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Presidential Address

Reproductive externalities and fertility behaviour[☆]

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Abstract

This article studies reproductive externalities within rural communities in poor countries. It is shown that such externalities create a link between household poverty, household size, and the local natural-resource base, each of which is viewed as being endogenous. The models presented here offer an explanation for the fact that in recent decades large groups of people in various parts of the world have been unable to lift themselves out of acute poverty even while their national economies have, on average, enjoyed economic growth. Implications for policy and institutional changes are drawn. © 2000 Elsevier Science B.V. All rights reserved.

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1. Complaints

Population growth elicits widely different responses from people. Some believe it to be among the most urgent problems facing humankind today (e.g., Ehrlich and Ehrlich, 1990), while others permute the elements of this causal

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chain, arguing, for example, that contemporary poverty and illiteracy in poor countries are the causes, rather than the consequences, of increasing numbers ('poverty is the problem, not population', or, 'the problem is not population, but lack of female education', as the sayings go). Still others suggest that even in the poorest of countries it can be expected to provide a spur to economic progress (e.g., Boserup, 1981). Among the many who remain, there is a wide spectrum of views, both on the determinants of population growth and on the effects of that growth on the environment and human well-being. In short, not only do our attitudes toward population size and its growth differ, but also there appears to be no settled view on how the matter should be studied. As with religion and politics, we all have opinions on population, and most of us hold on to them with tenacity.

Over a decade ago an inquiry was made into the economic consequences of population growth (National Research Council, 1986). Drawing on time series and cross-regional data, the investigators observed that population size and its growth can have both positive and negative effects. They noted that population growth is not exogenously given. Nevertheless, for tractability, they treated it as a causal factor in their inquiry and concluded that there was no cause for concern over the high rates of growth being experienced in poor countries.¹ This view was stressed by Simon (1989), who found no negative effect of population growth on economic development.

But regression results depend on what is being regressed on what. So, for example, there can be set against Simon (1989) more recent cross-country studies by Mauro (1995) and Eastwood and Lipton (1999), who have found a negative correlation between population growth and economic growth and a positive correlation between population growth and the magnitude of absolute poverty. In short, cross-country regressions in which population growth is a determining factor have given us mixed messages. I argue below that, even though we have learnt something from cross-country regressions, they have in part misdirected us into asking wrong questions.

The practice of regarding population growth as a determining factor is reflected too in growth theory and its applications. A central tenet of the theory of economic growth is that output per head in steady state is a decreasing function of the rate of growth of population. But this is about as far as the theory has been taken in the direction of demography. The links between demographic behaviour and the character and performance of institutions have yet to be put on the research agenda. Agnosticism on demographic matters would seem to be the prevailing mood among growth economists.²

Similarly, environmental and resource economics have in large measure neglected poverty and population in poor countries. For example, Kneese and

¹ Kelley (1988) contains a review of the findings.

² See, for example, the survey article by Temple (1999).

Sweeney (1985, 1993) and Cropper and Oates (1992) surveyed the economics of environmental resources, but said nothing on the issues alluded to here. Their surveys are accurate reflections of the dominant literature, for the environmental-resource base has consistently been viewed by economists as an ‘amenity’. Thus, it is even today a commonplace that, to quote a recent editorial in London’s *Independent* (4 December 1999), ‘... (economic) growth is good for the environment because countries need to put poverty behind them in order to care’, or that, to quote the *Economist* (4 December, 1999, p. 17), ‘... trade improves the environment, because it raises incomes, and the richer people are, the more willing they are to devote resources to cleaning up their living space.’

I quote these views not so as to question that poverty should be a phenomenon of the past, nor to suggest that arbitrary restrictions on trade do not cause much harm, but to show that environmental natural resources are widely viewed as *luxuries*. This is a wrong view. The environmental natural-resource base is *not* a luxury. Producing, as it does a multitude of ecosystem services, including soil regeneration, pollination, nitrogen fixation, and water purification, the natural-resource base is a *necessity*.³ The environmental economics to be found in the North (using the term in its current geopolitical sense) does not exactly resonate among those who worry about degradation of the natural-resource base in the South and the additional hardship this brings to the many among the poorest of people whose lives depend directly on that base.⁴

Sadly, both population and the environment have continued to be kept aside in discussions on contemporary economic development. Even when studying the semi-arid regions of sub-Saharan Africa and the Indian sub-continent (poverty-ridden land masses, inhabited by some 2 billion people, experiencing the largest additions ever known to their population), modern economists do not usually regard population growth, poverty, and the state of the local natural-resource base as interconnected. Inquiry into each factor has in large measure gone along its own route. Evidence that total fertility rates have recently declined not only in South Asia, but even in sub-Saharan Africa (Table 1), may further keep population concerns outside mainstream development economics.⁵ The divide would seem to be complete.⁶

³ Daily (1997) is a collection of essays on the character of ecosystem services.

⁴ I have gone into these concerns in greater detail in Dasgupta (1982, 1993, 1996, 1997a).

⁵ *Total fertility rate* (TFR) is the number of live births a woman would expect to give if she were to live through her child-bearing years and to bear children at each age in accordance with the prevailing age-specific fertility rates. If TFR were 2.1 or thereabouts, population in the long run would stabilise.

⁶ Birdsall (1988), Kelley (1988), and Schultz (1988) are three authoritative surveys on the subject of population growth in poor countries. None of them touched on environmental matters. Nor does a large literature on poverty (e.g., Dreze and Sen, 1990) address demographic and environmental themes. There are recent exceptions (e.g., Bardhan and Udry, 1999), but they really are exceptions.

Table 1
Total fertility rates and GNP per head in a sample of countries

	TFR		GNP per head ^a	Average annual % growth of GNP per head ^b
	1980	1996	1996	1965–96
China	2.5	1.9	3330	6.7
Bangladesh	6.1	3.4	1010	1.0
India	5.0	3.1	1580	2.3
Pakistan	7.0	5.1	1600	2.7
Sub-Saharan Africa	6.6	5.6	1450	– 0.2
(Nigeria)	6.9	5.4	870	0.1
USA	1.8	2.1	28,020	1.4
World	3.7	2.8	6200	1.2

^aDollars at purchasing power parity.

^bGNP growth calculated from constant price GNP in national currency units.

Source: World Bank (1998, Tables 1.1, 1.4, and 2.15).

Among poor countries, there is little direct connection between GNP per head and total fertility rate (Birdsall, 1988). Nor is there a close connection there between GNP per head and the crude birth rate less the crude death rate (Table 2). Nevertheless, it should be a puzzle that neither demographic nor environmental matters have been of concern to development economists. Much of the rationale for development economics, as a specialization, is the thought that poor countries suffer particularly from institutional failures. But institutional failures in great measure manifest themselves as *externalities*. So, to ignore, say, population in the study of poor countries would be to suppose that demographic decisions there give rise to no externalities of significance, and that externalities arising from institutional failure have a negligible effect on demographic behaviour. I know of no body of empirical work that justifies such presumptions.

2. Population, poverty, and natural resources: Local interactions

Despite the neglect, a few investigators have studied the interface of population, poverty, and the local natural-resource base. The ingredients of their work have been around for some time; what is perhaps new is the way they have been put together. The work has involved a fusion of theoretical modelling with empirical findings drawn from a number of disciplines, most notably, anthropology, demography, ecology, economics, and the nutritional and political sciences.

Table 2
Crude birth and death rates per 1000 people

	B ^a		D ^b		B-D	
	1980	1996	1980	1996	1980	1996
China	18	17	6	7	12	10
Bangladesh	44	28	18	10	26	18
India	35	25	13	9	22	16
Pakistan	47	37	15	8	32	29
Sub-Saharan Africa	47	41	18	14	29	27
(Nigeria)	50	41	18	13	32	28
World	27	22	10	9	17	13

^aCrude birth rate per 1000 people.

^bCrude death rate per 1000 people.

Source: World Bank (1998, Table 2.2).

I do not suppose the work amounts to a theory, it is more like a new *perspective*. One of its chief aims is to offer an explanation for the fact that in recent decades large groups of people in various parts of the world have been unable to lift themselves out of acute poverty even while their national economies have, on average, enjoyed economic growth. At the grandest level, the aim has been to create a set of analytical tools to account for the fact that, even though the world economy as a whole has enjoyed economic growth over the past fifty years or so, large masses of people in certain regions have remained in poverty. Economic growth has not ‘trickled down’ consistently to the poorest, nor have the poorest been inevitably ‘pulled up’ by it.

I should stress that several particular models have been constructed to develop the new perspective. We still are nowhere near to having an overarching model, of the kind we economists are used to in the theory of general competitive equilibrium.⁷ Some models have as their ingredients large inequalities in land ownership in poor countries and the non-convexities that prevail at the level of the individual in transforming nutrition intake into nutritional status and, thereby, labour productivity (Dasgupta and Ray, 1986, 1987; Dasgupta, 1993, 1997b). Others are based on the fragility of interpersonal relationships in the face of an expanding labour market and an underdeveloped set of credit and insurance markets (Dasgupta, 1993, 1998, 1999). Yet others are built on possible links between fertility behaviour and free-riding on local common-property resources (Dasgupta and Mäler, 1991; Nerlove, 1991; Cleaver and Schreiber,

⁷ In this, the literature I am alluding to resembles much contemporary economic theory.

1994). The models differ in their ingredients. What they have in common, however, is a structure that is becoming increasingly familiar from the theory of locally interacting systems.⁸ To put it in contemporary terminology, the new perspective on population, poverty and the local environment sees the social world as self-organizing itself into an *inhomogeneous* whole, so that, even while parts grow, chunks get left behind; some even shrink. To put it colloquially, these models account for locally confined ‘vicious circles’.⁹

In this lecture I present an outline of this work when seen through one particular lens, namely *reproductive externalities*, laying stress on the arguments that have shaped it and on the policy recommendations that have emerged from it.¹⁰ The framework I want to present here focuses on the vast numbers of small, rural communities in the poorest regions of the world, and it identifies circumstances in which population growth, poverty, and degradation of the local natural-resource base can be expected to feed on one another, cumulatively, over periods of time. What bears stressing is that the account does not regard any of the three to be the prior cause of the other two: over time each of them influences, and is in turn influenced by, the other two. In short, they are all endogenous variables.

Needless to say, it is not assumed that poor, illiterate people, when subjected to such ‘forces’ of positive feedback, do not try to find mechanisms with which to cope. The models assume that people do the best they can in the circumstances they face. What the models do is to identify conditions in which this is not enough to lift communities out of the mire. Turner and Ali (1996), for example, have shown that, in the face of population pressure in Bangladesh, small land-holders have periodically adopted new ways of doing things so as to intensify agricultural production. However, the authors have shown too that this has resulted only in an imperceptible improvement in average well-being and a worsening of the ownership of land, the latter owing to the prevalence of distress-sales of land. This is the kind of finding which the new perspective anticipated, and was designed to meet.

Reproductive externalities have not been much studied in the ‘new economic demography’ so far. Surveying the field, Schultz (1988, p. 417) wrote: ‘Consequences of individual fertility decisions that bear on persons outside of the family have proved difficult to quantify, as in many cases where social external diseconomies are thought to be important.’ An important exception was a recent attempt by Lee and Miller (1991) at quantifying the magnitude of reproductive externalities in a number of developing countries. The magnitude was found to be small. However, the authors searched for potential sources of externalities in public expenditures on health, education and pensions, financed by

⁸ Brock and Durlauf (2000) is a fine technical account of that structure.

⁹ Myrdal (1944) called such forms of feed-back ‘cumulative causation’.

¹⁰ I offer a broader account in Dasgupta (1993, 1995).

proportional taxes. But such taxes are known to be very limited in scale in poor countries. Moreover, the benefits from public expenditure are frequently captured by a small proportion of the population. So, perhaps, it should not be surprising that the reproductive externalities consequent upon public finance are small in poor countries. The externalities I study here are of a different sort altogether.

As we would expect from experience with models of complex systems, general results are hard to come by. The models that have been studied analytically are only bits and pieces. But they offer strong intuitions. They suggest also that we are unlikely to escape having to engage in simulation exercises if we are to study models less specialized than the ones that have been explored so far.¹¹

This should have been expected. Economic demography can be a most frustrating subject. It would seem that for any theoretical inference (say, on fertility matters), no matter how innocuous, there is some set of data from some part of the world over some period that is not consonant with it.¹² Over 40 years of demographic research have uncovered that the factors underlying fertility behaviour include not only the techniques that are available to households for controlling their size, but also the household demand for children. The latter in particular is influenced by a number of factors, whose relative strengths would be expected to differ across cultures, and over time within a given culture, responsive as they are to changes in income and wealth and the structure of relative prices. Thus, the factors which would influence the drop in the total fertility rate in a society from, say, 7 to 5 should be expected to be different from those which would influence the drop from 5 to 3 in that same society.

Across societies the matter is still more difficult. The springs of human behaviour in an activity at once so personal and social as procreation are complex and inter-connected, and empirical testing of ideas is always fraught with difficulty. These observations are merely a reminder that a general theory of fertility behaviour is not currently available. They are also a reminder that empirical validation of propositions is hard to come by. There are far too many variables to contend with. Moreover, data often come without appropriate controls, so that what may appear to be a counter-example to a thesis is not necessarily a counter-example.

3. The household and gender relations

As a concept the *household* is not without its difficulties. It is often taken to mean a housekeeping or consumption unit. The household in this sense is the

¹¹ Lutz and Scherbov (1999) offer a thoughtful review of why and how.

¹² See Cleland (1996) for a demonstration of this.

eating of meals together by members, or the sharing of meals derived from a common stock of food (Hajnal, 1982). This definition has the merit that it is in accordance with most modern censuses, but there is a problem with it: in rural communities it does not yield exclusive units (Goody, 1996). A household shares a 'table' and may, for example, include live-in servants who do not cook for themselves. In many cases some meals are had in common, while others are not; and often raw and cooked food is passed to parents in adjacent cottages, apartments, and even rooms. The boundaries vary with context, especially where food is not consumed together round a table (as in Europe) but in bowls in distinct groups (as in sub-Saharan Africa). In none of these cases is the housekeeping unit the same as the consumption unit, nor is the consumption unit necessarily well-defined.

Economists have brazened these difficulties out and have debated something else. They have taken the household to be a well-defined concept, but have debated if it is best to continue to model it as a unitary entity, in the sense that its choices reflect a unitary view among its members of what constitutes their well-being (the utility maximising model), or if it instead ought to be modelled as a collective entity, where differences in power (e.g., between men and women) manifest themselves in the allocation of food, work, education, health-care.

The bulk of the evidence points today in the direction of the household as a collective entity (Alderman et al., 1995). For example, if a household were unitary, its choices would be independent of which member actually does the choosing. But recent findings have revealed, for example, that income in the hands of the mother has a bigger effect on her family's health (e.g., nutritional status of children) than income under the control of the father (Kennedy and Oniang'o, 1990). Moreover, in some parts of the world (e.g., the northern parts of the Indian sub-continent), household choices have been found to reflect allocations that favour some members (i.e., these inequalities cannot be explained by differences in needs); for example, men and boys over women and girls, and the young over the elderly.¹³ Household decisions would assume strong normative significance if the household were unitary, less so if it were not. The evidence seems to be that the unitary household is uncommon when the family is impoverished and the stresses and strains of hunger and illness make themselves felt.

Since we know that gender inequities often prevail in work, education, food, and health-care allocations, it should not be surprising that they prevail over fertility choices as well. Here also men typically wield greater influence, even though women bear the greater cost. To grasp how great the burden can be, consider that in sub-Saharan Africa the total fertility rate has for long been between 6 and 8 (Table 1). Now each successful birth involves at least a year

¹³ Chen et al. (1981) is a pioneering quantitative study. See Dasgupta (1993) for further references.

and a half of pregnancy and breast-feeding. Making the obvious corrections, we can conclude that in a society where female life expectancy at birth is 50 years, and where the total fertility rate is, say, 7, at birth about half of a woman's adult life would be expected to be spent either carrying a child in her womb or breast-feeding it. And we have not allowed for unsuccessful pregnancies.

Gender inequalities are an important component of the population problem in poor countries. In this regard, the focal point of the United Nations Conference in 1994 on Population and Development, namely, women's reproductive rights and the means by which they could be protected and promoted (e.g., via an increase in women's education), is consonant with the new perspective.¹⁴ But the Cairo Conference came very near to treating the problems as identical. The new perspective, of which I am speaking, does not; it sees more in the population problem. To demonstrate this convincingly, I adopt a unitary view of the household. Because I am concerned here with reproductive externalities, this also simplifies the exposition.

Nor does the new perspective identify the population problem with inadequate family planning programmes. In the following section I argue why.

4. Birth control

Except under conditions of extreme nutritional stress, nutritional status does not appear to affect fecundity (Bongaarts, 1980). During the 1974 famine in Bangladesh the rural population lost over 1.5 million additional children. The stock was replenished within a year (Bongaarts and Cain, 1981). Of course, undernourishment can still have an effect on sexual reproduction, through its implications for the frequency of still-births, maternal and infant mortality, and a possible reduction in the frequency of sexual intercourse.

A most obvious determinant of fertility is the available technology for birth control. Cross-country regressions (e.g., Pritchett, 1994) confirm that the fraction of women of reproductive age who use modern contraceptives is strongly and negatively correlated with total fertility rates. So it should not be surprising that family-planning programmes are often seen as a pre-requisite for any population policy. But these regression results mean only that contraception is a proximate determinant of fertility, not a causal determinant. They could mean, for example, that differences in fertility rates across nations reflect differences in fertility goals, and thereby differences in contraceptive use.

People in all societies practise some form of birth control: fertility is below the maximum possible in all societies. Even in poor countries, fertility is not unresponsive to the relative prices of goods and services. Extended breast-feeding and post-partum female sexual abstinence have been common

¹⁴An early study on the role of women's education on fertility behaviour is Cochrane (1983).

practice in Africa. In a study on !Kung San foragers in the Kalahari region, Lee (1972) observed that the nomadic, bush-dwelling women among them had an average birth-spacing of nearly four years, while those settled at cattle-posts gave birth to children at much shorter intervals. From the viewpoint of the individual nomadic !Kung San woman, it is significant that the social custom is for mothers to nurse their children on demand, and to carry them during their day-long trips in search of wild food through the children's fourth year of life. Anything less than a four-year birth interval would, therefore, increase mothers' carrying loads enormously, impose a threat on their own capacity to survive, and reduce their children's prospects of survival. In contrast to bush dwellers, cattle-post women are sedentary, and are able to wean their children earlier.

Traditional methods of birth control include abortion, abstinence or rhythm, coitus interruptus, and prolonged breast-feeding.¹⁵ These options are often inhumane and unreliable: modern contraceptives are superior. Nevertheless, successful family-planning programmes have proved more difficult to institute than could have been thought possible at first (Cochrane and Farid, 1989). Indeed, barring a few countries, fertility rates in sub-Saharan Africa did not show any significant decline, despite a decline in infant mortality rates over the past decades.

In a notable article, Pritchett (1994) analysed data from household surveys conducted by the World Fertility Survey and the Demographic and Health Surveys programmes, which included women's responses to questions regarding both their preferences and their behaviour on fertility matters. Demographers had earlier derived several indicators of the demand for children from these data. One such indicator, the 'wanted total fertility rate' (Bongaarts, 1990), can be compared to the actual total fertility rate for the purpose of classifying births or current pregnancies in a country or region as wanted or unwanted. Regressing actual fertility on fertility desires in a sample of 43 countries in Asia, Africa, and Latin America, Pritchett found that about 90% of cross-country differences in total fertility rates are associated with differences in desired fertility. Moreover, excess fertility was found not to be systematically related to the actual total fertility rate, nor to be an important determinant of the rate. The figure 90% may prove to be an over-estimate, but it is unlikely to prove to be greatly so.¹⁶ Even in poor households, the use of modern contraceptives would involve only a small fraction (1% or thereabouts) of income.¹⁷

¹⁵ Anthropologists have, however, argued that in parts of western sub-Saharan Africa prolonged breast-feeding is not a birth-control measure, but a means of reducing infant mortality: traditionally, animal milk has been scarce in the region.

¹⁶ I am grateful to John Bongaarts for helpful conversations on this matter.

¹⁷ Schultz (1993) has also shown that family-planning outreach activities explain little of either cross-country variations in fertility or changes over time in fertility within a country. He has found that the level and gender composition of education (affecting, for example, child mortality), the extent of agricultural employment (affecting the cost of raising children), and the level of nutrition (affecting, once again, child mortality), taken together, explain most of both types of variation.

It would therefore appear that even in poor countries fertility rates today are dependent mostly (perhaps 70–80%) on the net demand for children and not on the extent of family-planning outreach activities, at least unless they are massive programmes, as in the Matlab experiment in Bangladesh (see Section 6). This sort of evidence led a number of social scientists to search for reproductive externalities which may help explain high, but differential, total fertility rates in South Asia and sub-Saharan Africa over a long period of time and which may possibly explain even their differential declines in very recent years. I discuss three types of such externalities in the next three sections.

5. Reproductive cost-sharing

In his famous analysis of fertility differences between seventeenth- and eighteenth-century Northwest Europe on the one hand and modern pre-industrial societies on the other, Hajnal (1982) drew upon the distinction between ‘nuclear’ and ‘joint’ household systems. He observed that in Northwest Europe marriage normally meant establishing a new household, which implied that the couple had to have, by saving or transfer, sufficient resources to establish and equip the new household. This requirement in turn led to late marriages. It also meant that parents bore the cost of rearing their children. Indeed, fertility rates in England were a low 4 in 1650–1710, long before modern family-planning techniques became available, and before women became literate (Coale, 1969). Hajnal contrasted this with the Asiatic pattern of household formation, which he saw as joint units consisting of more than one couple and their children.

Parental costs of procreation are also lower when the cost of rearing the child is shared among the kinship. In sub-Saharan Africa, ‘fosterage’ within the kinship is a commonplace: children are not raised solely by their parents, the responsibility is more diffuse within the kinship group (Goody, 1976; Bledsoe, 1990). Fosterage in the African context is not adoption. It is not intended to, nor does it in fact, break ties between parents and children. The institution affords a form of mutual insurance protection in semi-arid regions. There is some evidence that, as savings opportunities are few in the low-productivity agricultural regions of sub-Saharan Africa, fosterage also enables households to smooth their consumption across time. In parts of West Africa upto half the children have been found to be living with their kin at any given time. Nephews and nieces have the same rights of accomodation and support as do biological offspring. There is a sense in which children are seen as a common responsibility. However, the arrangement creates a free-rider problem if the parents’ share of the benefits from having children exceeds their share of the costs. From the point of view of the

parents, taken as a collective, too many children would be produced in these circumstances.¹⁸

Related to this is a phenomenon that has been observed by Guyer (1994) in a Yaruba area of Nigeria. In the face of deteriorating economic circumstances, some women bear children by different men so as to create immediate lateral links with them. Polyandrous motherhood enables women to have access to more than one resource network.

In sub-Saharan Africa, communal land tenure of the lineage social structure offers yet another inducement for men to procreate. In addition, conjugal bonds are frequently weak, so fathers often do not bear the costs of siring a child. Anthropologists have observed that the unit of African society is a woman and her children, rather than parents and their children. Frequently, there is no common budget for the man and woman. Descent in sub-Saharan Africa is, for the most part, patrilineal and residence is patrilocal (an exception are the Akan people of Ghana). Patrilineality, weak conjugal bonds, communal land tenure, and a strong kinship support system of children, taken together, are a broad characteristic of the region (Caldwell and Caldwell, 1990; Caldwell, 1991; Bledsoe and Pison, 1994). In principle they provide a powerful stimulus to fertility. Admittedly, patrilineality and patrilocality are features of the northern parts of the Indian sub-continent also. But conjugal bonds are substantially greater there. Moreover, as agricultural land is not communally held, large family sizes lead to fragmentation of landholdings. In contrast, large families in sub-Saharan Africa are (or, at least *were*, until recently) rewarded by a greater share of land belonging to the lineage or clan.

6. Conformity and contagion

One motive for procreation, common to humankind, relates to children as ends in themselves. We are genetically endowed to want and to value them. It

¹⁸To see that there is no distortion if the shares were the same, suppose c is the cost of rearing a child and N the number of couples within a kinship. For simplicity assume that each child makes available y units of output (this is the norm) to the entire kinship, which is then shared equally among all couples, say in their old age. Suppose also that the cost of rearing each child is shared equally by all couples. Let n^* be the number of children each couple other than the one under study chooses to have. (We presently endogenize this.) If n were to be the number of children this couple produces, it would incur the resource cost $C = [nc + (N - 1)n^*c]/N$, and eventually the couple would receive an income from the next generation equalling $Y = [ny + (N - 1)n^*y]/N$. Denote the couple's aggregate utility function by the form $U(Y) - K(C)$, where both $U(\cdot)$ and $K(\cdot)$ are increasing and strictly concave functions. Letting n be a continuous variable for simplicity, it is easy to confirm that the couple in question will choose the value of n at which $yU'(Y) = cK'(C)$. The choice sustains a social equilibrium when $n = n^*$. It is easy to check that this is also the condition which is met in a society where there is no reproductive free-riding. It is a simple matter to confirm that there is free-riding if the parents' share of the benefits from having children exceeds their share of the costs.

has also been said that children are the clearest avenue open to ‘self-transcendence’ (Heyd, 1992). Viewing children as ends ranges from the desire to have children because they are playful and enjoyable, to a desire to obey the dictates of tradition and religion. One such injunction emanates from the cult of the ancestor, which, taking religion to be the act of reproducing the lineage, requires women to bear many children.¹⁹ This latter motivation has been emphasized by Caldwell and Caldwell (1990) to explain why sub-Saharan Africa has for the most part proved so resistant to fertility reduction.

The problem with the argument by Caldwell and Caldwell is that, although it explains why fertility rates in sub-Saharan Africa are high, it does not explain why the rates have not responded to declines in infant mortality. The cult of the ancestor may prescribe reproduction of the lineage, but it does not stipulate an invariant fertility rate. Even in sub-Saharan Africa, total fertility rates have been below the maximum possible rate; so they should be expected to respond to declines in infant mortality, a matter I come back to in Section 7, where I offer one possible explanation for the resistance that sub-Saharan Africa has shown to reductions in fertility rates.²⁰

The view that children are an end in themselves provides a potentially powerful mechanism by which reasoned fertility decisions at the level of every household could lead to an unsatisfactory outcome from the perspectives of all households. It arises from the possibility that traditional practice is perpetuated by conformity. Procreation in closely-knit communities is not only a private matter, it is also a social activity, presumably influenced by both family experiences and the cultural milieu. Formally speaking, conformist behaviour would occur if every household’s most desired family size were an increasing function of the average family size in the community (Dasgupta, 1993). This is, of course, a ‘reduced form’ of the concept, and the source of a desire to imitate could lie in reasons other than an intrinsic desire to be like others. It could be that similar choices made by households generate mutual positive externalities, say, because people care about their status, and a household’s choice of actions signals its

¹⁹ Writing about West Africa, Fortes (1978, pp. 125–126) says “... a person does not feel he has fulfilled his destiny until he or she not only becomes a parent but has grandchildren ... (Parenthood) is also a fulfillment of fundamental kinship, religious and political obligations, and represents a commitment by parents to transmit the cultural heritage of the community ... Ancestry, as juridically rather than biologically defined, is the primary criterion ... for the allocation of economic, political, and religious status”. See also Goody (1976). Cochrane and Farid (1989) remark that both the urban and rural, the educated and uneducated in sub-Saharan Africa have more, and want more, children than their counterparts do in other regions. Thus, even the younger women there expressed a desire for an average of 2.6 more children than women in the Middle East, 2.8 more than women in North Africa, and 3.6 to 3.7 more than women in Latin America and Asia.

²⁰ Between 1965 and 1987 the infant mortality rate in a number of the poorest countries in sub-Saharan Africa declined from about 200 per 1000 live births to something like 150 per 1000 live births (World Bank, 1989).

predispositions (e.g., their willingness to belong), and thereby affects its status (Bernheim, 1994).

Whatever the basis of conformism, there would be practices encouraging high fertility rates that no household would unilaterally desire to break. Such practice could well have had a rationale in the past, when mortality rates were high, rural population densities were low, the threat of extermination from outside attack was large, and mobility was restricted. But practices can survive even when their original purposes have disappeared. It may then be that, so long as all others follow the practice and aim at large family sizes, no household on its own wishes to deviate from the practice; however, if all other households were to restrict their fertility rates, each would desire to restrict its fertility rate as well. In other words, conformism can be a reason for the existence of multiple, Pareto rankable social equilibria.

This said, it must also be acknowledged that testing for multiple equilibria is a most difficult matter. For the moment it is analytical reasoning that tells us that a society could in principle get stuck at a self-sustaining mode of behaviour, characterized by high fertility and low educational attainment, even when there is another, potentially self-sustaining, mode of behaviour that is characterized by low fertility and high educational attainment.

This does not mean that society would be stuck with high fertility rates forever. As always, people differ in the extent of their absorption of traditional practice. There would inevitably be those who, for one reason or another, experiment, take risks, and refrain from joining the crowd. They are the tradition-breakers, and they often lead the way. Educated women are among the first to make the move toward smaller families (see Farooq et al., 1987, for a commentary on West Africa). A possibly even stronger pathway is the influence that newspapers, radio, television, and now the internet play in transmitting information about other life-styles (Freedman, 1995). The analytical point here is that the media may be vehicle through which conformism increasingly becomes based on the behaviour of a far wider population than the local community. In a pioneering, but thoroughly neglected work, Adelman and Morris (1965) found 'openness' of a society to outside ideas to be a powerful stimulus to economic growth. It is possible that the reductions in total fertility rates that have been taking place in the Indian sub-continent in recent years (Table 1) are due in great measure to the wider influence people there have been subjected to.

Demographers have made few attempts to discover evidence of behaviour that is guided in part by an 'attention to others'. The two exceptions with which I am familiar are Easterlin et al. (1980) and Watkins (1990). The former studied intergenerational influence in a sample of families in the United States and reported a positive link between the number of children with whom someone had been raised and the number of children they themselves had.

In her study of demographic change in Western Europe over the period 1870–1960, Watkins (1990) showed that differences in fertility and nuptiality

within each country declined. She found that in 1870, before the large-scale declines in marital fertility had begun in most areas of Western Europe, demographic behaviour differed greatly within countries. Provinces (e.g., counties and cantons) within a country differed considerably, even while differences *within* provinces was low. There were thus spatial clumps within each country, suggesting the importance of the influence of local communities on behaviour. In 1960 differences within each country were less than what they were in 1870. Watkins explained this in terms of increases in the geographical reach national governments enjoyed over the 90 years in question. The growth of national languages would be a medium through which reproductive behaviour was able to spread.

There is one recent finding which could also point to contagious behaviour. Starting in 1977, 70 'treatment' villages were serviced by a massive programme of birth control in Matlab Thana, Bangladesh, while 79 'control' villages were offered no such special service. The contraceptive prevalence in the treatment villages increased from 7% to 33% within 18 months, and then more gradually to a level of 45% by 1985. The prevalence also increased in the control villages, but only to 16% in 1985. Fertility rates in both sets of villages declined, but at different speeds, and by 1980 the difference in fertility rates had reached a figure of 1.5, even though there had been no difference to begin with (Hill, 1992). If we were to assume that, even though influence travels, geographical proximity matters, we could explain why the control villages followed those 'under treatment', but did not follow them all the way. Contagion did not spread completely.

7. Breakdown of the commons and the added need for labour

The poorest countries are in great part biomass-based subsistence economies.²¹ Much labour is needed even for simple tasks. Moreover, households in great numbers there do not have access to the sources of domestic energy available to households in advanced industrial countries. Nor do they have water on tap. In semi-arid and arid regions water supply is often not even close at hand. Nor is fuel-wood near at hand when the forests recede. This means that the relative prices of alternative sources of energy and water faced by rural households in poor countries are quite different from those faced by households elsewhere. In addition to cultivating crops, caring for livestock, cooking food and producing simple marketable products, members of a household may have to spend as much as five to six hours a day fetching water and collecting fodder and wood. These are complementary activities. They have to be undertaken on

²¹ I am thinking of countries in sub-Saharan Africa and the Indian sub-continent. There the agricultural labour force as a proportion of the total labour force is of the order of 60–70%, and the share of agricultural-value added in GNP is of the order of 25–30%.

a daily basis if the household is to survive. Each is time consuming. Labour productivity is low not only because capital is scarce, but also because environmental resources are scarce. From about the age of 6 years, children in poor households in the poorest countries mind their siblings and domestic animals, fetch water, and collect fuelwood, dung (in the Indian sub-continent), and fodder. Mostly, they do not go to school. Not only are educational facilities in the typical rural school woefully inadequate, but parents need their children's labour. Children between 10 and 15 years have been routinely observed to work at least as many hours as adult males (see, for example, Bledsoe, 1994; Cleaver and Schreiber, 1994; Filmer and Pritchett, 1996).

The need for many hands can lead to a destructive situation when parents do not have to pay the full price of rearing their children but share such costs with their community. In recent years, mores that once regulated local resources have changed. Since time immemorial, rural assets such as village ponds and water holes, threshing grounds, grazing fields, and local forests and woodlands have been owned communally. This form of ownership and control enabled households in semi-arid regions to pool their risks. Jodha (1986, 1995) studied evidence from over 80 villages in 21 dry districts in India and concluded that, among poor families, the proportion of income based directly on their local commons is for the most part in the range 15–25%. A number of resources (such as fuelwood and water, berries and nuts, medicinal herbs, resin and gum) are the responsibility of women and children. In a study of 29 villages in south-eastern Zimbabwe, Cavendish (1998, 1999) arrived at even larger estimates: the proportion of income based directly on local commons is 35%, the figure for the poorest quintile is 40%. Howe (1986), Wade (1988), Chopra et al. (1990), Ostrom (1990, 1992), Baland and Platteau (1995) and others have shown that, traditionally, many communities have protected their local commons from overexploitation by relying on social norms, by imposing fines for deviant behaviour, and by other means. But the very process of economic development can erode traditional methods of control, the pathway being increased urbanization and mobility (Dasgupta, 1993, 1999). Social norms are also endangered by civil strife and by the usurpation of resources by landowners or the State. Resource allocation rules practised at the local level have also not infrequently been overturned by central fiat. A number of States in the Sahel imposed rules which in effect destroyed communitarian management practices in the forests. Villages ceased to have authority to enforce sanctions on those who violated locally instituted rules of use. State authority turned the local commons into free-access resources.²² Whatever the cause, as social norms degrade, parents pass some of the costs of children on to the community by over-exploiting the commons. This is another instance of a demographic free-rider problem.

²² See Thomson et al. (1986) and Baland and Platteau (1996).

The perception of an increase in the net benefits of having children induces households to have too many. This is predicted by the standard theory of the imperfectly-managed commons (Appendix, Sec. A.3). Now, it can certainly be that, when households are further impoverished owing to the erosion of the commons, the net cost of children increases (of course, household size continues to remain above the optimum from the collective point of view). Loughran and Pritchett (1998), for example, have found in a data set from Nepal that increasing environmental scarcity lowered the demand for children, implying that the households in question perceived resource scarcity as increasing the net cost of children. Apparently, increasing firewood and water scarcity in the villages in the sample did not have a strong enough effect on the relative productivity of child labour to induce higher demand for children, given the effects that work in the opposite direction. Environmental scarcity there acted as a check on population growth. However, theoretical considerations suggest that, in certain circumstances increased resource scarcity induces further population growth and, thereby, triggers a spiralling process. As the community's natural resources are depleted, households find themselves needing more 'hands'. No doubt additional hands could be obtained by the adults working even harder, but in many cultures it would not do for the men-folk to gather fuel-wood and fetch water for household use.²³ No doubt too that additional hands could be obtained if children at school were withdrawn and put to work. But, as we have seen, mostly the children do not go to school anyway. In short, when all other sources of additional labour become too costly, more children are produced, thus further damaging the local resource base and, in turn, providing the household with an incentive to enlarge yet more. This does not necessarily mean that total fertility rate would increase. If the infant mortality rate were to decline, there would be no need for more births in order for a household to acquire more hands. However, what would happen along this pathway is that poverty, household size, and environmental degradation would reinforce one another in an escalating spiral. By the time some countervailing set of factors were to make the benefits of having further children diminish and, thereby, to stop the spiral, millions of lives would have suffered by a worsening of poverty. In Appendix A provide a simple model to illustrate such possibilities.

Cleaver and Schreiber (1994) have provided evidence of a positive link between population increase and environmental degradation in the context of rural sub-Saharan Africa, Batliwala and Reddy (1994) for a set of villages in Karnataka, India, and Heyser (1996) in Malaysia. In a careful statistical analysis of data from a set of villages in the Sindh region in Pakistan, Filmer and Pritchett (1996) very tentatively reported a positive link between fertility and

²³ Filmer and Pritchett (1996) summarise empirical findings on time allocation in household activities by children in rural areas in poor countries.

deterioration of the local environmental-resource base. None of these investigations quite captures what the theory I am sketching here tells us to study, namely, the link between desired household size and the state of the local environmental-resource base. But they come close enough; limitations in existing data sets prevent investigators from getting closer to the theory.²⁴ In any event, these studies cannot reveal causal connections, but they are not inconsistent with the idea of a positive-feedback mechanism such as I have described. Over time, the spiral would be expected to have political effects, as manifested by battles for resources (Durham, 1979; Homer-Dixon et al., 1993).²⁵

To be sure, families with greater access to resources would be in a position to limit their size and propel themselves into still higher income levels. Admittedly, too, people from the poorest of backgrounds have been known to lift themselves out of the mire. Nevertheless, there are forces at work which pull households away from one another in terms of their living standards. India provides a possible example of how the vicious cycle I have described can enable extreme poverty to persist amid growth in the well-being of the rest of society.

8. Institutional reforms and policies

If in earlier days social scientists looked for policies to shape social outcomes for the better, their focus today is more on the character of institutions within which decisions are made by various parties in society. But if policies which read well often come to naught in dysfunctional institutions, the study of institutions on their own is not sufficient: good policies cannot be plucked from air. There is mutual influence here, and the task of the social scientist is to study it.

In this article I identified a number of institutional and policy failures that come allied with pro-natalist reproductive externalities. I did this by trying to connect demographic and environmental concerns. The perspective that emerges from combining them tells us that the most potent avenue open for bringing down fertility rates in the semi-arid regions of sub-Saharan Africa and the Indian sub-continent involves the simultaneous deployment of a number of policies, not a single panacea, and that the relative importance of the various prongs would depend on the community in question. Thus while family-planning services (especially when allied to public-health services) and measures that empower women (through both education and improved employment opportunities) are certainly desirable, there are also other policies that commend

²⁴ However, Deon Filmer has informed me that his colleagues at the World Bank have found in a sample of Nepalese villages a positive relationship between (primary) school attendance and the availability of local natural resources.

²⁵ Crook (1996) questions the poverty–population link. But as he treats population density and land productivity as exogenous variables, it is not quite a test of the thesis.

themselves, such as the provision of infrastructural goods (e.g., cheap sources of household fuel and potable water) and measures that directly increase the economic security of the poor. Some of these policies are not those which would come to mind if we studied demographic problems in isolation.

In any event, the aim should not be to force people to change their reproductive behaviour. Rather, it should be to identify policies and encourage such institutional changes that would internalise the externalities I have described. Recent declines in fertility rates in the Indian sub-continent and in parts of sub-Saharan Africa suggest that outside influence, via the media, has been powerful. Observing life-styles elsewhere can no doubt be unsettling to many, but it can give people ideas that are salutary. To the extent that reproductive behaviour is based on conformism (I have little notion of what that extent is), modern communication channels, linking the village to the outside world, would be expected to have a powerful effect. But the media is likely to be hampered in arbitrary ways except in politically open societies. Dasgupta (1990) and Dasgupta and Weale (1992) showed that in poor countries political and civil liberties are congruent with improvements in other aspects of life, such as income per head, life expectancy at birth, and infant survival rate. Since then Przeworski and Limongi (1995) have shown that these liberties are negatively correlated with fertility rates. We have, therefore, several reasons for thinking that political and civil liberties have instrumental value, even in poor countries; they are not merely desirable ends. But each of the prescriptions offered by the new perspective that I have tried to present here is desirable in itself, and commends itself even when we do not have fertility rates of poor countries in mind. To me this is a most agreeable fact.

Appendix A. The village commons and household size

The observation that increases in population bring in their wake additional pressures on the local natural-resource base is, no doubt, a banality. So, in what follows I study the reverse influence: the effect of a deterioration of the local natural-resource base on desired household size.

In Section 7 I argued that free-riding on the commons among villagers can impoverish households in such a way as to create an additional need for household labour. Such a need would translate itself into a demand for more surviving children if having more surviving children were the cheapest means of obtaining that additional labour. Of course, this is only one possibility; another is that the receding commons impoverish households in such a way that, at the margin, children become too costly, with the result that the number of surviving children declines. In this appendix I offer a formal account of both possibilities. The model enables us to identify parametric conditions under which the various

outcomes would be expected to occur. I then compare the non-cooperative village to a cooperative one. The model is timeless. Adjustments over time can then be analysed in terms of comparative statics.

A.1. The single household

I consider a bio-mass based village economy consisting of N identical households. N is taken to be sufficiently large that the representative household's size does not affect the economy. The model is deterministic. Household size is assumed to be a continuous variable, which is a way of acknowledging that realized household size is not a deterministic function of the size the household sets for itself as a target.

Let n be the size of a household. Members contribute to production, but they also consume from household earnings. We aggregate inputs and outputs and assume that household production possibilities are such that *net income* per household member, $y(n)$, has the quadratic form,

$$y(n) = -\alpha + \beta n - \gamma n^2 \quad \text{where } \alpha, \beta, \gamma > 0 \text{ and } \beta^2 > 4\alpha\gamma. \quad (\text{A.1})$$

The quadratic form is useful. It enables us to capture certain crucial features of a subsistence economy in a simple way, thereby permitting us to draw conclusions easily. For example, (A.1) presumes that there are fixed costs in running a household, which is altogether realistic: in order to survive, a household must complete so many chores on a daily basis (cleaning, farming, animal care, fetching water and collecting fuel-wood, cooking raw ingredients, and so forth), that single-member households are not feasible. Eq. (A.1) also presumes that when the household is large, the costs of adding numbers begin to overtake the additional income that is generated. This too is clearly correct.

It follows from (A.1) that $y(n) = 0$ at

$$\underline{n} = [\beta - \sqrt{(\beta^2 - 4\alpha\gamma)}] / 2\gamma, \quad (\text{A.2a})$$

$$\bar{n} = [\beta + \sqrt{(\beta^2 - 4\alpha\gamma)}] / 2\gamma. \quad (\text{A.2b})$$

\underline{n} is the 'fixed cost' of maintaining a household, while \bar{n} could be interpreted to be the environment's 'carrying capacity'. I assume that the household 'chooses' its size so as to maximize net income per head. Let n^* denote the value of n at which $y(n)$ attains its maximum and let y^* denote the maximum. Then

$$n^* = \beta / 2\gamma, \quad (\text{A.3a})$$

$$y^* = -\alpha + \beta^2 / 4\gamma. \quad (\text{A.3b})$$

$y(n)$ is depicted as the curve ABC in Fig. 1, where B is the point $(\beta / 2\gamma, -\alpha + \beta^2 / 4\gamma)$.

Imagine now that the household faces an increase in resource scarcity. We are to interpret this in terms of receding forests and vanishing water-holes. The

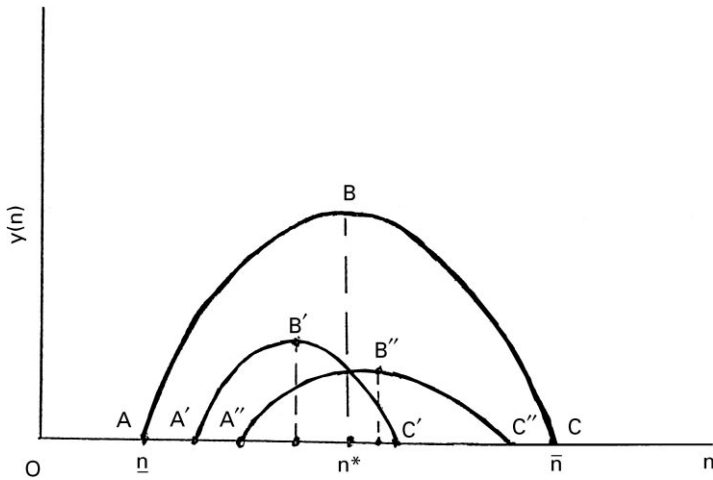


Fig. 1. Household income per head as function of household size.

index of resource scarcity could then be the average distance from the village to the resource base. So, an increase in resource scarcity would mean, among other things, an increase in n .

But it would typically mean more. For example, Eqs. (2a) and (2b) tell us that the household would face an increase in resource scarcity if α , γ , and α/γ were to increase and β were to decline in such a way that \bar{n} declines. Note too that in this case, both n^* and y^* would decline (Eqs. (3a) and (3b)). The resulting $y(n)$ is depicted as the curve $A'B'C'$ in Fig. 1. In short, the increase in resource scarcity shifts the curve ABC to $A'B'C'$.

Consider instead the case where each of α , β , and γ increases, but in such ways that \underline{n} and n^* increase, while \bar{n} and y^* decline. This is the kind of situation in which a household finds that its best strategy against local resource degradation is to increase its size even while finding itself poorer. The resulting $y(n)$ is depicted as the curve $A''B''C''$ in Fig. 1. In short, the increase in resource scarcity shifts the curve ABC to $A''B''C''$. This sort of case was noted originally in Dasgupta and Mäler (1991) and Nerlove (1991).

A.2. Social equilibrium

We now construct an equilibrium of the village economy. The state of the local natural-resource base is taken to be a function of the village population, which I write as M . So I assume that α , β , and γ in Eq. (A.1) are functions of M . Write $\alpha = \alpha(M)$, $\beta = \beta(M)$, and $\gamma = \gamma(M)$. A symmetrical equilibrium of the village economy is characterized by $M^* = Nn^*$. That is, n^* and y^* are the

solutions of

$$n^* = \beta(Nn^*)/2\gamma(Nn^*), \quad (\text{A.4a})$$

$$y^* = -\alpha(Nn^*) + [\beta(Nn^*)]^2/4\gamma(Nn^*). \quad (\text{A.4b})$$

I assume that a solution exists and that $n^* > 1$.

A.3. The optimum village

Consider next an optimizing village community. It would choose n so as to maximize²⁶

$$y(n) = -\alpha(Nn) + \beta(Nn)n - \gamma(Nn)n^2. \quad (\text{A.5})$$

Let \hat{n} be the optimum household size. Then \hat{n} is the solution of

$$[\beta(Nn) - 2n\gamma(Nn)] - N[\alpha'(Nn) - n\beta'(Nn) + n^2\gamma'(Nn)] = 0. \quad (\text{A.6})$$

A comparison of Eqs. (A.4a) and (A.6) tells us that $\hat{n} < n^*$ if

$$-\alpha'(Nn^*) + n^*[\beta'(Nn^*) - n^*\gamma'(Nn^*)] < 0. \quad (\text{A.7})$$

That is, if (A.7) holds, the village is overpopulated in social equilibrium. An alternative way of thinking about the matter would be to say that an institutional reform which reduces the ‘freedom of access’ to the commons would lower fertility.

Now (A.7) certainly holds if

$$\alpha', \gamma' > 0 \quad \text{and} \quad \beta' < 0 \quad \text{at} \quad n = n^*. \quad (\text{A.8})$$

But (A.7) holds also if

$$\alpha', \beta', \gamma' > 0, \\ [-\alpha' + (\beta\beta'/2\gamma) - (\beta^2\gamma'/4\gamma^2)] < 0 \quad \text{at} \quad n = n^*. \quad (\text{A.9})$$

A.4. The effect of increased resource scarcity

Let us study the implications for equilibrium household size and the standard of living consequent upon small exogenous shifts in the functions $\alpha(M)$, $\beta(M)$ and $\gamma(M)$. We take it that prior to the shifts inequality (A.7) holds. The perturbations will be taken to be sufficiently small so that (A.7) continues to hold in the new equilibrium.

Consider first the case where the perturbation consists of small upward shifts in $\alpha(M)$ and $\gamma(M)$ and a small downward shift in $\beta(M)$. Notice that if (A.8) holds,

²⁶I avoid rigour here and assume (without justification) that the optimum is symmetric in households.

both n^* and y^* would be marginally smaller in consequence of the perturbation. This is the case we would expect intuitively: a small increase in resource scarcity results in poorer, but smaller, households.

Now consider the case where (A.9) holds. Suppose the perturbation consists of small upward shifts in each of the functions $\alpha(M)$, $\beta(M)$ and $\gamma(M)$. We can so set the relative magnitudes of the shifts that the small increase in resource scarcity results in poorer, but larger, households, that is, y^* declines marginally but n^* increases marginally. This is the timeless counterpart of the positive feedback mechanism between population size, poverty and degradation of the natural-resource base that was discussed in Section 7. Such a feedback, while by no means an inevitable fact of rural life, is a possibility. In this paper I have argued that evidence of the experiences of sub-Saharan Africa and the northern parts of the Indian sub-continent in recent decades are not inconsistent with it.

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