Income level and income inequality in the Euro-Mediterranean region, c. 14-700

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Was the Euro-Mediterranean region at the time of the Roman empire and its Western successor states more unequal than the European Union today? We use some scant evidence on personal income distribution within the Empire and differences in average regional incomes to conclude that the Empire was more homogeneous, in terms of regional incomes, than today's EU, and inter-personal inequality was low. Moreover, income inequality was likely less around year 700 than in Augustus's time. The latter finding contrasts with a view of rising inequality as the Western Roman Empire dissolved.

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1. Introduction

How unequal is Europe? With the advent and enlargement of the European Union, we have a pretty good idea. The EU28 Gini coefficient has reached the level of the United States.[2] The same question can be asked for the earlier periods: just before World War I, at the beginning of the Industrial Revolution, in the Middle Ages, in Late Antiquity, all the way to the beginning of the Common Era.

But the answer is not as easy; we need to have two crucial pieces of information: an estimate of average incomes in all political units (countries or regions) that compose Europe at a given point in time, and an estimate of inequality within each of these units. Both are crucial, and neither is readily available for most of the past two millenia, even if recently important progress was made in estimating average incomes and income inequalities in different parts of Europe after 1300 (see, for example, Alfani 2015, Alfani and Ryckbosch 2016, Reis 2017). The question of how different are mean incomes deals with similarity in average living conditions across Europe. It is an immensely important issue. How significant it is, may be best appreciated with reference to the on-going discussion regarding the EU enlargement. The EU28 has caught up in inequality with the United States because of the enlargement towards the Eastern areas of the continent which have significantly lower mean incomes. Thus, in 2007, after Bulgaria and Romania (and previously eight other post-Communist countries) became members of the European Union, the EU-wide Gini coefficient (across all individuals in the area) reached 41 points which is about the same as the Gini calculated across all individuals in the United States. The difference however is that in the case of the EU, most of inequality is due to mean income differences between the member-states. If we take EU15 the Gini coefficient is only 33, about the same as the median Gini of the fifteen countries and significantly less than US inequality. In other words, the European Union is unequal because the level of development in its Western and Eastern halves is unequal, not because each individual member-country is unequal.

[2] Calculated from the recent (2013) SILC data. See also Brandolini (2007).

The objective of this paper is to set a similar, albeit much more conjectural, baseline for a discussion of inequality in the Euro-Mediterranean region in a period that ranges from the end of Augustus' rule to the conquest of the Southern Mediterranean shores by Islam. It is, as conventionally regarded, a period that encompasses the peak of power, and possibly prosperity, of the Roman Empire and its largest territorial expansion. The Roman Empire, like the European Union today, created a single market with a single currency (with the notable exception of Egypt) where goods, people and capital moved relatively easily and were subject to similar laws; had extended citizenship to all individuals under its rule, but had also ultimately witnessed the fall and the dissolution of its Western part into a number of independent kingdoms.

The data for this exercise are very sparse. However, the contours are worth trying to draw so that other pieces of information can be either fitted within the proposed empirical narrative, or used to improve it. The exercise may be viewed as a part of a larger endeavor whose aim would be to present a history of global inequality between political entities and ultimately individuals in the world. It is a difficult project to do but breaking it into more manageable pieces, for example by large regions like the Euro-Mediterranean (as we shall do here) and by expressing incomes in terms of subsistence, might just make it feasible. It should be also kept in mind that by covering the Euro-Mediterranean region, one includes (in the beginning of the first century) between 20 and 30 percent of the then existing world population, and possibly more of global income. [3] In taking the regional approach, and combining regional results into an overall whole, one would replicate the way that progress has been made in some contemporary studies, in particular those of relative national price levels (PPPs). They were originally calculated for OECD countries only, and then later, including today, are done by region, with each region linked to the others, so that at the end we get a global picture as a summation of the regional ones.

[3] The median range for the Roman population in the beginning of the first century, is 50 to 60 million. World population is reckoned to have been 200 to 300 million (see van Zanden, 2003, p. 3). Maddison (2008, Table 1.12, p. 54) uses a "low-count" for Roman Empire (44 million) which still yields 20 percent of the world population used by the same author (226 million, Table 2.1, p. 70).

2. Regional and overall average incomes

Roman imperial incomes have been estimated in four "currencies": in local monetary units (Goldsmith 1984, Temin 2003), in wheat-equivalents (Scheidel and Friesel, 2009), in modern international dollars (Maddison 2008; Milanovic, Williamson and Lindert, henceforth MLW 2007), and in subsistence. The latter estimation was, explicitly or implicitly, done by all the cited authors. It is also the estimation technique that we shall use here. Once everything is expressed in subsistence, it is an easy task to price the subsistence in modern international dollars, whether as $PPP 300 or $PPP 400, "translate" Roman incomes into current prices, and thus open the door to a comparison with the estimates of the average income in the Medieval Europe or in modern times.

Almost all Roman income estimates are related to, or based on, Goldsmith's (1984) estimate for the year 14 (at the death of Augustus). Goldsmith estimated the average annual per capita income and expenditures to be HS 380 (HS=sesterces). MLW take Goldsmith's estimate and, using various assumptions about the minimum consumption needs and price of wheat, arrive at the minimum subsistence basket costed at HS 180. Thus their average income is 2.11 times the subsistence. Maddison also takes Goldsmith's mean income estimate as given while revising components (labor income, elite income, investment) and the population of the Empire. [4] He converted the estimated mean income of HS 380 into 1990 Geary-Khamis international dollars through comparison of the Roman income with the average income for the 1688 England contained in Gregory King's social table. The purchasing power of HS 380 in terms of wheat and gold was related to the purchasing power of England's mean income in 1688 in terms of the same two commodities. In terms of gold, Roman income turns out to be equal to 38 percent of 1688 England while in terms of wheat, it is equal to 42.3 percent of England's income (Maddison, 2008, pp. 51-52). Maddison takes an approximate average of the two (40 percent) which then yields $PPP 571. Since subsistence is assumed by Maddison to be $PPP 400, his Roman income estimate is 1.42 subsistence.

[4] I am aware that population numbers are far from certain and are contested (see, for example, Lo Cascio 1994, and Scheidel 2001) but I am taking Maddison's calculation (as well as the calculations of other authors) as a whole and cannot change its components. For a "low [population] count" argument, see Turchin and Scheidel (2009) who use the finds of coin hoards to estimate population density.

For the year 150, we use the mean income estimate derived from Scheidel and Friesen (2009) imperial income distribution. Scheidel and Friesen (as we shall discuss in Section 4) are concerned with both the average income and income distribution. They provide estimates in wheat-equivalents for 13 income classes [5] Their estimated average income is 707 wheat-equivalent kg, which using their own estimated subsistence minimum of 390 kg of wheat-equivalent, translates into a mean income of 1.8 subsistence. [6]

The next link in the chronological chain leads us to the time of Diocletian's Price Edict issued in 301. Allen (2007) has used the data on prices and wages contained in the Edict to estimate real wage. He finds that the unskilled real wage was 1.2 times Allen's own defined "bare bones subsistence minimum" for the family of 4, the ratio which is about the same as for unskilled wage in India around 1820 or in China around 1870 (see Allen 2007, Figure 3). Assuming wage-to-GDP per capita ratio to have been the same in Rome as in the other two countries gives the mean income of 1.33 subsistence minima.[7] An alternative derivation of the mean would use Bairoch's (1977) "rule", namely the idea that the average per capita income in preindustrial societies is equal to about 200 daily wages of an unskilled male worker. To go from Allen's real wage to Bairoch's mean income, we

[5] This is strictly speaking true only for nine non-elite income classes. For the top four income classes, incomes are given in monetary units, but monetary units can be converted into wheat-equivalents using Scheidel and Friesen preferred average price of wheat of 2.5 HS per modius.

[6] There is some confusion regarding the calculated mean income. In Scheidel and Friesen (2009, Table 4), the upper bound of the mean income is given as 604 kg of wheat-equivalent. However, when we translate their own income distribution data in wheat-equivalents, and use their "optimistic" scenario regarding the distribution of recipients, the mean is 707 kg of wheat-equivalent (see Section 4 below). The latter estimate seems preferable because it is based on very detailed distribution data while the former estimate (income of up to 604 kg of wheat-equivalent) is obtained more coarsely from the GDP income side alone. The 707 kg estimate is also consistent with their own statement that the estimated mean income is "around $700" (p.74) in 1990 Maddison-used international dollars.

[7] Maddison (2007) GDP per capita estimate for India in 1820 is $PPP 533, and for China in 1870, $PPP 530. These amounts divided by the subsistence of $PPP 400 yield 1.33.

also need the employment rate. We can use Goldsmith (1984) assumption of 40 percent.[8] The resulting mean income works out to be barely above subsistence. [9]

The following step is more complicated. Ward-Perkins (2005), provides a graph (Figure 6.1, p.122) where average incomes are displayed for five regions of the Empire (and later, after the fall of the Western Empire, for the five geographical regions): North Africa, Italy, Roman Britain, Aegean "world", and the Levant. His graph shows the estimates (or more exactly, the guesstimates) covering the period 300-700. The lines are continuous, but are centered around the centennial years. The vertical axis displays the level of "economic complexity" ranging from "minimal" to "considerable". We can readily assume that the minimal economic complexity, which we denote by M, coincides with an average income level that is at, or around, subsistence. However, the graph is unlabeled and it is not unambiguously clear to what income level does the top, termed "considerable economic complexity", achieved in the late antiquity, correspond. But we know that Allen's mean income for the year 301 must equal the Empire average, calculated as the weighted average of the five regions, for (almost) the same year (300) from Ward-Perkins' data. In other words,

(1) $$\mu M = \sum_i s_i O_i = \sum_i s_i \gamma_i M$$

where μ = estimated all-Empire mean income based on Allen (μ=1.33), s_i = share of *i*-th region in total population, O_i = the height of the ordinate in Ward-Perkins's graph. The height of the ordinate for each region can be expressed as the multiple (γ_i) of the minimum level of economic complexity (M). When we set the top of the graph ("considerable economic complexity") to be equal to a certain number of Ms, all γ_i are uniquely determined. But they also need to be such that equation (1) is satisfied. It turns out that only when Ward-Perkins's "considerable complexity" (top of the graph) is 1.44 times the subsistence, the weighted average of the geographical incomes in his graph produces an overall mean income μ=1.33 in the year 301. Once we thus know the top and the

[8] Used also by Madison (2008, pp.47 and 61) although he breaks total population into free (with a lower employment ratio) and slaves (10 percent of the population, with a higher employment ratio).The overall number however comes to 40 percent.

[9] Obtained as 1.2 (Allen's result) multiplied by 4 (assumed household size) multiplied by 0.4 (employment rate) multiplied by 200 (Bairoch's rule) and divided by 365 days. The result is 1.05 subsistence.

bottom of the graph, we can easily convert the values given in the graph for the later years (400 to 700) into comparable multiples of the subsistence minimum. The results of this exercise for the years 14, 150 and 300 are shown in Table 1 (see the last line) and Figure 1.

In the calculations, Allen's 301 estimate is the crucial "hinge" on whose value the rest depends. If 301 estimate is lower (as implied, for example, by the use of Bairoch's "rule"), then the decline of income over the period 400-700 must be less because by 300, the average income has already fallen as low as the subsistence "floor". If, on the other hand, the estimate for 301 is higher than Allen's, then the decline over the subsequent period can be steeper (there is more "space" for incomes to fall). This is because at the end of the period (in the year 700), income is barely above subsistence under any scenario. One or the other assumption for the income level in 301 has nevertheless clear implications for how disastrous we judge the post-300 period to have been.

Several things need to be noted. First, Ward-Perkins provides regional averages which enable us, by calculating the overall imperial mean, to link his estimates to Allen's value obtained for the year 301. These regional averages (transformed into multiples of the subsistence thanks to the calibration exercise explained above) are also shown in Table 1. Second, in order to complete the regional picture, I have added to the Ward-Perkins's five regions, the sixth region (by the way, strangely omitted): Gaul and Iberia. I have assumed that its mean income follows during the years 300-700 the same pattern as the mean income for Peninsular Italy, or alternatively that its mean income is consistently 10 percent below that of Italy (assuming a bigger difference is not reasonable because Gaul and Iberia would then be the poorest region, below Britain, and around year 600 its mean income would fall below subsistence). Third, other than the Empire-wide mean income estimate for the year 14, Maddison (2008) also provides regional averages for the same year. I have "squeezed" Maddison's estimates provided for fourteen regions into the regional classification given by Ward-Perkins. (The regional "allocation" is explained in the Notes to Table 1.) [10] We can thus obtain relatively complete regional income estimates for the period 14-700 which we shall use in the next Section to compute regional inequality.

[10] This is the reason why in Table 1, I show Maddison's estimate for the year 14 rather than the MLW estimate.

[Figure 1 around here]

Using our central estimate, based on Maddison's (2008) value for the year 14, the overall pattern is of an increase in the average Euro-Mediterranean income between 14 and 150, and then an equi-proportional decrease between years 150 and 300 (Figure 1). Afterwards, there is a steady, although not as sharp decline. These values are, of course, rough approximations but to get an idea of the estimated change, we note that between years 14 and 150, the overall mean income per capita rose by 27 percent (an average rate of growth of 0.16 percent p.a.), while in the next century and a half, it dropped by about as much. If we use the MLW (2007) value for the year 14, the picture is different because a rapid decline sets in from the very beginning of the period considered here and continues all the way to 300. Moreover, the relative merits of the two periods (early vs. the Late Empire and dissolution) are now reversed. It is over the first period that the decline was faster. After 300, it continued but at a slower pace. In either case, at the end of the period (around 700), the overall mean income had declined to the level only about 15 percent above the subsistence.

Discussion. Is the income pattern depicted in Table 1 and Figure 1 plausible? Three important points have to be kept in mind. First, there is a conventional view that income in the Euro-Mediterranean region might have reached its peak in the first century, and perhaps even later (as implied by one set of data here), around mid-second century. Although each individual documentary piece of evidence (distribution of shipwrecks, size of domestic animals, construction of public buildings, concentration of lead in ice caps, attestation of water-lifting devices in literary sources, number of surviving manuscripts, fish-salting capacity) can be dated somewhat differently and explained by various causes and not necessarily as being indicative of an income peak achieved in the first century or at its close, the sheer accumulation of the evidence and its apparent broad chronological coincidence end up by being compelling. [11] After marshalling most of this evidence,

[11] See Ward-Perkins (2005, Chapter V), Kehoe (2008), Jognman (2008, pp. 610-615), Bowman and Wilson (2009, p. 37-42), Wilson (2009). For a view that income might have peaked at the time of the Augustan principate, see Scheidel (2008, 2009a, in particular pp. 13-23) and to some extent also Wilson (2009, pp. 226). According to Scheidel, further Roman growth, after a period of conquests, was anyway unsustainable due to lack of technological innovations (needed to keep per capita incomes rising while the population is growing). This is a view similar to that of Schiavone (2000).

Jongman (2008, p. 616) concludes: "The tide seems to have turned in the late second century AD, possibly as a result of the Antonine Plague".[12] One need not subscribe to that particular causal explanation though, to hold the view that the period around 14-150 might have represented the high water-mark of the Euro-Mediterranean preindustrial prosperity.

It is not inconceivable that the most disastrous period started just after 150 and carried on until Diocletian's assumption of power (285) and his reforms. In view of what we know happened during that period: the epidemics, almost incessant civil war, low average duration of central power (emperors), warfare on the borders, high inflation, reversal to elements of natural economy, this seems plausible. Although each of these factors existed before, never were all of them present together and with the virulence they exhibited between the rules of Commodus and Diocletian. We know from the research on growth in the last 20 years that all of these factors (except epidemics; see Pamuk 2007) are associated with declines in real income: civil wars and inflation are the obvious cases in point;[13] weak and unstable central power implies instability of institutional rules, another element associated with low modern growth.

Second, there seems to be a broad consensus that the average income declined in the Late Empire, and either continued on the downward path or remained low after the dissolution of the Western Empire. [14] These two essential features (the peak between early first and mid-second century and steady decline afterwards) are present in the results given here which is remarkable since the data on which the calculations are based are in many ways independent estimates from five sources (Maddison; Milanovic, Lindert and Williamson; Scheidel and Friesen; Allen; and Ward-

[12] The crippling effect of the epidemics (the Antonine plague of 160-180 and the Cyprian plague of 249-270) has been documented by Duncan-Jones (1996) and Harper (2015, 2016).

[13] See e.g. Barro (1997).

[14] For example, a recent volume on the quantification of Roman economic history introduces its scope thus: "'[t]he chronological parameters are 100 BC-AD 350, covering the period of greatest imperial expansion and economic growth (to *c.* AD 200), followed by a century conventionally perceived as one of contraction or decline" (Bowman and Wilson, 2009, p.3). A recent popular book (Goldsworthy, 2009, pp. 144-5), puts it this way: "In the year 300 the economy of the Roman Empire was certainly more sophisticated and robust than anything that would be seen in the same regions for over a thousand years. Without statistics we cannot say how it compared to the conditions of the second century, but it is unlikely to have been stronger and most probably had declined, probably by a large margin". According to McCormick (2001, p. 30): "The overall economic trend of the Roman world from c. 200 to 700 was downward. This is not to say that decline prevailed everywhere, all the time…But within these chronological limits, the overarching [downward] pattern is now clear, even if the details are sometimes sporadic and even contradictory".

Perkins). What the sources have in common though, and which enables our putting them together, is that they are based on expressing the mean as a multiple of the subsistence (or at least that such a multiple can be derived from them). The physiological subsistence minimum provides the numeraire which holds the whole edifice together. But even if the pattern seems plausible, one must not interpret the exact years for which the data have been displayed here as anything more than representing a very approximate dating—dating which must be inclusive of the adjacent *decades*. Even the year 301 which corresponds to the data from Diocletian's Edict must be taken as representative of a longer period. It is also not evident that Diocletian's prices and wages from the Edict were truly "market-based" or actual prices used in most transactions (Rathbone, 2009, p. 317).

Third, regional income pattern revealed by Table 1 is interesting. The severest decline, by far, occurs in Italy, and it is fairly constant over time. The Aegean region appears to stay at the same income level until rather late in our period: it is only in 700 that the average income there is substantially lower than around the time of Diocletian's edict. North Africa reaches its peak in 400, and the Levant in 520, by which time Peninsular Italy is barely above subsistence. The income evolutions of the Aegean, North Africa and the Levant seems quite different from the one that traditionally attracts most attention, i.e., Italy and Western Europe. Although the overall tendency is to the decline, the regional movements were not fully synchronized.

[Table 1 around here]

3. Regional and overall inequality

Regional mean income estimates from Table 1 allow us to calculate overall regional inequality. Table 2 shows that the gap between the richest and poorest region has tended to go down. In the year 14, the gap between the richest region (Italy) and the poorest (Roman Britain) was almost 2 to 1. Afterwards, the gap never exceeded 1.4, and at the end of the period was 1.23. By then, the richest region was the Levant, [15] and the poorest remained Britain, even if the difference between Britain and other European regions practically vanished. They were all within the narrow range of 1.07 and 1.13 times the subsistence. The entire Euro-Mediterranean area, with the

[15] The Levant includes Egypt, Greater Syria and Cyprus.

exception of the Levant, was substantially poorer in 700 than it was seven centuries earlier and the average regional incomes were more similar. In other words, the impoverishment of the Euro-Mediterranean region (with the exception of the Levant) was generalized.

Moving toward an estimate of inequality among individuals in the entire region, we begin by calculating population-weighted inequality from the regional data given above. Population-weighted Gini represents an inter-personal Gini coefficient obtained on the assumption that all individuals in each region have the mean income of that region.[16] In other words, it assumes that the entire source of inter-personal inequality is geographical (what is called "the between component") while the "within component" (inequality within each region) is zero. Table 2 shows the results. In 14, the population-weighted Gini was relatively high, at more than 10 Gini points. By years 300 and 400, it has gone down to extremely small values around only 1 Gini point reflecting the fact that the income gap between the regional mean incomes had all but vanished. Afterwards, the population-weighted Gini rose somewhat but nevertheless stayed very low.

[16] This is Concept 2 Gini as defined by Milanovic (2005).

[Table 2 around here]

Population-weighted Gini represents the lower bound of actual inter-personal inequality in the entire region. As explained, this is because its assumption is that within-regional inequality is non-existent (that is, all individuals have the mean income of their region). But we can also make an estimate of the *maximum* inter-personal inequality. Combining these two will therefore enable us to draw a band within which inter-personal inequality in the Euro-Mediterranean region must lie. The maximum Gini is derived on the assumption that everybody in the entire Euro-Mediterranean region lives at the subsistence, and only a tiny (tending to infinitesimally small) elite appropriates the entire surplus above the subsistence. The maximum Gini is a function of mean income. If, for example, the mean income is just above the subsistence, then, however small the elite, the overall Gini cannot be very high because income of that elite will be quite limited.[17] The concept of the maximum feasible Gini was defined by Milanovic (2006), and more formally derived and studied in MLW (2007). The formula for the maximum feasible Gini is $(\alpha-1)/\alpha$, where α is the ratio between mean income and subsistence minimum. To calculate the maximum Gini for the Euro-Mediterranean region as a whole we therefore apply the values from Table 1 (last row). The results for upper- and lower-bound Gini are shown in Figure 2. For simplicity, I show only the central case scenario (that is, without the alternative income levels for Gaul and Iberia). Two conclusions can be made.

First, inequality between individuals was likely to have been at its peak at about the same time when the mean income in the entire region was at the highest.

Second, it is likely that inequality declined in the later centuries, and at the end of the period must have laid within a relatively narrow range between 3 and 13 Gini points. [18] Such a low inequality (less than 13 Gini points) for a region that included about 26 million people is extremely unusual. Actually, we have no contemporary or historical examples of inequality that is so low. In

[17] A helpful way to see why Gini must be limited is to recall that Gini is calculated as the sum of all bilateral income comparisons between individuals (scaled by the number of such comparisons and mean income): if almost all bilateral comparisons are zero (among all individuals who have the same, subsistence, income) and elite's income is limited (because of low overall income), Gini cannot be very high.

[18] The bounds are 4 and 12 Gini points if we use alternative incomes for Gaul and Iberia.

the WIDER database, which is the largest compendium of post World War II income distribution statistics, it is only Bulgaria (in the late 1960s and mid-1970s), and Czech and Slovak republics (in the late 1980s, and probably before) that have Ginis under 19.[19] The lowest recorded Gini is 15.9, and is almost certainly an underestimate.

This leaves us with several possibilities among which it is difficult or impossible to choose. First, our estimate of the mean income might be biased downward. If the true mean income was higher, then obviously, the maximum feasible (and perhaps, the actual) inequality could be greater. The second possibility is that the actual Gini might have exceeded the upper-bound Gini. This can occur only if the bulk of the population is at less than the subsistence. MLW (2007) note four cases of countries where this appears to have been the case. They were all colonies, with the highest "inequality extraction ratio" (the ratio between actual and maximum feasible inequality) of 113 percent in Moghul India around 1750, and 110 percent in Nueva España (Mexico) around 1790. The situation might have been the same or similar in the Euro-Mediterranean region between years 500 and 700. This also implies a reduction of the population since life at less than subsistence is not possible. The third possibility is that income inequality was uniquely low in the Euro-Mediterranean region. A fourth possibility represents a combination of the three listed above: mean income might have been somewhat higher, a percentage of the population could not reproduce itself, and overall inequality, measured by the Gini, could have been very low. We simply lack information to choose between these different variants. However, as I shall argue below (*contra* most views), it is possible that inequality in the Late Empire and subsequently was indeed unusually low.

[Figure 2 around here]

4. Inter-personal inequality

For two years (14 and 150) we have direct estimates of inter-personal inequality based on social tables where salient income (or social) classes are listed with their estimated mean incomes and population shares. Such estimates were provided for the year 14 by MLW (2007, see Annex 2),

[19] See http://www.wider.unu.edu/research/Database/en_GB/database/.

and year 150 by Scheidel and Friesen (2009). Both use Goldsmith (1984) as the starting point for the estimate of elite incomes (senators, equestrian orders, and municipal decurions), and then make different assumptions regarding the incomes of the rest of the population, in particular for the income of the "middling groups". MLW (2007) introduce a group of "other rich people" that comes in-between the elite and most of the population. Their total number of income groups is 11. Scheidel and Friesen (2009) provide a more detailed classification with 13 income groups (see Table 3). Although the notional dates for which the two social tables apply are different, it is clear from the texts that the underlying assumptions and the treatment of the Roman society are similar, and that it would be wrong to consider the tables as really applying to two different periods in Roman history. In essence, we are offered just one "story" of income segmentation in the high imperial period. Because it post-dates MLW and provides estimates for more social classes, in the rest of the analysis I shall use only the Scheidel-Friesen social table.

The social table created by Scheidel and Friesen produces a Gini of 41.3.[20] This Gini amounts to about 90 percent of the maximum feasible Gini, given the estimated mean income of 1.81 subsistence (41.3 vs. 45.7 Gini points). It thus falls within the expected "shaded" range (see Figure 2). As mentioned, the ratio between actual and maximum feasible Gini is called the "inequality extraction ratio" (MLW, 2007) and denotes how much of feasible inequality the elite is able to "extract". If the ratio is 100 percent, then inequality is pushed to its utmost (feasible) limit.[21] To give some historical examples: in Byzantium around year 1000, the inequality extraction ratio was calculated as 94 percent, in England in 1209 as 69 percent, and in England and Wales in 1688 (based on Gregory King's social table) as 57 percent.[22] Within this context, Roman inequality extraction ratio of around 90 percent is indeed high, but is not so excessive as to prevent physical reproduction of the population, and is less than in some 18th and 19th centuries' colonies.

[20] Milanovic, Lindert and Williamson (2009), with 11 social classes, find a very similar Gini of 39.4. Both calculations assume that only inequality between groups matters, and inequality within groups is non-existent. This is obviously a simplifying assumption, rendered necessary by the lack of data for within-group inequality, but the bias need not be significant if the bulk of income segmentation is explained by the assumed social segmentation, and the groups included in the social table are salient.

[21] "Feasible" in this context means that society could theoretically continue as a "going concern": no people would die from starvation.

[22] See Milanovic, Lindert and Williamson (2009).

[Table 3 around here]

Discussion. The implication of the upper- and lower-Gini bounds from Figure 2 is that inequality was probably substantially lower in the Late Empire as well as after the dissolution of the Western half of the Empire than in the mid-second century. If Gini decreased from around 40 in the mid-second century to as low as 15 or even 13 by year 600 or 700, this represent an enormous reduction in inequality (albeit over a long time) for which we have no historical precedent. It is also true that the mean income at the same time might have been almost halved—another dramatic development. For this however we do have modern analogs. During the Great Depression 1929-33, real per capita income contracted by more than 30 percent in the US and more than 25 percent in Germany. A more recent parallel is that of the transition from planned to market economy: Russia's GDP per capita shrunk by some 40 percent between 1989 and the trough of 1998.

But neither of these income changes is really comparable to the Roman. First, the modern depressions took place over a much shorter period and were more in the nature of shocks than sustained downward movements that seem to have characterized the "demodernization" of the Roman Empire in Italy and Western Europe. Second, and probably more importantly, income declines took place from the levels that were substantially above subsistence: American GDP per capita in 1929 and Russia's in 1989 were around $PPP 7,000, that is some 17 times greater than the subsistence. In the Roman Empire, the decline occurred from a level around twice the subsistence to a level barely above the subsistence. Now, the maximum feasible inequality approach (and common sense) tell us that a decline to the level close to the subsistence could not have been accompanied by more or less unchanged distribution of income because most of the population would have starved to death. Thus there would have been a massive population decline, independently of epidemics that affected the Empire over that period. It is also doubtful that--however rapacious the elite--such uneven distribution at such a low level of income could have been politically sustainable. Therefore, the story of decreasing inequality *pari passu* with decreasing mean income contains a fair degree of plausibility. Roman decline in both average income and inequality was, it seems, a unique phenomenon. Never before and never after had people of different

generations been faced by a movement from a reasonably complex and prosperous but highly unequal society to a much poorer, primitive and more equal.

This view of decreasing inequality in the Late Empire and afterwards is at odds with what many modern scholars argue. Starting with Rostovtzeff (1926) and Walbank (1946), and more recently Brown (1978) and Cameron (1993), the dominant view has been that, at least in the Western half of the Empire, and very likely overall, there was an *increase* in inequality.[23] This is linked to the emergence of the manorial system, based on natural economy, where relatively few rich aristocrats were surrounded by numerous serfs. Limits on the movement of labor, obligation for sons to continue in fathers' professions etc., introduced by Constantine are all features of a proto-feudal society, departing strongly from a much more free market (and presumably less socially unequal), system under the early Empire. As Jongman (2008, p. 597) writes: "By the late empire, an ever smaller imperial elite controlled an ever larger share of the economy's surplus above subsistence". [24]

Can this impressionistic view of high inequality be reconciled with our argument that the Gini, and thus *measured* inequality, was low? Yes, if we argue that the impressionistic view does not really concern itself with inequality as it is measured, but with the "inequality extraction ratio". In very poor societies, where mean income is close to subsistence, total surplus, and thus measured inequality (as argued above) cannot be very large. But all or most of that surplus can be controlled by a tiny elite. If one focuses on the latter, one may "see" huge inequality even if, when measured by the Gini or other standard inequality measures, inequality is rather low. This is the situation similar to the one recently discussed by Williamson (2010) in relationship to Latin America after the European conquest: an *apparently* huge inequality (that is, a high inequality extraction ratio) coexisting with a low Gini. In the centuries of the late antiquity, the Euro-Mediterranean region might have

[23] "One striking feature of the 4th century is the tendency of landowners [in the Western half of the Empire] to amass estates and wealth on an enormous scale….It revealed a dangerous concentration of wealth in the west…while the government itself became increasingly weak. In the east, by contrast, senatorial fortunes were smaller, partly in view of the very recent development of the senate of Constantinople and the prominence in it of men of much more ordinary origin." (Cameron, 1993, pp. 117-8). Or in Brown's (1978) words: "The phenomena that distinguished the society of the Later Empire—a sharpening of the division between the classes, the impovershment of town councilors and the accumulation of wealth and status into ever fewer hands—were the most predictable developments in the social history of the Roman world. They were under way by AD 200."

[24] Or, "for all we know, later antiquity was the world of increased poverty for the masses, and ever larger fortunes for the rich" (Jongman, 2008, p. 616).

featured the control of the entire surplus above subsistence by a military-aristocratic elite while conventionally measured inequality was --nevertheless-- low.

These results hold some implications for the Malthusian view of the ancient world. The left panel of Figure 3 shows the usual pattern of a single Malthusian wave with an increase in the average per capita income from points A to B, which triggers population growth, and with the latter in turn depressing mean income until it drops below subsistence and eventually returns to its previous level. At the end of the "wave", point C is characterized by the same mean income and the same (zero) net population growth as point A.[25] Now, the measured inequality would at the initial point A be very low while the inequality extraction ratio would be very high (possibly close to 100 percent). This would be a society composed of a multitude of people eking out a bare subsistence and a tiny elite collecting whatever above the subsistence there exists. As the average income increases, measured inequality (shown in the right panel of Figure 3) also rises. This happens because the rich gain more than the poor and there is also some uneven trickle-down in the sense that not all the poor see their incomes rise equally. Some income gradation is thus introduced among the lower ranks where previously there was none. The extraction ratio must go down simply because the Malthusian movement assumes that some of the surplus is now received by the poor too (for otherwise they would not have procreated more). After point B, however, the movements reverses as the second stage of the wave undoes the effects of the first. Now, the measured inequality decreases because relative incomes are reduced more among the rich while the poor in their downward movement are "caught" by the immovable floor of subsistence; the inequality extraction ratio, on the contrary, goes up as the dwindling surplus is again captured by the rich only. It may be this second part of the "wave" (from points B to C) that we are capturing in the sixth to eight century, that is, a decreasing mean income, lower measured inequality, and a higher extraction ratio.

[Figure 3 around here]

5. Was there a Roman middle class?

[25] At C, population returns to its initial level so C is a replica of A.

The next question is, what social structure is implied by the Scheidel-Friesen social table? The key question is whether in the Principate there was a class that could be considered as "middle" or "middling" class ("plebs media"), and how important was it, compared both to what is our today's conception of the middle class, and to other historical preindustrial societies.

The definition of the "middle class" is inherently elusive. Poverty can be defined in an absolute sense, invariant across societies and times, as some physiological minimum necessary for survival. But the middle class is entirely different. Being "middle", it is "middle" with respect to something else. Hence, an absolute definition is much more questionable. A relative definition, on the other hand, runs the risk of bracketing under the title of "middle" historically very different social groups. In addition, we do tend to introduce an implicit element of judgment as to what the "middle class" should include: it should not be "middle" only in terms of its position in income distribution, but must include "respectable" level of income (and thus an element of "absolute" definition sneaks back in) and perhaps other characteristics like "acceptable" education. [26] In historically poor societies, these characteristics are unlikely to have been satisfied if we impose our today's conception of what the "middle class" should include.

Recently, a definition originally introduced by Lester Thurow in 1987 (middle class are all individuals with income within 25 percent of the median) has been popular. We cannot apply it to our social table because our distribution is too rough, with more than a half of the population included in one, second from the bottom, income class (see Table 3). An alternative may be to use the recently proposed Ravallion's (2009) "developing world middle class". He defines it as "those who are not deemed 'poor' by the standards of developing countries but are still poor by the standards of rich countries" (p. 4). This would include all people, living in developing countries, whose per capita income ranges between $PPP 2 and $PPP 13 per day. According to this criterion, some 13 percent of the Roman population living around year 150 would be classified as "middle class". [27] How important is it compared to some modern societies? Using the same standard, in

[26] Nancy Birdsall (2007, p. 4) defined global middle class as including some "acceptable" education level "to have the economic security associated with middle class status in an integrated global economy".

[27] We convert incomes into international dollars, by pricing subsistence at $PPP 350 per capita (at 2005 prices).

2005, India's middle class is estimated at 24.1 percent, China's at 61.8 percent, and that of Sub-Saharan Africa at 25.8 percent. [28] Clearly, Rome, having been a very poor society by modern absolute-income standards, also had a small middle class by modern standards: only about half as numerous (in the relative sense) as today's India or Sub-Saharan Africa.

But perhaps locating Rome among some historical preindustrial societies might help shed more light on its middle class? Figure 4 shows the income shares of the top five or six percentiles of recipients in the Roman Empire around year 150, Byzantium around 1000, England in 1290, and England in 1801-3. It shows the reverse cumulative distributions, starting with the share of the top 1% and cumulating while going down the income distribution ladder. The estimations are based on the social tables for the societies closest in time to Rome that we have, except for England and Wales 1801-03 which is used to highlight the difference between the ancient societies and those in the midst of the Industrial Revolution. The dots, other than for the top percentile, refer to the *actual* observations from the social tables. For the top 1%, the share is calculated by assuming that top incomes follow a Pareto distribution. The approach is basically the same as recently used by Atkinson (2007).[29]

It is best to focus on the intercept at the point x=1 which gives the share of the top 1% in total income, and on the slope of the line. Relatively modern societies with some middle class (like England and Wales in 1801-03) have a low intercept and a steeply rising line. The steep increase shows that the adjacent percentiles (people between the top 1% and the fifth or sixth percentile) have relatively high incomes too so the cumulative function increases rapidly. They represent what may be termed the "upper middle class." At the other end of the spectrum, there is Byzantium, where the intercept is high (the top 1% receives 30 percent of total income) but the slope of the line is flat. The implication is that the richest people are "cut off" from the rest of the population, not only because their income is so high, but because the neighboring percentiles are relatively poor. There is in Byzantium much less of an "upper middle class" than in the English case. Societies like

[28] Ravallion (2009, Table 3, p. 27).

[29] The estimation procedure is explained in detail in Appendix 2. There I list several caveats necessitated by the fact that our social tables are different from the usual income distribution data sources.

Byzantium can be considered "hyper-elitist". At the extreme, as in our derivation of the maximum feasible inequality, the line could combine a very high intercept and a barely upward-sloping portion for the other percentiles. In such a society, only the top percentile is different from the rest while all the others are either at the same, or similar, income level. In contrast to a "hyper-elitist" society, Roman income distribution shows a much smaller share of the top 1% (13.7 percent of total income), and a more steeply rising line. The Roman distribution is not dissimilar from the one for England in 1290 except that there is (not surprisingly) greater evidence of a substantial upper middle class in Rome than in the medieval England. Overall, the top 5 percent of income recipients received around 30 percent of total income in Rome. This can be contrasted with a quarter of total income they receive in the modern United States and United Kingdom, 27 percent in modern Chile and a third in Brazil.[30] Thus, compared to a couple of ancient societies for which we have the data, Rome in year 150 CE exhibits some evidence of a more "modern" pattern of income distribution, characterized by less extreme wealth at the top, and a reasonably-sized upper middle class.

[Figure 4 around here]

6. Conclusions

Quantification of history is important because it sets the numerical limits to what we believe, presses us to come with different and better estimates, and ensures consistency in our thinking. For example, if we find that inequality is greater than implied by the inequality possibility frontier which charts maximum levels of inequality for each level of average income, then we either have to revise our estimates of inequality, or of mean income, or look more carefully whether the society might not have been an extremely exploitative one, not allowing even subsistence income for all of its members. It is in this spirit that one should consider the quantification for the period 1-700 attempted here.

As mentioned in the introduction, the paper should be also considered as a part of a larger work whose objective would be a reconstruction of global inequality between nations and peoples

[30] Calculated from World Income Distribution (WYD) database, available at http://econ.worldbank.org/projects/inequality

for most of the recorded history in the Common Era. The project can probably advance more easily if the first level of analysis is conducted for separate regions (say, Euro-Mediterranean, Asia, Africa) which could be later put together. For the same reason, it is probably also better to express average incomes in terms of regional subsistence minima. This allows for a much greater flexibility; both because we do not need to set a dollar amount to subsistence, and secondly, we can allow for the fact that the cost of subsistence may differ between the regions, depending on their climate, fertility of soil, type of food that is consumed by the poor etc. Then the fact that in one region subsistence is more expensive (whatever being more "expensive" may mean in an era where the regions hardly engaged in any economic intercourse) should not be a problem at all. Fundamentally, real income is expressed in how much above subsistence it allows people to live. Whether reaching that subsistence is "cheap" (say, in warmer climates) is immaterial.

Combining various studies of the Roman economy covering the period of up to late antiquity we conjecture that the mean income was at its peak already at the time of the Augustan Principate, or at the latest around mid-second century. After that, it would seem that the decline was particularly rapid until around 300, and then slowed down. However, by that point the Euro-Mediterranean region was not, on average, much richer than the minimum needed for survival; thus the "floor" of subsistence prevented further sharp income declines. At the same time, regional income differences diminished. Peninsular Italy, which in the fist century, was the richest region declined the most. On the other hand, the Levant and the Aegean region did not experience significant decline until relatively late, that is, only around 600 or even later. Using a social table that gives income distribution by social class for the Roman Empire around the year 150, the Gini is estimated at 41 points, which is about the same level as in today's United States and the European Union. [31] Measured by regional income inequality, the Empire was certainly more homogeneous than the European Union today although less so than the United States (see Appendix 3).

But the decline in the average Euro-Mediterranean income must have been, we argue, accompanied by a decreasing, and not increasing, inequality simply because a low level of average income could not sustain a very high inequality while at the same time ensuring survival of all the

[31] And Russia and China too (see Appendix 3).

population. To allow for the persistence of high inequality (that is, as it was around 150) one must argue that a non-trivial percentage of the population earned less than subsistence, and thus that the population must have shrunk on account of poverty alone. This seems unlikely. We believe that it is possible to reconcile the conjectured low measured inequality with the *impression* of a high post-300 inequality because the latter may, in reality, refer to the speculation (or a fact) that the elite was appropriating much more of the surplus above subsistence than before. The inequality extraction ratio might have indeed been going up while the conventionally measured inequality was trending down. Those who observed poverty of most contrasted to the wealth of the very few tended to conclude that inequality must have unambiguously risen. But they might have failed to account for the fact that the numerous poor were now all equally impoverished, and that measured inequality (calculated across all individuals) could not, on that account alone, have been very high. [32]

The analysis conducted here does not address at all the "why", that is why a more sophisticated and richer society was replaced by a less sophisticated and poorer one. It does not deal with "the fall of Rome". It does not either deal with that ultimate "what would have been", the question of whether the Euro-Mediterranean civilization of late antiquity could have evolved right then into a civilization of commercial capitalism without going through a ten-century long "detour". [33] But by providing some conjectural estimates of income and upper and lower boundaries of inequality, it may circumscribe a bit better the terms of both debates.

[32] Obviously, if one measures inequality by focusing only on the top and the bottom, such inequality could have been very high. But more correctly, and appropriately, inequality is measured by an index that takes income of everyone into account.

[33] Although that question seems to me to have been answered in the negative by absence of proto-capitalist evolution by the Eastern half of the empire, at least until the 12th century, after which it merely struggled to survive.

Appendix 1. Estimated regional population, years 1-700 (in 000s)

Year	1	14	200	300	400	500	520	600	700
North Africa	4200	4200	4500	4347	4200	3995	3975	3800	3750
North & Central Italy	7000	7000	7000	5916	5000	4183	4109	3500	3700
Roman Britain	700	700	700	748	800	693	683	600	600
Aegean world	11050	13050	12550	11723	10950	9591	9464	8400	8900
Levant	7225	8700	8450	7354	6400	5713	5649	5100	5700
Gaul and Iberia	10750	11050	13000	10512	8500	5376	5135	3400	3950
Total	*40925*	*44700*	*46200*	*40600*	*35850*	*29551*	*29015*	*24800*	*26600*

Source: For years 1, 200, 400, 600, Maddison (2008, Table 1.3, p. 37). For year 14, Maddison (2008, p. 54). For years 300, 500, 520 interpolation from Maddison (2008, Table 1.3). For year 700, calculated from McEvady and Jones (1978). Maddison's regional classification modified to fit Ward-Perkins' classification. Definitions are as follows. Sicily, Sardinia, Corsica, Baetica, Narbonensis and other Gaul are Gaul and Iberia; Greece, Danubian Provinces and Asia Minor are Aegean world; Tunisia, Libya, Algeria and Morocco are North Africa; Egypt, Greater Syria and Cyprus are Levant; Peninsular Italy is North and Central Italy. Data for Roman Britain (not included in Maddison) are from McEvady and Jones (1978, p. 43) which is also the source for all of Maddison's population data.

Appendix 2: Derivation of the top 1 percent income share

Define H(y) = cumulative percentage of people with incomes higher than *y*. *W*e can also call it the "headcount of the rich" by analogy with the similar cumulative headcount of the poor, at the other end of the distribution.

If H(y) follows a Pareto distribution then:

(1) $H(y) = Ay^{-a}$

where a=Pareto constant. Rewriting (1) as

(1a) $\ln H(y) = A' - a \ln y$

we can see that *a* plays the role of a "guillotine" such that each percent increase in income "cuts" the percentage of people with that income and greater by *a* percent. [34] If we do not have individual-level data but income distribution tables with grouped data as here (fractiles of income distribution), then *y* should ideally be the lower bound of the income interval. There are two differences between these requirements and the data we have. First, we have only social classes arranged by their mean incomes and population shares. In other words, we have the percentages of people with an *average* income and do not know lower or upper bounds of their income ranges. Second, there are very likely "leakages"--namely people from lower (mean-poorer) social groups whose actual incomes are higher and should be part of the top (and the reverse). This problem is specific to the type of data we have here. These two departures of our data from the usual way income distribution statistics are presented (when given in a grouped form) should be kept in mind.

Now, let us define G(y) = total income of those with incomes above *y* divided by total population *N*; if it follows a Pareto distribution, then (see Atkinson, 2007, Box, p.27).

(2) $G(y) = \frac{a}{a-1} Ay^{-(a-1)}$

[34] Percentage change in the headcount ratio H(y) is equivalent to the percentage change in people with income greater than, or equal to, *y*.

Also, by definition, y_h = mean income of people with income greater than *y*, and

$$G(y) = \frac{y_h H(y) N}{N}$$

This means

$$(3)\ y_h = \frac{G(y)N}{H(y)N} = \frac{G(y)}{H(y)} = \frac{a}{a-1}\frac{A}{y^{a-1}}\frac{y^a}{A} = \frac{a}{a-1}y$$

For example, if the Pareto constant is 2, then the mean income of those with income greater than *y*, will be 2*y*.

Using (1) and (2), we can link G(y) and H(y):

$$(4)\ G(y) = \frac{a}{a-1}Ay^{-(a-1)} = \frac{a}{a-1}Ay^{-a}y = \frac{a}{a-1}H(y)y$$

Write the expression (4) to the exponent *a*:

$$(G(y))^a = \left(\frac{a}{a-1}\right)^a H^a y^a = \left(\frac{a}{a-1}\right)^a H^a \frac{A}{H} = KoH^{a-1}$$

where Ko = constant, and we use expression (1).

Now this means that

$$a\ln G = \ln K_0 + (a-1)\ln H = K + (a-1)\ln H$$

where the constant K=ln Ko. Then,

$$\ln H = \frac{a}{a-1}\ln G + C$$

The ratio between the change in H and change in G is:

$$(5)\ \frac{d(\ln H)}{d(\ln G)} = \frac{\ln H1 - \ln H2}{\ln G1 - \ln G2} = \frac{(a/a-1)\ln G1 - (a/a-1)\ln G2}{\ln G1 - \ln G2} = \frac{a}{a-1}$$

The share of total income received by people whose income is greater than *y*, s(y), is equal to:

$$(6)\quad s(y) = \frac{G(y)N}{\mu N} = \frac{G(y)}{\mu}$$

where μ=overall mean income.

We transform (5)

$$(7)\quad \frac{\ln H1 - \ln H2}{\ln G1 - \ln G2} = \frac{\ln H1 - \ln H2}{\ln s1 + \ln \mu - \ln s2 - \ln \mu} = \frac{\ln H1 - \ln H2}{\ln s1 - \ln s2} = \frac{a}{a-1}$$

Expression (8) is the relationship that we fit in order to get the Pareto constant and to interpolate for the values that we do not have in the original data. For example, in the case of Rome, the actual data are: H1=1.42 and H2=0.86. H1 people receive s(y)= 17.54 percent of total income. And H2 people receive s(y) = 12.29 percent of total income.

Thus,

$$\frac{\ln 1.418 - \ln 0.861}{\ln 17.544 - \ln 12.289} = = \frac{0.499}{0.356} = 1.401$$

From which we find the Pareto constant *a*=3.49.

The top 1 percent receive the share in-between the two shares. To find the income share of the top 1 percent, denoted by s(y*), we use (7) again.

$$\frac{\ln 1.418 - \ln 1}{\ln 17.544 - \ln s(y^*)} = 1.401$$

$$\frac{0.349}{2.865 - \ln s(y^*)} = 1.295$$

And thus s(y*)=13.67 percent.

We obtain the same result if we go from the other direction:

$$\frac{\ln 1 - \ln 0.861}{\ln s(y^*) - \ln 12.289} = 1.401.$$

Appendix 3. Break-down of Gini in Roman Empire and modern societies

	United States	Roman Empire	Russia	European Union	China
Inequality between units	8	11	20	23	24
Inequality among people within units	33	30	22	18	18
Total inequality among people	41	41	42	41	42
Approximate share of between inequality (in %)	*20*	*27*	*48*	*57*	*57*
Note: number of units	50 states	14 regions	89 subjects of feder.	28 nations	29 provinces

Note: Roman inequality calculated from 14 regions from Maddison (2007, p. 54); year 14. For modern societies, own calculations from surveys from around 2005 (World Income Distribution, WYD). Societies ranked from left to right according to the importance of the "between" inequality.

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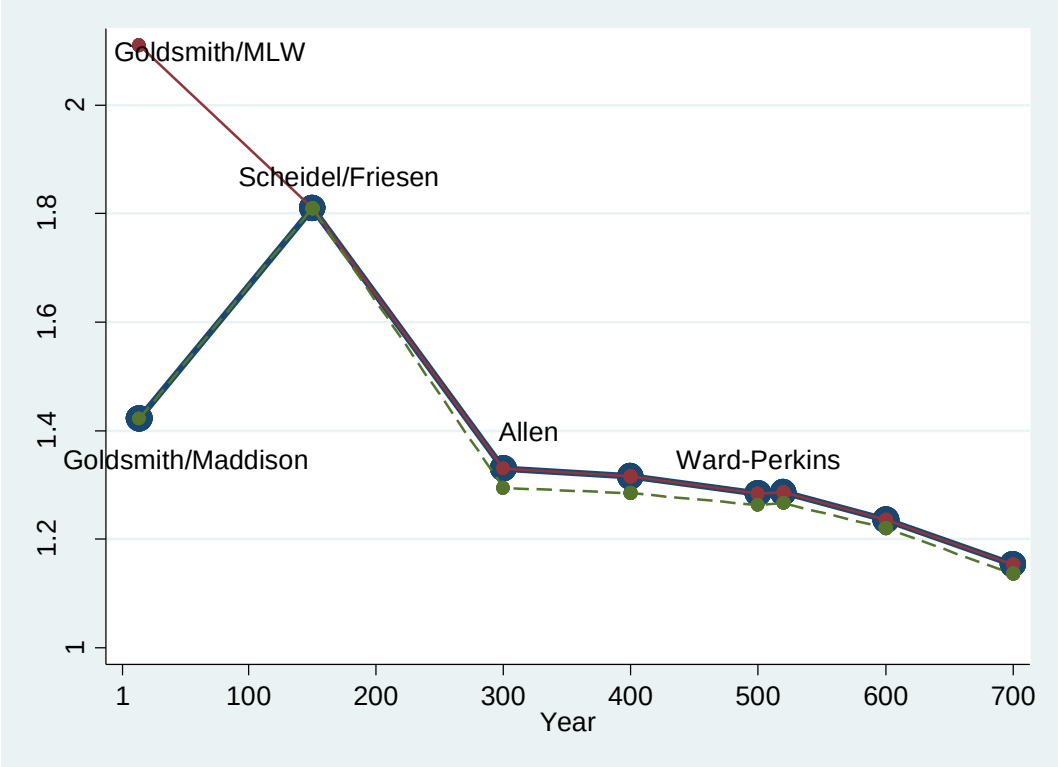
Figure 1. Estimated average per capita income in the Euro-Mediterranean region, years 14-700

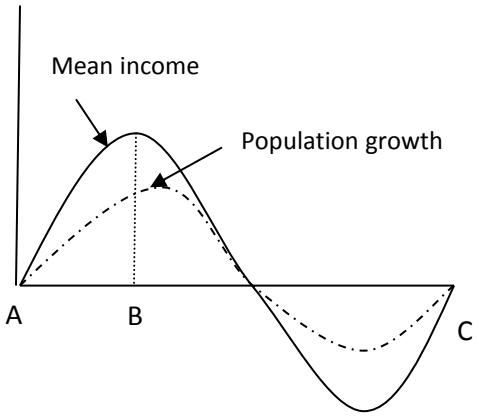


Note: Thick solid line with markers is a "central estimate" that includes Madison's estimate for 14 and total income mean from Table 1. Dashed line (from year 300 to year 700) is based on the Empire total mean income that uses the alternative income estimates for Gaul and Iberia. Thin solid line includes MLW (2007) income estimate for year 14.

Figure 2. Upper- and lower-bound Gini for inter-personal inequality in the Euro-Mediterranean region, years 14-700

Figure 3. Stylized Malthusian movement

Mean income and population growth



Measured inequality and inequality extraction ratio

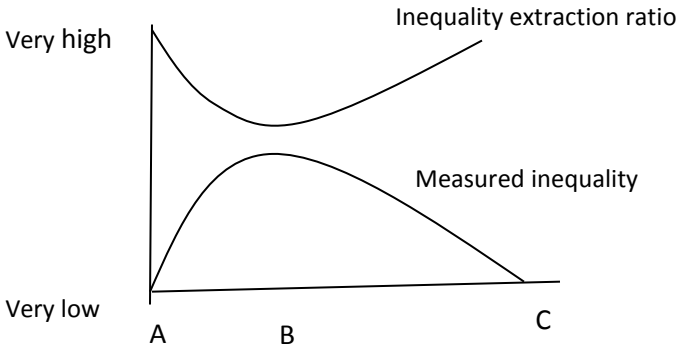
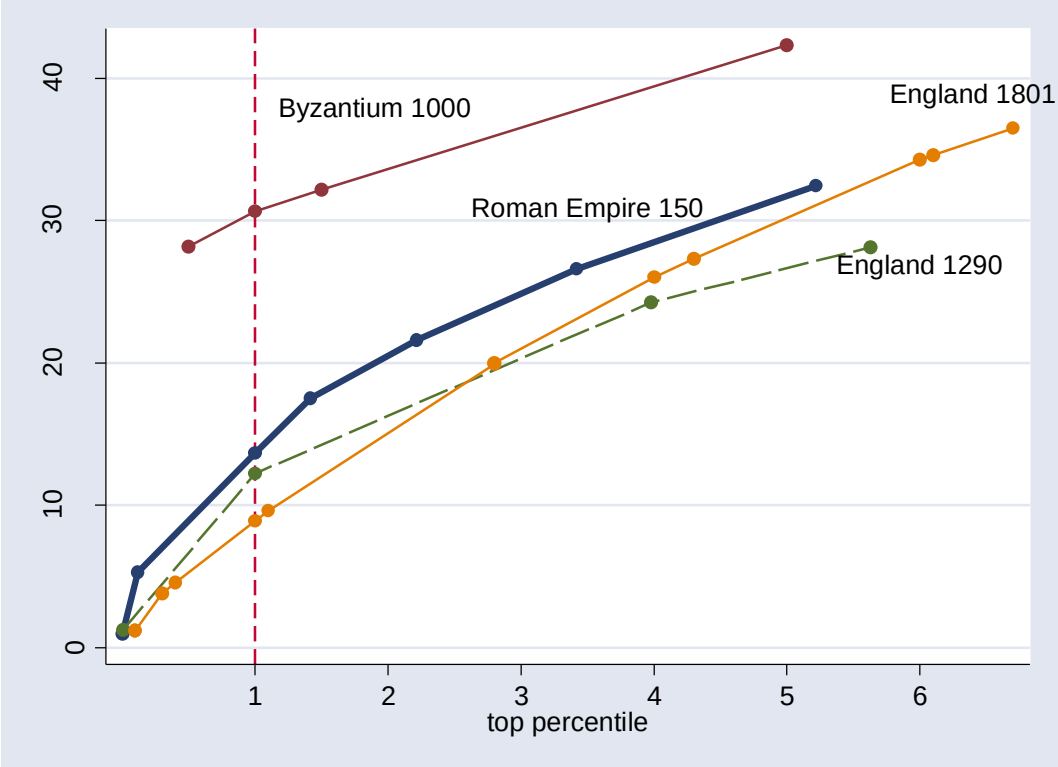


Figure 4. The top five or six percentiles of income distribution and their shares in total income



Source: Calculated from the Roman social table (Table 3 above), and social tables provided in MLW (2007). Pareto interpolation used to estimate the share of the top 1 percent. Dots refer to the income shares actually observed in social tables.

Table 1. Regional and overall average per capita income in the Euro-Mediterranean region, years 14-700 (expressed in subsistence)

Year	14	150	300	400	500	520	600	700
North Africa	1.20		1.40	1.40	1.26	1.24	1.18	1.11
Peninsular Italy	2.14		1.35	1.31	1.18	1.15	1.11	1.13
Roman Britain	1.10		1.22	1.20	1.04	1.04	1.04	1.07
Aegean world	1.30		1.31	1.31	1.35	1.37	1.31	1.11
Levant	1.44		1.29	1.31	1.40	1.42	1.35	1.29
Gaul and Iberia	1.20		1.35	1.31	1.18	1.15	1.11	1.13
Alternative Gaul/Iberia			1.22	1.18	1.06	1.04	1.00	1.02
Total	*1.42*	*1.81*	*1.33*	*1.32*	*1.28*	*1.29*	*1.24*	*1.15*
Total (with alternative income for Gaul/Iberia)	*1.42*	*1.81*	*1.29*	*1.28*	*1.26*	*1.27*	*1.22*	*1.14*

Note. Year 14: calculated from Maddison (2007, Table 1.12, p. 54). Year 150, calculated from Scheidel and Friesen (2009; based on Tables 6 and 8; see also Section 4 below). Year 300: calculated from Allen's (2007) results for the year 301 and Maddison (2007). Years 300-700 derived from Ward-Perkins (2007, Table 6.1) as explained in the text, Regional data from Maddison (2007, p.54) are "converted" into Ward-Perkins's classification as follows: Sicily, Sardinia, Corsica, Baetica, other Iberia, Narbonensis and other Gaul comprise Gaul and Iberia. Greece, Danubian provinces and Asia minor comprise the Aegean "world". Tunisia, Libya, Algeria and Morocco are Roman North Africa. Egypt, Greater Syria and Cyprus are the Levant. Peninsular Italy in both sources us the same. The population data (see Annex) are from Maddison (2007, Table 1.3., p. 37) and McEvady-Jones (1978).

Table 2. Some indicators of regional and inter-personal inequality in the Euro-Mediterranean region, years 14-700

Year	14	300	400	500	520	600	700
Relative gap (richest-to-poorest region)[a]	1.95	1.15	1.19	1.35	1.37	1.30	1.26
Population-weighted Euro-Med Gini	10.5	1.5	1.0	4.0	4.8	4.5	2.8
Population-weighted Gini with alternative income for Gaul/Iberia	10.5	2.5	2.6	5.4	6.2	5.6	3.8

Source: Calculated from Table 1. a/ Includes alternative income values for Gaul/Iberia in years 400 and 700 when Gaul/Iberia is the poorest region (according to alternative income).

Table 3. Social table for the Roman empire around year 150

Income (social) group	Estimated average income (in HS per capita p.a.)	Income in wheat-equivalents (kg, per capita, p.a.)	Estimated population share (in %)	Average income in terms of subsistence
Senatorial order	75000	200100	0.003	513.1
Equestrian odder	10000	26680	0.114	68.4
Decurial order	2500	6670	0.743	17.1
Other wealthy	2500	6670	0.557	17.1
Middle level 5	1350	3603	0.8	9.2
Middle level 4	1105	2948	1.2	7.6
Middle level 3	859	2293	1.8	5.9
Middle level 2	614	1638	2.7	4.2
Middle level 1	368	983	6.5	2.5
Military	265	707	1.6	1.8
Poor 3	215	573	19.0	1.5
Poor 2	153	409	55.0	1.0
Poor 1	92	246	10.0	0.6
Total	*265*	707	*100*	*1.8*

Source: Based on Scheidel and Friesen (2009, Tables 6, 7 and 8). Wheat equivalents for classes Middle level 5 and below are the mid-points of bracket estimates given by Scheidel and Friesen (Table 7). Income in sesterces for the top four classes from their Table 6, converted into wheat equivalents using the price of 2.5 HS per modius (HS 0.375 per kg). Wheat and HS equivalents for the military assumed equal to the overall mean (as per Scheidel and Friesen, Table 10). Population shares based on Scheidel and Friesen's "optimistic" scenario.