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The Economics of the World's Poorest Regions

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The Economics of the World's Poorest Regions*

by

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Summary

This paper analyses the interface in poor countries of population growth, rural poverty, and deterioration of the local natural-resource base, a subject that has been much neglected by modern demographers and development economists. The motivations for procreation and resource-use in rural communities of the poorest regions of the world are analysed. Four potentially significant types of "externality" associated with fertility behaviour and use of the local natural-resource base are identified. Three are shown to be pronatalist in their effects, while the fourth is shown to be ambiguous, in that it can be either pro- or anti-natalist. It is shown that one of the externalities may even provide an invidious link between fertility decisions and the use of the local natural-resource base. Macro-statistics on population and the use of natural resources are shown to be consistent with the micro theory and evidence that I report here: data suggest that the poorest regions have been following economic programmes in which long-run well-being has not been sustained.

Contents

1 Introduction

1.1 Motivation and Outline

If there are only a few pathways that lead to economic prosperity, the number of routes societies can take to experience stagnation - even decay - are many. I have been asked to talk at this conference about those countries that have been the "laggards" in the race to contemporary economic development. I want to do this not only by identifying the various senses in which certain regions of the world have at best remained where they were decades ago, but also by trying to understand how they have managed to do so.

Only a few years back a paper with my intentions would have identified weaknesses in public policy - including the choice of wrong investment projects - as the cause of economic failure. Today the temptation would be to point to inadequacies of institutions. One can even read such a change in focus in the way the World Bank's annual World Development Report has evolved since its inception in 1978. But even when the prevailing institutions are progressive, good policies and sound investment projects cannot be plucked from air. Institutions, policies, and investments are so dependent on each other, that, if you want to probe one, you simply have to keep an eye on the others.

Bearing that dependence in mind, I have for some years been studying resource allocation mechanisms along which, in recent decades and at spatially localised levels, population growth and degradation of the natural-resource base have related in an adverse way to poverty.[1] These mechanisms are capable of creating pathways that sustain poverty at the local level even in the presence of economic development at a wider, geographical scale. The mechanisms in question harbour particular types of reproductive and environmental externalities. The externalities are locally confined and are at the root of "positive feedbacks" between poverty, population growth, and degradation of the local natural-resource base. In these mechanisms none of the three is the prior cause of the others: over time each influences, and is in turn influenced by, the others. In short, they are all endogenous variables.

1.2 Grumbles

That Nature is a direct part of our productive base may appear a commonplace, but scratch an economist and you are likely to find someone who regards it as a luxury. For it is even today commonly thought that, to quote an editorial in the UK's The Independent (4 December 1999), "... (economic) growth is good for the environment because countries need to put poverty behind them in order to care"; or, to quote The Economist (4 December, 1999: 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."

The view's origin can be traced to World Bank (1992), which observed an empirical relationship between GNP per head and atmospheric concentrations of industrial pollutants. Based on the historical experience of OECD countries, the authors of the document suggested that, when GNP per head is low, concentrations of such pollutants as the sulphur oxides increase as GNP per head increases, but when GNP per head is high, concentrations decrease as GNP per head increases further.[2] Among economists this

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[1] See Dasgupta (1982, 1993, 1996, 1998, 2000, 2001a, 2003).

[2] See also Cropper and Griffiths (1994) and Grossman and Krueger (1995).

relationship has been christened the "environmental Kuznets curve".[3] The moral that would appear to have been drawn from the finding is that resource degradation is reversible: degrade all you want now, Earth can be relied upon to rejuvenate it later if you require it.

The presumption is false. The existence of ecological thresholds means that damage to ecosystems can be irreversible. The environmental Kuznets curve was detected for mobile pollutants. Mobility means that, so long as emissions decline, the stock at the site of the emissions will decline. But reversal is the last thing that would spring to mind should a grassland flip and become covered by shrubs, or should the Atlantic gulf stream come to a halt. As an overarching metaphor for "tradeoffs" between manufactured and natural capital, the relationship embodied in the environmental Kuznets curve has to be rejected.[4]

Although non-convexities are prevalent in global ecosystems (e.g., ocean circulation, global climate), it is as well to emphasise the spatial character of many of the positive feedbacks that are associated with non-convex processes. In this connection, aggregation at the regional or national level can mislead hugely.[5] Cross country regressions, on which much contemporary understanding of the pathways to economic progress and stagnation is based, can also mislead. Societal features that could be important, but have not yet found expression in quantitative form on a national basis, are overlooked in them. For example, in an early study (Dasgupta, 1990), economic failure among the poorest countries was read in terms of restrictions in political and civil liberties. More recently, Easterly and Levine (1997) have sought to explain sub-Saharan Africa's appalling economic performance in terms of ethnic diversity, quantitative measures of which, as it happens, are available at the country level. However, one may ask why ethnic allegiance should have played such a role in Africa as the authors have discovered, or why political and civil liberties have been so scarce there. One may ask the more basic question as to why the public sphere of life there continues to elicit so little trust and commitment. The approach I take below leads me to offer an account that is not at odds with Easterly and Levine, but it provides something of an explanation for the way ethnic membership is able to play a damaging, coordinating role in sub-Saharan Africa. Nor is the theory I develop here at odds with Dasgupta (1990), but it has the virtue of explaining why certain other socio-economic variables (such as the fertility rate) are so different in Africa from what they are in other poor regions.

The analytical foundations of the resource allocation mechanisms I discuss here are not dissimilar to the ones studied by Collier and Gunning (1999) in their survey paper on sub-Saharan Africa. But the evidence I collate here is based on a wider set of considerations than is to be found in the Collier-Gunning

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[3] It is, of course, a misnomer. The original Kuznets curve, which was an inverted U, related income inequality to real national income per head on the basis of historical cross-country evidence.

[4] For further discussions of the environmental Kuznets curve, see Arrow, Bolin, et al. (1995) and the responses it elicited in symposia built round the article in Ecological Economics, 1995, 15(1); Ecological Applications, 1996, 6(1); and Environment and Development Economics, 1996, 1(1). See also the special issue of Environment and Development Economics, 1997, 2(4). See also Dasgupta, Levin, and Lubchenco (2000). For the pure mathematics of "non-linear" ecological processes, see Murray (1993).

[5] See the interchange between Johnson (2001) and Dasgupta (2001b) on this.

study. So, the mechanisms I track differ from the ones reported by them. The pathways I study give prominence to population growth and natural-resource degradation in the world's poorest regions, matters that go mostly unnoted by Collier and Gunning.

Sen (1999) and Easterly (2002) in their turn focus on different measures of human well-being (freedoms and GNP, respectively) for judging economic success, but they show a common lack of interest in what makes for sustainable well-being. Neither author takes the role of natural capital in our lives seriously; nor does either offer much analysis of the causes and consequences of rapid population growth in the poorest regions of the world.[6]

Contemporary models of economic growth are equally dismissive of the importance of natural capital. In their extreme form, growth models embed an assumed positive link between the creation of ideas (technological progress) and population growth in a world where the natural-resource base comprises a fixed, indestructible factor of production.[7] The problem with the latter assumption is that it is wrong: the natural environment consists of degradable resources (soil, watersheds, fisheries, and sources of fresh water; more generally, ecological services). It may be sensible to make that wrong assumption when studying a period when natural-resource constraints did not bite, but it is not sensible for studying development possibilities open to today's poor regions, most especially when no grounds are offered for supposing that technological progress can be depended upon indefinitely to more than substitute for an ever-increasing loss of the natural-resource base.

In any event, we should be sceptical of a theory that places such enormous burden on an experience not much more than two hundred years old. Extrapolation into the past is a sobering exercise: over the long haul of history (a 5000 years stretch, say, upto about two hundred years ago), economic growth even in the currently-rich countries was for most of the time not much above zero.[8]

The decision concerning whether or not to pay heed to the natural-resource base cannot now be left to the discretion of development economists and growth analysts. There is now an enormous body of empirical work in anthropology and ecology that not only emphasises the role natural capital plays in our lives, but also points to the interplay of reproductive behaviour and the way the natural-resource base is used by communities. Moreover, a substantial literature in environmental and resource economics has

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[6] Sen (1994) was even contemptuous of those who have argued that high population growth has been a hindrance to economic betterment in sub-Saharan Africa and the Indian sub-continent.

[7] Kremer (1993) develops such a model to account for 1 million years of world economic history.

[8] See Fogel (1994, 1999), Johnson (2000), and especially Maddison (2001). The claim holds even if the past two hundred years were to be included. The rough calculation is simple enough:
World per capita output today is about 5000 US dollars. The World Bank regards one dollar a day to be about as bad as it can be: people would not be able to survive on anything much less than that. It would then be reasonable to suppose that 2000 years ago per capita income was not less than a dollar a day. So, let us assume that it was a dollar a day. This would mean that per capita income 2000 years ago was about 350 dollars a year. Rounding off numbers, this means very roughly speaking that, per capita income has risen about 16 times since then. This in turn means that world income per head has doubled every 500 years, which in its turn means that the average annual rate of growth has been about 0.14 percent per year, a figure not much in excess of zero.

exposed the inability of commonplace institutions to price natural resources in ways that reflect their scarcity values. Agricultural scientists have also drawn attention to the fact that future prospects of food being available to the world's poorest inhabitants depend critically on our ability to manage human numbers and natural capital.[9]

The models discussed below assume that people, when subjected to such "forces" of positive feedback as I have alluded to, seek ways to cope with the circumstances they face. But the underlying externalities associated with their actions ensure that there can be significant differences between private and social returns to various economic activities. The models identify conditions in which the coping mechanisms people adopt is not enough to lift households and communities out of the mire. For example, the models assert that if reproductive behaviour is pro-natalist, it is because private returns to having large numbers of children are relatively high, other things the same, even when the social returns are low. The models presume that if communities degrade their natural-resource base, it is because collective endeavours to maintain the base cannot withstand the pressure of private malfeasance, other things the same. And so on.

In such circumstances the positive feedback assumes a sinister form, meaning that its consequence is at best economic stagnation. 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. The authors have shown too that this has resulted in only an imperceptible improvement in the standard of living and a worsening of the ownership of land, the latter probably owing to the prevalence of distress sales of land. These are the kind of findings that the perspective I offer here anticipated and was designed to meet.

1.3 Plan of the Paper

The plan of the paper is as follows:

Part I offers macro-evidence on contemporary poverty. In Section 2 I collate some well-known regional statistics on poverty, measured in terms of income. But income is a flow and, as customarily measured, it is unable to reflect long run possibilities. At a conference on economic development we should be interested in the long run. So in Section 3 I draw attention to the weaknesses of indicators of short-run well-being, such as income and GNP per head, and argue that movements in an all-inclusive index of wealth should instead be used to determine whether long-run well-being is sustainable.[10] By manipulating rough estimates of changes in wealth in a number of countries, I then put the theory to work and show that over the past twenty-five years or so, the two poorest regions of the world, namely, the Indian sub-continent and sub-Saharan Africa, have been pursuing economic programmes along which average long run well-being has not been sustained. The estimates on which my calculations are based are very, very crude, but there is nothing I can do about it: applied development economics has not kept pace with the part of economic theory that takes the environment and sustainable development seriously. But the findings, such as they are, imply that the poorest countries have decumulated their capital stock, relative to growth in their

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[9] IFPRI (1995) and Pinstrup-Andersen and Pandya-Lorch (1995).

[10] The argument is based on Dasgupta and Mäler (2000), Dasgupta (2001a) and Arrow, Dasgupta, and Mäler (2003a,b), who have proved the result at progressively greater levels of generality.

populations.

In Part II (Section 4) I offer a microeconomic theory that goes some way toward explaining the macrostatistics of Part I. The account I offer here is qualitative, and is based on four types of reproductive and environmental externalities. Three of the externalities ensure that the private returns to pro-natalist behaviour are higher than the social returns. They also ensure that the private returns to resource conservation are lower than the social returns. The effect of the fourth (owing to conformist behaviour) is ambiguous. The analysis points to the presence of significant economic distortions, implying that the inhabitants of the poorest countries have also suffered from too little consumption. Taken together, the analysis implies that, over the past few decades, people in the poorest countries both consumed and invested to little.

Development practitioners, both in academia and international organizations, have responded to expressions of concern over population growth and degradation of the natural-resource base in poor countries by pointing to contemporary history's many winners.[11] After all, or so they have rightly observed, world output of grain has more than kept pace with population growth, people everywhere on average live longer today than they did in the past, eat better, are better educated, and (excepting in sub-Saharan Africa) earn more. But village level studies in the poorest regions of the world, being more discriminatory, have frequently revealed something else also, or so I have found. They have uncovered enormous additional hardship that has been experienced during the process of recent economic changes. One purpose of Section 3 is to show how a revision of national accounts can enable macro level statistics to better reflect micro level facts. It seems to me such a correspondence is necessary if we are to search for policies that can be expected to lead to economic progress, rather than economic growth. The framework developed in Section 4 is able to read not only contemporary history's winners, but also its many losers. Naturally, in this paper I use the theory to account only for the losers.

In what follows, I make no attempt to forecast the future, nor do I try to review how societies that are currently affluent grew in population even while accumulating wealth by substituting knowledge, skills, and manufactured capital for natural resources.[12] My aim here is to use economic theory and the recent historical experience in poor regions to suggest a way of thinking about economic stagnation in the contemporary world. I do not suggest that the experience I summarise below had anything inevitable about it. There were public choices that could have been made and that would have resulted in superior collective outcomes. Implictly though, I shall be arguing that such choices were ignored in part because of faulty economic analysis.

I have resisted the temptation to conclude the paper with policy recommendations. In any case, some of the policies that commend themselves emerge directly from the analysis presented here. They need no special pleading. More generally, though, it seems to me development economists writing on the world's poorest regions have for too long been fast with policy recommendations, but do not have an awful lot to show for it. Pretty much everything I say here is tentative, and I am loath to draw firm conclusions from them. The one point on which I am not at all tentative, though, is that development economists have

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[11] See, for example, Johnson (2001).

[12] Landes (1969, 1998) are compelling accounts of that experience.

neglected certain key features of the environments in which people in rural parts of poor countries make decisions. This paper is largely an attempt to redress the balance.

Part I: Macro-evidence

2 The Aggregate Background

Spatially localized natural assets are of the utmost importance to the world's poor. When wetlands, inland and coastal fisheries, woodlands, ponds and lakes, and grazing fields are damaged (say, owing to agricultural encroachment or urban extensions or the construction of large dams), traditional dwellers suffer. For them - and they are among the poorest in society - there are frequently no alternative source of livelihood. In contrast, for rich eco-tourists or importers of primary products, there is something else, often somewhere else, which means that there are alternatives. The range between a need and a luxury is enormous and context-ridden. Macroeconomic reasoning glosses over the heterogeneity of Earth's resources and the diverse uses to which they are put - by people residing at the site and by those elsewhere. National income accounts reflect this reasoning by failing to record a wide array of our transactions with Nature.

The reason why changes in the size and composition of natural capital are in large measure missing from national accounts is that Nature's services most often do not come with a price tag. The reason for that is that property rights to natural capital are often very difficult to establish, let alone enforce. And the reason for that is that natural capital is frequently mobile. At the broadest level soil, water, and the atmosphere (which are capital assets themselves) are media that enable capital assets to connect among themselves and flourish, meaning that a disturbance to any one asset can be expected to reverberate on many others at distances away, sometimes at far distances. Under current practice though, the consequences of the connectedness of natural capital can easily go unnoted in economic transactions. It can then be that those who destroy mangroves in order to create shrimp farms, or cut down forests in the uplands of watersheds to export timber, are not required to compensate fishermen dependent on the mangroves, or farmers and fishermen in the lowlands whose fields and fisheries are protected by the upland forests. Economic development in the guise of growth in per capita GNP can come in tandem with a decline in the wealth of some of the poorest members of society.

Being very heterogeneous, aggregate indices of natural resources are hard to find. Table 1 summarises evidence on poverty and population growth, but not on changes to the state of natural capital. Poverty (sometimes it is called "extreme poverty"; see World Bank, 1990), is taken to be the condition of a person living on less than one US dollar a day. As the table shows, there were 1.2 billion poor people in the world at the turn of the century. So, the poor are about a fifth of the world's population. They are concentrated in China, South Asia, and sub-Saharan Africa, numbering in excess of one billion. But there are differences in the incidence of poverty even among those three regions: as proportions of populations, South Asia and sub-Saharan Africa are home to the largest numbers of poor people.

The poorest countries are in great part agriculture-based subsistence economies. The agricultural labour force as a proportion of the total labour force is on the order of 60-70 percent, and the share of agricultural-value added in GNP is on the order of 25-30 percent.

That both sub-Saharan Africa and South Asia have grown in numbers in excess of 2 percent per year for several decades is well known. Table 2 offers a picture of population growth in terms of crude birth and death rates. The table shows that increases in population size have come about because declines in mortality rates during the second half of the last century (a remarkably good thing) were not matched

by reductions in fertility rates. Population increase has brought in its wake additional pressure on local resource bases (a not-so-good thing).

The poor live in unhealthy surroundings, a fact that is both a cause and effect of their poverty.[13] Nearly two million women and children die annually in poor countries from exposure to indoor pollution. (Cooking can be a lethal activity among the poor.) Additionally, over 70 percent of fresh water sources are contaminated or degraded. Moreover, groundwater withdrawal in poor countries exceeds natural recharge rates by a phenomenal 160 billion cubic metres per year. World Bank (2001) suggests that 5-12 million hectares of land are lost annually to severe degradation, and that soil degradation affects 65 percent of African croplands and 40 percent of croplands in Asia.

Thus far, the background picture on poverty. In the following section I argue why we need to broaden the study of economic performance from a near-exclusive attention on short-run measures of well-being, such as GNP per head and the United Nations' Human Development Index, by including in our assesments movements in wealth.

3 Wealth and Sustainable Well-Being

3.1 Why Wealth

In speaking of an economy, I want to cast a wide net here. The economy in question could be that of a household, or it could be that of a village, a district, a state, a nation, or even the whole world. An economy's prospects are shaped by its institutions and by the size and distribution of its capital assets. Taken together they are its productive base. However, institutions are different from capital assets, in that the former comprise a social infrastructure for guiding the allocation of resources (e.g., laws and property rights), among which are the capital assets themselves.

We have a name for the overall worth of an economy's capital assets: <u>wealth</u>. Although economic statisticians have customarily interpreted wealth narrowly, the measure is in fact an inclusive one. Wealth is based on a comprehensive list of assets, one that includes not only manufactured capital (roads and buildings; machinery and equipment; cables and ports) and human capital (health, knowledge, and skills), but also natural capital (oil and minerals, fisheries, forests, grazing land and aquifers, more broadly, ecosystems).

Wealth is an aggregate measure. To say that an economy's wealth has increased is to say that in terms of their worth, there has been an overall accumulation of capital assets. By the same token, to say that wealth has declined is to say that there has been an overall decumulation. Of course, even if some assets have decumulated, wealth would increase if there has been a compensatory accumulation of other assets in the economy. I shall use the term <u>inclusive investment</u> to mean any change in wealth, regardless of whether the change is a decline or an increase.[14] Inclusive investment is to be contrasted from recorded investment. Since a wide range of services obtained from natural capital are missing from standard economic accounts, recorded investment could be positive even if inclusive investment were negative. This would happen if the economy accumulated manufactured and human capital, but destroyed or degraded natural capital at a fast rate - a possibility I explore below.

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[13] The mutual causation is explored in Dasgupta (1993, 1997).

[14] Inclusive investment is called "genuine saving" by Hamilton and Clemens (1999).

An asset's worth is measured in terms of the flow of benefits it is able to generate over time. Being the aggregate worth of all capital assets, wealth therefore reflects something like an economy's capacity to sustain human well-being - today and in the future. In fact one can say more: <u>Subject to certain qualifications, a rise in wealth per person, measured at constant prices, corresponds to an increase in the average well-being of present and future generations, taken together</u>. This is the sense in which wealth is a measure of intergenerational well-being; concommitantly, it is the sense in which an accumulation of wealth corresponds to sustained development. Inclusive investment is thus a key to economic progress.

Now consider in contrast GNP, which is taken to be the sum of an economy's rate of consumption and its (gross) investment in manufactured and human capital. GNP misleads not only because changes in the size and composition of much natural capital are ignored by it, but also because, being <u>gross</u> national product, the index does not acknowledge that capital assets depreciate. So it is possible for GNP to increase over a period of time even while the economy's wealth declines. This would happen if increases in GNP are brought about by mining capital assets - for example, degrading ecosystems and depleting oil and mineral deposits -, without investing appropriate amounts of output in the accumulation of other forms of capital, such as health and education. There is then little reason to expect movements in GNP to parallel movements in wealth. Of course, a situation where GNP grows and wealth declines cannot last forever. If wealth decumulates sufficiently, GNP will eventually have to decline also. But the moral is telling: GNP (or for that matter the Human Development Index (HDI); see below) is not a measure of human well-being, meaning that movements in GNP (or for that matter HDI) are a poor basis for judging economic progress.

3.2 What about the Residual?

The aggregate output of an economy is produced by various factors of production. We can therefore decompose observed changes in output over time into its sources: how much can be attributed to changes in labour force participation, how much to accumulation of manufactured capital and human capital, how much to the accumulation of knowledge brought about by expenditure in research and development, how much to changes in the use of natural resources, and so on? If a portion of the observed change in output cannot be credited to any of the above factors of production, that portion is called the change in total factor productivity (TFP). Growth in TFP is also known as the "residual", to indicate that it is that bit of growth in output which cannot be explained.

Should wealth decline, could growth in TFP not compensate for the decline and ensure that long-run well-being is sustained? Traditionally, labour force participation, manufactured capital, and marketed natural resources have been the recorded factors of production. In recent years human capital has been added. Attempts have been made also to correct for changes in the quality of manufactured capital brought about by research and development. But national accounts mostly still do not include the use of non-marketed natural resources - nor, for that matter, non-marketed labour effort. They do not, for the understandable reason that shadow prices of non-marketed natural resources are extremely hard to estimate. Moreover, how do you estimate unrecorded labour effort? Now imagine that over a period of time the economy makes increasing use of the natural-resource base, or of unrecorded labour effort. The residual would be overestimated. In fact, a simple way to increase the residual would be to "mine" the natural-resource base at an increasing rate. But this would be a perverse thing to do if we seek to measure economic prospects.

What if it is possible to decompose the growth of an economy's aggregate output in a

comprehensive manner, by tracing the growth to the sources originating in all the factors of production? To assume that over the long run the residual could still be positive is to imagine that the country enjoys a "free lunch" (like manna from heaven). Is the latter a possibility? One way to enjoy a free lunch, for poor countries at least, is to use technological advances made in other countries without paying for them. The residual then reflects increases in freely available knowledge. However, adaptation is not without cost. To meet local conditions, adjustments need to be made to product design and to the processes involved in production; all of which require appropriate local institutions, frequently missing in poor countries.

Of course, total factor productivity can have short bursts in imperfect economies. Imagine that a government reduces economic inefficiencies by improving the enforcement of property rights, or by reducing centralized regulations (import quotas, price controls, and so forth). We would expect the factors of production to find a better use. As factors realign in a more productive fashion, the TFP would increase.

In the opposite vein, TFP could decline during a period. Increased government corruption could be a cause, or civil strife, which not only destroys capital assets, but also damages a country's institutions (public or civic). When institutions deteriorate, assets are used even more inefficiently than previously: TFP declines.

Table 3, taken from Collins and Bosworth (1996), gives estimates of the annual rate of growth of GNP per head and its breakdown among two factors of production (manufactured and human capital) in various regions of the world. The estimates are given in the first three columns. The period was 1960-94. The fourth column represents the residual in each region. This is simply the difference between figures in the first column and the sum of the figures in the second and third columns.[15] Collins and Bosworth did not include Nature's services as factors of production. If the use of those services has grown during the period in question (a most likely possibility), we should conclude that the residual is an overestimate. Even so, the residual in Africa was negative (-0.6 percent annually). The true residual was in all probability even lower. The residual in South Asia, the other really poor region of the world, was 0.8 percent annually, but as this is undoubtedly an overestimate, I am unclear as to whether there has been any growth in total factor productivity in that part of the world.

3.3 Wealth Movements in Poor Countries

Even though there are no markets for many natural assets - and therefore no observable prices that reflect their worth - it is possible to estimate the shadow prices of Nature's services if we are prepared to put in the effort and apply some low cunning.[16] Shadow prices measure the social worth of goods and services in an economy, and are the ones to use in determing movements in wealth.

By estimating shadow prices and then adding net investment in natural capital to recorded investment, Hamilton and Clemens (1999) recently calculated inclusive investment in a large number of countries. There is a certain awkwardness in the steps the investigators took to arrive at their figures. Their accounts are also incomplete. For example, among the resources making up natural capital, only commercial forests, oil and minerals, and the atmosphere as a sink for carbon dioxide were included. Not

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[15] Subject to rounding-off errors.

[16] The search for ways to estimate shadow prices of natural capital is an active field of research today. The hard part of the work lies in determining the connectedness of natural capital from a study of the ecological processes at work.

included were water resources, forests as agents of carbon sequestration, fisheries, air and water pollutants, soil, and biodiversity. So there is an undercount, possibly a serious one. Moreover, some of the methods they deployed to estimate shadow prices are dubious. Nevertheless, if we are to read the true macroeconomic character of the recent economic history of poor countries, we have to start somewhere.

The first column of figures in Table 4 contains estimates of inclusive investment, as a proportion of GNP, during the period 1973-93. Notice that both Bangladesh and Nepal disinvested: aggregate capital assets declined there during the period in question. In contrast, inclusive investment was positive in China, India, Pakistan, and sub-Saharan Africa. So, the figures could suggest that the latter countries were wealthier at the end of the period than at the beginning. But when population growth is taken into account, the picture changes.

The second column of figures in Table 4 provides the annual rate of growth of population over the period 1965-96. All but China experienced rates of growth in excess of 2 percent a year, sub-Saharan Africa and Pakistan having grown in numbers at nearly 3 percent a year.

What we do is to use the figures in the first two columns to arrive at estimates of the percentage rate of change in wealth per capita at constant prices. Since a wide variety of capital assets (for example, human capital and various forms of natural capital) are unaccounted for in national accounts, there is a bias in published estimates of output-wealth ratios, which traditionally have been taken to be something like 0.25 per year. In what follows, I use 0.15 per year as a check against the bias in traditional estimates for poor countries. Even these figures are almost certainly too high.

The third column of Table 4 contains my estimates of the annual rate of change in per capita wealth at constant prices. The procedure I followed in arriving at the figures was to multiply inclusive investment as a proportion of GNP by the output-wealth ratio, and then subtract the population growth rate from that product. This is a crude way to adjust for population change, but more accurate adjustments would involve greater computation.[17]

The striking message of the third column is that in all but China there has been capital decumulation during the past 30 years or so. This may not be a surprise in the case of sub-Saharan Africa, which is widely known to have regressed in terms of most socio-economic indicators. But the figures for Bangladesh, India, Nepal, and Pakistan should cause surprise. Even China, so greatly praised for its progressive economic policies, has just about managed to accumulate wealth in advance of population growth. In any event, a more accurate figure for the output-wealth ratio would almost surely be considerably lower than 0.15. Using a lower figure would reduce China's accumulation rate. Moreover, the estimates of inclusive investment do not include soil erosion or urban pollution, both of which are thought by experts to be especially problematic in China.

How do changes in per capita wealth compare with changes in conventional measures of well-being? The fourth column of Table 4 contains figures for the rate at which GNP per head changed during 1965-96; and the fifth column records whether the change in the United Nations' Human Development

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[17] Arrow, Dasgupta, and Mäler (2003a,b) have developed precise formulae for how the conversion ought to be done under a variety of circumstances.

Index over the period 1987-1997 was positive or negative.[18]

Notice how misleading our assessment of long-term economic development in the Indian sub-continent would be if we were to look at growth rates in per capita GNP. Pakistan, for example, would be seen as a country where GNP per head grew at a healthy 2.7 percent a year, implying that the index doubled in value between 1965 and 1993. The corresponding figure in the third column implies though that the average Pakistani became poorer by a factor of about 1.5 during that same period.

Bangladesh is recorded as having grown in terms of per capita GNP at 1 percent a year during 1965-1996. The figure in the third column of Table 4 implies that at the end of the period the average Bangladeshi was only about half as wealthy as she was at the beginning.

The case of sub-Saharan Africa is of course especially depressing. At an annual rate of decline of 2 percent in per capita wealth, the average person in the region became poorer by nearly a factor of two. The ills of sub-Saharan Africa are routine reading in today's newspapers and magazines, but the ills are not depicted in terms of a decline in wealth. Table 4 suggests that sub-Saharan Africa has experienced an enormous decline in its capital assets over the past three decades.

What of the Human Development Index (HDI)? As the third and fifth columns of Table 4 show, HDI offers a picture that is the precise opposite to the one we should obtain when judging the performance of poor countries. For sub-Saharan Africa the index grew, but for China it declined.[19] Moreover, Bangladesh and Nepal have been exemplary in terms of HDI. The Human Development Index misleads even more than GNP.

The figures in Table 4 for movements in per capita wealth are rough and ready and we should not regard them with anything like the certitude we have developed over the years for international statistics on GNP and the demographic and morbidity statistics of poor countries. My estimates are a first cut at what is an enormously difficult set of exercises. But the figures, such as they are, show how accounting for natural capital can make for substantial differences to our conception of the processes of economic development. We would by now have been far ahead in our understanding of what really has happened in poor countries if development economists had taken Nature's services seriously in the past.

Part II: Micro-theory

If in recent decades poor countries have experienced both a decline in wealth per head and unprecedented population growth, what accounts for the experience? Contemporary writings on population growth in poor countries stress that there is a negative link between education (especially female education) and fertility. It is now a commonplace that female education triggers fertility reduction. The problem with this viewpoint is that the education elasticity of fertility would appear to differ substantially across space and time.[20] Moreover, Susan Cochrane, to whom we owe the first, clear studies showing the links between

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[18] The period covered for HDI is short only because the index was first published in 1990 in the United Nations Development Programme's Human Development Report 1990.

[19] The reason China is seen to have regressed is that HDI is a relative index: even when a country has improved in terms of each component of HDI, it could still show a deterioration if some other countries have improved even more.

[20] There are also places in Africa where the elasticity has been found to have the "wrong" sign (Jolly and Gribble, 1993).

female education and fertility reduction, was herself reluctant to attribute causality to her findings (Cochrane, 1979, 1983), as have investigators studying more recent data (Cohen, 1993; Jolly and Gribble, 1993), for the reason that it is extremely difficult to establish causality. Women's education may well reduces fertility. On the other hand, the initiation of childbearing may be a factor in the termination of education. Moreover, even when education is made available by the state, households may choose not to take up the opportunity: the ability (or willingness) of governments in poor countries to enforce school attendance or make available good education facilities is frequently greatly limited. Economic costs and benefits of education and the mores of the community to which people belong influence their decisions. It could be that the very characterstics of a community (e.g., an absence of associational activities among women, or a lack of communication with the outside world) that are reflected in low education attainment for women are also those giving rise to high fertility. Demographic theories striving for generality would regard both women's education and fertility to be endogenous variables. The negative relationship between education and fertility in such theories would be an association, not a causal relationship. The two variables would be interpreted as "moving together" in samples, nothing more. The models underlying the discussion below are based on institutional fundamentals. They stand in contrast to the prevailing view of female education as the driver of fertility reduction.

4 Reproductive and Environmental Externalities

Children are both ends in themselves and a means to economic betterment - even survival. What causes private and social costs and benefits of reproduction to differ? One likely source of the distinction has to do with the finiteness of space.[21] A larger population means greater crowding, and households acting on their own would not be expected to "internalize" crowding externalities. The human epidemiological environment becomes more and more precarious as population densities rise. Crowded centres of population provide a fertile ground for the spread of pathogens; and there are always new strains in the making. Conversely, the spread of infections, such as HIV, would be expected to affect demographic behaviour, although in ways that are not yet obvious.[22]

Large-scale migrations of populations occasioned by crop failure, war, or other disturbances are an obvious form of externality. But by their very nature they are not of the persistent variety. Of those that are persistent, four types come to mind.

4.1 Cost-Sharing

Fertility behaviour is influenced by the structure of property rights; for instance, rules of inheritance. In his influential analysis of fertility differences between preindustrial seventeenth- and eighteenth-century Northwest Europe, on the one hand, and Asiatic preindustrial societies, on the other, Hajnal (1982) distinguished 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 residence. 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

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[21] See, for example, Harford (1998).

[22] Ezzell (2000).

techniques became available and long before women became literate.[23] 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.[24] 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. It is possible that, because opportunities for saving are few in the low-productivity agricultural regions of sub-Saharan Africa, fosterage also enables households to smoothen their consumption across time.[25] In parts of West Africa upto half the children have been found to be living with kin at any given time. Nephews and nieces have the same rights of accommodation 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.[26] From the point of view of parents, taken as a collective, too many children would be produced in these circumstances.

In sub-Saharan Africa, communal land tenure within the lineage social structure has in the past offered further inducement for men to procreate. Moreover, conjugal bonds are frequently weak, so fathers often do not bear the costs of siring children. 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, have been a broad characteristic of the region.[27] They are a source of reproductive externalities that stimulate fertility. Admittedly, patrilineality and patrilocality are features of the northern parts of the Indian sub-continent also,[28] but conjugal bonds are substantially greater there. Moreover, because agricultural land is not communally held in India, large family size leads 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.

A desire to pool risks means, more generaly, that material gains from good fortune are shared

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[23] Coale (1969) and Wrigley and Schofield (1981).

[24] Bledsoe (1990) and Caldwell and Caldwell (1990).

[25] This hypothesis could be tested by comparing the age structure of households that foster out and those that foster in.

[26] For a proof of the proposition, see Dasgupta (1993).

[27] See Caldwell and Caldwell (1990), Caldwell (1991), and Bledsoe and Pison (1994).

[28] Among the prominent Nayyars of the southern state of Kerala, India, descent is matrilineal. Kerala is noteworthy today for being among the poorer of Indian states even while attaining a TFR less than 2.

among one's kinship. But it has been observed by social scientists that in African societies the fruits of hard work and thrift are not distinguished greatly from good fortune.[29] This dulls private incentives. Arnott and Stiglitz (1991) have developed a formal account of the externalities that prevail when market and non-market institutions supply what is in effect the same commodity (e.g., insurance). Their purpose was to show that the existence of non-market institutions can prevent people from transacting as much in the market as they should for their collective good. The argument can be extended to include the reluctance people have to engage in the public sphere of life when communitarian institutions are entrenched at the local level. In such circumstances the State is able to be predatory.

4.2 Conformity and "Contagion"

That children are seen as an end in themselves provides another mechanism by which reasoned fertility decisions at the level of every household can lead to an unsatisfactory outcome from the perspectives of all households. The mechanism 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, influenced by both family experiences and the cultural milieu. Formally speaking, behaviour is conformist if, other things being equal, every household's most desired family size is the greater, the larger is the average family size in the community.[30] This is a "reduced form" of the concept, and the source of a desire to conform could lie in reasons other than an intrinsic desire to be like others. For example, similar choices made by households might generate mutual positive externalities, say, because people care about their status; and a household's choice of actions signals its predispositions (e.g., their willingness to belong) and so affects its status.[31] In a world where people conform, the desire for children is endogenous.[32]

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. Thus, as long as all others follow the practice and aim at large family size, no household on its own may wish 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 short, conformism can be a reason for the existence of multiple reproductive equilibria.[33] The multiple equilibria may even be Pareto rankable, in which case a community could get stuck at an equilibrium mode of behaviour even though another equilibrium mode of behaviour would be better for all.

These are theoretical possibilities. Testing for multiple equilibria is very difficult. As matters stand, it is only analytical reasoning that tells us that a society could in principle get stuck at a self-sustaining

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[29] Platteau and Hayami (1998).

[30] Dasgupta (1993).

[31] Bongaarts and Watkins (1996).

[32] Household "preferences" embodying such interactions are often called "social preferences".

[33] Dasgupta (1993).

mode of behaviour characterized by high fertility (and low educational attainment), even when there is another, potentially self-sustaining, mode of behaviour characterized by low fertility (and high educational attainment).

This does not mean that the hypothetical society would be stuck with high fertility rates forever. External events could lead households to "coordinate" at a low fertility equilibrium even if they had earlier "coordinated" at a high fertility equilibrium. The external events could, for example, take the form of public exhortations aimed at altering household expectations about one another's behaviour (e.g., family planning campaigns run by women). This is a case where the community "tips" from one mode of behaviour to another, even though there has been no underlying change in household attitudes to trigger the change in behaviour.

In addition to being a response to external events, the tipping phenomenon can occur because of changes in the peer group on whose behaviour households base their own behaviour. Inevitably, there are those who experiment, take risks, and refrain from joining the crowd. They subsequently influence others. They are the tradition-breakers, often leading the way. It has been observed that educated women are among the first to make the move toward smaller families.[34] Members of the middle classes can also be the trigger, becoming role models for others.

A possibly even stronger pathway is the influence that newspapers, radio, television, and now the Internet exert in transmitting information about other lifestyles.[35] The analytical point here is that the media may be a vehicle through which conformism increasingly becomes based on the behaviour of a wider population than the local community: the peer group widens. Such pathways can give rise to demographic transitions, in that fertility rates display little to no trend over extended periods, only to cascade downward over a relatively short interval of time, giving rise to the classic logistic curve of diffusion processes.

In a pioneering article 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 fertility reductions that have been experienced in India and Bangladesh in recent years were the result of the wider influence people have been subjected to via the media or to attitudinal differences arising from improvements in family planning programmes. To be sure, fertility reductions have differed widely across the Indian sub-continent (not much reduction in Pakistan so far, a great deal in southern India), but we should not seek a single explanation for so complex a phenomenon as fertility transition.[36]

Demographers have made few attempts to discover evidence of behaviour that is guided in part by an attention to others. Two exceptions are Easterlin, Pollak and Wachter (1980) and Watkins (1990).[37] The former studied intergenerational influence in a sample of families in the United States. They reported a positive link between the number of children with whom someone had been raised and the number of

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[34] See Farooq, Ekanem, and Ojelade (1987) for a commentary on West Africa.

[35] Bongaarts and Watkins (1996) and Iyer (2000).

[36] In this connection, the Indian state Andhra Pradesh offers an interesting example. Female illiteracy there is high 55 percent and some 75 percent of the population have access to radio or television. The fertility rate there is now 2.3.

[37] A most recent exception is Krishnan (2001) on data from India.

children they themselves had.

In her study of demographic change in Western Europe over the period 1870-1960, Watkins (1990) showed that regional differences in fertility and nuptiality within each country declined. 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) differed considerably, even while differences within provinces were low. There were thus spatial clumps within each country, suggesting the importance of the influence of local communities on behaviour. By 1960 differences within each country were less than they had been in 1870. Watkins explained this convergence in behaviour in terms of increases in the geographical reach national governments enjoyed over the 90 years in question. The growth of national languages could have been the medium through which reproductive behaviour spread.

One recent finding could also point to contagious behaviour. Starting in 1977 (when the TFR in Bangladesh exceeded 6), 70 "treatment" villages were served by a massive programme of birth control in Matlab Thana, Bangladesh, while 79 "control" villages were offered no such special service. The prevalence of contraceptive use in the treatment villages increased from 7 to 33 percent within 18 months, and then rose more gradually to a level of 45 percent by 1985. The prevalence also increased in the control villages, but only to 16 percent in 1985. Fertility rates in both sets of villages declined, but at different speeds, with the difference in fertility rates reaching 1.5 births per woman, even though there had been no difference to begin with.[38] If we assume that, although influence travels, geographical proximity matters, we could explain why the control villages followed the example of villages "under treatment", but did not follow them all the way. Contagion did not spread completely.[39]

4.3 Interactions among Institutions

Externalities are prevalent when market and non-market institutions co-exist. Earlier we noted that if non-market institutions are entrenched, they can prevent potentially more efficient institutions from emerging. In what follows, I present a case offering the opposite moral: namely, that an expansion of markets can destroy non-market institutions and make certain vulnerable groups worse off. How and why might such externalities affect fertility behaviour? A number of pathways suggest themselves.[40]

Long-term relationships involving cooperation are frequently sustained by social norms - for example, norms of reciprocity. Social norms can be reliably observed only among people who expect to encounter one another in recurring situations.[41] Consider a community of "far-sighted" people who know one another and expect to interact with one another for a long time. By far-sighted, I mean someone who applies a low rate to discount future costs and benefits of alternative courses of action. Assume that the

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[38] Hill (1992).

[39] I am grateful to Lincoln Chen for a helpful 1996 correspondence on this point. For a formal account of contagion models, see Blume and Durlauf (2000).

[40] Dasgupta (1993, 1999).

[41] This is the setting studied in the theory of repeated games. Maintaining reputation could also be a reason why people keep trust, but such motives for cooperative behaviour does not rely on social norms. See Fudenberg and Tirole (1991).

parties in question are not individually mobile (although they could be collectively mobile, as in the case of nomadic societies); otherwise the chance of future encounters with one another would be low, and people would discount heavily the future benefits of the current costs they incur for the purposes of cooperation.

Simply stated, if people are far-sighted and are not individually mobile, a credible threat by all that they would impose stiff sanctions on anyone who broke the agreement would deter everyone from breaking it. But the threat of sanctions would cease to have bite if opportunistic behaviour were to become personally more profitable. The latter would happen if formal markets develop nearby. As opportunities outside the village improve, people with lesser ties (e.g., young men) are more likely to take advantage of them and make a break with those customary obligations that are enshrined in the prevailing social norms. People with greater attachments would perceive this and infer that the expected benefits from complying with agreements are now lower. Norms of reciprocity would break down, making certain groups of people (e.g., women, the old, and the very young) worse off. This is a case where improved institutional performance elsewhere (e.g., growth of markets in the economy at large) has an adverse effect on the functioning of a local, nonmarket institution: it is a reflection of an externality.

When long-term relationships breaks down, people build new ones to further their economic opportunities. Those who face particularly stressful circumstances resort to draconian measures to build new economic channels. Guyer (1994) has observed that in the face of deteriorating economic circumstances, some women in a Yaruba area of Nigeria have borne 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.

Cain (1981, 1983) showed that where capital markets are nonexistent and public or community support for the elderly are weak, children provide security in old age. The converse is that if community-based support systems decline, children become more valuable. But we have just noted that community-based support systems in rural areas may degrade with the growth of markets in cities and towns. So there is a curious causal chain here: growth of markets in towns and cities can lead to an increase in fertility in poor villages, other things being the same. There is evidence of this. In her work on Sarawak, Heyzer (1996) has observed that half the forest area there has now been lost and that this has disrupted the lives of indigenous people in different ways. Communities that lived in the heart of the forest were most severaly affected, while others, living near towns, were able to turn from swidden agriculture to wage labour. This transformation, however, involved male migration, leaving women behind to cope with a decreasing resource base. As subsistence alternatives declined, children become one of the few remaining resources that women could control. There was thus a new motivation for having children: to help their mothers with an increased workload. The process involved the creation of new patterns of wealth and poverty, where wealth is based on resource extraction and poverty results from the loss of a community's resource base.

Of course, growth of markets in towns and cities, by making children less reliable as an investment for old age, can lead to a reduction in fertility. Here we have identified an influence of the growth of markets on fertility that runs in the opposite direction. Only formal modelling of the process would enable us to determine which influence dominates under what conditions.

4.4 Household Labour Needs and the Local Commons[42]

Among poor households in rural communities much labour is needed even for simple tasks. Moreover, many households lack 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 nearby 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, household members may have to spend several hours a day fetching water and collecting fodder and wood. These complementary activities have to be undertaken on a daily basis if households are to survive. Labour productivity is low because both manufactured capital and environmental resources are scarce. From an early age (as early as 6), 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.[43]

The need for many hands can in principle 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, social norms that once regulated local resources have changed. Since time immemorial, rural assets such as village ponds and water holes, threshing grounds, grazing fields, swidden fallows, and local forests and woodlands have typically been owned communally. As a proportion of total assets, the presence of such assets ranges widely across ecological zones. In India the local commons are most prominent in arid regions, mountain regions, and unirrigated areas; they are least prominent in humid regions and river valleys.[44] There is a rationale for this, based on the human desire to reduce risks. Community ownership and control enabled households in semi-arid regions to pool their risks. An almost immediate empirical corollary is that income inequalities are less where common-property resources are more prominent. Aggregate income is a different matter though, and the arid and mountain regions and unirrigated areas are the poorest. As would be expected, dependence on common-property resources even within dry regions would appear to decline with increasing wealth across households.

Jodha (1986, 1995), studying evidence from over 80 villages in 21 dry districts in India, 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 percent. 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 (2000) arrived at even larger estimates: the proportion of income based directly on the local commons is 35 percent, with the figure for the poorest quintile reaching 40

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[42] A formal model that captures the ideas developed in this section is in Dasgupta (2000: Appendix).

[43] See Filmer and Pritchett (2002).

[44] Agarwal and Narain (1989).

percent. Such evidence does not of course prove that the local commons are well managed, but it suggests that rural households have strong incentives to devise arrangements whereby they would be well managed.

A number of investigators have shown that many communities have traditionally protected their local commons from overexploitation by relying on social norms, by imposing fines for deviant behaviour, and by other means.[45] I argued earlier that the very process of economic development, as exemplified by urbanization and mobility, can erode traditional methods of control. Social norms are endangered also by civil strife and by the usurpation of resources by landowners or the state. For example, resource-allocation rules practiced at the local level have frequently been overturned by central fiat. A number of states in the Sahel imposed rules that in effect destroyed community management practices in the forests. Villages ceased to have authority to enforce sanctions against those who violated locally instituted rules of use. State authority turned the local commons into free-access resources.[46] As social norms degrade, whatever the cause, parents pass some of the costs of children on to the community by overexploiting the commons. This is another instance of a demographic free-rider problem.

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. It is also true 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 what is desirable from the collective point of view). Loughran and Pritchett (1998), for example, have found in Nepal that increasing environmental scarcity lowered the demand for children, implying that the households in question perceived resource scarcity as raising the 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: as the community's natural resources are depleted, households find themselves needing more "hands". No doubt additional hands could be obtained if the adults worked even harder, but in many cultures it would not do for the men to gather fuel-wood and fetch water for household use. No doubt, too, 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 the fertility rate will 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, along this pathway poverty, household size, and environmental degradation could reinforce one another in an escalating spiral.

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[45] Among them, Howe (1986), Wade (1988), Chopra, Kadekodi, and Murty (1990), Ostrom (1990, 1992), Baland and Platteau (1996). The theory of the commons, both when managed cooperatively and when not, is in Dasgupta and Heal (1979: Ch. 3).

[46] See Thomson, Feeny and Oakerson (1986) and Baland and Platteau (1996). Eicher (1999) traces sub-Saharan Africa's current inability to feed itself to state policies in the 1960s and '70s that amounted to the emasculation of agriculture.

By the time some countervailing set of factors diminished the benefits of having further children and, thereby, stopped the spiral, many lives could have suffered by a worsening of poverty.

Cleaver and Schreiber (1994) have provided very rough, aggregative evidence of a positive link between population increase and environmental degradation in the context of rural sub-Saharan Africa; Batliwala and Reddy (1994) for villages in Karnataka, India; and Heyser (1996) for Sarawak, Malaysia. In a statistical analysis of evidence from villages in South Africa, Aggarwal, Netanyahu, and Romano (2001) have found a positive link between fertility increase and environmental degradation; while Filmer and Pritchett (2002) have reported a weak positive link in the Sindh region in Pakistan.

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 natural-resource base. But they come close enough; limitations in existing data prevent investigators from getting closer to the theory.[47] In any event, these studies cannot reveal causal connections, but, excepting the study by Loughran and Pritchett (1998), they are consistent 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 scarce resources, for example, among competing ethnic groups.[48] The latter connection deserves greater investigation than it has elicited so far.

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 improve their circumstances. Nevertheless, there are forces at work that pull households away from one another in terms of their living standards. Such forces enable extreme poverty to persist despite growth in the well-being for the rest of society.

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[47] 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.

[48] Durham (1979) and Homer-Dixon (1994, 1999).

References

Adelman, I. and C.T. Morris (1965), "A Factor Analysis of the Interrelationship between Social and Political Variables and per Capita Gross National Product", Quarterly Journal of Economics, 79(2), 555-578.

Agarwal, A. and S. Narain (1989), Towards Green Villages: A Strategy for Environmentally Sound and Participatory Rural Development (New Delhi: Centre for Science and Development).

Aggarwal, R., S. Netanyahu, and C. Romano (2001), "Access to Natural Resources and the Fertility Decision of Women: The Case of South Africa", Environment and Development Economics, 6(2), 209-36.

Arnott, R. and J.E. Stiglitz (1991), "Moral Hazard and Nonmarket Institutions: Dysfunctional Crowding Out or Peer Review?", American Economic Review, 81(1), 179-190.

Arrow, K.J., B. Bolin, R. Costanza, P. Dasgupta, C. Folke, C.S. Holling, B.-O. Jansson, S. Levin, K.-G. Mäler, C. Perrings, and D. Pimentel (1995), "Economic Growth, Carrying Capacity, and the Environment", Science, 268(5210), 520-1.

Arrow, K.J., P. Dasgupta, and K.-G. Mäler (2003a), "The Genuine Saving Criterion and the Value of Population", Economic Theory, 21, 217-225.

Arrow, K.J., P. Dasgupta, and K.-G. Mäler (2003b), "Evaluating Projects and Assessing Sustainable Development in Imperfect Economies", Environmental and Resource Economics, forthcoming, 2003.

Baland, J.-M. and J.-P. Platteau (1995), Halting Degradation of Natural Resources: Is There a Role for Rural Communities? (Oxford: Oxford University Press).

Batliwala, S. and A.K.N. Reddy (1994), "Energy Consumption and Population", in F. Graham-Smith, ed., Population: The Complex Reality (London: The Royal Society).

Bledsoe, C. (1990), "The Politics of Children: Fosterage and the Social Management of Fertility Among the Mende of Sierra Leone," in W. Penn Handwerker, ed., Births and Power: Social Change and the Politics of Reproduction (London: Westview Press).

Bledsoe, C. and G. Pison, eds. (1994), Nupitality in Sub-Saharan Africa: Contemporary Anthropological and Demographic Perspectives (Oxford: Clarendon Press).

Blume, L. and S.N. Durlauf (2001), "The Interactions-Based Approach to Socioeconomic Behavior", in S.N. Durlauf and H. Peyton Young, eds., Social Dynamics (Cambridge, MA: MIT Press).

Bongaarts, J. and S.C. Watkins (1996), "Social Interactions and Contemporary Fertility Transitions", Population and Development Review, 22(4), 639-682.

Cain, M. (1981), "Risk and Insurance: Perspectives on Fertility and Agrarian Change in India and Bangladesh", Population and Development Review, 7(3), 435-474.

Cain, M. (1983), "Fertility as an Adjustment to risk", Population and Development Review, 9(4), 688-702.

Caldwell, J.C. (1991), "The Soft Underbelly of Development: Demographic Transition in Conditions of Limited Economic Change," Proceedings of the Annual Bank Conference on Development Economics 1990 (Supplement to the World Bank Economic Review), 207-54.

Caldwell, J.C. and P. Caldwell (1990), "High Fertility in sub-Saharan Africa," Scientific American, 262(5), 82-89.

Cavendish, W. (2000), "Empirical Regularities in the Poverty-Environment Relationships of Rural Households: Evidence from Zimbabwe", World Development, 28: 1979-2003.

Chopra, K., G. Kadekodi and M.N. Murty (1990), Participatory Development: People and Common Property Resources (New Delhi: Sage Publications).

Cleaver, K.M. and G.A. Schreiber (1994), Reversing the Spiral: the population, agriculture, and environment nexus in sub-Saharan Africa (Washington, D.C.: World Bank).

Coale, A.J. (1969), "The Decline of Fertility in Europe from the French Revolution to World War II," in S.J. Behrman, L. Corsa, and R. Freedman, eds., Fertility and Family Planning: A World View (Ann Arbor, Michigan: University of Michigan Press).

Cochrane, S. (1979), Fertility and Education: What Do We Really Know? (Baltimore, MD: Johns Hopkins University Press).

Cochrane, S. (1983), "Effects of Education and Urbanization on Fertility," in R. Bulatao and R. Lee, eds., Determinants of Fertility in Developing Countries, Vol II (New York: Academic Press).

Cohen, B. (1993), "Fertility Levels, Differentials and Trends", in K.A. Foote, K.H. Hill and L.G. Martin, eds., Demographic Change in Sub-Saharan Africa (Washington, D.C.: National Academy Press).

Collier, P. and J.W. Gunning (1999), "Explaining African Economic Performance", Journal of Economic Literature, 37(1), 64-111.

Collins, S. and B. Bosworth (1996), "Economic Growth in East Asia: Accumulation versus Assimilation", Brookings Papers on Economic Activity, 2, 135-191.

Cropper, M.L. and C. Griffiths (1994), "The Interaction of Population Growth and Environmental Quality", American Economic Review, 84 (Papers & Proceedings), 250-4.

Dasgupta, P. (1982), The Control of Resources (Cambridge, MA: Harvard University Press).

Dasgupta, P. (1990), "Well-Being and the Extent of its Realization in Poor Countries", Economic Journal, 100 (Supplement), 1-32.

Dasgupta, P. (1993), An Inquiry into Well-Being and Destitution (Oxford: Clarendon Press).

Dasgupta, P. (1996), "The Economics of the Environment", Environment and Development Economics, 1(4), 387-428.

Dasgupta, P. (1997), "Nutritional Status, the Capacity for Work and Poverty Traps", Journal of Econometrics, 77(1), 5-38.

Dasgupta, P. (1998), "The Economics of Poverty in Poor Countries", Scandinavian Journal of Economics, 100(1), 41-68.

Dasgupta, P. (1999), "Economic Progress and the Idea of Social Capital", in P. Dasgupta and I. Serageldin, eds., Social Capital: A Multifaceted Perspective (Washington, D.C.: World Bank).

Dasgupta, P. (2000), "Population, Resources, and Poverty: An Exploration of Reproductive and Environmental Externalities", Population and Development Review, 26(4), 643-689.

Dasgupta, P. (2001a), Human Well-Being and the Natural Environment (Oxford: Oxford University Press).

Dasgupta, P. (2001b), "On Population and Resources: Reply", Population and Development Review, 26(4), 748-754.

Dasgupta, P. (2003), "Population, Poverty, and the Natural Environment", in K.-G. Mäler and J. Vincent, eds., Handbook of Environmental Economics, Volume 1 (Amsterdam: Elsevier Science).

Dasgupta, P. and G.M. Heal (1979), Economic Theory and Exhaustible Resources (Cambridge: Cambridge University Press).

Dasgupta, P., S.A. Levin, and J. Lubchenco (2000), "Economic Pathways to Ecological Sustainability", <u>BioScience</u>, 50(4), 339-345.

Dasgupta, P. and K.-G. Mäler (1991), "The Environment and Emerging Development Issues," <u>Proceedings of the Annual World Bank Conference on Development Economics 1990</u> (Supplement to the <u>World Bank Economic Review</u>), 101-32.

Dasgupta, P. and K.-G. Mäler (2000), "Net National Product, Wealth, and Social Well-Being", <u>Environment and Development Economics</u>, 5(1), 69-93.

Durham, W. (1979), <u>Scarcity and Survival in Central America: Ecological Origins of the Soccer War</u> (Stanford, CA: Stanford University Press).

Easterlin, R., R. Pollak, and M. Wachter (1980), "Toward a More General Model of Fertility Determination: Endogenous Preferences and Natural Fertility," in R. Easterlin, ed. <u>Population and Economic Change in Developing Countries</u> (Chicago: University of Chicago Press).

Easterly, W. (2002), <u>The Elusive Quest for Growth</u> (Cambridge, MA: MIT Press).

Easterly, W. and R. Levine (1997), "Africa's Growth Tragedy: Policies and Ethnic Divisions", <u>Quarterly Journal of Economics</u>, 112(4), 1203-1250.

Eicher, C.K. (1999), <u>Institutions and the African Farmer</u>, Distinguished Economist Lecture, CIMMYT, Mexico City.

Ezzell, C. (2000), "Care for a Dying Continent", <u>Scientific American</u>, 282(5), 72-81.

Farooq, G., I. Ekanem, and S. Ojelade (1987), "Family Size Preferences and Fertility in South-Western Nigeria," in C. Oppong, ed., <u>Sex Roles, Population and Development in West Africa</u> (London: James Currey).

Filmer, D. and L. Pritchett (2002), "Environmental Degradation and the Demand for Children: Searching for the Vicious Circle in Pakistan", <u>Environment and Development Economics</u>, 7(1), 123-146.

Fogel, R.W. (1994), "Economic Growth, Population Theory, and Physiology: The Bearing of Long-Term Processes on the Making of Economic Policy", <u>American Economic Review</u>, 84(3), 369-395.

Fogel, R.W. (1999), "Catching Up with the Economy", <u>American Economic Review</u>, 89(1), 1-19.

Fudenberg, D. and J. Tirole (1991), <u>Game Theory</u> (Cambridge, MA: MIT Press).

Grossman, G.M. and A.B. Krueger (1995), "Economic Growth and the Environment", <u>Quarterly Journal of Economics</u>, 110(2), 353-77.

Guyer, J.L. (1994), "Lineal Identities and Lateral Networks: The Logic of Polyandrous Motherhood," in C. Bledsoe and G. Pison, eds., <u>Nuptiality in Sub-Saharan Africa: Contemporary Anthropological and Demographic Perspectives</u> (Oxford: Clarendon Press).

Hajnal, J. (1982), "Two Kinds of Preindustrial Household Formation Systems," <u>Population and Development Review</u>, 8(3), 449-494.

Harford, J.D. (1998), "The Ultimate Externality", <u>American Economic Review</u>, 88(1), 260-265.

Heyser, N. (1996), <u>Gender, Population and Environment in the Context of Deforestation: A Malaysian Case Study</u> (Geneva: United Nations Research Institute for Social Development).

Hill, K. (1992), "Fertility and Mortality Trends in the Developing World," <u>Ambio</u>, 21(1), 79-83.

Homer-Dixon, T.E. (1994), "Environmental Scarcities and Violent Conflict: Evidence from Cases", <u>International Security</u>, 19(1), 5-40.

Homer-Dixon, T.E. (1999), Environment, Scarcity, and Violence (Princeton, NJ: Princeton University Press).

Howe, J. (1986), The Kuna Gathering: Contemporary Village Politics in Panama (Austin, Texas: University of Texas Press).

IFPRI (1995), A 2020 Vision for Food, Agriculture, and the Environment (Washington, DC: International Food Policy Research Institute).

Iyer, S. (2002), Religion and Fertility in South India (Delhi: Oxford University Press).

Jodha, N.S. (1986), "Common Property Resources and the Rural Poor", Economic and Political Weekly, 21, 1169-81.

Jodha, N.S. (1995), "Common Property Resources and the Environmental Context: Role of Biophysical versus Social Stress", Economic and Political Weekly, 30, 3278-83.

Johnson, D. Gale (2000), "Population, Food, and Knowledge", American Economic Review, 90(1), 1-14.

Johnson, D. Gale (2001), "On Population and Resources: A Comment", Population and Development Review, 27(4), 739-747.

Jolly, C.L. and J.N. Gribble (1993), "The Proximate Determinants of Fertility", in K.A. Foote, K.H. Hill and L.G. Martin, eds., Demographic Change in Sub-Saharan Africa (Washington, D.C.: National Academy Press).

Kremer, M. (1993), "Population Growth and Technological Change: One Million B.C. to 1990", Quarterly Journal of Economics 108(3), 681-716.

Krishnan, P. (2001), "Cultural Norms, Social Interactions and the Fertility Transition in India", Mimeo., Faculty of Economics, University of Cambridge.

Landes, D. (1969), The Unbound Prometheus (Cambridge: Cambridge University Press).

Landes, D. (1998), The Wealth and Poverty of Nations: Why Some Are So Rich and Some So Poor (New York: W.W. Norton).

Loughran, D. and L. Pritchett (1998), "Environmental Scarcity, Resource Collection, and the Demand for Children in Nepal", Mimeo., World Bank, Washington, D.C.

Maddison, A. (2001), The World Economy: A Millennial Perspective (Paris: OECD, Development Research Centre).

Murray, J.D. (1993), Mathematical Biology (Berlin: Springer-Verlag).

Ostrom, E. (1990), Governing the Commons: The Evolution of Institutions for Collective Action (Cambridge: Cambridge University Press).

Ostrom, E. (1992), Crafting Institutions for Self-Governing Irrigation Systems (San Francisco, CA: ISC Press for Institute for Contemporary Studies).

Pinstrup-Andersen, P. and R. Pandya-Lorch (1995), "Poverty, Food Security, and the Environment", 2020 Brief No. 29, International Food Policy Research Institute (IFPRI), Washington, DC.

Platteau, J.-P. and Y. Hayami (1998), "Resource Endowments and Agricultural Development: Africa versus Asia", in Y. Hayami and M. Aoki, eds., The Institutional Foundations of East Asian Economic Development (London: MacMillan).

Sen, A. (1994), "Population: Delusion and Reality", New York Review of Books (September 22), 62-71.

Sen, A. (1999), <u>Development as Freedom</u> (Oxford: Oxford University Press).

Thomson, J.T., D.H. Feeny, and R.J. Oakerson (1986), "Institutional Dynamics: The Evolution and Dissolution of Common Property Resource Management", in National Research Council, <u>Proceedings of a Conference on Common Property Resource Management</u> (Washington, D.C.: US National Academy of Science Press).

Turner, B.L. and A.M.S. Ali (1996), "Induced Intensification: Agricultural Change in Bangladesh with Implications for Malthus and Boserup", <u>Proceedings of the National Academy of Sciences</u>, 93, 14984-14991.

Wade, R. (1988), <u>Village Republics: Economic Conditions for Collective Action in South India</u> (Cambridge: Cambridge University Press).

Watkins, S.C. (1990), "From Local to National Communities: The Transformation of Demographic Regions in Western Europe 1870-1960," <u>Population and Development Review</u>, 16(2), 241-72.

World Bank (1990), <u>World Development Report</u> (New York: Oxford University Press).

World Bank (1992), <u>World Development Report</u> (New York: Oxford University Press).

World Bank (1998), <u>World Development Indicators</u> (Washington, D.C.: World Bank).

World Bank (2000a), <u>World Development Report</u> (New York: Oxford University Press).

World Bank (2000b), <u>World Development Indicators</u> (Washington, D.C.: World Bank).

World Bank (2001), <u>World Development Indicators</u> (Washington, D.C.: World Bank).

Wrigley, E.A. and R.S. Schofield (1981), <u>The Population History of England 1541-1871: A Reconstruction</u> (Cambridge: Edward Arnold).

Table 1

Poverty[a] and Population Growth

Region	Number in 1998	HI[b] (%)
	(millions)	
East Asia & Pacific (excluding China)	65	11
China	213	18
Europe and Central Asia	24	5
Latin America and the Caribbean	78	16
South Asia	522 (495)[c]	40

Bangladesh
  India
  Pakistan		

sub-Saharan Africa	290 (242)[c]	46
Total	1,192 (1,270)[c]	24

[a] People living on less than 1 US dollar a day in 1998.

[b] Headcount Index (HI): proportion of people that are poor.

[c] People living on less than 1 US dollar a day in 1990.

Source: World Bank (2000a, Table 1.1; 2000b, Table 2.1)

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

[a] : crude birth rate per 1000 people
[b] : crude death rate per 1000 people

Source: World Bank (1998, Table 2.2)

Table 3

Sources of Economic Growth, 1960-94

	g(Y/L)	g(K)	g(H)	g(A)
East Asia	4.2	2.5	0.6	1.1
South Asia	2.3	1.1	0.3	0.8
Africa	0.3	0.8	0.2	-0.6
Middle East	1.6	1.5	0.5	-0.3
Latin America	1.5	0.9	0.4	0.2
United States	1.1	0.4	0.4	0.4
Other industrial countries	2.9	1.5	0.4	1.1

Key: g(Y/L): annual percentage rate of change in GNP per head

g(K): share of GNP attributable to manufactured capital multiplied by annual percentage rate of change in manufactured capital

g(H): share of GNP attributable to human capital multiplied by annual percentage rate of change in human capital

g(A): percentage rate of change in total factor productivity (residual)

Source: Collins and Bosworth (1996).

Table 4

Genuine Investment and Wealth Accumulation in Selected Regions: 1970-93

_____

	I/Y[a] (%)	g(L)[b]	g(W/L)[c]	g(Y/L)[d]	Δ(HDI)[e]
Bangladesh	-0.3	2.3	-2.40	1.0	+ve
India	10.7	2.1	-0.50	2.3	+ve
Nepal	-1.5	2.4	-2.60	1.0	+ve
Pakistan	8.2	2.9	-1.70	2.7	+ve
Sub-Saharan Africa	4.7	2.7	-2.00	-0.2	+ve
China	14.4	1.7	1.09	6.7	-ve

_____

[a] I/Y: inclusive investment as percentage of GNP. (Source: Hamilton and Clemens (1999, Tables 3 and 4; and personal communication from Katie Bolt, World Bank). Inclusive investment includes total health expenditure (i.e., public plus private), estimated as an average during 1983-1993, from data supplied by the World Health Organization.

[b] g(L): average annual percentage rate of growth of population, 1965-96. (Source: World Bank (1998, Table 1.4).

[c] g(W/L): average annual percentage rate of change in per capita wealth at constant prices.

[d] g(Y/L): average annual percentage rate of change in per capita GNP, 1965-96. (Source: World Bank (1998, Table 1.4).

[e] Δ(HDI): sign of change in UNDP's Human Development Index, 1987-97. (Source: UNDP (1990, 1999)).

Assumed output-wealth ratio: 0.15 per year.