Center for Liberal-Democratic Studies

WORKING PAPERS IN ECONOMIC HISTORY

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May 2006

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Using recent economic statistics from the peak period of Byzantine political and economic influence, we estimate the average income around the year 1000 to have been about 6 nomismata per capita per annum. This is then translated into current prices using two independent methods. They both yield an estimate around $PPP 640-680 in 1990 international prices. It is argued that this amount is some 20 percent below an average estimate of Roman incomes at the time of Augustus (around year one). Assuming that most of income differences in Byzantium were due to the differences in average incomes between social classes, we estimate the Gini coefficient to have been in the range between 40 and 45.

JEL classification: N30, N33
Keywords: Byzantium, Rome, income, inequality, agricultural societies
Number of words: about 8,900.

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1. Introduction. Why the 10-11th century Byzantium?

The period of the late tenth and first half of the eleventh century was the second peak of Byzantium's economic and political power, after the 6th century peak under Justinian. Politically Eastern Roman Empire stretched almost as far as it did under Justinian. It controlled all of Anatolia, parts of the Middle East, the south of the Crimea, the Balkans, and the Southern Italy. It thus stretched from Bari in the West to the Caucasus in the East, from Cherson in the Crimea to Antioch in the Middle East. The territories that were lost compared to the Justinian's Byzantium were Northern Africa (including Egypt) and Southern Spain, Northern Italy, parts of Sicily, Syria, Lebanon and Palestine. Its estimated population was between 12 and 18 million.

This is also the period that coincided with a strong rule of Basil II (976-1025), a key emperor of the Macedonian dynasty. Basil II was able to simultaneously roll back the Eastern advances of the Turks, and to recapture Bulgaria and reintegrate the Balkans into Byzantium. And he was also able to hold at bay attempts by the Normans to take over Southern Italy and control the Adriatic. [2] He was thus victorious on the three fronts, the very fronts from which the danger was about to continue and in the second part of the 11th century—after disastrous losses in 1071 against the Seljuqs at Manzikert and Normans in Bari—lead to the gradual weakening and shrinking of the Empire.

Basil II's time was also a relative high point of Byzantine economic affluence, a fact not unrelated to military successes which improved security of peasants, brought greater harvests and stimulated agricultural and urban economy.[3] As Toubert (2002, p. 385) writes, the eleventh century was the high point of Byzantium, both politically and economically, regardless of whether the "economic renaissance" is dated from Basil II's reign or slightly before. "The political upturn [in the 10-11 century] is coincidental with an economic recovery. Indeed, some aspects of the military-political stabilization and expansion had direct economic consequences. Increased security within the frontiers of

[2] For Basil's rule, see Ostrogorsky (1969, Part IV, Chapter VI).

[3] "The level of security [of Byzantine peasants] has never been as high as in Basil II's vast empire." (Lefort, 2002, p. 288).

the empire meant that peasants could cultivate their fields without constant risk that the fruits of their labor would be appropriated by the enemy or that their productive resources would be destroyed by raids." (Laiou, 2002d, p. 714). The main advance came from the reinvigorated power of small land-owning peasantry that has been gradually expropriated by the magnates over the previous two centuries. Basil II realized that the foundation of Byzantine economic and political power lay in small independent farmers who were both soldiers and tax-payers. Their impoverishment during the two previous centuries and gradual swallowing up by the large landholders led to the development of large latifundias. As the magnates grew more powerful and independent from the Emperor, both state's tax collection ability and its military might weakened. The weakness of the state thus clearly proceeded from an increased economic inequality and growing power of the nobility. Basil II set out to reverse these trends, most notably through implementation of his novel (law) of 996, by confiscation of large estates, by obligation to return to the peasants the land cheaply acquired during the periods of distress, and by strengthening the central control. [4]

The study of the tenth century Byzantium has relevance for several reasons. First, Byzantium was the richest state in the Christian world at the cusp between the tenth and eleventh century. It was probably one of the richest in the world although the Abassids in Baghdad and the Ummayads in Spain might have been about equally rich.[5] It is interesting to compare its level of income with another empire at its peak, its predecessor, the Roman Empire under Augustus (for which such estimates do exist). Second, such a comparison tells us something about the maximum income levels that pre-industrial societies have achieved. Third, inequality of income and wealth has surely played an important role in Byzantine politics, in its rise and fall. In addition, it should also inform us about the likely levels of inequality that could have been sustained in agricultural

[4] The gist of his novel was hardly unique, but the implementation was more serious than before. The same problems were diagnosed in Romanos I novel issued in 934 which says that "the number of [small] holdings is shown to be linked to the abundance of food, to the payment of taxes, and to the fulfillment of military obligations, all of which would be lacking if this great number [of peasants] absconded." (quoted from Lefort, 2002, pp. 282-3).

[5] To quote Lopez (1951, p. 215), "[a]ll we can say is that [in terms of per capita income] up to the late tenth, and perhaps late eleventh, century the Byzantine Empire must have greatly outstripped the nations of Western Europe and equaled the more fortunate regions of the Muslim world."

societies. Fourth, the period up to the mid-11th century represents the end of the long period of more than seven centuries of price stability. Starting with the rule of Constantine IX (1042), the solidus or the nomisma began the period of debasement which would make its gold content at the end of the 11h reduced to one-tenth of the original.[6] Thus the very fragmentary evidence on wages and prices on which we must rely to obtain a picture of living standards becomes all but useless after the mid-11th century since we lack a yardstick with which to compare the data.

2. The approach

The approach which we follow to convert the contemporary data into today's dollar equivalents is as follows. First, we find the subsistence minimum (SM) basket in physical terms that was used for (say) military rations or even more modest payments in kind. Second, we price this basket in local currency. Third, we relate known nominal wages and other incomes to the nominal value of the subsistence basket, *viz.* express other incomes in terms of the basket. For these three steps, we need the data that are relatively easy to find even for the ancient societies. They are of two kinds: average nominal wage, and unit costs of key food items that enter into the subsistence basket. Once we have these two, we have the "Ricardian wage", that is a wage expressed in terms of the subsistence minimum. We write these steps in equations (1) and (2):

$$B_l = \sum_i B_{i,n} * P_{i,l} \qquad (1)$$

$$w_b = \frac{W_l}{B_l} \qquad (2)$$

where $B_{i,n}$ = physical ("natural") quantity of *i*-th good that is included in the subsistence basket, $P_{i,l}$ = price of *i*-th good expressed in local currency *l*, B_l = value of total basket expressed in local currency, W_l = wage expressed in local currency, w_b = wage expressed in terms of baskets (subsistence minima).

[6] See Kaplanis (2003).

The fourth step relies on an assumption that there must be a relationship between a Ricardian wage and average income of a society. If the "normal" wage is at the subsistence, it is unlikely that the mean income of a society is high. Thus we derive an estimate of average national income based on the rules—in this particular case, Bairoch's rule—that "convert" annual wages into mean national income. In addition, we perform several checks to verify how thus calculated income relates to other pieces of macro evidence. This step is shown in equation (3)

$$y_b = F(w_b) \tag{3}$$

where y_b = income expressed in terms of SMs, F(.) = conversion function of "normal" wage into mean income.

The next two steps take us from the world of the past to the present. In the fifth step, we simply take the current dollar value of the subsistence minimum. Sixth, we convert the average income (expressed in terms of the subsistence basket) from equation (3) into current dollars. This step can be written,

$$y_\$ = y_b * B_\$ \tag{4}$$

where $B_\$$ = subsistence basket expressed in current dollars, and $y_\$$ = income expressed in current dollars.

The key step is No. 4 which relates what is known regarding individual incomes and wages to what the average income of a nation may be. Note that since the valuation of the subsistence minimum in today's prices cannot involve a major error—simply because the subsistence minimum is the same in quantity terms then and now—the principal potential cause of error is contained in the step 4 which "translates" wage estimates into an overall per capita income estimate. Several calculations of the step 4 will be undertaken. Finally, we proceed to an estimate of income distribution building it from the estimates of average incomes of different social classes. This assumes that most of inequality between individuals can be reduced to inequality between social groups. In other words, income differences *within* each social class (say, workers, farmers etc.) play a relatively small role in total inequality. In a hierarchical society like

Byzantine, this is a reasonable assumption. In addition, the mean retrieved from the calculation of income distribution should match the mean that we obtain from step No. 4.

3. Minimum baskets and real wages

The average "modest" salary (including benefits in kind) for an unskilled worker was estimated by Morrisson and Cheynet (2002, p. 869) at about 1 nomisma (N) per month or between 10 and 12 N per year.[7] The important thing is to see what this modest salary can purchase. Again, according to Morrisson and Cheynet, the money equivalent of military rations (see Table 1) amounted to about 6 N per year. We shall denote this amount as AMB (average minimum basket). The adjective "average" is crucial because it indicates that this minimum is not a subsistence minimum but is somewhat higher—such that an "average" *adult* person of modest means would find it acceptable or usual.[8] The ration is based on food consumption of four key products: wheat (bread), wine, olive oil, and meat to which are added some quantities of dried vegetables and cheese. The daily quantities implied in the military rations are about 0.5 kilo of wheat, 1 liter of wine, 0.5 pound of meat and 0.1 of liter of olive oil. This amounts to a relatively high consumption of meat of some 60 kg per year. However, here we deal with soldiers whose meat requirements were significantly greater than the average per capita consumption.[9]

One may contrast Byzantine military rations to those of the American forces at the beginnings of the Revolutionary War in 1776. Their daily rations included 450 grams of meat, 0.5 kg of flour, a bit less than 0.5 liter of milk, and about 1 liter of beer. Meat

[7] The salaries were constant (in nominal and real terms) for a very long period from the sixth to thirteenth century (see Liaou, 2002a).

[8] It is similar to the *social* minimum that existed in Eastern Europe under Communism. The minimum incorporated some social "average" view regarding what was a modest but acceptable standard of living. (The use of "minimum" and "average" in the same sentence is not a contradiction. It was a "minimum" line because it was relatively low. But it was also an "average" line because this was something that an "average" household should have.)

[9] Current subsistence minimum used for Turkey assumes annual consumption of around 40 kg of meat per capita. Data for Turkey are from the 1999 Haceteppe University norms-based minimum consumption basket (available from the author on request). I am grateful for this reference to Ruslan Yemtsov.

intake in 1776 was almost twice as generous while the rest seems very similar. [10]

While the military ration was relatively generous, monastic rations can be, according to Morrison and Cheynet, regarded as a subsistence minimum (SM). The monastic ration all but excluded meat, and implied consumption of wine and oil which were respectively one-half and one-third of the military rations.[11] The consumption of wheat was the same in both rations. If we then translate monastic rations in money terms, we get an estimate of about 3.5 N per year. This latter amount shall be considered a monetary equivalent of the subsistence minimum.

In terms of calorific content, the military ration provides 3700 calories per day, and the monastic ration about 2300. In terms of the daily protein intake, the two rations provide respectively 120 and 70 grams.[12] According to FAO, the minimum caloric intake for an adult working male is about 3000 calories per day. The World Bank Living Standard Measurement Survey uses in the construction of the poverty line 2900 calories per day for an adult male and 2200 for an adult female.[13] Indian Council of Medical Research (Gopalan 1992, quoted in Allen, 2001, p. 426) takes the minimum for a working man to be 2800 calories. The military ration should therefore provide a sufficient amount of calories for a day of strenuous physical activity while the monastic ration should be enough for the mere subsistence. [14]

None of these two rations include anything but food. There are at least two

[10] See Conference Notes prepared by the US Quartermaster General in 1949; available at http://www.qmfound.com/history_of_rations.htm.

[11] The same amounts of wheat and wine per capita were used in an old people's home run by a monastery (see Harvey, 1989, p. 206).

[12] This is calculated taking the following assumptions (from Allen, 2001, p.421). Calorie and protein contents are respectively: per kilo of: bread 2450 and 100; meat, 2500 and 200; olive oil (butter), 7286 and 7; cheese 3750 and 214; wine (per liter), 850 and 0.

[13] Data based on FAO standards and Professor Latham (Cornell University) data on nutritional requirements.

[14] According to Allen (2001, p. 425), the subsistence minimum for an adult male in the early Middle Ages in Europe implied a consumption of slightly less than 2000 calories per day. Quoting Fogel's work, Allen notes that this amount would place a person in the second income decile in England around 1500. Our Byzantine monastic ration is accordingly somewhat more generous.

important omissions: housing costs and expenditures on clothing. Any other expenditure like those on entertainment, a whole variety services from barbers to health and education and so forth may be disregarded. Rents (see Morrisson and Cheynet, 2002, p. 872) were very low in the case of small houses, and we can surely assume them low for the poor people. Accordingly, we shall increase both the AMB and SM by some 5 percent to reflect the housing and clothing needs.[15] This therefore yields an average minimum standard of expenditures of about 6.3N per year, and the subsistence minimum of about 3.7 N per year. The latter amount is crucial because we shall argue that no person can subsist on less than 3.5-3.7N per year.

[15] Marx (1976, vol. 1, Part 7, Chapter 25, Section 5 (f), p. 706) gives the following ratios for food and non-food components for Ireland in two years, 1848-49 and 1868-69. For food only, 1 shilling and 3.25 pence, and 2 shillings and 7.25 pence respectively; for non food, 3 pence and 6 pence respectively. In both cases, this gives the food basket mark up of 19 percent (1 shilling = 12 pence.) Allen (2001, p. 426) increases on the account of rent the food basket in the early Middle Ages by 5 percent only. The average mark up of today's food poverty baskets is about 20 to 25 percent (personal communication by Martin Ravallion).

Table 1. Military and monastic rations
(all amounts per capita)

	Military ration				Monastic ration		
	Consumption per annum	Price per unit (in N)	Consumption in metric equivalent per annum	Total expenses in N per annum	Consumption per annum	Consumption in metric equivalent per annum	Total expenses in N per annum
Wheat	20 modioi	1/12	192 kg	1.67	20 modioi	192 kg	1.67
Wine	365 xestai	1/730	365 liters	0.5	18 measures	184 liters	0.25
Meat	180 pounds	1/114	60 kg	1.62	none		0
Oil	36.5 xestes	1/50	36.5 liters	0.75	1 measure	9.1 liters	0.2
Dried vegetables	3 modioi	1/6	38.4 kg	0.5	2 modioi	26 kg	0.33.
Cheese	50 pounds	1/50	17 kg	1	50 pounds	17 kg	1
Total				~6			~3.5

Note: The military ration per person is based on the Morrisson-Cheynet summary of military rations (p. 871) combined with some data given in their Table 20 (p. 870) and Table 5 (p. 822-4) regarding the price of wheat. Monastic ration is based on three rations given in their Table 20.
Unit conversions: 1 modios of wheat = 12.8 kg. 1 xesta = 1 liter. 1 liquid measure of wine (metron) = 10.25 liters. 1 liquid measure of oil = 9.1 liters (see Morrisson and Cheynet, 2002, p. 817), 1 pound = 328 grams (see Entwistle, 2002, p. 611).
Discussion of average wheat prices. For the second half of the 10^{th} and the first half of the 11^{th} century non-crisis prices given by Morrisson and Cheynet (2002, p. 823) range between 1/15N and 1/8N. Lefort (2002, p. 301) uses 1/12N per modios as the average price. Morrisson and Cheynet (2002, p. 858) cite Basil I's policy of maintenance of "normal" wheat prices at 1/12N. Kaplanis (2003) gives the wheat price as 1/12N. Harvey (1989, p. 203) believes that during the "normal times" the price was between 1/8N and 1/10N per modios. Therefore, the range of "normal" prices is from 1/15 N to 1/8N; we use the mean of this range (1/12N).

The implication is then that a "modest" wage of 9-12N was sufficient to buy between 2.4 and 3.2 subsistence minima, and less than two more generous adult AMB baskets. In terms of Robert C. Allen's (2001, pp. 425-6) "welfare ratios"(defined as wage divided by 3.15 adult subsistence minima supposed to cover the needs of a four-member household including rent), the Byzantine wage would lie between 0.76 and 1.[16] This means that one modest wage would be either barely sufficient to cover subsistence needs of a family of four, or may even fall a bit short of it. We can also compare the Byzantine welfare ratio with the ones calculated by Allen (2001, p. 428, Table 6) for building laborers in the 16th century Europe. Taking the first half of the 16th century, almost all European welfare ratios, with the possible exceptions of Florence/Milan, Augsburg and Paris (where they are estimated at respectively 0.92, 0.92 and 0.87), are higher than in Byzantium. But in the second half of 16th century when European real wages fell, the welfare ratios in most of Europe, except in Northern parts (London, Antwerp, Amsterdam) where they were higher, ranged between 0.75 and 0.9. These welfare ratios were thus very similar or even a bit lower than in the early 11th century Byzantium.

The recent real wage calculations by Gregory Clark (2005) enable us to make a further comparison. Clark (2005, p. 1308) shows that construction workers' real wages in Britain were almost exactly the same in the first decade of the 13th century and in the beginning of the 16th century. [17]We have just seen that the latter, calculated in terms of Allen's "welfare ratios", were higher than the Byzantine wages of the early 11th century. Then, Byzantine real wages calculated here must have been also somewhat less than the real wages in Britain 1200.

[16] The use of Allen's approach fits particularly well because the average household size in Byzantium was not far off 4 members. The average family side (or more exactly, the number of persons per hearth) was calculated to have been between 4.7 and 4.9 in the early 14th century (see Lefort, 2002, p. 244). Since, it was the period of strong demographic pressure, the average size was probably lower in the 10-11th century. For the 10th century, the average family size is assumed by Lefort to have been 4.3.

[17] This assumes that Clark's and Allen's real wage series are fully consistent. Without further exploration of data sources, one cannot be fully certain of this.

Other wages

Morrison and Cheynet (2002, p. 865) provide some additional evidence regarding different wages. In the early 12th century, *protoasekretes* (a medium-level government official) was paid more than 30N per year, a notary more than 20N, a doctor about 9N, and a servant 7.3N.[18] The highest officials were paid much more. Under Leo VI (ruled from 886 to 912), the heads of most *themes* (largest administrative units into which the Empire was organized) were paid between 5 and 10 pounds of gold, or between 360 and 720N, annually. [19]

Finally, to appreciate how relevant is "modest" wage of 10-12 N, one can look at the military pay. Morrisson and Cheynet (2002, p. 861) quote the annual *rogai* (emoluments) of sailors and soldiers in the year 949. Their cash compensations ranged from the minimum of 3N for ordinary sailors and soldiers (with no seniority) to 30N for *toumarches*. [20] But since in addition, soldiers were receiving in-kind rations which we estimated to be worth about 6.5N per year, this yields the minimum compensation for ordinary sailors and soldiers of 9.5N. Treadhold (1992, cited in Morrisson and Cheynet, p. 861) similarly gives money compensations from 9N for soldiers to 144N for commanders.

Another evidence is provided by Vryonis (1967, p. 83) who estimates annual government expenses for the Anatolian army to have reached 1 million gold solidi (that is, 1 million N). The estimate is not dated, but if we assume that it relates to the peak of Byzantine military power, in the tenth century when the size of the Army was estimated at some 120,000 soldiers (not all of whom were in Anatolia), we again get an approximate average cost per soldier which could not have been very far off 10N per year. A summary of our calculations is presented in Table 2.

[18] Calculated using the price of wheat as 1/12N per modios (since wages include not only cash, but in kind component as well).

[19] Ostrogorsky (1969, p. 246). But the heads of the three most important themes (Anatolian, Armenian and Thracian) received much more: 40 pounds of gold or 2880N.

[20] Runciman (1964, p. 143) gives the following range: from 1N for the first-year privates increasing by 1N with each year of seniority and going up to 12-18N for soldiers, to 72-124N (one to two pounds of gold) for lower officers, and all the way to between 1440 and 2880N (20 to 40 pounds of gold) for *strategoi*.

Table 2. Summary of income and subsistence minimum estimates
for Byzantium around year 1000

	Amount in nomismata per year	Calorie intake	Allen's "welfare ratio"
Unskilled wage or pay of an ordinary soldier (inclusive of benefits in kind)	9-12	---	0.76-1
Money equivalent of a soldier's food ration	6.5	3700	---
Average Minimum Basket (AMB)	6.8	---	---
Subsistence minimum, food only (SM)	3.5	2300	---

4. Moving from wages to average income

Using Bairoch's rule, namely that the average per capita income of a country in preindustrial societies is equal to about 200 daily wages of an unskilled male worker,[21] and assuming the "modest" wage to have been 10.5N per year (the average between 9N and 12N), gives the average per capita income of about 6N per year. This in turn makes the average income equal to about 1.7 subsistence minima.

We can cross-check this amount with others. Kaplanis (2003, p. 782) cites estimates by Treadgold (1997) and Morrisson (2002, p. 941) according to which the imperial budget in 1025, the last year of Basil II's rule, reached 5.9N million.[22] This yields a per capita amount of between one-third and one-half nomisma which in turn means that the government budget amounted to between 5 and 8 percent of national income.[23] This is a fairly sensible number.

[21] Originally proposed by Bairoch (1977) and calculated within the context of European economies of late 18th and 19th century. Bairoch allows that it can be meaningfully used for other pre-industrial societies. According to Goldsmith (1984, p. 279, footnote). however, Bairoch's "200 rule" gives too high income for the Roman period where, according to Goldsmith, the multiplier should be about 110. There are two reasons adduced by Goldsmith why it should be so. The first is lower wage dispersal (that is, relatively high wage of unskilled male laborers compared to the mean wage); the second, high share of wages in national income. It is impossible to say whether these two reasons were operative in Byzantium (and indeed, *pace* Goldsmith, whether they were operative in the Augustan Rome either) and thus whether our estimate of average income may be too high.

[22] For a detailed breakdown of the budget, see Treadgold (1997, Table 13).

[23] Assuming alternatively a population of 12 or 15 million (and rounding off the numbers).

Making a giant leap into the present-day world of PPPs, where the subsistence minimum is estimated to be about $PPP 400 per capita per year (at 1990 Geary-Khamis prices), this calculation places Byzantine's average per capita income at $PPP 680.[24]

Another way of converting Byzantine incomes into today's PPP incomes, and thus providing a check on the amount just calculated consists in employing the indirect approach and comparing incomes in Byzantium with those in Rome. That approach presents some advantage because of a similar composition of consumption in the two periods. It also allows us to use the calculations done for Rome in order to "peg" our estimates of incomes in Byzantium to some already made estimates which have indeed tried to "make the jump" between incomes in Antiquity and today.

5. Comparison of Roman and Byzantine wages and average incomes

Table 3 compares military rations (AMB) in the 10th century Byzantium and Augustan Rome. The wheat allotment per soldier was almost twice as large in Rome as in Byzantium: 1 kg per day vs. a bit over 0.5kg.[25] For meat, Harl (1996, p. 456) quotes soldiers' daily ration of ½ pound of pork.[26] This is the same as in Byzantium. For wine and oil, I use the data on average per capita consumption in the city of Rome. Wine consumption was generally estimated at 100 liters per person annually. Taking into account that total population included some 2/3 of persons below 18 years of age, women, and the elderly whose consumption was less, it is not unreasonable to estimate that per capita consumption of prime age adult male (or soldiers) was, as in Byzantium, around 1 liter per day. Olive oil consumption in Rome was thought to have been around

[24] We have adopted Maddision's estimate of $PPP400 to represent the subsistence minimum (see Maddison, 1998. p.12). Note that the purely physiological minimum "sufficient to sustain life with moderate activity and zero consumption of other goods" (Bairoch, 1993, p.106) was estimated to be $PPP 80 at 1960 prices (Bairoch, ibid). Taking US consumer price index to convert international dollars yields $PPP 355 at 1990 prices But Maddison's estimate in additional allows for expenses above the bare physiological minimum.

[25] Roman consumption is equivalent to 50 modii per year per soldier; see Goldsmith (1984, p. 266) and Davies (1989, p. 187). Harl (1996, p. 271) puts the annual consumption at 48 modii per soldier. This was understandably higher than civilian per capita consumption estimated by both Schiavone (2000, p. 96) and Harl (1996, p. 271) to have been about 200 kg per year. .

[26] A very "generous" allocation would have amounted to 1 pound of meat per day; see Duncan-Jones (1990, p.110, fn.16).

22 liters per person which is again comparable to some 34 liters per adult male in Byzantium. [27] Thus, taking the key staples of meat, oil and wine it would seem that what might have been considered modest average amounts in Rome and Byzantium were similar. The only exception is wheat whose ration seem to have been higher in Rome.

[27] The conversion factor is different (and smaller) here than for wine since oil, unlike wine, is consumed in similar quantities by persons of all ages and gender.

Table 3. Comparison of the military rations in Byzantium (circa year 1000) and Augustan Rome (circa year 1)
(all amounts per capita)

	Byzantium (around year 1000)			Rome (around year 1)			
	Per soldier			Per soldier			Per inhabitant of Rome
	(1)	(2)	(3)=(2)x(1)	(4)	(5)	(6)=(5)x(4)	(7)
	Consumption per annum	Consumption in metric equivalent per annum	Expenses in N per annum	Consumption per annum	Consumption in metric equivalent per annum	Expenses in HS per annum	Consumption per annum
Wheat	20 modioi	192 kg	1.67	50 modii	340 kg	110-115	100 kg 2/
Wine	365 xestai	365 liters	0.5		365 liters		100 liters 3/
Meat	180 pounds	60 kg	1.62	180 pounds	60 kg 6/		
Oil	36.5 xestes	36.5 liters	0.75		36 liters 5/		22 liters 4/
Other grains						15	
Other food			1.5			70	
Other expenditures						150	
Total expenditures			6			350	
Memo: Total national expenditures (income) per capita			6			380 1/	

Note: The Roman modius was 6 ¾ kg. 1 pound = about 1/3 kg. Sources: Roman calculations from Goldsmith (1984, p. 266 fn); Byzantium from Table 1.
1/ 30 HS (the difference between 380 and 350) includes government expenditures (see Goldsmith, 1984, p. 268). 2/ Finley (1985, p. 198). 3/ Calculated from Finley (1985, p. 205). The same figure is given in Schiavone (2000, p. 96). 4/ Schiavone (2000, p. 96). 5/ Harl (1996, p. 456, note 12) quotes a lower amount of 4 pounds per month which would amount to 22 liters per year. 6/ Harl (1996, p.456, note 12) quoting Roth, *Logistics* (pp. 207-8) and Roy W. Davies, *Service in the Roman Army* (1989, pp. 191-96).

In Table 4 we proceed to the next calculation where all amounts are expressed in terms of the monetary equivalent of the subsistence minimum. Since the AMBs are, as we just seen, broadly similar, SMs that represent physiological minima must be even more so. For Byzantium, we use the same SM as described above: the monastic ration. For Rome, we use the well-documented value of the *alimenta* benefits paid to children (mostly boys) from poor families and under 15 years of age. This could be considered as a subsistence minimum particularly if instead of boys these money amounts are used to cover food costs of more aged persons.[28] The *alimenta* payment amounted to 180 sesterces (HS) annually.[29]

Table 4. Comparison of Augustan Roman and Basil Byzantine incomes

	Byzantium	Rome	Byzantium	Rome
	In nomisma	In HS	In terms of SM	
Subsistence minimum	3.5	180 1/	1	1
Military ration	6		1.7	
Average consumer expenses		350		2
Average modest wage 2/	9-12	800	2.6-3.4	4.4
Soldier's gross pay 2/	9-12	1200 3/	2.6-3.4	6-2/3
Average monetary income per recipient		1000		5
Average per capita expenditure or income	6	380	1.7	2.1

Note: All Roman data are from Goldsmith (1984) unless explicitly stated otherwise.
1/ This is the amount of *alimenta* for boys under 15 years of age (see Goldsmith, 1984, p. 268). 2/ Inclusive of imputed value of food. 3/ Calculated from Finley (1985, p. 104). It refers to the legionnaires' pay in the period around the year 100.

[28] Alimenta was state payment for poor young boys (supposed, as the name implies, to cover their food needs) introduced under Nerva and Trajan. It was paid from the interest proceeds earned on a large state fund. The scheme lasted for more than a century and covered a number of towns, mostly in Italy (see Finley, 1985, pp. 40 and 202).

[29] Exactly the same amount (180 HS per capita per annum) is reckoned by Harl (1996, p. 274) to have represented the subsistence minimum. He quotes Roman authors who report that between 2 and 2.5 asses (0.5 to 0.625 HS) were deducted for legionnaires' pay to defray their food expenses. If we multiply this by 365 days, we get an amount between HS 180 and HS 220.

We see in Table 4 that the average annual average wage was estimated by Goldsmith (1984, p. 269) to have been 800 HS or equal to 4.4 times the subsistence minimum. We have seen above that the average wage of an unskilled worker in Byzantium was between 2.4 and 3.2 times the subsistence minimum. Since we argued that the two subsistence minima are the same in real terms, then the Byzantine average real wage must have amounted to between 60 percent and 80 percent of the average Roman wage.

Turning to a comparison of average incomes, Goldsmith has estimated the average per capita income in Augustan Rome to have been 380 HS per annum. [30] This is 2.1 times the subsistence minimum. We have estimated the average income in Byzantium to have been 6 nomismata per person annually, which is about 1.7 times the subsistence minimum. Byzantine average income was about 20 percent lower than Roman. We thus find about a similar relationship to hold (not surprisingly) between Roman and Byzantine average incomes as between their average unskilled wages. Now, if for Rome we use Maddison's (2007) most recent estimate of per capita income in the Peninsular Italy which is $PPP 813, [31] Byzantine income during Basil II reign is reckoned to have been $PPP 650.[32] This last estimate needs to be compared with our direct estimate of $PPP 680. Note that the two estimates are independent.[33] As a contemporary comparator of

[30] Note however that Goldsmith uses only material goods in his calculation of the Roman income; no services are included (see Goldsmith, 1984, p. 268). Similarly, as pointed out by Laiou (2002c, p. 688 fn), he takes no position on the respective shares of commercial and in-kind (natural) transactions in Roman Empire's total income. Presumably, the latter are included in his calculations.

[31] All data on Roman wages and subsistence minimum used here come from Peninsular Italy and are reported in Maddison (2007), also available at www.ggdc.net/Maddison/. It should be noted that Maddison's earlier estimates of Roman income have been criticized as too low by Federico (2002).

[32] There are several other ways to convert Roman incomes into today's PPP values. One can do it through the use of gold equivalents as Maddison (2001, 2004) has originally done; or one can use Goldsmith's estimate expressed in sesterces and apply to it various estimates (guesses?) of the PPP ratios made by Clark (1957) and Finley (1985). Neither of these two approaches makes much sense. The use of gold as numeraire is entirely arbitrary and not frequently done today. The application of the rather crude guesses of PPPs made by Finley and Clark leads to absurdly high incomes. The reader interested in these estimates may obtain them from the author on request or consult an earlier version of the paper available on http://repec.org/ or www.ssrn.com.

[33] Many indirect estimates are possible. We have chosen Rome. But we could have chosen also Western Europe around 1500. We have seen above that the Allen's welfare ratios in Paris in the first half of the 16th

Byzantium, consider English GDP per capita in 1086 which was estimated to have been about $PPP 550 (see van Zanden (2005), p. 17). The "development" hierarchy would thus seem to have been: Peninsular Italy in Augustan time with a GNI per capita slightly above $PPP 800 per year, [34] then Byzantium in a period almost ten centuries later with an income around $PPP650, followed by England at the same time with an income of about $PPP 550.

In conclusion, the fact that the averages incomes in the most developed agricultural economies like Augustan Rome and Basil's Byzantium were about twice or less the subsistence minimum might indicate that the pre-industrial societies were unlikely to ever exceed that ceiling. This in turn has implications for our assessment of the average standard of living in other, non-Western, pre-industrial economies like those of China, India, pre-Colombian Americas, and Africa.

Average income levels also set an upper boundary on inequality. With an average income close to the subsistence, inequality can only be minimal and may be more substantial in the areas of wealth and prestige than actual income. Such poor societies, as was argued by both Tocqueville and Kuznets, must have had quite low income differentiation.[35] As societies develop, income inequality has the "space" to grow simply

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century were close to the welfare ratios in Byzantium around 1000. If incomes are similar too, then Maddison's GDI per capita estimate for France around year 1500, which is $PPP 727, may serve as a reasonable proxy for the Byzantine income in 1000 (see Maddison, 2004).

[34] Maddison's (2007) Roman estimate refers to national disposable income, that is includes net transfers that Peninsular Italy received from other parts of the empire.

[35] Kuznets (1965, p. 217): "It seems plausible to assume that in the process of growth, the earlier periods are characterized by a balance of counteracting forces that may have widened the inequality in the size distribution of total income for a while because of the rapid growth of the non-A [non-agricultural] sector and wider inequality within it. It is even more plausible to argue that the recent narrowing in income inequality observed in the developed countries was due to a combination of the narrowing inter-sectoral inequalities in product per worker, the decline in the share of property incomes in total incomes of households, and the institutional changes that reflect decisions concerning social security and full employment." Tocqueville (1997, pp.42-3).. "If one looks closely at what has happened to the world since the beginning of society, it is easy to see that equality is prevalent only at the historical poles of civilization. Savages are equal because they are equally weak and ignorant. Very civilized men can all become equal because they all have at their disposal similar means of attaining comfort and happiness. Between these two extremes is found inequality of condition, wealth, knowledge-the power of the few, the poverty, ignorance, and weakness of all the rest."

because there is a surplus which can be appropriated or redistributed among members of the society. To this issue we turn next.

6. An estimate of income distribution

Rural vs. urban population

The population of Byzantium whose territory, as we have seen, included in Basil II's times, all of today's Turkey, parts of Southern Italy, and most of the Balkans was estimated by Treadgold (2001, p. 236) to have been 12 million, by Andreades (1924) 15 million, and by Harl (1996) 18 million.[36] [37]

Some 90 percent of Byzantium's population was rural. [38] According to Bairoch (1985, p. 158), the rate of urbanization in Europe in the year 1000 was 12 to 15 percent if one uses as the definition of the city an agglomeration with more than 2000 people (or 9-11% if one uses the threshold of 5000 people). Bairoch's numbers do not include Byzantium. But urbanization in Byzantium was probably greater than in Europe since Constantinople alone, whose population was estimated at between 400,000 and 500,000 people (Harvey, 2003, p. 307), contained 3 percent of the entire Byzantine population.[39] The other important cities included Thessaloniki, Adrinanople, Thebes, Corinth, Athens and Preslav (for a brief period of independence, the Bulgarian capital). We shall accordingly use a rate of urbanization of 10%.

Income differences in rural areas

[36] See Harl at http://www.tulane.edu/~august/H303/handouts/Population.htm. This includes about 10 million in Anatolia, 5 million in the Balkans and Greece, up to 1 million in Constantinople and 2 million in southern Italy and Syria.

[37] For comparison, the population of the Roman empire in Augustus' time was estimated at between 50 and 60 million (see Goldsmith, 1984, p. 270).

[38] For Augustan Rome, Goldsmith (1984, p. 272) estimates urban population under the Principate to have amounted to around 9 percent. To give another example: Allen (2003, p, 408) estimates urban share in England around 1500 to have been 7 percent, but in Italy to have been a high 22 percent.

[39] Or even more if one takes a higher population estimates for Constantinople like the one by Harl cited above.

In the rural areas, we distinguish (socially and functionally) between the land-owning smallholders (peasants) and tenants (the *paroikoi*). Only the first were paying taxes to the state and one of the recurrent themes of the Byzantine history of the 8th-12th century is government's attempts to reverse the trend toward the accumulations of holdings and conversion of landowners into tenants. Basil II's policy (for the reasons of military expediency as well as for fiscal reasons) took very strongly the side of small farmers and by his 996 novela he banned further acquisitions (consolidations) of land acquired from small farmers and imposed the retroactive return of the land which was previously acquired at "unjust" prices from farmers in distress.[40] [41] The reason why many landowning peasants sold their land and became tenants lay in high taxation. This reduced overall tax intake of the state (an early version of the Laffer curve). Tenants were tied to the soil, and in that sense were similar to serfs. However according to Lefort (p. 238) "the distinction between landholder and tenant farmer was weakened once tenures held by *paroikoi* were considered hereditary." There is only an apparent difference between this view of Lefort's which is based on farmers' and tenants' similarity of economic status, and Ostrogorsky (1969) who held that the difference between tenants and landowners was fundamental. The latter view was based on the social consequences which the disappearance of small landholders had for state's ability to extract taxes, raise an army and defend its territory rather than on the similarity of economic condition of smallholders and tenants.

On the large latifundia-like estates, we can distinguish between wage laborers and slaves (see Lefort, 2002, p. 241). But, as Lefort writes, "wage laborers [and slaves] as a category of rural workforce, did not play a decisive role in agricultural production. The overall impression is that the direct management of the demesne required an increasingly

[40] See Ostrogorsky (1969, p. 291).

[41] "Unjust" price was deemed to be less than one-half of the "just" or normal market price. The idea was based on Justinian's concept of "leasio enormis" and (according to Laiou, 2002e, p. 1133 fn who quotes Sirks) owes nothing to the Christian idea of the "just price."

smaller workforce." (p. 242). [42] So, basically in agriculture, we deal with a fairly homogeneous—from the point of view of income—workforce: the differences between landowning peasants, tenants, wage-workers and slaves appear to have been minimal.

Lefort (2002, pp. 301-44) provides a very revealing and important attempt to quantify rural incomes. Obviously such calculations are highly suggestive and depend on a number of simplifying assumptions. Most of the assumptions are based on the *obiter dicta* collected from contemporary sources. Lefort calculated revenues (inclusive of input costs), gross income (inclusive of taxes) and net income (after tax) for three types of rural inhabitants: landowning farmer, tenant and large landowner.[43] The landholdings are assumed to be 80 *modioi* (10 ha) for both tenant and small farmer.[44] Both farms generate total output of 20N per annum with production costs of 5.2N. This gives gross income of 14.8N. The farmer pays 4.6N in taxes (which, recalling our earlier calculations, is a bit more than one annual subsistence minimum). The tenant pays only 1.5N in taxes (tenants were not subject to land taxation) but, on the other hand, has to pay 5N for the rent. The overall result is that it leaves the farmer's family with a net income 10.2N (inclusive of the imputed value of consumption in kind) and the tenant's household with a net income of 8.3N. Using the assumption of 4.3 persons per household, this yields a net per capita income from farming of 2.4N for the small farmer and less than 2N for the tenant. Both households must have had some additional sources of income (fruit or vegetable production, wine or honey or possible non-agricultural income from artisanal work), but these additional sources were probably just sufficient to put them barely at the subsistence level (3.5N per annum). [45]

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[42] The number of rural slaves was not substantial: "..agricultural slavery gradually dwindled to insignificance, and serfdom, widespread though it became in certain regions and periods, never played a dominant role" (Lopez, 1951, p. 223 fn).

[43] Harvey (1989, p. 36) gives the same social classification in rural areas: slaves, wage laborers, independent peasant farmers and large landowners.

[44] This is consistent with Harvey's (1989, p. 54) statement that the average landholding was about 80 to 100 *modioi*.

[45] Ostrogorsky (1951, p. 97) looks at rural income differentiation through the lens of the data on taxes paid by the families who joined the Chilandar monastery on Mount Athos. Although Ostrogorsky speaks of "high inequality" among the families (p. 97), the data on 43 families that he gives show a Gini coefficient

The situation is, of course, different with the large landowner. He is assumed by Lefort to own 500 hectares of land (50 times as much as the small farmer) and to produce an annual output valued at 1000N. The large landowner, of course, leases these lands, and receives as rent ¼ of output value, i.e. 250N. [46] After paying 7N for management costs (which is less than one modest annual wage), it leaves him with 243N in gross income. Total land levies are estimated at 156N (a very high tax rate in excess of 60% of gross income), and his net income is 87N per year.[47] Assuming that other sources of income (not quantified by Lefort) add some 20 percent to that amount, and that landowner's family size is also 4.3 persons, per capita income works out to be about 25N per year.

Income differences in urban areas

While the population share of the urban sector was estimated at 10 percent, its share in total income was very likely greater. Laiou (2000d, p. 745) estimates that in the period of the expansion (10-12 century), nonagricultural sector contributed 25 percent of GNP (including both monetized and non-monetized parts). Among the non-agricultural population income differentiation was certainly much greater than among farmers. According to Morrisson and Cheynet (2002, p. 872), non-agricultural population can be divided into four groups. The poorest group consists of beggars and "marginals" who might have represented between 10 and 20 percent of the urban population and who probably lived at the subsistence minimum. The next were unqualified workers, "able, over a long period, to earn at most 1 nomisma per month, when not unemployed" (Morrisson and Cheynet, 2002, p. 872). The third group were "qualified workers, professional soldiers and craftsmen, who enjoyed a wide margin of income, three to ten

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of taxes paid of 25. Obviously, such information is highly fragmentary and incomplete (we do not have data on families' income but on their taxes only, and we lack the data on family size); however, the implied inequality does not appear to have been very high.

[46] Note that 250N from the rent corresponds to what we have assumed above to have been rent payments made by farmers (5N per ten hectares).

[47] Note that the assumed overall tax rates (out of gross income) are 31% for the farmer, 10% for the tenant, and as high as 62% for the large landowner.

times more than that of unqualified worker" (ibid). This is basically what we may call "the urban middle class." Finally, the richest group were "important officials, judges or *strategoi* [generals], as well as wealthiest merchants and bankers whose incomes differed by the first category by a factor of 150 or more" (ibid). This is the group of civilian and military nobility that were constantly vying for power with emperors and in this case most notably with Basil II. Among them, military salaries were higher than those of civilian officials. Morrisson and Cheynet (2002, p. 869), cite the example of an eminent judge whose patrimony amounted to 100 to 150 pounds of gold vs. an eight to ten times higher wealth accumulated by a military man of a similar rank. Note that 100 pounds of gold is equivalent to 7200N which at 6 percent per annum, yields an income of 432N per year. This is almost 150 subsistence minima, the amount suggested by Morrisson and Cheynet to have been the average income of the richest urban class. For simplicity, we shall (conservatively) estimate income of this group at 100 subsistence minima or 350N. [48]

Finally, the last group was the army that in Basil II's time numbered about 120,000 soldiers, that is about 10 percent of the urban population.[49] [50] We have left out monks and priests whose numbers are difficult to ascertain and who lived in independent communities.

Estimating overall income distribution

Of course, the best we can do is to estimate overall income distribution using mean income per social class as defined here and thus implicitly assuming that all of the

[48] Another glimpse into the incomes of the rich is provided by a quote (reported in Lopez, 1951, p. 220) of a merchant in the early 10th century who considered a person worth 1000N to be a "substantial citizen." This is somebody whose property-generated income alone might have been about 60N per year. According to the same source, a very rich person would be worth 1500N, that is have a property income of 100N. Note however the very high incomes of the top imperial officials mentioned before which could range into the four digit amounts. The number of such recipients must have been extremely small though.

[49] Runciman (1964, p. 145) quoting Bury (p. 236) estimates the Byzantine Army at its peak (that is, around 9-10 century) to have numbered 120,000 soldiers. Stephenson (2003, p. 32), using two different sources believes that Basil's Army never numbered more than 110,000 soldiers. Treadgold (1997) argues that the number is too low and that the size of the Army during Basil II was in excess of 200,000. I prefer to use a more conservative estimate.

[50] Some of the army (generals) might have already been included among the top classes. Yet such double-counting must be minimal.

income differences are accounted for by the differences between the classes, and none within the classes. This is obviously a gross simplification. Yet it can be defended, substantively, by arguing that in the socially polarized societies, it is indeed the between differences which account for most of inequality, and also by recalling that the same type of calculations, in the absence of the individual data, have been conducted for the early England (William Perry) or France or for that matter any country where we do not have household survey data.

In total (excluding nobility) we have seven classes, 3 in rural areas and 4 in urban areas. Three classes (farmers, tenants, and city "marginals") comprising 90 percent of the population were living at, or slightly above, the subsistence minimum. Table 5 shows the approximate composition and income (in terms of nomismata and then converted in SMs) of the various groups. We have assumed that small land-owning farmers accounted for approximately two-thirds of the rural population and that one-third were tenant farmers, wage earners and slaves working on large demesnes. Incomes of these groups were, as we have seen, quite similar: all were around the subsistence minimum. For large landowners, we take the estimate of 25N per capita. Thus the overall average rural income works out to be around 4.3N per capita per year—barely above the subsistence minimum (this regardless of the assumed shares for landowning farmers and tenants since their incomes are practically undistinguishable).

Among the non-agricultural population, "marginals" and beggars were living at the subsistence minimum. For workers' families, we assume an income in line with our earlier estimations of wages and average incomes: their per capita income is equal to the national average (6N). For the urban middle class, we use the lower bound of the Morrisson and Cheynet estimate and put their average income at thrice the income of workers' families, that is 18N per capita per annum. This is, in addition to the very rich, the most difficult group to estimate income for since it is also the most heterogeneous. Finally, ordinary soldiers in the Army were paid (as we have seen) about the same as

unskilled workers. [51] This yields an average non-agricultural income (excluding nobility) of between 9.9N and 12.7N per capita (depending on the assumed shares of the middle class vs. workers). In conclusion, the average urban income appears to have been around two-and-a-half to three times the average rural income, again not counting the incomes of the civilian and military nobility. Finally, for nobility's average income, we take Lefort's conservative estimate of 100 subsistence minima.

Of course, for the entire calculation to make sense we must retrieve an overall average income in the neighborhood of 6N per capita per annum. This is indeed the case: depending on the population shares assumed, the average income turns out to lie between 6.2N and 6.4N per capita. We may thus conclude that our simulation is consistent with the conclusions obtained earlier regarding the average level of income in the whole Empire. Furthermore, it is also consistent with the estimated share of 25 percent (or up to 30 percent) contributed by the non-agricultural sector to total GDP. It then remains simply to calculate the measures of inequality assuming that only between class inequality matters. We obtain a Gini coefficient that ranges between 40 and 41.

[51] In other words, we assume that the average per capita income of families of unskilled workers and soldiers is the same.

Table 5. Estimated average income by social class and total inequality

Per capita income by social type	% of agricultural population	% of non-agricultural population	% of total population 1/ 2/	Average income (in N)	Average income (in SM baskets)
Tenants *(pariokoi*), wage laborers and slaves	30-40		28-37	3.5	1
Small farmers 3/	59-69		52-61	3.8	1.1
Large landholders	1		1	25	7
Total agricultural	***100***		***90***	***3.9-4***	***1.1***
Marginals and beggars		10-20	1-2	3.5	1
Workers		20-30	2-3	6	1.6
Traders, craftsmen (middle class) 3/		34-57	3.5-5.5	18	5.1
Army (ordinary soldiers)		10	1	6.5	1.9
Total non-agricultural (excl. nobility)		***94-97***	***9.5***	***9.9-12.7***	***2.8-3.6***
Civilian and military nobility		3-6	0.5	350	100
Overall income				***6.2-6.4***	***1.8-1.9***
Gini (in percent)					40-41
Urban-rural income ratio (excl. nobility)					2.5-3.1

Note: N=nomisma; SM=subsistence minimum. Gini coefficient expressed in percentages. It thus ranges from 0, theoretical perfect equality, to 100, equally theoretical perfect inequality where entire income is appropriated by one individual.
1/ Agricultural population is assumed to account for 90 percent of total population. 2/ All percentages rounded off to the nearest ½ percent. 3/ The two largest groups' shares within agricultural and non-agricultural population (respectively, small farmers and the middle class) adjust to sum up to 100.

We next try to account for the within-group inequality. We do this by "elongating" (diversifying) the distribution of the two most heterogeneous and richest classes: urban middle class and nobility. Each is broken into three subgroups (with a Pareto-type distribution within groups, i.e., with population shares decreasing as income goes up) that more or less cover the spectrum of income received by the numerically significant number of people belonging to these classes.[52] For the urban middle class, we use Morrisson and Cheynet's range of three to ten times the unskilled worker's family

[52] What this means is that we do not attempt to include people with extravagantly high incomes—whose wealth is often referred to in the contemporary texts—because such few extremely rich individuals or families are never included in modern household surveys either. This is not only the matter of them being so few that they are unlikely to be randomly selected, or because they might refuse to participate in a survey. The reason why the top-coding of very high incomes is often done in modern surveys is to avoid the results being swamped by a few individuals with enormous wealth and income. The inclusion of a Bill Gates and a few similar individuals in the US survey, for example, could increase the Gini for the United States by a few percentage points. But then their non-inclusion the following year would lead to a recorded drop in inequality which, of course, has nothing to do with real changes.

income, that is 18N to 60N per capita, while the nobility is divided into three subgroups with very high incomes of respectively 300N, 350N and 600N per capita. We then calculate a new Gini with 12 income classes, and obtain a value lying between 42 and 43.5.

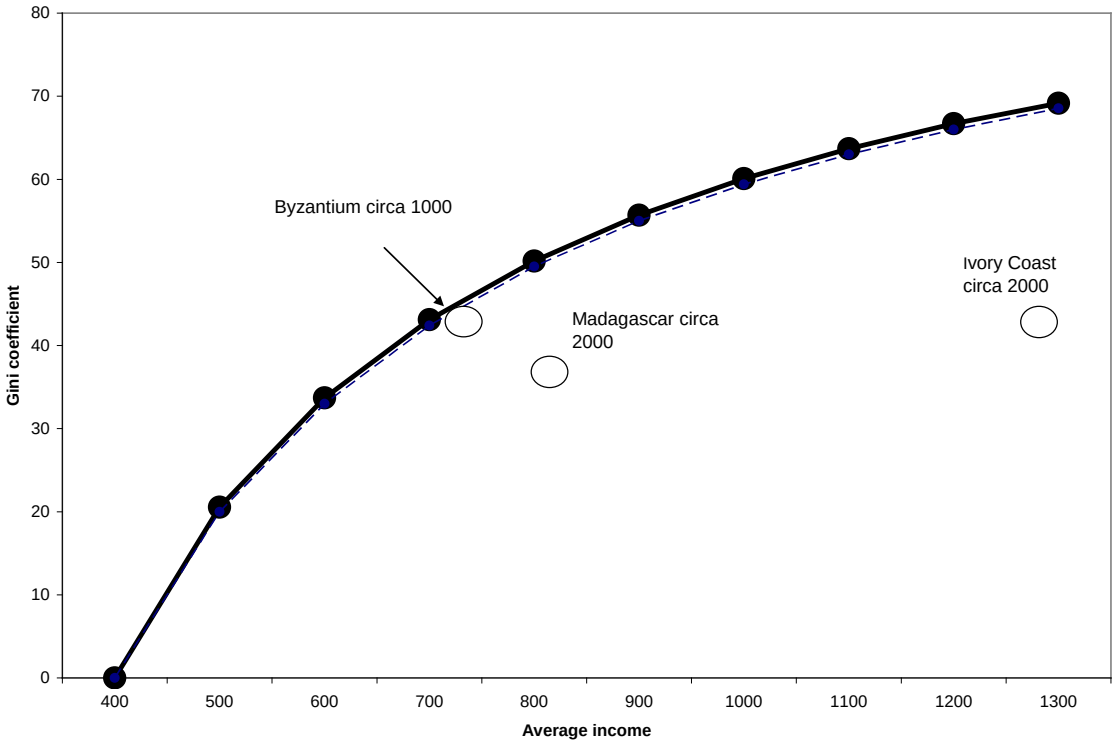
We have mentioned above that low level of mean income places a sort of maximum on the Gini coefficient that we are likely to observe. The reason is easy to explain. Suppose that there is a society with an average income just slightly above the subsistence minimum. If all members of the society are to survive, then the surplus, even if it appropriated by a tiny group of people, cannot be large, and the Gini coefficient must be relatively low. Other measures of inequality must be also low: if, for example, 99 percent of the population live at the subsistence the top-to-bottom decile ratio cannot be very high. As mean income grows, of course, there is more of a surplus to distribute and inequality may grow as well. Figure 1 shows our Byzantium results within such a context. On the horizontal axis we measure mean per capita income which ranges from the subsistence minimum ($PPP 400) to three times that much. On the vertical axis is the maximum Gini coefficient compatible with a given level of mean income and with either 99 percent, or 99.9 percent, of the population living at the subsistence and, respectively, 1 percent or 0.1 percent receiving (and sharing evenly) the surplus. We can call this schedule "the inequality frontier."

As can be seen, the estimated level of inequality in Byzantium is fully compatible with inequality that would have obtained if 99 percent of the population were living at the subsistence and one percent shared the entire surplus (evenly). [53] In conclusion, this means that even if a Gini coefficient of 41-43 does mot seem extremely high by today's standards (where many Latin American countries have Ginis exceeding 50), one need to take into account the fact that the average level of income was much lower then, and the surplus much smaller. The Byzantium inequality, viewed through such a lense, seems to

[53] Our counterfactual (e.g., 99 percent at the subsistence, 1 percent takes the surplus) is a highly stylized one. In the real world, incomes will be more finely graduated, and thus inequality even among people whose incomes are barely above subsistence will also contribute to the Gini.

have reached the ceiling.[54] To illustrate this, we contrast within the inequality frontier framework Byzantium with modern-day relatively poor countries of Madagascar and Ivory Coast. In the latter two, inequality even if high by contemporary standards is well below the inequality frontier. In Byzantium, it was at the frontier.

Figure 1. Inequality frontier (maximum Gini) for different average income levels



Note: Broken line calculated with the assumption that 99% of the population lives at the subsistence and 1% shares the surplus; the full line, calculated with the 99.9% and 0.1% assumptions. Sources: Byzantium: see the text. Madagascar and Ivory Coast: income levels from Maddison (2004); Ginis from World Income Distribution (WYD) dataset developed by Milanovic (2005).

[54] For example, if average income is $PPP 10,000, then a distribution rule by which the entire surplus is appropriated by 0.1 percent of the population, would yield a Gini coefficient of 96. Thus, while Byzantine inequality, was "maxed out" , Latin American inequality could be said to have "used" only about a half of the maximum inequality (Gini of 50 over 96) compatible with a mere survival of the population.

7. Conclusions

We had two objectives in this paper: to come with a plausible estimate of Byzantine average income at the time of the Empire's economic and political peak around the year 1000, and to estimate the level of inequality at the same time. Both objectives were motivated by broader questions: first, what is the maximum income level that pre-industrial societies, at their most advanced stage, could achieve, and second, what level of inequality they could sustain? On the first question, we estimate Byzantium's income level to have been slightly under $700 at 1990 international prices with the plausible range being from $PPP 680 to $PPP 770. This is estimated to be some 20 percent less than the average Roman income at the time of the Principate. A further implication of these calculations is that a realistic maximum income that could be envisaged for the pre-industrial societies might be a bit more than twice the subsistence minimum, or around $PPP 1000 (at 1990 international prices).

On the second question, we find that even at this very modest (from today's rich world's perspective) income level, income inequality was comparable to what it is in today's more unequal societies. For Byzantium in the year 1000, we get a Gini estimate just short of 45 which is a level of inequality somewhat higher than in today's United States or Russia but less than in South Africa or Brazil. This is a level of inequality quite close to what is the maximum inequality that can exist at the estimated Byzantine average income—compatible of course with a guaranteed subsistence minimum for all. Thus it would seem that sizeable inequality must appear at a fairly low level of average income—perhaps as soon as the mankind crosses the threshold of subsistence.

These results indirectly open up the issue of the Kuznetsian process of inverted U curve that inequality supposedly charts as country's income rises. Even if it is true in terms of recorded inequality, the underlying social reality is entirely different. In one case—at a very low average income—even a relatively modest Gini will mean that the surplus is appropriated by a tiny fraction of the population. Inequality would have been at its feasible peak. An increase in inequality as income goes up is therefore compatible, somewhat paradoxically, with a (socially) less concentrated acquisition of income: the

underlying social reality may be less inegalitarian even if the Gini coefficient is greater.

Finally, a methodological point is, I think, worth making. Reconstruction of income statistics and estimate of average per capita income for ancient societies is likely to remain extremely complex and subject to a large margin of error. Our approach relies on somewhat firmer and more easily obtainable data. It is based on finding the data on nominal wages and expressing them in terms of the subsistence minimum. This real wage in the Ricardian sense must bear a certain relationship to mean income of a nation. We have assumed Bairoch constant here, but lower ratios could also be envisaged. Whatever the case, the estimated mean income should be then double-checked against the plausible data of "political arithmetick" kind which should list estimated average incomes and population shares of key social classes. This not only provides a check on the mean, but gives us an insight into the extent of inequality because the bulk of it was, in the strongly hierarchical societies of the past, accounted by the differences between, rather than within, classes.

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