10

What Malthus Missed

Though John Maynard Keynes had the highest opinion of his contributions to economics,[1] Malthus continues to be bad-mouthed by many of today's sociologists and economists. The passion displayed by some of his detractors is grossly disproportionate to the magnitude of his errors. A conscientious listing of the explicit statements made by Malthus would, I am sure, show that far more than 95 percent of them are correct. But for any writer who becomes notorious for voicing unwelcome "home truths," a correctness score of 95 percent is not enough. Envy, an all-too-human failing, is not unknown among critics.[2] Envy sharpens the critical faculties but dulls the sense of proportion.

Seeking a Counterbalance to Exponential Growth

The potentially unlimited growth of debt through the exponential growth of usury is counterbalanced, as we have seen, by such factors as bankruptcy, repudiation of debts, and inflation. Potentially exponential biological reproduction is also kept in check by counterbalancing forces. Every species "seeks" to convert the matter of its surroundings ("the environment") into more of its own kind, without limit. But since the amount and quality of convertible matter does have limits, so also must the growth of every population be limited. What in fact does limit the growth of populations?

Malthus was concerned only with the human species. Having found a mathematical expression for reproduction he then sought another mathematical expression for the limitation to human fertility. No one thinks he was successful in this second endeavor. We note that as a student at Cambridge he was graduated as Ninth Wrangler. The quaint term "wrangler" is awarded by the English to someone who takes honors in mathematics. Since Malthus placed ninth in his class we may assume that he was only modestly endowed with mathematical ability. We should not be surprised to learn that he made a serious mistake in applying mathematics to the problem of the factors limiting human populations. (Look again at Box 9-1 on page 88.)

In successive intervals of time, Malthus said, the human species has the potential of increasing as the numbers in the series 2, 4, 8, 16, etc. In this he was on firm ground. In the absence of environmental resistance, every species has this ability: the number expected at time t is 2^t, where the unit t is the doubling time for the species. Population growth is exponential (or, as Malthus said, "geometrical").

But where did Malthus get the idea that "subsistence" would increase only "arithmetically," as in the series 2, 3, 4, 5, etc.? Not from science, certainly. History is silent as to the origin of this postulate, but I have a suggestion to make. Is it perhaps significant that his ratios echo a passage in Francis Bacon? In a collection of succinct "Antitheses" published in 1623, under the heading "Nature," Bacon entered the following suggestive passage. "*Custom advances in an arithmetical ratio, nature in a geometrical.* . . . Custom against nature is a kind of tyranny, and is soon and upon slight occasion overthrown."[3] Did Malthus know of this passage? I know of no documentary evidence that he did. But Bacon's views on science and technology ("custom," in this quotation) were as much esteemed in Malthus's day as they are ignored in ours. It is possible that Malthus got his two ratios from Bacon: more we cannot say.

Be that as it may, the comparison of the two series, term by term, gave Malthus the result he wanted for his theory, namely a damping down of population growth with the passage of time. Apparently satisfied with the result, he stopped looking for an alternative theory. His complacency in the face of cogent and widespread criticism cannot be defended. Those who say that Malthusianism has been discredited are on solid ground if this aspect of his theoretical system is what they have in mind.

Malthus can be refuted by a comparison of the three ratios shown in Box 10-1. Line A is Malthus's arithmetic series used as a measure of increase in subsistence units—food, principally. Line B is the geometrical series for population growth, where the living units are labeled as "mouths" that eat the food. If the figures in these two lines are turned into a series of fractions, with the term in line A as the numerator and the corresponding term in line B as the denominator, the results (fractional term by fractional term) read: 1 — ¾ — ½ — 5/16 — 3/16, and so on. Each fractional term shows the amount of *subsistence per individual* available at the moment of time given in the numbers above the double line in the box. The larger the population the less the subsistence per person. So said Malthus; but why in fact should this be so? Malthus did not answer this question; in fact he did not even ask the question. His opponents did.

Folk wisdom supported the critics. In Latin America it is said, "Every baby is born with a loaf of bread under his arm." Perhaps that places too much faith in Providence, which sometimes double-crosses babies. Europe boasts a more defensible aphorism: "Each new mouth brings with it a new pair of hands." This wisely proposes not providence but self-help as the pretext for optimism. Line C in Box 10-1 shows that the number of pairs of hands is exactly equal to the number of

Box 10-1. Malthus Refuted by Nature's Ratios.

Malthus reached his pessimistic conclusions by comparing series B with series A. His opponents justified their optimism by comparing series B with series C.

Elapsed Time:	2	3	4	5	6
A. Subsistence units (food)	2	3	4	5	6
B. Consuming units (mouths)	2	4	8	16	32
C. Labor units (pairs of hands)	2	4	8	16	32

mouths (Line B). The ratio of B to C is 1 throughout. Should it not be true, then, that the subsistence gained by human effort will forever be able to keep up with the demand created by human reproduction?—"How about that, Mr. Malthus?"

"Providence" Discourages Inquiry

Malthus may not have given enough attention to the mystery of the falling-off in the rate of population growth. An excuse for not trying hard was readily available in his day (as it is not in ours). This was the *panchreston,*[4] the "explain-all" called "Providence."

Etymologically, the word *providence* comes from the Latin *providere,* to provide. From "making provision for" it is easy to move to "exercising foresight." Early on, religious writers spoke of "God's providence," meaning his provision for man. The eighteenth century was the "Age of Enlightenment," when many thoughtful men abandoned "God" as an explanatory principle. But centuries of use of the word "God" made it socially risky to abandon entirely the thought behind the word. A compromise became popular among the elite of that century: they substituted the word "Providence" for "God" or "God's providence." Adopting this ploy amounted to playing both sides of the street: the hope was, no doubt, that both theists and atheists would accept the postulated "cause" of all that happens in the world.

Malthus, writing his essay at the end of the eighteenth century, turned out a sort of geological stratification of beliefs about the cause of the world as it is (see Box 10-2). Starting off with a supreme being (God) he shifts to the ambivalent concept

Box 10-2. Malthus on Providence.

The Supreme Being has ordained that the earth shall not produce good in great quantities till much preparatory labour and ingenuity has been exercised upon its surface. . . . The processes of ploughing and clearing the ground, of collecting and sowing seeds, are not surely for the assistance of God in his creation, but are made previously necessary to the enjoyment of the blessings of life, in order to rouse man into action, and form his mind to reason.

To furnish the most unremitted excitements of this kind, and to urge man to further the gracious designs of Providence by the full cultivation of the earth, it has been ordained that population should increase much faster than food. This general law . . . undoubtedly produces much partial evil, but a little reflection may, perhaps, satisfy us, that it produces a great overbalance of good. . . .

Leisure is, without doubt, highly valuable to man, but taking man as he is, the probability seems to be that in the greater number of instances it will produce evil rather than good. It has been not infrequently remarked that talents are more common among younger brothers than among elder brothers, but it can scarcely be imagined that younger brothers are, upon an average, born with a greater susceptibility of parts. The difference, if there really is any observable difference, can only arise from their different situations. Exertion and activity are in general absolutely necessary in one case and are only optional in the other.

That the difficulties of life contribute to generate talents, every day's experience must convince us.

An Essay on the Principle of Population, 1798.

of Providence. At the end of the passage he moves to a position that is even farther from a theistic commitment, to an explanatory principle that can only be called "the nature of things." Accepting without question the justness of primogeniture, Malthus points to the beneficial effects of short-changing younger brothers, who are thereby stimulated to greater effort. As a group it was supposed that their potentialities were developed more fully. Suffering was justified by its good "side effects" (as we might call them).

Having reached this convenient conclusion, Malthus (the sixth of seven children) was, like the first son under primogeniture, not strongly motivated to look harder for a better explanation of the forces that curbed exponential growth. Population growth in a limited world brought suffering to man, thus impelling him to exercise foresight in the planning of his life. Human suffering was part of God's plan to make human beings more energetic, more virtuous. For Malthus, the pains of overpopulation found their function in the nature of things. Like the Buddha, Malthus accepted the "sorrow" of life.

The Difficult Birth of "Diminishing Returns"

Whitehead's insight that a new idea is often first tripped over by someone who doesn't realize what he has "discovered" is well exemplified in Malthus's work. Though his concept of arithmetical ratios failed to explain satisfactorily the decline of population growth rates, Malthus did in fact stumble across the fundamental concept his theory needed—and never realized what he had found. To the second edition of his book, published five years after the first, he added the significant passage below ("corn" is British English for wheat, rye, or barley):

> [W]hen an additional *depopulation* takes place in a country which was before populous and industrious, and in the habit of exporting corn, if the remaining inhabitants be left at liberty to exert, and do exert, their industry in the same direction as before, it is a strange idea to entertain that they would then be unable to supply themselves with corn in the same plenty; particularly as *the diminished numbers would, of course, cultivate principally the more fertile parts of their territory, and not be obliged, as in their more populous state, to apply to ungrateful soils.*[5]

This assertion, like many facets of Malthusian theory, is based on a theory of human behavior. If, says Malthus, a farmer finds he no longer needs actively to work *all* his land, he will first stop farming those portions that require the most labor, thus living an easier life without sacrificing any of its good. A strict moralist, viewing such behavior in others might condemn it as laziness, but would the moralist behave any differently himself? If he would, he is a fool. The belief that the normal person seeks to minimize the time and effort he expends on essential work is an important *default position* of human psychology, as described in Chapter 5. This position in turn derives from the major default position of biology—that selection favors economizers.

The assumptions Malthus made about human behavior were, and are, ones that are subscribed to by most people. His prediction, without doubt a correct one, was that reducing population size somewhat would lead to greater agricultural productivity *per unit effort.* He just missed stating the law of diminishing returns. All he needed to do to make this discovery was to invert his example: to ask what would

happen when the diminished population surged back to its initial, larger size. Obviously the marginal land ("ungrateful soils") that had been taken out of cultivation would have to be cultivated once more. This change would force agriculturalists as a group to work harder to produce the same amount of food per capita. When an increase in population requires a more-than-proportionate increase in effort to maintain the same per capita productivity, we say that *the point of diminishing returns* has been reached. Malthus never realized how an inversion of his example could furnish him with the growth-damping principle his population theory needed.

Worse: when, a decade later, several other economists explicitly stated the law of diminishing returns, Malthus just as explicitly denied that this was what he had been blundering toward when he proposed his arithmetic ratio. To the day of his death, almost two decades later, he never gave in. How many fruitless arguments might have been forestalled had Malthus had a more flexible mind!

History Apparently Makes a Mockery of "Diminishing Returns"

In a manner of speaking, history conspired to mock Malthus. Correcting for inflation, the real wages of British workers have been estimated for Malthus's day.[6] From 1800 (two years after the publication of the *Essay*) to 1824 (ten years before the author's death) the British population increased by 25 percent. During the same period the real wages *per worker* also increased by 25 percent: more people, living better—a most un-Malthusian development! In the next quarter of a century, while population increased by 56 percent, wages *per worker* increased another 40 percent. In what we call the "developed world" this trend continued during the succeeding century. It is not surprising, then, that many economic theoreticians came to feel that the law of diminishing returns either was not true or had been unduly emphasized.

Today's economists give much more emphasis to the opposite effect, called "economies of scale," or "returns to scale." In his *Wealth of Nations,* Adam Smith gave a general explanation for the observed ability of a large manufacturing firm to make things at a lower cost than a small firm: the "division of labor" whereby the job is subdivided into many small parts that can be more efficiently performed by workers specializing in mini-tasks. In the light of this practice, the "diseconomy of scale" implied by the law of diminishing returns needs to be accounted for.

"Diminishing Returns" in a Larger Context

What factors, acting jointly, determine the productivity of a piece of land? The principal ones are listed in Box 10-3. In Malthus's time the first factor listed was the principal determinant of the size of the crop: there was not much variation in the other factors in ordinary farming. Variation of different plots of soil with respect to inherent fertility can lead to diminishing returns. At each stage of agricultural expansion the most fertile hitherto unexploited plot is developed next. This means that the expansion of cultivated land under the pressure of population suffers from

Box 10-3. Agriculture: The More Obvious Production Factors.

Inherent fertility of the soil
Genetic quality of the seeds
Amount and quality of cultivation
Amount of fertilizer
Amount of pesticides
Amount and timing of water inputs

diseconomies of scale. Thus sayeth theory. In fact, from Malthus's time onward (ignoring fluctuations in the weather), the returns per acre actually increased, particularly in the twentieth century. How is a Malthusian to account for this embarrassing truth?

Peasant agriculturalists in the past did little to modify the factors listed in Box 10-3. The domestication of all the major grains took place before men learned to read and write, and so did much of the genetic improvement of the seeds, the improvement taking place slowly over the millennia. It wasn't until a century after Malthus that experimentalists learned how to bring about rapid improvements in seed quality.

Some significant improvements in the other factors of agricultural production occurred even in Malthus's time, accelerating later. Overall, the diminishing returns caused by the policy of using the best lands first have been overshadowed by the increasing returns resulting from improvements in other production factors. Yet with each factor there finally comes a level of application at which diminishing returns dominate the results.

Take, for example, the matter of fertilizer. The first additional unit of fertilizer may bring about a 10 percent improvement, say; as may a second, a third, and a fourth unit. Finally, some *n*th unit adds less than 10 percent; and the $n + 1$th still less. Ultimately, as many a backyard farmer learns, adding more fertilizer may actually be destructive: overfertilization "burns" the crop. How can a graph show both the good and the bad effects of increasing efforts (of a given kind) on productivity?

Figure 10-1 is a generalized graph of per capita productivity plotted against effort (pounds of fertilizer applied; gallons of water, hours of working the soil, or whatever). There is an early phase (initial to optimum, which we can abbreviate as I–O) during which economies of scale are realized. Then at the optimum the curve turns over, producing a plateau (O–B) that may be restricted in one case, extensive in another, until the effort reaches B, standing on the brink of disaster (D). Once the B–D phase has been entered, no sane person would knowingly call for more and more effort of the same kind.

The discipline of economics grew up when the industrial revolution was in the I–O phase; it is understandable that the idea of economies of scale became engrained in economic thinking; wishful thinking would have it so. Somewhat later, ecology was developed by students of the living world, for whom the opposite perception comes easily. Exponential reproduction moves each species rapidly through the I–O phase; what one might call the natural imperialism of the species soon brings it to the O point, the *carrying capacity of the environment.* The corrective role played by other species (predators, competitors, disease germs, and so on)

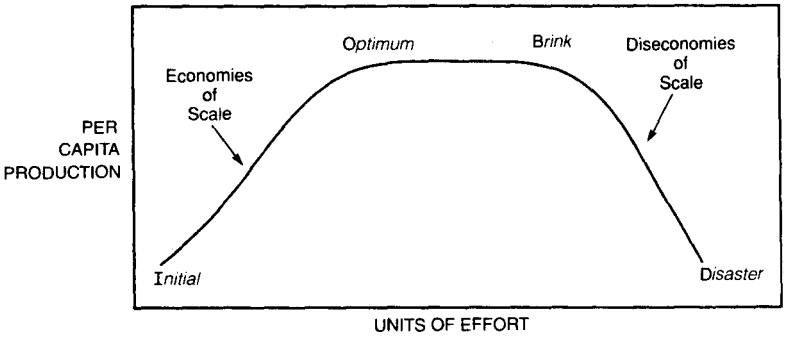

Figure 10-1. Reconciliation of economies of scale and diseconomies of scale. The generalized curve shows how per capita production is affected by units of effort. The O–B plateau may be either extensive or nonexistent. Optimists tend to see only the I–O segment, pessimists the B–D.

tends to keep the target species fluctuating around the O level. The imperialism of one species is kept from achieving too much demographically by the equally compulsive imperialism of others.

Trouble comes when man steps into the system of nature and tries to increase productivity *without limit.* Time after time greedy human beings move some production function onto the slippery slope of B–D. The consequences remind the greedy once more that there can be "too much of a good thing"—any good thing.[7] This means, of course, that *quantity matters* when we try to decide what is best or right.[8] A comprehensive ethical system must be numerate. Traditional systems of ethics, such as the Ten Commandments, are almost invariably innumerate.

Analysis that takes account of only one production factor at a time is finally not enough. All the factors can vary, and the optimum point for one is affected by the level of other factors. "Fertilizer" is a collective word for many substances, and the *balance* of nitrogen with phosphorus, for instance, matters. The working together, the *synergism,* of many factors is important. It is the task of scientific agriculturalists to try to work out the complex interaction of all the factors—a task that is not finished in a year or a decade.

The complexity of the real world does not justify assuming that economies of scale continue forever, at all levels of effort or population numbers. Emphasizing economies of scale while neglecting diseconomies is, of course, merely one more example of preferring optimism to pessimism, a dangerous attitude for a prophet to adopt.

Beyond Shiva

If, as European folk wisdom has it, each new mouth brings with it a pair of hands, how are we to view the fantastic changes brought about by the industrial-scientific revolution of the past two hundred years or so? Have we not now reached a stage at which each new mouth comes into the world with *more* than a single pair of

hands? The woolgathering mind may recall statues of the Indian god Shiva, with his many (most commonly four) lively arms and busy hands.

If scientists were inclined to take up new gods (which they are not), Shiva would be a fine one for representing science and technology ("custom," in Bacon's language). Even before Malthus, technology began to increase the output of human hands (through such inventions as the wheelbarrow), but the change did not catch people's attention for a long time. Everyone is aware of it now. Especially in the developed world it has become obvious that material income per capita has increased greatly. The Shiva of Western technology is indeed a many-handed god.

As the beneficiaries of more than two centuries of rapid growth of science and technology, the masses cannot easily be persuaded that they should be worried about the future of population and the environment. Yet we would do well to remember that the Hindus' Shiva is a god of both creation and destruction. It is not without reason that we perceive a many-handed god as uncanny and frightening. Technology is a blessing to be sure, but every blessing has its price. The price of increased complexity is increased vulnerability. The growth of technology can be symbolized as an increase in the number of hands and arms of Shiva.

Now that *our* Shiva has a thousand arms, can we be entirely confident that all of them are, at all times, firmly under the control of a competent mind? What if the brain of the thousand-armed Shiva of technology goes berserk?