Demographic Causes and Consequences of the Industrial Revolution

Julian L. Simon
University of Maryland

Introduction

This paper inquires into the relationship of population to the industrial revolution. It concludes that increased European population density, and the economic development in the eighteenth and nineteenth centuries were the fundamental causes of each other.

On the one side, the industrial revolution emerged out of increased technical knowledge and improved social organization. Knowledge is the product of human minds, and more minds create more knowledge, other things equal. The larger number of Europeans who were alive in, say, 1850 than 1450 or 1050 produced knowledge more rapidly than if the number of persons had not grown in the previous centuries. Furthermore, the types of social organization that may be found among a relatively small political community, living at relatively low population density, do not well fit a larger community with higher density. New types of social organization therefore tended to evolve. The later types of organization tended to be better fitted for an industrial society than the earlier types, and therefore facilitated the industrial revolution.

On the other side of the relationship, industrial societies have enabled much larger numbers of persons to be born and to remain alive than have agrarian societies. This has occurred because a) more-advanced societies produce more sustenance per hectare than do less-advanced societies, and b) the larger amount of sustenance can be produced by fewer people in the agricultural labour force, and therefore there is less crowding on the land and a larger labour force available for industrial and other non-agricultural work.

This essay develops these two themes, taking up the causes of the growth in population first, and afterward its consequences.

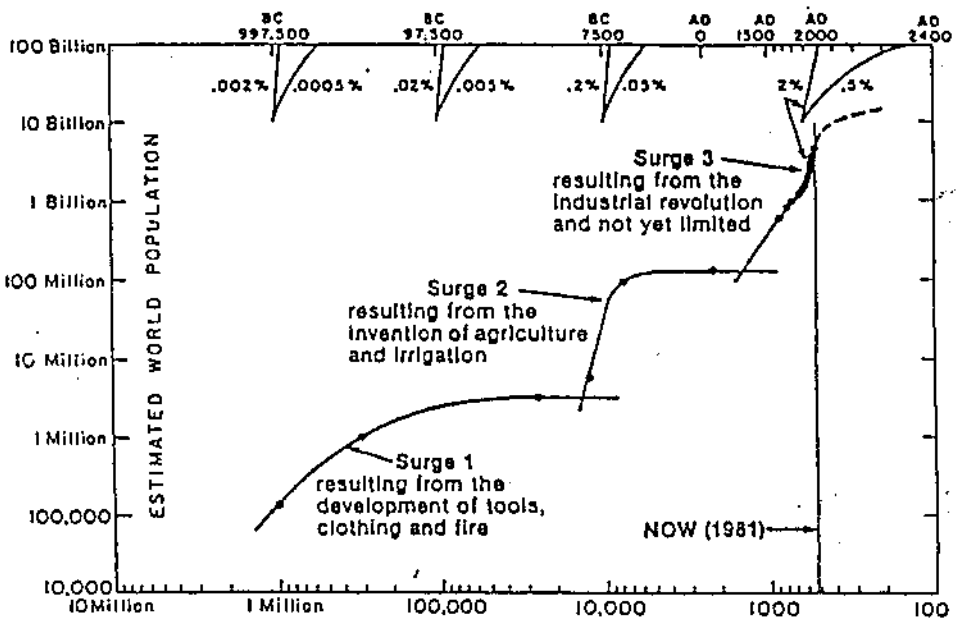
The causes of population increase during the industrial revolution

The rate of increase in population during the industrial revolution in Western Europe and its industrializing overseas extensions was far faster than ever observed before in human history. The matter is placed in the widest

perspective by Figure 1. From 1750 to 1845 in Europe, population increased 80%, a far higher rate of growth than ever before, and «more than twice the previous record, the 36% increase of the XIIth century» (McEvedy and Jones, 1978, p. 29).

Figure 1

Growth of the human population of the world over last one million years



Please notice that the axes are logarithimic
(Source: After Decvey, 1960, by Tinsley, 1980).

Populations grew because the death rate fell spectacularly fast and far. In my view, this drop in mortality is the most notable phenomenon in human history. Figure 2 portrays the course of this event for France, because good data are available for that country. The key fact is that prior to the industrial

revolution life expectancy rose only infinitesimally in each century and millenium, and the entire increase over thousands of years until the industrial revolution was less than in some decades since then.

Figure 2

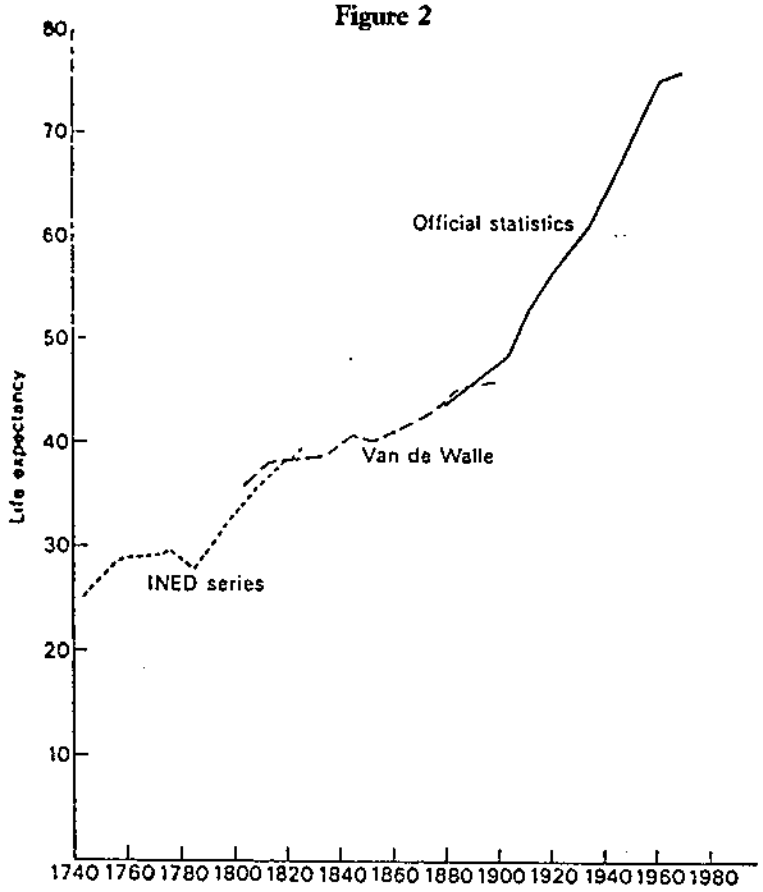


Figure 2 Female expectation of life at birth, France

Source: Compiled by the author.

Figure 3 shows how a rough balance between births and deaths kept the Swedish population from growing rapidly until the period of the industrial revolution, at which time the drop in mortality led to rapid population increase until the birth rate fell, also.

Figure 3

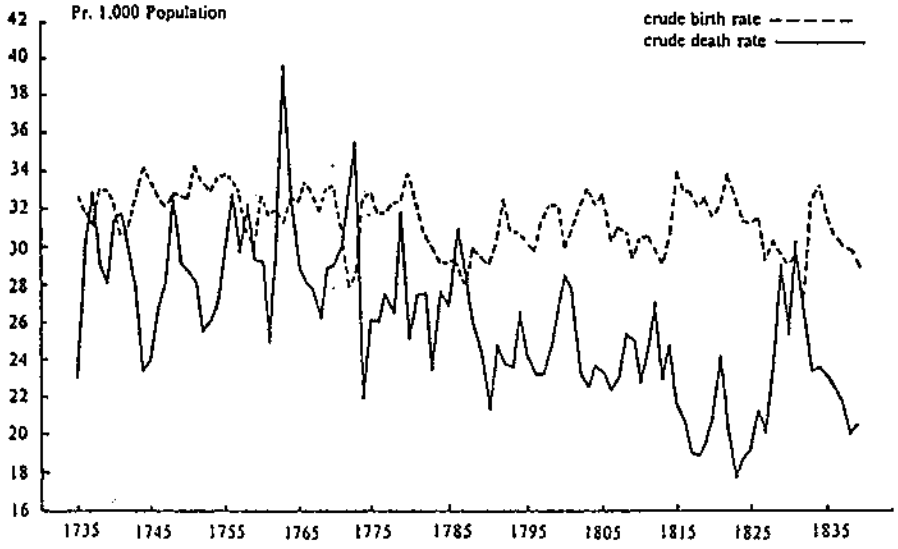


Figure 3 – Crude birth rate (f) and crude death rate (m)
Denmark 1735–1839 pr. 1000 mean population

Source: Otto Andersen, "The Decline in Danish Mortality before 1850 and its Economic and Social Background" in Pre-Industrial Population Change, Tommy Bengtsson, Gunner Fridlizius, and Rolf Ohlsson (Eds.), (Stockholm: Almquist and Wicksell International, 1984).

At the same time, the birth rate rose, due mainly to more marriages. Within marriage the birth rate may also have risen at some times in some places, or it may not; if there was an increase, it was sufficiently modest in extent as to be subject to current scientific controversy about it occurrence. Most important is that the birth rate did not immediately *fall* in such fashion as to balance the decrease of the death rate and keep population from growing. We cannot say with any certainty why people did not reduce fertility for a long time in most countries. (France was an early exception.) Partial explanations include the following: a) People had previously wanted more children than remained alive, and the fall in the death rate simply enabled them to realize that desire. b) Slow-changing social values and habits kept most people from contraception. c) Increased ability to provide sustenance for children increased people's demand for children. d) The fall in mortality was not immediately obvious and hence did not immediately stimulate changes in behaviour.

The causes of the fall in the death rate are also somewhat unclear, though in recent years scholars have made rapid progress in understanding the phenomenon. Some part of the mortality drop may have been unconnected

with economic progress; the climate may have improved and yielded better crops, the rat population may have spontaneously altered its species composition in such fashion that the rigours of plague diminished, and the other disease environment may have become less dangerous. Some part of the improvement may stem from economic progress in only very indirect fashion, if at all, notably through shorter periods of breastfeeding and hence less inhibition of pregnancy. But economic progress was surely responsible for most of the improved life expectancy.

Economic progress helped people live longer by providing better diets. McKeown (McKeown and Brown, 1955: McKeown, 1985) has argued forcefully that "the slow growth of the human population before the eighteenth century was due mainly to lack of food, and the rapid increase from that time resulted largely from improved nutrition" (1985, p. 29). The importance of nutrition is surprisingly difficult to establish, however, and some scholars have recently wondered whether sufficiency of nutrition had any effect at all, citing the puzzling fact that in the late middle ages nobles apparently did not live much longer than commoners. (See, for example, Livi-Bacci, 1985, and other discussions in the same volume). Yet it is an obvious fact that where sustenance is very difficult to come by — say, among the Eskimos, and among desert nomad tribes — population grows slowly or not at all. This would seem to be sufficient proof of a relationship between availability of food and how long people live, in connection with the number of children that they bring into the world (which the available evidence suggests is small, on average, among such groups as the Eskimos and nomads.) And recent work of his own on the history of people's heights, as well as other biometric work, led Fogel to say, concerning "The modern secular decline in mortality in Western Europe [which] did not begin until the 1780s", that "reductions in chronic malnutrition ... may have accounted for most of the initial improvement" which occurred before 1830 and 1840 in Britain and France respectively (1989, pp. 1 and 2).

Economic progress also helped people live longer by improving the health environment. Some part of this was direct medical progress such as vaccination. Such advances in medical practice can be attributed to the combination of a scientific attitude and a greater base of scientific medical knowledge, both of which were enhanced by the industrial revolution; these advances occurred in the countries that were experiencing the industrial revolution, and did not occur in countries such as India and China that were outside the ambit of the industrial revolution.

The health environment was also improved indirectly by economic progress through development of the physical infrastructure of society, especially provision of purer communal drinking water. Such improvements were not mainly intended to improve health and reduce death, but they nevertheless did so to an important degree. Building such infra-structure requires farming to be sufficiently efficient so that society can afford to employ people on such community projects. Also required is that the population be sufficiently large

and dense that such projects are economical. The same is true for roads and other communication systems which contributed to the spread of health technology.

At present, wealthier people live longer than poorer people, for all the reasons discussed above. And wealthier countries have longer average life expectancies than poorer countries; indeed, life expectancies in the poorest countries were no greater just a few decades ago than in poor (or even "rich") countries even two hundred years ago. These facts would seem to confirm the causal connection between the increase in the standard of living beyond subsistence for the multitudes, and the increase in life expectancy, both of which accompanied the industrial revolution.

The effects of demography upon the industrial revolution

The primitive theory of population which had existed at least since classical Greece, and which Malthus formalized, was wholly falsified by the demographic history described above. Instead of the large increase in population leading to immiseration, it was accompanied by the first permanent increase in living standards well above subsistence enjoyed by the bulk of countries' populations. Never before the industrial revolution had a substantial proportion of any country's population enjoyed incomes much above the subsistence level. This may be inferred from the key fact that almost all of every country's population was employed in agriculture, which meant that little labour was engaged in producing the non-agricultural products which constitute the difference between subsistence incomes and above-subsistence incomes. In the absence of non-agricultural products there cannot be much market activity, and without markets for which to produce, farmers produce only for their own subsistence.

The set of events associated with the industrial revolution enabled communities for the first time to reduce the danger of mass starvation. Increasingly, communities had the knowledge and the tools to produce enough food so that there was a margin of safety in case the crops were bad for a year or even two. Just as important, intercommunication of villages and towns by means of roads and markets enabled areas with bumper harvests to sell and transport at reasonable prices to areas with poor harvests.

It must be understood that poor harvests tend to be localized, and transportation systems mitigate food shortages. For example, France in the XVIIIth century was the richest country in the world, with a bountiful agriculture. But there were frequent localized famines. And people died from the famines though there was often a rich harvest in nearby areas. This occurred because transportation was so expensive that "food would not normally be transported more than fifteen kilometers from its place of origin" (Clark and Haswell, 1967, p. 189). Nowadays, modern road systems prevent mass famine even in the face of climatic disaster such as occurred in the Sahel in the 1970s

and 1980s, and in the Indian state of Bihar in the 1960s. Except for governmentally induced starvation such as occurred in China in 1958-1961, in the Ukraine in the 1930s, and in Ethiopia in the 1980s, many fewer people die of famine nowadays than a hundred or two hundred years ago, though there are many times more people alive now (Johnson, 1970). Reduction of danger from famine was part-and-parcel of the industrial revolution in Europe.

The industrial revolution also brought abject poverty and urban squalor to large numbers of people in industrial areas such as Manchester. We may accept as fact that there were larger absolute numbers of people in such dire straits while the industrial revolution was in full swing than before it began. But the proper interpretation of this fact goes beyond social failure and perversion of universal human values due to the industrial revolution.

It is important to recognize that the data do not indicate the immiseration that is popularly believed. Ashton (1954) showed how the evidence did not support the conventional view of historians about the occurrence of such immiseration. And recent careful statistical research (Lindert, 1986, and references therein) has increased doubt whether persons of lower economic class were indeed increasingly worse off as the period proceeded.

Then there is the crucial matter of the role of values in interpreting these data. Hayek emphasises that the fast population growth experienced in the industrial revolution meant that more poor people were enabled to stay alive than in earlier times. [1] He focuses upon the comparison between *fewer and more* poor people being alive, rather than simply comparing a *given number* of persons' state of economic welfare. If one believes that human life is a good thing, then the demographic-economic effect of the industrial revolution may be seen as a gain for humanity, rather than as a tragedy. And it must be remembered that the existence of additional poor people at that earlier time - suffering as well as enjoying life - speeded the industrial revolution to the point where such mass suffering from poverty no longer existed, even for the larger populations that had been brought about. The mechanisms of this transformation are discussed below.

The very high concentration of the labour force in agriculture at the beginning of the industrial transformation may be illustrated by the fact that in the United States as late as 1800, perhaps 80% of the labour force worked in agriculture. Then in the two centuries since then, this proportion fell by a factor

[1] In Hayek's words:

What later enabled those who did not inherit land and tools from their parents to survive and multiply was the fact that it became practicable and profitable for the wealthy to use their capital in such a way as to given employment to large numbers. If "capitalism has created the proletariat," it has done so, then, by enabling large numbers to survive and procreate (1960, p. 119).

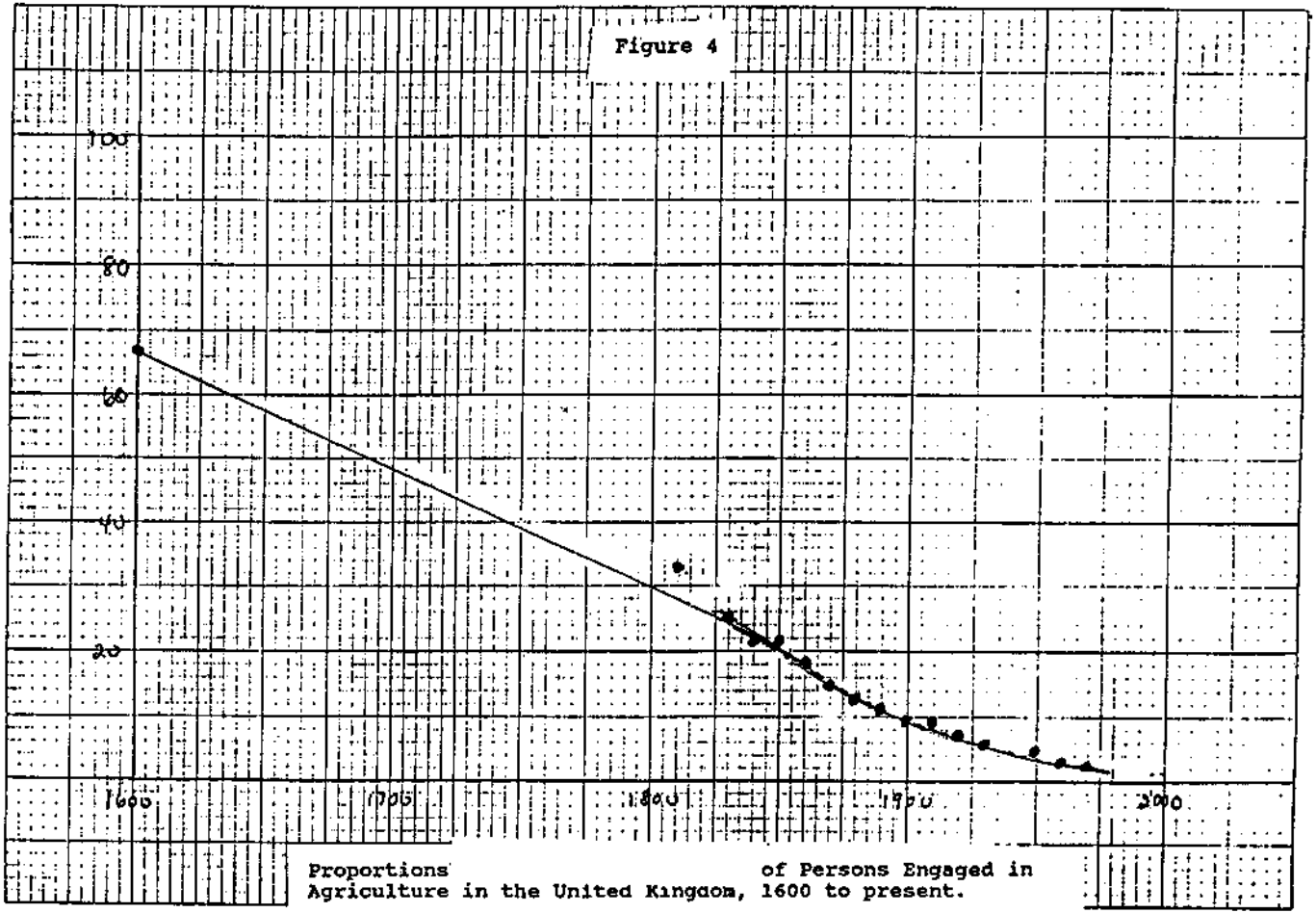


Figure 4
100
80
60
40
20
1600
1700
1800
1900
2000
Proportions of Persons Engaged in Agriculture in the United Kingdom, 1600 to present.
Sources: Mitchell, p.61; Deane, various pages.

of forty, to perhaps 2% of the labour force, and much of that 2% is only part-time agricultural labour. The course of this all-important shift may be seen for the United Kingdom in Figure 4, where the *absolute* drop in numbers of agriculture workers can be seen, also.

The industrial revolution was both a cause and a consequence of this exodus from farming. As it became increasingly possible for a worker in agriculture to feed more and more people outside of agriculture, the number of people who could be employed in industry increased. As industry expanded, there was in turn a greater demand for labour that attracted persons to leave the farms. And as industry competed with agriculture for labour, there was greater incentive for agricultural landowners to find ways to farm more efficiently by economizing on labour with more and newer machines, biological innovations, and new agronomical processes.

Even before the shift of labour out of agriculture greatly increased the demand for new agricultural technology, the increase in population brought more consumers and hence greater demand for food production from stocks of land which were expensive to expand. This in turn increased the demand for new developments in agricultural knowledge. Increased supply of new knowledge followed upon the expanded opportunity; this is seen in data on British agricultural patents, and in data on the publication of books about agriculture, during the period 1550 to 1850 (Simon and Sullivan, 1986). The increase in new agricultural inventions accelerated around 1800, and the same was true for non-agricultural inventions. It is therefore reasonable to think that the rapid increase in population which accompanied the industrial revolution was a major factor in speeding up the development of new technology, through the demand for new technology as well as through the supply of additional persons with ingenious minds who could respond to the opportunities for gain offered by the demand for new technology.

This process has long been misunderstood as a *race* between population and technology. Rather, pressure from increasing population (together with increasing affluence) influences the advance of technology in the ways described above, as well as by way of increased volume of production leading to faster «learning-by-doing» and of better ways to produce efficiently. It is vital that the entire sequence be understood as this dynamic process: impending shortages and other economic problems induce solutions that eventually leave the economy better off than if the shortage problems had not arisen.

This process can be illustrated with the case of England and energy sources. The English became alarmed, beginning in the 1600s and then intensifying in the 1700s (Thomas, 1986), by an impending shortage of energy due to the deforestation of the country for firewood. People feared a scarcity of fuel for both heating and for the iron industry. This impending scarcity led to the development of coal.

Then in the mid-1800s the English came to worry about an impending *coal* crisis. The great English economist, Jevons, calculated that a shortage of coal

would halt the growth of England's industry by 1900; he carefully assessed that *oil* could never make a decisive difference. Triggered by the impending scarcity of coal (and also of whale oil in the United States) ingenious profit-minded people developed oil into a more desirable fuel than coal ever was. And in 1994 we find England exporting both coal and oil.

Here we should note that it was not governments that developed coal or oil, because governments are not effective developers of new technology. Rather, it was individual entrepreneurs who sensed the need, saw opportunity, used a wide variety of available information and ideas, made many false starts which were very costly to those failed individuals (but not to others in the society), and eventually arrived at coal as a viable fuel — because there were enough independent individuals investigating the matter for at least some of them to arrive at sound ideas and methods. This occurred in the context of a competitive enterprise system that worked to produce what was needed by the public.

Because of the unprecedently rapid change in the economy, as well as because of the increases in income and population, the period of the industrial revolution created a large number of new problems for society and the economy. But society also developed new ways to solve problems. And for the first time in history, though self-induced economic difficulties caused slowing in economic growth from time to time, the solutions were not «Malthusian». That is, there were not the usual periods of food shortage and starvation, as there were in the 1300s and 1500s after periods of rapid growth.[2] For example, Europe used new nautical techniques to discover the New World which greatly expanded its area of food production after population had grown to new heights at unprecedented rates. When the land of the New World is included along with that of Europe, persons per square mile are calculated to have decreased from 26.7 in 1500 to 4.8 in 1650, and had only risen to 9.0 by 1800, according to Webb (1952, quoted by Jones, 1981, p. 83).

This description of the development process may sound similar to Toynbee's challenge-and-response explanation of effort. But challenge alone does not clearly specify the mechanism at work. Rather, we must note the presence of two different aspects of challenge that must operate at once: a) the «need» for additional effort as a result of the temporary cessation in the growth

[2] van Bath's description is as follows:

Nearly all over Europe the population began to increase rapidly after 1750, in some lands earlier, in others later. ... The unforeseen rise of population was bewildering to its contemporaries. They were afraid it would end in a disastrous famine. In truth, this might well have happened, if new ways to increase agricultural production and greatly to expand industry had not been discovered. ... The remarkable thing about the modern western civilizaion of the eighteenth century was that it was able to keep individual consumption constant, while production was regulated to match it. It is even likely that individual consumption went up, in spite of the great growth of population. (1963, p. 221).

of wealth that occurs due to population growth causing diminishing returns; and b) the opportunity for effort to pay off, as seen in the vistas of new possibilities for economic exploitation, and in the presence of new tools and knowledge to exploit.[3]

The process was cumulative. The existing stock of knowledge — written in books, embodied in machinery, and expressed in workers' practices — is a crucial input for new discoveries. The richer in technical knowledge that countries became during the industrial revolution, the easier it was to become even richer in additional technology. And as noted above, the larger population led to a larger stock of knowledge through both supply and demand channels.

Concerning production capital: by a process of mutual accretion, the stock of capital and the size of the population increased together throughout the industrial revolution. But the physical capital represented by factories was of less importance than it seemed. Contrary to the views of economists as late as the years just after World War II, we have learned that — given the availability of knowledge of how it is to be done — a population of knowledgeable and energetic people can build (or re-build) a large stock of physical capital in a relatively short time; the size of the stock of plant and equipment is more the *measure* of an industrial economy than a *constraint* upon its productivity, except in the very short run.

The less-obvious social capital probably was of greater importance than machinery capital in the long run, and depended more heavily upon the size of the population. Roads, urban water delivery systems, irrigation systems (though in Europe irrigation was less important than in the Middle East and East), dams, dykes, harbours, and other infra-structure have already been mentioned, as has been their close relationship to population density. This relationship is very marked in modern data for groups of countries at similar income levels; where population is more dense, road networks and electrical power networks are more available to rural populations (Glover and Simon, 1975). And there is considerable reason to think that transportation and communications networks are the key elements in economic development.

[3] It is important that need alone is not enough. Consider this observation by van Bath:

In the Netherlands the high degree of agricultural development must be attributed to the great number of inhabitants, each with only a small patch of ground to cultivate, but making the most intensive use of it. This advanced development was not the result of a high general level of prosperity in the countryside, but rather of the great density of the rural population. To put it shortly — and therefore not without over-generalization — the reason for the transition to intensive cultivation was not wealth but necessity. This is clearly shown in a treatise by a French writer on Flemish farming in 1776 in French Flanders. After having pointed out that the soil in these parts was, on the whole, of poorer quality than in some French departements, he explains that the superior results of the Flemish farming were due to heavy manuring and the moral qualities of the peasants, that is to say their diligence and thrift (1963, p. 242).

Perhaps even more important, but certainly more difficult to pin down statistically, is the effect of population size and density upon social and political organization. This element in economic development is given ever-greater importance by such scholars as Jones (1981) and McNeill (1963)[4]. Stevenson argues that increasing density leads to better-articulated organization of society; this seems plausible, but the phenomenon is difficult to quantify.

Population density also leads to better-organized markets. Hicks (1969) and North (1981) have shown the historical connection at the local and regional level. This phenomenon was seen most vividly after the depopulation of the Black Death. Land was more available to cultivators than before, at lower rents, and wages were higher. But, overall economic conditions apparently were less favourable even for the poor in general economic depression; this was caused by the disappearance of markets due to the lack of people and products to support them.

The presence of cities — which (along with infra-structure) seem to have been a crucial pre-condition of the industrial revolution in England, Holland, and elsewhere — also requires relatively dense populations in surrounding areas. Cities and markets are closely related phenomena. Pirenne's magisterial analysis (1925/1969) depends heavily upon population growth and size. Larger absolute numbers of people were the basis for increased trade and consequent growth in cities, which in turn strongly influenced the creation of an exchange economy in place of the subsistence economy of the manor. According to Pirenne, growth in population causing cities to grow also reduced serfdom by offering serfs a legal haven in the city, as memorialized in the saying «town air makes free». The alternative of moving to the city to work must also have reduced the power of landlords over tenant farmers, and therefore must have resulted in better terms of rental from the tenant's point of view. This, together with the freedom of town life must have contributed to an increase in personal liberty, and worked to end feudalism, though the causes of the end of serfdom are a subject of much controversy[5].

The question arises: If more people cause there to be more ideas and knowledge, more growth of markets and cities, and hence higher productivity and income, why did not the industrial revolution begin in India and China? We may note that size in terms of population within national boundaries was

[4] But if the opportunity represented by an existing stock of knowledge to be applied intensively had not pre-existed, the need would only have resulted in Malthusian disaster, as had happened in earlier times.

[5] Surprising confirmation of the importance of political and economic organization comes from North's analysis (1968, p. 953) of the sources of productivity change in ocean shipping for 1600 to 1850. Rather than technological development being preeminent, "The conclusion which emerges from this study is that a decline in piracy and an improvement in economic organization account for most of the productivity change observed."

not very meaningful in earlier centuries when national integration was much looser than it is now; the relevant variable is population density rather than total population, and if borders had been drawn arbitrarily so that we thought of China and India each as ten states instead of one, the situation would not be fundamentally different in the past. And at present, differences in education may explain much, but do not explain the differences between the West and the East over the five centuries or so up to, say, 1850.

There seems to have been a nexus of inter-connections between loosening of feudal ties, growth of cities, personal economic freedom, political freedom, openness of societies, competition among European states, economic advance, and population growth. McNeill (1963), Jones (1981) and others have suggested that over several centuries the relative looseness and changeableness of social and economic life in Europe, compared to China and India, helps account for the emergence of modern growth in the West rather than in the East[6]. Change implies economic disquilibria which (as Schultz [1975] reminds us) imply exploitable opportunities which then lead to augmented effort. (Such disequilibria also cause the production of new knowledge, it would seem.)[7]

More specifically, the extent to which individuals are free to pursue economic opportunity, and the extent to which there is protection for the property which they purchase and create for both production and consumption, together with the presence of diversity and competition at all levels, seem to make an enormous difference in the propensity of people to develop and

[6] More generally, it seems reasonable that the power of landowners must be reduced by increasing job opportunities for unskilled and semi-skilled in the cities. This would seem to explain why one does not hear of rapacious agricultural landowners in developed countries. And it suggests that China need not worry about ownership of farm land despite the production system shifting to free enterprise in 1979-1981. Through its role in promoting cities and markets, population growth may be seem as promoting this element of freedom. (See Domar, 1970, for a discussion of this matter.).

[7] McNeill's discussion is illuminating:

[M]erchants were disreputable in China. Confucius had ranked them at the bottom of the social scale...

The nub of the difference between the Far East and the Far West lay in the fact that despite the development of great cities, of a significant regional specialization, and of a highly skilled artisan class, these features of "modern" Chinese life were successfully encapsulated within older agricultural social relationships. The commercial and artisan classes of China never developed a will and self-confidence to challenge the prestige and values of the bureaucracy and landed gentry; whereas in northwestern Europe the evolution of merchant communities from the pirate bands of the ninth-tenth centuries gave them from the start a sense of independence from — indeed of hositility toward — the landed aristocrats of the countryside. European merchants did not cater to anyone: they sought to become powerful in their own right and soon succeeded in doing so. Indeed, by the thirteenth century in Italy, and by the sixteenth century in critically active centre's of northern Europe, merchants had

innovate. Clough (1951, p. 10) discussed the importance for the «development of civilization» of

> ... a social and political organization which will permit individuals to realize their total potential as contributors to civilization. What is implied here is that in a system where social taboos or political restrictions prevent large segments of a culture's population from engaging in types of activity which add most to civilization, the culture cannot attain the highest degree of civilization of which it is capable. Thus the caste system in India, restrictions on choice of occupation in medieval Europe, and the anti-Semetic laws of Nazi Germany curtailed the civilizing process.

This factor seems to be the best explanation of the "European miracle," to use Jones's term, in comparison to the recent centuries' histories of India and China[8].

The question of why societies have more or fewer social rigidities, and why Europe should have been so much more open than India and China, are questions that historians answer with conjectures about religion, smallness of countries with consequent competition and instability, and a variety of other special conditions. Population growth also may cause a rigid structure to break up. This is Boserup's thesis (1965) applied to simple, small, societies, and Lal 1991 has made this case effectively for the history of India's economic development over thousands of years. Lal suggests that it was only the rapid population growth starting around 1921 which cracked the "cake of custom"

captured the state and bent it to their own purposes to a degree utterly inconceivable in Confucian China.

The net effect of the weakness of the Chinese mercantile class was to blunt (or control?) the social and political impact of a number of important technological developments in which China conspicuously led the world during the period before 1000 A.D. Inventions like paper and porcelain, printing and gunpower, were not entirely without effect upon Chinese society as a whole; but the full and reckless exploitation of these inventions was reserved for the looser, less ordered society of western Europe, where no overarching bureaucracy and no unchallengeable social hierarchy inhibited their revolutionary application (McNeill, 1963, p. 514).

[8] It must be noted that change and social stability are not opposites. Change is not the same as instability or chaos. And according to Jones (1981, p. 149)

[T]he rise of the nation-state ... seem[s] to account for ... the establishment of the stable conditions necessary for expanding development and growth, for the diffusion of best practices in technology and commerce, and in several countries for the actual founding of manufactories where there had only been handicrafts. The self-propulsion of market forces explains much, at least in the less authoritarian parts of north-west Europe. A full explanation of the generalisation of novelty must also take the nation-state into account.

Another element: Elsewhere (Simon, 1987) I have systematically developed the hypothesis that the combination of a person's wealth and opportunities affect a person's exertion of effort. This idea may help explain the phenomenon at hand.

and the Hindu caste system, and caused the mobility which allowed India to begin modern development.

A fuller analysis of the subject at hand — and one that is beyond the powers of this writer — would also consider the effects of the pre-existing social and economic frameworks upon the reaction to population growth. A flexible framework may enable population and economic growth to facilitate each other, whereas a rigid framework may mean that population growth leads only to immiseration and eventually the cessation of the population growth. As Weir (1984, p. 48) noted in a comparison of French and English history:

> "If ... we allow that some societies may be more successful than others at generating productivity growth in response to population growth, then a new set of research questions will emerge to integrate economic and demographic history."

Most (if not all) historians (e.g. Nef, 1958, 1960; Gimpel, 1976) agree that the period of rapid population growth from before AD 1000 to the beginning of the middle of the 1300s was a period of extraordinary intellectual fecundity. It was also a period of great dynamism generally, as seen in the extraordinary cathedral building boom. But during the period of depopulation due to the Black Death plague (and perhaps due to major famines around 1315-17 and to climatic changes starting with 1300s, and perhaps starting even earlier when there also was a slowing or cessation of population growth due to other factors) that continued until perhaps the 1500s, intellectual and social vitality waned.

These are very slow-moving phenomena, of course, and changes during the industrial revolution continue and extend population-related changes begun centuries before in Europe. For our own time, we finally have solid statistical evidence from comparisons of centrally-planned versus market-directed economies of the importance of the political and economic structure in economic development. For example, comparisons of pairs of countries with the same history, language and culture are particularly revealing -North Korea versus South Korea, East Germany versus West Germany, and China versus Taiwan and to some extent Hong Kong and Singapore. These contemporary data help us infer the effects of population growth in causing greater openness, diversity, and decentralization in earlier centuries.

Even slower-changing than political and economic structure are basic institutions of law and convention. These institutions tend to evolve gradually

Ceteris paribus, the less wealth a person has, the greater the person's drive to take advantage of economic opportunities. The village millions in India and China certainly have had plenty of poverty to stimulate them. But they have lacked opportunities because of the static and immobile nature of their village life. In contrast, villagers in Western Europe apparently had more mobility, less constraints, and more exposure to cross-currents of all kinds, and hence were more easily able to loosen their rural ties and join in the industrial revolution.

rather than being altered by political upheaval or legislation. Hayek (forthcoming) argues that property rights and the family are the two most important institutions in determining the economic progress of a nation. He suggests that they, as well as the rest of the rich tapestry of cultural patterns, develop by a process of cultural selection wherein communities that grow in numbers are more likely to have their institutions be dominant in the wider world than are groups that do not increase in population. Much of this evolutionary process takes place over thousands of years, rather than the "mere" hundreds of years which encompass the industrial revolution. But the effects were important for economic development; for example, the system of Anglo-Saxon common law and its protection for property surely aided the course of the industrial revolution in England. Therefore, these slow-moving effects of population increase should not be forgotten in our survey of demographic consequences. And in turn, the industrial revolution affected the institutions of family and property rights.

Most difficult of all to pin down is the effect of population growth and the industrial revolution, and their proximate effects discussed earlier, upon individual psychology and small-group sociology. Adam Smith remarks that "The progressive state is in reality the cheerful and the hearty state to all the different orders of the society. The stationary is dull; the declining melancholy." And it was a commonplace during the earlier part of the industrial revolution that industrial work discipline, including attention to the daily time schedule for work hours, was both important and slow to develop. Many writers have discussed the mentality of progress, and the notion of systematic scientific progress, that were concomitants of the industrial revolution.

However accurate these observations may be, they do not stand on the same level of demonstrated fact as do the phenomena discussed earlier. We can do little more than mention psychological and small-group effects and pass on. But the brevity of this treatment should not be taken as suggesting that these factors may not be of great significance. (On the other hand, perhaps human nature should be seen as having been changed relatively little by the industrial revolution. The meaning of "little" and "much" are quite subjective, of course).

Conclusion

The main themes of this article are summarized in the Introduction. After this review, perhaps the reader will be satisfied that demographic change was an indispensable element woven into the fabric of the Industrial Revolution. Population growth was both cause and consequence. Its importance can only be indicated by asserting that if population had not been able to grow as fast as it did, the progress of the Industrial Revolution would have been much slower than it was.

REFERENCE

Ashton, T. S., "The Treatment of Capitalism by Historians", in F. A. Hayek (ed.), *Capitalism and the Historians* (Chicago: U. of C. Press, 1954), pp. 31-61.

Boserup, Ester, *The Conditions of Economic Growth* (London: Allen and Unwin, 1965).

Clough, Shepard B., *The Rise and Fall of Civilization* (New York: Columbia University Press, 1951, 1957).

Clark, Colin, and Margaret Haswell, *The Economics of Subsistence Agriculture* (New York: St. Martin, 1967).

Deane, Phyllis, "Great Britain," in *The Fontana Economic History of Europe: The Emergence of Industrial Societies, Part One,* edited by Carlo M. Cipolla (London: Fontana, 1970).

Domar, Evsey D., "The Causes of Slavery or Serfdom: A Hypothesis", *The Journal of Economic History*. XXX, 1970, pp. 18-32.

Fogel, Robert William, "Secular Trends in Mortality, Nutritional Status, and Labour Productivity", mimeo, February 2, 1989.

Gimpel, Jean, *The Medieval Machine* (New York: Penguin, 1976).

Glover, Donald, and Julian L. Simon, "The Effects of Population Density Upon Infra-structure: the Case of Road Building." *Economic Development and Cultural Change,* Vol. 23, 1975, pp. 453-68.

Hayek, Friedrich A., *The Constitution of Liberty* (Chicago: University of Chicago Press, 1960).

Hayek, Friedrich A., *The Fatal Conceit,* (Chicago: University of Chicago Press, 1991).

Hicks, Sir John, *A Theory of Economic History,* (London: Oxford University Press, 1969).

Johnson, D. Gale, "Famine." *Encyclopaedia Britannica,* 1970.

Jones, Eric L., *The European Miracle* (New York: Cambridge UP, 1981).

Lal, Deepak, *Cultural Stability and Economic Stagnation: India, 1500 BC-1980 AD* (London and New York: Oxford U. P., forthcoming).

Livi-Bacci, Massimo, "The Nutrition-Mortality Link in Past Times: A Comment", in Rotberg and Rabb, pp. 95-100.

Lindert, Peter H., "English Population, Wages, and Prices: 1541-1913", in Robert I. Rotberg and Theodore K. Rabb (eds.), *Population and Economy* (Cambridge: CUP, 1986), pp. 49-74.

McEvedy, Colin, and Richard Jones, *Atlas of World Population History* (New York: Penguin Books, 1978).

McKeown, Thomas, "Food, Infection, and Population", in Rotberg and Rabb, 1985, pp. 29-50.

McKeown, Thomas, and R. G. Brown, "Medical Evidence Related to English Population Changes in the Eighteenth Century", *Population Studies,* Vol 9, 1955, pp. 119-141.

McNeill, W. H., *The Rise of the West — A History of the Human Community* (Chicago: The University of Chicago Press, 1963).

Nef, John V., *Western Civilization Since the Renaissance* (New York: Harper and Row, 1950/1963).

North, Douglass C., *Structure and Change in Economic History* (New York: Norton, 1981)

North, Douglass C., "Sources of Productivity Change in Ocean Shipping, 1600-1850, "*The Journal of Political Economy, 1968, Vol. 76, 5* pp. 953-967.

Pirenne, Henri, *Medieval Cities* (Princeton: Princeton University Press, 1925/1969).
Rotberg, Robert I., and Theodore K. Rabb, *Hunger and History* (New York: Cambridge Univ. Press, 1985).
Shultz, Theodore W., "The Value of the Ability to Deal with Disequilibria'," in *Journal of Economic Literature,* 1975, pp. 827-46.
Simon, Julian L., *Effort, Opportunity, and Wealth* (Oxford, UK: Basil Blackwell, 1987).
Simon, Julian L., and Richard J. Sullivan, "Population Size, Knowledge Stock, and Other Determinants of Agricultural Publication and Patenting: England, 1541-1850," *Explatims in Economic History,* Vol. 26, 1989, pp. 21-44.
Slicher van Bath, B. H., *The Agrarian History of Western Europe, A.D. 500-1850* (London: Arnold, 1963).
Stevenson, Robert F., *Population and Political Systems in Tropical Africa* (New York: Columbia University Press, 1968).
Thomas, Brinley, "Escaping from Constraints: The Industrial Revolution in a Malthusian Context", in Robert I. Rotberg and Theodore K. Rabb (eds.), *Population and Economy* (Cambridge: CUP, 1986), pp. 49-74.
Webb, Walter Prescott, *The Great Frontier,* (Boston, Mass.: Houghton Mifflin, 1952).
Weir, David R., "Life Under Pressure: France and England, 1670-1870," *The Journal of Economic History,* Volume XLIV, March 1984, pp. 27-48.