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AN ESTIMATE OF AVERAGE INCOME AND INEQUALITY IN BYZANTIUM AROUND YEAR 1000

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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 640-720 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.

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

The period of tenth and eleventh century was the peak of Byzantium's economic and political power. Politically Eastern Roman Empire stretched almost as far as it did under Justinian. It controlled all of Anatolia, parts of the Middle East, the southern side of the Crimea, the Balkans, and the Southern Italy. It thus stretched from Bari in the West to Caucasus in the East, from Cherson in the Crimea to Antioch in the Middle East. The only territory that was lost compared to the Justinian's Byzantium was Northern Africa. 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 to lead to the gradual weakening and ultimately the destruction of the Empire some four and a half centuries later. Indeed as Byzantium were in the later years to grow weaker, it would first lose its Italian possessions, then most of the Anatolian plateau, then Serbian and Bulgarian kingdoms would wrest independence, so that at the very end Byzantine's writ would be limited to Constantinople and a few enclaves in the Peloponnesian and Morea.

Basil II's time was also the 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

[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).

an economic recovery. Indeed, some aspects of the military-political stabilization and expansion had direct economic consequences. Increased security within the frontiers of 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 his novel (law) of 966, 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, as we shall briefly survey below, Byzantium was the richest state in the western world (and possibly in all the world) at the cusp between the tenth and eleventh century. It is thus important 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 abut 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 societies. Fourth, the period up to the mid-11th century represents the end of

[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).

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.[5] 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.

Per capita income of Eastern Roman Empire or Byzantium was certainly higher than income of all neighboring countries with the possible exception of (some) Arab dominated areas. 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." Byzantine's income was higher than that of Western Europe (as testified by the impression that Constantinople made on Western visitors). It was certainly higher than the income of the neighboring regions in the Balkans that see-sawed between being independent and being parts of the Empire (or at least Byzantine Commonwealth)[6] like Bulgars, Serbs, Hungarians, Pechenegs or Russians. It was surely higher than the income of Turkic tribes that were beginning to encroach on Byzantine eastern regions. In the rest of the world, the comparators could be China, India and the pre-Colombian American civilizations, [7] in particular the Maya for whom this period represented the pinnacle of their classical period. But obviously for them, we have no data that may help us even guess what the average income levels were.

One needs to distinguish wealth from income however. It is likely that the advantage of Byzantium compared to the European West in terms of wealth was greater than in terms of income. So the exclamations of admiration and dazzlement by the Westerners need to be placed in their context and somewhat discounted, not solely because of high income differences within the Empire (so that nobles' wealth meant little

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[5] See Kaplanis (2003).
[6] See Fowden (1993).

to an average citizen) but more because of the probably much higher average wealth-to-income ratio in Byzantium compared to the West. This for the following reasons. Wealth is by definition the product of saving and plunder. Since Byzantine incomes were during a very long period after the dissolution of the Western Roman Empire, higher than the incomes in Western Europe, the accumulation of saving must have also been greater. One needs to add to this that Constantinople in particular benefited from its position of imperial capital, due to the huge construction works (circuses, palaces, acquaducs, churches) undertaken most famously by Constantine, Justinian and Basil I, but also from the state-sponsored plunder of other cities and regions that Constantine ordered to embellish his new capital and make it equal if not greater than Rome. Therefore the accumulation of treasures, acquired from gifts, plunder, purchase etc. in Constantinople must have been, as indeed we are told by the contemporary sources, impressive. However these non-income yielding treasures like tapestries, paintings, jewels etc. had but a very scant relevance for the standard of living of an ordinary Byzantine. Perhaps ideally we should impute some income in kind to the citizens of Constantinople and other large cities from more hygienic environment than probably found in Western Europe, access to more nicely decorated public spaces or to libraries. But these are small amounts and therefore differences in wealth between Byzantium and the West, and in particular differences in ostentatious wealth, should not mislead us to believe that differences in income were of the same magnitude.

Constantinople was, as was Rome of the earlier ages, the world emporium, the place which attracted foreign traders and where all kinds of foreign and exotic goods could be purchased. Largely, this was due to the position of Constantinople straddling the road to the Orient and to the luxury products (like silk and spices) that have chronically fed the trade deficit of the West in relation with the East. But it was also due to the use of more developed agricultural techniques compared to their neighbors, stronger role of the state and thus stronger military, and perhaps better education (literacy) of its population compared to the neighboring countries. In the cultural sense Byzantium was the center of

[7] Maddison (1998, p. 16, note 3) in his historical study of the Chinese economy, assumes that China and Roman Empire were at the same level of income in the year AD 1.

the Western world not only because it was the center of active Christianity but also because its language (which since Justinian moved more and more toward Greek exclusivity) was the language of the Bible, as well as of Greek neo-Platonists and was thus the *lingua franca* of all intellectual and cultural exchange. Byzantine Greek-speaking missionaries spread Christianity to the East and Central Europe, covering the vast region from today's Azerbaijan to Bohemia. The conversion of the Rus to Christianity in 988 and of Hungarians in the year 1000 were important milestones on that road. Finally, in keeping with Byzantium's role as the main trading area, its solidus played the role of the international medium of exchange practically uncontested until about eighth century (see Vryonis, 1967, p. 21) when it began to share it with the Arab-minted dinar, and continued doing so until the end of the eleventh century (see Lopez, 1953).

In conclusion, Byzantium around the year 1000, by being the richest and leading nation of the West, fulfilled all the functions which we have come to expect from a global hegemon: it was the trading center, its currency was the store of value ("the dollar of the Middle Ages" as dubbed by Lopez (1951)) and the medium of exchange internationally. Its language was the *lingua franca* of commerce and science, while its cultural influence on large areas of the world fashioned the prevailing ideology of the times. Thus around year 1000, its position was no different in substance—although it might have differed in scope—from that played by the Augustan Rome about a thousand years earlier, or that played by the United States one thousand years later.

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. Fourth, we derive an estimate of average income based on the rules that "convert" daily or monthly wages into average national incomes,

and then perform several additional checks to verify how thus calculated income relates to other pieces of macro evidence. Fifth, we find the current dollar value of the subsistence minimum. Sixth, we convert the average income (expressed in terms of the subsistence basket) into current dollars. These steps can be written as follows:

$$B_l = \sum_i B_{i,n} * P_{i,l} \quad \text{(step 2)}$$

$$w_b = \frac{W_l}{B_l} \quad \text{(step 3)}$$

$$y_b = F(w_b) \quad \text{(step 4)}$$

$$B_\$ = \sum_i B_{i,n} * P_{i,\$} \quad \text{(step 5)}$$

$$y_\$ = y_b * B_\$ \quad \text{(step 6)}$$

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, 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), y_b = income expressed in terms of SMs, F(.) = conversion function of wages into incomes, $B_\$$ = 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 conversion of the subsistence minimum into today's prices cannot involve a major error—simply because 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 a hierarchical society like Byzantine, this is a reasonable assumption.

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. [8] 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.[9] 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 requirement were significantly greater than the average per capita consumption.[10]

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 intake in 1776 was almost twice as generous while the rest seems very similar. [11]

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

[9] 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.)

[10] 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.

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

While the military ration were 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. [12] 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.[13] 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.[14] 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. [15]

[12] 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).

[13] This is calculated taking the following assumptions (from Allen, ND, p.38). 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.

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

[15] According to Allen (ND, p. 22), 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 writes 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.

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 (top of page 871).
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. In the Morrisson-Cheynet (2002, p. 870) summary of military rations, wheat prices are given as 1/30N per modios. This, according to the data given in their Table 5 (p. 822), must refer to a much earlier period (6th century) or to Egypt where wheat prices were historically lower. Harl (1996, p. 283) gives wheat prices in Justinian's time as 1/30N. However, for the second half of the 10th and the first half of the 11th 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) also 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. Runciman (1964, p.175) gives the price of 1 modios of wheat (from 960 until 1214) as 1/8 N. According to Brehier (1976, p. 193; who quotes Andreades 1924), the price of one modios of wheat in the 10th century was 1/10N. Laiou (2002d, p. 721) quotes a contemporary source from 960 writing at the time of dearth of bread who states that after the government decided to prohibit merchants from stockpiling wheat and driving its price up, the price of one modius fell to 1/7 or 1/8 N. Finally, according to Laiou (2002e, p. 1138) grain prices were stable between ninth and late eleventh century. Therefore, the range of "normal" prices is from 1/15 N to 1/8N; we use the mean of this range (1/12N).

None of these two rations include anything but food. There are at least two 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 whose food consumption consisted only of the bare essentials. Accordingly, we shall increase both the AMB and SM by some 10 percent to reflect the housing and clothing needs.[16] This therefore yields an average minimum standard of expenditures of about 6.5N per year, and the subsistence minimum of about 3.8 N per year. The latter amount is crucial because we shall argue that no person can subsist on less than 3.5-3.8N per year.

The implication is then that a "modest" wage of 9-12N was sufficient to buy between 2.6 and 3.4 food subsistence minima, and less than two more generous adult AMB baskets. A family of four individuals[17] would need more than one earner just to survive at the barest minimum. [18]

Other wages

An indirect evidence on the level of wages is provided by slave prices. Morrisson and Cheynet (2002, p. 847) give the price for an adult Greek male slave in the year 962 as 30N and the price of an adult Muslim prisoner "before year 1000" as 33-1/3 N. Assuming that the buyers expected the slave to work for at least 15 years, and the rate of

[16] Marx (1976, vol. 1, Part 7, Chapter 23) 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 (ND, p. 23) increases on 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).

[17] 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.

[18] This conclusion differs from the one made by Morrisson and Cheynet (2002, p. 872) who write that "one nomisma seems to have represented the normal monthly wage for an unqualified (and unfed) worker which was certainly sufficient to feed and even clothe a family."

interest of 6 percent per annum, [19] this gives an expected annual yield (gain) of 3.3 nomismata. This, in turn, means that, assuming the slave's costs of subsistence to be around 6N, the equivalent wage that would have to paid had the work been market-based, would have been 9.3N which is close to the amount of 10 to 12N estimated by Morrisson and Cheynet to be the average unskilled wage.[20] Secondly, the surplus rate earned on the slave (yield divided by costs) was therefore around 55 percent (3.3N divided by 6N) which is high but does not seem unreasonable. For example, in a study of the 19th century Mauritius, Chenny, St.-Amour and Vencatachellum (2004, p. 429) find that the average male slave's price was about 300 piasters. Using the same assumptions as above, this gives an annual yield of a little over 30 piasters while the average wage for an unskilled job done by a freeman was 144 piasters per year (Chenny et al, 2004, p. 436, fn). The surplus rate earned on slaves was therefore 26 percent (30 over 114).

Morrison and Cheynet (2002, p. 865) provide some additional evidence regarding different wages. In the 10th 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.[21] 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

[19] Six percent is a reasonable discount factor. Justinianistic scale of interest was 4, 6 and 8 percent. Later, legal interests rates were set at 4, 6 and 8 nomismata per pound of gold thus ostensibly preserving Justinian's numbers while effectively bringing about an increase in interest since a pound of gold consisted of 72 N. In percentage terms, interest was thus 5.5, 8.3 and 11.1 percent (see Laiou, 2002e, p. 1130, fn). Finley (1985, p. 104) also uses 6 percent p.a. as the average interest to convert wealth into annual income flows.

[20] This is based on the following calculation. Purchase of a slave is like any other investment. Then its price (P) must bring a yield (Y) commensurate with a yield in alternative investments. Consequently

$P = \sum_{i=1}^{n} \frac{Y}{(1+r)^i}$ where Y = yield is the difference between a market wage and the subsistence which the slave is paid, n = estimated number of years during which slave will work, and r = interest rate. Since in the example here, yield works out to be 3.3N, and the minimum for a working adult was estimated above at 6, then the commensurate wage (for slave's work) would have to be 9.3 N..

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

Empire was organized) were paid between 5 and 10 pounds of gold, or between 360 and 720N, annually. [22]

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*. [23] 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.

[22] 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.

[23] 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*. The top-to-bottom ratio was thus more than 200-to-1.

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

	Amount in nomismata per year	Calorie intake
Unskilled wage or pay of an ordinary soldier (inclusive of benefits in kind)	9-12	
Money equivalent of a soldier's food ration	6.5	3700
Soldier's food ration plus housing and clothing costs (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,[24] and assuming the "modest" wage to have been 10N per year (an approximate average between 9N and 12N), gives the average per capita income of about 6 N 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.[25] 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.[26] This is a fairly sensible number.

[24] See Goldsmith (1984, p. 279, footnote). According to Goldsmith, however, Bairoch's "200 rule" (derived from the European data from the 18th and 19th century) 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.

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

[26] Assuming aleternatively 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.[27]

Another way to convert these amounts is to use gold as the numeraire. This, as we shall see, is the approach used by Maddison (2001, 2003) when he converts the calculations of Augustan Rome's income presented by Goldsmith (1984) into the 1990 $PPP values. One pound of gold was equivalent to 72 N (see Laiou, 2002e, p. 1139).[28] The average per capita income of 6 N per year is equal to 0.08 pound of gold or to about 36 grams of gold. In 1990 prices, the dollar equivalent of 36 grams of gold was worth about $500. [29]

In summary, we have two direct conversions of the estimated Byzantine average income. They are $PPP 500 and $PPP 680 in international dollars of 1990.

But possibly the best and most interesting way of converting Byzantine incomes into today's PPP incomes consists in comparing incomes in Byzantium with those in Rome. That approach presents some advantage because of a similar composition of consumption in the two countries. 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. We thus turn to a review of several existing calculations of average incomes in Augustine Rome.

[27] The physiological minimum "sufficient to sustain life with moderate activity and zero consumption of other goods" (Bairoch, 1993, p.106) was taken to be $PPP 80 at 1960 prices (Bairoch, ibid). Taking US consumer price index to convert international dollars yields $PPP 355 at 1990 prices We round it off to $PPP 400.

[28] This was the ratio established by Constantine when he minted his *solidus*, and it remained practically unchanged until the middle of the 11th century.

[29] The 1990 average London gold price was $385 per ounce or per 28 grams of gold (see IMF, International Financial Statistics).

5. Comparison of Roman and Byzantine average incomes

Table 3 compares military rations (AMB) in the 10th century Byzantium and Augustine 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.[30] For meat, Harl (1996, p. 456) quotes soldiers' daily ration of ½ pound of pork. This is exactly the same as the meat ration in Byzantium. [31] 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 the 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 22 liters per person which is again comparable to some 34 liters per adult male in Byzantium. [32] 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.

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.[33] The *alimenta* payment amounted to 180 sesterces (HS) annually.[34]

[30] Harl (1996, p. 271) also holds that in Rome an adult male consumed about 2 pounds of bread daily.
[31] Although one might wonder whether this is an underestimate since this amount was only 80 percent of the daily meat *annona* granted to plebeians by Aurelian (see Hart, 1996). One would have expected that the soldiers would get at least as much as urban proletariat.
[32] 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.

We see in Table 4 that the average annual per capita consumer expenditures in Rome, estimated by Goldsmith (1984) to have been 350 sesterces, are equal to about two subsistence minima (the Roman *alimenta*).[35] Similarly, the average wage was estimated by Goldsmith (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 2.6 and 3.4 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 2/3 and 4/5 of Roman average wage.

Similar ratios obtain for average incomes. As already explained, Goldsmith has estimated the average per capita income in Augustan Rome to have been 380 HS per annum. 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. We thus find about a similar relationship to hold (not surprisingly) between Roman and Byzantine average incomes as between their average unskilled wages. Byzantine average income was about 20 percent lower than Roman.

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[33] Alimenta was state payment for poor young boys (supposed, as the name implies, to cover their food needs) introduced under 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).

[34] 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.

[35] 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.

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. 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 Davies, *Service in the Roman Army*, pp. 191-96.

But how much were Roman and Byzantine average incomes expressed in today's $PPP values? We have several estimates for Rome since a number of authors have tried to convert Roman incomes into present-day equivalents. Consider first Goldsmith's estimate which is the most recent and which is thought by Maddison (1998, p. 16, note 3) to be "an extraordinary erudite, ingenious and ambitious attempt to estimate total and per capita income in the Empire at the time of Augustus." Maddison's (2001, 2003) estimate of Roman incomes was explicitly based on Goldsmith's calculations. Goldsmith expressed 380 HS into gold-equivalents. This is worth about 31 grams of gold per person p.a. Gold-equivalent incomes of countries that might have been thought to be at a similar level of development as the Augustan Rome were 17 grams for the mid-19th century India, 27 grams for the mid-19th century Brazil, 70 grams for England in 1688 and 100 grams for France in 1820. Using Maddison's data for $PPP incomes of these counties and years, Roman income of 31 grams of gold can be variously interpreted to have amounted to between $PPP 352 and $PPP 971 (Table 5). Maddison then appears to select England as the valid comparator and sets Roman incomes at around $PPP 500. There are two problems with this approach.

Table 4. Comparison of Augustine Roman and 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

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 legionnairies' pay in the period around the year 100.
All Roman data are from Goldsmith (1984) unless explicitly stated otherwise.

Table 5. Conversion of Roman incomes into modern PPP equivalents

(1)	(2)	(3)
	Income expressed in gold (grams)	Income in 1990 $PPP
I. Gold-equivalent estimates		
Rome (under Augustus)	31	---
India (mid-19th)	17	971
Brazil (mid-19th)	27	787
England (1688)	70	531
France (1820)	100	352
In 1990 gold prices 1/		426
II. Goldsmith's estimate of HS 380 (with various PPPs)		
Goldsmith's income estimate (with Goldsmith's own estimate of PPP based on Clark's estimate of purchasing power of the HS in the 4th century) 2/		1742
Goldsmith's income estimate (with Clark's estimate of purchasing power of HS around year AD 1) 3/		2370
Goldsmith's income estimate (with Finley's estimate of purchasing power of HS) 4/		2500
III. Direct SM-based estimate (here) 5/		840
Average (excluding the implausible extremes)		882

1/ 1990 average gold price was $385 per ounce.
2/ Goldsmith's estimate of the purchasing power of the sesterce in the year 1 (based, in turn, on Clark's estimate of the sesterce's purchasing power in the Diocletian time) is $PPP 0.5 in international dollars (or more exactly in Clark's International Units) at 1925-34 prices. Goldsmith then translates this (1984, p. 280, fn. 80) into $PPP 3.5 at 1983 prices. Indexing further for US CPI inflation between 1983 and 1990 (31 percent), converts Goldsmith's estimate of 380 HS into $PPP 1742 at 1990 international dollars.
3/ Clark (p. 662) gives a direct purchasing power estimate of 1 drachma around year 18BC, the nearest date to year 1, to be 0.68 IU (in 1925-34 prices). Applying the same conversion as before to get to 1990 international dollars, yields $PPP 2370. For the exchange ratio between HS and the drachma see the note in the text.
4/ Finley estimates the purchasing power of HS to be $PPP5 at 1983 prices (see however footnote 40 below).
5/ From Table 3 (2.1 subsistence minima each valued at $PPP 400).

First, the use of gold-equivalent expresses real amounts of goods and services (and in particular food which accounts for the bulk of expenditures) in terms of one commodity—gold—whose relative price is, of course, subject to variation. There is no reason why gold should be a better standard of value than any other commodity. One can as well, or even more reasonably, use a wheat standard of value and express all nominal values in units of wheat. [36]

Second, even if one were to accept an unchangeable gold standard, there is no reason why out of the four countries given by Goldsmith, England should be selected as a the only comparator. If we use an unweighted average of the four countries given by Goldsmith, Roman incomes work out as $PPP 660, some 20 percent higher than if we use England only.

We can now move to several additional estimates.[37] First, by using directly the 1990 gold prices, we obtain that Roman incomes were equal to $PPP 426. Then, we move to various estimates which all use Goldsmith's direct income estimate expressed in local currency (Table 5). One: we use Goldsmith estimate, apply to it Goldsmith's own estimate of the purchasing power of the sesterce, [38] and get, converted into 1990 international price, an income of $PPP 1742. Two: we take Goldsmith's HS estimate, apply to it Clark's estimate of the purchasing power of the drachma, take the exchange rate between the (non-Egyptian) drachma and HS at the time of the Principate to be 1

[36] Clark (1957, p. 657) for example shows this to be one of the ways in which Roman incomes could be converted into modern-day equivalents. He notes (quoting Runciman) that while the gold price of wheat was the same in the 15th century Byzantium and in the early 20th century Greece, the relative prices of other goods (expressed in wheat or gold) had gone down.

[37] Goldsmith also mentions Clark's direct estimate of Roman incomes. However, this is mysterious. Goldsmith (1984, p. 280, fn. 80) writes that Clark (p. 552) has estimated the average Roman income at the time of Diocletian at 181 international units in prices of 1925-34. There are several problems with that statement. First, the correct reference should be to the page 664, and not page 552. Second, Clark's estimate refers to a food basket of the AMB type, not to average incomes or expenditures, that is, it refers to *notional*, not actual, expenditures. Third, it refers explicitly to a basket per *adult*, not per capita. I have thus decided not to include this estimate.

[38] Itself based on Clark's purchasing power estimate.

drachma = 1 HS, [39] and get an implausibly high income of about $PPP 2370 (at 1990 prices). Three: we use again Goldsmith's local currency estimate, and apply to it Finley's (1973 edition, p. 104; quoted in Goldsmith, p. 280, fn. 80 [40]) generous estimate of the purchasing power of the Roman sesterce, to obtain the highest estimate of $PPP 2500. The last estimates is, almost certainly, off mark. The PPP number given by Finley is (as mentioned in the footnote below) merely a rough illustration of the order of magnitudes, not at all an estimate. We can therefore safely disregard it.

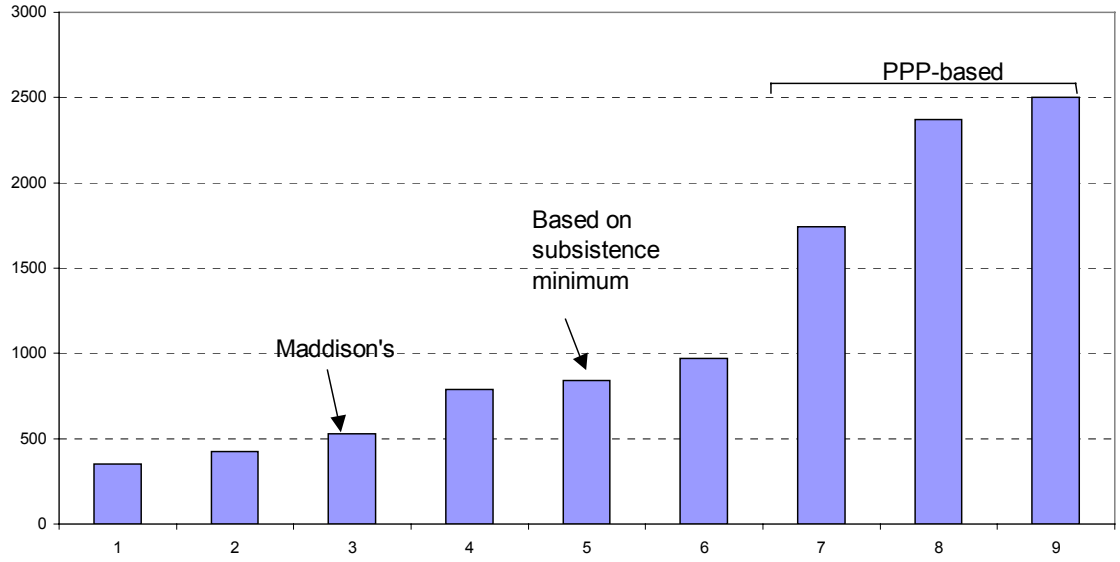
Finally, if we use our direct estimate of Roman incomes based on its relationship to the subsistence minimum from Table 4 and the price the subsistence minimum in 1990 prices, we get our final estimate of $PPP 840.

We can see (Figure 1) that all three direct PPP estimates yield much higher amounts than other estimates. If, after disregarding the Finley "estimate", we also eliminate the two extreme—highest and lowest—estimates, the mean is $PPP 880 and the median lies between $PPP 787 and $840. Both however are still significantly higher than the value selected by Maddison.

[39] The conversion is based on the following text from Harl (1996, p. 98): "Silver currencies in the East were premised upon one of three standards. In the most widely used standard - known as the Attic or, in Siria, as the Tyrian - a silver drachma equaled the denarius so the principal stater, a tetradrachma, was exchanged against 4 Roman denarii. Next in popularity was a drachma at three-quarters of the denarius whereby the tetradrachma was valued at 3 denarii. This lighter standard went under various names - Rhodian or cistophoric in Asia Minor, Antiochene in Syria. In Egipt, a more debased standard prevailed and Claudius in A.D. 41/2 tariffed the drachma at one-quarter of a denarius, so that the tetradrachma was equal to 1 denarius." I am using the first exchange rate. With the second (4 drachma = 3 HS), Roman incomes would be even higher. I am grateful to Mihail Arandarenko for the discussion of the drachma-denarius (HS) exchange rate.

[40] I am unable to find this reference in my copy of Finley's book (1985, Penguin's, the second edition). There is, on page 104, an off-hand comparison between the past and modern incomes which—if taken as an estimate rather than as an illustration (which I think it is)—gives 1HS to be equal to a little less than $3 at undisclosed prices (presumably 1973 prices because that was the date of the book's publication). Goldsmith seems to have used this off-hand illustration as an estimate.

Figure 1. Comparison of various estimates of average Roman incomes around year AD1



Note: Incomes expressed in international Geary-Khamis dollars of year 1990. Source: Table 5.

In the final step, if we settle on Roman Augustan incomes of between $PPP 800 and $PPP 900 per person per year, then—since the Byzantine average income around the year 1000 was some 20 percent less—it follows that Byzantine income was between $PPP 640 and $PPP 720 per capita per year. This is consistent with $PPP 680 that we obtained before using a direct ratio between the average income and the subsistence minimum and pricing the minimum in 1990 prices.[41]

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 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. Their average incomes too must have ranged between one and two times the subsistence minimum.

[41] Note that these are two independent methods of estimation.

Average income levels also set an upper boundary on inequality. With an average income close to 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.[42] As societies develop, income inequality has the "space" to grow simply 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, the Middle East and most of the Balkans was estimated by Treadgold (2001, p. 236) to have been 12 million, by Andreades 15 million, and by Harl 18 million.[43] [44]

[42] Kuznets (1966, 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."

[43] 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. Note that according to Beloch's population study (quoted in Maddison, 1998, p. 16), around year 1, population in what later became the Byzantine Empire was 19.5 million. I suppose that it includes African possessions which were no longer held by Basil II, so it seems that the population over the area that belonged to Byzantium of the year 1000 was about the same as under the Roman Empire in the year 1. According to Treadgold (2001, p. 236), Byzantium's population around year 300 was 21 million, that is significantly larger than during Basil II reign. (The territory too was larger in 300.)

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

Some 90 percent of Byzantium's population was rural. [45] [46] 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). The 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.[47] 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

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.[48] [49] 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

[45] For Augustian Roman Empire, 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.
[46] According to George Plethon, a cameralist political economist and adviser to the despot of Morea in the early 15th century, the Byzantine society is divided into three classes: those who labor in the fields, those who provide services (merchants, artisans, workers) and the rulers (see Laiou, 2002e pp. 1139-40).
[47] Or even more if one takes a higher population estimates for Constantinople like the one by Harl cited above.
[48] See Ostrogorsky (1969, p. 291).
[49] "Unjust" price was deemed to be less than one-half of "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."

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 the state 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 smaller workforce." (p. 242). [50] 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.[51] The landholdings are assumed to be 80 *modioi* (10 ha) for both tenant and small farmer.[52] Both farms generate total output of 20N per annum with production costs of 5.2N. This gives gross income of

[50] 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).
[51] Harvey (1989, p. 36) gives the same social clasification in rural areas: slaves, wage laborers, independent peasant farmers and large landowners.
[52] This is consistent with Harvey's (1989, p. 54) statement that the average landholding was about 80 to 100 *modioi*.

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 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 clearly these additional sources were probably just sufficient to put them barely at the subsistence level (3.5N per annum). [53]

The situation is, of course, different with the large landowner. He is assumed by Lefort to own 800 hectares of land (80 times as much as the small farmer) and to produce an annual output valued at 1000N. [54] The large landowner, of course, leases these lands, and receives as rent ¼ of output value, i.e. 250N. 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, and thus his net income is 87N per year.[55] Even assuming that the large landowner has no other sources of income, and that his family size is also 4.3 persons, per capita income is about 20N per year, or more than five times as much the income of an average farmer.

[53] Ostrogorsky (1951, p. 97) looks at rural income differentiation through the lens of data on taxes paid by the families who joined the Chilandar monastry 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 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, inequality does not appear to be very high.

[54] The efficiency of production (yields) are assumed the same on all types of lands (farmer's, tenant's, large landowner's). It is then strange that the large landowener who owns 80 times more land produces only 50 times more than the small farmer. It may perhaps be explained by economies of scale.

[55] 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.

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 (200d, p. 745) estimates that in the period of the expansion (10-12 century), nonagricultural sector contributed 25 percent of the 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 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.[56]

[56] 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.

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.[57] [58] 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 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 7 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 quite similar: all were around the subsistence minimum. For large landowners, we take Lefort's estimate of 20N per capita. Thus the overall average rural income works out to be around 3.9N per capita per year—barely above the subsistence minimum (this

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[57] 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. Treadgold (1997) believes 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.

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. For the urban middle class, we use the lower bound of the Morrisson and Cheynet estimate and put their average income at twice the income of workers' families, that is 12N per capita p.a. 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 workers. [59] This yields an average non-agricultural income (excluding nobility) of between 8 and 9.6N per capita (depending on the assumed shares of the middle class vs. workers). In conclusion, urban incomes appear to have been between two and two-and-a-half times higher than 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 6N and 6.17N 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 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.

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

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

Table 7. Estimated average income by social class and inequality

Per capita income by type of family	% 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*	59-69		52-61	3.8	1.1
Large landholders	1		1	20	6
Total agricultural	***100***		***90***	***3.9***	***1.1***
Marginals and beggars		10-20	1-2	3.5	1
Workers		20-30	2-3	6	1.6
Traders, craftsmen (middle class)*		34-57	3.5-5.5	12	3.2
Army (ordinary soldiers)		10	1	6.5	1.6
Total non-agricultural (excl. nobility)		***94-97***	***9.5***	***7.7-9.3***	***2.2-2.7***
Civilian and military nobility		3-6	0.5	350	100
Overall income				***6-6.1***	***1.7-1.8***
Gini (in percent)					40-41
Urban-rural income ratio (excl. nobility)					2-2.5

1/ Agricultural population is assumed to account for 90 percent of total population. 2/ All percentages rounded off to ½ percent.

* 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.[60] For the urban middle class, we use Morrisson and Cheynet's range of two to ten times the unskilled worker's family income, that is 12N 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 43 and 45. Note that Goldsmith (1984, p.276, fn. 63) quotes Pareto's calculation of Rome's Gini to have been 50, an amount higher, but not too much so, than what we estimate here for Byzantium.

It is thus remarkable how both income and inequality seemed to have changed little over the previous millennium. If indeed Augustine Rome and Basil's Byzantium were within some 20 percentage points of each other in terms of income, they were closer (in the relative sense, and of course much more so in the absolute sense) than are the United States and Western Europe to each other today. In terms of inequality too, they were very similar with Byzantium being probably a shade less unequal. But then again, this is a tiny difference, much less than the difference between the United States and Brazil today.

[60] 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 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.

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 640 to $PPP 720. This is estimated to be some 20 percent less than average Roman incomes at the time of Principate. A further implication of these calculations is that a realistic maximum income that could be envisaged for pre-industrial societies might be about twice the subsistence minimum, or less than $PPP 1000 (at 1990 international prices). This is an income level that we can still encounter today in the poorest countries of the world. Thus despite all the amazing developments elsewhere, in many parts of the world, humanity may not gone much beyond what was achieved a millennium or two millenia ago. 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 of 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. 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.

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