gatherer societies. … The argument is instead that is 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 hour after hour, day after day. There is nothing natural or harmonic, for example, in having a disposition to work even when all basic needs of survival have been achieved. (Clark, 2007a, 187-188).

This is more a story about *Überschleppers* versus *Unterschleppers*, than *Übermenchen* versus *Untermenschen*. McCloskey is wrong when he claims that I am, like him, an unqualified admirer of bourgeois values. Being a cheerleader for the bourgeois values, as he is, creates a murky entanglement of economics and value judgements that I, at least, want to avoid.

5. There is no evidence that "survival of the richest" changed pre-industrial genes or culture

McCloskey asserts that the processes of "survival of the richest" could not significantly effect on the culture or genetics of societies like England by 1800. He quotes in support the arguments of Sam Bowles in his review of the book in *Science* (Bowles, 2007).

Adapting one of Bowles' points McCloskey tries to land a knockout blow. Regression to the mean would in a few generations destroy any effects of "survival of the richest" on behavior, by taking descendants back to the average characteristics of the population. Such selection could thus only influence behavior for any descendants of the economically successful for a few generations.

This is just a misunderstanding of the concept of regression to the mean. If McCloskey was right farmyard animals would all be at their medieval sizes still, and instead of the wonderful modern extravagance of dog breeds all dogs would have the characteristics of wolves and would make bad house pets. As a further reduction as absurdum man would never have evolved from apes in the first place. Why haven't creationists latched onto this wonderful insight, which according to McCloskey Galton, the great Social Darwinist fully appreciated (and yet clung to Social Darwinism)?

The reason is that if we take a population that varies on some characteristic, such as height, and eliminate the bottom 10 percent of the height distribution in one generation then we will for all time change the average height of that population. This is because we have changed the average underlying average genotype of the population. Because of regression to the mean the long run effect will not be as great as on the current generation. Because of random and environmental effects some of the people we removed had a large genotype, and some people we left in had the small genotype. But all regression to the mean in future generations will be to this higher mean. If we keep removing the bottom 10 percent of the population then over generations average height will keep increasing, and the variance of height diminishing, until we get to the maximum genetic potential for height in the population.[4]

Bowles' point runs into the same reduction ad absurdum. If it was true you could never by any temporary intervention permanently change the characteristics of a population.

McCloskey challenges me to be a true scientist and calculate the quantitative magnitude of the selection process posited. This is a straightforward calculation, and it shows that it would have strong effects. There is ample evidence that even in a few thousand years there could be significant changes in expressed human nature, by processes of inheritance within families. We know from quantitative genetics that this possibility depends just on two parameters:

(1) How hereditable was orientation towards economic success? How much did the economic performance of fathers predict that of sons?

(2) How much reproductive advantage did the rich have?

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[4] That is, until the genes promoting height become fixed in the population.

Since economic orientation was and is highly hereditable, and it conferred large reproductive advantages, expressed human behavior could change quite quickly in the pre-industrial world.

Note that people's economic behaviors are influenced by three systematic forces: their genes, culture vertically inherited from their parents, and culture horizontally acquired from the society they live in. For purposes of social policy the most important distinction is not between genes and culture, but is between traits acquired within families (which are very hard to change by any social policy) and traits acquired from peer imitation. This is the effect I estimate below. I also show, however, that based on modern evidence the *majority* of these effects would be genetic.

The Hereditability of Wealth

Hereditability is simply the correlation between parental behavior and child behavior. It varies greatly across human traits from near 0 to near 1. To measure this we would need measures of the average characteristics of both parents (since each child has two parents) compared to those of children. Since by law assets in pre-industrial England were controlled by males, we have no direct measure of the economic status of women. With perfect assortive mating the characteristics of both parents would be the same, and we can just look at father-son correlations in wealth. If mating was random, and children inherited characteristics from both parents, then the hereditability would be twice the father-son correlation. It turns out to be a law in genetics that the presence or absence of assortive mating has no effect on how rapidly a trait with a reproductive advantage will spread in a population. So we will not worry too much about this.

Assuming a constant dispersion of incomes the father-son correlation of wealth can be estimated by estimating the coefficient b in the expression

$$\ln y = b \ln y_p + u$$

where lny is the log of income or wealth of sons (measured relative to the average income), and lny_p is the log of income or wealth of fathers, measured similarly.

If *b* is 0, the trait is completely non-heritable. If *b* is 1 then the trait is completely passed on from fathers to sons. Since sons only inherit half their genes from their fathers, for a genetically inherited trait we would expect that b should be 0.5 or less (unless mating is assortive when it can be as high as 1). *u* is the random element in the transmission of traits from parents to children, created by differences in environment and by chance.

For traits important to breeders of farm livestock – milk yield, fleece weight, litter size, body weight – hereditability varies, but averages around 0.4.[5] This relatively low number implies that most of the variation in features like offspring body weight comes from random features. Yet despite this just by selection on observed characteristics animal breeders have been able over a few hundred years to greatly change the attributes of domestic animals. The medieval cows and sheep in England were tiny compared to their modern equivalents.

Economic success, measured by the correlation of wealth at death between fathers and sons, was much more heritable in the pre-industrial world than the average animal trait. The correlation here, measured as b, for 240 father-son pairs in England 1550-1850 was 0.67.

Hereditability and Human Behavior

At a lunch in 1936 with the critic Mary Colum, Ernest Hemingway said, "I am getting to know the rich." Colum replied, "The only difference between the rich and other people is that the rich have more money."[6] If this was true for the pre-industrial world then the differential survival of the rich would have had no long lasting impact on culture or genetics in these societies. The rich got

5 Hartl, 1985, 404.

6 Eddy Dow, New York Times, Nov 13, 1988. This is the basis for the oft quoted but fictive exchange between Fitzgerald and Hemingway.

established as class by some original act of violent expropriation in earlier times. Then their children inherited this wealth, and the reproductive success that came with it. But this process had no effect on human nature, since the rich were no different from anyone else in the society.

We can show, however, that the rich in pre-industrial England had to be different in personality and culture from the poor. The way we can show this is by estimating the connection between the wealth of sons and fathers controlling for the numbers of children (N). Thus I estimate the coefficients *b* and θ in

$$lny = b lny_p + \theta\, ln(y_p/N)$$

y_p is the wealth of the father, y_p/N the expected bequest received by the son. If the only advantage of rich sons was the bequest received then *b* should be 0. If the bequest did not matter then θ should be 0.

The estimated coefficients are

$$lny = 0.51 lny_p + 0.18 ln(y_p/N)$$

While the coefficient on lny_p is statistically different from 0, the coefficient on $ln(y_p/N)$ is indistinguishable from 0 statistically (the standard error is 0.17). Though the numbers of children in the fathers' families varied from 1 to 11, the estimated effect of this on the wealth of the son at death is modest. The best estimate is that the wealth of the son at death depends only 18% on wealth transmitted from the father. Most of the correlation in the wealth of sons and fathers at death depends on the transmitted of talent from fathers to sons, either genetically or culturally.

Thus we know that in pre-industrial England economic success was highly hereditable, and that this was mainly because the children of the rich differed genetically or culturally from the general population. Note also, since this will matter below, that there is a very modest quality/quantity tradeoff with sons in pre-industrial England. Moving from a family of 2 children to one of 4 children would reduce the expected wealth of sons by 12%. Moving from 2 to 10 children reduces sons expected wealth by just 25%.

Changing Human Nature

Suppose for simplicity we assume that economic success mainly came from possession of some complex trait, *Z*, which depended on the inheritance of a favorable draw of many factors. We can be agnostic for the moment about whether this was passed on genetically or culturally. This trait, for example, would include how many hours of work effort people put in each day, and how patient people were. Suppose also $y = Z + e$, where e is the random component. Income or wealth depends on how much of the trait you possess. How fast could such a trait spread among the population in the reproductive conditions of pre-industrial England, given that the possessors of the trait had twice the number of surviving children than those who did not possess it, but there was imperfect transmission between parents and children?

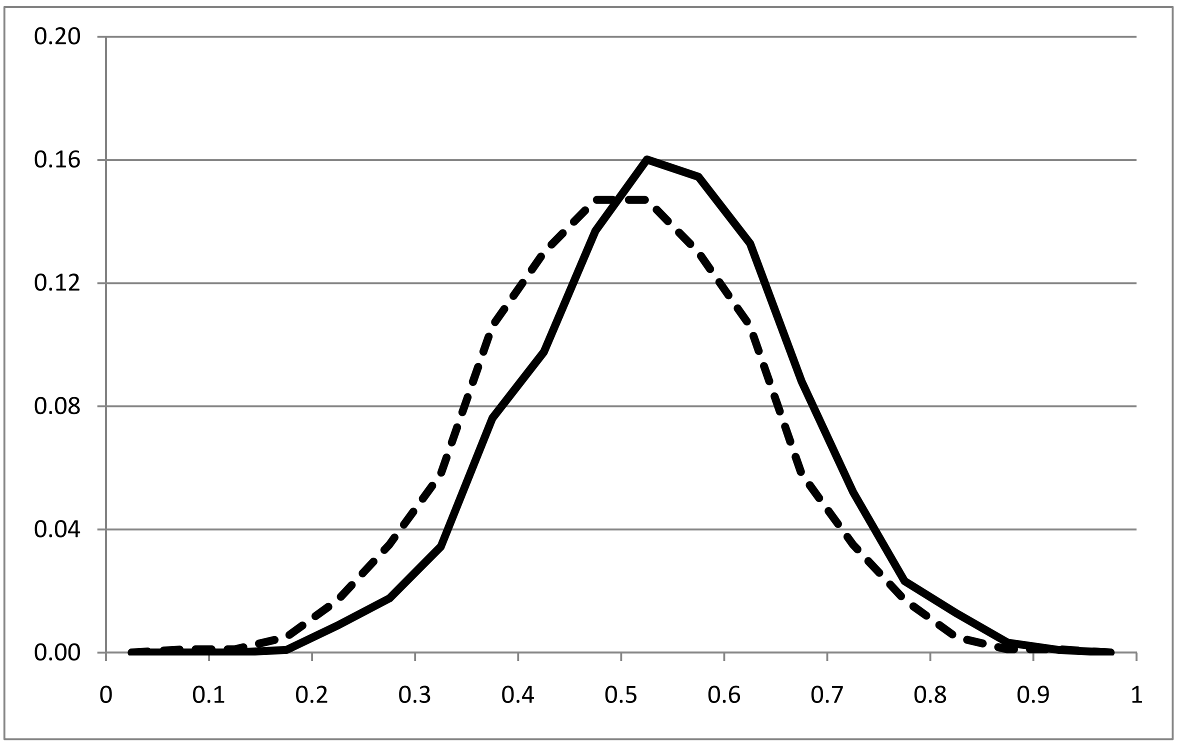
Figure 1 shows an assumed initial distribution of income y, assumed to follow a normal distribution with mean of 0.5. Figure 1 also shows the distribution of income among the offspring, with the assumption of a hereditability of 0.6 from father to son. That is

$$\ln y = 0.6 \ln y_p + u$$

For simplicity I assumed that the top quartile of the population had 3.2 surviving children, the next quartile 2.4, the next 1.6 and the lowest 0.8.

With these assumptions the average level of y, and hence of the trait Z, in the next generation increases by nearly 7% on the base. Thus even one generation in pre-industrial England is enough to change the distribution of the expressed trait significantly. Assuming an average generation length of 33 years there would be 18 generations between 1200 and 1800, plenty of time for significant changes in peoples' economic aptitudes. If we take the much longer interval between the Neolithic Revolution and the Industrial Revolution we are talking about 8,000 years, 240 generations. That is time enough for quite significant changes in the way people behaved.

Figure 1: The Change in Distribution of Economic Abilities over One Generation in Pre-industrial England



Another interesting feature of this change is that the variance of economic abilities declines as a result of this selection process. From one generation to the next people become more alike in their underlying economic abilities Z, and that the distribution of y becomes more peaked over time. The evolutionary process would not just raise the mean, it would also reducing the dispersion.

Could this change be genetic?

We see changes in basic behaviors before 1800. We see also the much greater reproductive success of those who embodied the more modern economic behavior. Economic success was strongly inherited, but that the mechanism of inheritance was not mainly the inheritance of wealth.

The mechanism of inheritance might still be purely cultural, a culture passed down vertically within families. For practical purposes of social policy this has the same impact as genetic inheritance, since the overwhelming majority of children are raised by their genetic parents. If this is a process that differed in its impact between one society and another, it does not matter whether the transmission mechanism between generations was genes as opposed to culture within families. It will be equally difficult to change through social policies that operate only outside families.

If one society experienced this process for a longer time, or more severely, than another then its members would have a persistent advantage in economic competition whatever the source of this advantage. But it is still intriguing to ask whether the processes I have identified could affect significant genetic changes in the historical era.

To conclude that the mechanism was genetic changes we need further information. But there is such information that makes this a very real possibility.

The rich in modern industrial society are genetically different from the poor. Stated thus boldly and starkly this seems a shocking, elitist statement. But this genetic difference shows in a number of ways.

First we can look at how closely the incomes of identical twins resemble each other compared to same-sex fraternal twins. Most of these studies have been done on males. With random mating by parents identical twins share 100% of their genes and fraternal twins only 50%. Under any reasonable assumption the environment will be very similar for fraternal as for identical twins.[7] If genetics made no difference to income, which was determined only by a combination of environment and chance, the correlation of income for identical and fraternal twins would be the same. In fact studies of twins consistently show the correlation of income for identical twins is about 0.2 greater than for fraternal twins (where the correlation can range from 0 to 1).[8] If the two parents have no genetic commonalities this would imply that genetics explains about .2 of the observed correlation of 0.4 between the incomes of brothers.

But marriage is to some degree assortive. People marry those who are like themselves in education and income. If there is an important genetic element in the determination of education and income, that in turn implies that people tend to marry those genetically similar. This means that even fraternal twins share more than 50% of their genetic material. The higher correlation of incomes between identical as opposed to fraternal twins is thus based on even less difference in genetic material, and so genes must be even more powerful in shaping income. With reasonable assumptions about the degree of assortiveness in modern mating, genetics can then explain .25 of the correlation of .4 between brothers' incomes.

The second source of information we have is the outcomes for biological children compared to adopted children. A recent study for Sweden, using an extraordinary good data set that identifies for children the education levels of both their adoptive and biological parents, finds that both nature and nurture matter to the educational attainment of children. But interestingly the relative impact of

[7] Some have argued that identical twins will have a more equal environment than fraternal twins, and this will account for the higher correlation in their outcomes. But if outcomes were so responsive to such modest changes in family environments then we would expect that social policies designed to address poor outcomes for some social groups which create similarly modest differences in the environment of children would be much more efficacious than they have proved to be.

[8] Bowles and Gintis (2002), 14.

the biological parents is roughly double that of the adoptive parents.[9] This is not directly evidence on income and wealth, but education levels are important predictors of both of these. And clearly genes explain the majority of educational attainment in modern Sweden.

Studies of criminality, using either twins or adoption methods, have similarly revealed a similarly strong genetic connection. One classic study is that of 14,427 Danish adoptees where the court convictions of the adoptees, their biological parents, and their adoptive parents are all known. When both sets of parents were non-criminal, the chances of the adoptee being convicted for a crime were 13.5%. When only the adoptive parent had a criminal record this chance rose very slightly to 14.7%. However if only the biological parent had a criminal record the chance of the adoptee having a criminal record rose much more, to 20.0%. If both sets of parents had a criminal record the chance of the adoptee having such a record was 24.5%. This suggests that genetic influences on the propensity to crime are much greater than environmental influences.[10]

Could the same forces identified above also cause significant genetic change over the course of 20-200 generations?

To simplify let there now be some genetic factor, a continuous variable g since it is the result of alleles at many loci, which helps determine economic success – the capitalist gene. Evidence from the twin studies cited above suggests that

$$y = 0.5g + u$$

Thus a person who has economic success two standard deviations above the average will typically have a "capitalist potential" just one standard deviation above average. The rest of their success will be a combination of luck, bequests, and the environment they grew up in.

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[9] Bjorklund, Jantti, and Solon, 2007.

[10] Mednick, et al., 1984.

Since we have assumed these genes have additive effects, if we take the average of parents economic success, we will find that their children have the same score on the "capitalist gene" index as the average of their parents (since all their genetic material comes from their parents). If marriage was purely random, and economic success depended only on the performance of men, then the son of a man two standard deviations above the mean in terms of economic success would be only 0.5 standard deviations above average in terms of his genetic potential for economic success. That would still imply that there was significant shift in the genetic composition of the population in each generation: a 2.5% increase on this measure per generation.

But marriage was not random in the pre-industrial world, at least in England and probably in most societies. Brides received dowries from their parents, and they in turn expected their children to inherit from their father-in-laws. So there was close matching in the economic status of partners in most marriages. If we assume on average that men married women whose father's had equal economic status to theirs, then by iteration the average bride would have as much of the capitalist gene as her husband. In this case, based on figure 1 above, there would be a 5% gain in the presence of this characteristic in the genetic makeup of the pre-industrial English per generation. Further two thirds of the changes in economic behaviors would indeed have genetic origins.

Sam Bowles objects that while personality traits are associated with economic success in the modern world, the hereditability of personality traits tends to be very low (Bowles (2007)). The hereditability of such traits was estimated in a large meta-study to average 0.13.[11] Thus there would be very weak selection for such traits in the pre-industrial world. However, evidence that specific traits measured by psychometricians have low hereditability does not on its own imply that a collection of traits that ensure economic success also has low hereditability.

[11] Loehlin, 2005.

For example, one of the most hereditable features of humans is the total ridge count across their 10 fingers, where the correlation between the average parent count and child count is 0.96. Yet for any given finger the hereditability of the count is only 0.63.[12] The reason is that at the level of single digits environmental and accidental features are much more important than when we average across 10 digits.

Similarly when psychometricians attempt to measure the hereditability of any particular feature of personality chance and environment may suggest a low value. The IQ of adults is highly hereditable (0.7 or more), and an important predictor of economic success. But these IQ scores are the composite of performance on a number of subtests (11 in the Wechsler intelligence test), where the hereditability of these subtest scores is much lower.

The precise way in which genetics influences economic success is not known. Factors such as IQ matter, but on their own explain very modest amounts of economic success. Other personality measures can also be shown to play some role. But since psychometricians have not set our systematically to find the personal predictors of economic success we do not know much about this. But we do not need to know exactly what these personality correlates are to know that they could have been strongly selected for within a few thousand years in the pre-industrial world.

The degree to which genes as opposed to chance or environment dictate outcomes is also dependent on the amount of variation in both genes and environment. It is not an absolute, but depends completely on such things as the range in social environments across families. In a society where 90% of people are bound serfs, and 10% own all the capital, environment will be a much more important predictor of outcomes than genetics. In a society like modern Sweden with extensive educational and health provision by the state, genetics may explain much more of economic success than otherwise.

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[12] Falconer, 1981, 160-1.

However, from at least the middle ages, pre-industrial England was a society with a very open structure. Most occupations were open to all, and anyone could accumulate property such as houses or land. There was every possibility for genetics to have an influence on outcomes even from the earliest years.

Conclusion

About 8,000-10,000 years ago people discovered the benefits of sedentary agriculture and began abandoned their roaming hunter-gatherer lifestyle. In the process they domesticated a large number of plants and animals. The wolf became the dog, the wild boar the farmyard pig.

Dogs, cattle, sheep, pigs, chickens all were transformed from wild animals to domesticated servants of humanity. In the process fundamental aspects of their natures were changed. Dogs have their origin in East Asian wolves of about 15,000 years ago, but they have acquired traits wolves do not possess. Thus dogs can read human faces and human actions in a way that wolves cannot, even when wolves are socialized with people from birth as with dogs.

Until recently, however, the one creature in the modern farmyard that was believed to be unchanged from Paleolithic times was man himself. We were assumed to still our original wild form. Thus there has been much attention to the "stone age mind" of modern man, and how this fits poorly with our new habitat of cities, crowds, and nations (Cosmides and Tooby, 1997).

But the evidence from pre-industrial England suggests that economic success was highly hereditable. Given how hard it is to change by social policy traits that are acquired within families, this, in terms of modern social impact it does not matter whether the mechanism of inheritance was genetic or not.

But evidence from the modern world establishes that economic success has a very important genetic component. Putting these together we can establish that there must have been significant genetic change from generation to generation in this dimension in societies like pre-industrial England.

This evidence fits well with recent claims that the rate of evolution among humans speeded up in the past 10,000 years. A recent study of variations in DNA across individuals concluded that "Rapid population growth has been coupled with vast changes in cultures and ecology, creating new opportunities for adaptation. The past 10,000 years have seen rapid skeletal and dental evolution in human populations, as well as the appearance of many new genetic responses to diet and disease."[13] In one particular case, the evolution of lactose tolerance has been traced in Northern Europeans to only the last 5,000-10,000 years.[14]

6. Does modern experience refute the idea of a genetic substrate to capitalist success?

McCloskey citing the review of the book by Robert Solow, argues that the experience of countries like India and China recently, and of immigrants to the US, shows that the idea that there are deep seated cultural or genetic differences in peoples' ability to succeed economically, which stem from the long histories of these societies, is unsupportable.

On the contrary, I think that there is a lot of modern evidence that is supportive of this possibility. What is emphasized in *A Farewell to Alms* is that the processes identified for England occurred in all settled pre-industrial agrarian societies, though perhaps with different force. That suggests that if we want to find the maximum possible cultural and genetic difference between groups in the modern world we should contrast the people from long settled agrarian societies with

[13] Hawks et al., 2007, 20,753.
[14] Bersaglieri, 2004.