Malthusian Economics

If we take the scattered and imperfect information we have about the global economy that we have from the distant past up to today we see a pattern like that of table 5.1.

Table 5.1: Economic Growth Through Deep Time

Longest-Run Economic Growth

Year	Population*	GDP per Capita**
-5000	5	$130
-1000	50	$160
1	170	$135
1000	265	$165
1500	425	$175
1800	900	$250
1900	1625	$850
1950	2515	$2030
1975	4080	$4640
2000	6120	$8175

*Millions

**In year-2000 international dollars.

Up until 1800 the growth rates of human populations were glacial. Population growth between 5000 B.C. and 1800 averaged less than one-tenth of a percent per year. (Nevertheless, the cumulative magnitude of population growth was impressive, carrying the number of human beings alive on the planet from perhaps 5 million in 5000 B.C. to 900 million in 1800; 7,000 years is a long time.)

Up until 1500, as best we can tell, there had been next to *no* growth in output per worker for the average human for millennia. Even in 1800 the average human alive had a material standard of living (and an economic productivity level) at best twice that of the average human alive in the year 1. The problem was not that there was no technological progress. There was. Humans have long been ingenious. Warrior, priestly, and bureaucratic elites in 1800 lived much better than their predecessors in previous millennia had lived. But just because the elite that ruled you lived better does not mean that you--if you were average--lived any better.

Only after 1800 do we see large sustained increases in worldwide standards of living. After 1800 human numbers grew as the population explosion took hold. It carried our total population to 6 billion in October 1999. Population growth on a world scale accelerated from a rate of 0.2% per year between 1500 and 1800 to 0.6% per year between 1800 and 1900, 0.9% per year between 1900 and 1950, 1.9% per year between 1950 and 1975, and—in the first slowing of the global rate of population growth--1.6% per year from 1975 to 2000.

Figure 5.1: Population Growth Since 1000

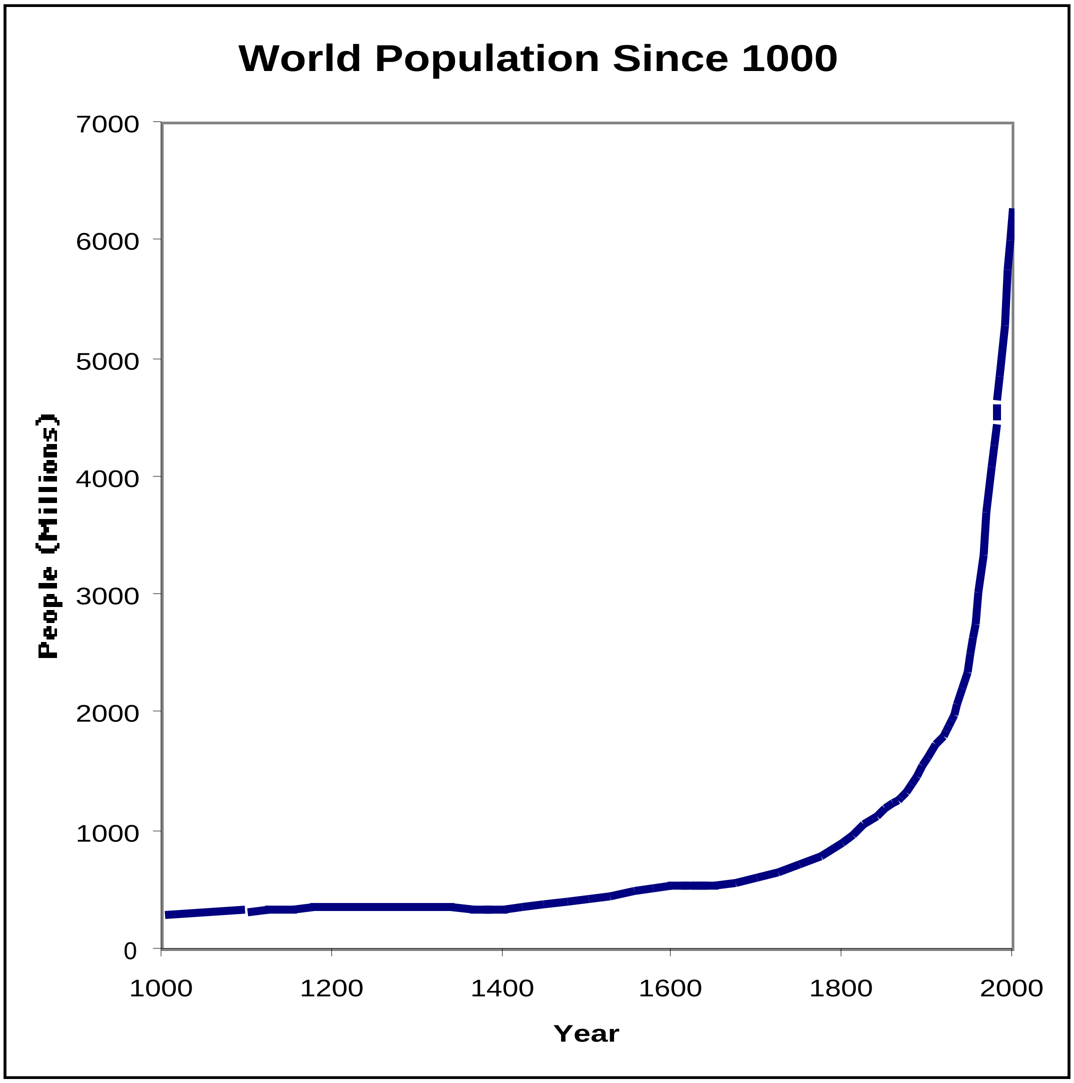

Figure Legend: The explosion of human populations since 1800 is called—not surprisingly—the *population explosion.*

Source: United Nations and Michael Kremer of MIT.

Average rates of material output per capita, which grew at perhaps 0.15% per year between 1500 and 1800, grew at perhaps 1.0% per year worldwide between 1800 and 1900, and have grown at an average pace of perhaps 2.0% per year worldwide between 1900 and 2000, as Figure 5.1 shows.

Why were there no sustained increases in the material productivity of human labor back before 1500? Because improved technology quickly ran aground on resource scarcity. As human populations grew the stocks of natural resources known had to be divided up among more and more people: miners had to exploit lower-quality metal ores, farmers had to farm lesser-quality agricultural land, and forests vanished. Who alive today has seen the the cedar forests of Lebanon? In spite of technological progress resource scarcity meant that the efficiency of labor was little if any greater in 1500 A.D. than in 1500 B.C.

One of the oldest ideas in economics is that increases in technology inevitably run into natural resource scarcity, and so lead to increases in the numbers of people but not in their standard of living of productivity. This idea was introduced into economics late by Thomas R. Malthus, who was to become the first academic professor of economics (Adam Smith had been a professor of moral philosophy) at the East India Company's Haileybury College.

Malthus saw a world in which inventions and higher living standards led to increases in the rate of population growth. With higher living standards women ovulated more frequently. More pregnancies were successfully carried to term. Better-nourished children (and adults) had a better chance of resisting diseases. Moreover, when incomes were high new farmsteads are relatively plentiful, and getting the permission of one's father or elder brother to marry was easier. For these reasons both social and biological, a higher standard of living back before 1800 led to a faster rate of population increase. And faster rates of population growth increased natural resource scarcity and lowered productivity until once again people were so poor and malnourished that population growth averaged a little bit more than zero.

We can modify our standard model of economic growth:

$$Y_t / L_t = (\kappa *)^{\lambda} \times (E_t)$$

to incorporate the effects stressed by Malthus—the downward pressure exerted by natural resource scarcity and diminishing returns on the efficiency of labor—by making two changes. First, we make the efficiency of labor E a function both of the raw level of technology A and also of the total labor force L:

$$E_t = \frac{A_t}{L_t}$$

This means that, if g_A is the proportional growth rate of raw technology A, that the growth rate g of the efficiency of labor E is:

$$g = g_A - n$$

Where n is the growth rate of the labor force.

Second, we follow Malthus and make the labor force growth rate n a function of the level of prosperity Y/L: the higher is output per worker, the faster is population growth:

$$n = \phi\left(Y/L - y^s\right)$$

Where ϕ is a parameter and y^s is the "subsistence" level of productivity—the level of productivity at which the society is so poor that the population does not rise at all. If the level of prosperity rises above y^s, the population grows. If the level of prosperity falls below y^s, the population shrinks.

In this modified model we look for an equilibrium in which the efficiency of labor E is constant and population growth n is equal to the rate of growth of bare technology g_A. For this to be true, it must be the case that:

$$g_A = \phi\left(Y/L - y^s\right)$$

So:

$$Y/L = y^s + \frac{g_A}{\phi}$$

Thus:

$$y^s + \frac{g_A}{\phi} = \left(\frac{s}{g_A + \delta}\right)^{\lambda} \times \left(\frac{A_t}{L_t}\right)$$

Which means that the population level—the level of the labor force L—at any moment in time is given by:

$$L_t = \left(\frac{s}{g_A + \delta}\right)^{\lambda} \times \left(\frac{A_t}{y^s + \frac{g_A}{\phi}}\right)$$

In this version of the model, the steady-state level of output per worker does not change over time: it is a function of the subsistence level of prosperity y^s, of how rapidly fertility increases with rising incomes ϕ, and of the rate of progress g_A of bare technology. The level of technology itself, the shape of the production function, the depreciation rate, the savings rate—all these have no effect on the level of output per worker, although they do have powerful effects on the size of the population. As knowledge advances and bare technology improves, the population grows, but the efficiency of labor and the average level of prosperity do not.

Malthus's views of the important determinants of prosperity and human happiness are clear in this model. The most important thing is to—via proper morals, religion, and authority—raise the level of prosperity y^s consistent with a stable population. In Malthus's model, at least, everything else has but a transitory or insignificant effect on the average level of prosperity.