Ancient Inequality

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Abstract

Is inequality largely the result of the Industrial Revolution? Or, were pre-industrial incomes as unequal as they are today? For want of sufficient data, these questions have not yet been answered. This paper infers inequality for 27 ancient, pre-industrial societies using what are known as *social tables*, stretching from the Roman Empire 14 AD, to Byzantium in 1000, to England in 1688, to Nueva España around 1790, to China in 1880 and to British India in 1947. It applies two new concepts in making those assessments – what we call the *inequality possibility frontier* and the *inequality extraction ratio*. Rather than simply offering measures of inequality, we compare its observed level with the maximum feasible inequality (or surplus) that could have been extracted by the elite. The results, especially when compared with modern poor countries, give new insights into the connection between inequality and economic development in the very long run.

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1. Good Questions, Bad Data?

Is inequality largely a byproduct of the Industrial Revolution? Or, were pre-industrial incomes as unequal as they are today? How does inequality in today's least developed, agricultural countries compare with that in ancient, agricultural societies dating back to the Roman Empire? Did some parts of the world always have greater income inequality than others? Was inequality augmented by colonization? These questions have yet to be answered, for want of sufficient data.

Simon Kuznets was very skeptical of attempts to compare income inequalities across countries when he was writing in the 1970s. In his view, the early compilations assembled by the International Labor Organization and the World Bank referred to different population concepts, different income concepts, and different parts of the national economy. To underline his doubts, Kuznets once asked (rhetorically) at a University of Wisconsin seminar "Do you really think you can get good conclusions from bad data?" Economists with inequality interests are indebted to Kuznets for his sage warning.[1] We are even more indebted to Kuznets for violating his own warning when, earlier in his career, he famously conjectured about his Kuznets Curve based on a handful of very doubtful inequality observations. His 1954 Detroit AEA Presidential Address mused on how inequality might have risen and fallen over two centuries, and theorized about the sectoral and demographic shifts that might have caused such movements. Over the last half century, economists have responded enthusiastically to his postulated Kuznets Curve, searching for better data, better tests, and better models.

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[1] His Wisconsin seminar paper became a classic (Kuznets 1976).

As we have said, Kuznets based his hypothetical Curve on very little evidence. The only country for which he had good data was the United States after 1913, on which he was the data pioneer himself. Beyond that, he judged earlier history from tax data taken from the United Kingdom since 1880 and Prussia since 1854 (1955, p. 4). For these three advanced countries, incomes had become less unequal between the late nineteenth century and the 1950s. He presented no data at all regarding earlier trends, yet bravely conjectured that "income inequality might have been widening from about 1780 to 1850 in England; from about 1840 to 1890, and particularly from 1870 on in the United States; and from the 1840's to the 1890's in Germany" (1955, p. 19). For poor, pre-industrial countries, he had only household surveys for India 1949-1950, Sri Lanka 1950, and Puerto Rico 1948 (1955, p. 20). These are all bad data judged by the standards Kuznets himself applied in the 1970s. They are also bad data judged by modern World Bank standards since those three surveys from the mid-20th-century would now be given low grades on the Deininger-Squire scale assessing the quality of income distribution data (Deininger and Squire 1996, pp. 567-71). Meanwhile, world inequalities have also changed. The mid 20th century convergence of incomes within industrial countries that so impressed Kuznets has been reversed, and the gaps have widened again.

We have reason, therefore, to ask anew whether income inequality was any greater in the distant past than it is today. This paper offers five conjectures about inequality patterns during and since ancient pre-industrial times. First, income inequality must have risen as hunter-gathers slowly evolved into ancient agricultural settlements with surpluses above subsistence. Inequality rose further as economic development in these early agricultural settlements gave the elite the opportunity to harvest those rising surpluses.[2] Second, and surprisingly, the evidence suggests that the elite failed to exploit their opportunity fully since income inequality did not rise anywhere near as much as it could have. While potential inequality rose steeply over the pre-industrial long run, actual inequality rose much less. Third, in pre-industrial times, overall inequality was driven largely by the gap between the rural poor at the bottom and the landed elite at the top. The distribution of income among the elite themselves, and their share in total income, was only weakly correlated with overall inequality. Fourth, ancient pre-industrial inequality seems to have been lower in crowded East Asia than it was in the Middle East, Europe, or the world as settled by Europeans. Only in China (and Singapore) since the 1980s have East Asian national inequalities matched those of other regions. Yet, it was no higher in pre-industrial Latin America than in pre-industrial western Europe. Fifth, while there is little difference in conventionally measured inequality between modern and ancient pre-industrial societies, there are immense differences in our new, less conventional measure: the share of potential inequality actually achieved today is far less than was true of pre-industrial times.

Our data are subject to all the concerns that bothered Kuznets, other economists, and the present authors. Our income inequality statistics exploit fragile measures of annual household income, without adjustment for taxes and transfers, life-cycle patterns, or household composition. None of our ancient inequality observations would rate a “1” on the Deininger-Squire scale. Yet, like Gregory King in the 1690s and Simon Kuznets in the 1950s, we must start somewhere. Section 2 begins by introducing some new concepts that we use for the analysis -- the *inequality possibility frontier* and the *inequality*

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[2] This result resembles Frederic Pryor’s (1977, p. 197 and 2005, p. 40) finding that among remote foraging and agricultural communities an index of wealth inequality seems to rise with an index of “economic development.” The rise in inequality seems to be tied to a rise in “centric” (regressive) taxes and tributes.

extraction ratio, measures of the extent to which the elite extract the maximum feasible inequality. These new measures open the door to fresh interpretations of inequality in the very long run. Section 3 presents our ancient inequality evidence. Section 4 explores the determinants of ancient inequalities and extraction ratios. Section 5 examines income gaps between top and bottom, and the extent to which observed inequality change over the very long run is driven by those gaps as opposed to the distribution of income among those at the top or the top's income share. We conclude with a research agenda.

2. The Inequality Possibility Frontier and the Extraction Ratio

The workhorse for our empirical analysis of ancient inequalities is a concept we call the *inequality possibility frontier*. While the idea is simple enough, it has, surprisingly, been overlooked by previous scholars. Suppose that each society, including ancient non-industrial societies, has to distribute income in such a way as to guarantee subsistence minimum for its poorer classes. The remainder of the total income is the surplus that is shared among the richer classes. When average income is very low, and barely above the subsistence minimum, the surplus is small. Under those primitive conditions, the members of the upper class will be few, and the level of inequality will be quite modest. But as average income increases with economic progress, this constraint on inequality is lifted; the surplus increases, and the maximum possible inequality compatible with that new, higher, average income is greater. In other words, the maximum attainable inequality is an increasing function of mean overall income.

Whether the elite fully exploit that maximum or allow some trickle-down is, of course, another matter entirely.

To fix ideas intuitively, suppose that a society consists of 100 people, 99 of whom are lower class. Assume further that the subsistence minimum is 10 units, and total income 1050 units. The 99 members of the lower class receive 990 units of income and the only member of the upper class receives 60. The Gini coefficient corresponding to such a distribution will be only 4.7 percent.[3] If total income improves over time to 2000 units, then the sole upper class member will be able to extract 1010 units, and the corresponding Gini coefficient will leap to 49.5. If we chart the locus of such maximum possible Ginis on the vertical axis against mean income levels on the horizontal axis, we obtain the *inequality possibility frontier* (IPF).[4] Since any progressive transfer must reduce inequality measured by the Gini coefficient, we know that a less socially segmented society would have a lower Gini.[5] Thus, IPF is indeed a *frontier*.

The *inequality possibility frontier* can be derived more formally. Define s=subsistence minimum, μ=overall mean income, N=number of people in a society, and ε=proportion of people belonging to a (very small) upper class. Then the mean income of upper class people (y_h) will be

$$y_h = \frac{\mu N - sN(1-\varepsilon)}{\varepsilon N} = \frac{1}{\varepsilon}[\mu - s(1-\varepsilon)] \qquad (1)$$

where we assume as before that the (1-ε)N people belonging to lower classes receive subsistence incomes.

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[3] Throughout this paper, we report Ginis as percent and thus here as 4.7 rather than 0.047.

[4] The IPF concept was first introduced in Milanovic (2006).

[5] The reader can verify this by letting one subsistence worker's income rise above subsistence to 20, and by letting the richest person's income be reduced to 1000. The new Gini would be 49.49.

Once we document population proportions and mean incomes for both classes, and assume further that all members in a given class receive the same income,[6] we can calculate any standard measure of inequality for the potential distribution. Here we shall derive the IPF using the Gini coefficient.

The Gini coefficient for *n* social classes whose mean incomes (y) are ordered in an ascending fashion ($y_j > y_i$), with subscripts denoting social classes, can be written as in equation (2)

$$G = \sum_{i=1}^{n} G_i p_i \pi_i + \frac{1}{\mu} \sum_{i}^{n} \sum_{j>i}^{n} (y_j - y_i) p_i p_j + L \tag{2}$$

where π_i=proportion of income received by *i*-th social class, p_i=proportion of people belonging to *i*-th social class, G_i=Gini inequality among people belonging to *i*-th social class, and L=the overlap term which is greater than 0 only if there are members of a lower social class (*i*) whose incomes exceed those of some members of a higher social class (*j*). The first term on the right-hand side of equation (2) is the within component (part of total inequality due to inequality within classes), the second term is the between component (part of inequality due to differences in mean incomes between classes) and L is, as already explained, the overlap term.

Continuing with our illustrative case, where all members of the two social classes (upper and lower) have the mean incomes of their respective classes, equation (2) simplifies to

$$G = \frac{1}{\mu} (y_j - y_i) p_i p_j \tag{3}$$

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[6] This is already assumed for the lower classes, but that assumption will be relaxed later for the upper classes.

Substituting (1) for the income of the upper class, and *s* for the income of lower class, as well as their population shares, (3) becomes

$$G^* = \frac{1}{\mu}\left[\frac{1}{\varepsilon}\bigl(\mu - s(1-\varepsilon)\bigr) - s\right]\varepsilon(1-\varepsilon) \qquad (4)$$

where G* denotes the maximum feasible Gini coefficient for a given level of mean income (μ). Rearranging terms in (4), we simplify

$$G^* = \frac{1-\varepsilon}{\mu}\bigl[\bigl(\mu - s(1-\varepsilon)\bigr) - s\varepsilon\bigr] = \frac{1-\varepsilon}{\mu}(\mu - s) \qquad (5)$$

Finally, if we now express mean income as a multiple of the subsistence minimum, μ=αs (where α≥1), then (5) becomes

$$G^* = \frac{1-\varepsilon}{\alpha s}s(\alpha - 1) = \frac{\alpha - 1}{\alpha}(1-\varepsilon) \qquad (6)$$

Equation (6) represents our final expression for the maximum Gini (given α) which will chart IPF as α is allowed to increase from 1 to higher values. For example, when α=1 all individuals receive the same subsistence income and (6) reduces to 0, while when α=2, the maximum Gini becomes 0.5(1-ε). Let the percentage of population that belongs to the upper class be one-tenth of 1 percent (ε=0.001). Then for α=2, the maximum Gini will be 49.95 (once again, expressed as a percentage), we can easily see that as the percentage of people in top income class tends toward 0, G* tends toward (α-1)/α. Thus, for example, for α=2, G* would be 0.5. The hypothetical IPF curve generated for α values ranging between 1 and 5 is shown in Figure 1.

[Figure 1 about here]

The derivative of the maximum Gini with respect to mean income (given a fixed subsistence) is

$$\frac{dG^*}{d\alpha} = \frac{1-\varepsilon}{\alpha}\left(1 - \frac{\alpha - 1}{\alpha}\right) = \frac{1-\varepsilon}{\alpha^2} > 0 \tag{7}$$

In other words, the IPF curve is increasing and concave. Using (7), one can easily calculate the elasticity of G* with respect to α as 1/(α-1). That is, the percentage change in the maximum Gini in response to a given percentage change in mean income is less at higher levels of mean income.

The *inequality possibility frontier* depends on two parameters, α and ε. In the illustrative example used here, we have assumed that ε=0.1 percent. How sensitive is our Gini maximum to this assumption? Were the membership of the upper class even more exclusive, consisting of (say) 1/50th of one percent of population, would the maximum Gini change dramatically? Taking the derivative of G* with respect to ε in equation (6), we get

$$\frac{dG^*}{d\varepsilon} = \frac{1-\alpha}{\alpha} < 0 \tag{8}$$

Thus, as ε falls (the club gets more exclusive), G* rises. But is the response big? Given the assumption that mean income is twice subsistence and that the share of the top income class is ε=0.001, we have seen that the maximum Gini is 49.95. But if we assume instead that the top income group is cut to one-fifth of its previous size (ε=1/50 of one percent), the Gini will increase to 49.99, or hardly at all. G* is, of course, bounded by 50. For historically plausible parameters, the IPF Gini is not very sensitive to changes in the size of the top income class.

The assumption that all members of the upper class receive the same income is convenient for the derivation of the IPF, but would its relaxation make a significant difference in the calculated G*? To find out, we need to go back to the general Gini formula given in (2). The within-group Gini for the upper class will no longer be equal to 0.[7] The overall Gini will increase by $\varepsilon\pi_h G_h$ where *h* is the subscript for the upper (high) class. The income share appropriated by the upper class is

$$\pi_h = 1 - \frac{1-\varepsilon}{\alpha}$$

and the increase in the overall G* will therefore be

$$\Delta G^* = G_h\left(1 - \frac{1-\varepsilon}{\alpha}\right)\varepsilon \ . \tag{9}$$

This increase is unlikely to be substantial. Consider again our illustrative example where $\alpha=2$ and $\varepsilon=0.001$. The multiplication of the last two terms in (9) equals 0.0005. Even if the Gini among upper classes is increased to 50, the increase in the overall Gini (ΔG^*) will be only 0.025 Gini points. We conclude that we can safely ignore the inequality among the upper class in our derivation of the maximum Gini. Moreover, note that maximum feasible inequality is derived on the assumption that the size of the elite tends towards an arbitrarily small number. That arbitrarily small number can be one (person) in which case, of course, inequality within the elite must be nil. This inference should not imply a disinterest in actual distribution at the top; indeed, we will assess the empirical support for it in section 5.

The inequality possibility frontier can also serve as a measure of inequality with a clear intuitive economic meaning. Normally, measures of inequality reach their extreme values when one individual appropriates the entire income of a community.[8] Such extreme values are obviously just theoretical and devoid of an economic meaning since

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[7] For the lower class, within-group inequality is zero by assumption since all of its members are taken to live at subsistence.

[8] At the extreme in our measure, one individual appropriates all the *surplus*.

no society could function in such a state. That one person who appropriated the entire income would soon be all alone (everyone else having died), and after his death inequality would fall to zero, and that society would cease to exist. The inequality possibility frontier avoids this irrelevance by charting maximum values of inequality compatible with the maintenance of a society (however unequal), and thus represents the maximum inequality that is sustainable in the long run. Of course, those at subsistence may revolt and overturn the elite, suggesting that the subsistence level is itself endogenous to more than just equilibrating Malthusian physiological forces.

3. The Data: Social Tables and Pre-Industrial Inequality

Income distribution data based on household surveys are, of course, unavailable for any pre-industrial society. The earliest household surveys of income and expenditures date from the late eighteenth century in England and the mid nineteenth century in other countries. We believe that some of the best estimates of ancient inequalities can be obtained from what are called *social tables* (or, as William Petty (1676) called them more than three centuries ago, *political arithmetick*) where various social classes are ranked from the richest to the poorest with their estimated population (family or household head) shares and average incomes. Social tables are particularly useful in evaluating ancient societies where classes were clearly delineated and the differences in mean incomes between them were substantial. Theoretically, if class alone determined one’s income, and if income differences between classes were large while income differences within classes were small, then all (or almost all) inequality would be explained by the between-class inequality. One of the best examples of social tables is offered by Gregory King's famous estimates for England and Wales in 1688 (Barnett 1936; Lindert and Williamson 1982). King's list of classes summarized in Table 1 is fairly detailed (31 social classes). King (and others listed in Table 1) did not report inequalities within each social class, so we cannot identify within-class inequality for 1688 England and Wales.

However, within-class inequalities can be roughly gauged by calculating two Gini values: a lower bound Gini1 which estimates only the between-group inequality and assumes within-group or within-social class inequality to be zero; and an upper bound Gini2 that estimates the maximum inequality compatible with the grouped data from social tables assuming that all individuals from a higher social group are richer than any individual from a lower social group. In other words, where class mean incomes are such that $y_j > y_i$, it also holds true that $y_{kj} > y_{mi}$ for all members of group *j*, where *k* and *m* are subscripts that denote individuals. Thus, in addition to the between-class inequality component, Gini2 includes some within-class inequality (see equation 2), but under the strong assumption that all members of a given social class are poorer or richer than those respectively above or below them. This strong assumption allows us to move beyond an accounting limited only to between-class inequality.[9] The differences between the two Ginis are in most cases very small, as the lion's share of inequality is accounted for by the between-class component (see Table 2). Detailed explanations for each income distribution are provided in the Appendix 1.

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[9] Gini2 is routinely calculated for contemporary income distributions when the data, typically published by countries' statistical offices, are reported as fractiles of the population and their income shares. In that case, however, any member of a richer group must have a higher income than any member of a poorer group. This is unlikely to be satisfied when the fractiles are not income classes but social classes as is the case here. The Gini2 formula is due to Kakwani (1980).

For two cases (South Serbia 1455 and Levant 1596), we have used Ottoman location-specific tax surveys. These surveys allow us to estimate mean income per settlement. In these two cases, settlements (hamlets, villages, towns) are the units of observation and building blocks for our estimates of inequality: they play the same role played by social or professional classes in all other cases. Although these two surveys are methodologically different, the wealth of information they provide (*viz*., much greater number of "groups" with their average incomes compared to the typical number of social classes that we have; see Table 1) leads us to believe that this location-specific approach to inequality estimation is of similar or equal quality as the class-based estimations.[10]

[Table 1 about here]

Table 1 lists 27 ancient pre-industrial societies for which we have calculated inequality statistics. These societies range from early first-century Rome (Augustan Principate) to India in the year of independence from Britain in 1947. Assuming somewhat conservatively an annual subsistence minimum of $PPP 300 per capita,[11] and

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[10] As explained above, both approaches underestimate inequality by assuming that income means of each group (social in one case, settlement in the other) hold for all members of that group. It could be argued that the downward bias is greater in the case of settlements (which may be economically more diverse within) than in the case of social classes (e.g., most nobles tend to be richer than most peasants). However, a very large number of settlements for which the means are available in the Ottoman surveys provides an offsetting influence to that bias: the informational content of having mean incomes for more than 1,000 settlements may be greater than having mean income estimates for half a dozen social classes.

[11] This is less than Maddison's (1998, p.12) assumed subsistence minimum of $PPP 400 which, in principle, covers more than physiological needs. Note that a purely physiological minimum "sufficient to sustain life with moderate activity and zero consumption of other goods" (Bairoch 1993, p.106) was estimated by Bairoch to be $PPP 80 at 1960 prices. Using the US consumer price index to convert Bairoch's estimate to international dollars yields $PPP 355 at 1990 prices. Our minimum is also consistent with the World Bank absolute poverty line which is 1.08 per day per capita in 1993 $PPP (Chen and Ravallion 2007, p. 6). This works out to be about $PPP 365 per annum in 1990 international prices. Since more than a billion people are calculated to have incomes less than the World Bank global poverty line, it is reasonable to assume that the physiological minimum income must be less. One may recall also that Colin Clark (1957, pp. 18-23), in his pioneering study of incomes, distinguished between international units (the early PPP dollar) and oriental units, the lower dollar equivalents which presumably hold for subtropical or tropical regions where calorie, housing and clothing needs are considerably less than those in temperate climates. Since our sample includes a fair number of tropical countries, this gives us another reason to use a conservatively low estimate of the physiological minimum.

with GDI per capita ranging from about $PPP 530 to just above $PPP 2000,[12] then α would range from about 1.8 to 6.8. A GDI per capita of $PPP 2000 is a level of income not uncommon today, and it would place 1732 Holland or 1801-03 England and Wales in the 40th percentile in the world distribution of countries by per capita income in the year 2000. With the possible exception of 1732 Holland and 1801-3 England, countries in our sample have average incomes that are roughly comparable with contemporary pre-industrial societies that have not yet started significant and sustained industrialization. The urbanization rate in our sample ranges from 2 or 3 percent (South Serbia 1455, Java 1880) to 45 percent (Holland 1561). Population size varies even more, from an estimated 80,000 in South Serbia 1455 and 237,000 in Levant 1596 (both covered directly by Ottoman censuses) to 350 million or more in India 1947 and China 1880.

The number of social classes into which distributions are divided, and from which we calculate our Ginis, varies considerably. They number only three for 1784-99 Nueva España (comprising the territories of today's Mexico, parts of Central America, and parts of western United States) and 1880 China. In most cases, the number of social classes is in the double digits. Understandably, large numbers of groups are found in the case of occupational censuses: thus, the data from the 1872 Brazilian census include 813 occupations, and the Levantine settlement census includes average incomes for more than 1400 settlements. The largest number of observations is provided in the famous 1427 Florentine (Tuscan) census where income data for almost 10,000 households are available. As we shall see below, these large differences in the number of groups have little effect on the measured Gini.

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[12] All dollar data, unless indicated otherwise, are in 1990 Geary-Khamis PPPs.

The estimated inequality statistics are reported in Table 2. The calculated Gini2's display a very wide range: from 24.5 in China 1880 to 63.5 in Nueva España 1784-99 and 63.7 in Chile 1861.[13] The latter figure is higher than the inequality reported for some of today's most unequal countries like Brazil and South Africa. The average Gini2 from these 27 data points is 44.7, while the average Gini from the modern counterpart countries is 40.4.[14] These are only samples, of course, but there is very little difference on average between them, 44.7 (ancient) – 40.4 (modern counterparts) = 4.3.[15] In contrast, there are very great differences within each sample: 58.8 (Brazil 2002) – 26.0 (Japan 2002) = 32.8 among the modern counterparts, while 63.5 (Nueva España 1784-99) - 24.5 (China 1880) = 39 among the ancient economies. In short, inequality differences within the ancient and modern samples are many times greater than are differences between them.

The Gini estimates are plotted in Figure 2 against the estimates of GDI per capita on the horizontal axis. They are also displayed against the *inequality possibility frontier* constructed on the assumption of a subsistence minimum of $PPP 300 (solid line). In most cases, the calculated Ginis lie fairly close to the IPF. In terms of *absolute distance,* the countries farthest below the IPF curve are the most "modern" pre-industrial economies: 1561-1808 Holland and the Netherlands, 1788 France, and 1688-1801 England and Wales.

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[13] South Serbia 1455 Gini is even lower (20.9) but the survey excludes Ottoman landlords. We shall make adjustment for such omission in the empirical analysis below.

[14] The modern counterpart countries are defined as countries that currently cover approximately the same territory as the ancient countries (e.g., Turkey for Byzantium, Italy for Rome, Mexico for Nueva España, modern Japan for ancient Japan, and so on).

[15] The hypothesis of equality of the two means is easily accepted (*t* test significant at 22 percent only).

How do country inequality measures compare with the maximum feasible Ginis at their estimated income levels? Call the ratio between the actual inequality (measured by Gini2) and the maximum feasible inequality the *inequality extraction ratio*, indicating how much of the maximum inequality was actually extracted: the higher the *inequality extraction ratio*, the more (relatively) unequal the society.[16] The median and mean inequality extraction ratios in our sample are 72.8 and 73.1 percent, respectively. Thus, almost three-quarters of maximum feasible inequality was actually "extracted" by the elites in our pre-industrial sample. To put a more positive spin on it, the elites did not want, or were unable, to extract the last one-quarter of maximum feasible inequality. The countries with the lowest ratios are 1924 Java and 1811 Kingdom of Naples with extraction ratios of 48 and 54 percent, respectively. In these cases, the elite left about half of the maximum feasible inequality on the table for the non-elite.

Two estimated Ginis are slightly greater than the maximum Gini implied by the IPF (given level of income): Moghul India 1750 (an extraction ratio of 112 percent) and Nueva España 1790 (an extraction ratio of 105 percent). Recalling our definition of the IPF, these cases can only be explained by one or more of these four possibilities: inequality within the rich classes is very large; the subsistence minimum is overestimated; the inequality estimate is too high; and/or a portion of the population cannot even afford the subsistence minimum. We have already analyzed and dismissed the first two possibilities. The third possibility is unlikely; as our estimates of inequality are calculated from a limited number of social classes, they are likely to be biased

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[16] The term "relative" is used here, *faute de mieux*, to denote conventionally calculated inequality in relation to maximum possible inequality at a given level of income, not whether the measure of inequality itself is relative or absolute.

downwards, not upwards. The last possibility offers the most plausible explanation. In these cases, a portion of the population might have been expected to die from hunger or lack of elementary shelter. But poor people's income often does, in any given month, or even year, fall below the minimum and they survive by borrowing or selling their assets. Still, the same individuals can not, by definition, stay below subsistence indefinitely. Such societies (that is, societies with such average income, social structure and income distribution) were not viable since the population could not be sustained. The fact that there are only two such societies in our sample -- 1750 Moghul India and 1790 Nueva España, both notoriously exploitative -- seems to confirm our hypothesis.

The data points for England and Wales, and Holland/Netherlands -- the only countries for which we have at least three pre-industrial observations -- are connected to highlight the evolution of inequality relative to IPF in those cases. Between 1290 and 1688, and particularly between 1688 and 1759, the slope of the increase of the Gini in England and Wales was significantly less than the slope of the IPF. Thus, the English extraction ratio dropped from almost 70 percent in 1290, to 57 percent in 1688 and to 55 percent in 1759. However, between 1759 and 1801, the opposite happened: the extraction ratio rose to almost 61 percent. Or consider Holland/Netherlands between 1732 and 1808. As average income decreased (due to the Napoleonic wars), so too did inequality, but the latter even more so. Thus, the extraction ratio decreased from around 72 to 68 percent.

[Table 2 and Figure 2 about here]

The *inequality possibility frontier* allows us to better situate these ancient inequality estimates in the modern experience. Using the same framework that we have just applied to ancient societies, the bottom panel of Table 2 provides estimates of inequality extraction ratios for some 25 contemporary societies. Brazil and South Africa have often been cited as examples of extremely unequal societies, both driven by long experience with racial discrimination, tribal power and regional dualism. Indeed, both countries display Ginis comparable to those of the most unequal pre-industrial societies. But Brazil and South Africa are several times richer than the richest ancient society in our sample, so that the maximum feasible inequality is much higher than anything we have seen in our ancient sample. Thus, the elites in both countries have extracted only about 60 percent of their maximum feasible inequality, and their inequality extraction ratios are about the same as what we found among the *less* exploitative ancient societies (1801-3 England and Wales, and 1886 Japan).

In the year 2000, countries near the world median GDI per capita (about $PPP 3500) or near the world mean population-weighted GDI per capita (a little over $PPP 6000), had maximum feasible Ginis of 91 and 95 respectively. The median Gini in today's world is about 35, a "representative" country having thus extracted just a bit less than 40 percent of feasible inequality, vastly less than did ancient societies. For the modern counterparts of our ancient societies, the ratio is just under 43 percent (Table 2). China's present *inequality extraction ratio* is 46 percent, while that for the United States is 40 percent, and that for Sweden 28 percent. Only in the extremely poor countries today, with GDI per capita less than $PPP 600, do actual and maximum feasible Ginis lie close together (2004 Congo D. R., and 2000 Tanzania).[17] Compared with the maximum inequality possible, today's inequality is *much* smaller than that of ancient societies.

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[17] Actually, the extraction ratio for Congo is in excess of 100 percent. It is very likely that Congo's real income ($PPP 450 per capita) is underestimated. But even so, the extraction ratio would be close to 100 percent.

It could be argued that our new *inequality extraction ratio* measure reflects societal inequality, and the role it plays, more accurately than any actual inequality measure. For example, Tanzania (denoted TZA in Figure 3) with a relatively low Gini of 35 may be less egalitarian than it appears since measured inequality lies fairly close to its *inequality possibility frontier* (Table 2 and Figure 3). On the other hand, with a much higher Gini of almost 48, Malaysia (MYS) has extracted only about one-half of maximum inequality, and thus is farther away from the IPF. This new view of inequality may be more pertinent for the analysis of power and conflict in both ancient and modern societies. Thus, a simple regression on the likelihood of conflict in modern countries fails to support the view that inequality measured by the Gini coefficient matters (see also Collier and Hoeffler 2004). However, there *is* a positive association between the inequality extraction ratio and conflict.[18] Space limitations prevent our pursuing this potentially important finding in this paper.

[Figure 3 about here]

Another implication of our approach is that it considers inequality and development jointly. As a country becomes richer, its feasible inequality expands. Consequently, if recorded inequality is stable, the *inequality extraction ratio* must fall; and even if recorded inequality goes up, the ratio may not. This can be seen in Figure 4 where we plot the inequality extraction ratio against GDI per capita for both ancient societies and their modern counterparts. Thus, the social consequences of increased

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[18] The results refer to a regression in which the occurrence of civil war (defined as "within war" by the Correlates of War project) in the period 1989-2000 is regressed against GDI per capita, democracy (Polity2 variable), ethnolinguistic fractionalization, and alternatively Gini coefficient or extraction ratio (with all dependent variables defined over the period 1980-1989). The coefficient on the Gini, as in most of the conflict literature, is not significant, while the extraction ratio is significant (at the 6 percent level). The results are available from the authors on request.

inequality may not entail as much relative impoverishment, or as much perceived injustice, as might appear if we looked only at the recorded Gini. This logic is particularly compelling for poor and middle-income countries where increases in income push the maximum feasible inequality up relatively sharply, since the IPF curve is concave. The farther a society rises above the subsistence minimum, the less will economic development lift its *inequality possibility frontier*, and thus the *inequality extraction ratio* will be driven more and more by the rise in the Gini itself. This is best illustrated by the United States where the maximum feasible inequality already stands at a Gini of 98.2. Economic development offers this positive message: the *inequality extraction ratio* will fall with GDI per capita growth even if measured inequality remains constant. However, economic decline offers the opposite message: that is, a decline in GDI per capita, like that registered by Russia in the early stages of its transition from communism drives the country's maximum feasible inequality down. If the measured Gini had been stable, the *inequality extraction ratio* would have risen. If the measured Gini rose (as was indeed the case in Russia), the *inequality extraction ratio* would have risen even more sharply. Rising inequality may be particularly socially disruptive under these conditions.

[Figure 4 about here]

4. Explaining Ancient Pre-Industrial Ginis and the Extraction Ratio

Using this rather sparse information from ancient societies, can we explain differences in observed inequality and the extraction ratio? We have available, of course, the Kuznets hypothesis whereby inequality tends to follow an inverted U as average real income increases. Although Kuznets formulated his hypothesis explicitly with a view toward the industrializing economies (that is, with regard to economies that lie *outside* our sample), one might wonder whether the Kuznets Curve can be found among pre-industrial economies as well. In addition to average income and its square, Table 3 includes the urbanization rate, population density and colonial status (a dummy variable). The regression also includes a number of controls for country-specific eccentricities in the data: the number of social groups available for calculating the Gini,[19] whether the social table is based on tax data, and whether the social table for a colony includes income for the colonists. The Kuznets hypothesis predicts a positive coefficient on average income and negative coefficient on its square. We also expect higher inequality for the more urbanized countries (reflecting a common finding that inequality in urban areas tends to be higher than in rural areas: Ravallion et al. 2007), and for those that are ruled by foreign elites since powerful foreign elites are presumed to be able to achieve higher extraction ratios than weaker local elites, and since countries with weak local

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[19] The rationale is that a greater number of groups provides a more finely-grained picture of distribution and hence perhaps yields a higher Gini than if we have only a few social groups. Social tables based on tax data (there are four such observations) may be expected to under-represent the bottom part of income distribution.

elites but large surpluses to extract will attract powerful colonizers (Acemoglu, Johnson and Robinson 2001).

The regression results readily confirm all expectations. Both income terms are of the right sign, and significant at 1.4 and 1.9 percent levels, supporting a pre-industrial Kuznets Curve. The sign on urbanization is, as predicted, positive, but since it competes with population density, its significance is somewhat lower. Still, each percentage point increase in the urbanization rate (say, from 10 percent to 11 percent) is associated with an increase in the Gini by 0.37 points. Colonies are clearly much more unequal: holding everything else constant, a colony would have a Gini about 13 points higher than a non-colony. *Dno_foreign* is a dummy variable that controls for two observations (South Serbia 1455 and Levant 1596) that were colonies but where their ancient inequality surveys did not include the incomes and numbers of colonizers at the top. This is therefore simply another control for data eccentricity, and its negative sign shows that being a colony, and not having colonizers included in the survey, reduces recorded inequality considerably (12 points) compared to what it is "expected" to be.[20] In summary, being a colony was a major determinant of measured inequality. Excluding South Serbia 1455 and Levant 1596, the measured Gini2 ranges between 24.5 for China 1880 and 63.7 for Chile 1861 (Table 2), that is, the spread is 39.2 percentage points, and the colony effect is 13.6/39.2=35%, a big number indeed.

The number of social groups that we use in our calculations of the Gini, or tax census origin of social tables, do not seem to affect the Gini values. This finding is

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[20] If colonies with no information on colonizers were a random draw from all the statistical population of all colonies (which of course they are not), we would expect the two coefficients to be the same but, of course, of opposite sign.

comforting, because it shows that our estimates of inequality are being driven by fundamentals, not by the way the social tables were constructed.

[Table 3 about here]

Population density poses a problem since it is negatively associated with inequality (in all formulations, including those not shown here) and is significant. According to regression 1 (Table 3), an increase in population density by 10 persons per square kilometer (equivalent to an increase in population density from that of the early nineteenth century Naples to England and Wales) is associated with a 1 Gini point decrease. It might have been expected that the introduction of a dummy variable for more densely populated (and perhaps more equal) Asian countries would have caused the effect of density (and perhaps even colony) to dissipate. This is not the case, as shown by regression 2 (Table 3). Only when we eliminate the two observations for Java, a region with the highest population density in our sample and with relatively low inequality (bearing in mind that it is also poor and a colony), does the negative coefficient on population density lose its statistical significance at conventional levels. Thus, while higher population density seems to be negatively associated with inequality, its significance crucially depends on the inclusion of the two observations for Java. If this effect holds for larger samples, then one could perhaps argue that in more densely populated countries the mere presence of lots of people in physical proximity to the elites limits elite's ability to extract as much surplus and puts a lid on inequality. Alternatively, we might interpret the correlation as suggesting more benign, pro-growth rule made it possible for population densities to reach high levels. Our current sample is too small to say more about causality.

When exploring the determinants of the extraction ratio, theory is less helpful. A simple plot of the extraction ratio against GDI per capita displays a negative relationship (Figure 5), although not strongly statistically significant (10 percent only). In regression 4 (Table 3), the extraction ratio is regressed against almost the same variables as with the Gini.[21] Income is negatively (and significantly) associated with the extraction ratio,[22] while being a colony and being more urbanized are both associated with higher extraction ratios. Having a colonial elite—with everything else the same—is associated with a very large 13.8 point increase in the extraction ratio. The introduction of population density (regression 5, Table 3) renders both income and urbanization rate statistically insignificant. The positive effect of being a colony remains and the coefficient even increases (to 27 extraction ratio points). As with inequality, population density is strongly negatively associated with the dependent variable. This result is weaker, but still persists at the 5 percent significance level, even after we eliminate observations for Java (regression 6). Figure 6 plots population density against the residuals from regression 6 (which omits the two observations from Java). As can be seen, the relationship is still strongly negative.

[Figures 5 and 6 about here]

When we draw together the analyses of inequality and the extraction ratio, the stylized picture that emerges is this: the Gini follows contours that are broadly consistent with the Kuznets Curve hypothesis (a rise and then a turn-around to falling inequality) even in pre-industrial societies, but the extraction ratio tends to fall as income increases, with no turn-around. In other words, while inequality at first increases as income per

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[21] We no longer include survey controls (number of groups or a dummy for tax-based source) since we have seen that they do not make a difference in the calculations of the Gini.

[22] Including income squared reveals no significant curvature (results not shown here).

capita rises, it does not increase to the full extent made possible by the larger surplus, so that the extraction ratio falls. There is thus asynchronism in the behavior of the recorded Gini and the extraction ratio as societies become richer. The introduction of population density (even after dropping the extreme observations) shows that higher population density puts downward pressure both on the Gini and the extraction ratio. Its effect is particularly strong in the latter case so that both income and urbanization become insignificant. Colonies record very high inequality and extraction ratios throughout.

The data also shed light on the historical persistence of inequality. First, it does not appear that ancient Asia was significantly less unequal when we control for other factors, such as population density. When the Asian dummy is added to regression 2, its coefficient is negative, but it is not significant. That is, population density may be sufficient to identify why ancient Asia had lower levels of inequality. Some have argued this result is driven by the absence of scale economies in rice cultivation (Jones 1981; Bray 1986), but we have already offered other possibilities as well.

Second, Stanley Engerman and Kenneth Sokoloff (1997, 2000) have offered a hypothesis to account for Latin American growth underachievement during the two centuries following its independence. Their thesis begins with the plausible assertion that high levels of income inequality, and thus of political power, favor rich landlords and rent-seekers, and thus the development of institutions which are compatible with the former but incompatible with economic growth. Their thesis argues further that high levels of Latin American inequality have their roots in the natural resource endowments present after Iberian colonization five centuries ago. Exploitation of the native population and African slaves, as well as their disenfranchisement, reinforced the development of institutions incompatible with growth. Engerman and Sokoloff had no difficulty collecting evidence which confirmed high inequality, disenfranchisement and lack of suffrage in Latin America compared with the United States. Oddly enough, however, their thesis has never been confronted with inequality evidence for the industrial leaders in western Europe. If we can show that inequality in England, Holland and France, prior to their industrial revolutions, was greater than or equal to Latin America, while during and after their industrial revolutions the former three led the world economically and the latter lagged behind (e.g. Maddison 2003, Prados de la Escosura 2004), the thesis would be damaged.

Table 2 presents inequality information for pre-industrial western Europe (that is, prior to 1810) and for pre-industrial Latin America (that is, prior to 1875). For the former, we have observations from 1788 France, 1561 and 1732 Holland, and 1688, 1759 and 1801 England-Wales. For the latter, we have Nueva España 1790, Chile 1861, Brazil 1872 and Peru 1876. Engerman and Sokoloff coined their hypothesis in terms of actual inequality. According to that criterion, their thesis must be rejected. That is, the (population weighted) average Latin American Gini (48.9) was *lower* than that of western Europe (52.9), not higher.[23] True, the variance in the Gini is considerable within both regions, but it is not true that pre-industrial Latin America was unambiguously more unequal than pre-industrial western Europe. However, Latin America was poorer than western Europe, and poorer societies have a smaller surplus for the elite to extract. Thus, *feasible inequality* was lower in Latin America (range of 59.9-62.4 versus European range of 77.7-79.8). As it turns out, *extraction rates* were considerably higher in Latin America than in western Europe. Thus, while measured inequality does not support the

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[23] The same is true of the unweighted average.

Engerman-Sokoloff thesis, the extraction rate does. This suggests a new question to be added to the long run growth debate: Why was the *extraction rate* so much higher in Latin America? Was it simply because they were colonized?

5. What Components Are Driving Overall Income Distribution?

How much of the inequality observed in ancient societies can be explained by the economic distance between the average rural landless peasant at the bottom and the average rich landed elite at the top? How much can be explained by the distribution among the elite at the top? And how much can be explained by the income share held by all the elite at the top?

Life at the Top: Income Distribution Involving the Elite

An impressive amount of recent empirical work has suggested that the evolution of the share of the top 1 percent yields a good approximation to changes in the overall income distribution in modern industrial societies (Piketty 2003, 2005; Piketty and Saez 2003, 2006; Atkinson and Piketty forthcoming). These studies find that most of the action takes place at the top of the income distribution pyramid and that changes or differences in the top 1 percent income share account for much of the changes or differences in overall inequality (Leigh 2007). These top share studies have also been performed on poor pre-modern India (since 1922: Banerjee and Piketty 2005), Indonesia (since 1920: Leigh and van der Eng 2006) and Japan (since 1885: Moriguchi and Saez 2005). So, are differences in the share of the top 1 percent also a good proxy for differences in overall income distribution in ancient pre-industrial societies?

The income share of the top 1 percent is estimated here under the assumption that top incomes follow a Pareto distribution. Our approach is basically the same as that recently used by Anthony Atkinson (forthcoming) and by others writing before him (see the references in Atkinson forthcoming).[24]

Table 4 reports the estimated income share of the top 1 percent of recipients, and the cut-off point, that is the income level (relative to the mean) where the top one percent of recipients begins. The countries are listed in descending order according to the top 1 percent share. In contrast with modern studies, the correlation between the top 1 percent share and the Gini is small (+0.10) and statistically insignificant.[25] This implies that differences in overall inequality are not reflected by differences in the top percentile share very well. Consider, for example, the Roman and Byzantine empires. Their estimated Ginis are very similar (39.4 and 41.1) but the top percentile share in Byzantium (30.6, the highest in our sample) is almost twice as great as in Rome (16.1).

[Table 4 about here]

The location of the cut-off point -- where the top percentile begins -- tells us a lot about the organization of societies. At one end of the spectrum is the Byzantine Empire with a very rich top one percent, but also with a very low cut-off point (matched only by the colonies Bihar 1807 and Java 1880). This would seem to indicate the absence of a middle class, that is, of those who would normally fill the "space" between the mean

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[24] The estimation procedure is explained in detail in Appendix 3. There we list several caveats necessitated by the fact that our social tables are different from the usual income distribution data sources.

[25] The correlation between the top 1% share and Gini coefficient among the modern comparators given in Table 3 is +0.97 (and statistically significant at less than 0.1 percent).

income and (say) an income 3 to 4 times greater than the mean. On the other hand, the top percentile was very rich in the Roman Empire (16.1 percent of total income), but the cut-off point was very high too: 12.4 times the mean (matched only by Moghul India 1750 and British India 1947, but Chile 1861 came close). This suggests a Roman income distribution with a long tail of rich people such that the 2nd-5th percentiles were also quite rich. This interpretation is supported by Figure 7 which shows the income distributions and the estimated top percentile share calculated using the Pareto interpolation (see the dashed line).[26] While the income share after the 1st, and up to the 4th and the 5th, percentile in Byzantium rises very slowly, the line rises more steeply in Rome, indicating that Romans in these percentiles were relatively wealthy. For comparative purposes, we also show the English 1801-3 data where the top 1 percent share, as well as the steepness of the line after the top percentile, is similar to that of Rome. It seems that the main difference among the very rich in Rome 14 and England 1801-3 was that the people just below the very top of the income pyramid were, relative to the mean, somewhat less rich in England than in Rome. Finally, notice that in all three cases, the top 5 percent of income recipients received between 30 and just over 40 percent of total income. In contrast, the top 5 percent received about a quarter of total income in modern United States and United Kingdom, while the share is 27 percent in modern Chile and a third in Brazil.

[Figure 7 about here]

Table 4 also reports modern counterparts of our ancient economies as well as a few other modern countries. Among modern counterparts, those (Mexico, Brazil) with

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[26] Note that the high intercept of the line indicates a very high income share of the very top (people even richer than the top 1 percent).

the highest top 1 percent share display values that are equal to the average for the ancient economies (top 1 percent receives around 14 percent of total income). A relatively low top 1 percent share (around 5 to 6 percent) combined with a low cut-off point (characteristic of advanced societies) announces a distribution where, first, the richest 1 percent are not extravagantly rich, and where, second, they are not very different from the rest of the population. Since we have already noted that Gini coefficients between the ancient and contemporary poor societies are not very different, this difference in the average top 1 percent shares between the ancient and modern implies that the link between top income shares and overall inequality is not very strong among ancient societies.

Life at the Bottom: The Unskilled Rural Wage Relative to Average Income

For twelve of the 27 observations in our ancient inequality sample, we can measure the economic distance between the landed elite and landless labor by computing the ratio of average family income (or average income per recipient, y) to that of landless, unskilled rural laborer (w). Figure 8 plots the relation between the overall Gini and the y/w ratio.[27] The correlation between y/w and the Gini is positive and significant (0.71). The estimated relationship also implies an elasticity of the Gini with respect to y/w of 0.36: thus, for every 10 percent increase in y/w, the Gini rose by 3.6 percentage points. Low measured inequalities in China 1880 and Naples 1811 (Ginis of 24.5 and 28.4: Table 4) were consistent with small gaps between poor rural laborers and average incomes (y/w of 1.32 and 1.49), or with a rural wage two-thirds to three-quarters of average income.

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[27] See also Appendix 2. This simple y/w index has been shown to be a good proxy for inequality among nineteenth and twentieth century poor economies (Williamson 1997, 2002).

High measured inequalities in Nueva España 1784-99 and England 1801-03 (Ginis of 63.5 and 51.5: Table 4) were consistent with large gaps between poor rural laborers and average incomes (y/w of 4.17 and 2.94), or with a rural wage only one-quarter to one-third of average income. There appears to be only one true outlier to the otherwise tight relationship in Figure 8, British India in 1947. Still, the overall relationship does suggest that the Gini correlates more closely with the gap between poor landless labor and the landed elite, than with the top 1 percent share: to repeat, Gini2 has a significant correlation of 0.71 with y/w, versus the insignificant 0.10 correlation with the share received by the top 1 percent.[28]

[Figure 8 about here]

6. New Inequality Insights and an Agenda for the Future

Our exploration ancient pre-industrial experience has uncovered three key aspects of inequality which had not been appreciated before.

First, as measured by the Gini coefficient, income inequality in pre-industrial countries today is not very different from inequality in distant pre-industrial times.[29] In addition, the variance of inequality among countries then and now is much greater than any difference in average inequality between then and now.

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[28] This 0.10 correlation refers to the 24 cases in Table 4. When we reduce the sample to the same 12 cases used for y/w, the correlation between the top 1 percent share and the overall Gini becomes negative 0.33.

[29] However, it seems likely that any measure of lifetime income (as opposed to annual income used here) inequality would confirm that ancient pre-industrial inequality was higher than modern pre-industrial inequality. After all, there has been an immense convergence in mortality and morbidity by social class in even poor countries since the First Industrial Revolution in Britain, and most of this was induced by elite policy towards cleaner cities and public health. See Milanovic, Lindert and Williamson (2007, section 6).

Second, the *extraction ratio* – how much of potential inequality was converted into actual inequality – was significantly bigger then than now. We are persuaded that much more can be learned about inequality in the past *and* the present by looking at the *extraction ratio* rather than just at actual inequality. The ratio measures just how powerful and extortionary are the elite, its institutions, and its policies. When the extraction ratio is regressed against income per capita, urbanization, population density, and whether the observation was a colony, very strong support emerges for a positive (exploitative) effect of foreign elites and for a negative effect of population density. Higher income also tends to diminish the ratio, although only mildly. This, combined with our empirical results regarding the evolution of the Gini coefficient in the same sample of countries, suggests that even in pre-industrial societies the elite does not fully exploit their opportunity to capture more of the rising surplus as average income increases. While we do not explore them here, there must be factors that kept the extraction ratio from increasing, or actually lowered it, long before the twentieth century appearance of universal suffrage and the rise of the welfare state.

Third, unlike the findings regarding the evolution of the twentieth century inequality in industrial and post-industrial societies, our ancient pre-industrial inequality sample does not reveal any significant correlation between the income share of the top 1 percent and overall inequality. Thus, an equally high Gini could be and was achieved in two ways: in some societies, a high income share of the elite coexisted with a yawning income gap between it and the rest of society, and with small differences in income among the non-elite; in other societies, those at the very top of the income pyramid were followed by only slightly less rich and then further down the line toward something that resembled a middle class. Why were some ancient societies more hierarchal while others more socially diverse? While this paper has focused on inequality in ancient societies, it has not explored the social structure underpinning that inequality, its determinants, and its impact. We hope to fill these social structure blanks in a sequel to this paper.

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Table 1

Data Sources, Estimated Demographic Indicators and GDI Per Capita

Country/territory	Source of data	Year	Number of classes	Estimated urbanization rate (in %)	Population (in 000)	Area (in km^2)	Population density (person/km^2)	Estimated GDI per capita
Roman Empire	Social tables	14	11	10	55000	3,300,000	16.7	633
Byzantium	Social tables	1000	8	10	15000	1,250,000	12.0	533
England and Wales	Social tables	1290	7	14.5	4300	130,000	33.1	639
Tuscany	Professional census	1427	9780					978
South Serbia	Settlement census	1455	615	2	80	6,344	12.6	443
Holland	Tax census dwelling rents	1561	10	45	983	21,680	45.3	1129
Levant	Settlement census	1596	1415	11	263	26,250	10.0	974
England and Wales	Social tables	1688	31	13	5700	130,000	44.0	1418
Holland	Tax census dwelling rents	1732	10	39	2023	21,680	93.3	2035
Moghul India	Social tables	1750	4	11	182000	3,870,000	47.0	530
England and Wales	Social tables	1759	56	16	6463	130,000	49.7	1759
Old Castiille	Income census	1752	33	10	1980	89,061	22.2	745
France	Social tables	1788	8	12	27970	550,100	50.8	1135
Nueva España	Social tables	1790*	3	9.1	4500	1,224,433	3.7	755
England and Wales	Social tables	1801-3	44	30	9277	130,000	71.4	2006
Bihar (India)	Monthly census of expenditures	1807	10	10.5	3362	108,155	31.1	533
Netherlands	Tax census of dwelling rents	1808	20	36.9	2100	41,865	50.2	1800
Kingdom of Naples	Tax census	1811	12	15	5000	82,000	61.0	752
Chile	Professional census	1861	32	29	1702	756,950	2.2	1295
Brazil	Professional	1872	813	16.2	10167	8,456,510	1.2	721

Country/territory	Source of data	Year	Number of classes	Estimated urbanization rate (in %)	Population (in 000)	Area (in km^2)	Population density (person/km^2)	Estimated GDI per capita
	census							
Peru	Social tables	1876	15	15	2469	1,285,000	1.9	653
China	Social tables	1880	3	7	377500	9,327,420	40.5	540
Java	Social tables	1880	32	3	20020	126,700	158.0	661
Japan	Tax records	1886		15	38622	377,835	102.2	916
Java	Social tables	1924	14	3	35170	126,700	277.6	909
Siam	Social tables	1929	21	10	11605	514,000	22.6	793
British India	Social tables	1947	8	16.5	346000	3,870,000	89.4	617

Note: GDI per capita is expressed in 1990 Geary-Khamis PPP dollars (equivalent to those used by Maddison 2003 and 2004). Population density is people per square kilometer. For the data sources and detailed explanations, see Appendix 1. Observations ranked by year.

* 1790 = 1784-1799.

Table 2

Inequality Measures

country/territory, year	Gini1	Gini2	Top income class (in % of total population)	Mean income in terms of s (s=$300)	Maximum feasible Gini (IPF)	Inequality extraction ratio (in %)*
Roman Empire 14	36.4	39.4	0.004	2.1	52.6	75.0
Byzantium 1000	41.0	41.1	0.5	1.8	43.7	94.1
England & Wales 1290	35.3	36.7	2.3	2.1	53.0	69.2
Tuscany 1427		46.1	1	3.3	69.3	66.6
South Serbia 1455	19.1	20.9	1	1.5	32.2	64.8
Holland 1561		56.0	1	3.8	73.4	76.3
Levant 1596		39.8	1	3.2	69.1	57.6
England & Wales 1688	44.9	45.0	0.14	4.7	78.8	57.1
Holland 1732	61.0	61.1	1	6.8	85.2	71.7
Moghul India 1750	38.5	48.9	1	1.8	43.4	112.8
Old Castille 1752	52.3	52.5	0.08	2.5	59.7	88.0
Eng1and & Wales 1759	45.9	45.9	0.006	5.9	82.9	55.4
France 1788	54.6	55.9	9.7	3.8	73.5	76.1
Nueva España 1790		63.5	10	2.5	60.2	105.5
England & Wales 1801	51.2	51.5	0.08	6.7	85.0	60.6
Bihar (India) 1807	32.8	33.5	10	1.8	43.7	76.7
Netherlands 1808	56.3	57.0	0.03	6.0	83.3	68.5
Naples 1811	28.1	28.4	0.7	2.2	52.9	53.7
Chile1861	63.6	63.7	0.08	4.3	76.8	83.0
Brazil 1872	38.7	43.3	1	2.4	58.3	74.2
Peru 1876	41.3	42.2	1.04	2.2	54.0	78.1
Java 1880	38.9	39.7	0.0004	2.2	54.6	72.8
China 1880	23.9	24.5	0.3	1.8	44.4	55.2
Japan 1886		39.5		3.1	67.2	58.8
Java 1924	31.8	32.1	0.18	3.0	66.9	48.0
Siam 1929	48.4	48.5	0.87	2.6	62.1	78.1
British India 1947	48.0	49.7	0.06	2.1	51.3	96.8
Average	*43.7*	*44.7*		*3.2*	*62.1*	*73.1*
Modern counterparts						
Italy 2000		35.9		62.5	98.3	36.5
Turkey 2003		43.6		22.0	95.4	45.7
United Kingdom 1999		37.4		66.1	98.4	38.0
Serbia 2003		32.2		11.2	91.0	35.4
Netherlands 1999		28.1		72.0	98.5	28.5
India 2004		32.6		6.4	84.2	38.7
Spain 2000		33.0		50.9	97.9	33.7
France 2000		31.2		69.4	98.4	31.7
Mexico 2000		53.8		24.1	95.7	56.2
Chile 2003		54.6		33.7	96.6	56.4
Brazil 2002		58.8		13.9	92.7	63.4
Peru 2002		52.0		12.3	91.8	56.7
Indonesia 2002		34.3		10.7	90.5	37.9
China 2001		41.6		11.5	91.2	45.6
Japan 2002		26.0		70.2	98.5	26.4
Thailand 2002		50.9		21.3	95.2	53.5
Average		*40.4*		*34.9*	*94.7*	*42.8*

country/territory, year	Gini1	Gini2	Top income class (in % of total population)	Mean income in terms of *s* (s=$300)	Maximum feasible Gini (IPF)	Inequality extraction ratio (in %)*
Other contemporary countries						
South Africa 2000		57.3		14.7	93.1	61.6
United States 2000		39.9		77.7	98.6	40.5
Sweden 2000		27.3		52.2	98.0	27.9
Germany 2000		30.3		62.0	98.3	30.8
Nigeria 2003		42.1		3.0	66.7	63.1
Congo, D.R., 2004		41.0		1.5	33.3	123.1
Tanzania 2000		34.6		1.8	44.4	77.9
Malaysia 2001		47.9		26.0	96.1	49.9

* Calculated using Gini2. Modern Ginis (except for Japan and China) calculated from individual-level data from national household surveys; obtained from Luxembourg Income Survey and World Income Distribution (WYD) database; benchmark year 2002 (see http://econ.worldbank.org/projects/inequality). Ginis for Japan and China calculated from published grouped data. **Source:** For ancient societies, see Appendix 1. Ancient societies ranked by year.

Table 3 Regression results for Gini coefficient and inequality extraction ratio

	Gini coefficient			Inequality extraction ratio		
	1	2	3	4	5	6
GDI per capita	304.7** (0.014)	310.4** (0.014)	307.9** (0.03)	-20.31** (0.03)	-7.09 (0.35)	-7.08 (0.37)
GDI per capita squared	-20.94** (0.019)	-21.40** (0.019)	-21.18** (0.04)			
Urbanization rate	0.369* (0.10)	0.357 (0.12)	0.377 (0.12)	0.692* (0.07)	0.372 (0.21)	0.382 (0.24)
Population density	-0.104*** (0.004)	-0.097** (0.01)	-0.104 (0.19)		-0.189*** (0.001)	-0.197** (0.043)
Colony (0-1)	13.62*** (0.004)	14.75** (0.004)	13.33*** (0.009)	13.83* (0.07)	27.27*** (0.000)	27.20*** (0.001)
Dno_foreign (0-1)	-11.96 (0.23)	-13.30 (0.20)	-11.41 (0.29)	-22.55* (0.06)	-40.30*** (0.000)	-40.32*** (0.002)
Asia (0-1)		-2.71 (0.47)				
Number of groups	-0.008 (0.27)	-0.007 (0.36)	-0.009 (0.29)			
Tax survey (0-1)	-2.77 (0.57)	-2.54 (0.60)	-2.91 (0.66)			
Constant	-1055.6** (0.013)	-1073.1** (0.014)	-1066.6** (0.027)	197.2*** (0.002)	119.9** (0.02)	120.0 (0.025)
No of obs Adjusted R^2	26 0.70	26 0.69	24 0.67	26 0.25	26 0.57	24 0.51

Note: Both GDI per capita are in natural logs. Coefficients significant at 10, 5 and 1 percent level denoted by respectively three, two and one asterisks. *p* values between brackets.

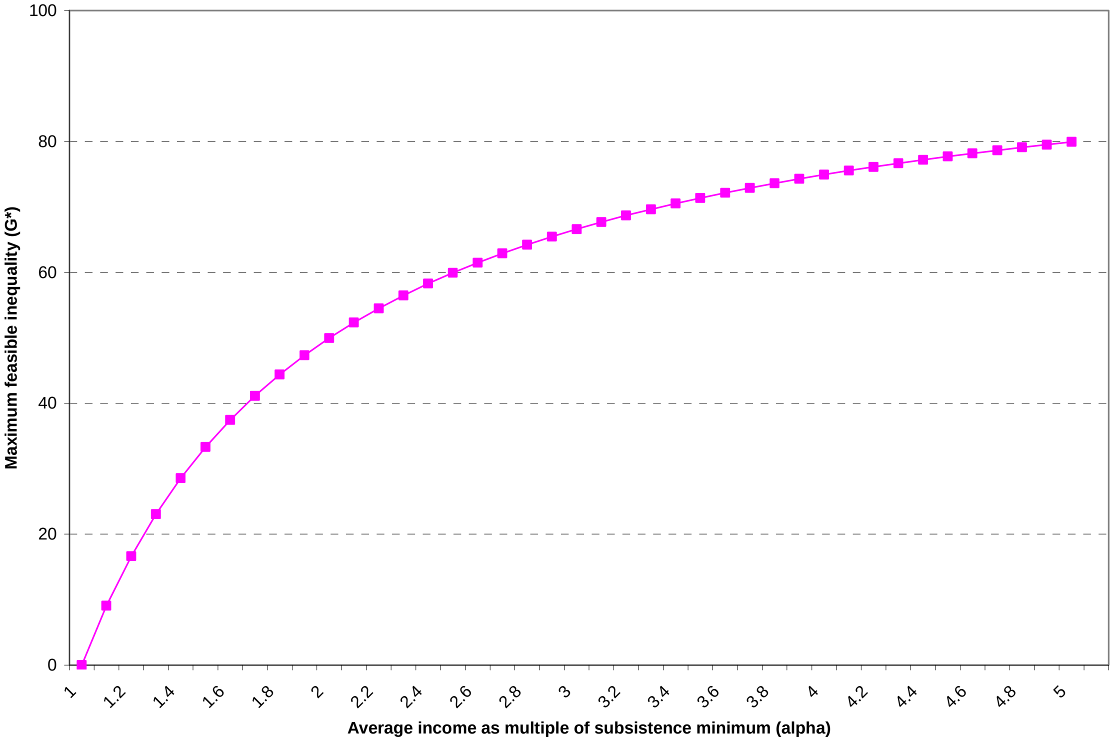
Table 4. Estimated Top of the Income Distribution

	Top 1% share in total income (in %)	The cut-off point (in terms of mean income)	Gini coefficient
Byzantium 1000	30.6	3.7	41.1
Chile 1861	25.7	11.8	63.7
China 1880	21.3	5.6	24.5
Nueva España 1790	21.1	9.8	63.5
Japan 1886	19.1	n.a.	39.5
Netherlands 1808	17.1	9.8	57.0
France 1788	16.8	6.9	55.9
Rome 14	16.1	12.4	39.4
India-Moghul 1750	15.0	15.0	48.9
K. of Naples 18	14.3	5.5	28.4
India British 1947	14.0	16.9	49.7
Holland 1753	13.7	9.1	61.1
Tuscany 1427	13.0	7.2	46.1
England 1290	12.2	6.1	36.7
Peru 1876	11.7	4.5	42.2
Bihar 1807	11.5	3.8	33.5
Java 1880	11.4	3.9	39.7
Java 1924	11.4	4.1	32.1
Brazil 1872	11.2	5.7	43.3
England 1759	10.9	4.2	45.9
England 1801	8.9	6.2	51.5
England 1688	8.7	6.1	45.0
Old Castille 1752	7.0	6.2	52.5
Siam 1929	6.7	5.1	48.5
Average	*14.6*	*7.4*	*45.4*
Modern counterparts			
Chile 2003	14.6	7.9	54.6
Brazil 2001	14.1	8.3	58.8
Peru 2001	12.5	6.9	53.0
Mexico 2000	11.5	8.0	53.8
Thailand 2002	11.1	6.2	50.9
UK 1999	7.0	4.3	37.4
Turkey 2003 *	9.0	5.7	43.6
Indonesia 2002 *	6.9	4.2	34.3
Italy 2000	6.0	4.2	35.9
Spain 2000	5.6	4.0	33.0
India 2004 *	5.2	4.2	32.6
France 2000	4.5	3.5	31.2
Netherland 1999	3.6	2.9	28.1
Average	*8.6*	*5.4*	*42.1*
Other modern countries			
US 2000	6.6	4.7	39.9
Germany 2000	4.9	3.6	30.3
Sweden 2000	4.6	3.1	27.3

Note: Income distributions for Holland not available. The ancient data do not include geographically-based Ottoman surveys. All modern countries as calculated from LIS and World Income Distribution (WYD) databases (from micro data in all cases). The cut-off point indicates the income level (expressed in terms of country mean) where the top percentile begins. For the modern societies, it is estimated by taking the mean income of the 99th percentile and adding 3 standard deviations (of income within that percentile), or directly from the individual-level data. Ancient societies ranked in descending order according to the top 1% share.
* = consumption data.

Figure 1

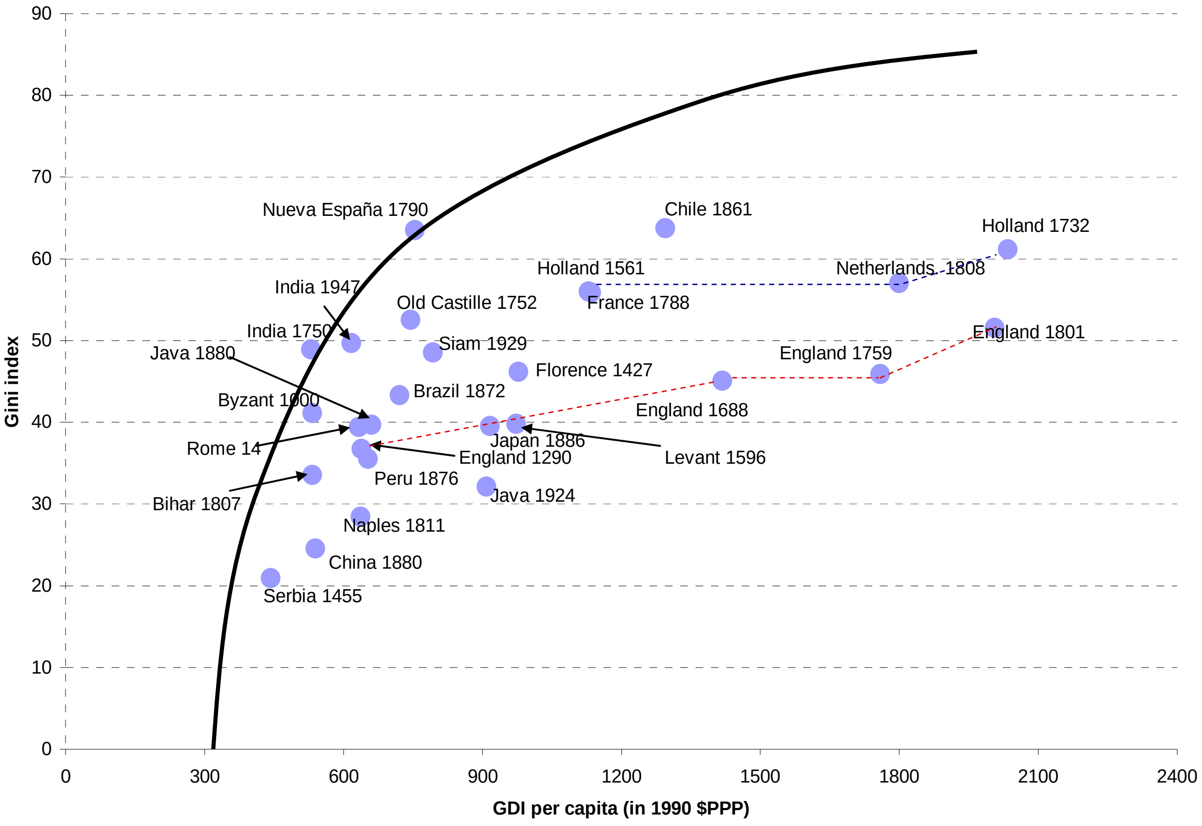
Derivation of the Inequality Possibility Frontier



Note: Vertical axis shows maximum possible Gini attainable with a given α.

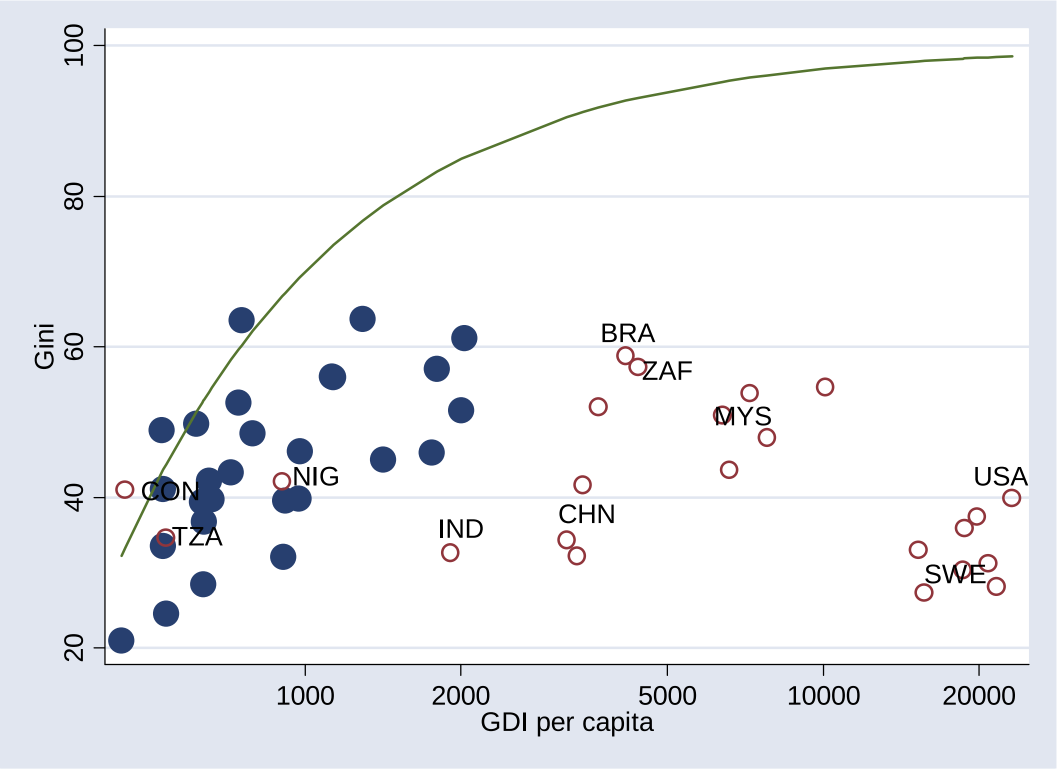
Figure 2

Ancient Inequalities: Estimated Gini Coefficients, and the Inequality Possibility Frontiers



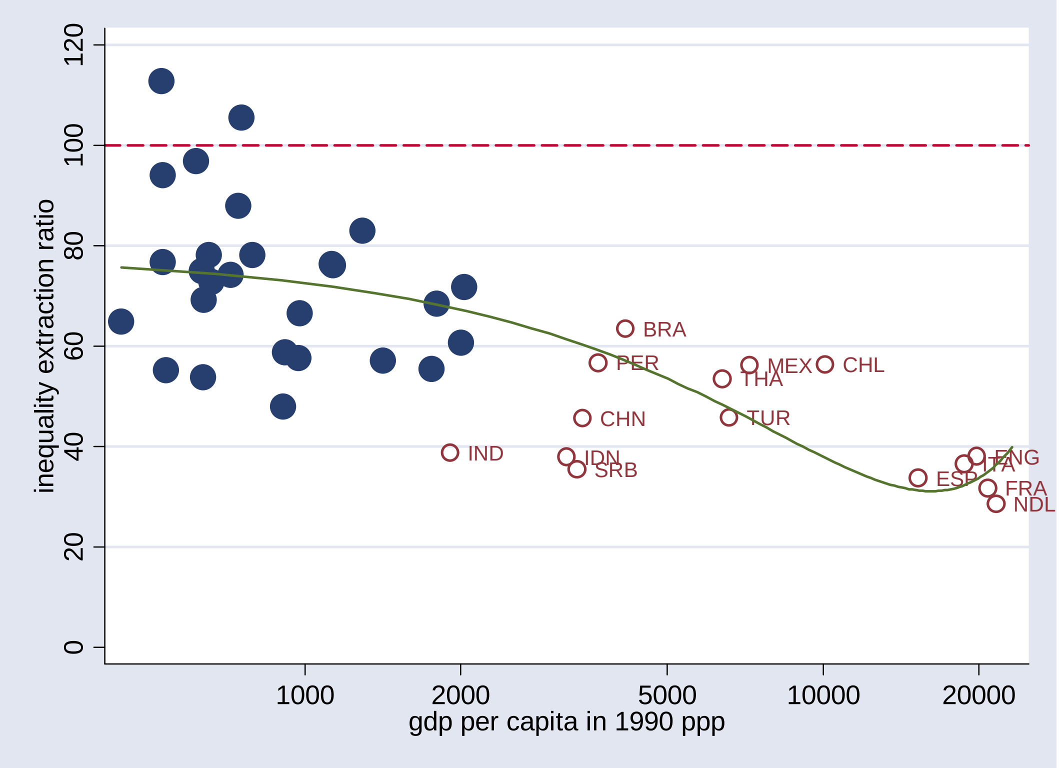
Note: The solid line IPF is constructed on the assumption that s=$PPP 300. Estimated Ginis are Ginis2.

Figure 3
Ginis and the Inequality Possibility Frontier for the Ancient Society Sample and Selected Modern Societies



Note: Modern societies are drawn with hollow circles. IPF drawn on the assumption of s=$PPP 400 per capita per year. Horizontal axis in logs.

Figure 4
Inequality Extraction Ratio for the Ancient Society Sample and their Counterpart Modern Societies



Note: Modern societies are drawn with hollow circles. Horizontal axis in logs. Inequality extraction ratio shown in percentages.

Figure 5. Relationship between GDI per capita and extraction ratio

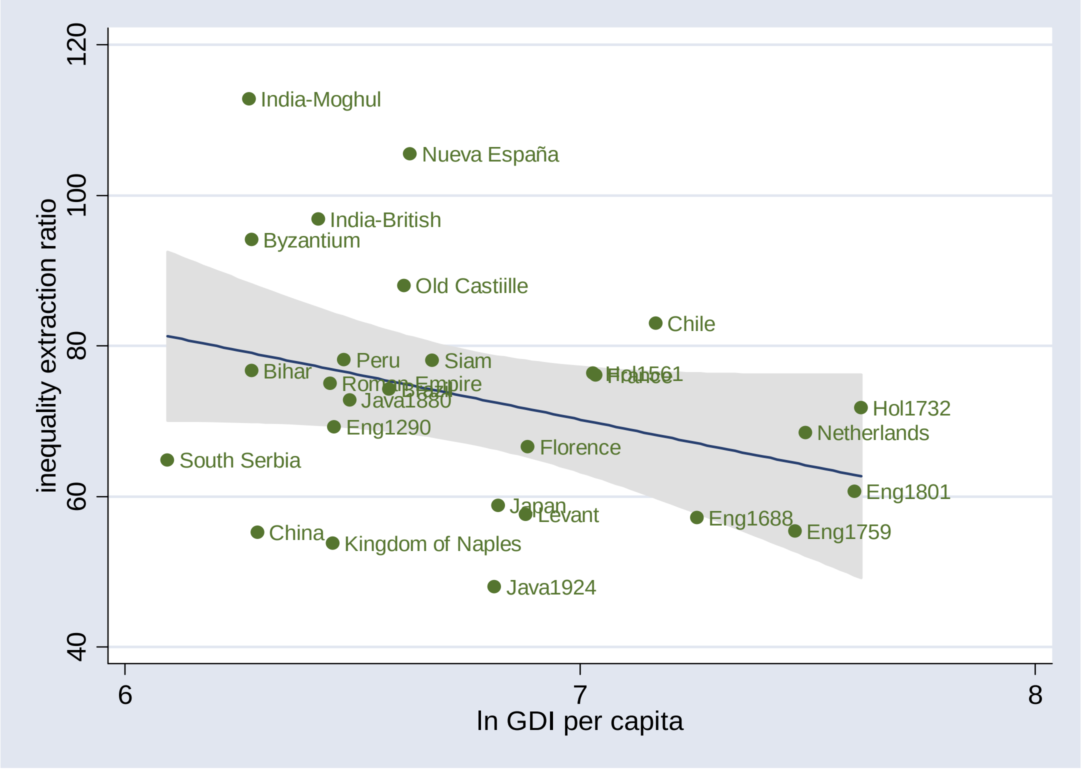
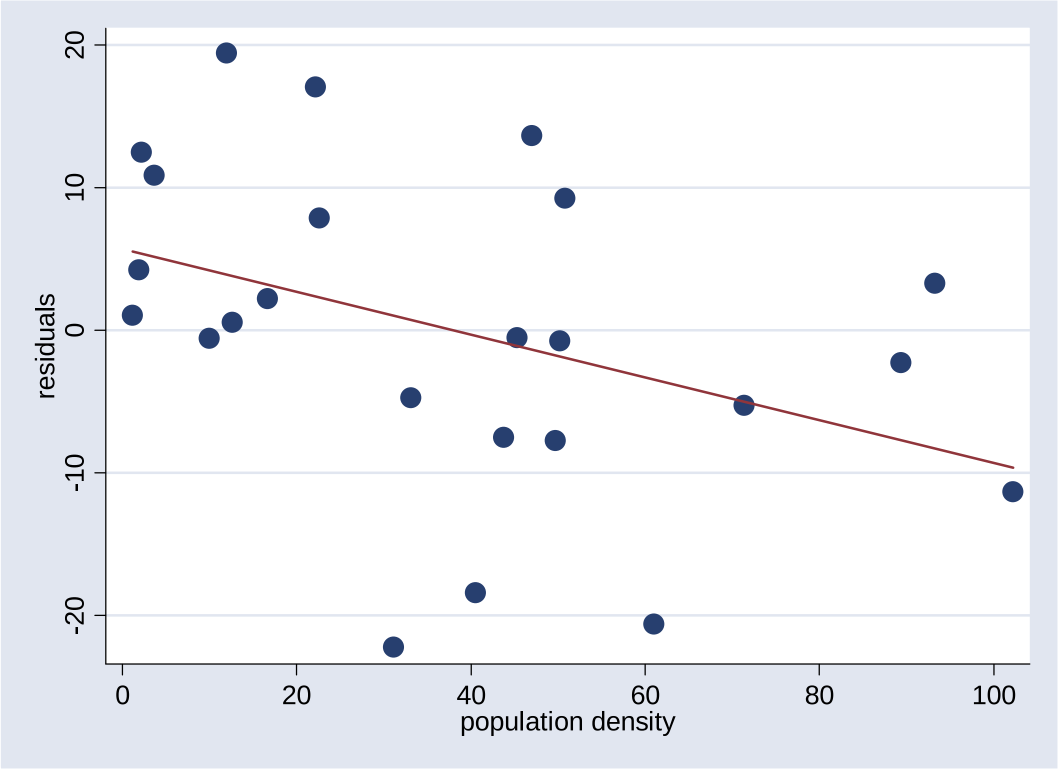
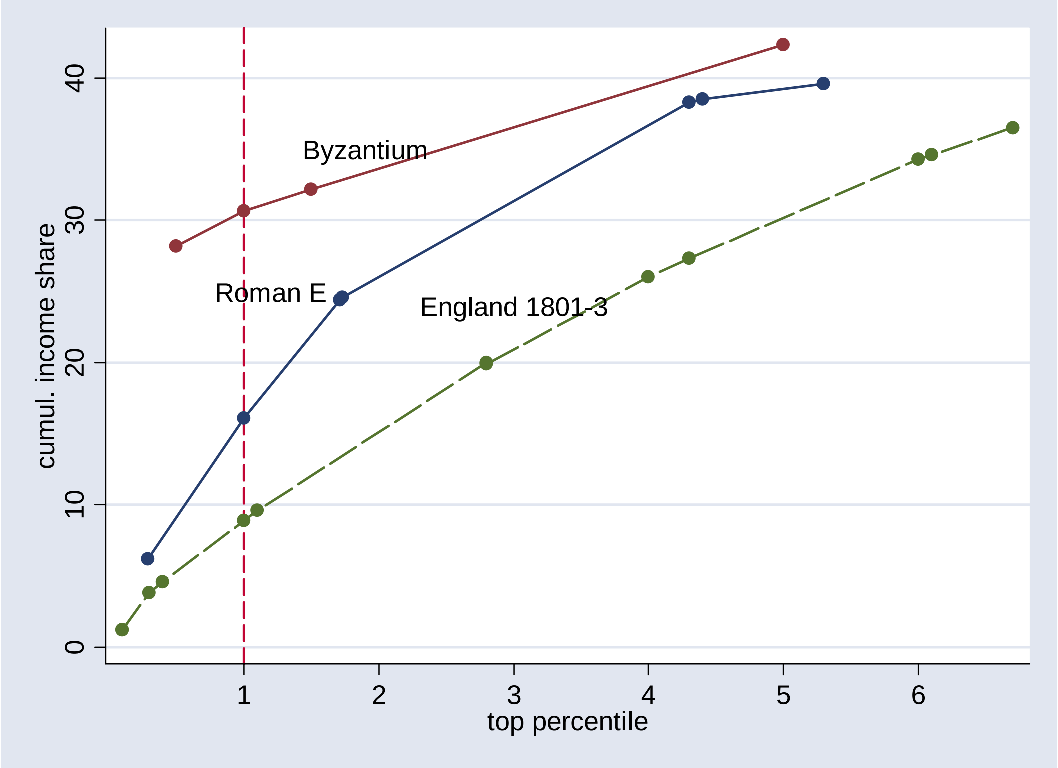


Figure 6. Population density and extraction ratio
(conditional on control variables from Regression 6, Table 3)



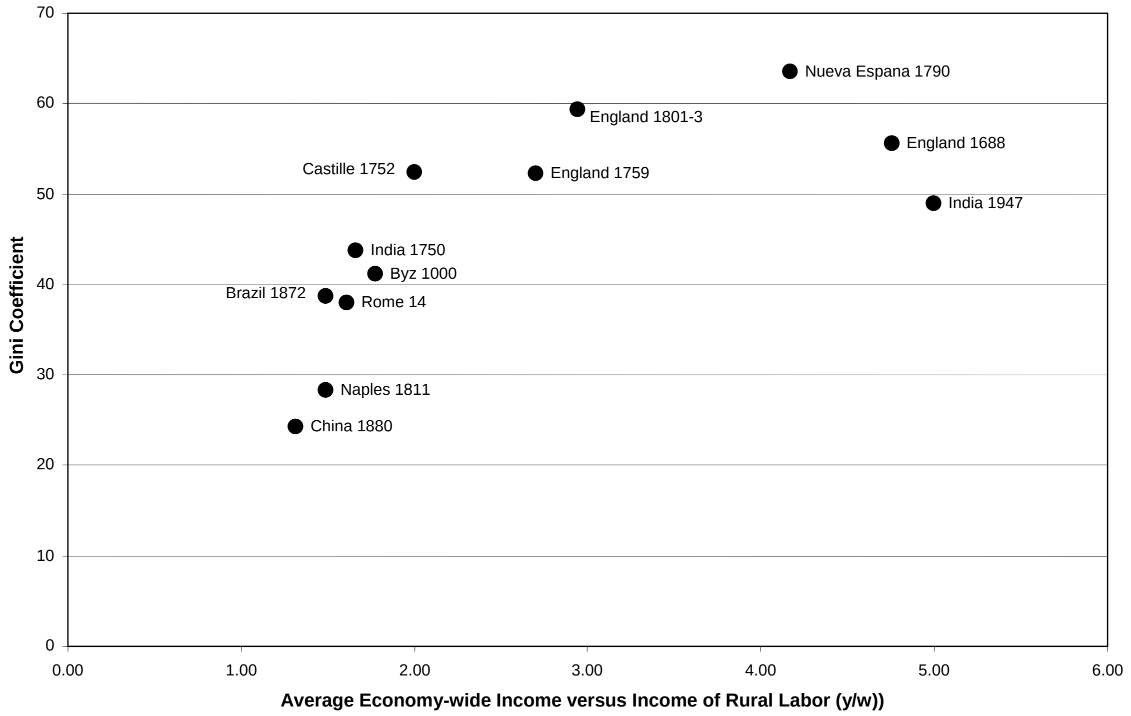
Note: Residuals from regression 6 (Table 3) where the two observations for Java are excluded.

Figure 7. Top five percentiles of income distribution in Byzantium 1000, Rome 14, and England 1801-3



Note: All data points except for the top 1 percent are empirical. The top 1 percent share is derived using Pareto interpolation.

Figure 8. Gini versus the y/w Ratio in an Ancient Sample of Twelve



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