root of the apparent long-run response of lower fertility to declining mortality is in the shift toward an entirely new pattern of child investment, as parents adjust their behavior in response to a new environment of costs and benefits of children, of which reduced mortality may be only one component.

### Family Planning Programs and Fertility

Whether organized family planning programs, privately or publicly subsidized, contribute to fertility decline is of obvious policy interest; governments of many developing countries, especially in Asia, have subsidized family planning in an effort to reduce fertility, and donors, especially the United States, have supported such efforts financially.

Measuring the impact of family planning programs on fertility decline requires controlling for other possible causes of fertility decline discussed above—such as increases in education or declines in mortality. It also requires data on some exogenous change in the availability or quality of family planning to a household, community or nation. Any such exogenous change would correspond to a change (increase) in the price of child quantity in the household demand model or change (reduction) in the cost of fertility control in the synthesis model. Information on change in the use of services is generally more widely available than information on availability, but does not suffice, since use is endogenous to people's fertility goals.

Lack of good information on change of the "price" of family planning (i.e. in the availability and quality of information or services) meant that until about a decade ago it was difficult to resolve the debate about the relative importance to fertility decline of the supply of family planning services vs. the "demand" factors—increasing education, falling infant mortality and so on. Early family planning programs in Korea, Hong Kong, and other areas of East Asia had been established in countries where a marked fall in fertility was already in progress; some of the continued decline might have occurred even without official programs. In other countries (such as India and Pakistan), where programs were also established in the 1950s and 1960s, fertility was changing little during the 1960s.

More recently, however, such information has accumulated, especially at the national level, e.g. the nation-level measures of family planning program effort of Mauldin and Lapham (1985), and at the community level; and though this and other such measures remain controversial due to measurement problems, they have permitted analyses of fertility change taking into account both supply and demand factors.

In general, the evidence from these analyses is that family planning programs do matter, having some negative effect on fertility independent of demand factors. The negative effect is relatively weak where other factors do not encourage low fertility, but powerful where other factors do. Boulier (1985), for example, estimates a variant of the household demand model for a sample of developing countries, using the Mauldin and Lapham 1972 index of family planning as one variable explaining fertility change over the period 1965–75. Other variables include the change during the same period in life expectancy, in adult literacy, in income per capita, in the proportion of the population in cities of 100000 or more, and in fertility change 1960–65. The 1972 index is treated as an endogenous variable, statistically identified using pre-1965 socioeconomic data. (Boulier himself notes that this is rather arbitrary.) Fertility decline in the period 1960–65 turns out to be an important predictor of the 1972 index; it is plausible that fertility decline itself induces government officials to augment resources for encouraging more fertility decline, particularly if it represents real demand for more services. However, even taking into account that a stronger family planning program in 1972 is associated with prior fertility decline (in 1960–65), the effect of the program on fertility decline in the concurrent period (1965–75) is still positive.

In a similar analysis, Wheeler (1985) estimates the effect of change in the Mauldin–Lapham index between 1972 and 1982 on fertility change from 1970 to 1980. He experiments with various functional forms in a simultaneous equations model, and concludes that in explaining fertility change over this period in developing countries, it is the combination of family planning availability with female education which must be stressed, since specifications including the interaction of these two are the most powerful.

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Studies within countries tend to complement these nation-level studies. Not surprisingly, cross-section studies of households, summarized by Boulier (1985), find that people are more likely to know about and use contraception the closer they live to a reliable source. Use of contraception does not necessarily reduce aggregate fertility, of course. However, Schultz (1973) in a study of administrative regions of Taiwan, found that fertility over the period 1964–69 declined more rapidly where health and family planning workers were more plentiful. Consistent with Wheeler's findings, the impact of workers was greater where child school enrollment rates were greater and infant mortality had declined more.

In another study, Rosenzweig and Wolpin (1982) examined the determinants of recent fertility among women in India in 1968–71, measuring family planning inputs by the fraction of villages having a family planning clinic in the district in which a woman resides. Holding constant wife's and husband's education, wife's age, farm and non-farm residence, and district level health, schooling, and sanitation characteristics, they reported that doubling the number of villages in a district with a family planning clinic (from 2 to 4 percent) would reduce fertility by 13 percent, as well as reducing child mortality and raising school attendance. In a later study [Rosenzweig and Wolpin (1986)], they examined the possibility that the availability of public services such as family planning and health to households cannot be treated as exogenous, given that governments may locate such services in specific places in an effort to compensate for or to complement "demand" factors. For the particular case they study, of the Philippines, they conclude that family planning services do reduce fertility; they also show that conventional tests could understate the true price effect of public programs in reducing fertility and improving health, since government appears to be following a compensatory strategy, locating services where other factors would mitigate against lower fertility and better health.

Finally, recent experimental studies testing the impact of family planning, summarized in World Bank (1984, pp. 119–121) suggest sustained programs can reduce fertility even in rural relatively uneducated populations; the most widely noted of these is that in Matlab, Bangladesh.

Greater availability or improved quality of family planning services, usually at no charge, reduces the overall price to potential users most obviously by reducing the cost of information or of travel. The economic models predict such a price reduction will reduce fertility (except where demand for births still falls short of biological supply); the empirical evidence is consistent with the prediction.

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