Estimates of World GDP, One Million B.C. – Present

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I construct estimates of world GDP over the very long run by combining estimates of total human populations with estimates of levels of real GDP per capita.

Population

I take my estimates of human population from Kremer (1993), but it would not matter if I had chosen some other authority. All long-run estimates of human population that I have found are quite close together (with the exception of estimates of population around 5000 BC, where Blaxter (1986) estimates a population some eight times that of other authorities). Note that
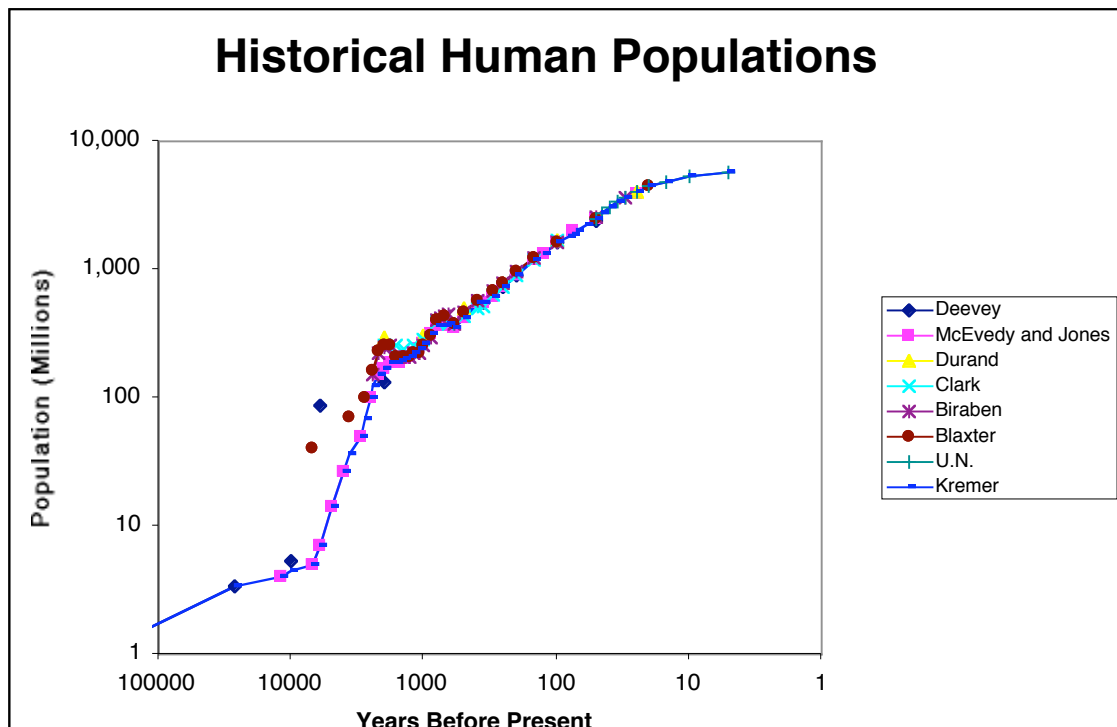
this does not mean that the estimates are correct—just that they are the same.

Kremer (1993) sees human populations as growing at an increasing proportional rate from perhaps 125,000 in one million B.C. to 6 billion today. Population reached approximately 4 million by 10000 BC, 50 million by 1000 BC, and 170 million by the year 1. Population then reached 265 million by the year 1000, 425 million by 1500, and 720 million by 1750 before exploding to 1.2 billion by 1850, 1.8 billion by 1900, 2.5 billion by 1950, and 6 billion today. Up until 1950 Kremer calculates that the rate of growth of human populations was roughly proportional to their total level.

GDP per Capita

Angus Maddison (1995) has constructed estimates of real GDP per capita for the world from 1820 to 1992. His estimates are best thought of as Laspeyres purchasing power parity estimates in 1990 international dollars. That is, they:

- Compare income levels across countries not using current exchange rates, but instead trying to change one currency into another at rates that keep purchasing power constant ("purchasing power parity").
- Value goods in relative terms using the prices found in a country in the middle of the world distribution of income ("international").
- Calculate a value for 1990 GDP per capita in the United States equal to U.S. current-dollar GDP per capita in 1990 ("1990 dollars").
- Do not take explicit account of the benefits of the introduction of new goods and new types of goods, but instead calculate GDP per capita in the past by valuing the commodities produced in the past at recent prices—and not making any correction for the restricted range of choice enforced by limited production possibilities ("Laspeyres").

All of these save the last is reasonable—is in fact a way of proceeding vastly preferable to the alternatives. I will return to the last of these later. But first I want to extend Maddison's estimates backward before 1820.

If you plot the rates of world population growth against Maddison's estimates of world GDP per capita, you find a very high and significant correlation between the two from the early nineteenth century until roughly World War II. After World War II the demographic transition has begun to

take hold in large parts of the world, but before World War II the higher is world GDP per capita, the faster is population growth—with a 1 percentage point per year increase in population growth associated with an increase in average world GDP per capita of $1,165 (with a t-statistic of 7.4 and an adjusted-R^2 of 0.84).

If you are enough of a Malthusian to believe that this tight relationship before World War II is not coincidence but instead reflects a near-linear dependence of the rate of human population growth on the margin between actual production and bio-cultural subsistence, then you can use the fitted relationship between population growth and Maddison-concept GDP per capita to backcast estimates of world GDP per capita before 1820.

Population Growth and Maddison-Concept GDP per Capita Since 1820
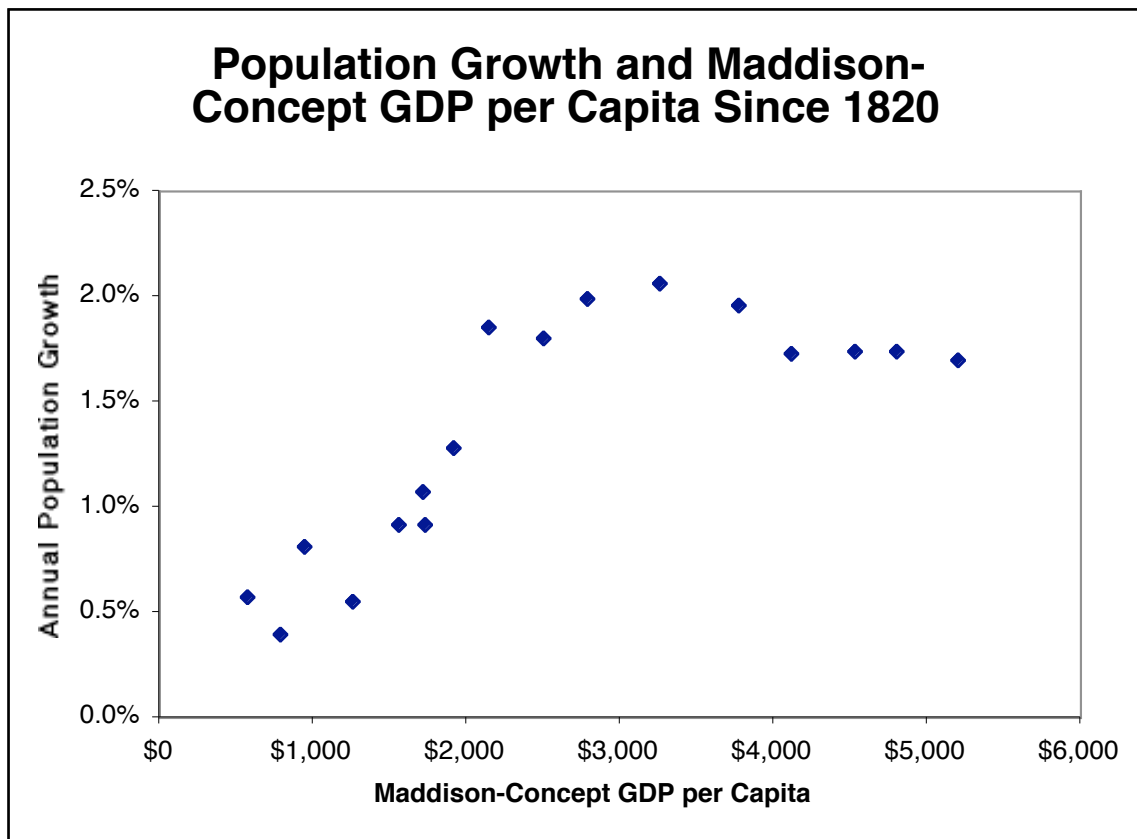
An alternative (preferred by Maddison) is to assume that GDP per capita was constant in Asia and Africa from 1500-1820, grew at 0.1 percent per year from 1500-1820 in Latin America and Eastern Europe, and grew at 0.2 percent per year from 1500-1820 in Western Europe (an estimate that Maddison attributes to Simon Kuznets (1973)); this alternative could then be

backcast further by assuming that pre-1500 GDP per capita was constant at near-Malthusian bio-cultural subsistence.

I prefer the first alternative (and have used it). But I also report estimates using the second.

New Goods

A large proportion of our high standard of living today derives not just from our ability to more cheaply and productively manufacture the commodities of 1800, but from our ability to manufacture whole new types of commodities, some of which do a better job of meeting needs that we knew we had back in 1800, and some of which meet needs that were unimagined back in 1800.

How much has this change—the fact that we make not just the same goods, but new goods and new types of goods—enhanced our material prosperity? Nordhaus (1997) provides perhaps the most eloquent and sophisticated argument that standard measures—like those of Maddison—that do not take explicit account of these factors grossly understate the rate of economic growth over the past two centuries.

I know that I at least would be extremely unhappy if I were handed my current income, told that I could spend it on goods at current prices, but that I was prohibited from buying anything that was not made before 1800. Yet Maddison's procedures would implicitly take such a reduction in the range of goods I could purchase as having no effect on my real income or real material standard of living.

But by how much has our power to make new things—not just the same things more efficiently—amplified our material prosperity?

In at least some models of growth in which the set of goods that can be produced expands, the correct measure of real output is proportional to the product of purchasing power (income divided by the average price of a good) and the number of goods that can be produced. As best as I can determine, about three-quarters of world expenditure today is spent on commodities that simply did not exist back in 1800. So I—somewhat arbitrarily—use this to assign an additional fourfold multiplication to output

per capita since 1800 in addition to the increases in output per capita calculated by Maddison.

But since this—large—extra adjustment is not to everyone's taste, I also report the "ex-Nordhaus" series without the "new kinds of goods" adjustment.

Conclusion

The outcome of this set of calculations is thus seven series: Kremer's (1993) estimates of population; three estimates of GDP per capita (my preferred estimate, the constant-before-1500 estimate, and the ex-Nordhaus estimate); and three estimates of total world real GDP (capita (my preferred estimate, the constant-before-1500 estimate, and the ex-Nordhaus estimate).

They are reported in the table below:

Average World GDP per Capita

(1990 International Dollars)

Year	Preferred	Ex-Nordhaus	Constant Pre-1500 GDP per Capita
-1000000	92	340	115
-300000	92	341	115
-25000	92	343	115
-10000	93	344	115
-8000	96	357	115
-5000	103	381	115
-4000	109	406	115
-3000	113	420	115
-2000	112	415	115
-1600	121	449	115
-1000	127	471	115
-800	143	530	115
-500	137	509	115
-400	130	483	115

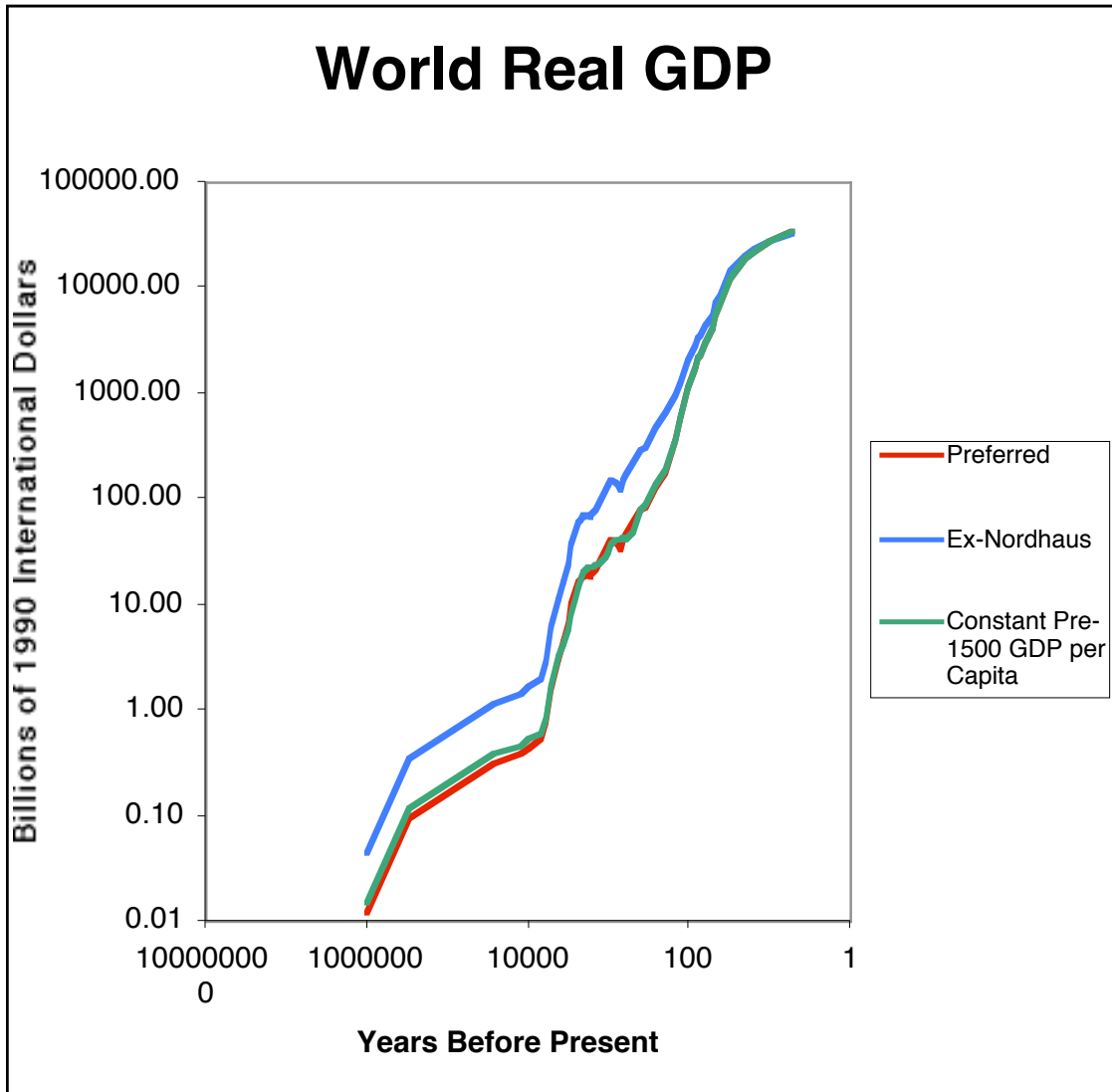|			
-200	113	420	115
1	109	404	115
14	102	380	115
200	98	362	115
350	94	350	115
400	97	360	115
500	102	379	115
600	104	387	115
700	112	414	115
800	116	430	115
900	131	486	115
1000	133	494	115
1100	124	459	115
1200	104	386	115
1250	99	367	115
1300	89	331	115
1340	109	406	115
1400	128	476	115
1500	138	512	115
1600	141	524	140
1650	150	556	155
1700	164	607	172
1750	178	662	190
1800	195	722	210
1850	300	788	300
1875	429	948	429
1900	679	1263	679
1920	956	1550	956
1925	1108	1735	1108
1930	1134	1716	1134
1940	1356	1915	1356
1950	1622	2138	1622
1955	1968	2505	1968
1960	2270	2792	2270
1965	2736	3251	2736
1970	3282	3768	3282
1975	3714	4119	3714
1980	4231	4533	4231
1985	4634	4797	4634
1990	5204	5204	5204
1995	5840	5641	5840
2000	6539	6103	6539

Total World Real GDP

(Billions of 1990 International Dollars)

Year	Preferred	Ex-Nordhaus	Constant Pre-1500 GDP per Capita
-1000000	0.01	0.04	0.01
-300000	0.09	0.34	0.11
-25000	0.31	1.15	0.38
-10000	0.37	1.38	0.46
-8000	0.43	1.61	0.52
-5000	0.51	1.91	0.57
-4000	0.77	2.84	0.80
-3000	1.59	5.89	1.60
-2000	3.02	11.20	3.09
-1600	4.36	16.16	4.12
-1000	6.35	23.55	5.73
-800	9.72	36.05	7.79
-500	13.72	50.90	11.46
-400	16.02	59.44	14.09
-200	17.00	63.05	17.19
1	18.50	68.65	19.48
14	17.50	64.91	19.59
200	18.54	68.80	21.77
350	17.93	66.53	21.77
400	18.44	68.40	21.77
500	19.92	73.90	22.34
600	20.86	77.39	22.92
700	23.44	86.97	24.06
800	25.53	94.70	25.21
900	31.68	117.52	27.73
1000	35.31	131.00	30.36
1100	39.60	146.91	36.67
1200	37.44	138.90	41.25
1250	35.58	132.01	41.25
1300	32.09	119.06	41.25
1340	40.50	150.27	42.39
1400	44.92	166.64	40.10
1500	58.67	217.64	48.70
1600	77.01	285.70	76.41

1650	81.74	303.24	84.53
1700	99.80	370.26	104.67
1750	128.51	476.75	136.67
1800	175.24	650.11	189.00
1850	359.90	945.60	359.90
1875	568.08	1256.10	568.08
1900	1102.96	2052.38	1102.96
1920	1733.67	2810.15	1733.67
1925	2102.88	3293.03	2102.88
1930	2253.81	3409.69	2253.81
1940	3001.36	4237.90	3001.36
1950	4081.81	5379.21	4081.81
1955	5430.44	6913.80	5430.44
1960	6855.25	8431.84	6855.25
1965	9126.98	10845.34	9126.98
1970	12137.94	13934.06	12137.94
1975	15149.42	16801.40	15149.42
1980	18818.46	20162.78	18818.46
1985	22481.11	23270.25	22481.11
1990	27539.57	27539.57	27539.57
1995	33644.33	32503.40	33644.33
2000	41016.69	38281.97	41016.69

World Real GDP

Chart: World Real GDP. Y-axis: Billions of 1990 International Dollars (logarithmic, from 0.01 to 100000.00). X-axis: Years Before Present (logarithmic, from 10000000 to 1). Legend: Preferred, Ex-Nordhaus, Constant Pre-1500 GDP per Capita.

World Average GDP per Capita
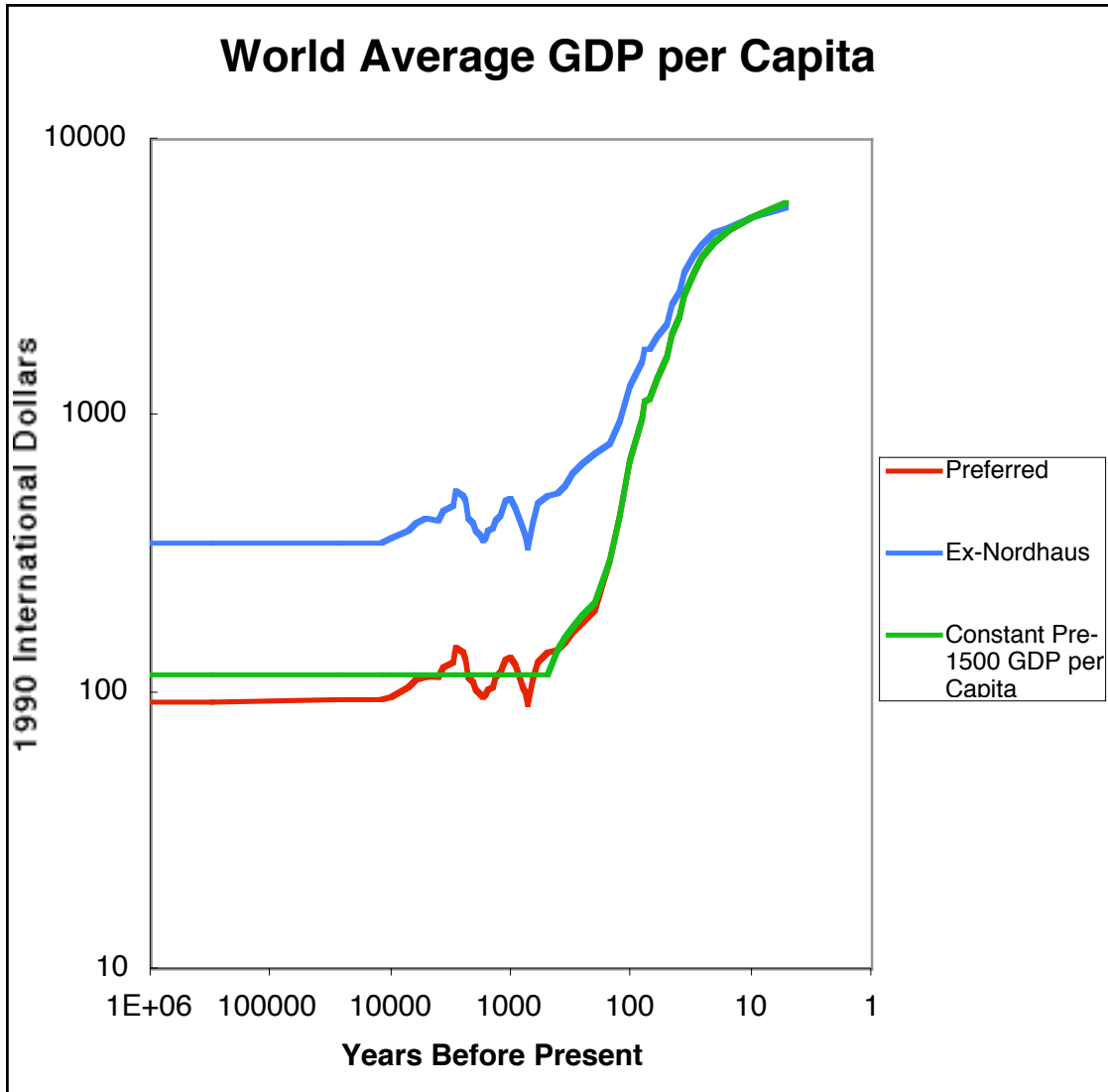
Total World Population

(Millions)

Year	Human Population (Kremer Series; millions)
-1000000	0.125
-300000	1
-25000	3.34
-10000	4
-8000	4.5
-5000	5
-4000	7
-3000	14
-2000	27
-1600	36
-1000	50
-800	68
-500	100
-400	123
-200	150
1	170
14	171
200	190
350	190
400	190
500	195
600	200
700	210
800	220
900	242
1000	265
1100	320
1200	360
1250	360
1300	360
1340	370
1400	350
1500	425
1600	545

1650	545
1700	610
1750	720
1800	900
1850	1200
1875	1325
1900	1625
1920	1813
1925	1898
1930	1987
1940	2213
1950	2516
1955	2760
1960	3020
1965	3336
1970	3698
1975	4079
1980	4448
1985	4851
1990	5292
1995	5761
2000	6272