Population Growth, Externalities to Childbearing, and Fertility Policy in Developing Countries

Ronald D. Lee and Timothy Miller

Government-financed family planning programs that assist individual couples to attain their desired number of children are easily justified. But government policies that coerce or use financial incentives to influence couples to alter their desired number of children require stronger justification. Such justification may reside in the externalities to childbearing—the costs and benefits of children that are passed on by parents to society. Externalities to childbearing might include public costs of education, health, and pensions, as well as taxes to be paid by children in the future; cost sharing for public goods and social infrastructure over an enlarged tax base; the dilution of per capita value of various forms of collective wealth; and the reduction of wages and per capita incomes in the future. We estimated these externalities for a number of developing countries. Although the net total estimated externality was typically negative, it dominated measurement error only when public holdings of natural resources were important. Public expenditures on health, education, and pensions, financed by proportional taxes, led to negative externalities in most developing countries. There are many sources of positive and negative externalities, and each estimate is uncertain, so the total externality is itself highly uncertain and often does not provide a clear case for policies going beyond family planning. Inclusion of environmental effects might alter this conclusion.

Why should governments take it upon themselves to intervene in the family-building decisions of their citizens? Is this simply a matter of unwarranted government meddling, as some might argue, or is it a justified effort to improve the public welfare, as most believe?

Roughly speaking, we can divide the completed fertility of a couple into two categories. The first of these, wanted births, means here the number of children that the couple would choose based solely on their tastes and socioeconomic circumstances. The second category, excess births, means here any additional children the couple have because of imperfect contraception resulting from lack of information; social or religious opposition; and costs of contraception.

Ronald D. Lee is professor of demography and economics at the University of California at Berkeley. Timothy Miller is a graduate student in demography and economics at the University of California at Berkeley. The authors are solely responsible for the views and results of this paper. They are grateful to John Quiggen for pointing out the externality arising from proportional taxation.

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including time, travel, and embarrassment. Governments have many excellent reasons for sponsoring projects such as family planning programs, which enable couples to approximate more closely their wanted births by reducing or eliminating excess births. Although actual family planning programs often attempt to persuade couples to choose low fertility, a pure family planning program limits its activities to assisting couples attain their reproductive desires without seeking to alter them.

As Kingsley Davis (1967, p. 731) pointed out some years ago, however, "there is no reason to expect that the millions of decisions about family size made by couples in their own interest will automatically control population for the benefit of society." Davis's influential article concluded that "in underdeveloped countries . . . the elimination of unwanted births would still leave an extremely high rate of multiplication." In such circumstances, policymakers might well consider fertility policies going beyond pure family planning—that is, policies designed to alter the number of births that a couple wants or chooses. One such policy is a system of financial incentives to influence fertility outcomes or contraceptive use. Another is to set the fertility level by fiat, as the one-child family policy does in China.

Such policies can be justified when the desired fertility of individual couples is socially nonoptimal—when there is a difference between the social and individual valuation of the costs and benefits of a birth. For example, the World Development Report (World Bank 1984) states that a justification for action by governments "is the gap between the private and social gains from having many children. . . . One reason [these gains] differ is the existence of 'externalities'" (1984, p. 54). Childbearing externalities are consequences of childbearing that do not impinge on the decisionmaking couple but rather accrue to society at large.¹ A good case can be made that a laissez-faire fertility policy is appropriate in the absence of externalities, and, in fact, some scholars (see Ng 1986, for example) have forcefully argued as much. Other scholars and governments believe that there are positive externalities to childbearing, so that governments actually should encourage fertility through financial incentives, by withdrawing support for contraceptive services and abortion, and possibly by making contraception and abortion illegal. Although pronatalist policies are most common in the industrial countries, where support for the elderly dominates other concerns, a number of developing countries, such as Malaysia, have them as well.

It is thus important from a policy point of view to determine whether there are significant externalities to childbearing, and, if so, whether on net they are

¹. "Externalities" are most commonly defined as in Nerlove, Razin, and Sadka (1987), who say they occur when "the activity of one agent indirectly affects the production possibilities or utilities of other agents outside the price system" (1987, p. 38). Sometimes effects occurring through the price system are referred to as pecuniary externalities, as distinct from technical or true externalities, which are as defined above.
positive, negative, or zero. Yet, surprisingly, hardly any efforts have been made along these lines. This statement may appear peculiar, given the amount of work that has been done on consequences of population growth in general (as reviewed, for example, in World Bank 1984; National Research Council 1986; and Kelley 1988). However, most consequences of childbearing, whether at the microeconomic or macroeconomic level, are not true (or technical) externalities. Rather, they are borne directly by the children's parents or pass through market channels (and are therefore only pecuniary externalities).

For example, the birth of a child may eventually shift the supply curve of labor and thereby depress the wages and average incomes of the next generation. But this may be no more an externality than is the effect of a new shoe factory in depressing the price of shoes; it harms other shoe manufacturers but benefits consumers. When all consequences of actions are mediated by a fully competitive market, theory tells us, the outcome will be Pareto-optimal (provided that there are no nonconvexities, such as increasing returns to scale). Recent analysis confirms that this theorem applies in the intergenerational demographic context as well (see Blandy 1974; Willis 1987; Nerlove, Razin, and Sadka 1987; and Lee, forthcoming, a).

Therefore, when we study externalities to childbearing, we must take care to isolate consequences that do not pass through the market and are not borne directly by the parents. Pecuniary externalities are also potentially important for population policy, but they fall under the general heading of consequences of population growth, and they bear quite a different relation to policy than do technical externalities.

Childbearing externalities are not the only possible justification for policies that go beyond family planning. Society may have goals different from those of its individual members, for example. It may care more about income distribution; it may discount the future less heavily than do individuals; or it may aspire to greater political, cultural, or military influence in the international arena. Furthermore, actual economies depart from the assumptions of perfect competition and perfect information. In any event, childbearing externalities are assessed in the context of an institutional environment that may itself be highly inefficient. In such circumstances, the absence of externalities no longer guarantees a socially desirable fertility level. What we examine here is therefore only a piece of the puzzle, albeit a very important piece.

In this paper, we first outline a way of thinking about reproductive externalities, and we identify the categories of externalities to which this approach leads. We then present estimates of externalities arising within each of these categories for a number of developing countries: Bangladesh, Brazil, India, Kenya, Mexico, and Saudi Arabia. For comparison, we present results for the United States as well. After considering some extensions of the basic framework of analysis and some reservations about the results, we discuss the policy implications of this research.
I. Conceptualizing Externalities to Childbearing

It is simple and instructive to view the question of externalities in the following way, which is based on Nerlove, Razin, and Sadka (1987; Phelps 1968 developed a similar model; see appendix 1 for a more formal description of the model). Consider a generation of couples that care about their own consumption, about the number of children they have, and about the future consumption of their children as adults. Couples realize that their children's future consumption depends, to some degree, on the number of children that they, the parents, have, because this will affect the bequest, such as the share of the family farm, that the parents can leave each child. Couples may be assumed to have perfect information about the future, although this is not necessary. Each couple chooses some level of fertility that maximizes its satisfaction, given its preferences and constraints as just described. The key question is whether the couples could do better if they reached a collective decision about fertility rather than choosing their fertility individually. For example, if they acted collectively, they could jointly choose the size of the labor force in the next period and thereby choose the wage level their children would face as adults; this choice is not available to them as individuals. Put differently, could a social planner with coercive powers over fertility, and acting solely in the interests of the couples as a group, increase their satisfaction over the level they could attain choosing their fertility individually under a policy of laissez-faire in reproduction? If so, then there is a difference between the implicit net cost of a child as perceived by the parents and as recognized on their behalf by the planner. The difference between these perceived costs equals the external costs of a child, and it is this difference that we seek to estimate below.

A comment is required on the time frame of the calculations. The model just outlined covers two periods, each of roughly thirty years. Taking the model literally, the effects of the first generation's fertility on the second generation's consumption can be evaluated over the course of this second thirty-year period, with or without discounting and more elaborate allowances for survival. But of course life goes on, and the second generation also will have children, and so on forever, we hope. One common way to incorporate an infinite time horizon is to use an infinitely recursive altruistic utility function (see some of the other models in Nerlove, Razin, and Sadka 1987, for example). However, in regard to the optimality of laissez-faire fertility in a fully private competitive economy, the recursive altruistic model gives the same answer as the simple two-period model. A second approach, which we take here, recognizes that each additional birth to a population of N people will increase the population size forever after by a factor of \((1 + 1/N)\), because in adding a birth we are also eventually adding an average number of descendants of that birth for every generation thereafter.\(^2\)

\(^2\) A more exact calculation can be made in the same spirit using the concept of reproductive value; for the case of India, which we examined in detail, this differed only negligibly from the \((1 + 1/N)\) approximation.
Discounting is also appropriate, and we have done so at the rate of population growth, which should equal the real rate of interest in a society with no growth in per capita income. If per capita income does grow, then many of the quantities entering in the calculations would be expected to grow at the same rate, and the discount rate would be correspondingly higher, so it would make little difference.\(^3\) Obviously this is a rough assumption, but we believe that in most cases using a higher discount rate would move the estimates of externalities closer to zero rather than increase them.

There are several points to note about this general way of framing the question. First, the only concern is with the well-being of the current generation; the well-being of future generations matters solely to the extent that current parents care about the subsequent well-being of their own children. Some would argue that society should have loftier goals than do individual parents and should care more about the welfare of future generations. That is a defensible position, but it would only strengthen whatever case for governmental intervention results from the present baseline analysis. Second, as posed, the question about externalities has no answer, for the answer depends on the institutional context, particularly on the nature and activities of the public sector and the nature of property rights in productive factors. Third, there is no particular interest either in population size or growth per se or in the growth rate of per capita income. Interest in these quantities arises only from the fundamental interests of couples in their own consumption and fertility and in the consumption levels of their children. It might well be that under some set of initial conditions, the optimal outcome would involve growing population and declining per capita income (see Lee 1990). Fourth, so far, the society has been viewed as a homogeneous whole, with no differences among couples in tastes or wealth. We will try to relax this assumption later. Fifth, although the question may appear to be framed narrowly here, this approach does directly address many of the concerns that have been expressed about population growth, particularly in response to Hardin's (1968) classic article on the "tragedy of the commons."

II. Sources of Externalities to Childbearing

*Laissez-Faire in a Fully Competitive Private Economy*

Analysis of the basic model (see appendix 1), with full private ownership and no public sector, yields the surprising result that the laissez-faire outcome is identical to the planner's, and no true childbearing externalities occur (see Nerlove, Razin, and Sadka 1987; Willis 1987; and Phelps 1968).\(^4\) The parental

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\(^3\) If the real rate of interest equals the rate of population growth plus the rate of growth of per capita income, and if quantities such as educational expenditures per pupil and taxes grow at the rate of per capita income, then present values will be the same as for the current calculation, which assumes no growth in per capita income.

\(^4\) Pitchford (1985) appears to show that externalities do occur under laissez-faire when some resource in fixed supply leads to diminishing returns to capital and labor used in fixed proportions. It seems to us,
concern that subdivision of the farm would reduce their children's future income corresponds exactly to the fertility consequences perceived by the planner. We refer to this as the baseline case. Certain deviations from the conditions of the baseline case may lead to childbearing externalities, as we now discuss in general and qualitative terms before attempting to assign quantitative estimates.

**Collective Wealth**

The most basic kind of reproductive externality arises when there is some form of asset held collectively to which all members of the population have free right of use or access. If the per capita value or usefulness of this asset is diminished as population grows, then there is an externality to childbearing. There are two problems to distinguish here. First, it is well known that a common property resource may be overused and degraded if the existing population has free access. Second, through high fertility, the population may grow too rapidly, because the effect of any couple's fertility on their own children's use of the common property resource is very small. It is this second kind of problem that concerns us here (see Lee, forthcoming, b). In the case of a privately owned family farm, each couple takes into account the effect of their fertility on their children's future share of the farm; in the case of a collectively owned asset, this effect is diluted and spread thinly over the entire population, so for any individual couple it is negligible.

Even in societies with well-developed systems of property rights, there are many collectively owned or shared assets: publicly owned land; government-owned industries; government-owned mineral rights; rights to fisheries and inland waterways; parks; the ozone layer; other aspects of the atmosphere, such as the temperature, the absence of acid rain, and so on; and public debt. In some socialist societies, the bulk of the productive resources may be collectively owned.

The value of the externality arising through these forms of collective wealth can be calculated once the value of the collective wealth is known. Generally, it will simply equal the per capita value of the collective wealth for the next generation. For example, consider a one-class society in which all the land is collectively owned. Rural China before the “new responsibility system” might fit this description, as might certain African regions in which land is tribally owned. Couples correctly believe that their children's second-period income is independent of their own fertility decisionmaking (because the only productive asset is collectively owned). The planner, however, sees the true shadow cost of

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however, that the result may be mistaken. On the one hand, if a class of landlords owns the fixed resource, the laissez-faire outcome has not been shown to be non-Pareto-optimal, because the interests of the landlords are not considered. This is like the case we consider below of a two-class society. On the other hand, if ownership in the resource is evenly distributed in the population, then the budget constraint of the parents does not take into account the dilution of rents per capita to this scarce resource when fertility is higher. But it is precisely the foresight of this dilution that leads to optimal fertility choices.
a child (for everyone) as second-period consumption minus the marginal product of labor rather than the average. The difference in perceived costs is roughly equal to the per capita value of implicit rents in the first period (see appendix 1). This is the same as saying that the childbearing externality arising from collective ownership of land equals the per capita value of land, which is the total rental value of the land divided by the size of the next generation.

Of course, the rent must be counted not only for a single year but over the adult life of the child (or, more realistically, the present value of the perpetual rent should be calculated). If the share of land (implicit rent) is 0.4 of average agrarian income, and if life expectancy of children in adulthood is twenty-five years, then this amounts to ten times the per capita income of the rural population, which is a very large amount. This constitutes a negative externality. (This number would be reduced by perhaps half with appropriate discounting, but it would be roughly doubled if we took into account that about half the rural population is dependent.)

To evaluate the childbearing externalities arising from collective ownership of assets, or from unowned environmental wealth, we must calculate the per capita value of all such wealth. For some forms of wealth this is relatively straightforward; for others, it is nearly impossible.

*Public Sector Provision of Public Goods*

Pure public goods can be enjoyed by any number of people with no congestion or diminution of individual satisfaction. The cost of providing public goods can be shared by the whole population, so public goods cost less per head when the number of taxpayers is larger. This leads to positive externalities to childbearing, because once again the eventual cost-spreading benefits of a couple's fertility are themselves spread widely over all couples and are negligible so far as the individual couple is concerned. The usual examples of public goods are defense expenditures, radio and television broadcasting, weather forecasting, expenditures on research and development and on culture and the arts. There are also quasi-public goods, which are subject to some congestion, but less than in proportion to the population using them. Important examples include many kinds of social infrastructure: transportation and communications networks, water supply and sewage systems, and harbors.

In the case of pure public goods, paid for by an equal tax on each household, the two-period model of Nerlove, Razin, and Sadka (1987) can be used to show that there is a positive externality to childbearing just equal to the per capita cost of the public good (see appendix 1). It is a relatively simple matter, then, to calculate this cost using governmental budget data.

5. Nerlove, Razin, and Sadka (1987) analyze the special case of dynastic taxes to fund the public good; when taxes are levied in this way, no externality arises. We know of no examples of real-world dynastic taxes, so the case discussed in the text appears to be the relevant one.
The Effect of Proportional Taxes

If taxes are levied as a proportion of income or consumption, as is common, then they distort the trade-off between fertility and children's future income, leading parents to have more children than is optimal (see appendix 1). The marginal addition to the population contributes taxes equal to the tax rate, $t$, times the marginal product of labor ($MPL$) while receiving services and transfers equal to $t$ times the average product of labor ($APL$), leading to a negative externality equal to $t(APL - MPL)$. This externality is superimposed on other effects resulting from the public versus private nature of the services provided and the age distribution effects to be discussed below. Proportional taxation converts a portion of a pecuniary externality (the effect of an incremental birth on the per capita income of the next generation) into a true externality.

Intergenerational Transfers

When an age group consumes more than it produces, it does so by virtue of some kind of transfer from a different age group that produces more than it consumes. Children and the elderly are the prime examples of dependent age groups. In developing countries, most such transfers take place within the family and therefore influence the couple's fertility decisions. For example, a couple may have an additional child to assure their support in old age. In the industrial welfare states, however, many substantial transfers take place through the public sector in the form of expenditures on health and education, as well as direct financial transfers through pension schemes and family allowances.

The other side of the coin, of course, is that people pay taxes to support these transfer programs, and, on average, an individual's receipt of transfers and payments of taxes should balance over the life cycle, when discounted appropriately. Analysis shows that the appropriate rate of discount is the population growth rate, and that when population growth is more rapid, tax rates must be higher if the people receive transfers at a younger average age than they pay taxes (see Lee, forthcoming, a). In many developing countries, we see that higher fertility and more rapid population growth do indeed have this effect, requiring higher taxes. In such countries there is concern that the public costs of education create negative externalities to childbearing. In some richer developing countries and in the industrial countries, the importance of public sector transfers to the elderly reverses the situation, and higher fertility permits lower tax rates.

In addition to these public expenditures on health, education, and pensions,
which are relatively age-specific, it may also be that population growth generates increased demand for various other governmental services, such as the social infrastructure discussed above, before it generates the increased taxes to pay for them. This also is a matter of the difference between the average ages at which one requires governmental services and pays taxes. For all these reasons, externalities arise through the influence of fertility on the age distribution of the population.

To calculate the externalities arising from public sector intergenerational transfers, we must first develop age profiles of receipt of transfers and of payment of taxes. This requires inspection of educational enrollment rates and budgets; of health care expenditure and utilization data; and of government data on pensions. Lacking direct data on the age incidence of taxes, we have assumed them to be proportional to labor earnings and have used age-earning profiles. In many countries tax revenues are raised mainly by taxes on consumption, so this assumption may not be too inaccurate; in any case, it appears to be the best we can do for the present. The next step in the estimation is to obtain appropriate stable population age distributions, reflecting current vital rates. In many developing-country populations, these should be fairly close to the actual age distribution of the population. Using the age profiles for transfers and the stable population, the next step is to calculate the average ages at which a transfer is received and at which taxes are paid. The externality to childbearing then equals the average age of receipt of transfer minus the average age of payment of taxes, times the per capita value of transfers received annually in the stable population, divided by the average age at childbearing times the total fertility rate (see Lee, forthcoming, a). For non-age-specific governmental expenditures other than pure public goods, we have assumed that the mean age of demand for services is midway between the average age of the population and the average age of earning and otherwise proceeded as just described.

Economies of Scale and Induced Technological Progress

It has sometimes been suggested that small countries, with low gross national product (GNP), do not provide sufficiently large markets to support an efficient level of operation for many industries, or perhaps for the economy as a whole. Arguments of this sort for positive economies of scale have lost much of their force as international economic integration proceeds, and there are many exam-

8. It is assumed that the public sector budget is balanced. The tax rate is then set so as to generate exactly the revenues needed for transfers, given the age distribution. Note that with these assumptions, the present value over the life cycle of the transfers received and the taxes paid is zero when the discount rate equals the population growth rate. That is, if the population is growing, each person will be paying taxes to support more transfers than they themselves received, and discounting at the population growth rate must set the present values equal. If a birth is foregone, there will be no net gain in the transfer budget unless government funds can be invested at a rate of return greater than the population growth rate (plus the rate of growth in per capita income). The calculation described in the text captures a subtler effect—the tendency of the child to raise the population growth rate and alter the population age distribution.
Table 1. Rough Estimates of Externalities to Childbearing in Selected Countries (U.S.$ of reference year)

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<tr>
<td>Mineral rights</td>
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<td>0 to -13,000</td>
<td>-289</td>
<td>-189,554</td>
<td>-168</td>
<td>-10,003</td>
<td>-7,433</td>
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<td>Government debt</td>
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<td>+107</td>
<td>+41</td>
<td>0</td>
<td>+151</td>
<td>+1,075</td>
<td>+755</td>
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<td>Government capital</td>
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<td>-1</td>
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<td>0</td>
<td>0</td>
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<tr>
<td>Government land</td>
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<td>-11</td>
<td>n.a.</td>
<td>-180</td>
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<td>Fisheries</td>
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<td>-35</td>
<td>-346</td>
<td>0</td>
<td>-929</td>
<td>-93</td>
<td>-60</td>
</tr>
<tr>
<td>Foreign aid</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>Subtotal (net)</td>
<td>+5,178</td>
<td>-15 to -13,205</td>
<td>-634</td>
<td>-208,894</td>
<td>-1,159</td>
<td>-9,268</td>
<td>-17,422</td>
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<tr>
<td>Public goods</td>
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<tr>
<td>Defense, public order</td>
<td>+57,637</td>
<td>+324</td>
<td>+98</td>
<td>+48,255</td>
<td>+472</td>
<td>+786</td>
<td>+682</td>
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<tr>
<td>Social infrastructure</td>
<td>+9,968</td>
<td>+352</td>
<td>+429</td>
<td>+13,463</td>
<td>+692</td>
<td>+4,964</td>
<td>+1,025</td>
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<tr>
<td>Public administration</td>
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<td>+35</td>
<td>+88</td>
<td>+19,383</td>
<td>+321</td>
<td>+2,192</td>
<td>+1,526</td>
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<tr>
<td>Subtotal (net)</td>
<td>+74,950</td>
<td>+710</td>
<td>+615</td>
<td>+81,100</td>
<td>+1,484</td>
<td>+7,942</td>
<td>+3,233</td>
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<td>Proportional taxes</td>
<td>0 to -41,000</td>
<td>0 to -350</td>
<td>0 to -140</td>
<td>0 to -9,000</td>
<td>0 to -540</td>
<td>0 to -3,500</td>
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<tr>
<td>Intergenerational transfers</td>
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<td></td>
<td></td>
<td></td>
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<td>Health, education, pensions</td>
<td>+35,713</td>
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<td>-6</td>
<td>-1,358</td>
<td>-48</td>
<td>-187</td>
<td>+463</td>
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<td>Other public expenditures</td>
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<td>-34</td>
<td>-16</td>
<td>-1,330</td>
<td>-22</td>
<td>-247</td>
<td>-168</td>
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<tr>
<td>Subtotal (net)</td>
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<td>-59</td>
<td>-22</td>
<td>-2,688</td>
<td>-70</td>
<td>-434</td>
<td>+295</td>
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<tr>
<td>Total net externality</td>
<td>+64,000 (rounded)</td>
<td>+640 to</td>
<td>-40 to</td>
<td>-130,000 (rounded)</td>
<td>+250 to</td>
<td>-1,800 to</td>
<td>-13,900 to</td>
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<tr>
<td>GDP per capita</td>
<td>+103,000</td>
<td>-12,900</td>
<td>-180</td>
<td>-139,000</td>
<td>-280</td>
<td>-5,300</td>
<td>-17,400</td>
</tr>
<tr>
<td>Ratio of net externality to GDP per capita</td>
<td>+4 to +6</td>
<td>+2 to -50</td>
<td>0 to -1</td>
<td>-20 to -22</td>
<td>+1 to -1</td>
<td>-1 to -2</td>
<td>-10 to -12</td>
</tr>
</tbody>
</table>

n.a. Not available. Note: The ranges in the last row result from the ranges on specific items and do not indicate the overall degree of uncertainty, which is far greater. Entries for public wealth, public goods, and age distribution effects assume that all taxes are head taxes; the entries under proportional taxes give the added correction if instead (as is highly likely) taxes are proportional to income or consumption. “Other public expenditures” includes half of the value of quasi-public goods (most infrastructural expenditures), plus all other expenditures not counted elsewhere. These are allocated by age midway between the average ages of the population and the labor force. “Social infrastructure” includes transportation, communications, research and development, and economic services. “Public administration” includes foreign relations and general government administration. For most countries, Hotelling's principle (Miller and Upton 1985) was used to estimate the value of the country's main nonrenewable asset (oil, natural gas, coal). For Kenya and Brazil, multiple mineral values assume costs of extraction of 60 percent of resource value. The value for public land in Kenya includes total estimated value of forests, assumed to be publicly owned, and the profits of restaurants and hotels, largely attributable to tourism in the national parks. The figure for land in Brazil attempts to value the rain forest (assumed to be one-quarter publicly owned), based on sustainable harvest, and without valuing its role in the global ecology (Peters, Gentry, and Mendelsohn 1989). It also includes a valuation of current hydropower. For data sources, see Appendix 2.
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ple of relatively small economies experiencing very rapid growth. It may be so
that larger, denser, or more rapidly growing populations stimulate technological
progress by shifting both the supply schedule and demand schedule for invention
and innovation (see Simon 1986; Boserup 1981; and Phelps 1968). So far, such
effects have largely defied measurement, but they may be important nonetheless.
In this paper, however, we will not be able to take them into account.

III. Estimates of Externalities to Childbearing

Having discussed several categories of externalities to childbearing and the
method to be used to evaluate each one, we now attempt to attach numbers to
them. This evaluation is based on a variety of published information, including
the results of household surveys, data on mineral reserves, census data, and
national and subnational budgets. It should be understood that these estimates
have been made without any special knowledge of the countries to which they
refer and that this introduces an additional layer of uncertainty onto whatever
arises from the many assumptions made. Table 1 draws together the estimates
for six developing countries, with comparisons to estimates for the United
States.

Estimates of Externalities Arising from Collective Wealth

The table reveals some dramatic differences among countries in the general
importance of the various items considered under this heading. Mineral reserves
dominate the entire calculation in India and Saudi Arabia. For Saudi Arabia this
is surely no surprise, because its oil revenues are well known to be extremely
important. Yet relative to per capita GDP, the role of coal reserves could possibly
be even more important in India. The uncertainty expressed in the table results
from the difficulty in valuing the reserves when the government coal industries
actually operated at a loss in the period examined.9 In fact, the coal industry
plays a rather minor role in the Indian economy, unlike oil in Saudi Arabia, so it
would perhaps be best to minimize its role in these calculations.10

9. The high estimate was made by valuing the underground coal at the price of Australian coal that is
imported to India, less the cost of extraction. Because there are surely important differences in quality,
this is doubtless too high. In fact, a number of countries operate coal industries at a loss to generate
employment and to ameliorate regional economic depression.

10. Perhaps a clearer real-world example of an externality arising from collective ownership of mineral
reserves is provided by the microstate of Nauru. The following passages are extracted from the United
Nations (1989, p. 195) summary of their views and policies on population: “Government development
objectives are strongly tied to the demographic situation since the entire economy is based on phosphate
mining that, through its revenues, funds and supports all social services. Phosphate is the only resource
the island has, and the supply is being rapidly depleted. The Government’s response has been to make
overseas investments in real estate, forming trust funds for the future welfare of its population.” Notwith-
standing the obvious negative externality to childbearing in this instance, the government would prefer
more rapid population growth.
Paralleling the value of mineral reserves in these countries is the possibly enormous value of Brazil's rain forest, listed under "government land." Valuation is necessarily very uncertain. The figure used estimates the present value of its sustainable yield of timber, fruit, and latex (see Peters, Gentry, and Mendelsohn 1989) and assumes that 25 percent of the rain forest is public land.\(^\text{11}\) Aside from the case of the Brazilian rain forest, government land, which is always difficult to value, is nowhere very important except perhaps in Kenya, where the value of tourism generated by the game parks is included.

Government debt, which can more easily be repaid with a larger population to share the burden, ceteris paribus, leads to a significant positive externality (relative to per capita GDP) in all countries other than Saudi Arabia. Surprisingly, debt is not strikingly large relative to per capita GDP in Mexico and Brazil in the mid-1980s; at 50 percent, it is comparable to debt in India and Kenya and smaller than debt in the United States, which, at 60 percent, dominates all other items of collective wealth.\(^\text{12}\)

Only in Saudi Arabia does government capital lead to significant negative externalities, and our estimate there is based entirely on the assumption that a good portion of previous public oil revenues was invested in publicly owned capital. We count neither capital formed from issue of bonds or equity nor capital funded from taxes.

Externalities arising from fisheries appear unimportant.\(^\text{13}\) If foreign aid is believed to be largely independent of the size of the population, then population growth reduces its per capita value. Taking a per capita present value of a stream of foreign aid at current levels over the adult lifetime of a child, this component is quite important for both Bangladesh and Kenya, where it comes to two or three times current per capita GDP.

Public Goods

Government budgets were inspected to select expenditures for items whose use was either not subject to congestion at all or was subject only partially to congestion. Not surprisingly, defense expenditures formed a very substantial

\(^\text{11}\) There are many problems in making such an estimate; among them is that if the entire Amazon rain forest were used in this way, the prices of the goods harvested might drop considerably. Of course, it would be impossible to use the rain forest in this way without enormous investments in social infrastructure. Furthermore, it is not clear to what extent the ownership of the rain forest is public.

\(^\text{12}\) Some developed countries would have net credit in this category. Both internal and external debt is relevant here, because the obligation to repay is shared by all, whereas the value of any debt instruments held by the population is internalized in the fertility decision.

\(^\text{13}\) It is not clear how to evaluate the fisheries. Under current institutional arrangements, access is largely unregulated, and consequently rents are largely dissipated through overfishing. The entire value of output may then be attributed to inputs other than the fisheries themselves. Alternatively, we might value the fisheries according to the potential rents generated under optimal management. In principle this could exceed the value of the current catch, but in practice is likely to be only a fraction of it. In the calculations, we have used half the present value of a perpetual stream of harvests of value equal to that in the base year. This is an exceedingly rough guess at the value of rents for an optimally managed fishery.
component of the total. Social infrastructural quasi-public goods, given a weight of one-half, were also quite important. Variation in these expenditures relative to per capita GDP was moderate, except for Saudi Arabia, which has very high relative public good expenditures funded through the oil revenues.\(^\text{14}\)

These items may appear irrelevant or peculiar, but in fact they are often of concern to scholars and policymakers. Governmental desire for a larger population to enhance military power goes back to ancient times and is well-known today. Edgeworth (1925, p. 20) wrote that a large population was desirable "for the sake of defense against or competition with foreign nations" and that "being must be secured before well-being" (quoted in Nerlove, Razin, and Sadka 1987, p. 82). A recent speech by Qaddafi (1987) strikes a very similar note, calling for rapid growth of the Arab population to a size of one billion for purposes of political and military power, while acknowledging the adverse economic consequences that would be likely to follow. One may well question the wisdom of heavy spending on the military in many countries, including the United States, but if we take governmental goals as given, such spending does create positive externalities to childbearing. It is also widely appreciated that denser population makes transportation and communication networks more affordable on a per capita basis, and in fact there are strong empirical associations between population density and social infrastructure capital such as roads (see Simon 1977 and Boserup 1981). Boserup (1981) has repeatedly stressed the importance of population size for major collective undertakings throughout history, including investment in and maintenance of social infrastructure such as irrigation systems. Expenditure on research and development for agriculture and other areas is another public good expenditure with important potential for economic development. These uniformly positive externalities arising from public good expenditures should not be dismissed lightly.

**Proportional Taxes**

The incremental population member may contribute less in tax revenues than the average member while receiving the average amount of publicly provided goods and services. Evaluation of the resulting negative externality is in principle straightforward: it is the survival-weighted present value of the tax rate times the difference between the average and the marginal product of labor, abstracting from variations by age that are considered below.

The countries examined here have ratios of total tax revenues to GDP ranging from 11 percent (Bangladesh) to 33 percent (Brazil and the United States; the remaining figures are India, 17.9 percent; Saudi Arabia, 18.5 percent; Kenya, 22.9 percent; and Mexico, 19.9 percent). If production is constant returns to

\(^{14}\) It is correct to count the Saudi Arabian public goods as generating a positive externality, even though they are financed by oil revenues rather than taxes. The reason is that the full value of the oil has already been counted as generating a negative externality, although the portion used to fund public goods does not do so.
scale, and the labor elasticity of output is 0.7, then the \( \text{APL} - \text{MPL} \) term would be 30 percent of per capita income, \( y \). Therefore this component of externalities would have a negative value of from 0.03\( y \) to 0.10\( y \) per year (equals 0.11 to 0.33 times 0.3) or a negative present value of 1.5\( y \) to 5\( y \). This is a substantial amount. More realistically, however, an incremental worker will contribute more than the short-run marginal product of labor over his or her lifetime, because the incremental worker also saves and accumulates nonhuman wealth, and has other, more complicated effects on the economy.\(^{15} \) For purposes of table 1, we attempted to bracket the possibilities by assuming that lifetime incomes of incremental population members lie in the range between 0.85 and 1.0 times the average life income. We then applied the tax rate for each country, calculated as the ratio of total taxes (central and local) to \( \text{GDP} \). Obviously these evaluations are very approximate.

**Intergenerational Transfers**

In developing countries, public expenditures on education and health are frequently mentioned as important negative externalities to childbearing, whereas in more developed countries, the positive role of children in supporting the parental generation in its retirement is stressed. Each of these views is qualitatively correct in its context, as table 1 indicates. Pension expenditures in most less developed countries are relatively low, in part because of the low proportion of the population at advanced ages and in part because expenditures on public pensions per elderly person are in any event minimal, even relative to per capita \( \text{GDP} \).

Brazil is a stunning exception, as the table shows. Brazil and a few other Latin American countries have strong public pension programs. The average elderly person in Brazil receives about fifteen times as large an annual transfer as the average child, a ratio many times greater than prevails even in the developed countries of the world.

Once we take into account that costly children will grow to pay taxes themselves one day, the magnitude of the negative externality per birth in developing countries appears to be small, on the order of 10 to 25 percent of per capita \( \text{GDP} \). (However, if the incremental child grows up to pay taxes only on the \( \text{MPL} \), the effect of these transfer programs is far greater, by a factor of two to five. This effect has already been taken into account in the preceding section.) This is far less than many other sources of externalities and would not appear to justify the emphasis given to the costs of such public sector transfers in forming fertility policy.

\(^{15} \) If incremental members of the population had lifetime incomes substantially lower than the average, then population growth would lead to substantially lower per capita income, other things being equal. However, a number of recent reviews of the literature on economic consequences of population growth find the evidence on this point mixed and inconclusive in many respects (World Bank 1984; National Research Council 1986; and Kelley 1988). There may be more adverse consequences in some contexts, such as Bangladesh, than in others, such as the United States.
Why are these estimates so low? There are two leading reasons. First, the calculations assume that the base population is homogeneous with respect to wealth and tastes, so that every child is assumed to pay the same taxes as an adult. But some children, who are born to poor families and who grow up poor, may receive average public sector transfers while paying below average taxes as adults (although the fact that the poorer population is generally in the rural areas, where they both receive poorer educational and health services and pay lower taxes, reduces the likely error arising from heterogeneity). Second, the calculations assume that the real rate of discount equals the stable population growth rate, which in these countries ranges from about 2 to 4 percent annually. Perhaps this discount rate is too low; with a discount rate of 10 percent, perhaps the earlier expenditures on education and health for children would overwhelm the later tax payments.\(^{16}\)

Aside from these two qualifications, it appears that externalities arising from the age distribution of public expenditures on health, education, and pensions in the developing countries here examined are relatively modest, generally amounting to no more than a fifth of per capita GDP. When the age distribution of demand for other governmental services is considered in relation to the age distribution of payment of taxes, a negative externality of roughly equal size is found. The total negative externality arising from the age distribution of interactions with the public sector is therefore between 15 and 40 percent of per capita GDP. For the United States, and most likely for other industrial economies, the heavy public involvement in provision of pensions generates a far more substantial positive externality, equal to 150 percent of the U.S. per capita GDP. As developing-country populations age, and as their public sectors accept greater responsibility for old age support, the small negative externalities from intergenerational transfers may become negligible and then turn positive. In Brazil and Mexico, this process has already advanced substantially. The age pattern of their transfers is closer to the industrial countries than to the other developing countries considered here, although the level of transfers is still relatively low by the standards of the industrial nations.

**Net Externalities to Childbearing**

Summing the subtotals of externalities arising from collective wealth, public goods, proportional taxes, and intergenerational transfers, we find an estimate of the net externality to childbearing. The bottom row of the table shows the ratio of this value to the level of per capita GDP for each country. For the

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16. For India, where the stable population growth rate would be about 2 percent per year, the real rate of return on long-term Indian government bonds issued over the past decade was almost exactly 2 percent. We have not checked the comparable number for the other countries. Regarding the discount rates, as noted elsewhere, higher discount rates largely reflect inflation and productivity growth, and both of these generate a corresponding rate of increase in costs and taxes and therefore leave the result of the calculation unchanged. Therefore it is unlikely that higher discount rates, if handled appropriately, would lead to very different results.
developing countries, these ratios are either close to zero or negative. (The ranges given in the table derive from specific items and are not intended to indicate the overall degree of uncertainty, which is far greater.) It is particularly striking that the ratios for Kenya and Bangladesh—both widely viewed as having serious population problems—are close to zero. It appears that only countries with high values of mineral reserves or other natural resources per head (Saudi Arabia, Brazil, and possibly India) have strongly negative childbearing externalities. If we take the plausible view that Indian coal reserves have a low value, then India would join Kenya, Bangladesh, and Mexico with net externalities close to zero. In contrast to these developing countries, the United States has positive externalities arising from three sources: substantial national debt; heavy military expenditures; and major public transfers to the elderly. The effects of these may be considerably reduced by the distortions of proportional taxes.

IV. EXTENSION TO A TWO-CLASS AGRARIAN SOCIETY

As explained, the previous analysis was based on the assumption of a homogeneous population, in which all members shared the same initial wealth and tastes. One might well wonder to what extent the results would hold up if we dropped this assumption. To explore these largely uncharted waters, we consider an agrarian society with a class of landless laborers and a class of landowners who also contribute labor. The two classes have identical preferences. Each behaves according to the appropriately amended baseline model. For landless labor, increased population reduces wages without any offsetting benefit from rising rents; perhaps, then, laborers could do better with lower fertility than under laissez-faire, and perhaps they could even do sufficiently better to compensate the landowning class for the difference between reduced rents and increased wages.

Analysis of the model (see appendix 1) confirms that under laissez-faire, the class of laborers chooses fertility that is too high to be optimal, in the sense that as a class they could benefit from reduced fertility, thereby withholding some of the next generation's labor. This is true even after taking appropriate account of the satisfaction and economic services they expect to receive from their children. The class-specific pseudo-externality to a child may be very large—perhaps as much as ten times the annual agrarian wage.

However, the high fertility of laborers generates a gain for the landowner-parents, by raising rents. In the neighborhood of the laissez-faire equilibrium, the utility gains of laborers from a fertility reduction would be exactly offset by the utility losses of landowners, so that no compensation or bribe would be possible (see appendix 1). The laissez-faire outcome is therefore Pareto-optimal, and a planner could not improve on it.

For a society that cared about the equality of income distribution, a fertility control program targeted on the landless laborers would be attractive. Not only
would it equalize the distribution of welfare in the current generation but for the
next generation it would both equalize the distribution of income and raise per
capita income (it would increase the welfare of the laborers primarily through
raising their anticipations for their children's future, as it would reduce the
anticipations of the landlords). Therefore, a case could be made for government
intervention based on concern for income growth over time as well as for equita-
ble income distribution within each generation. This case would not rest on
externalities in the sense of market failure, however. 17

V. Reservations

At this point, let us consider some problems with the method and the data.
We discuss three that we believe are particularly important.

Estimates Reflect Transitory and Suboptimal Policy Decisions
in Other Spheres

First, the estimates are based heavily on current government allocation deci-
sions and therefore reflect nonoptimal and transitory policies in other spheres.
For example, in the mid-1980s, military spending in the United States was 6.6
percent of GDP. This public good outlay alone generates an externality of 3.3
times per capita GDP, or roughly half of the total net externality found. But now,
with the relaxation of East-West tensions, military expenditures may be sub-
stantially reduced, leading to a reduction in calculated externalities. Each child
born has a permanent effect on the population size, ceteris paribus, and calcu-
lated externalities should not depend on such changeable items. Nor is it clear
that population policy should depend on a level of military expenditures that
many would perceive as inappropriately high. Similar comments could be made
about the effects of current public transfers to the elderly. These were far less in
the 1960s, and calculated externalities surely would have looked very different
then. In developing countries, such expenditures are likely to become increas-
ingly important as both fertility and mortality decline and as development pro-
ceeds. The calculations might be better if they were based either on some con-
cept of optimal public expenditures (which would be operationally impossible)
or perhaps on an appropriate cross-national average of public expenditure
allocation. Such an approach would reduce the influence of military spending in
the U.S. calculation and thereby reduce the positive externality. For other public
goods, and for collective wealth, we believe it would make little difference. For
population age structure (intergenerational transfers), it would probably neu-
tralize the currently mildly negative externalities to fertility in all developing
countries here examined.

17. In practice, there is only very weak evidence of an association of population growth rates with
income distribution (Lam 1987) or of an association between population growth or density and per capita
levels or growth rates of income (National Research Council 1986).
Estimates Ignore Environmental Consequences

A second serious problem is that potentially enormous environmental externalities have been excluded from the collective wealth category, for want of appropriate data. Many valued aspects of the environment are highly congestible, such as the ability of airsheds to absorb emissions of carbon and other pollutants without serious degradation, manifested as acid rain, global warming, and deterioration of the ozone layer. Proper consideration of such effects might swamp the externalities considered here. At the same time, it must be noted that most of these externalities are global, not national, in scope, and therefore best addressed through international rather than national channels. In addition, environmental concerns may well provide compelling new reasons for public involvement in private reproductive decisions, but they have not been the basis for most population policies to date, and therefore it is still instructive to examine the logic of the more familiar and conventional bases for intervention.

Estimates Assume Population Homogeneity

The third major difficulty with these estimates is that they are based on the assumption that the populations are homogeneous with respect to wealth and tastes. But if one subgroup has stronger preferences for children than another, might not its fertility inflict externalities on the other (see Greene 1985)? Or might not the fertility of poorer subgroups impose costs on the public sector that would not be fully repaid by the children as adults? These are difficult questions on which very little work has been done. We suggested in the previous section that in a society of landowners and landless laborers, the fertility of laborers would be at a socially efficient (that is, Pareto-optimal) level under laissez-faire, even though laborers as a class could raise their utility by collectively reducing their fertility. Thus a policy aimed at reducing fertility of the landless laborers would raise the utility of their current generation, redistribute income toward them in the next generation, and reduce the utility of landowners in the current and subsequent generation. For laborers as a class, the laissez-faire fertility level is not optimal, even taking their satisfaction from childbearing into account, while their laissez-faire fertility is not too high from a societal point of view, if distributional issues are ignored.

It is our guess that aside from environmental collective wealth, the various difficulties and adjustments just discussed do not seriously alter the main results. We suspect that net negative externalities to childbearing are not sizable in most developing countries, except when there are unusually valuable mineral reserves, and that even then this source of externality will appear distant from the concerns of policymakers in most countries. We therefore do not believe that the reason why parents in many developing countries choose high fertility is because they are able to pass important net costs of childbearing onto society, although common sense tells us that fertility is often far too high. The reasons for high fertility, and the justifications for governmental intervention, typically must be sought elsewhere.
VI. POLICY IMPLICATIONS

Implications of Externalities

The policy implication of an identified net externality is in principle straightforward. As measured here, the externality is the difference between the parental perception of the net cost of a child and the social perception, which incorporates the parents' but also adds any spillovers. The indicated policy is either to subsidize or to tax each birth so as to equate the parental perception of costs with the full social cost. Public funds required or raised in this manner are then taken from tax revenues or used to offset general taxes, as the case may be. A finding of significant negative externalities per child therefore would provide explicit support for a policy of financial disincentives for childbearing and would indeed identify a specific amount for the disincentive. As it happens, the research reported here did not find significant net externalities for some countries of prime interest, such as Bangladesh and Kenya.

If reproductive externalities do not appear to justify policies going beyond family planning in some important high-fertility settings, where does that leave fertility policy? Must these countries reconcile themselves to the rapid population growth that would continue even if all couples attained their current reproductive goals—goals that may be very high, as they are in Kenya, for example? Recent research disagrees about the scope for reducing fertility and population growth rates through elimination of unwanted fertility (see Bongaarts 1990; Westoff 1988), so such a conclusion might well cause concern. In fact, however, such a conclusion would be premature, for several reasons.

Effects of Less Costly Contraception

Sociologists and family planning workers have long argued that the ability to control fertility can itself lead to a reduction in the desired family size. Becker (1981) showed that because of the peculiar interaction of the quantity and quality of children in the household budget constraint, a reduction in cost of contraception has a kind of multiplier effect on fertility, leading to a simultaneous decline in desired family size and increase in desired investment per child. For this reason, family planning programs can be expected to do more than help couples achieve their current family size goals; they also can induce a reduction in those goals.

Inaccurate Parental Expectations

The estimates of externalities assumed that parents had complete information about the conditions to be faced by their grown children and about their proba-

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18. Westoff (1988, p. 232), after analyzing data from recent Demographic and Health Surveys for Brazil, Peru, the Dominican Republic, and Liberia, concludes that "the overwhelming majority of women who want no more children or who want to postpone fertility, at least in the four countries discussed here, are behaving in a manner consistent with that goal." Bongaarts (1990) asserts that conventional estimates are biased and develops a new measure that suggests that on average 22 percent of births in forty-six developing-country populations are unwanted.
bility of survival. But there may be systematic distortions in the information on which parents base their decisions. On the one hand, parents probably underestimate the extent of secular economic growth in per capita incomes and therefore underestimate their children's future incomes. This would lead them to reduce their fertility more than would be appropriate. On the other hand, parents probably underestimate the pace and certainty of mortality decline and therefore have higher fertility than necessary to achieve a high probability of the desired number of surviving adult children. This leads them to raise their fertility above the appropriate level. Likewise, parents may misjudge the future return to education and other investments in child quality, leading them to choose a greater number of children and invest less in each. The point here is that a policy of disseminating information on these matters may aid couples in choosing an individually appropriate level of fertility, and this level may well be lower than otherwise.

**Individual Concern for Community Outcomes**

The analysis of externalities was based on the assumption that individuals care only about their own well-being and that of their children. But it is plausible to believe that individuals care also about the distribution of income in their communities and about the improvement over time in average living conditions. Such considerations add a new dimension to the analysis and would surely lead to important negative externalities.

**Absence of Institutional Substitutes for Children**

An absence of negative externalities suggests that individual fertility motives are consistent with maximization of individually based social welfare. But their absence does not imply that current fertility levels are either individually or socially efficient in a broader sense. Fertility decisions are taken in a particular institutional context, and the calculation assesses their efficiency only relative to that context. In most high-fertility settings, surveys and anthropological studies indicate that children are valued for a number of instrumental purposes: to provide old age support for the parents; to provide insurance against risks to income, health, and physical security; and to provide labor services at home and in production (for example, see Bulatao 1979). Such services that children supply are viewed as more important than direct psychic satisfactions, at least for higher-parity children. As developing markets and the public sector come to provide more cost-effective substitutes for many of these services, the individually optimal level of fertility falls, and both individual and social welfare rise. High fertility is not absolutely optimal; rather, it is optimal in a *suboptimal* institutional context.

**VII. Conclusions**

Evidence on adverse macroeconomic consequences of population growth is weak and mixed, but, in any event, it could not in itself provide grounds for
governmental intervention in reproductive decisionmaking. After all, if parents prefer to have more children at the cost of lower per capita household income, why should governments dispute that decision? Of course, if couples' fertility exceeds their desired family size, an excellent case can be made for governmental support for family planning programs to enable couples better to regulate their fertility. But policies designed to alter a couple's family size choice, or to coerce a certain outcome, are a different matter. From the point of view of welfare theory, justification requires that societal goals differ from individual ones, that individuals are poorly informed, or that the setting deviates in significant ways from a competitive market economy. Here we have considered one important deviation from full competitive markets—external costs and benefits of childbearing. If consequences of childbearing are neither borne entirely by the parents nor pass through markets but rather spill over to society at large, then society has a legitimate interest in influencing childbearing decisions. Belief that such childbearing externalities exist and are negative in most developing countries is the most common justification for policies going beyond family planning.

We have identified four broad categories of externality: dilution of the per capita value of collective wealth; dilution of costs of collective projects with public good aspects; incentive reduction due to proportional taxes; and the effect of population age distribution on the tax rate necessary to support public sector activities such as health, education, pensions, social infrastructure, and other services. We attempted a rough evaluation of many kinds of externalities in each of these four categories for a variety of countries. For some of the countries widely viewed as having serious population problems, the net total of these quantifiable externalities was close to zero. For others, the value of collectively held mineral rights dominated the calculation, leading to a large negative externality, but one that may seem unconvincing to many as a basis for fertility policy. Countries in which most agricultural land is collectively owned, such as China, have an additional large source of negative childbearing externalities. For the United States, there is evidence of positive externalities to childbearing, a result that may prove typical for industrial nations when environmental costs are excluded.

We conclude that externalities to childbearing, although apparently somewhat negative in most developing nations, do not typically provide a strong rationale for fertility policies going beyond pure family planning (the point estimates of the negative externalities are often large enough to warrant interventionist policies. The difficulty lies in the wide band of uncertainty surrounding them). This finding, which might well be altered if environmental problems were incorporated in the analysis, is tentative for reasons discussed earlier. In any event, a policy of vigorous family planning, combined with dissemination of information about mortality declines and the gains from parental investment in education, would be entirely consistent with this finding. Such policies in themselves might lead to reductions in desired family size, particularly by promoting investment in child quality. We further suggest that the apparent absence of sizable negative externalities in many developing countries does not mean that
high fertility is socially or individually desirable in any general sense, because it is rational only in settings where superior institutional substitutes for many of the services of children do not exist. Efforts to provide alternative sources of risk spreading, provision for old-age support, physical security, and health care might well lead to fertility declines and might raise both individual and social welfare. At the same time, coercive measures to reduce fertility without such institutions in place might reduce both individual and social welfare.

Stronger fertility policies might be justified on grounds not considered here: society may care more for the welfare of future generations or for that of some current family members than do family decisionmakers; or society may care about the distribution of income rather than just Pareto-efficiency. The main finding here, however, is that given the current state of research, externalities to childbearing do not themselves provide a convincing rationale for fertility policies involving financial incentives or various forms of coercion. The analysis here—restricted to the case of pure or technical externalities to childbearing—does not suggest that in most developing countries fertility policies should go beyond assisting well-informed parents to attain the family size goals they choose.

APPENDIX 1. THE MODEL, WITH PUBLIC GOODS, COLLECTIVE WEALTH, AND PROPORTIONAL TAXATION

Baseline Case

Following Nerlove, Razin, and Sadka (1987), consider a population of \( N \) couples homogeneous with respect to tastes and wealth. Utility depends on a family's current consumption, \( c_1 \), their number of children, \( n \), and the consumption they anticipate for their children as adults in the second period, \( c_2 \). Parental satisfaction arises from the average consumption by their children as adults, not from the total. Each family owns a farm yielding output that depends on labor inputs according to the homogeneous production function \( f(\cdot) \), with land suppressed as an argument. They may leave a positive or negative bequest of \( b \) to the next generation. Storage of \( b \) is possible without gain or loss. Assume with Nerlove, Razin, and Sadka (1987) that all families, besides possessing identical tastes and endowments, also have perfect foresight about the fertility of other families, so that second-period wages, \( w_2 \), and rents, \( r_2 \), are known to first-period parents.

The individual couple seeks to maximize its utility as follows:

\[
\text{(A-1) } \max U(c_1, c_2, n) \quad \text{(over } c_1, c_2, n) \]

Subject to:

- \( w_1 + r_1 - b = c_1 \)
- \( nA(w_2) + A(r_2) + b = nA(c_2) \)
- \( A(w_2) = w_2 \)
- \( A(r_2) = r_2 \)
- \( A(c_2) = c_2 \)
The terms $w_i$ and $r_i$ refer to wages and rents (to the fixed family holding) in each period, and $A(.)$ denotes the second-period value anticipated in the first period. The last three equations express the assumption of perfect foresight. The five constraints can be combined to get

\[(A-2) \quad w_1 + r_1 + nw_2 + r_2 = c_1 + nc_2\]

The representative couple's first-order conditions are

\[(A-3) \quad \frac{U_n}{U_{c_1}} = c_2 - w_2 \quad \text{and} \quad U_{c_2} = nU_{c_1}\]

The assumption of perfect foresight assures that the wages and rents expected to prevail in the second period will indeed do so.

An omniscient planner recognizes that second-period wages and rents depend on the choice of first-period fertility, $n$, so that

\[(A-4) \quad w_2 = f'(n) \quad \text{and} \quad r_2 = f(n) - nf'(n)\]

Otherwise, the planner's problem is identical to the individual's. The planner's first-order condition for fertility differs from the individual's by a term: $U_{c_1} (dr_2/dn + ndw_2/dn)$. But the term in parentheses is readily shown to equal

\[(A-5) \quad [-nf''(n) + nf''(n)] = 0\]

Therefore the form of the planner's first-order condition for fertility is no different from the individual's. The other first-order condition is readily seen to be the same as well. Therefore the planner, in seeking to maximize the utility of the first-generation parents, would make exactly the same choice of fertility as they, and no externality occurs.

**Public Goods and Collective Wealth with a Household Tax**

Assume the parental utility function now additionally incorporates satisfaction from consumption of a public good in period 1, $P_1$, and from their children's consumption of a public good in period 2, $P_2$. In each period, the government independently chooses a level of the public good (which may or may not be optimal) and levies an equal tax, $t_i$, on all households to pay for it. (The assumption that the public good is financed by a household tax rather than a dynastic tax is critical, because Nerlove, Razin, and Sadka showed that with a dynastic tax no externality occurs.) In addition to revenues from taxes, the government can sell the publicly held national wealth, which has value $R$. The government has a balanced budget, and the net tax may be positive or negative. Note that environmental collective wealth under current institutional arrangements is not owned by the government and cannot be sold; furthermore, it can be enjoyed and used by all, regardless of whether they benefit from tax reductions.

The problem for the representative couple is as follows:

\[(A-6) \quad \max U(c_1, c_2, n, P_1, P_2) \quad \text{(over } c_1, c_2, n; P_i \text{s are given)}\]
Subject to:
\[ f(1) + f(n) = c_1 + nc_1 + t_1 + nt_2 \]

The couple's first-order condition for fertility is

\[ \frac{U_n}{U_{c_1}} = c_2 + t_2 - f'(n) \]

The planner recognizes that a larger population can share the potential revenues from selling the national wealth, \( R \), and likewise shares the costs of providing \( P_2 \):

\[ t_2 = \frac{(P_2 - R)}{nN} \]

Optimizing with this additional constraint, we get the planner's first-order condition

\[ \frac{U_n}{U_{c_1}} = c_2 - f'(n) \]

The term \( t_2 \) in a couple's first-order condition, equation A-7, vanishes in the planner's, equation A-9, because the planner sees that no matter how many children a couple has, their children's combined next period total tax obligation (for next period's public goods) will remain the same, provided all other couples have the same number of children. Consequently, an amount \( t_2 = (P_2 - R)/(nN) \) should be subtracted from the couple's perceived marginal cost of children (where \( n \) is taken equal to the planner's optimal value of children per couple) in order to internalize these two externalities. If \( P_2 > R \), there is a net positive externality. If \( P_2 < R \), there is a net negative externality.

**Proportional Taxes**

So far, we have assumed that all taxes are head taxes. However, more realistically, taxes are levied at a rate \( t \) of income or consumption expenditure. Let the utility function be as before, including public goods, but now suppose that all first- and second-period income is taxed at the rates \( t_1 \) and \( t_2 \), respectively, so that the budget constraint becomes

\[ (1 - t_1)f(1) + (1 - t_2)f(n) = c_1 + nc_2 \]

The parents' first-order condition for fertility under laissez-faire now becomes

\[ \frac{U_n}{U_{c_1}} = c_2 - (1 - t_2)f'(n) \]

The planner knows that the second-period tax will be set to raise revenues equal
to $P_2 - R$, so that

$$t_2 = \frac{(P_2 - R)}{Nf(n)}$$

Optimizing with this additional constraint we get the planner's first-order condition:

$$\frac{U_n}{U_{c_1}} = c_2 - f'(n)$$

The factor of $1 - t_2$ in the private first-order condition vanishes in the planner's, because the planner sees that no matter how many children a couple has, their children's next period total tax obligation (for next period's public goods) will remain the same, provided all other couples have the same number of children. Consequently, an amount

$$f'(n)t_2 = \frac{f'(n)(P_2 - R)}{Nf(n)}$$

should be added to the couple's perceived marginal cost of children (where $n$ is taken equal to the planner's optimal value) in order to internalize these two externalities. This is a negative externality per child.

Comparison of this figure with the earlier result for a fixed head tax of $(P_2 - R)/(nN)$ (see the discussion following equation A-9) indicates that the positive externality in the case of a household tax must be reduced by $[r_2/f(n)] [(P_2 - R)/(nN)]$. The first quantity in brackets is the proportional share of nonlabor inputs (land) in output; the second is the previous head tax. In other words, there is an additional negative externality to childbearing equal to this expression, to be applied when taxation is proportional. If $R > P_2$, and $R$ is expected to be used to offset future taxes, then this becomes a positive externality—or, put differently, the negative externality resulting from $R$ is smaller by this amount when the tax is proportional rather than fixed.

Now suppose that the government taxes the population proportionately to supply them with a private good, such as education or health, in per capita amount $z$, taken as given by the parents. With the usual utility function and budget constraint, their first-order condition becomes

$$\frac{U_n}{U_{c_1}} = c_2 - (1 - t_2)f'(n)$$

The planner, however, knows that $z$ will have to be provided for each child, and also that the tax $t_2$ must be set so as to raise sufficient revenue to do this, so that

$$t_2f(n) = nz$$
The planner's first-order condition is then

\[ \frac{U_n}{U_{c1}} = c_2 + z - f'(n) \]  

Consequently there is a negative externality per child equal to \([t_2 f'(n) - z]\).

Substituting for \(t_2\) from equation A-16 and \(r_2\) from equation A-4 gives this negative externality as \([r_2/f(n)]z\) (where \(r_2/f(n)\) is the share of nonlabor inputs in output), or \(-E_{w,n}z\) where \(E_{w,n}\) is the elasticity of wages with respect to the numbers of workers. More generally, as explained in the paper, this negative externality will equal the difference between the average and marginal product of labor, times the proportional tax rate.

Note that the correction is the same for public and private goods, relative to the head tax or household tax. (No externality occurs in the case of a head tax for a private good supplied by the public sector.) Therefore, all that is necessary to make the correction is that the proportional tax rate be known, and the difference between the average and marginal product of an additional member of the population over the life cycle be known.

**Collective Landownership as a Special Case**

Suppose all land is collectively owned, and consequently alter the baseline model so that a couple expects each of its children to receive a second-period income equal to the population average income, regardless of the number of children born. The planner's first-order conditions are unchanged; for fertility:

\[ \frac{U_n}{U_{c1}} = c_2 - f'(n) \]  

Under laissez-faire, the couple's first-order condition will be

\[ \frac{U_n}{U_{c1}} = c_2 - y_2 \]

where \(y_2\) is average second-period income from nonparental sources, given by the implicit wage, \(f'(n)\), plus the per capita share of implicit rents on the collectively owned land. To make the first-order conditions equal in the neighborhood of the planner's chosen fertility, a term equal to the per capita share of implicit rent at the planner's second-period population size must be added to the laissez-faire first-order condition. If the initial population size is at equilibrium, then this simply equals the initial per capita value of rent; if the initial population is above the optimum, then the appropriate implicit rent share will be somewhat larger than that prevailing in the base period, and conversely.

**Heterogeneity: Landlords and Laborers**

Landowners and laborers are assumed to have identical utility functions as described above. Suppose there are \(M\) landlord couples in the first period, and the representative couple chooses fertility \(m\). Similarly there are \(N\) laborer cou-
ples with the representative couple choosing fertility \( n \). Consumption levels in period \( i \), for laborers and landlords, respectively, are \( c_{m_i} \) and \( c_{n_i} \). Landlords supply labor as well as land, and all face the same wages in each period. Both have accurate expectations of second-period outcomes. The budget constraints are

\[
\begin{align*}
\text{A-20} & \quad c_{m_i} = r_1 + r_2 + w_1 + m(w_2 - c_{m_2}) \\
& \quad c_{n_i} = w_1 + n(w_2 - c_{n_2})
\end{align*}
\]

where \( r_2 \) refers to second-period rents on the family land as held in period 1.

The relevant first-order conditions are readily shown to be

\[
\text{A-21} \quad \frac{U_m}{U_{c_{m_i}}} = c_{m_2} - w_2 \quad \text{and} \quad \frac{U_n}{U_{c_{n_i}}} = c_{n_2} - w_2
\]

Evidently the implicit price of children is higher for landowners, so long as \( c_2 \) is a normal good (that is, landowners will choose higher consumption for their children, which makes them more expensive).

The planner takes into account that both \( r_2 \) and \( w_2 \) depend on the size of the labor force in the second period, \( L_2 \), equal to \( mM + nN \). Clearly

\[
\text{A-22} \quad \frac{dw_2}{dn} = N \left( \frac{dw_2}{dL_2} \right) \quad \text{and} \quad \frac{dw_2}{dm} = M \left( \frac{dw_2}{dL_2} \right)
\]

and similarly for \( dr_2/dn \) or \( dr_2/dm \). For a constant returns to scale production function, we must also have that the change in total rents is equal to

\[
\text{A-23} \quad M \left( \frac{dr_2}{dL} \right) = -L \left( \frac{dw_2}{dL} \right)
\]

Is the laissez-faire outcome Pareto-optimal? Consider the effect of a change in the fertility of laborers, \( n \), in the neighborhood of the laissez-faire equilibrium. Evidently higher fertility would raise rents and depress wages, benefiting landlords and harming workers. But would it be possible for either group to bribe or compensate the other, and still come out ahead? Calculation shows that it would not; the money value of the utility changes, aggregated for each class, are equal and of opposite sign. (Use the budget constraint to substitute for \( c_{n_i} \) and \( c_{m_i} \) in the utility function for each class, differentiate with respect to \( n \), use first-order conditions to simplify, divide by the marginal utility of consumption in the first period to express utility changes in terms of the consumption good, and multiply by the number of couples in each class, to establish this result. The result is probably transparent to the clever.) Therefore the laissez-faire outcome is Pareto-optimal, and the planner could do no better.

Nonetheless, there is a considerable benefit to workers as a class from restricting their fertility. At the laissez-faire equilibrium, if all change their fertility together, then

\[
\text{A-24} \quad \left( \frac{dU_n}{dn} \right) / \left( \frac{dU_m}{dn} \right) = nN \left( \frac{dw_2}{dL_2} \right) = \left( \frac{nN}{L_2} \right) w_2 E_{w,1}
\]

where \( E_{w,1} \) is the elasticity of wages with respect to labor, which equals the share of nonlabor inputs in production, or perhaps 0.4 or so. If there are four
times as many laborers as landowners, then this expression has a value of roughly one third of the wage level.

Thus the gain to the workers as a class from reducing their fertility by one child would be equal to one third of the lifetime wage earnings of a worker, or perhaps ten times annual wage earnings.

APPENDIX 2. PARTIAL LISTING OF DATA SOURCES FOR TABLE 1.

General Sources

Country-Specific Sources
Washington, D.C.; and various other statistical publications of the Bureau of the Census.

References


The National Academy of Sciences' study, *Population Growth and Economic Development* (1986), concluded that "on balance . . . slower population growth would be beneficial to economic development for most developing countries." But the study also noted that quantifying the impact of rapid population growth is fraught with difficulties, because population growth and economic growth are linked in a very complex way. Hence, it made a plea for more research on, among other things, the "nature and extent of externalities to childbearing." The paper by Ronald Lee and Timothy Miller responds to this plea.

The divergence between the net costs of children to parents and to society is often cited as a justification for policies to lower fertility, but there have been very few attempts to measure the externalities to childbearing. In this paper the authors estimated the magnitude of three childbearing externalities—those due to collectively owned natural resources, to public goods, and to intergenerational transfers. Externalities due to environmental degradation were not evaluated but may be important. The authors sensibly do not attempt to value the impact of population density on technological progress or on returns to scale. They calculated selected externalities for seven countries and found that the net total externality for most countries is only slightly negative; that negative net externalities are substantial only when there are important natural resources; and that public expenditures on health, education, and pensions lead only to small externalities in developing countries.

I would like to underscore the point that this paper is exclusively about externalities to childbearing and their magnitude. Although population growth is mentioned in the title, the paper does not deal with the optimal rate of population growth or the impact of rapid population growth on development. As the authors note, the presence of externalities is only one of several possible reasons for social planners to want to affect fertility. They may care about raising per capita incomes and income distribution, for example. Even if there are no childbearing externalities, very rapid population growth may exacerbate...
problems caused by other market imperfections, leading to adoption of policies to lower fertility.

The discussion of the nature of externalities and the modeling are very clear. The model is a simple one, designed to demonstrate certain key points. It has some strong and unrealistic assumptions, but the sensitivity of the model to some of the assumptions is dealt with. My comments, then, address two issues: do the results make sense? And, how does this paper inform population policy?

On the first issue—whether the results make sense—I would suggest that this paper is an honest and careful attempt to quantify a phenomenon that cannot be satisfactorily quantified. I have never tried to quantify childbearing externalities myself, so I had an open mind about the feasibility of these calculations when I began reading the paper. The characteristics of the externalities to childbearing are well brought out and discussed in the context of a simple two-generation model. Yet, confronted with the numerous assumptions and qualifications to all of these estimates as well as the fact that many externalities simply could not be estimated at all, I had serious doubts about the numbers by the time I reached the conclusion. I fully expected the paper to conclude that these externalities simply cannot be measured and that the numbers presented are of limited use in informing policy. Instead, the authors concluded that “externalities to childbearing do not typically provide a strong rationale for fertility policies going beyond family planning.”

Do the results make sense? The results on net externalities in table 1 lead us to completely counterintuitive policy prescriptions. Theory states that countries with negative net externalities to childbearing should raise taxes or lower subsidies on children, whereas those with positive externalities should lower taxes or raise subsidies on children. Consider the results for two countries, Saudi Arabia and Kenya. According to the calculations in table 1, Saudi Arabia’s mineral wealth leads to very high negative externalities, so it should be promoting policies to lower fertility. Yet we know that Saudi Arabia is among the wealthiest developing countries, rich in resources and capital, but that it faces a labor shortage, prompting the influx of migrant workers. Thus, even though the population growth rate is greater than 4 percent per year, and the total fertility rate (the number of children a woman would have in her lifetime if she were to bear children at the current age-specific fertility rate) is more than seven, in actual fact, authorities would like to raise fertility.

Now consider Kenya, which has very low per capita income of only $300 annually, a very high population growth rate of more than 4 percent, stagnant growth in per capita income, and a population-doubling time of only seventeen years. The pressure on arable land in Kenya is severe. Relative to Saudi Arabia, Kenya is rich in labor but poor in resources. These factors have led to an increase in the commitment of leaders to lower fertility in recent years. Nevertheless, the calculations in table 1 imply that Kenya should encourage fertility.

Even if the paper had found more intuitively satisfying results, its methodology still presents many aspects that make one uncomfortable. First, most of the
individual externalities are dependent on current or past government spending decisions, such as government debt, foreign aid, public goods spending (in particular, defense spending), and intergenerational transfers. In this sense, the level of externality is being endogenously determined by the social planner. Further, the level of spending on these items is not necessarily the optimal level. Poor countries have small negative spending externalities on social services simply because they can afford to spend very little per capita on social services. The result, according to table 1, is that they have less to lose from high fertility than a wealthy country; yet high fertility will prevent them from achieving their objective of raising per capita spending.

A second objection, related to the first, is that the levels of externalities in table 1 also reflect a host of existing subsidies, taxes, and other policies elsewhere in the economy that may or may not be optimal. These distortions are not taken into account in the calculations. Can we be sure that the numbers in table 1 are attributable purely to childbearing externalities and not to other underlying market distortions? This issue has an important bearing on the conclusions of the paper. The authors note that "childbearing externalities are assessed in the context of an institutional environment that may itself be highly inefficient." In such circumstances, the absence of externalities no longer guarantees a socially desirable level of fertility. Bearing this in mind, I don't think that we can say that Bangladesh has a socially desirable level of fertility, even though this paper implies that it has zero net externalities.

Third, the concept of externalities here is static. There is no dynamic process in which the rate of population growth affects externalities.

As for the specifics, I have a few questions about the way the calculations were made:

- How plausible is the assumption that the population growth rate equals the discount rate for the countries other than India?
- How were these resources valued—by their financial costs or their shadow prices?
- The interpretation of the signs on the net externalities is clear; how should the magnitudes be interpreted? (Is this the level of the incentive that should be charged to each household so that fertility decisions correspond to socially optimal outcomes?) In the paper it is suggested that these net externalities are small. Compared with what? How large are other externalities? A negative externality equivalent to 15 to 40 percent of per capita income sounds large to me.

On the second major issue I raised—whether the paper informs population policy—I would ask the following question: if the levels of net externalities are so small, fluctuate from year to year, and are highly dependent on planners' decisions and reflect other market distortions, how useful can they be in informing population policy?

For all of the reasons cited above, these results should not be used to guide
population policy. Actual population policies are often at variance with the results in table 1, suggesting that (even if the numbers are correct) pure externalities are not the most important criteria guiding fertility policy. In fact, the type of externalities examined here are not the most widely cited reasons for fertility policy. Government planners are usually concerned with raising per capita income faster than otherwise would be the case. Welfare economists are concerned that rapid population growth will result in greater income inequality; that high fertility in this generation will depress wages in the next; and that the next generation will have higher per capita incomes if fertility is limited. Rapid population growth lowers the returns to labor and raises the returns to capital and fixed resources, worsening income distribution.

Both of these concerns—the impact of rapid population growth on per capita income growth and on the distribution of income—arise from pecuniary externalities to population growth. The market adjusts, and a Pareto-efficient result prevails. However, there will be clear winners and losers, and this is the concern of policymakers. I am not convinced that one can estimate the magnitude of externalities, but if one were to try, it would be far more useful for population policy to assess the magnitude of the two pecuniary externalities almost always cited for fertility policy.

Those are my main observations. The authors raise many of the same criticisms in their paper. The difference is that we disagree on the conclusions and policy relevance. As a parting observation, I'd like to note that the paper does seem to equate "beyond family planning" policies with incentives, disincentives, and coercion. Yet there is an important category of "beyond family planning" policies that act to change peoples' tastes for large families while at the same time promoting development. I am speaking of policies to educate girls, to implement reforms in land rights, and to improve credit for the poor, to name three. They do not fit well into the theory of externalities, which takes tastes as given, but they nevertheless promote lower fertility and are ethically more acceptable than disincentives.

Reference