Chapter 3: Living Standards in the Malthusian Era

> (The inhabitants of Tierra del Fuego in 1832) These poor wretches were stunted in their growth, their hideous faces bedaubed with white paint, their skins filthy and greasy, their hair entangled, their voices discordant, and their gestures violent. Viewing such men, one can hardly make one's self believe that they are fellow-creatures, and inhabitants of the same world …. If a seal is killed, or the floating carcass of a putrid whale is discovered, it is a feast; and such miserable food is assisted by a few tasteless berries and fungi (Darwin (1839), p. ---).

> (Tahitians in 1769) These happy people may almost be said to be exempt from the curse of our forefather; scarcely can it be said that they earn their bread with the sweat of their brow when their cheifest sustenance Bread fruit is procurd with no more trouble than that of climbing a tree and pulling it down (Banks (1962), p. 341).

Introduction

The logic of the Malthusian economy is clear. There should be no systematic gain in living standards on average across societies between earliest man and the world of 1800 on the eve of the Industrial Revolution. Disease, war, infanticide and customs regulating marriage and sex could raise material living standards above the average. But on balance the happy circumstances that made for Tahiti in 1769, or the unhappy ones that made for Tierra del Fuego in the 1830s, were no more likely anywhere in 1800 as in 10,000 BC. In this chapter I consider the evidence for this first crucial contention of the Malthusian model of society. Were material living standards truly no better on average in 1800 AD than in 10,000 BC or even 100,000 BC?

Real Wages before 1800

The best evidence on this are comprehensive measures of real wages per work hour, but such measures demand much more evidence than we can find for most pre-industrial economies, and not all societies have economies that are elaborate enough to contain labor markets. Pre-industrial England, however, has a uniquely well documented wage and price history. The relative stability of English institutions after 1066, and the early development of markets, allowed a large number of documents with wages and prices to survive in the records of churches, monasteries, colleges, charities, and local and national government. These documents have been the basis of many studies of pre-industrial wages and prices.[1] Using these we can construct a relatively comprehensive estimate of nominal wages, and of the prices of consumption goods, back to the year 1208-9. 1209 is in the reign of King John, and the struggle between the king and the feudal barons over their respective rights that lead after the defeat of John to the Magna Carta of 1215.

The weights for expenditures in the cost of living index are derived mainly from budget studies of manual workers expenditures collected in the years 1786-1854, when social commentators began to collect such information on a large scale, as summarized by Sarah Horrell. The Horrell average budget shares, together with earlier evidence for London manual workers from Vanderlint (1734), are given in table 1. Since, as we shall see real living standards in England do not vary by more than about 2:1 over the years 1200-1800, we use the same set of weights for the major categories of expenditure throughout these years.

At the living standards of English workers typical of the years before 1860 food constituted the major expenditure, and I assume in estimating real wages trends in England that workers spent 68% of their incomes on food. For bread and flour, the staple article that formed the largest single share of workers' expenditures, I use the price of wheat. Both bread and flour

[1] Most notable are those of James E. Thorold Rogers, William Beveridge, Elizabeth Gilboy, Henry Phelps-Brown and Sheila Hopkins, Peter Bowden, David Farmer, Bernard Eccleston, Donald Woodward, Steve Rappaport, Jeremy Boulton, and Charles Feinstein. Rogers (1866, 1888a, 1888b, 1902), Beveridge (1936, 1939), Gilboy (1934), Phelps Brown and Hopkins (1954,

had very different qualities that are hard to control for over long time intervals, and the cost of wheat was a very large share of the cost of flour and bread. Further the available bread prices until well into the nineteenth century were those for bread in London, whose price was regulated by statute until 1815. Using wheat avoids all these quality issues. Further a breakdown of the costs of bread baked for the Navy in 1767 given by Beveridge suggests that the price of flour and bread should move closely in line with that of wheat, since wheat constituted 92% of the costs of making bread, and would be an even larger share of the costs of flour.

The Composition of Bread Costs, 1767

Wheat	91.7%
Salt	0.8%
Yeast	1.0%
Fuel	3.3%
Wages	3.0%

Over time the ratio of the assize price of bread in London to the cost of wheat changes markedly. Thus the ratio of the price of 4 lbs. of bread in London in pence to the price of a bushel of wheat in England in shillings falls from an average of 1.36 in 1670-1769 to 1.14 in the years 1770-1799, but then bounces back up to 1.32 in the years 1820-69 when the assize was abolished.[2] Given the cost shares noted above this would not be possible if the bread was of constant quality. The quality of bread would vary according to what fraction of the wheat was incorporated in the flour. Thus it has seemed more prudent to use the price of wheat as a proxy for bread and flour, and include an increased allowance for salt, fuel, and services in the cost of living index to cover the manufacturing cost. The costs of barley meal and oatmeal were

1956), Bowden (1967, 1985), Farmer (1988, 1991), Eccleston (1976), Rappaport (1989), Woodward (1995), Boulton (1996, 2000), Feinstein (2000).

2 Webb and Webb (1904).

similarly proxied by the prices of barley and oats. Together these basic grains and potatoes formed 31% of the cost of living index.

Even in England meat prices by the pound can be found only after 1540. Before this meat was typically quoted by the live animal, the carcass, the quarter carcass, or such cuts as the leg, not by weight. Earlier scholars such as Phelps Brown and Hopkins thus use live animal prices as a proxy for meat prices in the years before the 1580s. However, this assumes that in the long interval 1260-1600 there was no change in average animal sizes. This is a dangerous assumption given other evidence that medieval animals were much smaller than those of the nineteenth century. So for the years before 1540 I approximate meat prices using the one animal product where there is abundant evidence of prices by the pound, which is suet or tallow, and also the price of a close substitute, fish. Since this was produced jointly with meat the hope is that the prices of the two would move together.

Sugar is calculated based on the price of sugar alone in later years, but earlier on the prices of both sugar and honey. For fuel I use an average of the price of faggots, turf and charcoal until the 1450s, an average of faggot and turf, charcoal and coal prices from 1450-1830, and after 1830 the price of coal alone.[3] For light and soap I use the prices of tallow candles from 1280 on, and of tallow the main input in making tallow candles, for the earlier years. Towards the end of the period gas lighting was spreading in towns. Thus for light I use a mixture of gas light prices and candle prices for the years after 1810.

A major innovation in the cost of living series here is the inclusion of housing rental costs, which I estimate constituted 10% of the expenditure of workers by the nineteenth century. Rents controlling for housing quality are estimated for 1290-1869 using the methods discussed in

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Clark (2002). For the years before 1500 there is only one source of housing rents, a detailed study of medieval Winchester by Derek Keane (Keane (1985)). After this the range of sources is greater. For London I have properties leased by various London Companies: the Armorers and Braziers, Carpenters, Clothworkers, and Grocers. In addition a substantial set of leases exists for houses owned by the Almshouse in Saffron Waldon, Essex before 1700.

The cost of living series used here also has much improved estimates of clothing and bedding costs. These again are estimated to constitute about 10% of total expenditure. Much new data for the years 1580-1869 was collected from the records of clothing charities administered by London Guilds or parishes. The Clothworkers' Company in particular supplied a wealth of information on linen, cloth, stocking and shoe prices over these years. For the later years the clothing provided to the inhabitants of Wyatt's Almshouse administered by the Carpenters' Company gave a continuous series of prices.

Using these data we derive the series of real wages for England from 1200-9 to 1860-9 portrayed in figure 3, where the real wage in the decade 1800-9 is set at 100. These wages have been continued to 2000 using a general cost of living index. Though they are a bit higher by 1800, real wages show remarkably little gain in the 600 years from 1200 to 1800. In the first half of the thirteenth century they are at 73 percent of their level by 1800-9. Also the fluctuations within the six hundred year period are much more important than any long run upward trend. Thus in 23 of the 60 decades between 1200 and 1800 real wages are estimated to be above their level in 1800-9. And the highest real wage found in this interval is in the decade 1450-9, long before 1800.

The English experience also shows that while the Malthusian economy displayed stagnating material living standards, these were not necessarily low standards of living even by the standards of many modern economies. I can also construct for England, given the abundance of data, at least a rough estimate of what total output per person was over time, and then see how this compares to modern economies. What we find is that though the technology in pre-industrial Europe, as we shall see, was fairly primitive, material living standards were high compared to the poorer countries in the modern world. Thus figure 4 shows estimated real Gross Domestic Product per person in England in various epochs compared to India from 1873 on. Interestingly only in the 1990s does India achieve a GDP per person which exceeds that of England in the poorest periods of its history from 1250 to 1860.[4] India in the years 1873 to 1939 had an output per person that was only half that of England before 1800, even for the lowest output years. And output per person in England in the fifteenth century was nearly four times that of India in the late nineteenth century.

This information on English living standards before 1800 thus illustrates that within any society under the Malthusian constraints wages and living standards can fluctuate by quite large amounts, and that societies subject to the Malthusian constraints were not necessarily particularly poor even by the standard of today's world.

There is little information on real wages for any society earlier than England in 1200. One exception is Roman Egypt in the first three centuries AD where the extremely dry climate has preserved a significant amount of papyrus inscribed with economic information. From this we can infer the real wage, measured crudely in terms of lbs of wheat flour the wage would typically buy per day, and compare it with later societies. For day laborers in agriculture the message is that Egyptian workers of 250 AD were nearly as well off as English farm workers in

[4]Real GDP per person is the sum of all goods and services in the economy produced domestically per person. It is not the same as real wages, but tends to be highly correlated with real wages.

1800-9. These workers were also as well paid as their counterparts in Egypt even up until the 1960s. They were also considerably better paid than Indian workers in many areas of India in 1900-14. Table 3 shows this comparison. Again there is no sign of any upward move in wages within the Malthusian era.

Within Europe Bob Allen has computed real wages of building workers in major cities from 1500 on. Comparing 1500-49 to 1750-99 in 17 European cities across 9 countries real wages of building workers declined in 16 of these 17 cities, the sole exception being London (Allen (2001), p. 428). Thus again we see no evidence of any upward trend.

Human Stature as an Index of Living Standards

Real wages are available for only a small share of pre-industrial societies. If we are to measure living standards for most of the pre-industrial era we need to resort to more roundabout methods. One is how tall the average person was in different societies. The most obvious effect that better material living standards have is to make people taller. If you travel even now to a poor country such as India one of the things that will strike you immediately is how short people are. Thus the current average height of English and American males is 175 cm (68.9 in). In contrast males aged 25-39 in four southern states in India in 1988-90 had an average height of only 64.4 inches, a full 4.5 inches shorter than males in the USA or England.[5]

There is little sign in modern populations of any genetically determined differences in potential statute, except for some rare groups such as the pygmies of Central Africa. And the

[5]Brennan, McDonald and Shlomowitz (1997), p. 220. The states were Kerala, Tamil Nadu, Karnataka and Andhra Pradesh.

positive correlation between health measures and height is well documented.[6] Stature is determined by both childhood nutrition and the incidence of childhood illness. Episodes of ill health at growth phases can stop growth, and there is only partial catch up later. But both nutrition and the incidence of illness depend on average material living conditions. Evidence on the stature of the living tends again to come from only a few pre-industrial societies – typically from military records, or measurements of convicts, slaves and indentured servants for identification purposes. But through measurement of the long bones in skeletal remains we can get evidence on the stature of a much earlier set of pre-industrial societies.

We get evidence for heights of the living at the dawn of the modern era in 1800 mainly from evidence on military recruits or conscripts, convicts and indentured servants. All these measures, however, have to be treated carefully because of potential selection biases. There are often height minima for soldiers, for example. Table 4 shows a summary of this evidence for the years around 1800 for Britain, France, the Netherlands, Sweden and the USA as compiled by Richard Steckel and Roderick Floud. Clearly at the onset of the Industrial Revolution heights of European males were intermediate between those of the modern US and Europe, and those of modern India. But also there was clearly a lot of variation across European societies, with French and Dutch heights little greater than for modern India, and US heights not much less than that of modern developed economies.

In comparison the people of Tahiti in 1769, with their stone age technology, seem likely to have been as tall or taller than the English in 1800. Joseph Banks on the Endeavour expedition of 1769 noted that the tallest Tahitian he measured was 75.5 inches (Banks (1962), p. 334).[7]

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6 Steckel (1995).

7 Tahiti was first contacted by Europeans with the arrival of the British with Captain Wallis in the *Dolphin* in 1767. This was quickly followed by de Bougainville's French ships in 1768.

Assume he saw a population as large as 500 adult males. With the modern US standard deviation for heights, we would expect to observe one man with height equal or exceed 75.5 inches at a mean height for males of 68.5 inches. This would exceed the heights in all western European countries around 1800 by a considerable margin. In England in 1800 only four adult males in 10,000 would be 75.5 inches or taller.

The earliest record we have of Indian heights is from measures of indentured immigrants from India to Mauritius in the 1840s on. But since these are the heights of 24-40 year old males, they consequently were born between 1803 and 1820, so that the height data refer to living conditions for men growing in the years 1803-1840. There are two potential biases in this group. First if they were signing up to work as indentured servants then they may have been drawn from the lower economic groups. But offsetting this, the contractors who were hiring them to engage in sugar cane cultivation had an incentive to recruit the most robust males they could find in this pool. Yet interestingly these Indian migrant workers are nearly two inches smaller on average than transported English convicts born in the years 1770-1815. This conforms with the information presented above that suggested that the English in 1800 were likely significantly wealthier than Indians in the nineteenth century. The first available records for the Japanese in the late nineteenth century again suggest they were very small even by the standards of England in 1800.

Finally as a guide to likely living conditions before the arrival of settled agriculture we have average heights for modern foraging societies. Here, as table 4 shows, there is a range of variation that is similar to that in agrarian societies around 1800. Some hunter-gatherers were

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But by the time Banks arrived with Captain Cook in 1769 the islands had been little changed by contact. The diaries and records of that visit provide much of the information on the nature of Polynesian society before it changed rapidly under European influence.

were significantly taller than the nineteenth century Indians or Japanese. The average heights of the modern hunter gatherers are about the same as those of the Dutch or the French circa 1800. Some hunter gatherers were as tall as all but the Americans in 1800. Thus the thousands of years of advance representing the difference between forager technology and that of agrarian societies around 1800 did not lead to any signs of a systematic improvement in human material living conditions.

Secondly we can look at the inferred heights of the male population measured from skeletal remains. Figure 3 summarizes the published evidence available on average heights from skeletal remains in Europe from 1 AD to 1800, where the average height estimate has been contolled for gender, for regional effects, and in a limited way for the age of the person at death. The century long averages summarize data from 9,477 sets of human remains. There is absolutely no trend in this series. Also shown are the heights of male conscripts by birth year for Sweden from 1820 on, and the heights of native born US males, from 1710 on. The gains in income after 1800 show up clearly in the heights of the living.

Table 5 shows measures of the average stature of males inferred from skeletal collections from various other locations and eras. The small numbers in many of these collections, the potential mismatch between the economic status of those leaving the remains and the general population, and the errors in going from long bone lengths to estimates of stature, all imply that there will be large potential errors in how well these samples represent the populations they were drawn from. But the overall pattern is very clear. Average heights in the skeletal record before 1 AD were just as great as those for the most advanced economies in the world in the eighteenth century, those of England and the Netherlands. The simple average of the heights in the collections dating before the birth of Christ in table 5 is 66 inches for males. This is greater than for skeletons in 18^{th} century England and the Netherlands. This is also about three inches less than for the richest modern economies, but exceeds heights for the poorer modern economies, such as India in the nineteenth and twentieth century, and Japan in the nineteenth century.

Heights, and hence living standards, did fluctuate somewhat before 1800. But the variations, as predicted in the Malthusian model, have no connection with technological advances. Thus Europeans in parts of the medieval period seem to have been taller than those in the classical period, or in the eighteenth and early nineteenth centuries. Polynesians in the period before contact with the outside world were also very tall by pre-industrial standards. This accords well with the inference drawn in table 4 from Banks' report on the heights of the tallest of the Tahitians. There was no doubt that the technology of the Polynesians was far behind that of the Europeans. Polynesia still was a Neolithic economy, for metals were unknown when the Europeans arrived. Thus fishhooks were laboriously fashioned from bone or coral. The preferred weapon of war was a wooden club. Canoes had to be fashioned from tree trunks using fire and stone axes. Indeed the local appreciation of the value of metal was such that initially a single nail would buy a pig, or a sexual encounter. The captains of visiting ships had to post extra guards, and institute severe punishments, to stop the sailors from removing nails from any part of the ship they could get access to. The local inhabitants on a number of occasions stole ship's boats to burn them to retrieve the nails. The local sea-fairing vessels were canoes sometimes mounted with sails, but not rigged in such a way that they could sail into the wind and thus of limited value. Thus long ocean voyages were hazardous. There was little or no local production of earthenware. There was no system of writing. Cloth was made from tree bark, but little clothing was required in the equatorial climate.

The reason for the very high living standards of Polynesia at the time of contact with Europeans, as we shall see in chapter 5, seem to have been a very high death rate created by infanticide, internal warfare, and human sacrifice. Polynesia was paradise for the living, but a paradise with a cost. In other locations, such as tropical Africa, nature itself supplied high material living societies through high death rates from disease. For European's at least tropical Africa was a deadly place. British troops stationed on the coast of West Africa in the eighteenth century had a death rate in the first year of 50 percent.[8] When the journalist Stanley made his famous journeys across Equatorial Africa in the late nineteenth century, the special ability that allowed him to make his discoveries was not any particular ability with guns or languages, but his ability to withstand the many illnesses that killed all of his white companions. The natural environment of Polynesia was benign. The scourge of the tropics, malaria, did not exist on the islands until imported along with the mosquito by white mariners. Thus the British and French crews spent months ashore in Polynesia with few if any deaths from local diseases. But where nature failed them the Polynesians seem to have supplied their own mortality.

For the pre-industrial Americas a research team led by Richard Steckel and Jerome Rose has assembled evidence from 65 excavations of grave sites in the Americas going back as far as 5,500 BC and as recently as 1908. Before 1650 all of the sites are for Native Americans. In the Steckel/Rose study, height is measured in a somewhat peculiar way. Thus, if the implied height of a skeleton is at or above the norm for modern populations it is given a score of 100. If it is three standard deviations below that norm it is given a score of 0 (that is if the skeleton is shorter than all but .5% of modern people it gets a score of 0). Implied heights between these extremes get a proportionate score between 0 and 100. With this scoring system the six grave sites for the

[8] Black Americans who returned to colonize Liberia after 1823 also had extraordinarily high

years 1870-1908 get an average score of 47.5. Thus people in the nineteenth century were not as tall as modern standards, but most fell within the modern range. There is little sign of any improvement in heights in this long interval from 5,450 BC to 1800. Throughout the period people are short relative to modern populations, but not any shorter in the pre-Columbian period than before.

The Steckel and Rose study also uses a more complex index to measure human health overall which gives equal weighting to seven health attributes revealed by bones: stature, dental enamel hypoplasias, dental cavities and abscesses, anemia, infections, degenerative Joint Disease, and trauma. On this more general index the authors find a significant decline in health from the earliest times to the arrival of Columbus for 23 pre-contact sites which had evidence for all seven health indicators. Average health declined with the discovery and development of systems of settled agriculture. The earliest Americans lived in small groups, in simple hunter-gatherer societies. They had few material goods and built no lasting buildings or monuments. Yet their diet was apparently sufficiently varied and plentiful that they avoided most of the symptoms of childhood deprivation: stunting, hypoplasia and anemia. Their isolation in small groups protected them from infectious diseases. Their constant movement in search of food prevented the accumulation of human waste that harbored germs and parasites, as occurs with settled agriculture. The evidence of their bones suggests life was physically arduous. Chronic diseases such as arthritis, skeletal infections, and dental deterioration are abundantly evident in the bones of adults. Measures of the implied age of skeletons imply that few of these hunter gatherers survived past age 50. Yet overall their health, as revealed by their bones, was better than the later generations from settled agricultural societies.

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death rates, though not as high as British troops.

Steckel and Rose conclude that the onset of settled agriculture in the Americas, which has been celebrated elsewhere as a major advance leading to modern civilizations, paradoxically led to a decline in average health. As they note "that life became 'nasty, brutish and short' for the typical person with the rise of agriculture, government, and urbanization." This despite the fact that the organized production of food, and the development of storage capacities, should presumably have led to more regular and predictable food supplies. Their findings here reflect a view held by many physical anthropologists that settled agriculture may have been accompanied everywhere by a decline in human material conditions, reflected in lower health levels. Thus in a recent review of this transition Clark Larsen concludes that "The shift from foraging to farming led to a reduction in health status and well-being" (Larsen (1995), p. 204).

This supposed decline had been explained in a number of ways. Some researchers have argued that the shift to settled agriculture have been forced on hunter-gathers by resource depletion. Others have argued that settled agriculture allowed for large scale redistribution of the benefits that benefited dominant groups at the expense of the majority of the population. Average material output per capita was likely much higher with settled agriculture, but the benefits were enjoyed by military elites. Indeed one reason for settled agriculture might have been military competition. Fortified towns supported by agricultural communities may have been created by the force of competition from other groups. Once towns, food stores, and cultivated fields were created, they created sources of rents that could be expropriated by the powerful. So with settled agriculture it might be that output per person as a whole went up, but the living standards of the majority of people fell. A third possibility for declining health levels is that settled agriculture led to a switch of consumption voluntarily away from relatively healthy food sources towards material goods and ways of life that were preferred, but were less healthy.

Did hunter gatherers find in settled agriculture a society that offered more consumer goods, and the excitement of urban living, but poorer health? We know that in Europe by the eighteenth century urban areas had very high levels of mortality. Indeed in most European societies before 1800 urban areas would have suffered declining population but for the migration from the countryside. Yet in Europe there was constant migration to cities and towns. Rural residents were willing to trade poorer health prospects for the higher material living standards and the amenities of the city.

This debate amongst anthropologists about the trend in living standards and health with the shift to settled agriculture would have benefited from consideration of the simple Malthusian model developed above. For when they find it puzzling or counterintuitive that technological advance can lead to declining statute and general health, if we correctly understand the logic of Malthusian economies none of this is surprising. For that model points out that ultimately what determines living standards is not resource availability or power elites, but where the birth rate and death rate schedules lie for each society. Since settled agriculture would affect both the birth and death schedules compared to hunter gatherer societies, there is no expectation that settled agriculture should lead to either higher life expectancies or better living standards once the population is in equilibrium.

Figure 4 shows hypothetical birth and death rate schedules for hunter gatherer society before the arrival of agriculture. These together ensure average material living conditions. The effect of settled agriculture on birth rates, it has been argued, was most likely an increase, since hunter gatherer societies, moving all the time, have a severe natural constraint on how many children under age five or six a women can have, since she can typically only carry one. Higher fertility on its own would promote lower living standards, as the figure shows. But as we shall see below most agrarian societies whose birth rates we can observe did impose some kind of limitation on natural fertility. And based on nineteenth and twentieth century studies of hunter gatherer societies, if these can be taken as a guide to Paleolithic hunter gatherers, the birth rate does not seem particularly low compared to those we shall see below for agrarian societies. Thus the average Total Fertility Rates reported in 40 ethnographies with this information was 5.3.[9] This as we shall see is not that different from pre-industrial Europe, Japan or China.

The effects of settled agriculture on death rates is similarly ambiguous. They may have risen, or they may have fallen. Death rates at given material living conditions would increase from the prevalence and development of infectious diseases. With small bands of people in infrequent contact with other groups such diseases would have limited opportunities to maintain themselves. But the larger settled communities agriculture brought, along with trade and commerce, facilitated infectious diseases. However, at the same time settlement plausibly reduced death rates through two effects. First settlement allowed for food storage, protecting people from the vagaries of food supplies in the hunter gatherer lifestyle. Secondly settlement reduced the exposure of people to environmental hazards such as wild animals and poisonous snakes, and made it easier for them to survive the effects of moderate accidents such as broken legs. Thus it is no surprise that Larsen, in his review of the effects on people of the transition to agriculture, concludes that "Several geographic settings show stature declines with agricultural adoption or intensification in pre-historic societies. In contrast, other regions show increase or no change in stature" (Larsen (1995), p. 191).

Another puzzle that Steckel and Rose report is that that the European and African settlers in the New World before 1800 (the Africans "settlers" being brought here involuntarily, of

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[9]Kelly (1995), pp. 206-8.

course) were typically less healthy than the indigenous people they displaced. This despite the fact that Europeans in the Americas in the eighteenth and nineteenth centuries seem to have been healthier than Europeans in Europe. This again surprises the authors. Thus they note “One might suppose that Europeans in Europe, and especially in the Americas, would have done better given their access to Old and New World animal and plant resources, notable technology, and their institutions of commerce, law, and politics that were placed in the service of global colonization.” But again, for reasons that should by now be clear, this is not in the least a puzzle.

Consumption Patterns and Living Standards

We can also get indirect measures of a society's living standards through evidence on consumption patterns. For each good there is a typical path of consumption with real income which can be represented by an Engel curve, as is shown in figure 5. Some goods, luxuries, account for a larger share of expenditure the richer consumers are. Others, necessities, account for a larger share of expenditure the poorer societies are. Thus just evidence on the share of output devoted to different commodities typically reveals whether a society is rich or poor. In the poorest agrarian societies the vast bulk of output is food, and typically foods that yield calories at the lowest cost – grains such as wheat, rice, rye, barley, oats, maize and beans or potatoes – consumed as porridge or as bread. As societies get richer there is more consumption of fats and proteins – milk, cheese, butter, eggs, meat and fish - but also more consumption of grains in more expensive forms as beer, or of fruits and fruit products such as wine.

The shape of the Engel curve at any point can be summarized by a single number, the income elasticity of demand, which measures the percentage increase in consumption of a good that a one percent increase in income generates. If the income elasticity of demand is greater than 1 then the good is a luxury, constituting a larger share in the expenditures of richer households. Conversely, if the income elasticity of demand is less than 1 then the good is a necessity, constituting a larger share in the expenditures of poorer households.

The income elasticity of demand for food products in general is always less than one, as is portrayed in figure 5, and for richer societies can be not much greater than 0.[10] The income elasticity is particularly low if we measure food as the raw foodstuffs produced on the farm, as

[10] This relationship was first discussed systematically by the Russian statistician Engel and consequently the curve relating consumption of any good and income is called the Engel Curve.

opposed to the value of processed foods. People can only consume a limited number of calories per day, and they can only consume more foodstuffs by buying more expensive forms of food: meat and dairy products as opposed to grains. Thus one good indirect measure of real incomes is just the share of income a household expends on food. For the poorest households this will typically be 70-80% of all expenditures. Even within the food categories, the percent spent on grains and starches will again be higher the poorer the household. These patterns are revealed in tables 5 and 6 which include data on the consumption patterns of rural laborers in India in 1950. Of their food and alcohol consumption, 83% was for grains and legumes. In contrast agricultural laborers in England in 1787-96, prior to the Industrial Revolution were spending only 61% of their food and alcohol consumption on grains. These workers reveal themselves to be richer than the equivalent Indian workers in 1950. Similarly while these Indian workers spent 86% of all their income on food, English agricultural laborers from 1787-96 spent only 77% of their income on food.

For England we get evidence on the consumption patterns of agricultural workers back to the thirteenth century because of the custom of feeding harvest workers that prevailed through much of this time. Table 6 thus also indicates the share of food expenditures devoted to various categories for England going back as far as 1250-99. English farm workers diet patterns throughout the middle ages suggests that they were living at a higher income level than farm workers in England in the 1790s.

Because consumption patterns imply equivalent occupational distributions, we can also get a picture of living standards in the pre-industrial period if we know the occupational distribution of the population. For Suffolk in the years 1620-35 a set of wills has been

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The relationship portrayed showing that the share of income spent on food declines with income transcribed, many giving occupations for male testators. Though these wills over-represent those in the higher income groups they do give us some insight into the distribution of occupations in a relatively poor period in pre-industrial England. Table 7 summarizes the occupations reported and their distribution across major areas of consumption. As we would expect agriculture and fishing was the most important, but it still accounted for only 63% of occupations. The next major occupational category is the production of clothing, accounting for 15% of occupations. Other significant categories were building workers, and those involved in food production and distribution, such as butchers and innkeepers. This occupational information again suggests that even in its poorest periods pre-industrial England was a relatively rich economy, with the average person significantly better off than the average person in India, for example, in the nineteenth and most of the twentieth century.

Calorie Consumption and Income

Another proxy for living standards is calorie consumption per person. Indeed one of the problems now faced by high income societies are the health costs of too abundant calorie consumption. How did calorie consumption in England in 1800 compare to earlier societies? The evidence we have for England is from surveys of poorer families, mainly those of farm laborers, made in 1787-96 as part of a debate on the rising costs of the Poor Law. So the English data for the 1790s is very much a lower bound for the population as a whole. Members of these families consumed an average of only 1,500 kilocalories per day. The only data we can get for the likely consumption of earlier societies comes from anthropologists observations of modern forager and shifting cultivation societies. These reveal a remarkable variation in calorie

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is sometimes called “Engel’s Law.”

consumption across the groups surveyed, ranging from a meager 1,700 kilocalories per person per day for the Hiwi to a robust 3,800 kilocalories per day for the Ache. But certainly people in these groups were eating better than the typical rural worker in England around 1800.

Engel Curves and Social History

The simple facts that material living standards showed no trend in agrarian societies for thousands of years before the Industrial Revolution, and that at low levels of income food demand dominates expenditures, explains much of the evolution we observe over world history in settlement patterns, and occupational distributions. The high demand for food by poorer households was what ensured that most pre-industrial societies were dispersed and agrarian. If 70-80% of income was being spent on food in the poorest societies, then typically 70-80% of the population would be employed in agriculture.[11] In contrast in the high living standards of the current USA about 3% of the population currently produces more than enough food for the entire population.

Agricultural employment demands a population that lives close to the fields, so agrarian societies are typically also rural societies, with a small share of the population in urban areas. Figure 6 shows for the 1990s the relationship between the proportion of a country's population employed in agriculture and the share of the population living in urban areas for a group of countries where both types of information are available. As can be seen the fit is fairly good, even though the definition of urban areas varies from country to country.[12]

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[11] This would not necessarily hold once countries traded substantial quantities of foodstuffs. But such substantial trade was rare before 1800.

[12] In Canada an urban area was any place with a population of more than 1000, while in Japan the population had to be 50,000 or greater.

Real Wages and Work Hours

We saw in chapter 2 that there may well have been significant increases in work hours per year between the earliest human societies and 1800. When we measure real living standards using measures such as stature or consumption patterns it does not allow for the fact that the people of 1800 worked longer, and at more tedious labor, to attain their living than their hunter gatherer forbears. In eighteenth century Polynesia, for example, here was little work because of the nature of agriculture on the islands. The main food supplies were from breadfruit trees and coconut palms, supplemented by pig meat and fish. But all the labor that was required for the breadfruit trees and the palms was to plant the tree, tend it till it grew to sufficient height, and then harvest the fruits when ripe. Further the Hiwi discussed above, who consumed a mere 1,700 kilocalories per day and often complained of hunger, at the same time put in a surprisingly small amount of time looking for food. Men would generally forage for less than 2 hours per day, even though the food returns from foraging were good (Hurtado and Hill (1987, 1990)).

Another way to measure the real living standards of people in 1800 relative to those of the pre-documentary past is to consider the number of kilocalories they produced per hour of labor when producing their major food staples. This is a measure of their consumption possibilities as opposed to their realized consumption which depends also on hours of work.

The surprise here is that while there is wild variation across forager and shifting cultivation societies, many of them had food production systems which yielded much larger numbers of calories per labor-hour than the English agriculture in 1800, at a time when labor productivity in English agriculture was probably the highest in Europe. In the decade 1800-9 the total value of output from English agriculture was about £82 million per year, from an agricultural labor force of about 1 million workers, each working an estimated 300 days of 10 hours per day per year. That implies the value of output per worker hour was 6.56 d. per worker per hour. In 1800-9 6.56 d. would buy 3,600 kilocalories of flour, but only 1,800 kilocalories of fats and 1,300 kilocalories of meat. Assuming English farm output was then half grains, one quarter fats and one quarter meat this implies 2,600 calories output per worker hour on average. Since the average person eats only about 2,000 kilocalories per day, this means each farm worker can feed 13 people, so productivity is very high in England.

Table 10 shows in comparison the energy yields of foraging and shifting cultivation societies per worker hour. The range in labor productivities is huge, but the minimum labor productivity, that for the Ache in Paraguay is about 2,000 kilocalories per hour, not much below England in 1800. And the median yield per labor hour is 4,750 kilocalories, nearly double English labor productivity. Some of the reported labor productivities are astonishing, such as for shifting cultivation of maize by the Mikea of Madagsacar. These societies, many of them engaging in the most primitive of cultivation techniques, thus typically had greater potential material outputs, at least in food production, than England on the eve of the Industrial Revolution. For example, the Peruvian Shipibo's staple crop, providing 80% of their calorie intake, is bananas cultivated in shifting patches of forest land. The technique of cultivation is extremely simple. The land is burned, and the larger trees felled. Banana seedlings are planted among the fallen trees and stumps. The land is periodically weeded to prevent weeds choking out the banana trees. Yet in these tropical conditions the yield is more than 60 lbs of bananas (15,000 kilocalories) per labor-hour.

These foraging and shifting cultivation societies were typically not materially more wealthy simply because their labor input was on average only about 60% of that of England in 1800. Whatever material prosperity the English had in 1800 was wrested from the soil by hard work and long hours. The evidence seems to be that Marshall Sahlins was substantially correct when he controversially claimed that foraging and swidden societies had a form of "primitive affluence," which was measured in the abundance of leisure as opposed to goods (Sahlins (19--)). In chapter 10 below we shall address the question of why labor inputs were seemingly greater in agrarian economies than in earlier societies.

Summary

There is ample evidence in the historical and skeletal record to support the key contention of the Malthusian model that living conditions before 1800 were independent of the level of technology of a society. But there is also evidence that living standards did vary substantially across different societies before 1800. Medieval Western Europe, for example, in the period between the onset of the Black Death in 1348 and renewed population growth in 1550, was an extraordinarily rich pre-industrial economy, rich even by the standards of the poorest economies of the world today. Polynesia before European contact also seems to have been prosperous. In contrast both India in the early nineteenth century and Japan even in the late nineteenth century appear to have been very poor societies in material terms. But even some modern societies that are relatively poor in material terms, such as the Hiwi foragers of Venezuela, are actually wealthy in terms of leisure, and have potential material incomes just as high as those of England in 1800.

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Table 1: Percent Expenditure by Category for English Manual Workers before 1869

Category of Expenditure	Vanderlint (1734)	1787-96 (Horrell)	1840-54 (Horrell)	Assumed here
Food and Drink:	**54.4**	**75.4**	**61.7**	**68.0**
Farineous	12.5	37.8	29.7	31.0
Meat	16.7	12.1	12.1	12.0
Dairy	8.4	14.8	8.7	11.7
Sugar and Honey	-	4.2	4.5	4.4
Beer	12.5	2.8	1.7	4.7
Tea	0	3.4	2.2	3.3
Coffee	0	0.0	1.0	0.0
Salt	-	-	-	0.5
Pepper	-	-	-	0.4
Other Food	4.2	0.6	2.3	0.0
Housing	7.2	5.3	10.9	10.0
Fuel	5.6	4.4	4.8	5.0
Light and Soap	4.2	3.8	5.2	4.5
Services	8.2	0.1	2.5	2.5
Tobacco	0	0.0	0.7	0.0
Other (Clothing, Bed linen)	20.5	11.0	14.2	10.0

Sources: Horrell (1996), pp. 568-9, 577. Vanderlint (1734), pp. 76-77.

Table 2: GDP per Capita in England Relative to Modern Economies.

Country	Year	Income per capita (1992 $)
UK	**1992**	**16,302**
Mexico	1992	7,867
Bulgaria	1992	6,774
Iran	1992	4,161
South Africa	1992	3,885
England	**1860s**	**2,982**
Indonesia	1992	2,601
England	**1400s**	**2,382**
England	**1760s**	**2,359**
Egypt	1992	2,274
Bolivia	1992	2,066
India	1992	1,633
England	**1300s**	**1,464**
Ghana	1992	1,249
Kenya	1992	1,176
Nigeria	1992	1,132
Malawi	1992	607
Chad	1992	504

Note: All incomes have been converted into what they could buy in terms of 1992 dollars.

Source:

Table 3: Wages measured in Wheat Equivalents

Location	Period	Day Wage (in lbs of wheat flour)
Roman Egypt	c. 250 AD	8.0
Egypt	1900-1914	8.3
Egypt	1930s	7.8
Egypt	1960s	9.0
England	1800-09	9.2
India – Behar	1900-09	5.0
India – Deccan	1900-09	4.9
India – Punjab	1900-09	12.3

Sources: Egypt, Rathbone (1991), Richards (1982). England, Clark (2001). India,

Table 4: Estimated Average Height of Adult Males by Period.

Period	Location	Ages	Average Height (cm)	Average Height (in)	Numbers of Observations, Notes
1800-30	UK[a]	-	170.7	67.2	-
1770-1815	English[b]	23-49	166.0	65.4	Convicts Transported
1830-50	Netherlands[a]	-	164.0	64.6	-
1800-20	France[a]	-	164.1	64.6	-
1830-50	Sweden[a]	-	168.0	66.1	-
1800-20	USA[a]	-	173.0	68.1	-
1868-80	Japan[a]	-	155.3	61.1	-
1769	Tahiti[c]	Adults	174.0*	68.5	
1842-4	Bihar[d]	24-40	161.0	63.4	1,016 Immigrants to Mauritius
1859-71	Bihar[d]	24-40	162.3	63.9	2,494 Immigrants to Mauritius
1965-6	Bihar[d]	24-40	162.3	63.9	2,668
1843	South India[d]	24-40	162.8	64.1	109 Immigrants to Mauritius
1869-73	South India[d]	24-40	163.3	64.3	546 Immigrants to Mauritius
1961-3	South India[d]	24-40	163.3	64.3	6,791
1988-90	South India[d]	25-39	163.6	64.4	2,398
1969	Kung[e]	21-40	163	64.1	33
1985	Hiwi[f]	Adults	154	60.6	62
1980s	Ache[f]	Adults	161	63.4	-
1970s	Anbarra[g]	Aduts	170	66.9	-
1910	Alaskan Eskimo[h]	Adults	168	66.1	-
1906	Canadian Eskimo[h]	Adults	162	63.8	Southampton Island

Notes: *See the text for the method of estimation.

Sources: [a]Steckel and Floud (1997), p. 425. [b]Nicholas and Steckel (1991), Table 5, p. 946. [c]Banks (1962), p. 334. [d]Brennan, McDonald and Shlomowitz (1997), p. 220. [e]Lee and DeVore

(1976), p. 172. [f]Hurtado and Hill (1987), p. 180-182. [g]Kelly (1995), p. 102. [h]Hawkes (1916), p. 207.

Table 5: Estimated Average Height from Skeletal Remains by Period.

Period	Location	Observations	Average Height (cm)	Average Height (in)
Mesolithic[a]	Europe	82	167.7	66.0
Neolithic[a]	Europe	190	167.3	65.9
Neolithic[i]	Denmark	103	173.2	68.2
Pre-Dynastic[b]	Egypt	60	165.0	65.0
Dynastic[b]	Egypt	126	166.0	65.4
2500 BC[c]	Turkey	72	166.3	65.5
1700 BC[d]	Lerna, Greece	42	166.3	65.5
2000-1000BC[e]	Harappa, India	-	169.2	66.6
1450 AD[h]	Marianas	30	173.0	68.1
1650 AD[h]	Easter Island	14	172.8	68.0
1500-1750 AD[h]	New Zealand	124	173.6	68.3
1450 AD[h]	Taumako	40	175.0	68.9
1400-1800 AD[h]	Hawaii	-	173.0	68.1
17th-18th C[g]	**Holland**	**143**	**166.5**	**65.6**
18th C[g]	**Norway**	**1,956**	**165.3**	**65.1**
18-19th C[g]	**England (London)**	**211**	**170.3**	**67.0**

Sources: [a]Meiklejohn and Zvelebil (1991), p. 133. [b]Masali (1972). [c]Mellink and Angel (1970). [d]Angel (1971). [e]----- . [g]Steckel (2001). [h]Houghton (1996), pp. 43-45. [i]Bennike (1985), pp. 51-2.

Table 6: Share of Different Products in Food and Alcohol Consumption

Group	Cereals and Pulses (%)	Sugar (%)	Milk, milk products, and fats (%)	Meat, fish and eggs (%)	Alcohol (%)
Agricultural Laborers, India, 1950	83.3	1.6	3.7	1.7	0.8
England, Farm Laborers, 1787-96	60.6	4.7	14.8	13.6	1.3
England, Urban Laborers, 1787-96	50.1	5.6	19.6	16.0	2.7
England, Harvest Workers, 1250-99	48.0	0.0	20.4	19.8	11.8
England, Harvest Workers, 1300-49	39.7	0.0	21.3	21.7	17.0
England, Harvest Workers, 1350-99	20.8	0.0	15.5	39.8	24.0
England, Harvest Workers, 1400-49	18.3	0.0	9.7	36.7	34.3

Source: Clark, Huberman and Lindert (1995). Dyer (19--).

Table 7: Share of different items in consumption

Group	Food and Alcohol (%)	Fuel and Light (%)	Housing (%)	Clothing and Footwear (%)	Other (%)
Agricultural Laborers, India, 1950	86.0	1.1	0.8	6.3	8.8
India, All Rural families, 1949	72.2	3.5	0.6	13.4	13.0
England, Farm Laborers, 1787-96	77.0	8.8	6.0	8.2	0.1
England, Farm Laborers, 1840-54	68.6	7.8	10.1	11.7	1.7

Sources: Clark (2001),

Table 8: The Occupation Distribution of Male Testators, Suffolk, 1620-35

Occupation	Number	Share (%)
Yeoman	238	
Husbandman	77	
Shepherd	13	
Fisherman	3	
All Farm and Fishing	**336**	**63.4**
Innkeeper	4	
All Food Production and Distribution	**17**	**3.2**
Clothier	19	
Weaver	17	
Tailor	16	
All Clothing	**80**	**15.1**
Carpenter/Joiner	14	
All Building	**35**	**6.6**
All Occupations	**530**	**100**

Sources: Allen (1989), Nesta (1987).

Table 9: Food Consumption per Capita, Forager and Subsistence Societies Versus England in 1800

Group	Years	Consumers	Kcal./day	g. Protein/day
England, farm laborers[a]	1787-96	All	1,508	
Ache, Paraguay[b]	1980s	All	3,827	
Aruni, New Guinea[d]	1966	All	2,390	
Bayano Cuna, Panama[f]	1960-1	All	2,325	49.7
Hiwi, Venezuela[b]	1980s	All	1,705	
!Kung, Botswana[b]	1960s	All	2,355	
Shipibo, Peru[e]	1971	All	1,665	
Yanomame, Brazil[c]	1974	All	1,637	65.5

Source: [a] Clark, Huberman and Lindert (1995), p. 223. [b]Hurtado and Hill (1987), p. 183. Hurtado and Hill (1990), p. 316. [c]Lizot (1977), p. 508-512 (counting everyone aged 3 and above as a consumer). [d]Waddell (1972), p. 126. [e]Bergman (1980), p. 205. [f]Bennett (1962), p. 46.

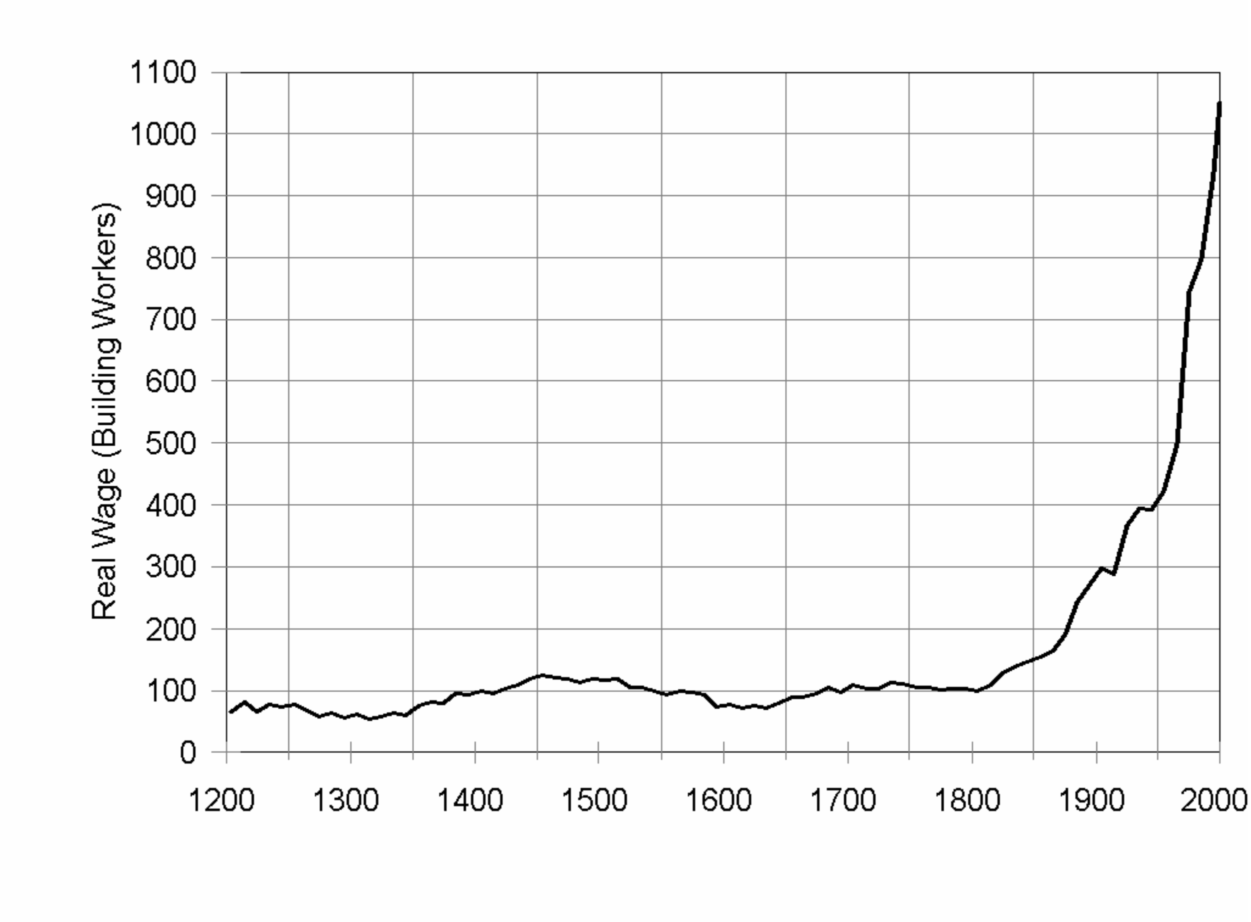
Table 10: Kilocalories produced per worker-hour, Forager and Subsistence Societies versus England, 1800

Group	Location	Staple Foods	Total Hours/Adult Male/Day	Kilocalories per hour
Ache[a]	Paraguay	Game (men)	6.9	1,340
Ache[a]	Paraguay	Palm fiber and shoots (women)	-	2,630
Hiwi[b]	Venezuela	Game (men)	3.0	3,735
Hiwi[b]	Venezuela	Roots (women)	-	1,125
Kantu[c]	Indonesia	Dry Rice	-	4,500
Kayapo[d]	Brazil		3.9	17,600
Machiguenga[e]	Peru	Manioc	6.0	4,984
Mikea[f]	Madagascar	Shifting cultivation maize	7.4	110,000
Mikea[f]	Madagascar	Tuber foraging	7.4	1,770
Shipibo[g]	Peru	Banana, Maize, Beans, Manioc	3.4	7,680
Tatuyo[h]	Columbia		7.6	-
Xavante[i]	Brazil	Rice/Manioc	5.9	7,100
Foragers, average			**5.7**	***4,750**
England, 1800[j]		Wheat, milk, meats	9.0	2,600

Notes: *Median of groups.

Sources: [a]Kaplan and Hill (1992). [b]Hurtado and Hill (1987), p.178. [c]Dove (1984), p. 99. [d]--- [e]----- [f]Tucker (2001), p. 183. [g]Bergman (1980), p. 133.

Figure 1: Real Wages, Building Workers, England, 1209-2000



Notes: 1800-9 set equal to 100.

Source:

Figure 2: GDP per person in pre-industrial England versus modern India

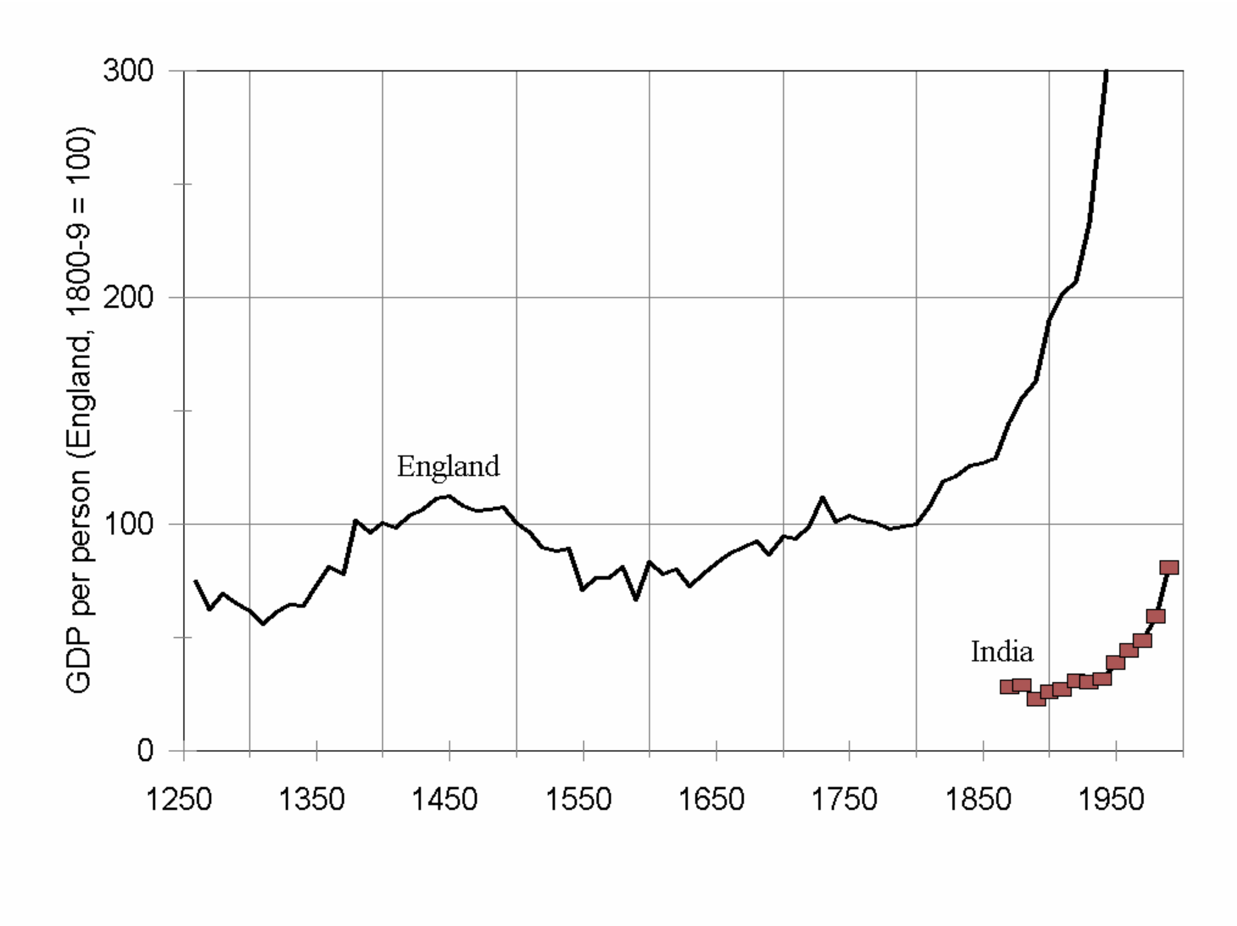
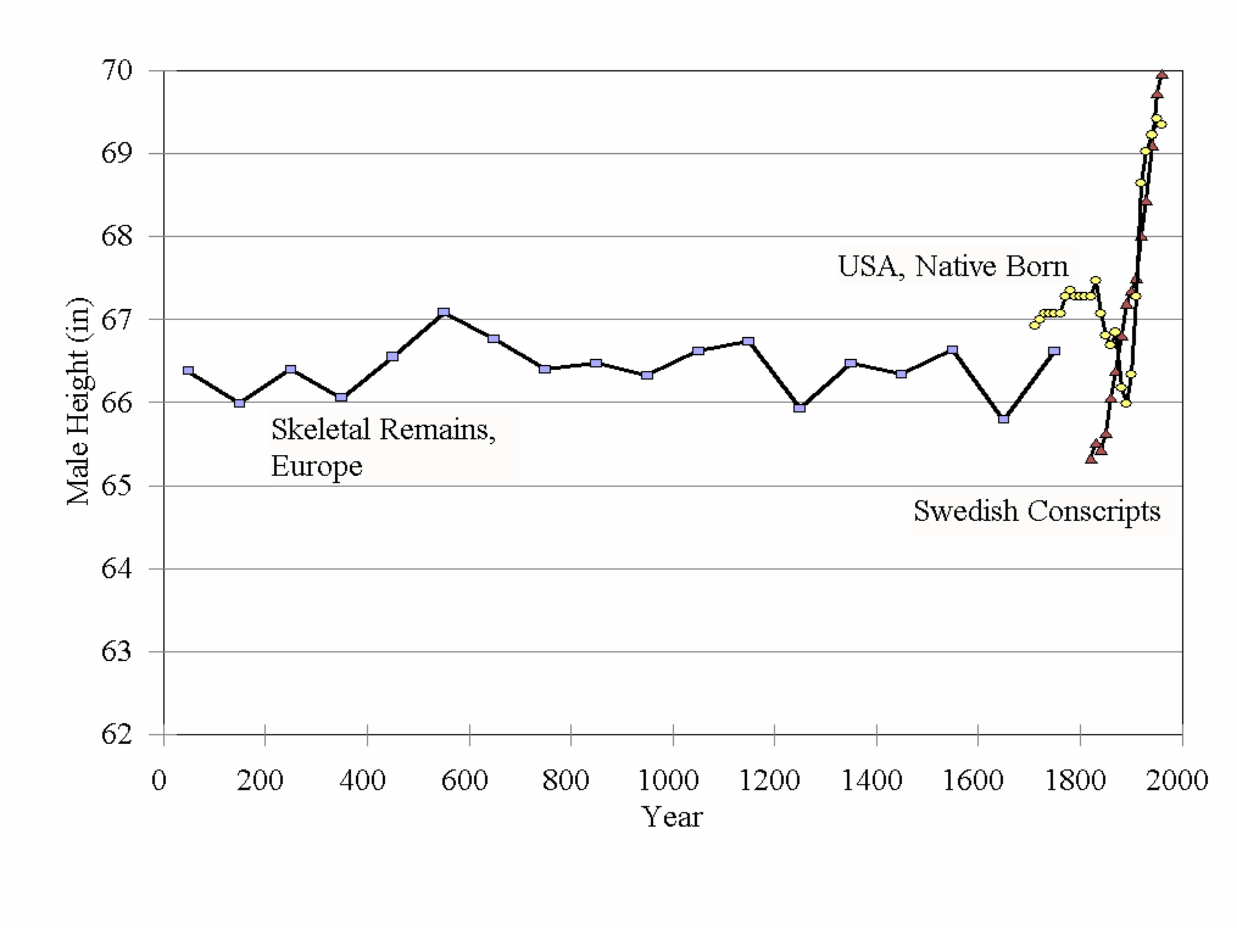


Figure 3: Male heights In Europe and the USA, 0 AD to 2000



Source: Koepke and Baten (2003), Steckel (2001), figures 3 and 4.

Figure 4: The Effects of the Transition to Agriculture

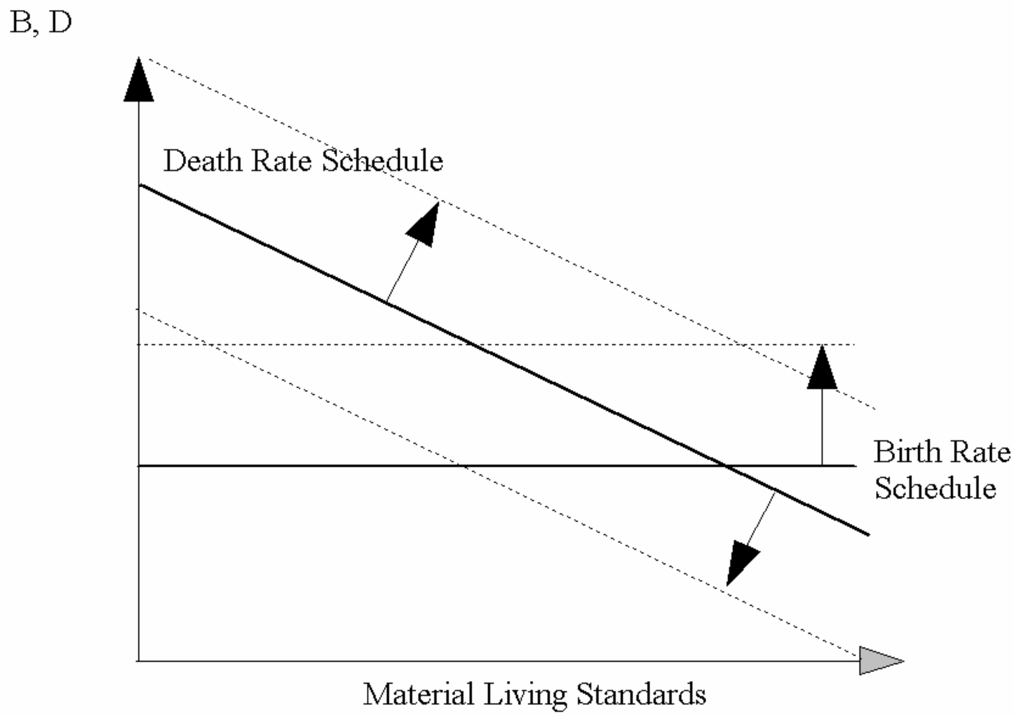


Figure 5: Engel Curves for different goods

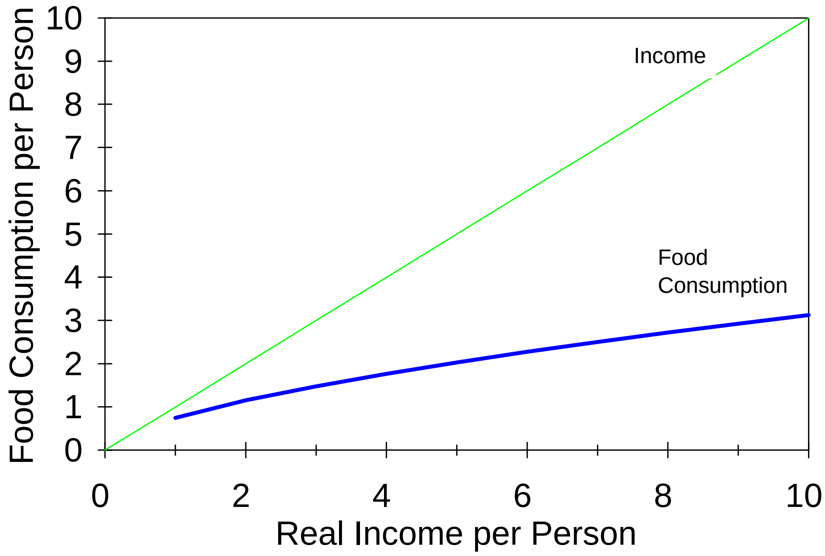
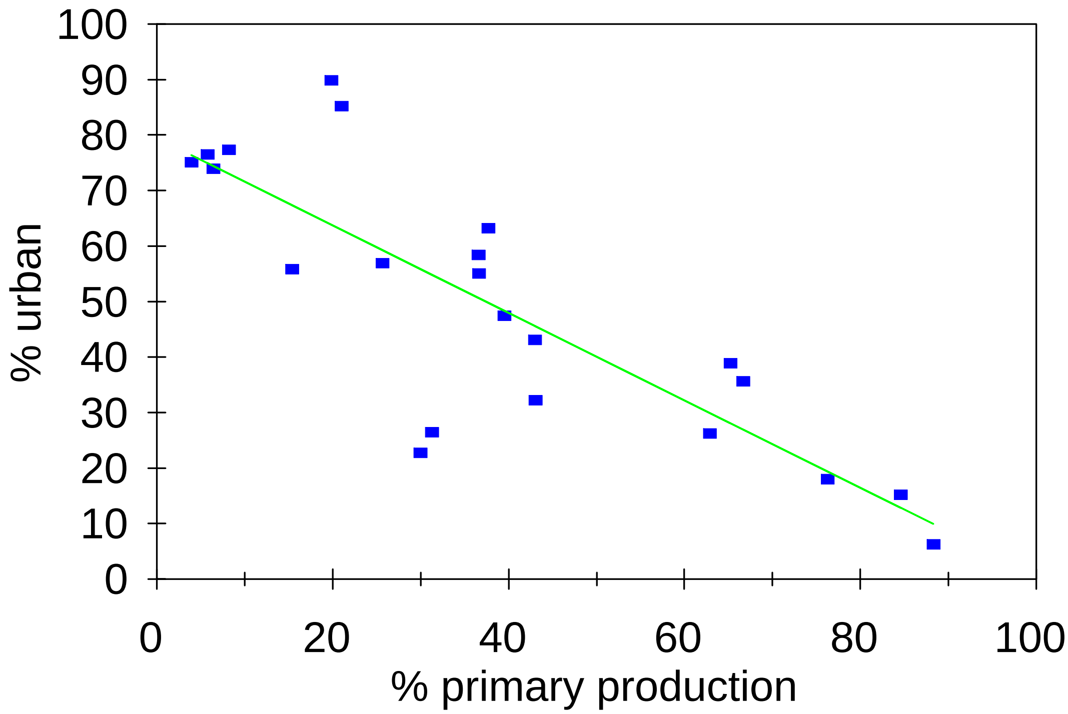


Figure 6: Share of Males Employed in Primary Sector and the Urban Population Share, Circa 1994



Source: