

Working Paper

Are There Ecological Limits to Population?

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WP-93-16
April 1993



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ABSTRACT

On a question everywhere recognized as important, sustainable development, social and natural scientists have very different approaches, adduce different kinds of data, offer different policy recommendations. Persistence of these differences has the awkward result of puzzling the conscientious policy maker, in effect asking him or her to solve a problem that is too difficult for the scientists concerned. On the other hand it allows the policy maker who is less conscientious to act as suits his or her interests for extraneous reasons; there will always be some intellectual support for whatever he or she wants to do.

The paper shows differences between social and natural sciences, specifically between those most closely involved, economics and biology, that help to account for the very different conclusions. These include the longer term perspective and the sense of contingency on the part of biologists, along with the view that mankind has arrived where it now is by adapting to the natural world, as against the shorter term interests, the intervention of the consciousness of participants, and the view that mankind is creative and not merely adaptive on the part of economists. For economists growth is now the normal condition; for biologists it is an aberration--an admirable one up to a point--of the last century or two.

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ARE THERE ECOLOGICAL LIMITS TO POPULATION? ¹

How does population relate to development?
How much population and development can the environment stand?
Weak data by no means imply weak effect

Nathan Keyfitz

THE LONG-TERM PERSPECTIVE: HUNTERS TO MEGACITIES

Through most of the two million or so years that we tool-using creatures have lived on earth we adapted well to the environment. Technology, and hence income, rose slowly; centuries, millennia, passed without appreciable change. Population did grow, but gradually; as recently as the Neolithic, say 10,000 years ago, there were only about 10 million of our ancestors spread out over all the hospitable parts of the planet, half as many as live today in Mexico City. Their average rate of increase to this point had been about 1/200,000 per year. That of Mexico today is over 5,000 times as rapid.

With their small number and their simple and stable techniques for gaining a livelihood they did not greatly disturb the natural environment in which they lived. Say Lee and Devore of human existence before the Neolithic,

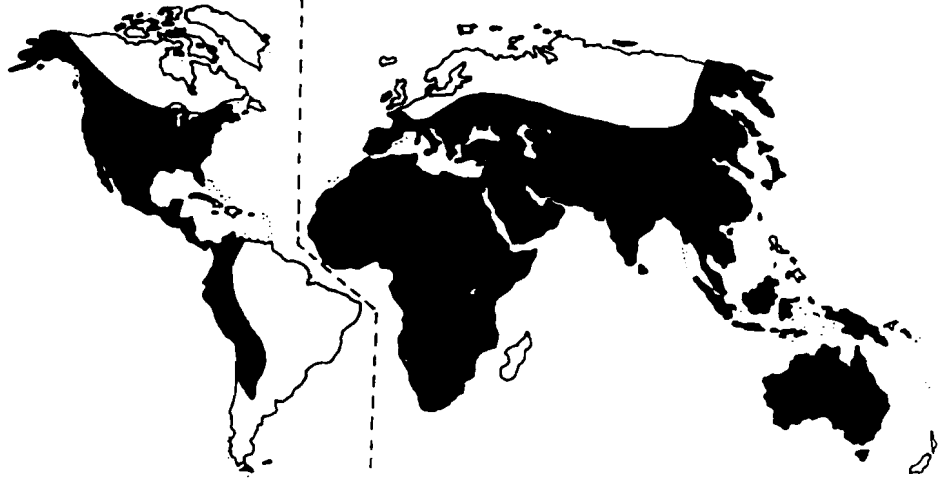
The hunting way of life has been the most successful and persistent adaptation man has ever achieved.²

The adaptation was based on a very long experience--people have lived by hunting a hundred times as long as they have lived by agriculture, and several thousand times as long as they have lived by industry.

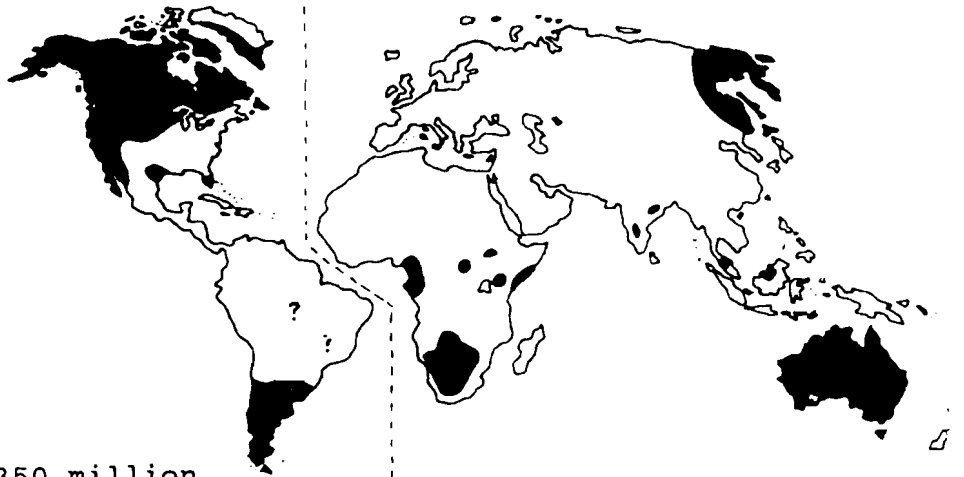
But what those hunting cultures could not adapt to was the agricultural world of increasing populations and expanding economies. Three maps provided by Lee and Devore show the hunters pushed out of good agricultural land by the tillers, with their increasing numbers and effective technologies of cultivation and of war. Once spread out over much of the land area of the planet, the hunting and gathering peoples were driven to the hills and other less accessible and less desirable places by peoples who took to the new technology, agriculture. And now after 10,000 years only small enclaves of hunters survive. The Inuit of Canada, the Native Peoples of the United States, the Yanomani of the Amazon, the Moi of Vietnam, are as always defenseless against the invasion of more "advanced" peoples, now drawn by the increasing commercial value of the diminishing forests. Their hunting grounds are clear cut for cattle ranches, paved over for cities.

¹Paper prepared for the Symposium of the National Academy of Sciences, Washington, D.C., Tuesday April 27, 1993.

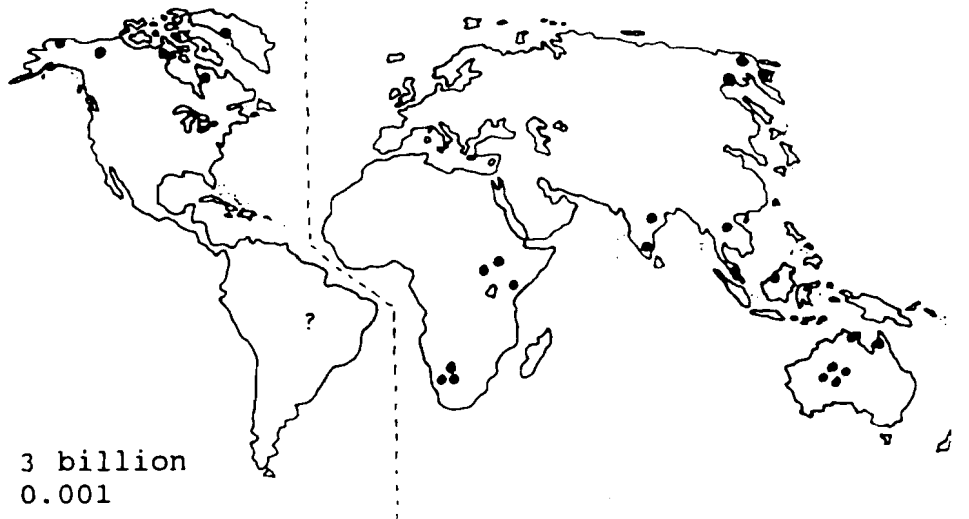
²Richard B. Lee and Irven Devore, Eds. 1968. Man the Hunter. Chicago: Aldine, p. 3.



World Population: 10 million
Per cent Hunters: 100



World Population: 350 million
Per cent Hunters: 1.0



World Population: 3 billion
Per cent Hunters: 0.001

Figure 1. Map showing distribution of hunters at three points of time. Source: Lee and Devore, *ibid.*, p. 14.

On the test of who is pushing whom about, who is surviving and who is disappearing, the agricultural-industrial peoples are better adapted, Yet for Lee and Devore the matter of adaptation is not settled: the books are not yet closed. In their words,

It is still an open question whether man will be able to survive the exceedingly complex and unstable ecological conditions he has created for himself. If he fails in this task, interplanetary archaeologists of the future will classify our planet as one in which a very long and stable period of small-scale hunting and gathering was followed by an apparently instantaneous efflorescence of technology and society leading rapidly to extinction.³

THE SHORTER PERSPECTIVE IS OPTIMISTIC

To take the point of view of the hunters will in modern terms be called pessimistic and a retrogression, and I cite it only as one extreme of a range of expression on people and the environment. Academic economics will serve to define the optimistic extreme: with modern ingenuity, given scope and stimulus by free markets, shortages will be overcome and deterioration repaired. Say labor economists Bloom and Freeman,⁴

The empirical evidence shows little relation between the growth of population and income per head or related economic variables.

Environment is passed over. The data, as Bloom and Freeman interpret them, support a "population neutral" point of view (p. 58). As Goran Ohlin⁵ in a different setting summed up:

There was no apparent relationship between population growth and economic growth.

Similarly the U.S. White Paper released on the occasion of the 1984 Mexico City Conference:

The relationship between population growth and economic development is not a negative one.

In these writings the environment with its limitations is not central; it is expected to provide an adequate base for the economy as population and production rise. Any necessary costs of cleanup will be an affordable deduction from the increasing income.

³Ibid.

⁴David E. Bloom and Richard B. Freeman. 1988. Economic development and the timing and components of population growth. Journal of Policy Modeling 10(1):57-81.

⁵Unpublished papers of the Friberg Conference, 1990. The same statement is to be found in many other places, including Nathan Keyfitz. 1977. Applied Mathematical Demography. New York: John Wiley and Sons, where a scatter diagram shows clearly the lack of relation.

DIFFERENT ELEMENTS ARE OPERATIVE IN THE SHORT AND LONG TERM

Disciplines concentrating on the here and now have not developed the means for handling change that takes place over decades and centuries--there is no reason why they should. Earth scientists, evolutionary biologists, ecologists, archaeologists, on the other hand, have time horizons long enough that they are familiar with changes in the environment and accustomed to studying them, and they are alarmed by the entry of a new element--human numbers and technology large and powerful enough to take their place alongside the forces of nature.

For many of their problems the various disciplines do not touch one another; but now the short-term and the long-term fields have a point of contact: they overlap in respect of population and economic growth on the one side and environment on the other.

Because of the overlap of interests those preoccupied with months are at the moment engaged in a lively controversy with those preoccupied by millennia. And the very different frameworks they have built up make them mutually incomprehensible. When biologists and economists try to talk to one another the biologists speak concretely about the fragile character of rain forests, and the economists more broadly about the power of substitution impelled by the price system. There is plenty of goodwill but effectively no dialogue.

IMPLIED FLATTERY OF NATURAL SCIENCE

Social scientists support their case with references to history, in this context to the history of the past two or three centuries. If anyone doubted the capacity of science to take care of us in the future let them just look back at the past; again and again there have seemed to be serious threats to our progress, shortages that looked as though they would be fatal, and yet we now number 5 1/2 billion and are on the average better off than ever. And as for the foreseeable future,

There are no natural limits to the ability of the planet to support a great many more than 5 billion people,⁶

always taking for granted that society will behave suitably and science will do its part. And the prospect for the distant future is still brighter:

In the very distant future, if our descendants outrun the food-producing capacity of the earth, they will by that time be sufficiently skilled and wealthy to build themselves artificial satellites to live on.⁷

⁶The London Economist, June 13, 1987, page 49.

⁷Colin Clark. 1958. Nature 181:1235-1236.

Natural scientists should be flattered by this confidence reposed in them. It is only they, after all, who can make the advances in fundamental knowledge on which the technology would be based, the technology that would permit 10 billion people to live prosperously on this same planet by the middle of the 21st century, even to colonize artificial satellites.

RETICENCE OF SCIENTISTS

Yet scientists do not accept the compliment; they take a view whose mature expression is given by the joint statement of this Academy and the venerable and equally distinguished Royal Society of London, that between them include a high proportion of the world's most creative scientists. I will refresh your memory by reading one sentence from the preamble:

If current predictions of population growth prove accurate and patterns of human activity on the planet remain unchanged, science and technology may not be able to prevent either irreversible degradation of the environment or continued poverty for much of the world.⁸

The conclusion at the end of the document followed from this preamble:

Global policies are urgently needed to promote more rapid economic development throughout the world, more environmentally benign patterns of human activity, and a more rapid stabilization of world population.⁹

Inventing a new generation of contraceptives is put high on the list of recommendations as something that science can do. Beyond that, however effective science may be,

it is not prudent to rely on science alone to solve problems created by rapid population growth, wasteful resource consumption and harmful human practices.¹⁰

Counting on science to fix things later could turn out to be as mistaken as damaging oneself by excessive drinking and smoking and expecting one's doctor to cure the consequences.

This assertion of social scientists on the one side--that population creates no problems for the environment that cannot be fixed by natural science and the technology derived from it--stands against the assertion of the natural scientists themselves on whom

⁸Population Growth, Resource Consumption and a Sustainable World. 1992. A Joint Statement by the officers of the Royal Society of London and the US National Academy of Sciences. Sir Michael Atiyah, President of the Royal Society of London and Frank Press, President of the US National Academy of Sciences.

⁹Ibid.

¹⁰Ibid.

the solution is to depend; for them, with increased population the ecological problems may be intrinsic, beyond the capacity of anyone to deal with.

DO WE ADAPT TO THE ENVIRONMENT OR CONSTRUCT IT?

When the discussion becomes concrete, for instance on how far the growth of population and the economy can go before the environment is damaged, temporarily or irretrievably, it turns out that words have different meanings for the two disciplines.

What does damage mean? If it is only the environment changing from what it is now as economic growth proceeds, that is taken for granted by economics; even the earliest agricultural peoples cut down trees to plant their small weedy patches of neolithic agriculture. Economics sees itself as dynamic; naturally man is changing the surface of the planet, and if some of the changes are disadvantageous that is temporary and remediable. If materials are used up they will be substituted as they have always been in the past--wood fuel by coal, coal by oil, copper by glass threads.

But biologists have in mind something quite different from substitution of materials. The natural environment is what we have adapted to in a very intricate process that they are only slowly coming to understand, and they do not know how our adaptation will be affected by changes now being made. We are doing experiments of unprecedented magnitude with the earth itself--the platform on which we are standing--and if things go wrong and start moving in a dangerous direction we may well not be able to stop or reverse the movement. Paul Ehrlich speaks for biologists when he says:

Natural ecosystems are still actively engaged in maintaining the planet's habitability--making it possible for over 5 billion to survive and a billion or two to thrive. Other organisms are functioning parts of those natural ecosystems; in the degree that we exterminate them, we imperil the capacity of Earth to support us and our descendants.¹¹

And Peter Raven and Edward Wilson on biodiversity:

Wild species...provide essential services to the ecosystem, from the maintenance of hydrologic cycles to the nitrification of soils.¹²

Even superficial reading shows how complex are the planetary systems on which we depend, how small a part of them is up to now mapped, classified, and understood. If even biologists do not understand the planetary processes, what about the rest of us?

Economists see their subjects as dynamic rather than passively adapting. In one categorization of biologists, they are said to

¹¹Paul R. Ehrlich and Anne H. Ehrlich. 1990. The Population Explosion. New York: Simon and Schuster, p. 260.

¹²Peter H. Raven and Edward O. Wilson. 1992. A fifty-year plan for biodiversity surveys. Science 258 (November 13):1099.

reason about human affairs by analogy to species that do not systematically and purposively construct the environment from which they derive sustenance.¹³

We should look carefully at this use of the word construct, whose importance was emphasized by its being printed in italics in the original.

DIFFERENT DISCIPLINES USE WORDS DIFFERENTLY

In fact in that one word construct quoted above from Preston lies a key difference between the two branches of knowledge. Does mankind construct the environment? Or does it modify, some would say tamper with, the environment? Again and again we have had to reverse a process that had been initiated, clean up air and water that had been dirtied, close down nuclear reactors, relocate deposits of dangerous waste; how sure can we be that we will always be able to backtrack, especially as the scale of our activities becomes larger with more people and more goods per person. The notion that we construct our environment has the appearance to some of a certain hubris. Stewart Udall evidently had it in mind when he wrote

...we have consistently exaggerated the contributions of technological genius and underestimated the contributions of natural resources.¹⁴

One could continue with other differences in language. Rationality is an important concept for economics; thus Amartya Sen:

Rational behavior in the form of maximization of self-interest makes the analysis of individual behavior a good deal more tractable than a less structured assumption would permit.... [From it is derived] the Fundamental Theorem of Welfare Economics.¹⁵

Biologists also deal with self-seeking, that is indeed widespread in animal behavior, but they do so under different names. They call the struggle for survival what in economics is the market. Adam Smith's invisible hand corresponds to Darwin's and Dawkins's Blind Watchmaker.¹⁶ The unguided and unplanned process of evolution brings a good

¹³Samuel H. Preston. 1986. Are the economic consequences of population growth a sound basis for population policy? Pages 67-95 in Jane Menken, ed. World Population and US Policy: The Choices Ahead. The American Assembly and W.W. Norton.

¹⁴Stewart L. Udall in William R. Catton, Jr. 1980. Overshoot: The Ecological Basis of Revolutionary Change. Urbana: University of Illinois Press. Quoted by Donella H. Meadows, Dennis L. Meadows, and Jørgen Randers. 1992. Beyond the Limits: Confronting Global Collapse. Envisioning a Sustainable Future. Post Mills, VT: Chelsea Green Publishing.

¹⁵Amartya K. Sen. 1987. Rational behavior. The New Palgrave: A Dictionary of Economics 4:68-74. A broader view is taken by the same writer in his 1977 paper: Rational fools: A critique of the behavioral foundations of economic theory. Philosophy and Public Affairs 6:317-345.

¹⁶Richard Dawkins. 1986. The Blind Watchmaker. London: Penguin Books.

outcome--what used to be called the survival of the fittest--in the same way as the competition in the market brings social welfare. For purposes of day-to-day administration, the market dispenses with Government, natural selection dispenses with God.¹⁷ So there are resemblances in the logic of the two disciplines, but these do not bring agreement on the substance.

For example economics calls the extraction of oil from under the ground production, and its subsequent use as fuel for automobiles consumption; an ecologist is more inclined to think of the whole sequence of production and consumption as destruction and asks what purpose is served that can justify its ecological cost. Economics on its side does not ask people's purposes, and certainly does not evaluate their importance; it aims to set the conditions under which individuals will have as much of what they want as is possible for them to get, subject to other individuals having the same opportunity.

Another concept that appears in both disciplines is equilibrium. For biology under most circumstances the environment sets limits within which innumerable species interact with it and with one another, and this "web of life" is seen as in a kind of equilibrium most of the time. While the idea is familiar enough it is mostly implicit--I see one college textbook of biology that does not mention it as such; on the other hand Dawkins (page 210) does mention it as illustrated by a special kind of thermostat.

For economics the first recorded use was by the Scottish economist James Steuart in 1769. The New Palgrave has more than a dozen articles on one aspect or another:

Equilibrium analysis...has been the foundation on which economic theory has been able to build up its not inconsiderable claims to 'scientific' status.¹⁸

While earlier in this century it was approached by counting equations and unknowns, more satisfactory methods have been developed in recent decades, in particular to take account of feedbacks and other nonlinearities. This is no place to elaborate, except to refer to one feature of the definition. Phelps speaks of

an outcome, typically from the application of some inputs, that conforms to the expectations of the participants in the economy.... [C]orrect expectations appear to be the essential property of equilibrium, at least in the orthodox use of the term.¹⁹

This is the inescapable requirement of all social science--that it take account of the expectations of participants, who interpose a layer of interpretation on all interactions. That is what makes economics and other social science in their way more difficult than natural science, and in particular more subject to divergent and changing viewpoints.

¹⁷Darwin in his Autobiography acknowledges Malthus and the idea of population pressing against food supplies. If only some could survive which would they be? Here was a mechanism of selection.

¹⁸Murray Milgate. 1987. Equilibrium: Development of the field. The New Palgrave 2:179.

¹⁹Edmund S. Phelps. 1987. Equilibrium: An Expectational Concept. The New Palgrave 2:177-179.

This aspect will inevitably reappear throughout the present paper. We have to stress that such difficulties are not arbitrarily introduced by social scientists: they are intrinsic to the subject matter.

Both economists and ecologists say that we do not know the mechanisms that are operating on the planet, and we should not interfere without knowing more. But the word "interfere" is used very differently by the two professions. The biologist sees us as drastically interfering right now, by what we do to the environment with our population and economic growth; the economist calls interference anything that would slow the economic growth. One more word to be added to the glossary of terms that each of the disciplines has to explain to the other.

DIFFERENCE OF PERSPECTIVES: RESPECT FOR CONTINGENCY

Beyond a difference of viewpoint on whether science can deal with the problems that have arisen and will arise with more people on this earth, and beyond differences of language, are differences of perspective. To the biologists that I read there are many possibilities at every stage, and if we have arrived over the course of millions of years at a condition where we are capable of discussing such matters as these, or even capable of speech, we are just lucky. They see nothing inevitable about it.

Stephen Jay Gould may be in the forefront of those ready to drop the 19th century view that the whole history of the earth, perhaps of the universe, has been an unstoppable march to arrive at the goal of contemporary man. "This common scenario is fiction rooted in traditional hopes for progress and predictability." He points out that

Mammals spent their first hundred million years--two thirds of their total history--as small creatures living in the nooks and crannies of a dinosaur's world. Their sixty million years of success following the demise of dinosaurs has been something of an afterthought.²⁰ (page 318)

The disappearance of the dinosaurs was by no means inevitable, and if they had stayed

mammals would still be small creatures in the interstices of their world. This situation prevailed for a hundred million years; why not for sixty million more?

He speaks of how quirky are climate and geography.

Continents fragment and disperse; oceanic circulation changes; rivers alter their course; mountains rise; estuaries dry up. If life works more by tracking environment than by climbing up a ladder of progress, then contingency should reign. (page 300)

²⁰Stephen J. Gould. 1989. Wonderful Life: The Burgess Shale and the Nature of History. New York: W.W. Norton.

And he adduces South American geological evidence for "the powerful role of contingency...against our smug, placental-centered parochialism." (page 298).

Similarly Paul and Anne Ehrlich,

relatively rapid and severe environmental changes occurred on several occasions, with catastrophic consequences for the life forms existing at those times.²¹

Such uncertainty in the historical process that brought us here conduces to a sense that the future is also uncertain, that we do not have matters under control, that we had better be very careful in what we do with this planet.

The 19th century view that all this is opposing was most clearly expressed by Herbert Spencer. He could confidently assure his readers that

Progress...is not an accident, but a necessity.... It is a part of nature,²²

and there could be absolutely no doubt about its continuing. This finds its reflection today in economic growth, that sums up all that is most admirable in the modern world. We expect economic production to continue increasing without any gap or interruption, if possible at 5 percent per year, but if that is not possible, then at least at some positive rate. Our children and our grandchildren will be richer than we are; if they are more numerous so that there are more problems of accommodating them, they will also have more powerful instruments for rearranging their environment.

Apparently the sense that income is increasing all the time, that the worst that damaging the environment can do is to slow it by some affordable percentage, justifies for many people our inconsiderate way of treating it. Not only can we casually despoil for our passing convenience the house in which our rich relatives will be living, but beyond that we can borrow money from those future rich relatives without excessive concern about repayment. That is what happens to economics when it becomes debased in the political arena.

CONFIDENCE

For economics itself, a social science, people's attitudes are central, for natural science the attitudes of subjects can mostly be disregarded.²³ If everyone thinks that a bank is insolvent then that bank will surely have to close its doors, however sound its balance sheet may be. Sociologist Robert Merton spoke of the "self-fulfilling prophecy"

²¹Ehrlich and Ehrlich, 1990, *op. cit.*

²²Herbert Spencer. 1850. *Social Statics*, Part i, Chapter 2.4.

²³Robert K. Merton. 1936. The unintended consequences of purposive social action. *American Sociological Review* 1:894-904.

to describe the general case where a belief, whether true or not, brings itself into existence. Label a boy a criminal, and that could lead him to criminal behavior.

It is true, for good or for bad, that our prosperity depends--among many other things, of course--on our confidence in the future. As I write²⁴ Prime Minister Major is urging confidence on the British people to overcome the depression into which their country has settled. An exaggerated sense of limits of the environment, its incapacity to support more people, would add to other factors depriving people of confidence.

This view that growth, and confidence in continued growth, leads to more growth comes up in many places. Alfred Sauvy, French demographer and economist, points out that closing down obsolete plants will arouse less resistance of workers if they have confidence that they can get jobs in newly established plants.²⁵ And the current London Economist puts it well in accounting for the progress of Japan,

Many of the different elements that fostered growth depended, in turn, on the assurance that growth would continue: lifelong employment, heavy investment in physical and human capital, the helping hand to struggling parts of the enterprise network, pro-business sentiment and lack of preoccupation over division of the spoils...failing industries were obliged to shrink over time; that was alright too because payrolls were always expanding in other industries.²⁶

It is confidence that propels the positive feedback here described.

So letting the public know that environmental prospects are not really bad recurs frequently. For instance David E. Bell, a respected economist and foundation executive, once Director of the US Bureau of the Budget:

In the 1950s and 1960s...there was much concern in the United States that world population growth would outrun the world's resources, leading to widespread famine, social disruption, and conflict.... Cutting the rate of population growth was seen by many as an urgent necessity to prevent worldwide disaster.

In retrospect, these fears were greatly exaggerated. In fact, the record of the past three decades has been remarkably good.²⁷

And Julian Simon²⁸ complained that the Meadows's in their Limits to Growth,²⁹ and

²⁴February 27, 1993.

²⁵Alfred Sauvy. 1980. La machine et le chômage (The machine and unemployment). Paris: Dunod.

²⁶The Economist, March 6, 1993, p. 22.

²⁷David E. Bell. 1986. Population policy: choices for the United States. Pages 207-228 in Jane Menken, ed. World Population and U.S. Policy. The Choices Ahead. New York: The American Assembly and W.W. Norton, p. 214.

²⁸Julian L. Simon. 1981. The Ultimate Resource. Princeton: Princeton University Press, p. 286.

the Club of Rome that sponsored their work frightened many people. The Meadows's would take that as a tribute to their success; if some of the 9 million people who bought Limits were frightened that is the first step to reversing some of the damaging tendencies.

Biology is unaffected by what trees or bacteria think of their results. Here is another dimension of the incommensurable nature of the two disciplines.

THE NEW ECONOMICS AND THE OLD

The revisionist neoclassical economics not only contrasts with biology but it differs sharply from 19th century economics. Until the middle of the 20th century economists and biologists alike were concerned about the limits of the earth. The fame of Malthus is based on his showing that unlimited reproduction and finite food supplies could not co-exist. And for John Stuart Mill, concerned with welfare if anyone was,

After a degree of density has been attained, sufficient to allow the principal benefits of combination of labor, all further increase tends in itself to mischief, as regards the average condition of the people.³⁰

When Malthus was writing, the global population had not quite reached one billion, and in Mill's time it was not much more than that. Yet now when the population is 5 1/2 billion their successors try rather to dispel our fears of overpopulation.

DATING THE REVERSAL--1971 AND 1986

The reversal of outlook in the social sciences occurred somewhat after the middle of the 20th century. There were early rumblings of the change; Julian Simon had started as a proponent of financial incentives to lower births, for instance for India, and it was about 1970 that he had a conversion and became the most hawkish of populationists.

Going further towards setting a definitive date for the change, we may compare a NAS report of 1971 entitled Rapid Population Growth with a 1986 report entitled Population Growth and Economic Development. In both cases a small group of largely social scientists examined substantially the same questions, and came up with decidedly different answers. The 1971 report centered on 17 reasons why smaller populations would benefit the less developed countries and it backed family planning programs at all costs. At that time an economist of the highest standing³¹ could still say,

Potential output per head will be higher in a stationary than in a growing population. One source of the increase will be greater investment per capita.

²⁹Donella H. Meadows, Dennis L. Meadows and Jørgen Randers. 1992. Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future. Post Mills, VT: Chelsea Green Publishing.

³⁰John Stuart Mill. 1848. Quoted by S.F. Singer, Washington Post, February 22, 1970.

³¹Joseph J. Spengler. 1971. Economic Growth in a Stationary Population. Paper given at PAA meeting, Washington, D.C., 1971.

To this source two others may be added: The fraction of the population of working age will be higher, and less capital will be required to countervail the pressure of population upon components of man's natural environment which are depletable or nonaugmentable.

Expressed in numbers, this was the model that had been used by Coale and Hoover³² in 1958, and that had found substantially faster economic growth in India and in Mexico if they slowed their population growth.

The 1986 report,³³ in contrast, had good as well as bad to say for the effect of LDC population growth on welfare. That NAS Working Group, of which the members were economists or demographers,³⁴ did not see population growth as a serious handicap to development. It asked among other questions, as the title of its Chapter 3,

Will slower population growth alleviate pollution.... (page 35)

That way of phrasing the question is based on the view that growth is the natural condition, but aside from that the wording is unfortunate. In logic there is no way that growth of any positive amount, small or large, could alleviate pollution. A different way of stating the question is needed if it is to mean anything. It could have been "Will slower population growth slow the rate of pollution?" or else it could concern absolute numbers of people. A smaller absolute population might or might not alleviate pollution, and special methods not related to population might alleviate pollution, but if the present wording asks whether doing a little more of what we are now doing can as such help the environment the answer is obviously no.

The 1986 NAS Report spoke of positive ecological effects of population density, in that the shortage of space and resources could force privatization, and once the resource, say a forest, was privately owned, the incentive to look after it would come into play. Instances noted by Ester Boserup³⁵ were cited. The work of Ansley Coale and Edgar Hoover that had been the chief basis for the large family planning programs sponsored by the United States in the 1960s and 1970s was only referred to in passing. The report made much of the writing of Julian Simon, and emphasized the right of couples to choose the numbers of their children, a purely ethical matter on which none of the members of

³²Ansley J. Coale and Edgar M. Hoover. 1958. Population Growth and Economic Development in Low-Income Countries. Princeton, NJ: Princeton University Press.

³³National Research Council, Working Group on Population Growth and Economic Development, Committee on Population. 1986. Population Growth and Economic Development: Policy Questions. Washington, D.C. National Academy Press.

³⁴Members were D. Gale Johnson and Ronald D. Lee, co-Chairs, Nancy Birdsall, Rodolfo A. Bulatao, Evan Mueller, Samuel H. Preston, T. Paul Schultz, T.N. Srinivasan, and Anne D. Williams. A new committee has since been appointed with approximately the same assignment, chaired by John P. Holdren. Its report is not yet available.

³⁵Ester Boserup. 1990. Economic and Demographic Relationships in Development. Essays selected and introduced by T. Paul Schultz. Baltimore and London: The Johns Hopkins Press.

the Committee had a claim to special knowledge. However admirable human rights are, we cannot derive them from the findings of either social or natural science. The report ended with

On balance, we reach the qualitative conclusion that slower population growth would be beneficial to economic development of developing countries.

a statement too moderate to satisfy ecologists, let alone the family planning community. And even less conclusive:

Thus there appears to be a legitimate role for population policy, provided its benefits exceed its costs.³⁶

One would have thought that there is a legitimate role for anything if its benefits exceed its costs. Is that the strongest argument that can be put forth for population control?

1974 AND 1984

We can confirm the dating of the change by noting the attitude of the United States delegation to the World Population Congress in Bucharest in 1974, with its stand in the World Population Congress in Mexico City in 1984. Again a reversal, and in the same direction, and also expressed in policy terms. In 1974 the US had pressed the LDCs to control their populations. It was not long after the day of Stephen Enke and his calculation that

development programs may do 15 or more times better when they invest in slowing population growth rather than in accelerating output growth.³⁷

subsequently made use of by President Johnson:

Let us act on the fact that \$5 invested in birth control is worth \$100 invested in economic growth.³⁸

The LDCs resisted somewhat, but by 1984 they had become convinced. Now it was the turn of the US to hold back on birth control. The official position of the United States Government had changed drastically in the 10 years:

³⁶National Research Council, *op. cit.*, p. 91.

³⁷Stephen Enke. 1968. Raising Per Capita Income through fewer Births. Publication 68-TMP-9. Santa Barbara, Calif: General Electric-TEMPO.

Stephen Enke. 1960. The gains to India from population control. Some money measures and incentive schemes. *Review of Economic Statistics* 17(2):175-81.

³⁸President Johnson, June 25, 1965, Speech before the United Nations.

In 1984 at the Mexico City UN Conference on Population the United States delegation announced a change...contained in the phrase "population growth is, of itself, a neutral phenomenon." This phrase represented the point of view of a number of scholars and economists (sometimes referred to as "supply side demographers")....³⁹

The delegation's paper went on to say that "more people do not necessarily mean less growth." It and the NAS Working Group report both said in effect that any problems arising out of more people would be dealt with by new technologies developed under the impulse provided by free and competitive markets.

IS THE RELATION OF POPULATION TO ENVIRONMENT VISIBLE?

We like to think that our policy recommendations to fix something are based on a causal analysis taking account of the facts. If a kitchen tap is leaking we immediately suspect that the cause is a worn washer, and this is confirmed when we replace that washer and the tap no longer leaks. In this case the causal mechanism can be (metaphorically) described as close to the surface; no need for scholarly investigation, for construction of models, for debate. Only if the mechanism of a phenomenon is hidden can controversy be generated about where it is really located. Our population and environment debate on its methodological side ranges around the degree of obviousness or hiddenness of the causal mechanisms underlying the problem.

So for the reading world the controversialists fall into two groups--those that consider the problem to be much deeper than it appears, and so requires extensive study, and those who see little to study--the problem is plainly too many people right now, and on present tendencies far too many in the future, and promotion of birth control is the short-term answer for which the present emergency calls. If you don't believe that people are destroying the environment, just go to China, Bangladesh, or Java and see for yourself. Or just look around the United States and read about the exhaustion of fossil water supplies in the Southwest or shortage of landfill sites for waste in the East. Or don't travel at all, but just read what numerous observers report in various crowded parts of the world.

HOW TO FORM A JUDGMENT? OBSERVATION ON THE GROUND

What is the testimony of knowledgeable scholars who have gone on missions to deal with some specific problem? They study the history of a small area, observe the way its people live, and draw their conclusions without announcing any methodology.

Thus we find a paragraph in the report of Richard Ford and Janet Welsh Brown on Kenya:

³⁹William H. Sullivan, President of the American Assembly. 1986. Preface. Pages 3-5 in Jane Menken, ed. World Population and U.S. Policy. The choices ahead. New York: The American Assembly and W.W. Norton, p. 4.

But continuing peace and prosperity for Kenya are not assured. Rapid population growth, combined with slowing growth of Kenya's agricultural sector, portends a crisis in food production. If current trends continue, by early next century Kenya could have twice as many people to feed, with land that may have lost in some areas up to half its productive potential from soil erosion alone. Because Kenya is heavily dependent on agriculture to sustain its economy, such a crisis could well lead to political and economic disruption. If Kenya's fundamental problems of productivity and population are not dealt with, Kenyan crises could be on our front pages.⁴⁰

Perhaps experts are asked to make recommendations on slowing down deforestation. Seema Agarwal, looking at the forests of Burma (renamed Myanmar by its present government), sees deforestation in its dry zone as due to population pressure.⁴¹

Perhaps it is a matter of the extreme pollution of seacoasts. A Canadian team looking at Indonesia's coasts found that with increasing economic and population growth many estuaries and coastal waters have passed the limits of their absorptive and rejuvenative capacities.⁴²

Perhaps it concerns the economic progress of one region of a country. James F. Hicks and Herman E. Daly see the population growth (nearly 5 percent per year) of Ecuador's Amazon Region as creating extraordinary pressures, significantly reducing the region's potential to contribute to Ecuador's economic development.⁴³

IS SOME SPECIAL KNOWLEDGE NECESSARY?

Lay people, however well-educated and experienced, who pronounce on the matter do not see a problem for study here. To them the problem is as completely on the surface as the problem of the leaking tap. Let me quote what some say.

Few lay people have had better opportunities to observe what goes on than Robert McNamara:

⁴⁰Richard B. Ford and Janet Welsh Brown. 1990. Land, resources, and people in Kenya. Pages 121-163 in Janet Welsh Brown, ed. In the U.S. Interest. Resources, Growth, and Security in the Developing World. Boulder: Westview Press, p. 121.

⁴¹Seema Agarwal. 1987. Scope of Biological Diversity in Burma, with Special Commentary on the Role of Women. USAID.

⁴²CIDA team. 1992. Marine and Coastal Sector Development in Indonesia, Vol. 1. Hull, PQ: CIDA. Reviewed in WRI, 1993 Directory of Country Environmental Studies, p. 152.

⁴³James F. Hicks and Herman E. Daly. 1990. Washington, D.C.: World Bank. As summarized in WRI, 1993 Directory of Country Environmental Studies, p. 129.

[T]he greatest single threat to the economic and social advancement of the majority of peoples in the underdeveloped world is rampant population growth.⁴⁴

And Vice President Al Gore, who likewise has had a chance to see the world more extensive than most of us:

No goal is more crucial to healing the global environment than stabilizing the human population.⁴⁵

or to go back a few years to 1968, just after he left office, President Eisenhower:

Once, as President, I thought and said that birth control was not the business of our Federal Government. The facts changed my mind. I have come to believe that the population explosion is the world's most critical problem.

Without knowing any of these people, I suggest that they do not claim any special insight or special scholarship; if they have read the technical debates they do not refer to them. If they were challenged they would simply give instances of places they had seen where the overpopulation was obvious.

THE PROBLEM IS NOT SO EVIDENT

Yet there are two shortcomings of inspection on the ground. What looks like an effect, and is indeed an effect, of population growth in the short run, may have quite different results in the course of more time. The 1986 NAS and other reports insist on this distinction between short and long run. And secondly cases are all special: surely we need some more general basis for policy. No satisfactory model is yet in sight; should we not be looking?

Economists say certainly; we need a deeper understanding of the long-term effects of what is happening if the action taken with good intentions is not to produce harmful results. There are theories, models, and empirical evidence showing that the relation of population to income and environment is not the simple matter the people on the ground may think; their judgment can be deceived by appearances. Hidden mechanisms are at work, and we have to uncover them before we will know what to do. Statistical evidence is often cited to show that the problem is not obvious and solvable by common sense.

⁴⁴Robert S. McNamara. 1973. One Hundred Countries, Two Billion People: The Dimensions of Development. New York: Praeger Press. As quoted by Allen C. Kelley. 1988. Economic consequences of population change in the Third World. Journal of Economic Literature 26(4):1684-1728, p. 1685.

⁴⁵Al Gore. 1992. Earth in the Balance. Ecology and the Human Spirit. New York: Houghton Mifflin, p. 307.

STATISTICAL EVIDENCE: SELECTION AND INTERPRETATION⁴⁶

Thus absolute numbers of people are increasing fast and easily give the impression that population is growing out of control. Even the annual increase of population is still rising, so one can say that the growth is accelerating. By the end of Table 1 in 2020 population will still be rising and annual increase will be as great as it is now. The birth columns of Table 1 suggest that it will be half-way in the first quarter of the 21st century before births peak, and well into the second quarter before the absolute number of births will come down even to the high levels of today.

Table 1. World population, births, and birth rates, 1950-2020; absolute numbers in thousands, crude birth rate (CBR) per 100,000 population.

	Population	World CBR	Births
1950	2515652	3733	93902
1960	3018878	3525	106418
1970	3693221	3165	116879
1980	4449567	2711	120610
1990	5246209	2504	131381
2000	6121813	2225	136223
2010	6989128	1992	139230
2020	7822193	1772	138570

That is the obvious condition of the unanalyzed statistics. But even the first step of a more sophisticated analysis, the calculation of rates, shows something different: rates of birth in the world have passed their peak; they now are lower than they were a decade ago and their decline will probably continue. This is the way that the NAS Working Group⁴⁷ shows the population data. The decline shown in such a representation of the data encourages the view that the population problem is now under control, and projecting the trend shows that stationarity will be reached in two or three decades.

Since the dawn of statistical observation writers have selected numbers according to the point they are trying to make. There are no rules against this, and no scholar proposes to stop the practice. Such data are soft and flexible enough that they can be used on either side of an argument with equal force.

⁴⁶This particular example of alternative explanation has been used before in a different connection: Nathan Keyfitz. 1992. Seven ways of causing the less developed countries' population problem to disappear--in theory. *European Journal of Population* 8(2):149-167.

⁴⁷National Research Council, *op. cit.*

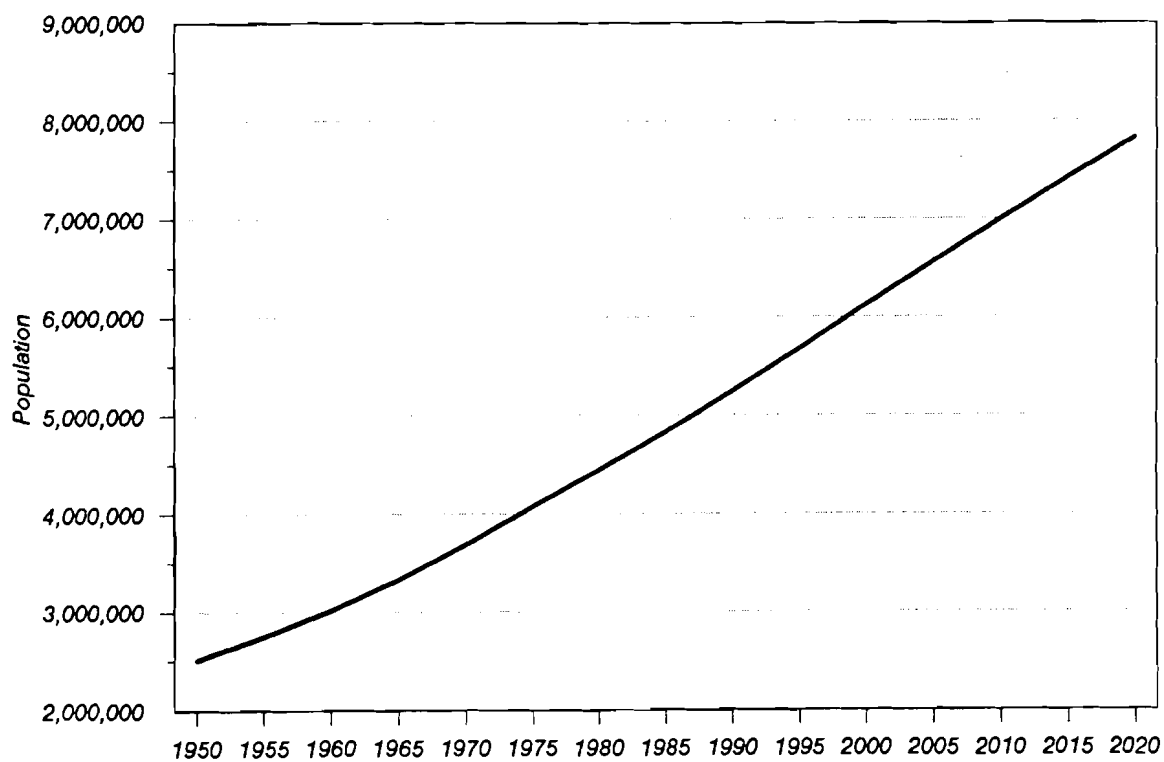
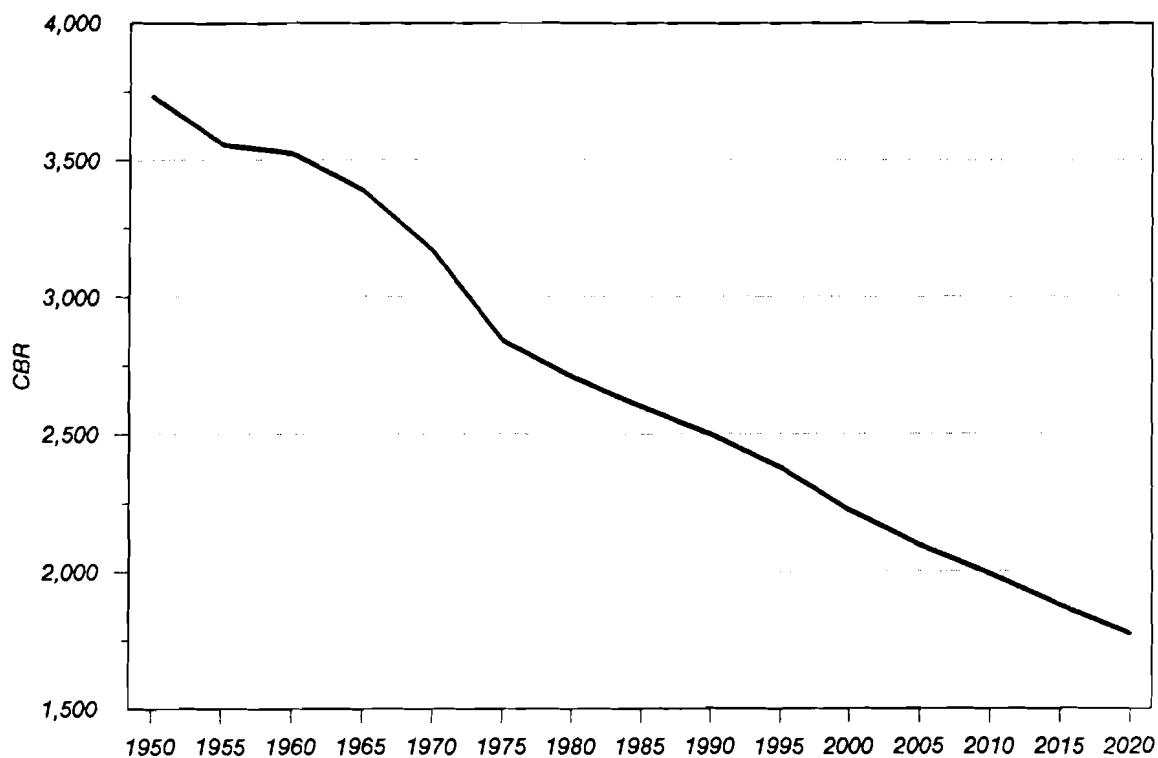


Figure 2. World population, births and birth rates. Source: United Nations. 1988. World Demographic Estimates and Projections, 1950-2025.

CROSS-SECTIONAL CORRELATION AND ITS INTERPRETATION

Among the various ways of assembling data that will bear on the effect of population none is more common than the scatter diagram of population growth against income growth, for countries as the unit. As long as a variety of countries is chosen, the picture always fails to show any relation. It is what experimenters call a null result.

The number of such charts that appear in the literature must be in the dozens. Every scatter diagram showing income increase against population increase in the past looks the same. I have shown one such picture myself;⁴⁸ a more recent portrayal due to Ansley Coale⁴⁹ follows as Figure 3.

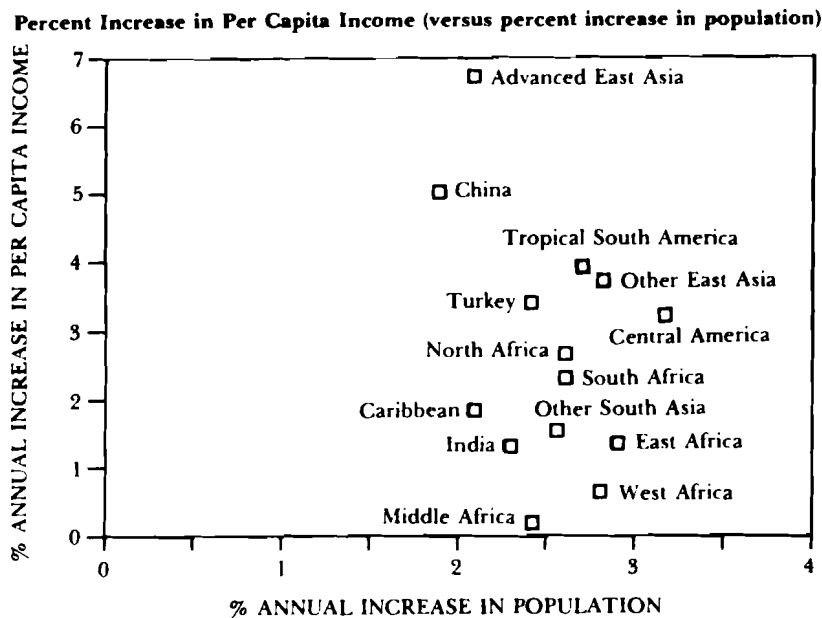


Figure 3. Scatter-diagram showing population increase against income increase. Source: Coale, *ibid.*, p. 98.

Does the null correlation demonstrate that population growth is no hindrance to economic growth? Of course not; all authors are aware of the uncertainties in inferring causation or its lack from such a cross-sectional relation.

To make a test we put the numbers in an analytical framework. Let us suppose that in reality population and its increase drastically check economic progress at the outset, but that after some development has occurred the birth rate starts to fall, and the

⁴⁸Keyfitz, 1977, *op. cit.*

⁴⁹Ansley J. Coale. 1986. Population trends and economic development. Pages 96-104 in Jane Menken, ed. *World Population and U.S. Policy. The Choices Ahead*. New York: The American Assembly and W.W. Norton.

negative relation is reversed. Let us also suppose that any extensive list of countries contains some in both the early and the later phase. Then the mix would show the null relation that we see in Figure 3.

To show that such diagrams do not prove causation either way, suppose that the correlation showed 1.00 between population growth and economic growth. Does that prove that population growth forces economic growth? Not at all; it could equally well prove that economic growth permits population growth--in fact this is the Malthusian model.

Beyond this, the correlation of 1.00 between population growth and economic growth could be consistent with no relation at all. It could be that both are influenced by some other variable, and they have absolutely no direct causal relation to one another. For example education could both lower the death rate (so increasing the rate of increase of the population) and also speed development. This positive effect could entirely hide any negative effect of population growth itself. Didier Blanchet lists a variety of other possibilities that are alternatives to a positive effect of population.⁵⁰

CAN MODELS DECIDE THE ISSUE?

The first test of any model is whether it proves too much. If it shows that population is always too large, or that more people can always be fitted in without damage to the environment, then it had better be dropped. The one thing we can say with assurance is that there are circumstances where there are too many people, and others where there are not enough. Most observers agree that Bangladesh is overpopulated, that the United States in the 19th century was underpopulated. Yet a model like that of diminishing returns on land always proves that there are too many people, and the possibility of increasing division of labor always comes with more people and is necessarily beneficial. Any model that cannot distinguish between the two cases cannot be helpful. The objection that it proves too much applies to any general formulation using only one or two variables.

But what about more complex models, that try to take in all the factors operating? Michael Chadwick⁵¹ has collected some ten instances of such work, all of them operating with enough variables that their authors could claim to have taken account of food, technology, consumption habits, everything bearing on the question. No one has analyzed the mechanics of these models in detail, that are simply meant for computer calculation.

They cannot all be correct, for they have enormously different outcomes. Forrester and the Meadows' found the collapse of the entire world industrial system unless some limits were imposed; Mesarovic and Pestel were milder in their conclusion, seeing only the need for international cooperation and coordination at the level of a "New World

⁵⁰Didier Blanchet. 1991. Notes and commentary. Population and Development Review 17(1).

⁵¹Michael J. Chadwick. 1992. The Biosphere and Humanity. Paper presented to the 20th Anniversary Conference of the International Institute for Applied Systems Analysis, May 13, 1992.

Order." The report of the Bariloche (Argentina) investigators was milder yet: with new aid policies funded by 2 percent of the industrial countries income all would be well. FUGI (Japan) found that with coordination of investment to shift it to the LDCs harmonious growth could be obtained all around. And so on. The variety of models, not made casually but worked on over years, is convincing evidence that however illustrative of possibilities the models may be no one of them proves anything. The collection shows the wide range of possibilities.

More hopeful would seem to be the standard models in terms of which economics makes its inferences. We think back to the classical three factors of production, land, labor and capital, that until this generation were the way of explaining production. With these an increase of population, i.e. labor, in the face of the same land and capital, inevitably implies a fall in production per person. But today land and capital in the classical sense have disappeared from production models.

Thus environmental-leaning Herman Daly speaks of neoclassical economic theory that

suffers from a total failure to distinguish the problem of optimal allocation of resources from the problem of the optimum scale of the entire economy relative to the ecosystem in which the economy is physically embedded.⁵²

In the same way, McNicoll⁵³ points to

the oddity of the virtual invisibility of total population size in modern demography... Population size has no implications for family structure, hence for behaviors determined within that structure... Constructing a demography where scale matters is an urgent task for the discipline.

Of course scale--how big are population and other elements of the economy--is the essence of the environmental problem, while allocation---which individuals and groups get what--affects the environment less. So why does economics neglect scale when it is so obviously relevant to all of its work, and not only the present subject? It does so, explains Kelley,

because useful estimates of scale effects are unavailable [and] substantial difficulties are encountered in assigning a value to the environment for future generations.⁵⁴

⁵²Quoted by Allen C. Kelley. 1988. Economic consequences of population change in the Third World. Journal of Economic Literature 26(4):1684-1728, p. 1719, from Herman E. Daly. 1986. Review of Population Growth and Economic Development: Policy Questions, in Population and Development Review 12(3):582-585.

⁵³Geoffrey McNicoll. 1992. The agenda of population studies: A commentary and complaint. Population and Development Review 18(3):399-420.

⁵⁴Kelley, op.cit.

That is certainly true--I have found no feasible suggestions on how to proceed on this difficult matter. Kenneth Arrow⁵⁵ has provided an elegant way of assessing irreversible alterations in the environment, and Robert Dorfman⁵⁶ has in his own work and the work of others that he has promoted provided the best instruction so far to be had on how to think about the environment. But Kelley's point about the difficulty of finding numbers still stands.

NEGATIVE ENVIRONMENTAL EFFECTS

We have to note that many of the most damaging environmental consequences of population growth have in the rich countries been cleared up in recent years. Examples often cited are London's polluted air of 25 years back and many of Europe's rivers.

Economic theory has a way of explaining how pollution that no one wants occurs nonetheless, and in terms of this explanation real problems can be solved. Most of these are the result of externalities, costs that producers or consumers can shift to others, and can be overcome through the normal operation of the price system; all that need be done is to tax in the right places. Yet such taxes would have to be legislated, and the main argument for a free economy is that it does not depend on the whims and political considerations that move legislatures. But now we hope that legislatures will act in the economically right way on the particularly sensitive matter of taxation, as long as it involves something important like environment.

Yet internalizing of externalities is especially difficult in regard to childbearing. If the cost of children is only partly paid by their parents, and part by the community for their education and other services, then standard theory tells us that there will be more children than there would be if all costs were covered by parents. Such direct costs are calculable in money and for the relatively short term. (Though Samuel Preston presents the case against externalities having much bearing on fertility decisions.⁵⁷)

Here is one matter in which it is inconceivable that legislatures will internalize costs. No one, parent or bachelor, would today vote for making education optional and putting its whole cost onto parents; once the child is born he or she has to be educated at least up to literacy--for ability to hold a job and be a responsible citizen. Beyond this if the country is already densely populated, longer-term non-monetary considerations suggest that there will be "too many" children born from the viewpoint of income of the next generation, though this is impossible to estimate quantitatively. And beyond this economic non-quantitative consideration, more children will be born than would be considered good by the subsequent generation in view of the destruction of the

⁵⁵Kenneth J. Arrow and A.C. Fisher. 1974. Environmental preservation, uncertainty and irreversibility. Quarterly Journal of Economics 88.

⁵⁶Robert Dorfman and Nancy Dorfman. 1992. Economics of the Environment: Selected Readings. 2nd Edition. New York: Norton.

⁵⁷Samuel H. Preston, about 1985. The Annals.

environment, again speaking of a country that is already crowded.⁵⁸ Will legislators take the viewpoint of later generations, knowing that these will not have votes until after they are dead? It is hard to be hopeful on this.

ECONOMICS: THE HISTORICAL RECORD

Let us then continue with our examination of statistical evidence and the logic of the inferences made from it. One item, especially salient in the patient and exhaustive researches of Simon Kuznets,⁵⁹ is the fact that our own industrialization got under way at exactly the same time as world population began to accelerate. Angus Maddison⁶⁰ provides (Table 2) a recent set of estimates, for 16 countries, now industrialized, over the past millennium and a half.

Table 2. Performance characteristics of four eras. Source: Maddison, *ibid.*, Table 1.2, p. 6. The sample includes sixteen countries, twelve from Europe, plus Australia, Canada, Japan, and the USA.

	Annual Compound Growth Rates	
	Population	Per Capita GDP
500-1500	0.1	0.0
1500-1700	0.2	0.1
1700-1820	0.4	0.2
1820-1980	0.9	1.6

It will be seen that as the rate of increase of the population grew so did that of the per capita Gross Domestic Product. That was the first time in world history that such a phenomenal growth of population has ever occurred, and certainly the first time for industrialization and its accompanying rise of income. When over the course of thousands of years two events occur within a few decades of one another they must surely be related. The sense of a relation is strengthened when we note that the fall of the birth rate during the 1920s and 1930s was accompanied by the fall in income of the 1930s, the subsequent rise of births after the War by a rise in income, and subsequent fall of the birth rate in the 1970s by a slowing of the increase of income, even a decline by some measures.

What seemed the natural interpretation of such facts to most of the 19th century economists was that couples took out a certain part of the increase of their incomes in children, and in the extreme expression they did so completely, and that prevented any possibility of a rise in income per head--ever. A series of writers from Malthus (in the

⁵⁸Some of this is in Paul Demeny. 1986. Population and the invisible hand. *Demography* 23(4):473-487.

⁵⁹Simon Kuznets. 1973. *Population, Capital and Growth*. New York: Norton.

⁶⁰Angus Maddison. 1982. *Phases of Capitalist Development*. New York: Oxford University Press.

First Edition only)⁶¹ to Richard R. Nelson⁶² constructed models embodying this causal mechanism. If Thomas Carlyle could write of "Respectable Professors of the Dismal Science,"⁶³ it was as much as anything in reference to the extreme Malthusian view that man's lot could never improve, because he was constantly breeding himself into continued poverty. Population growth was so fast they feared that it would not ever stabilize again, that is not without the increase of deaths.

But what if the causation was the other way round--the increase of population was what brought about the increase of income? That hypothesis, daring to show itself after more than a century in which the world had convinced itself of the Malthusian view, and at first presented hesitatingly as a speculation, has removed any basis that might have existed for calling economics dismal. It rather put economists in harmony with the optimistic carpe diem attitude of the present time.

Of course if we are to conclude on this basis that countries that are currently industrializing need not concern themselves much with their increases of population we have to eliminate some other possibilities than that it was population growth that had that beneficent effect. For one thing absolute sizes of population have multiplied by an order of magnitude--from the England of 9 million people at the start of the 19th century to the China of 1.1 billion or the India now approaching 900 million. Can we not argue that it was the smallness of the English population that gave it such a possibility of development, rather than the revisionist view that the rapid growth was the cause of development? True it was larger than it had been earlier, but perhaps it needed to grow just enough for the division of labor to operate, and at 9 million it had done so.

I hope that I have quoted enough materials in this and the just preceding sections to carry conviction that the evidence for a relation between population and either development or environment is extremely weak.

WEAK EVIDENCE VERSUS A WEAK RELATION

But we have to beware of confounding two quite different propositions, that because of a shortcoming of language are expressed in the same words. We know evidence is indeed weak, for all the reasons above stated and others. That is not my private view alone, but the view also of the eminent scholars above quoted. Is it possible that the effects of population themselves, the harm it does to development and to the environment, are very strong and negative even though they cannot be measured or estimated? The same writer, in the same book, will speak of the inadequacies of the data and the difficulties in its interpretation, and then that writer will conclude with something like

⁶¹Thomas Robert Malthus. [1798] 1967. Population: The First Essay. With a foreword by Kenneth E. Boulding. Ann Arbor: University of Michigan Press.

⁶²Richard R. Nelson. 1956. A theory of the low-level equilibrium trap in underdeveloped economies. The American Economic Review 46 (December):894-908.

⁶³Thomas Carlyle. 1950. Latter Day Pamphlets No. 1.

the empirical evidence shows little relation between the growth of population and income per head or related economic variables.⁶⁴

Is this an assertion regarding the data--the fact that it does not prove anything--or is it a substantive assertion regarding the causation of economic growth? The English language is such that that sentence can be interpreted either way; one way entirely correct, the other wholly unjustified.

The confusion causes real trouble when the failure to support a relation between population growth and development or environment is taken as an argument against family planning. Think of the assertion that there is little statistical evidence to support giving family planning high priority. The statement is literally true if interpreted as expressing a limitation of the data, but the trouble comes when it is taken as a recommendation against family planning, as on a quick reading it can easily be. At the level of action it can be positively dangerous.

To repeat, "The data do not support vigorous family planning policies" can mean two very different things:

Family planning policies could be crucially necessary but the data do not have a bearing on that one way or the other,

or

The data prove that family planning policies will do little good.

This ambiguity of language, common to English and French but not to German,⁶⁵ has caused a great deal of trouble. The linguistics of the matter is not what concerns me but the use of one meaning that is clearly true to imply another meaning that is wholly unsubstantiated. I have many times heard exactly this statement made as though it was a substantive assertion capable of opposing family planning programs, where it is only true as a methodological statement qualifying certain kinds of data.

If neither statistics nor complex models are capable of proving much, we may be driven back to giving an elementary identity a common sense interpretation.

THE PROPORTIONALITY HYPOTHESIS

Consider the proportionality hypothesis, that for many is the natural first step in thinking about population.

⁶⁴Bloom and Freeman, *op. cit.*

⁶⁵H.W. Fowler (*A Dictionary of Modern English Usage*, 2nd Edition, Oxford: Oxford University Press, 1965) takes up a related issue. Thus "all that glitters is not gold" could mean either that nothing that glitters is gold, or that there are things that glitter that are not gold. In this case the latter is plainly intended, but in the case that is important for this argument one meaning is what the data say, the other an illegitimate inference from the data, merely intended to persuade.

A doubling of population would ordinarily not be burdensome if the stock of capital and the natural resource endowment could double at the same rate.⁶⁶

If there is a 5 percent increase of population there will be, as a first approximation, a 5 percent increase in all the difficulties, as well as a 5 percent increase in all the benefits. More generally we can write the identity:

Damage to environment = Population x (Damage to environment / population),

as far as I know originally used (in a somewhat more elaborated form, not necessary for the present purpose) to Paul Ehrlich and Barry Commoner. No one can deny the truth of this as so written, and in one form or another it is often taken as showing incontrovertibly that damage is proportional to population. Including twice as many automobiles, twice as much city crowding, twice as many slums, twice as many wars, twice as many refugees.

But others stress that there would be twice as many geniuses, twice as many entrepreneurs. Note the possibilities of selection of which items to apply the proportionality rule to.

The identity is bound to be true at any one moment, but the question for those who would apply it as a substantive proposition is to decide whether it is true with change over time. That depends on the factor within parentheses being constant: will the increased population at some future date do as much damage per person to the environment as the population is now doing? Will people be living the same way, each consuming the same amount of energy, as people are now doing? And if they are, will the marginal impact be the same over the range of population densities in question?

LESS THAN PROPORTIONAL DAMAGE: THE BOSERUP EFFECT

Against the observations of apparent negative effects of growth, Ester Boserup⁶⁷ describes instances in which a clear positive effect appears, where population pressure forced technical and institutional change. She observed long-fallow (slash-and-burn) agriculture, that with tropical soils allows for only two or three crops before the tillers have to move on, and where they cannot return for as much as 40 or 50 years. When the population is too dense to support that kind of agriculture they change to a more settled technique with short fallow, fertilizers, green manure, in which the land can support over 10 times as much population. Beyond such technical improvement with density, Ester Boserup reports cases where population increase has been the agent of change of institutions in directions--especially privatization--that induced people to be better custodians of the environment.

⁶⁶Enke, 1960, *op. cit.*

⁶⁷Ester Boserup. 1981. Population and Technological Change. Chicago: University of Chicago Press; and Boserup, 1990, *op. cit.*

That is undoubtedly true of some instances, but there are other instances in which the opposite is true. The people among whom I lived, in East Java, were irrigated rice cultivators with a traditional response to crowding. Clifford Geertz offers the best known description of their lives.⁶⁸ As one expects, the response depends on the way crowding and land shortage is interpreted; they saw it as necessitating sharing, and the result was declining incomes with increasing population in my village, until the village was rescued by an exogenous element--the highly productive seeds and planting techniques of the Green Revolution provided by the central government.

Both mechanisms are of much interest to a student of society, as showing how the impact of a physical change--population growth--depends on the interpretation of it derived from the preceding culture.

MORE THAN PROPORTIONAL

At least proportionality seems a fair starting point, the direction of modification that seems to apply in particular cases. Insofar as the people in question have to cultivate poorer land their average level of living will be lower with twice as many people. Insofar as they have a larger market for industry their average will be higher, except that if they have free trade with the rest of the world their larger market at home will make little difference. And if they pass the sustainable limit of a renewable resource, like the fishery or forest, so that it collapses, then the negative population effect will be far more than proportional.

Paul Ehrlich gives many instances quite aside from renewable resources where once density passes a certain point the effect will be more than proportional to the population increase. For example he suggests a threshold effect for the air of a city:

If there are only a few thousand cars in a city, natural air movements may carry away the noxious effluents, and rainfall may cleanse the air so that there is little or no health hazard. A few hundred thousand motor vehicles, however, may easily overwhelm these natural dispersal and cleansing functions, and produce life-threatening smog.⁶⁹

CAUSATION IS SLIPPERY

An economist discusses evidence and proof on the relation of population on the one side and progress on the other.

The amount of solid empirical work on the subject is limited, especially for developing countries, partly because the subject is not really a tractable one for quantitative analysis... The only natural experiment available for analysis is human history; cross-section analyses are a poor substitute... [B]ecause

⁶⁸Clifford Geertz. (1963) 1971. Agricultural Involution. Berkeley: University of California Press.

⁶⁹Ehrlich and Ehrlich, 1990, op. cit.

population change is both consequence and cause of economic change, its effects are hard to trace... To be tractable, such models require simplifying assumptions: on the substitutability of labor for capital in production, for example, and the rate and sources of technological change.⁷⁰

The substitutability of labor for capital is indeed a crucial aspect of the problem. I once lived in a village in Java where the local carpenter made looms on which the women wove cloth. Labor physically created capital at the local level, so the substitutability would be high, and models based on this could well show economic space for more people. But would not additional people have more trouble finding a livelihood in the same village if capital had to be bought outside the village, or outside the country? I would think that in this common condition the substitutability would be less, and so the return to increments of labor less.

And Simon Kuznets, who looked into such matters more thoroughly than anyone else I know of, agreed:

[W]e have not tested, or even approximated, empirical coefficients with which to weight the various positive and negative aspects of population growth.⁷¹

We have it similarly from Allen Kelley, a highly respected economist who is also a demographer, who goes further into the reasons why empirical resolution of the questions is difficult. For one thing we need "a formal model that reveals and measures the economic outcomes of alternative population scenarios," and "the problems of constructing such a model are formidable."⁷² Over the 60 or so years to which the model must apply if it is to be useful for this purpose, institutional change, intractable to modelling, is bound to occur, and the model has to embody feedbacks in which it is impossible to distinguish causes from effects.

When limits of land came to be overlooked earlier in the century and Malthus' food constraints were put aside as technology produced more and more per hectare, stress came to be laid on shortage of capital for development as the reason for controlling population. Fewer children required less parental expenditure, less community expenditure for schools. But perhaps parents work harder because they have more children to support, so savings will remain just as high with many children as with fewer. After mature consideration of this question Geoffrey McNicoll concludes

⁷⁰Nancy Birdsall. 1989. Economic analyses of rapid population growth. Research Observer 4(1):23-50, p. 24.

⁷¹Simon Kuznets. 1960. Population change and aggregate output. In Demographic and Economic Change in Developed Countries. A Conference of the Universities-National Bureau Committee for Economic Research. Princeton: Princeton University Press, p. 339. As quoted by Kelley, op. cit., p. 1686.

⁷²Kelley, op. cit.

What then can be said about the net savings or investment impact of rapid population growth? The answer appears to be very little.⁷³

In default of other evidence we have to clutch at the most solid straws we can find. And one of these straws is cross-national correlations, referred to above, and on which there is a considerable literature. But Ronald Lee gives his evaluation of this literature, and I am the last to contradict him:

[T]hese cross-national studies have not provided what we might hope for: a rough and stylized depiction of the consequences of rapid population growth; unless, indeed, the absence of significant results is itself the result.⁷⁴

Kelley agrees:

[S]tatistical correlations provide little prima facie information about the size or nature of the net impact of population growth on economic growth.⁷⁵

In the end it turns out that the empirical data are a less solid indicator than one would like to think, and one's opinion depends on rather simple models that one carries around in one's head. The 19th century had the idea of marginal productivity--that the increment of population would have to take up submarginal resources, and so would lower the average income. That applies especially in resource-intensive activities, agriculture in particular. The 20th century thinks more in terms of manufacturing in which returns increase with larger markets, so more people is beneficial. But "most technical economies are realized by firms of moderate size," though there are exceptions.⁷⁶ For Coale and Hoover⁷⁷ limited capital was the reason why income per head would be higher with fewer people--once population had increased to the scale of India or Mexico. And with the service economy neither land nor capital is very important, so it would seem that population can expand indefinitely.

Do we give up the economic and demographic research at this point? No, far from it--we must try harder. That is what all the authorities I have quoted on the inadequacies of present data say or clearly imply--Simon Kuznets, Nancy Birdsall, Allen Kelley, Ronald Lee, Geoffrey McNicoll. And pending more solid empirical results what help can be offered to policy makers? I submit that the only possible guide to policy is nothing better or worse than intuition, most often based on something like the proportionality assumption above described, and that may be summarized, "if the new population

⁷³Geoffrey McNicoll. 1984. Consequences of rapid population growth: An overview and assessment. *Population and Development Review* 10(2), as quoted by Kelley, *op. cit.*, p. 1716.

⁷⁴Ronald D. Lee. 1983. Economic consequences of population size, structure and growth. *IUSSP Newsletter*, No. 17, pp. 43-59 (Jan.-Apr.). Quoted by Kelley, *op. cit.*, p. 1701.

⁷⁵Kelley, *op. cit.*

⁷⁶Kelley, *op. cit.*, quoting E.A.G. Robinson.

⁷⁷Coale and Hoover, *op. cit.*

behaves as the old then an increase of 1 percent in population will increase environmental difficulties by 1 percent." For many reasons this is in most instances a minimum estimate.

SCHOLARS LIKE THE SUBJECTS THAT THEY STUDY

A common feature of all disciplines is that scholars like the subjects that they study. Anthropologists like the peoples among whom they live in much discomfort, and taxonomists like the species they identify and classify. The point is raised by Samuel Preston in commenting on a statement of the President of the Environmental Fund:

These modes of thought seem to come particularly easily to biologists and ecologists, who as a group are almost surely endowed with an above-average reverence for nature and are inclined to view man's intrusions as violations of a sanctified order.⁷⁸

Ecologists do not deny that they like nature. Thus Paul and Anne Ehrlich put that first among the four values of biodiversity.

As the dominant species on earth, homo sapiens has an ethical, stewardship responsibility towards humanity's only known living companions in the universe. Second,...biodiversity has aesthetic values. Third,...direct economic values... Fourth,...an array of free ecosphere services, without which civilization could not exist.⁷⁹

All four have their place--disputes concern only the order.

Nor is it necessary to study for a doctorate in biology to appreciate the wonders of the natural world. Anyone, whatever his or her discipline, who attentively reads a clear description of a tropical rain forest, or of the behavior of bats, or of the detective work by which geologists and archaeologists have been able to provide a history of past life on earth, will be fascinated by these subjects. So one is astonished to read that

...no single exhaustible resource is essential or irreplaceable; it is valued for its economic contribution, not for its own sake.⁸⁰

As biologists like nature, so economists like economic growth. They regard as a predominating objective the ever-increasing production of commodities and services. Ecologists also like free markets and maximum possibilities of choice, but they worry that automobile travel would be less if roads were not subsidized, and the demand for home energy intensive equipment is artificially spurred by advertising that itself wastes materials.

⁷⁸Preston, 1986, op. cit., p. 69.

⁷⁹Paul R. Ehrlich and Anne H. Ehrlich. 1992. The value of biodiversity. Ambio 21(3).

⁸⁰National Research Council, op. cit., p. 86.

Values cannot but come into the matter; people have to decide these for themselves; all agree that science cannot tell them what they should do, but ecologists believe that science should be more active in telling the consequences of different kinds of behavior.

THE COMMODITY CYCLE AND THE CONNECTEDNESS OF THINGS

That study of consequences has been perhaps the main contribution of the ecological movement in recent years. It has drawn attention to the commodity cycle, much shorter for economics than for ecology. For the economist it starts with the exploration that discovers the iron ore or the petroleum deposit and ends once the car leaves the showroom and the gasoline is pumped at the service station. Anything that happens after those moments is of no consequence for the Gross National Product--houses are the only item that is followed after the moment of sale to the consumer.

For the ecologist the oil cycle starts a hundred million or more years earlier, when the oil got into the ground, and keeps on through the time when emissions are released as the car is driven to the effect of the nitrogen compounds on the forest and the effect of the carbon dioxide on the global temperature. For steel the cycle starts with the iron ore, continues through the use of the car, its scrapping, perhaps its presence for many years on the landscape, finally its disposal as landfill that integrates it with the ground again.

What has the length of the commodity cycle to do with population? A great deal; if the cycle ends at the moment of sale then any effects, good or bad, that might result from its use are omitted and hence invisible. If the commodity does not disappear into thin air the moment the consumer takes possession of it, and trying to follow its path, then the number of people who buy and ultimately discard it will be decisive for the environment. And that number is seen by ecologists as a simple product--the population and its level of consumption.

Economists see the matter otherwise. If the aftereffects of consumption are of concern that will show itself in the market and will be handled in many ways. People will buy smaller cars, as they did in fact after the oil crisis of 1973; people will insist on less packaging. The European housewife is charged the equivalent of \$.10 for a bag to carry her groceries out of the store, so she brings her own bag. The moment that the public becomes concerned about any problem prices will reflect that concern. Including that they will spontaneously alter to respond to any difficulties caused by more people.

Of course the market will not operate to the social advantage unless people are charged the full costs of their decisions--including the smoke that harms the neighbors' lungs, the destruction of landscapes that will affect their children. The one admitted role of government is to ensure through taxes that such externalities are included in costs, which is to say that they are internalized. When that is done there will then be nothing to fear from more people.

Ecologists agree, but only in part. In the play of interests that constitutes democratic politics, how can anyone hope that such fine tuning of prices will emerge? Those who assert most vigorously the incompetence of governments are also the ones to argue for

trusting with governments this supremely important task. Fewer rather than more people will not solve all problems, but if it solves any part of the tangle that is to the good.

Working with the longer commodity cycle reveals another feature of our industrial life, the connectedness of things. It was Barry Commoner,⁸¹ more than 20 years ago, who had the general insight on this, and urged us to follow through the consequences of the commodity cycle. And he referred to the work of Rachel Carson, writer and marine biologist, who ten years earlier had drawn to the attention of a wide public some unexpected effects of the use of DDT.

As crude a weapon as the cave man's club, the chemical barrage has been hurled against the fabric of life.⁸²

DDT was shown to have the effect of thinning the shells of birds' eggs, and it worked its way through the marine food chain, to the point where its use in the United States and Europe diminished the number of penguins around the South Pole. DDT was quickly phased out and replaced by less harmful chemicals, but it was part of what developed the sense on the part of scientists that perhaps fixing things with technology had some limits.

EXTRA-ACADEMIC INFLUENCES

The sharp change of viewpoint in the latter half of the 20th century, along with the extraordinary difficulty of securing clear proofs of causation, makes one wonder to what extent the extra-scholarly influences have been at work. Kelley raises the point when he says that one of the reasons for the reorientation of scholarly population thought could be

a changed political climate--a return to traditionalist views about the family, and challenges to government's family-planning policies, especially those relating to abortion.⁸³

Responsible writers on the subject all concede that the statistical evidence for the population effect on development and on the environment is weak. It depends heavily on the model into which the data are fitted. We have no way of interpreting numbers without putting them into some kind of model; the number of possible models is infinite, and it is extremely difficult to coax the observations into selecting which one is congruent with them. Thus Livi-Bacci describes two camps:⁸⁴

⁸¹Barry H. Commoner. 1971. The Closing Circle: Nature, Man, and Technology. New York: Alfred A. Knopf.

⁸²Rachel Carson. 1987 [1962]. Silent Spring. 25th Anniversary Edition. Boston, Massachusetts: Houghton Mifflin.

⁸³Kelley, op. cit.

⁸⁴Massimo Livi-Bacci. 1992. A Concise History of World Population. Cambridge, MA: Blackwell.

[For one] the link between demographic growth and environmental degradation seems clear, judging from the pollution caused by industrial expansion... [The other] has complete faith in the ability of populations to adjust to larger numbers. Technological progress...allows substitution of primary resources, costs can be 'internalized' [to protect the environment]...the physical and economic well-being of world population is constantly improving as a result of scientific and economic progress.

He has little confidence in existing statistical or other data as instruments for judging catastrophism versus optimism:

It is difficult, if not impossible, to choose between these two modes of foreseeing the future (page 198) [and hence] control [of population] tends to be less and less a matter of calculations and more and more one of values.

Yet perhaps science can go one stage further than proposed by Livi-Bacci, and continue its work of clarification of the conditions for a rich and unpolluted world. I have tried to present, in as symmetrical a form as I could, the views of ecologists and economists. If each of the disciplines would respect the authority of the other in the territory over which they overlap, they would lessen the burden for lay people of deciding between them, and would raise the standing of both disciplines. That is at least the first step towards an answer to what could well be the most basic issue of our time.