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World Population Growth: An Anti-Doomsday View

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Every schoolchild seems to "know" that the natural environment is deteriorating and that food is in increasingly short supply. The children's books leave no doubt that population size and growth are the villains. In the *Golden Stamp Book of Earth and Ecology* we read: "If the population continues to explode, many people will starve. About half of the world's population is underfed now, with many approaching starvation. . . . All of the major environmental problems can be traced to people—more specifically, to too many people." But these facts, which are reported to children with so much assurance, are either unproven or wrong.

The demographic facts, to the extent that they are known, are indeed frightening, at first glance. The human population appears to be expanding with self-generated natural force at an exponential rate, restrained only by starvation and disease. It seems that, without some drastic intervention to check this geometric growth, there will soon be "standing room only."

Worry about population growth is not new. Euripides, Polybius, Plato, and Tertullian are on record as citizens who feared that population growth would cause food shortages and environmental degradation. Malthus did "standing room only" arithmetic. In 1802, a Dutch colonial official wrote that Java, which had a population of 4 million, was "overcrowded with unemployed." Now most of Indonesia's 125 million people live in Java, and again the country is said to be overcrowded.

The common view of population growth—especially of population growth in poor countries—is that people breed "naturally." That is, poor people are assumed to have sexual intercourse without concern for the possible consequences. In the words of the environmentalist William Vogt, whose book *Road to Survival* (1948) sold millions of copies, population growth in Asia is the result of "untrammeled copulation" by Moslems, Sikhs, Hindus, and the rest of "the backward billion." A. J. Carlson, a physician, wrote in a 1955 issue of the *Journal of the American Medical Association,* "If we breed like rabbits, in the long run we have to live and die like rabbits." This idea goes hand in hand with the view that population growth will increase geometrically until starvation or disease halts it.

The idea of "natural breeding," "natural fertility," or "untrammeled copulation" has been buttressed by experiments in animal ecology, which some biologists say can serve as models of human population growth. The analogies that have been proposed include John B. Calhoun's famous observations of Norwegian rats in a pen, the putative behavior of flies in a bottle or of germs in a bucket, and the proclivities of meadow mice and cotton rats—creatures that keep multiplying until they die for lack of sustenance. But as Malthus himself acknowledged in the revised edition of his *Essay on Population,* human beings are very different from flies or rats. When faced with a bottle-like situation, people are capable of foresight and may abstain from having children for "fear of misery." That is, people can choose a level of fertility to fit the resources that will be available. Malthus wrote, "Impelled to the increase of his species by an equally powerful instinct, reason interrupts his career, and asks him whether he may not bring beings into the world, for whom he cannot provide the means of support."

Demographic history offers evidence that people can also alter the limit—expand the bottle. That is, they can increase resources when they need to. Population growth seems not to have been at all constant or steady over the long sweep of time. The broadest picture of the past million years shows three momentous and sudden changes, according to the paleoecologist Edward Deevey. The first such change, a rapid increase in population around

1 million B.C., followed the innovations of tool-using and tool-making. Deevery speculates that the aid of various tools "gave the food gatherer and hunter access to the widest range of environments." But when the new power from the use of primitive tools had been exploited, the rate of population growth fell and population size became almost stable.

The next rapid jump in population started perhaps 10,000 years ago, when men began to keep herds and to plow and plant the earth, rather than simply foraging for the plants and game that grew naturally. Once again, the rate of population growth abated after the initial productivity gains from the new technology had been exploited, and again population size became nearly stable in comparison with the rapid growth previously experienced.

These two episodes of a sharp rise and a subsequent fall in the rate of population growth suggest that the present rapid growth—which began in the West between 250 and 350 years ago—may also slow down when, or if, the new industrial and agricultural knowledge that followed the Industrial Revolution begins to yield fewer innovations. Of course, the current knowledge revolution may continue without foreseeable end. Either way, over the long term, population size can be seen to adjust to productive conditions, contrary to the popular belief in constant geometric growth. In this view, population growth represents economic success and human triumph, rather than social failure.

Deevey's account of population history still leaves us with the impression that population growth has an irresistible, self-reinforcing logic of its own. That perspective is so broad, however, that it can be misleading. For example, the demographers Colin Clark and Margaret Haswell have shown in their book *The Economics of Subsistence Agriculture* that even in as large an area as Europe, where local ups and downs might be expected to cancel each other out, population from 14 A.D. to 1800 did not grow at a constant rate, nor did it always grow. Instead, there were advances and reverses, provoked by a variety of forces; famine and epidemic were not the only checks.

Income has a decisive effect on population. Along with a temporary jump in fertility as income rises in poor countries comes a fall in child mortality, because of better nutrition, better sanitation, and better health care (though in the twentieth century mortality has declined in some poor countries without a rise in income). As people see that fewer births are necessary to achieve a given family size, they adjust fertility downward. Increased income also brings education and contraception within reach of more people, makes children more expensive to raise, and perhaps influences the desire to have children. It usually initiates a trend toward city living; in the city, children cost more and produce less income for the family than they do in the country.

The process by which these effects of economic development reduce fertility in the long run is called the "demographic transition." We see clearly in the excellent historical data for Sweden that the deathrate began to fall *before* the birthrate fell. We can see the same relationship between income and birthrate in many other countries. At present, the birthrate is far below replacement—that is, below zero population growth—for a number of the largest countries in Europe. Fertility has been falling in many developing countries as well. For example, the birthrate per thousand people declined in Cuba and Singapore from 1965 to 1975 by 40 percent; in Hong Kong by 36 percent; in South Korea by 32 percent; in Costa Rica by 29 percent; in Taiwan by 20 percent; in China by 24 percent; in India by 16 percent. I think we can be reasonably sure that the European pattern of demographic transition is being repeated now in other parts of the world as mortality falls and income rises.

When looking at the demographic facts with an eye to judging what ought to be done about population, we want to know what the future holds, how great the "pressures" of population size and growth will be. However, the history of demographic predictions gives us reason to be humble about turning forecasts into policy. In the 1930s, most Western countries expected and feared a decline in their populations. The most extensive investigation of the matter was undertaken in Sweden, in 1935, by some of the world's best social scientists. All four of their projections predicted that the number of Swedes would decline by as much as 2 million by 1985. But all of their hypotheses about the future—intended to bracket all of the conceivable possibilities—turned out to be far below the actual course of population, which has instead grown by about 2 million. That is, the future turned out far better, from the point of view of those scientists, than any of them guessed it might. If the Swedes had introduced fertility-increasing programs, as the demographers advised, the results would have been contrary to what they *now* want.

The Swedes were not alone in making inaccurate, pessimistic forecasts. A research committee of eminent scientists appointed by Her-

bert Hoover in 1933 reported that "we shall probably attain a population between 145 and 150 million during the present century." None of a variety of forecasts made in the 1930s and 1940s by America's greatest demographic experts predicted a population as large as 200 million people even for the year 2000, but the United States reached a population of 200 million sometime around the year 1969, and is far beyond that now. A good many of the forecasters actually predicted a decline in population before the year 2000, which at the present time we know is impossible unless there is a holocaust.

There is no reason to believe that contemporary forecasting methods are better than older ones. We have seen great variety in forecasts of world population through the 1970s. For example, in 1976, "the best demographic estimates" of world population for the year 2000 set it at "nearly 7 billion," according to the executive director of the United States Fund for Population Activities (UNFPA), Raphael Salas. By 1979, Mr. Salas spoke of nearly 6 billion people by 2000. Thus, in three years, Mr. Salas's figures declined by almost a billion people, or nearly one seventh.

In the United States, as recently as 1972, the President's Commission on Population Growth forecast that "even if the family size drops gradually—to the two-child average—there will be no year in the next two decades in which the absolute number of births will be less than in 1970." How did it turn out? In 1971—the year *before* this forecast was transmitted to the President and then published—the absolute number of births (not the birthrate) was already less than in 1970. By 1975, the absolute number of births was barely higher than in 1920, and the number of white births was actually lower than in most years between 1914 and 1924. In this case, the commission did not even backcast correctly, let alone forecast well. Embarrassing mistakes like this ought to make us think twice before we take demographic predictions to heart.

Making forecasts of population size requires making assumptions about people's choices; such assumptions have proven wrong in the past, as we have seen. We can expect that income will continue to rise, but how much of it will people expect a child to cost them? What other activities will compete with child-rearing for parents' interest and time? Such hard-to-predict judgments are likely to be the main determinants of population growth. We can at least say confidently, however, that the growth of population during the past few centuries is no proof that population will continue to grow straight upward toward infinity and doom.

Although no one knows what population size or rate of growth the future holds in store, one often hears that zero population growth, or ZPG, is the only tolerable state. Classical economic theory bolsters this conviction. It purports to show that population growth inevitably reduces the standard of living. The heart of all economic theory of population, from Malthus to *The Limits of Growth,* can be stated in a single sentence: The more people using a stock of resources, the lower the income per person, if all else remains equal. This proposition derives from what economists have called the law of diminishing returns. Two men cannot use the same tool, or farm the same piece of land, without producing less than they would if they did not have to share. A related idea is that two people cannot nourish themselves as well as one person can from a given stock of food. The age distribution that results from a high birthrate reinforces this effect: the number of children in proportion to workers will be larger. Also, the more children women have, the less chance they have to work outside the home, so the work force is diminished further.

According to this reasoning, both sheer numbers of people and the age distribution that occurs in the process of getting to the higher numbers ought to have the effect of a smaller per capita product. But the evidence does not confirm the conventional theory. It suggests that population growth almost certainly does not hinder, and perhaps even helps, economic growth.

One piece of historical evidence is the concurrent explosion of population and economic development in Europe from 1650 onward. Further evidence comes from a comparison of the rates of population growth and output per capita in those developed countries for which data are available for the past century. No strong relationship between the two variables appears. For example, population has grown six times faster in the United States than in France, but the rate of increase in output per capita has been about the same. The populations of Great Britain and Norway grew at the same pace for the past century, but the rate of Norway's output per capita was about a third faster. Australia, on the other hand, had a very fast rate of population growth, but its rate of increase in output per capita was quite slow.

Studies of recent rates of population growth and economic growth are another source of evidence. In less-developed countries, per capita

income has been growing as fast as or faster than in the developed countries, according to a World Bank survey for the years 1950 to 1975, despite the fact that population has grown faster in developing countries than in developed countries.

Such evidence does not show that fast population growth in developed countries *increases* per capita income. But it does contradict the belief that population growth inevitably *decreases* economic growth. The lack of a cause-and-effect relationship between population and economic growth has a number of explanations, as follows:

- People make special efforts when they perceive a special need. For example, American fathers work extra, the equivalent of two to five weeks a year, for each additional child. In the long run, this yearly 4 to 10 percent increase in work may fully (or more than fully) balance the temporary loss of labor by the mother. (The other side of this coin is that people may slack off when population growth slows and demand lessens.)
- The larger proportion of young people in the labor force which results from population growth has advantages. Young workers produce more in relation to what they consume than older workers, largely because the older workers receive increases in pay with seniority, regardless of productivity. And because each generation enters the labor force with more education than the previous generation, the average worker becomes more and more knowledgeable.
- Population growth creates business opportunities and facilitates change. It makes expansion investment and new ventures more attractive, by reducing risk and by increasing total demand. For example, if housing is overbuilt or excess capacity is created in an industry, a growing population can take up the slack and remedy the error.
- More job opportunities and more young people working mean that there will be more mobility within the labor force. And mobility greatly enhances the efficient allocation of resources: the best matching of people to jobs.
- Population growth promotes "economies of scale": the greater efficiency of larger-scale production. Through this mechanism, the more people, the larger the market, and therefore the greater the need for bigger and more efficient machinery, division of labor, and improved transportation and communication. Hollis B. Chenery, an economist, compared manufacturing in less-developed countries and found that, all else being equal, if one country is twice as populous as another, output per worker is 20 percent larger. It is an established economic truth that the faster an industry grows, the faster its efficiency improves. One study, which compared the output of selected industries in the United States with the output of those same industries in the United Kingdom and Canada, showed that if you quadruple the size of an industry, you may expect to double the output per worker and per unit of capital employed. This should hold true for the developed world in general.

A larger population also provides economies of scale for many expensive social investments that would not be profitable otherwise—for example, railroads, irrigation systems, and ports. And public services, such as fire protection, can also be provided at lower cost per person when the population is larger.

All of the explanations just summarized have economic force, but the most important benefit that population growth confers on an economy is that people increase the stock of useful knowledge. It is your mind that matters economically, as much as or more than your mouth or hands. In the long run, the contributions people make to knowledge are great enough to overcome all the costs of population growth. This is a strong statement, but the evidence for it seems strong as well.

The importance of technological knowledge has clearly emerged in two famous studies, by Robert Solow in 1957 and by Edward Denison in 1962. Using different methods, both calculated the extent to which the growth of physical capital and of the labor force could account for economic growth in the United States. Denison made the same calculations for Europe. They found that even after capital and labor are allowed for, much of the economic growth cannot be explained by any factor other than improvement in technological practice (including improved organization). Economies of scale as a result of larger factories do not appear to be very important from this point of view, though technology improves more rapidly in large, fast-growing industries than in small, slow-growing ones. This improvement in productivity doesn't come for free; much of it is bought with investments in research and development. But that does not alter its importance.

What is the connection between innovation and population size and growth? Some ideas

come from people, it seems reasonable that the number of improvements depends on the number of people using their heads. This is not a new idea. William Petty wrote in 1683 that "it is more likely that one ingenious curious man may rather be found out amongst 4 millions than 400 persons." Hans Bethe, who won the Nobel Prize for physics in 1967, has said that the prospects for nuclear fusion would be rosier if the population of scientists were larger. Bethe said, "Money is not the limiting factor.... Progress is limited rather by the availability of highly trained workers."

Even a casual consideration of history shows that as population has grown in the last century, there have been many more discoveries and a faster rate of growth in productivity than in previous centuries. In prehistoric times, progress was agonizingly slow. For example, whereas routinely we develop new materials—say, plastics and metals—millennia passed between the invention of copper metallurgy and of iron metallurgy. If population had been larger, technological discoveries would surely have come along faster. Ancient Greece and Rome have often been suggested as examples contrary to this line of reasoning. Therefore, I plotted the numbers of great discoveries, as recorded by historians of science who have made such lists, against Greek and Roman populations in various centuries. This comparison showed that an increase in population or its rate of growth (or both) was associated with an increase in scientific activity, and population decline with a decrease.

In modern times, there is some fairly strong evidence to confirm the positive effect of population growth on science and technology: in countries at the same level of income, scientific output is proportional to population size. For example, the standard of living in the United States and in Sweden is roughly the same, but the United States is much larger than Sweden and it produces much more scientific knowledge. A consideration of the references used in Swedish and United States scientific papers and of the number of patented processes that Sweden licenses from the United States bears this out.

Why isn't populous India a prosperous and advanced country? I have not argued that a large population will by itself overcome all the other variables in a society—its climate, culture, history, political structure. I have said only that there is no evidence to prove that a large population *creates* poverty and underdevelopment. India is poor and underdeveloped for many reasons, and it might be even more so if it had a smaller population. The proper comparison is not India and the United States but India and other poor countries, and the fact is that India has one of the largest scientific establishments in the Third World—perhaps in part because of its large population.

It cannot be emphasized too strongly that "technological and scientific advance" does not mean only sophisticated research, and geniuses are not the only source of knowledge. Much technological advance comes from people who are neither well-educated nor well-paid: the dispatcher who develops a slightly better way of deploying the taxis in his ten-taxi fleet, the shipper who discovers that garbage cans make excellent cheap containers, the supermarket manager who finds a way to display more merchandise in a given space, the clerk who finds a quicker way to stamp prices on cans, and so on.

Population growth spurs the adoption of existing technology as well as the invention of new technology. This has been well documented in agriculture, where people turn to successively more "advanced" but more laborious methods of getting good as population density increases—methods that may have been known but were ignored because they weren't needed. For example, hunting and gathering—which require very few hours of work a week to provide a full diet—give way to migratory slash-and-burn agriculture, and that yields to settled, long-fallow agriculture, and that to short-fallow agriculture. Eventually fertilizer, irrigation, and multiple cropping are adopted. Though each stage initially requires more labor than the one before, the end point is a more efficient and productive system.

This phenomenon also explains why the advance of civilization is not a race between technology and population, each progressing independently of the other. Contrary to the Malthusian view, there is no direct link between each food-increasing invention and increased production of food. Some inventions, such as a better calendar for planting, may be adopted as soon as they prove successful, because they will increase production with no more labor. Others, such as settled agriculture or irrigated multicropping, require more labor, and thus will not be adopted until there is demand.

The fact that people learn by doing is a key to the improvement of productivity in particular industries, and in the economies of nations. The idea is simple: the bigger the population, the more of everything that is produced. With a greater volume come more chances for

people to improve their skills and to devise better methods. Industrial engineers have understood this process for many decades, but economists first grasped its importance when they examined the production of airplanes during World War II. They discovered that when twice as many airplanes are produced, the labor required per plane is reduced by 20 percent. That is, if the first airplane requires 1,000 units of labor, the second will require 800 units, and so on, though after some time the gains from increased efficiency level off. Similar "progress ratios" describe the production of lathes, machine tools, textile machines, and ships. The effect of learning by doing can also be seen in the progressive reduction in price of new consumer devices in the years following their introduction to the market—room air-conditioners and color television sets, for example.

In the short run, all resources are limited: the pulp-wood that went into making this book, the pages the book will allow me, and the attention the reader will devote to what I say. The longer run, however, is a different story. The standard of living has risen along with the size of the world's population since the beginning of recorded time. There is no convincing economic reason why these trends toward a better life should not continue indefinitely. Adding more people causes problems, but people are also the means to solve these problems. The main fuel to speed the world's progress is our stock of knowledge, and the brake is our lack of imagination. The ultimate resource is people—skilled, spirited, and hopeful people—who will exert their wills and imaginations for their own benefit, and so, inevitably, for the benefit of us all.