Genetically Capitalist? The Malthusian Era, Institutions and the Formation of Modern Preferences.

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Before 1800 all societies, including England, were Malthusian. The average man or woman had 2 surviving children. Such societies were also Darwinian. Some reproductively successful groups produced more than 2 surviving children, increasing their share of the population, while other groups produced less, so that their share declined. But unusually in England, this selection for men was based on economic success from at least 1250, not success in violence as in some other pre-industrial societies. The richest male testators left twice as many children as the poorest. Consequently the modern population of the English is largely descended from the economic upper classes of the middle ages. At the same time, from 1150 to 1800 in England there are clear signs of changes in average economic preferences towards more "capitalist" attitudes. The highly capitalistic nature of English society by 1800 – individualism, low time preference rates, long work hours, high levels of human capital – may thus stem from the nature of the Darwinian struggle in a very stable agrarian society in the long run up to the Industrial Revolution. The triumph of capitalism in the modern world thus may lie as much in our genes as in ideology or rationality.

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Introduction

The basic outline of world economic history is surprisingly simple. Indeed it can be summarized in one diagram: figure 1. Before 1800 income per capita varied across societies and epochs, but there was no upward trend. A simple but powerful mechanism, *the Malthusian Trap*, kept incomes within a range narrow by modern standards. The average person in 1800 was no better off in material terms than the average person of 10,000 or 100,000 BC.

In this paper I argue that there is evidence that the long Malthusian era in stable agrarian societies actually changed human preferences, perhaps culturally but also perhaps genetically. To show this I demonstrate first that for England the rich had a reproductive advantage at least from 1250 onwards. I also show that this advantage was likely inherited by their children. Finally I show that in the same interval there are signs that preferences were changing in the pre-industrial economy. In a time when the rich were taking over genetically people were becoming more middle class in their orientation: time preference rates were lower, hours of work longer, and numeracy and literacy increasing. Thus the long delay between the Neolithic Revolution of 6,000 BC which established settled agriculture and the eventual Industrial Revolution may in part be explained by the time necessary for the formation of preference consistent with modern capitalism.

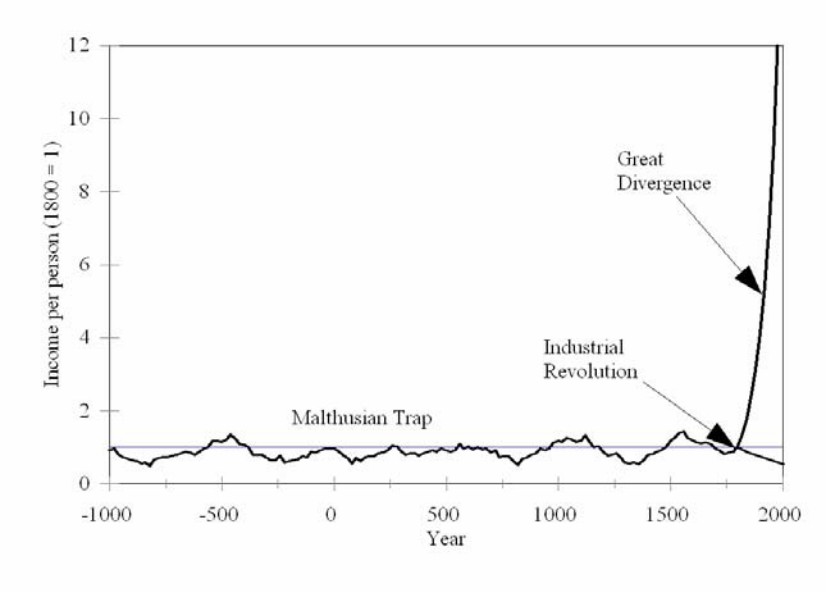

Figure 1 World Economic History in One Picture. After 1800 income in some societies rose sharply, while in others it declined.

The Malthusian Trap – Economic Life to 1800

A spare but powerful economic model, which requires only three basic assumptions, and can be explained in graphs, explains why technological advance improved material living conditions only after 1800.

The vast majority of human societies, from the original foragers of the African savannah, through settled agrarian societies until about 1800, had an economic life that was shaped and

governed by one simple fact: in the long run births had to equal deaths. Since this same logic governs all animal species, until 1800, in this "natural" economy, the economic laws for humans were the same as for all animal species.

It is common to assume that the huge changes in the technology available to people, and in the organizational complexity of societies, between our ancestors of the savannah and Industrial Revolution England, must have improved material life even before modern economic growth began. But the logic of the natural economy implies that the material living standards of the *average* person in the agrarian economies of 1800 was, if anything, worse than for our remote ancestors.

Women, over the course of their reproductive lives, can give birth to 12 or more children. Still in some current societies the average women gives birth to more than 6 children. Yet for the world before 1800 the number of children per woman that survived to adulthood was always just a little above 2. World population grew from perhaps 0.1 m. in 100,000 BC to 770 m. by 1800. But this still represents an average of 2.005 surviving children per woman before 1800. Even within successful pre-industrial economies, such as those in Western Europe, long run rates of population growth were very small. Table 1 shows for a number of European countries population in 1300 and 1800, and the implied numbers of surviving children per woman. None of these societies deviated far from two surviving children per woman. Some force must be keeping population growth rates within rather strict limits over the long run.

The Malthusian model supplies a mechanism to explain this long run population stability. There are just three assumptions:

Table 1 Populations in Western Europe, 1300-1800[1]

Year	c. 1300	c. 1800	Surviving Children per woman
Norway[a]	0.40	0.88	2.095
Southern Italy[c]	4.75	7.9	2.061
France[d]	17	27.2	2.056
England[b]	5.8	8.7	2.049
Northern Italy[c]	7.75	10.2	2.033
Iceland[a]	0.084	0.047	1.930

1. Each society and epoch has a **BIRTH RATE,** determined in part by customs regulating fertility, and rising with material living standards.

2. The **DEATH RATE** in each society declined as living standards increased.

3. **MATERIAL LIVING STANDARDS** declined as population increased.

Figure 2 shows graphically the three assumptions of the simple Malthusian model. The horizontal axis for both panels is material living conditions, indicated as *y*. In the top panel birth, *B*, and death, *D*, rates are plotted on the vertical axis. The material income at which birth rates equal death rates is called the *subsistence income* denoted in the figure as *y**. This is the income that just allows the population to reproduce itself. At material incomes above this the birth rate exceeds the death rate and population is

1 [a]Tomasson, 1977, 406. [b]Clark, 2006a. [c]Federico and Malanima, 2002, table 2. [d]Le Roy Ladurie, 1981, ---.

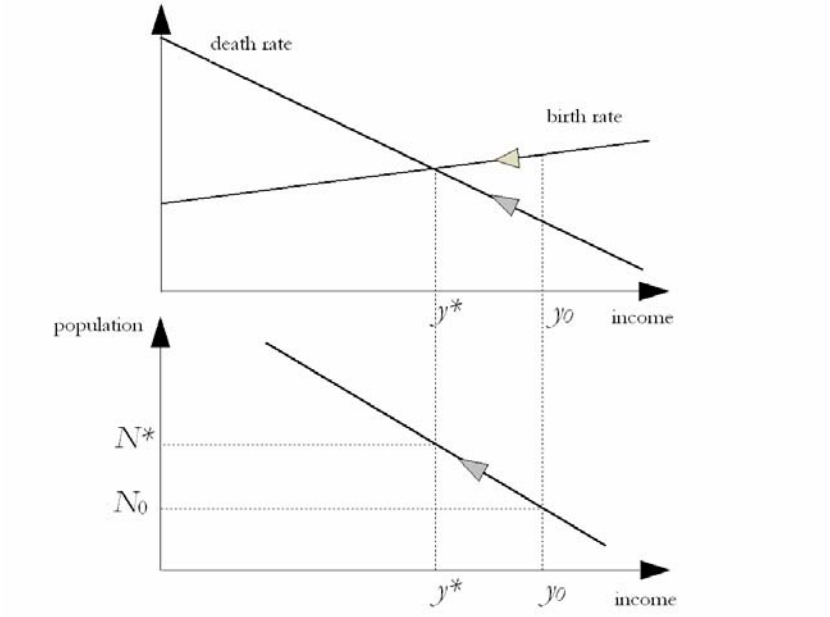

Figure 2 Long Run Equilibrium in the Malthusian Economy

growing. At material incomes below this the death rate exceeds the birth rate and population declines. Notice that this subsistence income is determined without any reference to the produc tion technology of the society. It depends only on the factors which determine the birth rate and those that determine the death rate. Once we know these we can determine the subsistence income, and life expectancy at birth.

In the bottom panel population, *N*, is shown on the vertical axis. Once we know *N*, that determines *y*, and in turn the birth rate and death rates. With just these assumptions it is easy to show that the economy will always move in the long run to the level of real incomes where birth rates equal death rates.

The crucial factor keeping the world economy in the Malthusian state was the rate of technological advance. As long as technology improved slowly material conditions could not permanently improve, even while there was cumulatively significant gain in the technologies. The economy of humans in the years before 1800 turns out to be just the "natural" economy of all animal species, with the same kinds of factors determining the living conditions of animals and humans.

Figure 3 shows a switch from an inferior technology, represented by curve T_0, to a superior technology, represented by curve T_1. Since population can only change slowly, the short run effect of a technological improvement was an increase in real incomes. But the increased income reduced the death rate, births exceeded deaths, and population grew. The growth of population only ended when income returned to subsistence. At the new equilibrium the only effect of the technological change was to increase the population. There was no lasting gain in living standards. The path of adjustment from an isolated improvement in technology is shown in the figure.

In the millennia leading up to 1800 there were significant improvements in production technologies, though these improvements happened slowly and sporadically. The technology of England in 1800, which included cheap iron and steel, cheap coal for energy, canals to transport goods, firearms, and sophisticated sailing ships, was hugely advanced on the technology of hunter gatherers in the Paleolithic before the development of settled agriculture. The degree of advance of technology was revealed in the encounters between Europeans and isolated Polynesian islanders in the 1760s. The English sailors who arrived in the previously isolated Tahiti in 1767 on the *Dolphin*, for example,

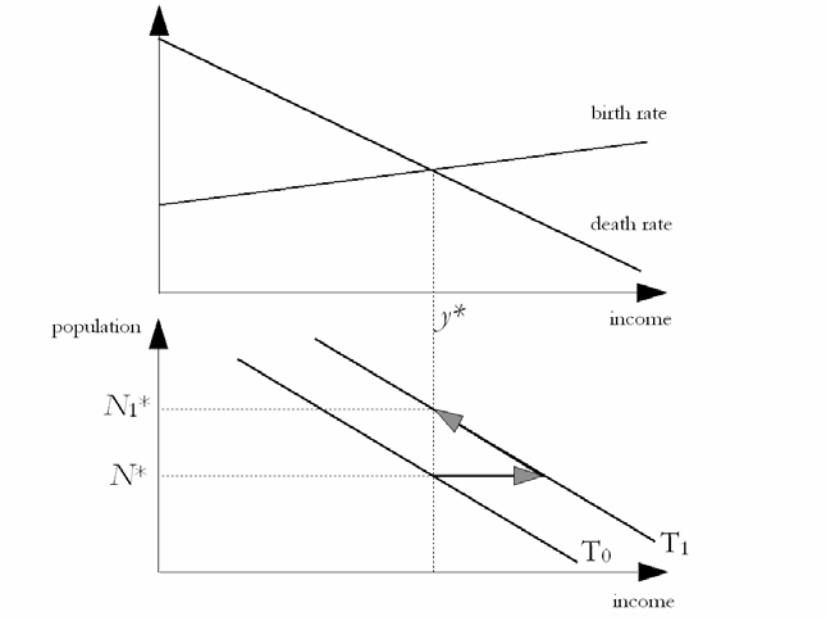

Figure 3 The Effects of Technological Advance

found a society with no metals. The iron of the Europeans was so valuable to the Tahitians that a single nail initially could be bartered for either a pig or a sexual encounter. Captain Wallis had to post guards, and institute severe punishments, to stop the sailors from removing nails from every part of the ship they had access to. The local inhabitants on a number of occasions stole ship's boats to burn them to retrieve the nails.[2]

But though technology was advancing before 1800 the rate of advance was always slow relative to the world after 1800. Figure 4, for example, shows for England, the actual location of the

[2] Robertson, 1955, ---. The price of pigs rose rapidly as the sailors depleted the local stock, so that when Captain Cook arrived in 1769 a pig cost an axe. Banks, 1962, ---.

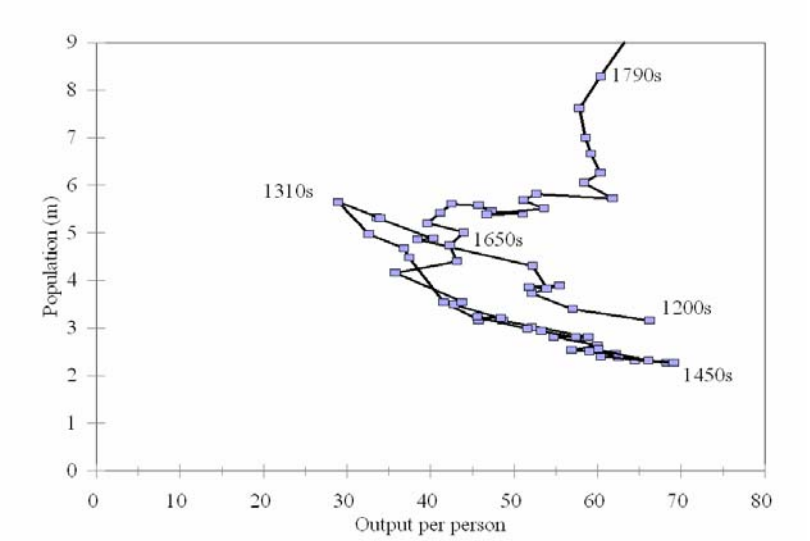

Figure 4 Revealed Technological Progress in England, 1200-1800

technology curve of Malthusian model from 1200 to 1800. From 1200 to 1650 there is seemingly complete stagnation of the production technology of the English economy. After 1650 the technology curve does shift upwards, but not at a rate fast enough to cause any sustained increase in output per person beyond what was seen in earlier years in the decades before 1800. Instead technological advance, as predicted, resulted mainly in a larger and larger English population. In particular in the later eighteenth century all technological advance was absorbed immediately into higher population. Before 1800 the rate of technological advance in any economy was so low that incomes were condemned to return to the Malthusian Equilibrium.

Testing the Malthusian Model

At first sight the claim of no material advance before 1800 seems absurd. Figures 5 and 6 show respectively a hunter gatherer family of the modern Amazonian rain forest, the Nukak, naked, and an upper class English family, the Braddyllds, painted in all their finery by Sir Joshua Reynolds in 1789. How is it possible to claim that material living conditions were on average the same across all these societies? But we can test empirically whether the average person in 1800 was any better off than the people of 10,000 BC on any dimension, and the answer is *no*.

Figure 7, for example, shows the real day wage of building laborers and farm workers in England by decade from 1200 to 1809 as an index with 1800-9, at the end of the Malthusian Era, set at 100 for farm workers. The real wage is just a measure of how many units of a standard basket of goods these laborers could buy with one day's earnings through these 60 decades.[3]

Real wages in England showed remarkably little gain in the 600 years from 1200 to 1800. The fluctuations within the six hundred years are much more dramatic than any long run upward trend. Thus in 39 of the 60 decades between 1200 and 1800 real wages for farm workers are estimated to be above their level in 1800. The highest real wages are found in the interval 1400-1549, long before 1800. The years around 1300, before the onset of the plague years in England in 1349, do show lower wages than in 1800. But wages in the early thirteenth century, are close to their level of 1800.

[3] These real wages are drawn from the series derived in Clark, 2005 and Clark, 2006a. These series are the most comprehensive measures available for living standards in any pre-industrial economy, including goods whose prices are typically not measurable such as housing.

Figure 5 The Nukak, a surviving hunter gatherer society in the Colombian rain forest. ©Gustavo Pollitis/Survival International

A proxy for living standards in the distant past is the living standard of surviving forager and simple agrarian societies. However, since these societies do not have labor markets with wages we need another metric to compare their material conditions to those of pre-industrial societies around 1800.

One such index of living standards is food consumption per person, measured as calories or grams of protein per person per day, shown in table 2. As income rises in poor societies, characteristically calorie consumption per person also increases. How did calorie consumption in England in 1800 compare to earlier societies?

Figure 6 The Braddyll family. Sir Joshua Reynolds, 1789.[4]

[4]Wilson Gale-Braddyll, Member of Parliament and Groom to the Bedchamber of the Prince of Wales.

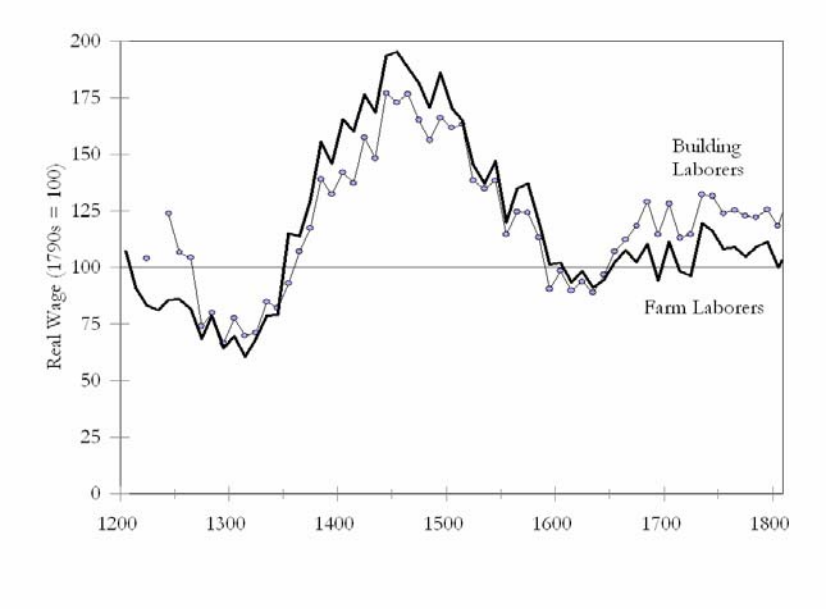

Figure 7 English Laborer's Real Wages 1209-1809.

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.[5] The poor consumed an average of only 1,508 kilocalories per day. The average income per head in these families at £4.6 per head, however, was only about 30 percent of average English income per person then of £15. We can estimate the average consumption in England using the income elasticities of calorie and protein consumption derived from this data. This is shown in the table also.[6] This is close to the average consumption calculated for Belgium in 1812
The information we have for the likely consumption of earlier societies comes from modern forager and shifting cultivation

[5]Eden, 1797.

[6] Clark et al., 1995, 223-4. Since the income elasticities would fall to almost zero for very high incomes, I assume the median consumer has an income of £12 per head.

Table 2 Calories and Protein per Capita[7]

Group	Years	Kcal.	Grams Protein
England, farm laborers[a]	1787-96	1,508	27.9
England, all[a]	1787-96	2,322	48.2
Belgium, all[b]	1812	2,248	-
Ache, Paraguay[c]	1980s	3,827	-
Hadza, Tanzania[h]	-	3,300	-
Alyware, Australia[h]	1970s	3,000	-
Onge, Andaman Islands[h]	1970s	2,620	-
Aruni, New Guinea[e]	1966	2,390	-
!Kung, Botswana[c]	1960s	2,355	-
Bayano Cuna, Panama[g]	1960-1	2,325	49.7
Mbuti, Congo[h]	1970s	2,280	-
Anbarra, Australia[h]	1970s	2,050	-
Hiwi, Venezuela[c]	1980s	1,705	64.4
Shipibo, Peru[f]	1971	1,665	65.5
Yanomamo, Brazil[d]	1974	1,452	58.1

societies. These reveal considerable variation in calorie consumption across the groups surveyed, ranging from a modest 1,452 kilocalories per person per day for the Yanomamo, to a kingly 3,827 kilocalories per day for the Ache. But the median is 2,340, implying that hunter-gatherers and subsistence agriculturalists ate as many calories as the median person in England or Belgium circa 1800. Primitive man ate well compared to one of the richest societies in the world in 1800. Indeed British farm laborers by

[7] [a] Clark, Huberman and Lindert, 1995, 223. [b]Hurtado and Hill, 1987, 183. Hurtado and Hill, 1990, 316. [c]Lizot, 1977, 508-512. [d]Waddell, 1972, 126. [e]Bergman, 1981, 205. [f]Bennett, 1962, 46. [g]Jenike, 2001, 212.

1863 had just reached the median consumption of these forager and subsistence societies.

Further the English diet of the 1790s typically had a lower composition of protein than these more primitive societies. Since the median forager ate as well as the English, they must have been eaten much better than the poorer Asian societies.

Variety of diet is another important component of human material welfare. On this dimension again hunter gatherers were significantly better situated. The English agricultural laborer did have by 1800 a limited access to the new goods of sugar and tea. But the overwhelming bulk of his diet was the traditional daily monotony of bread, leavened by modest amounts of beef, mutton, cheese and beer. In contrast hunter gatherer diets were widely varied. The diet of the Yanomamo, for example, included monkey, wild pig, tapir, armadillos, anteaters, alligators, jaguar, deer, rodents, a large variety of birds, many types of insects, caterpillars, various fish, larvae, freshwater crabs, snakes, toads, frogs, various palm fruits, palm hearts, hardwood fruits, brazil nuts, tubers, mushrooms, plantains, manioc, maize, bananas, and honey.[8]

Malthus and Darwin: Survival of the Richest

As has been emphasized, in the Malthusian Era the economic laws that governed human society were the same as those that govern all animal societies. Indeed Charles Darwin proclaimed his inspiration for *On the Origin of Species* was Malthus's *On a Principle of Population*. Darwin then employed his theory of natural selection in *The Descent of Man* to explain how humans evolved from earlier

[8]Chagnon, 1983, 57-8. In addition Yanomamo men were daily consumers of tobacco and a hallucinogenic snuff.

progenitors. Darwin's insight that, as long as population was regulated by Malthusian mechanisms, mankind would be subject to natural selection was profoundly correct.

In the Malthusian era on average every woman could have only two surviving offspring. But these two had to be selected by some mechanism from the average of 5 children each women had in the pre-industrial era. And as long as mothers and fathers varied in their characteristics this survival process favored some types of individuals over others. The Darwinian struggle that has shaped human nature did not end with the Neolithic Revolution, but continued indeed right up to 1800.

The first two basic Malthusian propositions, shown in figure 2, imply that reproductive success, the number of offspring a person leaves on their death, increased with income. This curve was drawn for society as a whole. But within any settled agrarian society there are huge variations in income per person at any time. The existence of land and capital as assets that generate rents allows some individuals to command much greater shares of output than others. The same Malthusian logic thus implies that those who are successful in economic competition in settled agrarian societies, those who acquire and hold more property, or develop skills that allow for higher wages, would also be more successful reproductively.

We can demonstrate the deep truth of this reasoning using an unusual source. This is the wills of a large sample of men in England around 1600, mainly drawn from Suffolk. Most of these wills were made very close to the death of the testator. 77 percent were entered into probate within a year of composition, implying that more than 77 percent of testators died within a year of composing the will. These wills record both the numbers of living children the testator had at the time of their will, and the likely

economic position of the testator, as revealed by how much they bequeathed. Below is a will typical except for its brevity.

JOHN WISEMAN of Thorington, Carpenter (signed with X), 31 January 1623.

> *To youngest son Thomas Wiseman, £15 paid by executrix when 22. Wife Joan to be executrix, and she to bring up said Thomas well and honestly in good order and education till he be 14, and then she is to bind him as apprentice. To eldest son John Wiseman, £5. To son Robert Wiseman, £5 when 22. To daughter Margery, £2, and to daughter Elizabeth, £2. To son Matthew Wiseman, £0.25. Rest of goods, ready money, bonds, and lease of house where testator dwells and lands belonging to go to wife Joan. Probate, 15 May 1623.* (Allen, 1989, 266.)

Wills could bequeath very small amounts, such as the following.

WILLIAM STURTENE of Tolleshunt Major, Husbandman, 14 November 1598.

> *To Francis my son 10s. To Thomas Stonard my son-in-law 1 cow in consideration of money which I owe him. To William and Henry his sons and Mary his daughter each a pewter platter. To Elizabeth my wife the rest of my goods. Probate, 3 February 1599. (Emmison, 2000, 171)*

Wills were not made by a random sample of the population, but were instead made by those who had property to bequeath. But the custom of making wills seems to have extended well down the social hierarchy in pre-industrial England. In Suffolk in the 1620s 39 percent of males who lived past age 16 made a will that

was probated.[9] Higher income individuals were more likely to leave a will, but there are plenty of wills available for those at the bottom of the hierarchy such as laborers, sailors, shepherds, and husbandmen.

Wills by 1600 mention nearly all surviving children. Potentially some children were omitted from wills because they received no bequest. But the numbers of omitted children must have been small.

One way this can be demonstrated is through the ratio of sons to daughters. Daughters were much more likely than sons to be excluded from wills: because they had married and were given their share of the inheritance in dowry, or because they were given no bequest. John Hynson of Fordham, Cambridge left to his two unmarried daughters Margaret and Mary £30 each. His three married daughters, whose names were not even given, were described thus "To my 3 daughters who are married 10s (£0.5) each."[10] Even bequests to unmarried daughters were generally smaller than for sons. For example, John Pratt of Cheveley, Cambridge left each son £5, but each daughter only £2.[11]

Hence the ratio of boys to girls named in wills can be used as a measure of how many daughters were omitted. The ratio of boys to girls would be 1.05 at birth in England circa 1600, falling to 1.03 for ages 1-25 because of higher infant mortality for boys.[12] Thus the expected ratio will be 1.03 if boys and girls had equal chances of being mentioned in wills. The actual ratio, as table 6.1 shows, averaged 1.05. Probably only 2 percent more girls

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[9]Probated means registered in the appropriate court. Since probate had a cost others would have made wills that were never probated.

[10]Evans, 1993, p. 217.

[11]Evans, 1993, p. 108.

[12]Based on estimated relative male and female mortality rates by age in 1580-1649 (Wrigley et al. , 1997, 296, 303).

than boys are omitted from these wills. But given that girls were so much more likely to be excluded if anyone was, the overall omission rate for children must have been very low.

Since we are interested in the reproductive success of testators, dead children were counted as surviving offspring if they themselves had produced living offspring. Thus William Cooke of Great Livermere in Suffolk, who died at about age 74, left four living children, but also two dead sons who both had two surviving children.[13] He was counted as having 6 children.

As can be seen in table 3 the average numbers of children per testator were modest. For a population to be just reproducing itself the numbers of children surviving each male at time of death would have to exceed two. It has to exceed two since some of these children are minors who would die before they would reach the age (sixteen or more) where they would be potentially writing wills. For the average testator in our sample to get 2 children who survived to age 16 at least they would need to have left 2.07 children when they died. Thus London testators circa 1620 were definitely not reproducing themselves. Those outside London in smaller towns, with 2.43 surviving children per testator, were experiencing a population growth of less than 20 percent per generation. Country testators, however, were growing by 40 percent per generation.

It might be still possible that poor families, having little to leave, more often omitted both boys and girls equally, which our gender ratio test will not discover. We can control for this kind of gender neutral omission by also examining the relationship between wealth and the frequency of either no child being named as an heir, or of no male heir being named.

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[13] Evans, 1987, p. 359.

Table 3 Surviving Children per Male Testator, England, 1580-1640

Location	Number of wills with information on children	Children per testator	Sons per testator	Ratio Sons/ Daughters
London	177	1.96	0.83	0.77
Town	344	2.39	1.19	1.02
Rural	2,210	2.92	1.50	1.06
ALL	2,731	2.79	1.42	1.04

The reasoning is as follows. Even if poorer testators omit some children from their wills because they have few assets, or chose to leave everything to one child, they will certainly not omit all their children for this reason. Further given the preference for males as heirs, while they might leave assets only to the oldest son, they would not omit all their surviving sons from a will. Thus if we take as an index of fertility either just the frequency of at least one child being named, or the frequency of at least one son being mentioned in the will, this should be proof against the type of omission of children possibly to be found in poorer families. We shall see below that when our analysis of fertility is carried out using these as alternative measures the results remain as strong as when using all children.

The estimated assets of testators were constructed from the information in wills by adding together the cash payments directed by the testator, with the estimated value of houses, land, animals,

grain bequeathed by the testator. The average value of assets equaled £235 in 1630s prices.[14] But the median value was only £100. This would generate an annual income of about £6 at the return on capital typical of this period. The yearly earnings of a carpenter in this period would be about £18, and of a laborer £12. This reinforces the idea that the wills covered a large part of the income range.

These measures of assets correlate well with literacy, as measured by whether the person signed the will, and with the occupation or social status of the person. Table 4 shows this by dividing testators into seven broad occupational categories. *Gentlemen* at the top of the scale were mostly literate, and had average bequests of more than £1,000. Laborers at the bottom were mostly illiterate, and had average bequests of £42. But within each social rank there were huge variations in the wealth of the testator. There were laborers with more assets than some of the gentry. Indeed knowing someone's occupation explains only about one fifth of the variation in assets across testators.

Figure 8 shows the estimated numbers of children per male of each of eight bequest classes - £0-9, £10-24, £25-49, £50-99, £100-199, £200-499, £500-999, £1000+ - revealed by the wills. The bottom four income groups cover the bottom 50 percent of testators. The numbers of children are shown both for all men, and for married or widowed men only. In both cases there is a very powerful connection between assets and surviving children.

For all men someone with less than £10 in bequests would typically have fewer than two children, while someone with £1000

[14] 1.1 houses, £44, 9.9 acres of land, £99, goods, £4, and £88 in cash.

Table 4 Testators by Social Rank, 1585-1638

Social Group	Numbers of wills	Fraction of testators literate	Average value of bequests (£)	Maximum value of bequests (£)
Gentry	59	0.94	1,084	10,935
Merchants/ Professionals	87	0.84	268	1,739
Farmers	659	0.50	406	7,946
Unknown	345	0.44	154	1,360
Traders	84	0.47	112	1,390
Craftsmen	267	0.40	85	525
Husbandmen	333	0.24	87	1,898
Laborers	100	0.14	42	210

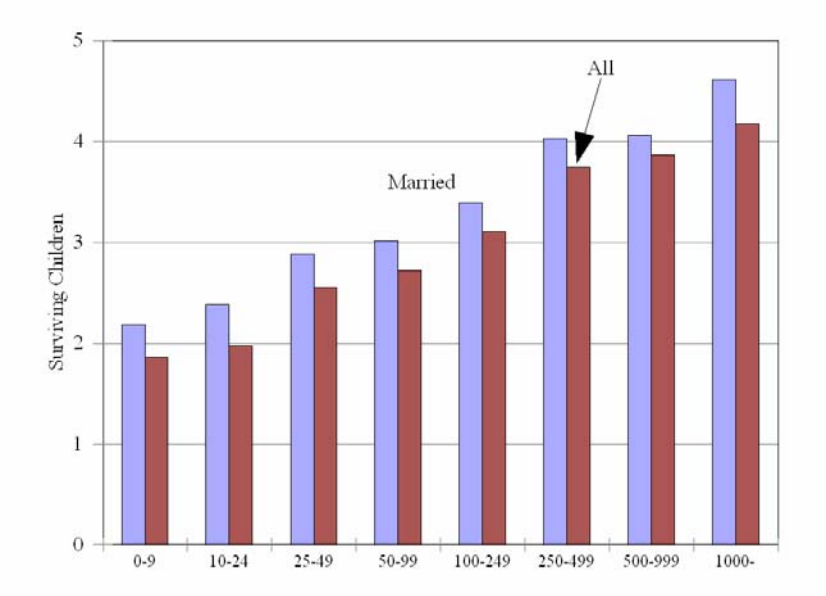

Figure 8 Surviving Children by Testator's Assets in £

or more, nearly four children. The link between assets and surviving children was thus extremely strong.[15]

The link shown here between assets and surviving children cannot be an artifact created by poorer testators omitting some children because they had nothing to bequeath them. This is evident in a number of ways. We know, for example, from the work of Wrigley and his associates that the typical male testator in England in these years would leave 2.58 surviving children.[16] So testators with assets with four children per family must be producing substantially more surviving children than the general population, and by inference than the poorest testators also.

Interestingly assets predict reproductive success much better than social status or literacy. Economic status rather than social class is what mattered for reproductive success in England in these years. Presumably this was because the occupational labels used to form people into status classes were imprecise. There were husbandmen who were literate and wealthier than yeomen who were illiterate. There were carpenters who worked for others and owned no assets, and there were carpenters who were employers and engaged in building and leasing property.

It could be that economic success was an idiosyncratic element, created by luck, or by personality factors that were non-hereditable. In this case while survival of the richest would have the social consequences illustrated below, it would have no possible long run effects on the characteristics of the population.

However, the children of the rich had one significant advantage over those of the poor, which was the significant amount they inherited from their parents. One thing that stands out in

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[15] Given that we have a very noisy measure of assets bequeathed, the true relationship between assets and children is most likely even stronger than shown in the figure.

[16] Wrigley et al., 1997, 614.

these wills is that the major concern of the writers was to ensure that their assets passed to their biological children, and absent these to others genetically related to them: nephews, nieces, brothers, sisters or cousins. Where wives were young enough to have children by another husband the fear was that the children of another man would benefit from the testators assets. Wives were sometimes forbidden to remarry, or were required to surrender bequests on remarriage. Even though the early seventeenth century was a time of relatively heightened religiosity, and the wills came from an area of England which produced many of the early Puritan settlers in New England, the amounts bequeathed to the poor were extremely small. Little also was left to the many servants the rich would have. Figure 9 illustrates the dominance of transmission of assets to those genetically related to the testator.[17] Bequests to the poor were typically less than 0.5 percent of the testator's assets. Bequests to those not genetically related were between 1 and 12 percent. The greater frequency of such bequests by poorer testators probably just reflects them more often having no genetic relatives to leave property to.

Thus the sons of the rich would typically end up inheriting, counting the dowry their bride would bring, about half their father's bequest. There is evidence that they used that advantage to out-reproduce the children of poorer testators.

The first form of this evidence is the numbers of grandchildren mentioned in the wills of richer and poorer testators. Only some grandchildren were mentioned in these wills. But if omissions were equally likely for the poor as for the rich, then if the children inherited some of the reproductive success of their

[17]Wives were counted as genetically related since the assets bequeathed to them were typically to raise children, or would pass on to children on their deaths

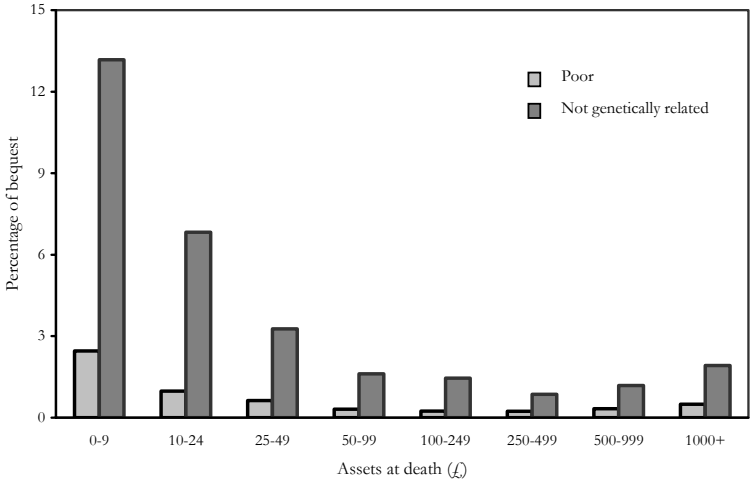

Figure 9 Share of bequests to those genetically related

parents, the ratio of grandchildren to children should be greater for the children of the wealthy. If there was no inheritance of reproductive advantage the ratio should be the same for the children of the rich and the poor. Figure 10 shows this ratio for a sub sample of the wills. It is clearly higher for the children of the rich. However it is only about 50 percent higher for the children of the two richest groups of testators than for the children of the poorest. So clearly this advantage is not perfectly hereditable, or this ratio would have been close to double for these groups.

A second check on the hereditability of these differences in reproductive success is to look at the correlation of assets between the wills of fathers and sons, since the size of the bequest is so closely linked to reproductive success. Figure 11 shows this relationship for 72 father-son pairs, where the bequest size has

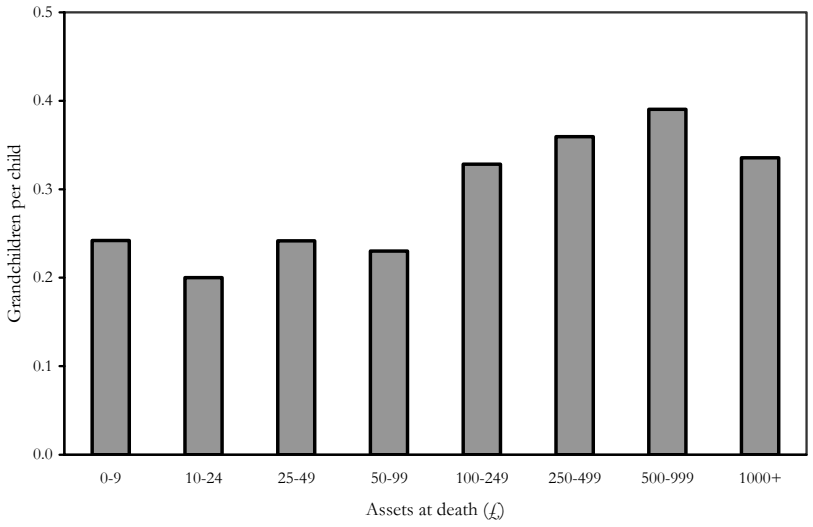

Figure 10 Grandchildren per child, by bequest class

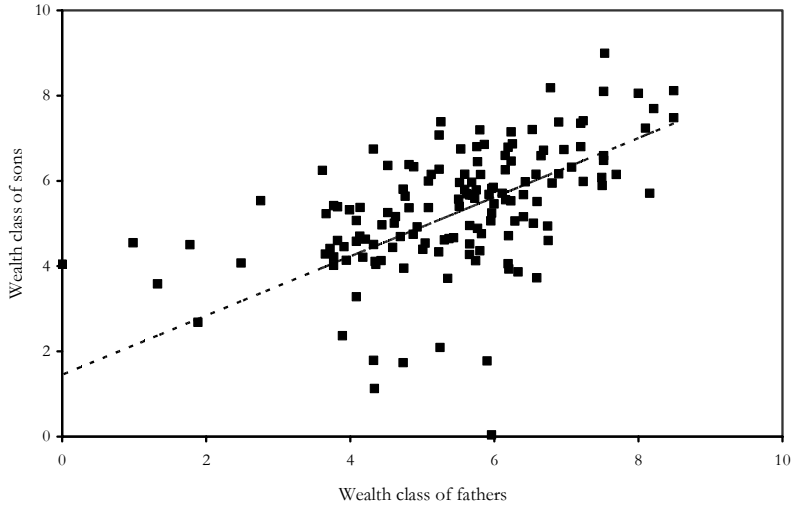

Figure 11 Bequests of the father, and of the son[18]

been transformed into units roughly equivalent to the intervals used in figure 8. Clearly there was a correlation between the

[18]The bequest measure here is ln(1+bequest).

wealth of fathers and sons where they both left wills. Rich fathers tended to have rich sons and vice versa

There are some problems with this data that limits what is can demonstrate, since the chances of a man making a will were much greater if they had a larger bequest to make. But if that was all that was happening we would expect poorer fathers, those who left less than £100 for example, to have a significantly richer son where their sons left wills. In practice the 20 fathers in this group whose average bequest was £51 left sons whose average bequest was only slightly higher at £123. So this effect cannot be purely selection. Economic status was indeed inherited.

There is evidence that the pattern uncovered here of much higher net fertility by richer groups existed in England at least by 1250. Medieval kings had a financial interest in the deaths of their tenants in chief, those who held land directly from the crown in the feudal system. These individuals were mostly an economically privileged group, and included the highest nobility of the land. Thus from 1250 on the king's officials conducted *Inquisitiones Post Mortem* on the deaths of these tenants, which are preserved in the Public Record Office. These inquisitions record only the following information, however, about surviving children: the oldest surviving son or his descendants; failing a male heir all daughters or their descendants.

The evidence of the wills in 1585-1638 provides a way to infer total numbers of surviving children from measures such as the fraction of times there was an heir, or the fraction of times there was a male heir, for wealthy groups such as royal tenants before 1500. Figure 12 shows two series by decade. The first is the average number of males per adult inferred for the whole population of England by decade from data on the aggregate movement of population. As can be seen, except for the phase of

population growth up to 1315, this number was one or below one. The second is the implied average number of adult male children produced by royal tenants. This was calculated by using the proportions revealed for 1585-1638 between total male surviving children and the fraction of testators leaving a son or leaving some child.

In the two periods in medieval England where the population was stable or growing, 1250-1349, and 1450-1500 tenants in chief were producing on average about 1.8 surviving sons, nearly double the population average. Even in the years of population decline from 1350 to 1450, though implied surviving sons per tenant in chief declined, it remained at above the replacement rate of in most decades. Thus, as later, in medieval England the rich seem to have been out-reproducing the poor.

Note that in England the reproductive success of the class that engaged in warfare on a large scale in the pre-industrial era, the aristocracy, was much poorer than for economically successful commoners, and was probably less good than that of the average person. Table 5 shows for the English aristocracy - kings, queens, dukes and duchesses - the Net Reproduction Rate, as well as life expectancy at birth for males by period from 1330 (when Dukes were first created) Medieval manorial tenants, for example, had a life expectancy at age 20 of about 30, compared to 22 for the aristocracy.[19]

These excess deaths at relatively young ages contributed to the low net fertility of aristocrats. Thus in the earliest period we observe fertility, 1480-1679, the aristocracy, despite its privileged social position was barely reproducing itself. Only after 1730

[19]Razi, 1980, 130.

Figure 12 Sons per Testator, 1250-1650

Table 5 The Demography of English Aristocrats, 1330-1829[20]

Period	Net Re-placement Rate	Male Life Expectancy at Birth	Male Life Expectancy at 20	Fraction of Deaths Violent
1330-1479	-	24.0	21.7	26
1480-1679	1.04	27.0	26.3	11
1680-1729	0.80	33.0	30.0	7
1730-1779	1.51	44.8	39.9	3
1780-1829	1.52	47.8	42.7	4

[20]Hollingsworth, 1965, 8-11. Hollingsworth considers only legitimate children, but argues that illegitimate children were few, less than 10 percent of these totals.

the general population. In this period also did aristocrats finally enjoy more reproductive success than the average person.

Thus from the earliest times we can observe in the pre-industrial era reproductive success in a settled agrarian economy like England seemingly went to those who succeeded in the economic sphere, and avoided occupations where violent death was a hazard. It is plausible that ever since the arrival of institutionally stable agrarian societies with private ownership of land and capital, and secure transmission of assets between generations, those who were economically successful, and in particular those who accumulated assets, were also reproductively successful.

Reproductive Success in Earlier Societies

The Malthusian assumptions imply that in all societies, those who command more income will have more reproductive success. This probably held even more strongly with other pre-industrial societies that, unlike Europe, were polygamous. For in these environments men could more effectively translate income into reproductive advantage.

Thus anthropologists have demonstrated that among pastoralists in modern Kenya, ownership of cattle correlates strongly with reproductive success through marrying more and younger wifes.[21] The Ache of Paraguay, hunter-gatherers, moved every day in search of game, so property ownership was minimal in this society, limited to what a person could carry. Reproductive success in this group was still correlated with economic success. But it was the success of males in bringing in meat to camp each day. All the adult males hunted, and Ache hunters who brought

[21]Borgerhoff-Mulder, 1987. Cronk, 1991.

home more meat had higher fertilities. The most successful hunters at the mean age of 32 had .31 children per year compared to 0.20 for the least successful. Survival rates were about the same for children of successful and unsuccessful hunters.[22]

But the mechanisms by which people commanded more income seem to have been very different in hunter gatherer societies than in the settled agrarian economies that preceded the Industrial Revolution.

As we saw for the case of the upper classes in England, violence was not a successful reproductive strategy. Rates of violent death were very low. This contrasts with conditions in modern hunter gatherer or shifting cultivation societies where accidents and violence are a much more important source of mortality. There mortality death rates from accidents and violence for males were typically 3-18 per 1000 males per year. At the extreme, among the Ache violence was the cause of most male deaths.

In these societies violence was a way of gaining more resources and hence more reproductive success. Thus Napoleon Chagnon in a famous study of the warlike Yanomamo society found that a major predictor of reproductive success was having killed someone. Male Yanomamo sired more children at a given age if they had murdered someone than if they had not.[23] Table 6 shows the numbers of children male Yanomamo had fathered as a function of age, and of their status as a "killer" or "non-killer."

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[22]Hill and Hurtado, 1996, 316-7.

[23]Of course, this raises the question of whether murder is a successful reproductive strategy for males, since some of those who fail in the attempt will die themselves, and not be reported upon here.

Table 6 Reproductive Success of Male Yanomamo, 1987[24]

Age	Killers n	Killers Average Offspring	Non-killers N	Non-Killers Average Offspring
20-24	5	1.00	78	0.18
25-30	14	1.57	58	0.86
31-40	43	2.83	61	2.02
41+	75	6.99	46	4.19

Social Mobility with Survival of the Richest

England in the years 1585-1638 was still a relatively static society, with little change in income per person. It was, as noted, a society still in the Malthusian grip where economic change was slow or non-existent. Consequently the relative numbers of occupations, the wage rates for different occupations, and the stock of housing per person changed little. Land per person fell, but land values were increasing with the growth of population, so the value of land per person also changed little. The great reproductive success of richer testators thus meant that their children had to be on average moving down the social ladder in terms of assets and occupations, and moving down reasonably rapidly.

Table 7 illustrates this for Suffolk in 1620-1638. The second column of the table shows the sample of male will makers from

[24]Chagnon, 1988.

Table 7 Inter-generational Mobility in Suffolk, 1620-38[25]

*higher courts

Assets	Males in First Generation	Share of first generation (%)	Male Adult Children	Share of second generation (%)
0 (no will)	2,204	61.0	(2,125)	49.8
0-10	140	3.9	135	3.2
10-24	101	2.8	107	2.5
25-49	125	3.5	158	3.7
50-99	211	5.8	294	6.9
100-199	260	7.2	398	9.3
200-499	288	8.0	491	11.5
500-999	116	3.2	220	5.2
1000-	68	1.9	137	3.2
1000- *	100	2.8	(201)	4.7
All	3,613	100	4,266	100

Suffolk arranged by asset class. Added to the observed wills are the appropriately sized group of males who made no will, assumed to have 0 assets, as well an appropriately sized group of testators whose wills were approved in higher courts, and whose assets are assumed to all exceed £1000. The next column shows the share of each class of males in the population in the first generation. The next column gives the observed numbers of male children from each asset class who reach at least age 16. We assume the

[25]The numbers in brackets in column 4 are estimates from the observed reproductive success of he highest and lowest group of will makers in the archdeaconry courts.

non-mill makers had the same numbers of children as those making wills whose assets were £0-9. For those whose wills were proved in higher courts we assume they had the same numbers of children as those of the highest observed asset class. This implies that of a population of 3,613 wills in the first generation we end up with 4,266 adult male successors in the next generation, an increase of 18 percent per generation. This is close to the 21 percent gain per generation found by Wrigley et al's. for England in this period.

The last column of the table shows the shares of the children of each asset class in the next generation. Testators with less than £10 in assets and those who left no will were 65 percent of the first generation. But their sons constituted only 53 percent of the next generation. Testators with more than £500 in assets were 7.9 percent of the initial generation. Their sons were 13.1 percent of the next generation. Given that assets per person in the population probably stayed constant over this interval, there thus must have been considerable net downward mobility in the population. Nearly half of the sons of higher class testators would end up in a lower asset class at death. Indeed net mobility would be downward for testators in all the groups with £25 or more in assets.

Zvi Razi's evidence from the court rolls of Halesowen 1270-1430 is consistent with the suggestion of the *Inquisitiones Post-Mortem* that the rich were much more successful in reproducing themselves in medieval England. Table 8 shows the percentage of families showing up in the court rolls of 1270-82 who had direct descendants holding land in the manor 70 years later in 1348. All the families with the largest holdings in 1270-82 still had direct descendants holding land. But only 25 of the 70 families holding the smallest amounts of land had a descendant holding land.

Table 8 Survival of Landowners, Halesowen, 1270-1348[26]

Family Type in 1270-82	Numbers of Families	Number with descendants holding land 1348	Percentage with descendant land holders
Rich	40	40	100
Middling	64	58	91
Poor	70	25	36
ALL	174	123	-

However the distribution of holding sizes had not become more unequal because though families with larger holdings in 1270-82 on net acquired land, they also often divided up their holdings between multiple heirs, keeping the size distribution in balance. Since Ravi's data does not allow us to know whether the small landholders were in fact suffering demographic collapse, or simply either disappeared from the court rolls, or leaving the manor, the data does not demonstrate that medieval England was experiencing the same population dynamics as later.[27] But it is consistent with that interpretation.

A further piece of evidence on the long history of these selective pressures comes from the modern genetic makeup of men in England. Genetically modern English males are 50-100% Anglo-Saxon, despite the fact that Anglo-Saxon migrants to England in

[26]Razi, 1981, 5.

[27]Inhabitants without land were less likely to appear in court rolls since they do not show up in land transactions or as pledges.

the fifth century AD are now believed to have constituted no more than 0.5% to 10% of the population.[28]

Thus economic orientation had a dynamic of its own in the static Malthusian economy. Middle class values, and economic orientation, were most likely being spread through reproductive advantage across all sections of stable agrarian societies.

Evidence of Preference Changes

The Malthusian era was one of astonishing stasis, in terms of living standards and of the rate of technological change. It was thus an economy where we would expect that only one thing, land rents, would change across the ages. Wages, returns on capital, the capital stock per person, hours of work per person, skill premiums, should all have remained the same on average from the dawn of market economies to the end of the Malthusian era. This reinforces the puzzle of how the economy ever escaped the Malthusian Trap. How did stasis before 1800 transform itself into dynamism thereafter?

Static living standards have been amply shown by empirical evidence above, as has the slow aggregate rate of efficiency advance. Yet there were, despite this, profound changes in basic features of the economy within the Malthusian era. Four in particular stand out. Interest rates fell from astonishingly high rates in the earliest societies to close to low modern levels by 1800. Literacy and numeracy increased from being a rarity to being the norm. Work hours rose between the hunter gatherer era to modern levels by 1800. Finally there was a decline in interpersonal violence. As a whole these changes show societies becom-

[28] Thomas, Stumpf, and Härke, 2006.

ing increasingly *middle class* in their orientation. Thrift, prudence, negotiation and hard work were imbuing themselves into communities that had been spendthrift, violent, impulsive and leisure loving.

A plausible source of this seeming evolution of human preferences is the survival of the richest that is evident in pre-industrial England. The arrival of institutionally stable agrarian economies with the Neolithic Agricultural Revolution of as early as 6,000-7,000 BC, gradually molded human behavior, probably mostly culturally, but also potentially genetically.[29] The people of the settled agrarian economies who launched the Industrial Revolution around 1800, though they lived no better than their grandfathers of the Paleolithic, were systematically different in attitudes and abilities. The exact date and trigger of the Industrial Revolution may remain a mystery, but its probability was increasing over time in the environment of institutionally stable Malthusian economies. Technology, institutions and people were interacting in an elaborate dance in the long pre-industrial agrarian era of 8,000-10,000 years. These changes are too elaborate to go into fully in this paper, but here I just describe one important one, the apparent decline in time preference over the pre-industrial era.

One of the most profound prices in any economy, along with the land rents and the wage rates, is the *interest rate* for the use of capital. Capital, the stored up output that is used to aid current production, exists in all economies. Its principal form in the settled agrarian economies that preceded the Industrial Revolution was housing and land improvements. But another important

[29]The insight into the potentially Darwinian nature of the Malthusian era owes to Galor and Moav, 2002, though the argument here employs different specifics. Recent experiments in domesticating foxes and rats suggest that with sufficiently strong selection, powerful changes can be made in the behavior of animals within as few as 8 generations. Trut, 1999.

element in temperate regions was the stored up fertility of the land, which constituted a bank that farmers could make deposits in and withdrawals from depending on the urgency of their needs. There was thus as much capital per unit of output in medieval Europe, India or China.

Measuring real interest rates is not easy in the modern world of relatively high and variable inflation rates, and rapidly changing asset prices. But inflation, at least in the case of England, is a modern problem generally absent from the Malthusian era. So typically in England the nominal return on assets, the annual payment to the owner divided by the price, provided a good measure of the real return on capital before 1800. For England we have two measures of the rate of return that stretch back with relatively few interruptions from the modern era to 1200. The first is the return on ownership of farmland, the major asset before 1800. The second is the return on *rent charges*. Rent charges were perpetual fixed nominal obligations secured by land or houses. The ratio of the sum paid per year to the price of such a rent charge gives the interest rate for another very low risk asset, since the charge was typically much less than the rental value of the land or house.

Both these assets have the additional attraction as a measure of returns on capital for the pre-industrial era in Europe in that they were both excused from any taint of usury under Catholic Church doctrine. Since land and houses were productive assets it was not usurous to collect a return on the ownership of land or housing, and there were never even limitations on the amount of this return. Such an exemption was fortunate since all across medieval Europe the Church was the greatest owner of land and rent changes.

Figure 13 shows the percentage return on land and rent charges by decade in England from 1200 to 2000. Medieval England had real rates of return typically 10 percent or greater. By the eve of the Industrial Revolution rates of return had fallen to 4-5 percent.

The rates of return witnessed for Medieval England were in fact typical of Europe in this period. Table 9 shows the returns on land purchases and rent charges for other areas in Europe 1200-1349. There is surprisingly little variation across the different countries. The decline in interest rates witnessed in England was echoed across the rest of Europe. Rates of return by 1600 had fallen from these medieval levels in Genoa, the Netherlands, Germany and Flanders.[30]

All societies before 1400 for which we have sufficient evidence to calculate interest rates show high rates by modern standards. In ancient Greece loans secured by real estate generated returns of close to 10 percent on average all the way from the fifth century BC to the second century BC. The temple of Delos, which received a steady inflow of funds in offerings, invested them at a standard 10 percent mortgage rate throughout this period.[31] Land in Roman Egypt in the first three centuries AD produced a typical return of 9-10 percent. Loans secured by land earned typically an even higher return of 12 percent.[32]

Medieval India similarly had high interest rates. Hindu law books of the first to ninth centuries AD allow interest of 15 percent of loans secured by pledges of property, and 24-30

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[30] Clark, 1988. Cipolla, 1993, 216-7, de Vries and van der Woude, 1997, 113-129, de Wever, 1978.

[31] Compound interest was not charged, so since some of the loans ran for a number of years the actual rate charged was somewhat lower than 10%. See Larsen, 1933, 368-379.

[32] Calculated from the ratio of rents to land sale prices given in Johnson, 1933, 83-173, using wheat prices from Duncan-Jones, 1990, 146.

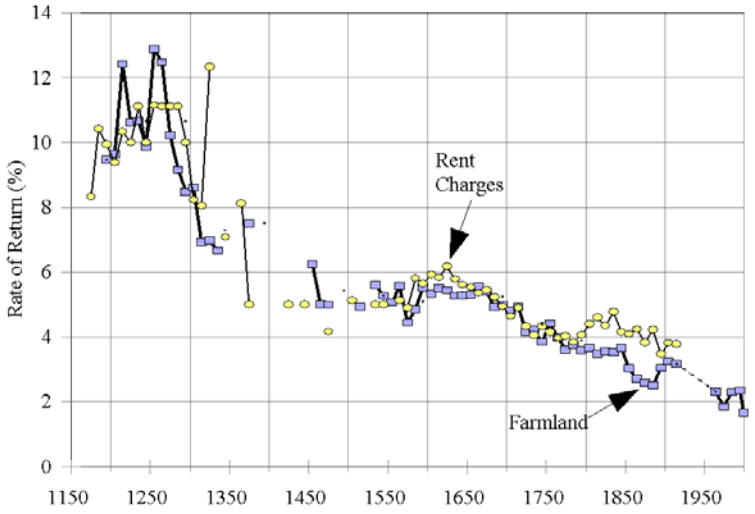

Figure 13 The Return on Land and on Rent Charges, 1170-2003 (by decade)[33]

Table 9 The Rate of Return on Capital across Europe, 1200-1349[34]

Place	Land	Rent Charges
England	10.0	9.5
Flanders	-	10.0
France	11.0	-
Germany	10.2	10.7
Italy	10.1	10.7

[33]For the years before 1350 the land returns are the moving average of 3 decades because in these early years this measure is very noisy. Clark, 1988, 1998. Modern returns from farmland ownership from UK, DEFRA, prices and rents of agricultural land.

[34]Clark, 1988, table 3. Herlihy, 1967, 123, 134, 138, 153 (Pistoia, Italy).

percent of loans with only personal security. Inscriptions recording perpetual temple endowments from the tenth century AD in South India show a typical income yield of 15 percent of the investment.[35] The return on these temple investments in South India was still at least 10 percent in 1535-1547, much higher than European interest rates by this time. At Tirupati Temple at the time of the Vijayanagar Empire the temple invested in irrigation improvements at a 10 percent return to the object of the donor. But since the temple only collected 63 percent on average of the rent of the irrigated land, the social return from these investments was as high as 16 percent.[36]

While the rates quoted above are high, those quoted for earlier agrarian economies are even higher. In Sumer, the precursor of Ancient Babylonia, between 3000 BC and 1900 BC rates of interest on silver loans were 20-25 percent. In Babylonia between 1900 BC and 732 BC the normal rates of return on loans of silver (as opposed to grain) was 10-25 percent.[37] In the sixth century BC the average rate on a sample of loans in Babylonia was 16-20 percent, even though these loans were typically secured by houses and other property. In the Ottoman Empire in the sixteenth century debt cases brought to court revealed interest rates of 10-20 percent.[38]

When we consider forager societies the evidence on rates of return becomes much more indirect, because there is no explicit capital market, or lending may be subject to substantial default risks given the lack of fixed assets with which to secure loans. Anthropologists, however, have devised other ways to measure

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[35] Sharma, 1965, 59-61.

[36] Stein, 1960, 167-9.

[37] Homer and Sylla, 1996, 30-1.

[38] Pamuk, 2006, 7.

people's rate of time preference rates. They can, for example, look at the relative rewards of activities whose benefits occur at different times in the future: digging up wild tubers or fishing with an immediate reward, as opposed to trapping with a reward delayed by days, as opposed to clearing and planting with a reward months in the future, as opposed to animal rearing with a reward years in the future.

A recent study of Mikea forager-farmers in Madagascar found, for example, that the typical Mikea household planted less than half as much land as was needed to feed themselves. Yet the returns from shifting cultivation of maize were enormous. A typical yielded was a minimum of 74,000 kcal. per hour of work. Foraging for tubers, in comparison, yielded an average return of 1,800 kcal. per hour. Despite this the Mikea rely on foraging for a large share of their food, consequently spending most time foraging. This implies extraordinarily high time preference rates.[39] James Woodburn claimed that Hadza of Tanzania showed a similar disinterest in distant benefits, "In harvesting berries, entire branches are often cut from the trees to ease the present problems of picking without regard to future loss of yield."[40] Even the near future mattered little. The Pirahã of Brazil are even more indifferent to future benefits. A brief overview of their culture included the summary,

> *Most important in understanding Pirahã material culture is their lack of concern with the non-immediate or the abstraction of present action for future benefit, e. g. 'saving for a rainy day.' (Everett, 2005, Appendix 5).*

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[39] Tucker, 2001, 299-338. Maize and manioc cultivation had higher yield variances, and so were riskier than foraging.

[40] Woodburn, 1980, 101.

Why did interest rates decline?

The real rate of return, r, can be thought of as composed of three elements: a rate of pure time preference, ρ, a default risk premium, d, and a premium that reflects the growth of overall expected incomes year to year, θg_y. Thus

$$r \approx \rho + d + \theta g_y.$$

People as economic agents display a basic set of preferences – between consumption now and future consumption, between consumption of leisure or goods – that modern economics has taken as primitives. Time preference is simply the idea that, everything else being equal, people prefer to consume now rather than later. The rate of time preference measures how strong that preference is.

The existence of time preference in consumption cannot be derived from consideration of rational action. Indeed it has been considered by some economists to represent a systematic deviation of human psychology from rational action, where there should be no absolute time preference. Economists have thought of time preference rates as being *hard-wired* into peoples' psyches, and as having stemmed from some very early evolutionary process.[41]

The "growth premium" in interest rates reflects the fact that if all incomes are growing it is harder to persuade people to lend money and defer consumption. Suppose everyone knows that in twenty years time their income will have doubled, which has been the case in a number of modern economies. They will all prefer to borrow from the future to enjoy better consumption now, rather

[41] Rogers, 1994, gives an evolutionary argument for why positive time preference would exist, deducing however that the time preference rate would always be the 2.5 percent or so observed in high income modern societies.

than save money when they are poor to spend when they are rich. Only through interest rates rising to high levels can sufficient people be persuaded to save rather than consume now. Since sustained income growth appeared in the economy only after 1800, the income effect implies a growth in interest rates as we move from the Malthusian to the modern economy, which of course we do not observe.[42] We should be the high interest rate society, not the Malthusian era.

Default risks also cannot explain high early interest rates. The default risk premium, *d*, reflects the fact that all investment involves some risk that the capital invested will not result in future consumption, but will be lost. The loss could come from the death of the investor, though if they have altruism towards their children this will reduce the compensation needed for this risk. However, the risk of the death of the investor, we know from the evidence presented above on mortality in the Malthusian era, was unchanged over time, and thus cannot explain any of the decline in interest rates.

So the extra 6-8 percent return that capital offered in Medieval England, if it came from default risks, had to stem from the risk of expropriation of the asset. But in the previous chapter I have emphasized that in fact medieval England was a very stable society, and that investments in land were in practice very low risk. Confiscation or expropriation was extremely rare, and real land prices were very stable over the long run.

The medieval land market offered investors a practically guaranteed 10 percent or more real rate of return with almost no risk. It was a society where anyone could significantly change

[42] The strength of this effect depends on θ, which in turn depends on how quickly the marginal physic benefit of a unit of consumption falls with greater consumption.

their social position just by saving and investing a modest share of their income. Suppose, for example, if a landless farm worker in thirteenth century England, at the bottom of the social ladder, were to start at age 15, invest 10 percent of their annual wage earnings in land, reinvesting any rents received. By age 50 they would have accumulated 85 acres to pass on to their children, or support them in comfort in old age, making them among the largest peasant proprietors in most medieval villages.

One other source of risk does exist in any society in purchasing land, and that is the risk that another claimant with a prior title will appear. Was it that the medieval legal system was so imperfect as to make all property purchases highly insecure?

A problem of any such interpretation is that different parts of England in the middle ages had very different jurisdictions and legal structures. Sometime before 1200, for example, London had secured from the Crown a large set of privileges. The first of these was that the city was allowed to pay a lump sum for taxes to the King "the farm of the city", and arrange its own collection within the city of this annual sum. The town was also allowed to appoint its own judges even in cases before the crown courts so that Londoners would only ever be judged by Londoners. Land cases were to be settled according to the law of the city, even in the king's courts. Londoners were free from trial by battle, the Norman tradition that resulted in some property cases being determined by armed combat as late as the 1270s.

In the reigns of Richard I and John (1189-1216) the kings' fiscal problems led them to sell off to many other towns similar rights and privileges to those of London. Thus by 1200 or soon thereafter there were a host of local legal jurisdictions in urban areas in England under which property would be held. If the high returns on land and rent charges were the result of deficiencies in

property laws and their enforcement, then we would expect some of these jurisdictions to perform much better than others. In those with the best defined property rights returns would be lowest. In the sample of rent charge returns I have for the years before 1349 I have enough data on a small group of cities and towns to compare their average rate of return with the national average. The results are shown in table 10. There is little difference between returns in the five specific locations and the national average rate of return. If property right insecurity explains high medieval rates of return different jurisdictions amazingly created systems with roughly the same degree of insecurity.

The third problem with an insecure property rights interpretation is that even if property rights were generally insecure in early societies, there would have been periods of greater and lesser security. Thus we would expect if the confiscation risk was the source of high early interest rates that interest rates would fluctuate from period to period, and would be connected to political developments. Yet not only were average rates of interest very high, they tended to be high and relatively stable over time where they can be measured reasonably well as with rent charges. Thus in figure 12 note that the rate of return on rent charges in the decades from the 1180s to the 1290s all fall within about 1% of the average rate of 10.4%. If these returns are so high because of the radical insecurity of property why did they not show any substantial deviations between decades, despite the huge changes in political regimes in this era?

Table 10 Rent Charge Returns 1170-1349 by location (%).[43]

Location	Number of Observations	Mean Return	Median Return
ALL	535	11.0	10.1
Canterbury	30	11.8	12.2
Coventry	48	11.4	10.0
London	84	10.3	10.0
Oxford	68	10.2	10.0
Stratford-upon-Avon	8	11.7	12.3
Sudbury	8	11.1	12.3

In the thirteenth century, for example, the reigns of John (1199-1216) and Henry III (1216-1272) were ones of greater turmoil in England. There was open rebellion in the last years of John's reign by the barons and again in the 1260s under Henry III. Edward I (1272-1307) ushered in nearly 40 years of stability and strong central government. But his son Edward II (1307-1327) was again a weak ruler who was eventually deposed and murdered by his wife and her lover and replaced as ruler by his son. But there is no correspondence between the periods of calm and stability, as under Edward I, and the prevailing interest rate. It is always high before 1300, whatever the high politics, but shows signs of declining in the turbulent years 1307-1327 (see figure 8.1).

[43]In calculating the mean returns 21 observations implying rates of return below 4% or above 25% were dropped. The mean without dropping these observations for the entire sample would be 11.5%.

The implied return on investments in land in Zele in Flanders, an area that suffered greatly from war and civil strife in the years 1580-1720, is shown in figure 8.2. These returns again show the influence of the war years with much higher returns on land purchases in the years 1581-92. But notably, despite the problems of war, the average return on land is only about 4 percent. The Netherlands and Belgium were the first areas in Europe to come close to modern rates of return in the pre-industrial era. And even in the worst years of the Spanish re-conquest in 1581-92, when many Protestants were fleeing from areas like Zele to the Dutch Republic, the average return on capital invested in land was still below the steady rate of 10% found even in the most secure circumstances in medieval Europe.

Thus despite the static living conditions of the pre-industrial world we have seen that somehow a very different society had emerged by 1800, at least in some parts of Europe. Returns on capital had fallen close to modern levels, work efforts were much higher in forager societies, skill premiums declined, interpersonal violence rates also declined, literacy and numeracy rose. Places like England were becoming more stereotypically middle class at all levels of the society.[44]

Selection Pressures

Why was Malthusian society, at least in Europe, changing as described as we approached the Industrial Revolution? Social

[44] Mokyr argues in an analogous way that the stock of *useful knowledge*, meaning the knowledge economic agents had about their physical environment, in Europe had been expanded greatly by 1800. The idea of performing experiments had diffused widely, for example. He ascribes this to the intellectual developments of the Age of Reason and the Enlightenment. Mokyr, 2002, 28-77. Mokyr, 2005, 286.

historians may invoke the Protestant Reformation of the sixteenth century, intellectual historians the Scientific Revolution of the seventeenth century or the Enlightenment of the eighteenth. Thus

> *The Enlightenment in the West is the only intellectual movement in human history that owed its irreversibility to the ability to transform itself into economic growth (Mokyr, 2005, 336).*

But a problem with the invocations of movers from outside the economic realm is that it merely pushes the problem back one step. Like invoking God to explain the creation of the world, it necessarily invites the question of the creation of God.

Protestantism may explain rising levels of literacy in northern Europe after 1500. But why after more than 1000 years of entrenched Catholic dogma was an obscure German preacher able to effect such a profound change in the way ordinary people conceived religious belief? The Scientific Revolution may explain the subsequent Industrial Revolution. But why after at least five millennia of opportunity did systematic empirical investigation of the natural world finally emerge only in the seventeenth century?[45] And had the unexpected and inexplicable Scientific Revolution never occurred would the world have forever remained in the Malthusian trap? Ideologies may transform the economic attitudes of societies. But ideologies are themselves also the expression of fundamental attitudes in part derived from the economic sphere.

There is, however, no need to invoke such a deus ex machina in the Malthusian era, given the strong selective processes identified above. The forces leading to a more patient, less violent,

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[45] Mokyr, in personal communication, argues that the Scientific Revolution and subsequent Enlightenment were themselves by products of the development of commercial capitalism in early modern Europe. But that, of course, creates another regress.

more hard-working, more literate and more thoughtful society were inherent in the very Malthusian assumptions that undergird pre-industrial society. Figure 14, for example, shows literacy rates for men circa 1630 as a function of bequeathed assets. As we saw the wealthiest testators who were almost all literate left twice as many children as the poorest, of whom only about 30 percent were literate. Generation by generation the sons of the literate were relatively more numerous than the sons of the illiterate.

Agrarian societies differed in two crucial ways from their forager predecessors. Agriculture allowed for much higher population densities, so that instead of living in communities of 20-50, people now lived in communities of hundreds to thousands. Already by 2,500 BC the cities of Sumeria are estimated to be as large as 40,000 people.[46] Agrarian societies also had large stocks of assets that were owned by specific people: land, houses, and animals. The sizes of these societies allowed the extensive use of money as a medium of exchange. Their size, and the importance of the income streams from these assets, created a need for enduring records of property ownership and property transfers. Thus a mass of clay tablets recording leases, sales, wills, and labor contracts survive from Ancient Sumeria and Babylonia. Figure 15 shows the most common type of cuneiform tablet, a receipt for delivery of goods.

In the institutional and technological context of these societies, a new set of human attributes mattered for the only currency that mattered in the Malthusian era, which was reproductive success. In this world literacy and numeracy, which were irrelevant before, were both helpful for economic success in agrarian

[46]Gat, 2002, --.

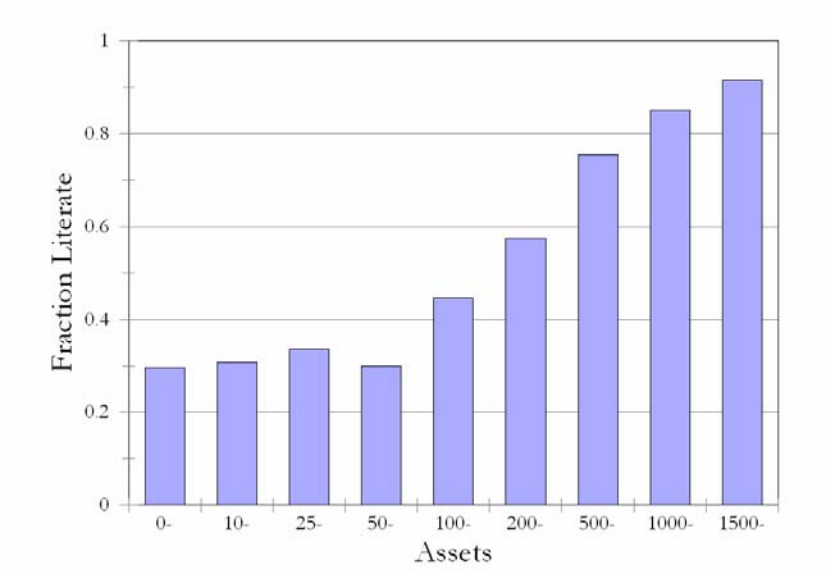

Figure 14 Literacy and Assets, England, male testators, 1630

Figure 15 Receipt for delivery of cattle, Mesopotamia Ur III (2112 – 2004 BC)[47]

[47]Snell, 1997, figure 7.

pre-industrial economies. Thus since economic success was linked to reproductive success, facility with numbers and words-was pulled along in its wake. Since patience and hard work found a new reward in a society with large amounts of capital, patience and hard work were also favored.

Trade and production in turn also helped stimulate innovations in arithmetic and writing systems designed to make calculations and recording easier. The replacement of Roman numerals by Arabic numerals in Europe, for example, was aided by the demands of trade and commerce. In medieval Europe,

> *the needs of commerce formed one important stimulus to the spread and growth of arithmetic (Murray, 1978, 191).*

In Europe religious bodies and the state, insulated from market pressures, were the slowest to adopt these innovations. The English Treasury was still employing Roman numerals in its accounts in the sixteenth century. But from the thirteenth century on Arabic numerals increasingly dominated commerce, and many treatises on arithmetic were clearly aimed at a commercial audience.[48]

So the market nature of settled agrarian societies stimulated intellectual life in two ways. It created a demand for better symbolic systems to handle commerce and production. And it created a supply of people who were adept at using these systems for economic ends. While living standards were not changing, the culture, and perhaps even the genes, of the people subject to these conditions were changing under the selective pressures they exerted. All Malthusian societies, as Darwin recognized, are inherently shaped by survival of the fittest. They reward certain behaviors with reproductive success, and these behaviors become the norm of the society.

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[48] Murray, 1978, 167-191.

What were societies like at the dawn of the settled agrarian era with the Neolithic Revolution of c. 8,000 BC? Based on observation of modern forager and shifting cultivation societies we expect that the early agriculturalists were impulsive, violent, innumerate, illiterate, and lazy. Ethnographies of such groups emphasize high rates of time preference, high levels of interpersonal violence, and low work inputs. Abstract reasoning abilities were limited.

The Pirahã, a forager group in the Brazilian Amazon, are an extreme example of this. They have only the number words "hói" (roughly one), "hoí" (roughly two), and "aibaagi" (many). On tests they could not reliably match number groups beyond 3. Once the number of objects reached as large as 9, they could almost never match them.[49] Yet the Pirahã perform very well as hunters, and in tests of spatial and other abilities. Similarly the number vocabulary of many surviving forager societies encompasses only the numbers 1, 2 and many. So forager society must thus have had no selective pressures towards the kinds of attitudes and abilities that make an Industrial Revolution.

The new world after the Neolithic Revolution offered economic success to a different kind of agent than were typical in hunter gatherer society: those with patience, who could wait to enjoy more consumption in the future. Those who liked to work long hours. And those who could perform formal calculations in a world of many types of inputs and outputs of what crop to profitably produce, how many inputs to devote to it, what land to profitably invest in. And we see in England, from at least the middle ages on, that the kind of people who succeeded in the economic system – who accumulated assets, got skills, got literacy – were increasing their representation in each generation. Thus it

[49] Gordon, 2004.

is plausible that through the long agrarian passage leading up to the Industrial Revolution man was becoming *biologically* more adapted to the modern economic world.

This is not in any sense to say that people in settled agrarian economies on the eve of the Industrial Revolution had become "smarter" than their counterparts in hunter gatherer society. For, as Jared Diamond points out in the introduction to *Guns, Germs and Steel*, the skills that ensure the survival and reproduction of hunter gatherers are many and complex.[50] This is illustrated by figure 16 which shows the earnings profile of a group of agricultural laborers with age in England around the 1830s, alongside the earnings profile of Ache hunters (measured in kilograms of meat). An English farm laborer reached peak earnings around age 20, while for an Ache hunter the peak did not come until the early 40s. This was despite the fact that the Ache reached a peak of physical strength in their twenties.

Clearly hunting, unlike agricultural labor, was a complex activity that took years to master. The argument is not that agrarian society was making people smarter. For the average person the division of labor agrarian society entailed made work simpler and more repetitive. The argument is instead that it rewarded with economic and hence reproductive success a certain repertoire of skills and dispositions that were very different from those of the pre-agrarian world: such as the ability to perform simple repetitive tasks for hour after hour, day after day. There is nothing natural or harmonic, for example, in having a disposition to work even when all the basic needs of survival have been achieved.

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[50]Diamond even goes so far as to argue that selection in agrarian economies would be based on resistence to epidemic diseases that arise with more concentrated populations, so that the people of forager societies were more intelligent than those of long settled agrarian economies. Diamond, 1997, ---.

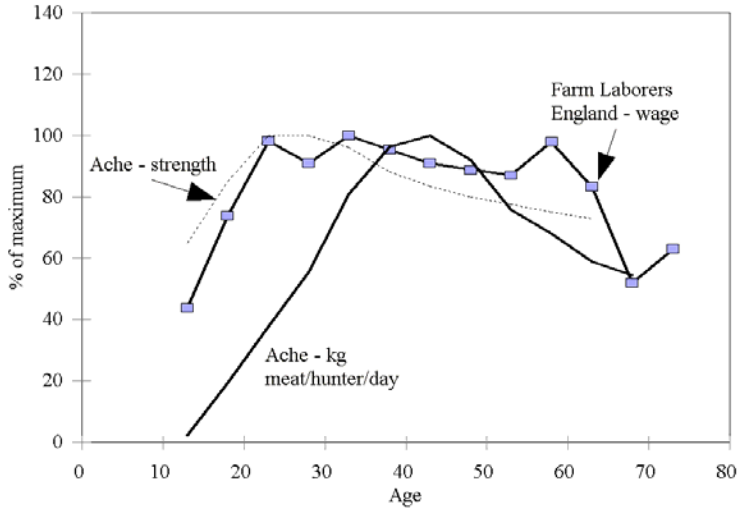

Figure 16 Output over the lifetime, hunter gatherer versus agrarian society[51]

The strength of the selection process through survival of the richest also seems to have varied depending on the circumstances of settled agrarian societies. Thus in the frontier conditions of New France (Quebec) in the seventeenth century where land was abundant, population densities low, and wages extremely high the group that reproduced most successfully was the poorest and the most illiterate.[52]

In China and Japan also, while richer groups had more reproductive success in the pre-industrial era, that advantage was more muted than in England. Figure 17, for example, shows the total fertility rate for the Qing imperial lineage in China

[51] Hunting success and strength, Hill and Hawkes, 1983. English farm wages, Burnette, 2005.

[52] Hamilton and Clark, 2006.

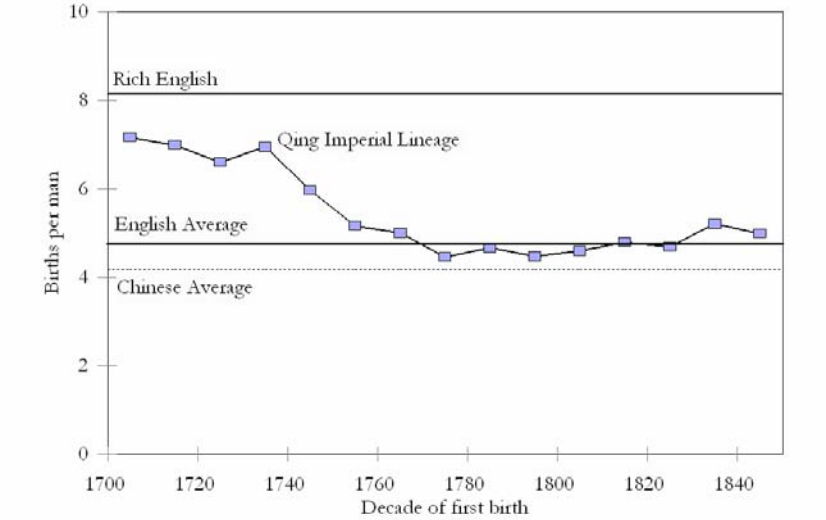

Figure 17 Male total fertility rate for the Qing Imperial Lineage

in 1644-1840. This is the number of births per man living to age 45. The royal lineage, which had access to imperial subsidies and allowances that made them wealthy, was more successful reproductively than the average Chinese man. But in most decades the advantage was modest – not anything like as dramatic as in pre-industrial England.

But these advantages cumulated in China over millennia perhaps explain why it is no real surprise that China, despite nearly a generation of extreme forms of Communism between 1949 and 1978, emerged unchanged as a society individualist and capitalist to its core. The effects of the thousands of years of operation of a society under the selective pressures of the Malthusian regime could not be uprooted by utopian dreamers.

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