Malthusian economy

ABSTRACT

The Malthusian economy was the economic system that characterized almost all economies before the industrial revolution. In this regime fertility and mortality rates at different material income levels determined the average real income level and life expectancy at birth. Thus before 1800 the improvement of production technologies resulted only in population growth, and not in any gains in material living conditions beyond those that were found in the original hunter gatherer societies.

The Malthusian economy is the economic system which prevails whenever a society's production technology advances so slowly that population growth forces incomes down to the subsistence level. In such an economy material welfare is independent of natural resources, technology and capital accumulation, but instead depends solely on the factors governing fertility and mortality. The resulting subsistence income can, however, vary widely across societies. Some Malthusian economies were rich by the standards of most countries in modern Africa, for example.

Almost all societies until 1800 were Malthusian, from the original foragers of the African savannah 50,000 years ago down through settled agrarian societies of considerable sophistication such as England, France, China and Japan in 1800. The operation of all human societies through history up until the Industrial Revolution can thus seemingly be described by this one simple economic system. An implication of this is that there was most likely no gain in material welfare between the evolution of anatomically modern humans and the onset of the Industrial Revolution.

Government actions, in so far as they change fertility or mortality, can influence material welfare in the Malthusian Economy, but in a contradictory fashion. Good governments that reduced mortality through order and security made people poorer. Bad governments that increased mortality through warfare and banditry made them wealthier.

The economic logic of these societies was first, though only partially, appreciated by Thomas Malthus in his famous *Essay on a Principle of Population* of 1798. Malthus's insights were elaborated by writers such as David Ricardo and James Stuart Mill into the system called classical political economy in the early 19th century. Ironically, this intellectual development happened just as for the first time the rate of technological advance was becoming sufficiently rapid to bring the Malthusian era to a close.

Insight into the Malthusian economy starts from the insight that the biological capacity of women to produce offspring is much greater than the number of births required to reproduce the population. If fertility is unrestricted women can have 12 or more children. Social institutions regulating marriage and contraceptive practices will determine the actual numbers of births per women. In modern societies these institutions and practices vary greatly, so the number of births per women varies greatly. Completed fertility now ranges across the world from a low of 1.15 in Spain to a high of 8.0 in Niger. Only where women happen on average to have two children who survive to adulthood will population be stable. Even small deviations from this number will cause rapid increases or decreases in population. Thus modern populations are not stable.

Despite this potential for explosive population growth, pre-industrial populations were remarkably stable over the long run. The average annual growth rate of world population from 10,000 BC to AD 1,800 was 0.05 per cent. The typical woman before 1800 thus had 2.02 children who survived to reproductive age. As an extreme case the population of Egypt, for example, is estimated at between four million and five million at 1,000 BC. The population in Greek and Roman Egypt a millennium later is estimated at this same four million to five million. The first modern census in 1848 suggests a population of 4.5 million. Thus over nearly 3,000 years the Egyptian population growth rate was to a close approximation zero, and women on average had two surviving children. Yet it is estimated that in Roman Egypt the average woman gave birth to six children. Some mechanism kept fertility and mortality in balance in these pre-industrial economies.

The Malthusian Equilibrium

The simple Malthusian model of how pre-industrial society functioned supplies an economic mechanism to explain its population stability. In its simplest version there are just three assumptions:

1. The *birth rate*, the number of births per year per thousand people, is a socially determined constant, independent of material living standards. Birth rates will vary across societies, but in this simplest model they are assumed to be independent in any given society of material living conditions.
2. The *death rate***,** the number of deaths per year per thousand persons, declines as material living standards increase. Again, the death rate will differ across societies depending on climate and lifestyles, but it assumed that in all societies it will decline as material living conditions improve.
3. *Material living standards* decline as population increases.

[Insert Figure 1 about here]

Figure 1 shows the first two assumptions of the simple Malthusian model in graphical form in the upper panel. The birth and death rates are plotted on the vertical axis, material income per capita on the horizontal axis. The first two assumptions of the simple Malthusian model imply that there is only one level of real incomes at which the birth rate equals the death rate, denoted as y^*. And this constitutes a stable equilibrium. Thus y^* is called the 'subsistence income' of the society: it is the income at which the population barely subsists, in the sense of just reproducing itself. This subsistence income is determined without any reference to the production technology. It depends only on the factors which determine birth and death rates. Once we know these factors we can determine the subsistence income.

Another aspect of human welfare is life expectancy at birth, that is, the average number of years a person will live. In the Malthusian era life expectancy at birth also depended only on the factors determining birth and death rates. This is because with a *stable* population, where annual births have equalled deaths for a long time, life expectancy at birth is the inverse of the crude birth rate. With fertility not restricted in

any way crude birth rates would be 50–60 per thousand in pre-industrial populations (based on modern experience). This would imply a life expectancy at birth of 20 years or less.

The term ‘subsistence income’ can lead to the confused notion that in the Malthusian economy people were always living on the edge of starvation. In fact, in almost all Malthusian economies the subsistence income was considerably above the income required for the physiological minimum daily diet. All pre-industrial societies for which we have good demographic records limited fertility below the biological maximum. Differences in the location of the mortality and fertility schedules generated subsistence incomes at very different levels. Thus, both 1450 and 1650 were periods of population stability in England, and hence periods where by definition income was at subsistence. But the wage of unskilled agricultural labourers was equivalent to about six lb of wheat flour per day in 1650, compared with 18 lb in 1450. Even the 1650 unskilled wage was well above the physiological minimum. A diet of about 1.33 lb of wheat flour per day would keep a labourer alive and fit for work (it would supply about 2,400 calories per day). Thus, pre-industrial societies, while they were subsistence societies, were not starvation regimes. England in 1450, indeed, was wealthy even by the standards of many modern societies such as those in sub-Saharan Africa.

The bottom panel of Figure 1 illustrates the third assumption. The panel has on the vertical axis the population, N, and on the horizontal axis the material income. As population increased material income per person by assumption declined. The justification for this assumption is the law of diminishing returns. Since one important factor of production, land, is always in fixed supply in pre-industrial economies, the law of diminishing returns implies that average output per worker fell as the labour supply increased as long as the technology remained static. Thus the average amount of material consumption available per person fell with population.

Figure 1 also shows how an equilibrium birth rate, death rate, population level and real income were arrived at in the long run in a pre-industrial economy. Suppose we start at an arbitrary initial population N_0 in the diagram, greater than N^*. This generates an income y_0, above the subsistence income. At this income the birth rate exceeds the death rate, so population grows until income falls to y^* and population equals N^*.

Changes in the Birth Rate, Death Rate and 'Technology' Schedules

Suppose that the birth rate schedule in Figure 1 was higher. Then at the equilibrium, real income would be lower, and the population greater. Thus any increase in birth rates in the Malthusian world drove down real incomes and reduced life expectancy. Conversely, anything which limited birth rates drove up real incomes and increased life expectancy. Thus in the pre-industrial era birth rates were a crucial determinant of material living conditions.

If the death rate schedule was higher, so that at each income there was a higher death rate, then the equilibrium real income would be higher. But if the birth rate was not responsive to income then a greater death rate increased real incomes but in the long run had no effect on the annual death rate or on life expectancy at birth. Thus in this simplest Malthusian model higher mortality risks at a given income were unambiguously a good thing, at least in the long run.

The simple Malthusian world thus exhibits an almost counter-intuitive logic. Anything that raised the death rate schedule, the death rate at a given income, such as war, disorder, disease, or poor sanitary practices, increased material living standards without changing life expectancy at birth. Anything that reduced the death rate schedule, such as advances in medical technology, or better public sanitation, or public provision for harvest failures, or peace, reduced material living standards without any gain in life expectancy at birth.

While the real income was determined from the birth and death schedules, the population size depended on the schedule linking population and real incomes. Above I labelled this the 'technology' schedule, because in general the major cause of changes in this schedule has been technological advances. But other things could shift this schedule – a larger capital stock, improvements in the terms of trade, climate improvements, and a more productive organization of the economy. A shift upwards in this schedule, in the short run, since population can change only slowly, would have increased real incomes. But the increased real incomes reduced the death rate, so that births exceeded deaths and population began growing. The growth of population ended only when the income returned to the subsistence level, y^*. At this new equilibrium the only effect of the

technological change was to increase the population supported. There was no lasting change in the living standards of the average person.

More Complicated Malthusian Models

An issue that has exercised historical demographers is whether the birth rate in pre-industrial societies was 'self-regulating'. What they mean by this is shown in Figure 2, which shows the birth and death schedules of a simplified Malthusian model, as well as a modified birth schedule, which slopes upwards with material incomes. In the modified Malthusian model it is assumed that in good times people married earlier and more people married, so that fertility increased, whereas in bad times fewer married, and they married later, so that fertility declined.

[Insert Figure 2 about here]

It should be clear that a positive association of fertility and income does not change the basic equilibrium of the model. The only difference is that increases in the death rate at any given material income are now not so unambiguously good, since they will be associated with higher fertility and mortality rates and hence lower incomes. The evidence for societies such as pre-industrial England, however, shows no response of fertility to income (Wrigley et al., 1997). Thus the simple model may well describe pre-industrial societies well.

[Insert Figure 3 about here]

What causes many more potential complications is a birth schedule that declines with material incomes. Suppose that as real incomes go up one of the responses of people is to desire fewer children. With a birth rate that declines with real incomes the model could have multiple crossings between the birth rate and death rate schedules. At those places where the birth rate schedule was declining more steeply than the death rate schedule the equilibrium would be unstable. Figure 3 gives a declining birth rate schedule that twice intersects the death rate schedule. The intersection at the lower real

income, y_0, is a stable equilibrium. But the second higher income equilibrium at y_1 is unstable. If real incomes drop below this level by any amount then population starts to grow, leading real incomes all the way down to the stable equilibrium at y_0. Conversely if they increase at all above y_1 then deaths will exceed births and real incomes continue to grow indefinitely. The population will fall eventually to zero.

In this case there is a 'Malthusian trap' in the pre-industrial economy. A society can be stuck in the subsistence income equilibrium unless some jolt such as acquiring extra land, experiencing a much higher death rate, or experiencing faster technological progress pushes up wages enough so that fertility falls permanently. The shock of the Black Death, however, which tripled real incomes for the poorest workers in England by 1450, did not lead to any permanent movement towards lower fertility and the escape from the Malthusian trap. Again, the evidence for pre-industrial demography suggests no declines in fertility with higher incomes.

The Empirical Implications of the Malthusian Model

The most interesting empirical implication of the Malthusian model is that material living conditions for people, including life expectancy at birth, may well have been unchanged between the dawn of humanity and AD 1800. Were the people in sophisticated societies such as England, France, the Netherlands, Japan and China in 1800 really no better off than the original hunter gatherers? This seems particularly counter-intuitive for England, reckoned to be the richest country the world by 1800. By then England was a society that would not seem that different from our own. The middle and upper classes in London breakfasted at coffee shops as they read the daily newspapers. They dwelled in homes of brick and glass with water supplied by lead pipes, lighted at night by oil harvested from sperm whales taken thousands of miles away in the oceans. There was extensive trade for luxury products from the tropics – cottons, silks, spices. How could the material condition of humanity not be better then than in the savage past when our ancestors faced the elements naked, and sought shelter at night in depressions in the ground or in crude lean-tos?

But even in England in 1800 the living conditions of the mass of the population were still primitive. The largest employment was still agriculture, where the average day

wage in 1800–9 was the equivalent of 5.7 lb of wheat flour. This was enough to keep a family fed only if most of the income was spent on the cheapest forms of food such as bread. Farm labourers lived in simple structures little better than those of the medieval period. They slept when it was dark because they could not afford lighting. They could afford one new set of clothing per year. English farm labourers six hundred years before, in 1200–9, received a wage which was the equivalent of 12 lb of flour, significantly more than in 1800. And at the best time for pre-industrial workers in England, circa 1450, when the population losses of the plagues which ravaged Europe from 1348 on were their greatest, the real wage was much higher, equivalent to 18 lb of flour. In the years 1200–1800 in England there is no sign of long-run gains in real wages for the mass of workers. We know also the real day wage of farm workers in Roman Egypt circa AD 250 was the equivalent of 5 lb of flour, not much less than England in 1800.

How did English material living conditions around 1800 compare with hunter-gatherer societies such as those that constituted society through the great bulk of human history? We can obtain insight on this in two ways. The first is by comparing living conditions in England in 1800 with those of the few surviving hunter-gatherer groups. Since the diets were very different here we have to use measures such as the number of calories consumed per person per day. In 1787–96 for the families of English farm workers this was a meagre 1,508 calories. For a group of eight hunter-gatherer societies studied in the 1960s to 1980s the average consumption was 2,272 calories, much better than for England. On this measure the English on the eve of the Industrial Revolution seem to have lived less well than the average hunter-gatherer. Another aspect of the quality of life is life expectancy at birth. One measure of this is the fraction of infants that survived the first year of life. In England as a whole this is estimated at 83 per cent in the second half of the 18th century. For modern hunter-gatherer societies survival rates were a little lower at 79 per cent. But this is still not that much lower than for the richest society in the world in 1800. And survival rates for infants in London, the richest part of England, were only 70 per cent because of the health hazards of city life.

A second measure is the average stature of people. Height is a good index of material living conditions, since it depends on both food consumption and the amount of sickness people experience as they grow. Average heights for adult males in England

circa 1800 were 67 inches or less. This was very good by the standards of societies just before industrialization. Average male heights in Japan in the late 19th century were 61 inches and in India in the early 19th century 64 inches. Yet these heights in England are little if any better than those recorded from skeletons of hunter-gatherers in the Mesolithic (10,000–5,000 BC) and Neolithic (5,000–1,000 BC) in Europe. Average male height from these skeletons is estimated at 66 inches. So overall, if we look at agrarian societies across the world in 1800 AD, the stature evidence suggests a decline in living conditions from hunter-gatherer society.

Thus, the evidence is that for the mass of humanity on the eve of the Industrial Revolution living conditions were no better and probably worse than in the hunter-gatherer past.

GREGORY CLARK

See also anthropometric history; historical demography; industrial revolution, Malthus, Thomas Robert.

BIBLIOGRAPHY

Bennike, P. 1985. *Paleopathology of Danish Skeletons*. Copenhagen: Akademisk Forlag.

Clark, G. 2007. *A Farewell to Alms: A Brief Economic History of the World*. Princeton, NJ: Princeton University Press.

Malthus, T. R. 1826. *An Essay on a Principle of Population*. 6th Edition. London: John Murray.

Miller, M. and Upton, C. 1986. *Macroeconomics: A Neoclassical Introduction*. Chicago: University of Chicago Press.

Koepke, N. and Baten, J. 2005. The biological standard of living in Europe during the last two millennia. *European Review of Economic History, 9 (1),* 61-95.

Steckel, R. and Rose, J., eds. 2001. *The Backbone of History: Health and Nutrition in the Western Hemisphere*. Cambridge: Cambridge University Press.

Wrigley, E. Davies R., Oeppen, J. and Schofield, R. 1997. *English Population History from Family Reconstruction: 1580–1837*. Cambridge and New York: Cambridge University Press.

Figure 1: Long Run Equilibrium in the Malthusian Economy

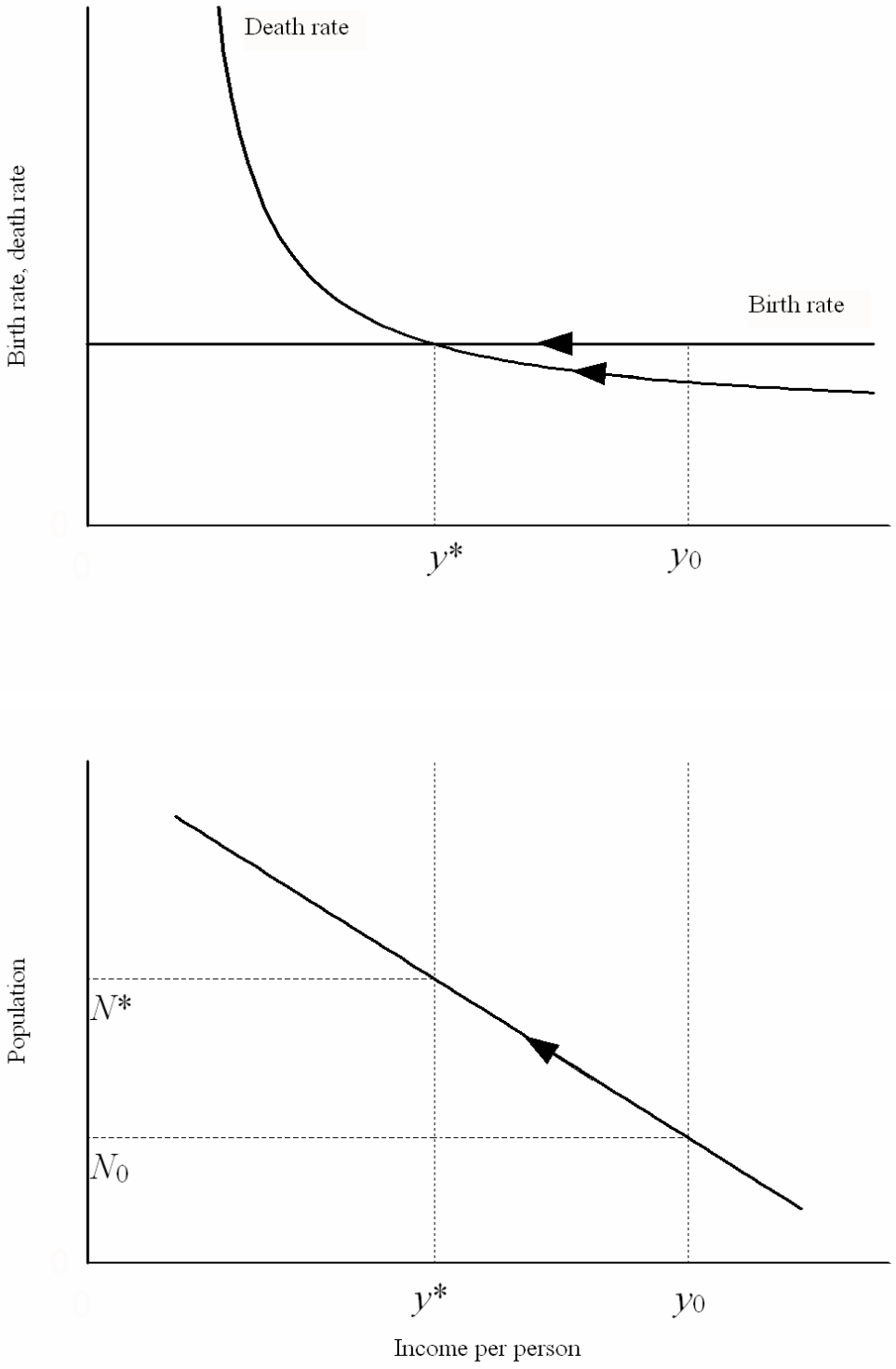

Figure 2: A Malthusian Model where Births Increase with Income

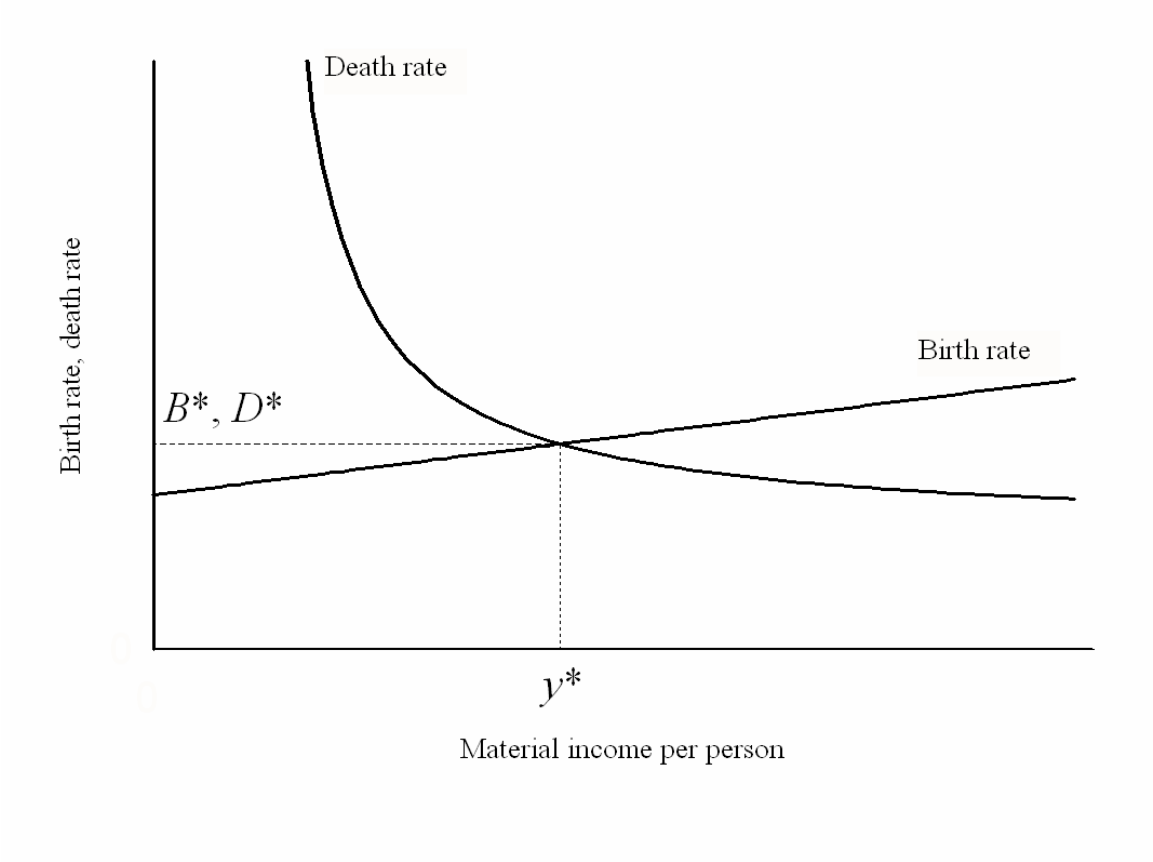

Figure 3: A Malthusian Model where Births Decline with Income