

Population:

70,000 years ago, back in the Early Paleolithic Age, there were perhaps 100,000 of *us*—100,000 East African plains apes who looked like us, moved like us, acted like us, talked like us, and from whom the overwhelming proportion of all of our heredity is derived. Yes, we have small admixtures (5%?) from other groups and subspecies and maybe even species, but overwhelmingly we are those proto-hundred-thousand's children. Each of them who has living descendants today has a place—has an astronomical number of places—on each of our <<http://ancestry.com>> family trees.

It looks as though we had back then had recently squeezed through a much smaller bottleneck. Perhaps there were only 10,000 of us 75,000 years ago, either because we were almost wiped out by some global natural ecological catastrophe, or because a few thousand of us acquired an edge, and thereafter mostly pushed our closest cousins out of ecological niches rather than spreading our genes by promiscuously intermarrying with them.

What might that edge have been?

Back 70,000 years ago we were expanding our range, filling in our available ecological niche. How abundant were we when we had filled our niche up? Gorilla populations equal about 1 per square kilometer of habitat. Humans are higher up the food chain—more predators than grazers, and would consequently be an order of magnitude more scarce if we think of us as just another large primate. But we are tool-making and language-using—able to boost our natural bodily capabilities with fur and bone and flint, and an anthology intelligence to boot. Guess that that gives a 2.5-fold multiplication of our numbers. That gives us a population of 5 million worldwide for gatherer-hunter *homo sapiens sapiens* -10000 years ago, when we had spread throughout the world and taken it all for our habitat, just at the cusp of the invention of agriculture and the coming of the Neolithic revolution.

Back then we were very, very smart herd animals. We gathered, we hunted (some), we protected ourselves, we made stone and wood tools, we understood our environment, we manipulated our environment, we communicated with each other, we cooperated and we fought, we talked, and we did the things that humans do.

But population could have been twice or four times as large—or 1/4. We simply do not know and cannot do more than guess.

Before then? 50,000 years ago we appear to have been confined to large parts of Africa—with our homo sapiens neanderthalis, homo sapiens denisova, homo floriensis, an unidentified archaic African lineage—with all of whom save *homo floriensis* we interbred—and possibly others living outside our range. Figure we had 1/10 of our present habitat, and thus had 1/10 the population: 200,000.

And before then? We think that the human population—aside from admixtures from later—went through a bottleneck of 10,000 of so 75,000 years ago, after which it bounced back relatively rapidly in geological time—to maybe 100,000—in 5000 years or so. Perhaps that was when our behavior and capabilities changed enough to make the subspecies that would absorb or displace or consume all of our close cousins. Perhaps not.

How about between the years -8000 and -6000? Then came the development of herding and agriculture: The Neolithic revolution. Over 2000 years, approximately 1/5 of humanity converted to farming and herding, and its population by perhaps tenfold, leaving humanity in -6000 with twice the population of 2000 years earlier. Why this doubling of worldwide population in 2000 years or so even though then-known agricultural technologies could only be applied in a small slice of the human habitat? Because living was easier when you were sedentary or semi-sedentary: you no longer had to carry babies substantial distances, and you could accumulate more useful stuff than you could personally carry. Plus even early agriculture and herding were *very* productive relative to what had come before. Since life was easier, more babies survived to grow up, and themselves reproduce.

Thereafter the frontier between farming and herding populations on the one hand and the now relatively much less numerous gatherer-hunters continued to move, expanding the region of settlement in which the Agarian Age had come. Agricultural populations were so much denser that the key factor determining the frontier over the millennia was the existence of technology to effectively farm, and the ability to make the investments to bring whatever farming technology would work for the region to bear.

McEvedy and Jones have a guess that the regions for which agricultural technology had been developed did not grow that much between -6000 and -3000, and that the intensity of farming did not grow that much either. Perhaps a world population of 10 million in -6000 grew to 15 million by -3000. But in 3000 come both bronze and writing: humanity as a whole—not just the individual band or village—becomes a time-binding anthology intelligence able to make metal tools. Thereafter growth in population rockets upwards, reaching probably 100 million in -400 and perhaps 200 million at the apogee of classical civilization in the Old World in the year 150.

How did this population growth from -3000 to 150 distribute itself? How much of a killer Bronze Age before -1000 and how much in the Iron Age afterwards? There is a debate over this: The HYDE Project sees the world population in -1000 as equal to 100 million. Most other—I won't call them authorities—guesses follow McEvedy and Jones and see the year- -1000 population as roughly 50 million. Did population worldwide quadruple from -1000 to +150 or only double? We cannot know: we can only guess. And I have not yet managed to figure out why the HYDE Project is willing to abandon the principle that guides other guessers here, that of safety in numbers.

After 150 we are on much more solid ground.

We are highly confident in our estimates of world population of 7.8 billion in 2020, 4 billion in 1975, and even 2.1 billion in 1930. Enough of the world has comprehensive censuses around 1900 that we are even highly confident of the 1.3 billion population number of 1870. The 875 billion and 480 billion for 1770 and 1500? Less confident, but still confident: enough information about city sizes, tax bases, and settlement patterns survives.

Before 1500 things get foggy again. That world population grew from about 200 to only about 220 million from 150 to 800 is a guess, but a reasoned guess. That world population in 1000 was 3/5 of what it would be in 1500 is another reasoned guess. And the remaining link—the growth from 220 in 800 to 300 million in 1000 in the Mediaval Efflorescence is not unreasonable.

So we do have a picture of human population history: the —population— column of a table:

Global Longest-Run Global Economic Growth

Date	Ideas Growth Rate h	Ideas Stock Level H	Real Income/ Capita y	Popula- tion P (millions)	Total Income Y (billions)		Population Growth Rate n	Labor Efficiency- Growth Rate g
-73000				0.01		Sub-speciation gateway?		
-68000		0.0082	\$1,200	0.1	\$0.12	Establishment of homo sapiens sapiens?	0.046%	
-48000	0.002%	0.011	\$1,200	0.2	\$0.24	Final radiation from Africa?	0.003%	0.000%
-30000	0.003%	0.018	\$1,200	0.5	\$1	Late Paleolithic era	0.005%	0.000%
-8000	0.005%	0.057	\$1,200	5	\$6	Neolithic revolution	0.010%	0.000%
-6000	0.003%	0.061	\$900	10	\$9	Agrarian society	0.035%	-0.014%
-4000	0.007%	0.070	\$900	13.23	\$12	Final start of “urbanization”?	0.014%	0.000%
-3000	0.007%	0.074	\$900	15	\$14	Start of Bronze-Literacy age	0.014%	0.000%
-1500	0.030%	0.117	\$900	37	\$33	Bronze-Literacy mode of production	0.060%	0.000%

-1000	0.030%	0.136	\$900	50	\$45		Start of Iron age	0.060%	0.000%
-400	0.060%	0.195	\$900	103	\$93		“Ancient” mode of domination (“Asiatic”?)	0.121%	0.000%
150	0.060%	0.272	\$900	200	\$180		High Antiquity	0.121%	0.000%
800	0.007%	0.285	\$900	220	\$198		Late-Antiquity Pause	0.015%	0.000%
1000	0.078%	0.333	\$900	300	\$270		Feudal mode of production	0.155%	0.000%
1500	0.062%	0.467	\$1,000	480	\$480		Commercial-Gunpowder-Empire mode of domination	0.094%	0.015%
1770	0.146%	0.694	\$1,100	875	\$963		Imperial-Commercial Revolution age (“bourgeois society”)	0.222%	0.035%
1870	0.365%	1.000	\$1,300	1300	\$1,690		Steampower mode of production	0.396%	0.167%
1930	1.793%	3.000	\$3,000	2100	\$6,300		Second-Industrial-Revolution mode of production	0.799%	1.394%
1975	2.256%	9.000	\$6,000	4000	\$24,000		Mass-Production mode of production	1.432%	1.540%
2020	2.282%	27.000	\$12,000	7800	\$93,600		Global-Value-Chain mode of production	1.484%	1.540%
2077	1.939%	81.000	\$33,173	9311	\$308,857		Info-Biotech mode of production	0.311%	1.784%
2100	1.939%	127.381	\$50,000	10000	\$500,000	?	Into the Future?	0.311%	1.784%
2200	2.000%	941.227	\$369,453	10000	\$3,694,528	?		0.000%	2.000%

It is built on sand. Much of it is smoke and mirrors. But we can use it to make not inferences, but rather judgments as to what the likely course of history was, or, rather, might have been.

Average Incomes:

What can we say about average income levels?

We have good data on average income levels from Greg Clark. They show average income levels—the wages the church paid to construction workers, minus the prices the church paid for staple necessities—stagnant, although with considerable variation by a factor of nearly two, from 1200 to 1850:

The English-Wage Hockey Stick





We have no reason to think that England back then was in any way atypical of Agrarian Age societies—the pattern that started in -6000 with the diffusion of herding and agriculture, and that began to end only after 1850 or so.

Consider: a preindustrial pre-artificial birth-control population that is nutritionally unstressed will triple in numbers every 50 years or so. That was the experience of the *conquistadores* and their descendants in Latin America. That was the experience of the English and French settlers coming in behind the waves of plague and genocide that had decimated the indigenous Amerindian population in North America. That was the experience of the Polish, Ukrainian, and Russian settlers on the Pontic-Caspian steppe, after the armies of the gunpowder empires, most notably of Yekaterina (né Sophie) II Holstein-Gottorp-Romanov, Tsarina of All the Russias, drove out the horse nomads and opened the black-earth regions to the plow.

But look at our population estimates: Back in the Agrarian Age it took the human population not 50 but 1500 years to triple. The population in the year 1500 of 480 million was barely more than two times what it had been in the year one. And yet is there anything that parents would work harder for and spend more effort on than trying to ensure that their children would survive to reproduce?

They could not do so, at least not to any sufficient extent to make the rate of population growth more than glacial. And note that this was not because of a shortage of births: 8 pregnancies is typical for an Agrarian Age woman. Queen Anne Stuart had 17.

The fact that, in the Agrarian Age, human populations took not 50 but 1500 years to triple is a measure of how poor, in the sense of being extraordinarily close to a biological population-sustaining limit, humanity was back in the Agrarian Age.

Moreover, life expectancy was short, even for the upper class: 20 to 30 at birth, rather than our 80 or so. Some plague might well get you. And if you were female, childbed might well get you as well. Of British queens, one in seven in the years from 1000 up to 1650 died in childbed.

Males escaped childbed mortality, and also by-and-large escaped the extra mortality from nursing sick children with infectious diseases. But if you were male, or unlucky and female, you faced risks from human violence. 1/3 of English monarchs from William the Conqueror up to 1650 died in battle, were assassinated, or were murdered after some sham show of judicial process. Probably the risks of violent death at the hands of others were lower for people who were not so eminent. Probably.

What if we look back before the Agrarian Age, back to the Gatherer-Hunter Age? We conclude that over the -8000 to -6000 Neolithic Revolution transition, average living standards almost surely fell significantly. Agriculturalists are shorter—figure about three inches, 7.5 centimeters—than their gatherer-hunter predecessors. Agriculturalist skeletons show additional signs of malnourishment in addition to stunting. They show a population prone to endemic diseases. They show a population much more vulnerable to plagues relative to gatherer-hunters. Biologically, it would seem, it was much better to be a typical person in the Gatherer-Hunter Age than in the post-Neolithic Revolution Agrarian Age: Your life expectancy is no less. Your daily life presents you with more interesting and less boring cognitive problems. You are much more buff, and swole. You lack access to the high and, perhaps, much of the low culture of Agrarian-Age civilizations. But how much of a loss is that?

Jared Diamond believes—or at least whoever wrote the title of his article believes—that the invention of agriculture was, as the title says, a bad mistake: humans would have been much better-off had we remained gatherer-hunters.

The typical standard of living during the Agrarian Age thus looks to me like what the World Bank would call the edge of dire poverty: \$2.50 a day, \$900 per year, the standard of living of our bottom 6%, our bottom 500 million today. That is what the bioevidence strongly suggests. That, if England was not in some way bizarrely and massively atypical, is what our best local data sets indicate. I therefore assert and set the typical human standard of living from the year -6000 through the year 1000 to be \$900 per year. And I assert and set the previous-era Gatherer-Hunter typical standard of living to \$1200 a year. That made gatherer-hunters much healthier and more energetic than agriculturalists, and more able to resist the slings and arrows of outrageous fortune, but gatherer-hunter life expectancy looks to have been no higher because there were more slings and arrows.

What about starting at the other end of history? We are very confident of our measures of average real income today: \$12,000 per year or so. We are confident that, at least as measured, it doubled every forty-five years or so back to 1870, when we think average world real income per capita—at least as we measure it—was about \$1300 per year, with the overwhelming share of the excess above \$900 coming in the economies of the “Dover Circle-Plus”—those places within 300 miles of the port of Dover at the southeast corner of the island of Great Britain, plus those cultures’ overseas settler colonies. If we take the rest of the world to still be at or near \$900, we know enough about quantitative growth in the Dover Circle-Plus from 1770-1870 to guess that the world in 1770 was at \$1100. And how about the year 1500? We know that starting about 1500 world population growth more than doubled, from its typical Agrarian-Age rate averaging less than 0.1% per year—less than 3% per generation. And this acceleration in population growth seems worldwide. It thus seems highly likely that there was some edge over \$900: call the typical human living standard in the year 1500 some \$1000 a year.

Issues of Measurement:

But when I write down these numbers, I am worried.

Styles of life and the relative prices of commodities are so different between the upper-middle class of the global north today and Neolithic near-subsistence farmers and Paleolithic gatherer-hunters that a one-dimensional “real income” measure may not have much income. Plus there is the fact that our income measures add things up based on what they cost, but the measure we want is what we spend our income on is worth to us. The difference is what economists call “consumer surplus.” (I think I have a memory of economist Robert Barro saying or writing somewhere that for a rival-material good consumer surplus was probably, on average, about equal to factor cost; but that for a non-rival attention-information good the ratio was likely to be much larger: perhaps five or ten to one. That struck me as very smart, and likely to be true. But I have been unable to find this anywhere.)

Nathan Mayer Rothschild, the richest man in the first half of the 1800s, died in his fifties of an infected abscess in his buttâ€”something we would cure with a lancing and a single dose of amoxicillin, followed by being yelled at by a medtech for having let it get so bad before asking for help. Does that mean that every single one of us with access to modern antibiotics is, properly assessed, richer than Nathan Mayer Rothschild was? In a profound sense, yes.



I once got ten pounds of potatoes at Trader Joeâ€™s for a dollar. Thatâ€™s 0.005 cents per calorie. At the California minimum wage, that is about 1 second of work for 100 calories. For a Neolithic near-subsistence farmer, about half your work-time has to be devoted just to getting calories, and your productivity is maybe 10000 calories for half-a-dayâ€™s work: 2500 calories/hour, or 2 minutes for 100 calories. Are we thus not the 12 times that the table above presents but rather 100 times richer on average than our predecessors? Perhaps. But there are also things we value that take just as much of our labor-time to obtain today as 5000 years ago, the respect of our peers high among them. And there are things we value today that our predecessors could not obtain at any priceâ€”like amoxicillin.

What is the proper average summary statistic of all of these multi-dimensions of economic growth? Is there a proper average summary statistic?

And we have not even reached the problem that perhaps what we most want to know cannot be quantified. There are things that are objective and can be measured: five bushels of properly-threshed barley kernels, or three gallons of water. There are things that are subjective that can nevertheless be accurately measured in an objective form: the feeling of heat, for example: this northern California hot tub here in the fog feels hot, and, indeed, is at a temperature of 105F: its molecules have thermal kinetic energy above that of absolute zero by 565/180 times the difference in thermal kinetic energy between water on the edge of boiling and water on the edge of freezing. But there are also things that are so subjective that one cannot imagine a quantitative measure that would be at all adequate: things like anger, rage, sorrowâ€”and joy.

Economists start with objectively measured prices and quantities of goods and services exchanged in markets, and then go on to construct quantitative measures of subjective things like willingnesses-to-pay and willingnesses-to-substitute and values and so forth. Mid-twentieth century British economist John Maynard Keynes warned us against carrying this too far:

Approximate statistical comparisons depending on some broad element of judgment rather than of strict calculationâ€™ may possess significance and validity within certain limits. But the proper place for such things... lies within the field of historical and statistical description, and their purpose should be to satisfy historical or social curiosity... of a similar character to the statement that Queen Victoria was a better queen but not a happier woman than Queen Elizabethâ€™ a proposition not without meaning and not without interest, but unsuitable as material for the differential calculus. Our precision will be a mock precision if we try to use such partly vague and non-quantitative concepts as the basis of a quantitative analysis...

Nevertheless, in spite of Keynesâ€™s warning, I do want to carry this far, for I think there is genuine insight to be gained here.

â€œTechnologyâ€œ:

Take the square-root of what we think is the total world labor population P and multiply it by our very crude measures of average real income per capita y , and call that product â€œtechnologyâ€œ the value H of the stock of useful ideas about manipulating nature and organizing humans discovered, invented, developed, and deployed globally into the world economy. Normalize H by setting its value in 1870 equal to 1.

Why take the square-root? Well, if we just multiplied average income by populationâ€”called total world real income â€œtechnologyâ€œ we would be implicitly assuming that labor is useless and unproductive. But that cannot be right: each mouth comes with two eyes, two hands, and a brain. If we just took average incomeâ€”called that â€œtechnologyâ€œ we would be implicitly assuming that natural resources are unimportant, and that it does not matter how small population growth has reduced the size of the average plot of land on which a typical personâ€™s food is to be grown. That also cannot be right: resource scarcity, and attempts to compensate for it, are a very real thing in our world, today and in our past.



above presents but rather 100 times richer on average than our predecessors? Perhaps. But there are also things we value that take just as much of our labor-time to obtain today as 5000 years ago, the respect of our peers high among them. And there are things we value today that our predecessors could not obtain at any priceâ€”like amoxicillin.

What is the proper average summary statistic of all of these multi-dimensions of economic growth? Is there a proper average summary statistic?

And we have not even reached the problem that perhaps what we most want to know cannot be quantified. There are things that are objective and can be measured: five bushels of properly-threshed barley kernels, or three gallons of water. There are things that are subjective that can nevertheless be accurately measured in an objective form: the feeling of heat, for example: this northern California hot tub here in the fog feels hot, and, indeed, is at a temperature of 105F: its molecules have thermal kinetic energy above that of absolute zero by 565/180 times the difference in thermal kinetic energy between water on the edge of boiling and water on the edge of freezing. But there are also things that are so subjective that one cannot imagine a quantitative measure that would be at all adequate: things like anger, rage, sorrowâ€”and joy.

Economists start with objectively measured prices and quantities of goods and services exchanged in markets, and then go on to construct quantitative measures of subjective things like willingnesses-to-pay and willingnesses-to-substitute and values and so forth. Mid-twentieth century British economist John Maynard Keynes warned us against carrying this too far:

Approximate statistical comparisons depending on some broad element of judgment rather than of strict calculationâ€”may possess significance and validity within certain limits. But the proper place for such things... lies within the field of historical and statistical description, and their purpose should be to satisfy historical or social curiosity... of a similar character to the statement that Queen Victoria was a better queen but not a happier woman than Queen Elizabethâ€”a proposition not without meaning and not without interest, but unsuitable as material for the differential calculus. Our precision will be a mock precision if we try to use such partly vague and non-quantitative concepts as the basis of a quantitative analysis...

Nevertheless, in spite of Keynesâ€™s warning, I do want to carry this far, for I think there is genuine insight to be gained here.

â€œTechnologyâ€”:

Take the square-root of what we think is the total world labor population *P* and multiply it by our very crude measures of average real income per capita *y*, and call that product â€œtechnologyâ€”the value *H* of the stock of useful ideas about manipulating nature and organizing humans discovered, invented, developed, and deployed globally into the world economy. Normalize *H* by setting its value in 1870 equal to 1.

Why take the square-root? Well, if we just multiplied average income by populationâ€”called total world real income â€œtechnologyâ€”we would be implicitly assuming that labor is useless and unproductive. But that cannot be right: each mouth comes with two eyes, two hands, and a brain. If we just took average incomeâ€”called that â€œtechnologyâ€”we would be implicitly assuming that natural resources are unimportant, and that it does not matter how small population growth has reduced the size of the average plot of land on which a typical personâ€™s food is to be grown. That also cannot be right: resource scarcity, and attempts to compensate for it, are a very real thing in our world, today and in our past.




The square-root is a compromise. Is it the right compromise? We can argue about that.

What would you suggest?

3250 words

Slides:



Econ 135 S 2023 Day 2 Slides
37.2MB â™ PDF File
[Download](#)
[Download](#)

[Leave a comment](#)

[Subscribe now](#)



The square-root is a compromise. Is it the right compromise? We can argue about that.

What would you suggest?

3250 words

Slides:



Econ 135 S 2023 Day 2 Slides
37.2MB â™™ PDF File

[Download](#)

[Download](#)

[Leave a comment](#)

[Subscribe now](#)