7 November 2008

Ancient Inequality

Branko Milanovic, World Bank
Peter H. Lindert, University of California - Davis
Jeffrey G. Williamson, Harvard University and University of Wisconsin

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 29 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.

We acknowledge help with the data from Ken Andrien, Carlos Bazdresch, Luis Bértola, Arne Bigsten, Maristella Botticini, Gwyn Cambell, David Clingingsmith, Metin Cosgel, Gustavo Delangel, Rafa Dobado González, Regina Grafe, Jan Luiten van Zanden, Paolo Malanima, Leandro Prados de la Escosura, Pierre van der Eng, Jim Roumasset, Jaime Salgado and Javier Rodriguez Weber. Without their generous help the paper would have been impossible. The paper has also been improved by the comments of participants at various meetings where it was presented: EHA (September 2007), CIDE (October 2007), Carlos III (December 2007), World Bank (February 2008), Canterbury (March 2008), Australian National University (April 2008), Monash (May 2008), Warwick (May 2008), Paris School of Economics (July 2008), Center for Global Development (September 2008), IISH (October 2008), and Wisconsin (October 2008). We are also grateful for comments from Mihail Arandarenko, Francisco Ferreira, Andrew Leigh, Jaime Pozuelo-Monfort, and Martin Ravallion. Lindert and Williamson acknowledge financial support from the National Science Foundation (SES-0433358 and SES-0001362) and, for Williamson, the Harvard Faculty of Arts and Sciences.

JEL classification: D3, N3, O1
Key words: Inequality possibility frontier, pre-industrial inequality, history.
Number of words: about 11,050

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.

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

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

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.

[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.

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 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 about doubles 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.

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)

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

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

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 (total inequality due to inequality within classes), the second term is the between component (total 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

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

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

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

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

$$G^* = \frac{1-\varepsilon}{\mu}\left[\left(\mu - s(1-\varepsilon)\right) - s\varepsilon\right] = \frac{1-\varepsilon}{\mu}(\mu - s) \tag{5}$$

Finally, if we now express mean income as a multiple of the subsistence minimum, $\mu=\alpha s$ (where $\alpha \geq 1$), then (5) becomes

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

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

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

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) $1/50^{th}$ 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

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

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

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

This increase is unlikely to be substantial. Consider again our illustrative example where α=2 and ε=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, 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 (not simply all the surplus). Such extreme values are obviously just theoretical and devoid of any economic content since 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 the 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

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

may revolt and overturn the elite, suggesting that the subsistence level is itself endogenous to more than just equilibrating Malthusian physiological forces.[8]

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

Income distribution data based on large household surveys are almost never available for any pre-industrial society. In lieu of surveys, we derive seventeen of our 29 estimates of ancient inequalities from what are called *social tables* (or, as William Petty 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.[9] 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 social table examples 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 a higher Gini2, which estimates the maximum inequality compatible with the social tables grouped data 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 $y_j > y_i$,

[8] Note that in the special case where subsistence is zero, G* rises to the maximum value of 1 (or 100 in percentage terms). To see this, let $\alpha \rightarrow \infty$ in equation (6) (which is the case if s=0) and apply L'Hospital's rule.

[9] As far as we can determine, the compilers of the social tables did include income in kind produced by the consuming households themselves. Looking at the English source materials in particular, we find that Gregory King and others sought to know what different people consumed, and tied their income estimates to that. In addition, the tax returns they often used for their estimates seem to include assessments of owner-occupied housing.

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 between-class inequality 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.[10] (The overlap component L from equation (2) is by construction assumed to be zero.) 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). This means that our Ginis will be fairly good estimates of inequality for (i) class-structured societies and (ii) societies whose social tables are fairly detailed, that is include many social classes. If (i), then the overlap should be expected to be fairly small, as (say) all members of nobility are richer than all artisans, and the latter than all farmers. Similarly, when social tables are detailed (a topic we discuss below), the definitions become fairly precise, and the overlap is less. Athe extreme, a social table such that each individual representis a "social class" would make the overlap equal to zero.

Our Gini would be downward biased in cases where social tables present only a few classes but in reality the social structure is finely gradated—in that case, both Gini1 and Gini2 would miss lots of "overlap" inequality. However, we believe that such cases are unlikely. Why? When authors of social tables created these tables, their interest was in the salient income cleavages they observed around them. If a society was strongly stratified, it seems likely that these observers would present estimated average incomes for only a few groups; if in contrast a society was less stratified, it seems likely that the observers would tend to supply estimates for many more social groups (as King and Massie did for England and Wales). Thus, the number of social groups is likely to vary across societies, and the co-existence of a finely class-gradated society with a social table containing only a few social classes is very unlikely.

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

[10] 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).

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 leads us to believe that their inequality estimation is of similar or equal quality as the class-based estimations.[11]

[Table 1 about here]

Table 1 lists 29 pre-industrial societies for which we have calculated inequality statistics. (Detailed explanations for each income distribution are provided in the Appendix 1.) These societies range from early first-century Rome (Augustan Principate) to India in the year of independence from Britain in 1947. Since we assume, somewhat conservatively, an annual subsistence minimum of $PPP 300,[12] and with GDI per capita ranging in our sample from about $PPP 450 to just above $PPP 2000,[13] α ranges from about 1.5 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-

---

[11] As explained above, both approaches underestimate inequality by assuming that the mean income 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.

[12] 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.

[13] All dollar data, unless indicated otherwise, are in 1990 Geary-Khamis PPP dollars.

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 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 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 Gini1 and Gini2 values.

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.[14] 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 29 data points is 44.3, while the average Gini from the modern counterpart countries is 40.6[15] These are only samples, of course, but there is very little difference on average between them, 44.3(ancient) – 40.6(modern counterparts) = 3.7.[16] 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

[14] 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.

[15] 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).

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

the ancient and modern samples are many times greater than are differences between their averages.

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.

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.[17] The median and mean inequality extraction ratios in our ancient sample are 74.2 and 74.9 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.

Three estimated Ginis are equal to or slightly greater than the maximum Gini implied by the IPF (given level of income): Moghul India 1750 (an extraction ratio of 113 percent), Nueva España 1790 (an extraction ratio of 106 percent) and Kenya in 1927 (an extraction ratio of 100 percent). Recalling our definition of the IPF, these cases can only be explained by one or more of the following 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

[17] 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.

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 downwards, not upwards. The last possibility offers the most plausible explanation. In the case of Moghul India and Nueva España, 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 cannot, by definition, stay below subsistence for long. Such societies were not viable since the population could not be sustained. The fact that the only two such societies in our sample, 1750 Moghul India and 1790 Nueva España, were both notoriously exploitative seems to support the fourth explanation.

The observations for England and Wales, and Holland/Netherlands -- the only countries for which we have at least three pre-industrial observations -- are connected to highlight their historical evolution of inequality relative to the IPF. 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 about 69 percent in 1290, to 57 percent in 1688 and to about 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 a little more than 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 44 percent (Table 2). China's present *inequality extraction ratio* is almost 46 percent, while that for the United States is almost 40 percent, and that for Sweden almost 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).[18] Compared with the maximum inequality possible, today's inequality is *much* smaller than that of ancient societies.

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 about 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.

[Figure 3 about here]

[18] 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.

Another implication of our approach is that it considers inequality and development jointly. As a country becomes richer, its feasible inequality expands. Consequently, even if recorded inequality is stable, the *inequality extraction ratio* must fall; and even if recorded inequality goes up, the extraction 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. 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 98.6. 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 Pre-Industrial Inequality and the Extraction Ratio

Using this 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, whether the social table is based on tax data, and whether the social table for a colony includes income for the colonizers. 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 able to achieve higher extraction ratios than weaker local elites, and since countries with weak local 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 less than 1 percent levels, strongly supporting a (conditional) 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 0.35 points. Colonies are clearly much more unequal: holding everything else constant, a colony would have a Gini about 12-13 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 (almost 10 points) compared to what one might expect.[19] 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 percent of that spread, a big influence indeed.

The number of social groups that we use in our inequality calculations does not seem to affect the Gini values. In the regression analysis of the extraction ratio, we shall

[19] 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.

experiment with different upward-adjusted values of the Gini (and hence higher values of the extraction ratio) to find out if our results are sensitive to the way Ginis were calculated, and, in particular, to the difference in the number of social groups used in the calculation.

[Table 3 about here]

Population density 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. One might have thought that the introduction of a dummy variable for more densely populated Asian countries would have caused the effect of density to dissipate. This is not the case, as shown by regression 2 (Table 3).[20] Thus, inequality is associated with lower population density and lower labor-land ratios, at least in our sample. If this effect holds for larger samples, what might explain it? Conventional economics gave us a strong prior which has been rejected: higher labor-land ratios in agrarian systems imply higher rents per hectare and lower labor productivity, and thus more inequality. Although we cannot explore competing explanations for this density result with our ancient inequality evidence, we can list some likely candidates. Here are two, with opposite causal chains. First, where land was scarce, land intensive products, like food grains, should have been expensive, especially in ancient times when there was no global grain market. Expensive grains implied the necessity of more nominal income to purchase a subsistence quantity of foodstuffs, and thus the appearance of lower measured inequality (and extraction ratios). Second, less

[20] True, when we eliminate the two Java observations, a region with the highest population density in our sample and with relatively low inequality, the negative coefficient on population density begins to lose its statistical significance at conventional levels (although barely so, since it is still significant at 5.3 percent).

exploitative societies, which arose for reasons we do not know, might have allowed higher subsistence (lower inequality and extraction ratios), bigger survival rates, larger populations, and thus greater density.

When exploring the determinants of the extraction ratio, theory is less helpful. A simple plot of the extraction ratio against ln GDI per capita displays a negative and statistically significant relationship (see Figure 5). In regression 4 (Table 3), the extraction ratio is regressed against much 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 16.2 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 25 extraction ratio points). Similar to the inequality result, greater population density is strongly associated with lower extraction ratios. The result persists even after we eliminate observations for Java (regression 6), although only at the 5 percent significance level. Figure 6 plots population density against the residuals from regression 6 (which omits the two observations from Java: see footnote 20). As can be seen, the relationship is still strongly negative.

[Figures 5 and 6 about here]

To explore the sensitivity of these results to the issue of measurement, we introduce three additional computations of the Gini. First, we use Deltas' (2003) correction whereby the measured Gini is adjusted by the n/n-1 ratio, where n is the number of social groups. [23] Second, we use information from the bootstrapped standard errors of the Gini. As expected, standard errors are generally greater the fewer the

[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).

[23] Deltas adjustment for small-sample Ginis is derived for the "usual" case where Gini is estimated from the ordered fractile data (and where the overlap component between the fractiles is, by construction, zero). We apply it here in a somewhat different context (where incomes of various social groups may overlap).

number of social groups.[24] We thus adjust our measured Ginis by adding, in one case, ½ of standard error, and in the other case, one standard error.[25] The regressions (reported in Appendix 4) show that all the main results carry over. The only notable change is that the coefficient on population density, in a formulation that omits the two observations from Java, is significant only around the 10 percent level. Simultaneously, the role of higher income in reducing the extraction ratio, particularly when Gini is revised upward a lot (measured Gini + one standard error), becomes stronger. We conclude that the population density results are not fully robust to some alternative upward Gini adjustments *combined* with the elimination of the two extreme population density observations.

When we draw together the analyses of inequality and the extraction ratio, the 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 capita rises, it does not increase to the full extent made possible by the larger surplus, so that the extraction ratio falls. In addition, 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. Finally, colonies record very high inequality and extraction ratios throughout.[26]

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.

---

[24] The correlation coefficient is -0.46.

[25] Because our measured Ginis do not include the "overlap" component, they underestimate "true" Ginis.

[26] With one exception, the data sources use the gross national income accounting convention, which measures global incomes for residents of a place. Thus the estimates include as "Indian" those British citizens resident in India, whereas those resident in Britain getting incomes from India are included in the British income distribution. The one exception is the estimate for the Roman Empire, which unavoidably aggregates the colonizing and colonized populations together (and for many reasons, Roman Empire may be considered a single political entity).

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 which appeals to the region's persistent inequality since 1492. 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 northwestern Europe. It would be damaged if we can show that inequality in England, Holland and France, prior to their industrial revolutions, was greater than or equal to that of 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).

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.[27] 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,

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

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 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).[28]

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 (+0.18) and statistically insignificant.[29] 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 poor correlation between the top 1 percent and overall inequality in the ancient pre-industrial sample is also supported by more evidence. Table 4 also reports modern counterparts to our ancient economies as well as a few other modern countries. Among the modern counterparts, those with the highest top 1 percent share (Mexico, Brazil) display values that are equal to the average for the ancient economies (about 14 percent of total income). Relatively low top 1 percent shares (from the UK at 7 percent to the Netherlands at 3.6 percent) plus low cut-off points (characteristic of advanced societies) announces modern distributions where the richest 1 percent are not extravagantly rich nor extremely different from the population average.[30] We have already noted that Gini coefficients in ancient and contemporary poor societies are quite similar, so the difference in the average top 1 percent shares between ancient and modern societies implies further support for the view that the link between top income shares and overall inequality is very weak between ancient and modern societies.

---

[28] 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.

[29] The correlation between the top 1% share and Gini coefficient among the modern comparators given in Table 4 is +0.97 (and statistically significant at less than 0.1 percent).

[30] The data for modern societies are calculated from household surveys that are, we believe, closer counterparts to our social tables than the top income shares calculated from tax data. The latter almost uniformly give higher values: for the developed countries, they range from about 5 to almost 15 percent of *gross* (pre-tax) income. We present these data for completeness in Table 4.

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

For fourteen of the 29 observations in our ancient inequality sample, we can measure the economic distance between the middle of the distribution and landless labor by computing the ratio of average income per recipient (y) to that of landless, unskilled rural laborer (w). Figure 7 plots the relation between the overall Gini and the y/w ratio.[31] The correlation between y/w and the Gini is positive and significant (0.52). The estimated relationship also implies an elasticity of the Gini with respect to y/w of 0.35: thus, for every 10 percent increase in y/w, the Gini rose by 3.5 percentage points. Low measured inequalities in China 1880 and Naples 1811 (Ginis of 24.2 and 28.4: Appendix 2) were consistent with small gaps between poor rural laborers and average incomes (y/w of 1.32 and 1.49: Appendix 2), or with a rural wage two-thirds to three-quarters of average income. High measured inequalities in Nueva España 1784-99 and England 1801-03 (Ginis of 63.5 and 51.4) 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 possible outlier to the otherwise tight relationship in Figure 7, British India in 1947. The overall relationship suggests 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, Gini has a significant correlation with y/w, but an insignificant 0.02 correlation with the share received by the top 1 percent.[32]

[Figure 7 about here]

6. New Inequality Insights and an Agenda for the Future

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

First, income inequality in pre-industrial countries today is not very different from inequality in distant pre-industrial times.[33] In addition, the variance of inequality among

[31] 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).

[32] This 0.02 correlation refers to the 26 cases in Table 4. When we reduce the sample to the same 14 cases used for y/w, the correlation between the top 1 percent share and the overall Gini becomes negative 0.21.

[33] 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

countries then and now is much greater than any difference in average inequality between them then and now.

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, repressive and extractive are the elite, its institutions, and its policies. Regression analysis suggests that colonies are much more unequal and have far higher extraction rates. In addition, ancient pre-industrial societies passed through a Kuznets Curve, inequality rising steeply until the beginning of modern economic growth. Economic development also tends to diminish the extraction ratio. This latter finding suggests that even in pre-industrial societies the elite do not fully exploit their opportunity to capture more of the rising surplus as average incomes increase. 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 appearance in the twentieth century of universal suffrage and the rise of the welfare state. Once the analysis control for these and other factors, there is no evidence left to support the view that high inequality has always been a special characteristic of Latin America, or that low inequality has always been a characteristic of Asia. Finally, greater population density is correlated with lower inequality.

Third, our ancient pre-industrial inequality sample does not reveal any significant correlation between the income share of the top 1 percent and overall inequality, unlike recent twentieth century findings for industrial and post-industrial societies. Pre-industrial societies could and did achieve high inequality in two ways: in some, a high income share of the elite coexisted with a yawning income gap between it and the rest of society, with small income differences among the non-elite; in others, those at the very top of the income pyramid were followed below 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 explored

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).

inequality over two millennia, it has not explored the social structure underpinning that inequality, its determinants, and its impact. We plan to pursue this issue in future work.

References

Acemoglu, Daron, Simon Johnson, and James Robinson (2001), "The colonial origins of comparative development," *American Economic Review*, 91, 5: 1369-1401.

Atkinson, Anthony B. and Wiemer Salvedra (2003), "Top Incomes in the Netherlands and the United Kingdom over the Twentieth Century", manuscript, June 2003.

Atkinson, Anthony B. (forthcoming), "Measuring top incomes: Methodological issues," in A. Atkinson and T. Piketty (eds.), *Top Incomes over the Twentieth Century*, Oxford: Oxford University Press.

Atkinson, Anthony B. and Thomas Piketty (eds.) (forthcoming), *Top Incomes over the Twentieth Century*, Oxford: Oxford University Press.

Bairoch, Paul (1993), *Economics and World History: Myths and Paradoxes*, New York: Harvester Wheatsheaf.

Banerjee, Abhijit and Thomas Piketty (2005), "Top Indian Incomes, 1922-2000," *World Bank Economic Review* 19, 1: 1-20.

Barnett, G. E. (1936), *Two Tracts by Gregory King*, Baltimore: Johns Hopkins University Press.

Bray, Francesca (1986), *The Rice Economies: Technology and Development in Asian Societies*, Oxford: Basil Blackwell.

Chen, Shaohua and Martin Ravallion (2007), "Absolute Poverty Measures for the Developing World, 1981-2005," World Bank Research Development Group, Washington, D. C.

Clark, Colin (1957), *The Conditions of Economic Progress*, 3rd ed., London: Macmillan and Co.

Deininger, Klaus and Lynn Squire (1996), "A New Data Set Measuring Income Inequality," *World Bank Economic Review* 10, 3: 565-91.

Deltas, George (2003), "The Small Sample Bias of the Gini Coefficient: Results and Implications for Empirical Research," *Review of Economics and Statistics* 85 (1): 226-34.

Engerman, Stanley and Kenneth Sokoloff (1997), "Factor Endowments, Institutions, and Differential Paths of Growth Among New World Economies," in *How Latin America Fell Behind,* ed. by S. Haber, Palo Alto, Cal.: Stanford: 260-304.

Engerman, Stanley, Stephen Haber and Kenneth Sokoloff (2000), "Institutions, Factor Endowments, and Paths of Development in the New World," *Journal of Economic Perspectives* 14, 3: 217-32.

Jones, Eric L. (1981), *The European Miracle*, Cambridge: Cambridge University Press.

Kakwani, Nanak (1980), *Income, Inequality and Poverty: Methods of Estimation and Policy Applicati*ons, Oxford and Washington, D.C., Oxford University Press and World Bank.

Kuznets, Simon (1955), "Economic Growth and Income Inequality," *American Economic Review* 45, 1: 1-28.

Kuznets, Simon (1976), "Demographic Aspects of the Size Distribution of Income: An Exploratory Essay," *Economic Development and Cultural Change* 25 (October): 1-94.

Leigh, Andrew (2007), "How Closely Do Top Income Shares Track Other Measures of Inequality?" *Economic Journal*, 117, 524 (November): F619–F633

Leigh, Andrew and Pierre van der Eng (2006), "Top Incomes in Indonesia, 1920-2004," unpublished, Australian National University (February 11).
Lindert, Peter H. and Jeffrey G. Williamson (1982), "Revising England's Social Tables, 1688-1812," *Explorations in Economic History* 19, 4: 385-408.
Maddison, Angus (1998), *Chinese Economic Performance in the Long Run*, Paris: OECD Development Centre.
Maddison, Angus (2003), *The World Economy: Historical Statistics*, Paris: OECD Development Centre.
Maddison, Angus (2004), *World Population, GDP and Per Capita GDP, 1-2001 AD*, available at http://www.ggdc.net/Maddison/content.shtml.
Milanovic, Branko (2006), "An estimate of average income and inequality in Byzantium around year 1000," *Review of Income and Wealth* 52, 3: 449-70.
Milanovic, Branko, Peter H. Lindert and Jeffrey G. Williamson (2007), "Measuring Ancient Inequality," *NBER Working Paper 13550*, National Bureau of Economic Research, Cambridge, Mass. (October).
Moriguchi, Chiaki and Emmanuel Saez (2005), "The Evolution of Income Concentration in Japan, 1885-2002: Evidence from Income Tax Statistics," unpublished, University of California, Berkeley.
Petty, William (1690; written circa 1676), *Political arithmetick, or, A discourse concerning the extent and value of lands, people, buildings* … London: Clavel and Mortlock.
Piketty, Thomas and Emmanuel Saez (2001), "Income Inequality in the United States, 1913-1998," *NBER Working paper No. 8467*, National Bureau of Economic Research, Cambridge, Mass.
Piketty, Thomas (2003), "Income Inequality in France, 1901-1998," *Journal of Political Economy* 111, 5: 1004-42.
Piketty, Thomas (2005), "Top Income Shares in the Long Run: An Overview," *Journal of European Economic Association* 3, 2-3: 1-11.
Piketty, Thomas and Emanuel Saez (2003), "Income Inequality in the United States, 1913-1998," *Quarterly Journal of Economics* 118, 1: 1-39.
Piketty, Thomas and Emanuel Saez (2006), "The Evolution of Top Incomes: A Historical and International Perspective," *NBER Working Paper 11955*, National Bureau of Economic Research, Cambridge, Mass.
Prados de la Escosura, Leandro (2004), "Colonial Independence and Economic Backwardness in Latin America," Departamento de Historia Economica y Instituciones, Universidad Carlos III de Madrid, *Working Paper 04-65* (December).
Pryor, Frederic (1977), *The Origins of the Economy*. New York: Academic Press.
Pryor, Frederic (2005), *Economic Systems of Foraging, Agricultural, and Industrial Societies.* Cambridge: Cambridge University Press.
Ravallion, Martin, Shaohua Chen and Prem Sangraula (2007), "New evidence on the urbanization of global poverty," *Population and Development Review* 33, 4: 667-701.
Williamson, Jeffrey G. (1997), "Globalization and Inequality, Past and Present," *World Bank Research Observer* 12, 2: 117-35.
Williamson, Jeffrey G. (2002), "Land, Labor and Globalization in the Third World 1870-1940," *Journal of Economic History* 62, 1: 55-85.

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 Castille	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
Kenya	Social tables	1914	13	3.9	3816	582,600	6.5	456
Java	Social tables	1924	14	3	35170	126,700	277.6	909
Kenya	Social tables	1927	13	4.3	3922	582,600	6.7	558
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
Kenya 1914	33.1	33.2	0.04	1.5	34.2	96.8
Java 1924	31.8	32.1	0.18	3.0	66.9	48.0
Kenya 1927	41.6	46.2	0.10	1.9	46.2	100.0
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	*41.9*	*44.3*		*3.1*	*60.6*	*74.9*
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
Kenya 1998		44.4		4.5	77.6	57.2
Indonesia 2002		34.3		10.7	90.5	37.9
China 2001		41.6		11.5	91.2	45.6

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 %)*
Japan 2002		26.0		70.2	98.5	26.4
Thailand 2002		50.9		21.3	95.2	53.5
Average		*40.6*		*33.1*	*93.6*	*43.6*
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	360.5*** (0.001)	366.7*** (0.001)	360.2*** (0.002)	-20.92** (0.022)	-6.48 (0.36)	-6.45 (0.39)
GDI per capita squared	-25.0*** (0.002)	-25.5*** (0.002)	-25.0*** (0.003)			
Urbanization rate (in %)	0.349* (0.08)	0.354* (0.08)	0.353* (0.093)	0.677* (0.07)	0.229 (0.42)	0.236 (0.43)
Population density	-0.105*** (0.001)	-0.100*** (0.003)	-0.107* (0.053)		-0.188*** (0.000)	-0.200** (0.025)
Colony (0-1)	12.63*** (0.001)	12.93*** (0.001)	12.41*** (0.002)	16.12** (0.027)	25.52*** (0.000)	25.35*** (0.000)
Dno_foreign (0-1)	-9.59 (0.25)	-9.97 (0.25)	-9.26 (0.29)	-25.28** (0.03)	-39.20*** (0.000)	-39.23*** (0.000)
Asia (0-1)		-1.28 (0.69)				
Number of groups	-0.009 (0.16)	-0.009 (0.19)	-0.010 (0.18)			
Tax survey (0-1)	-4.86 (0.57)	-4.85 (0.24)	-4.85 (0.28)			
Constant	-1246*** (0.001)	-1266*** (0.001)	-1245*** (0.002)	201.6*** (0.001)	117.6** (0.013)	117.6** (0.018)
No of obs Adjusted R^2	28 0.75	28 0.73	26 0.73	28 0.34	28 0.65	26 0.60

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

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
Kenya 1927	31.7	20.9	46.2
Byzantium 1000	30.6	3.7	41.1
Chile 1861	25.7	11.8	63.7
Kenya 1914	23.2	20.5	33.1
China 1880	21.3	5.6	24.5
Nueva España 1790	21.1	9.8	63.5
Peru 1876	20.8	9.6	42.2
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
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	*15.9*	*8.6*	*45.0*
Modern counterparts (based on household surveys)			
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*
Modern counterparts (based on tax data and gross income)**			
US 1998	14.5		39.9
UK 2000	13.0		37.4
France 1998	7.8		31,2
Japan 2005	9.2		26.8

India 1999	9.0	36.0
Netherlands 1999	5.4	28.1

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 99^{th} 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.
** These results are from tax studies of the share of top percentiles of tax payers' gross (before tax) income in total national gross income. Note that the top income share in household surveys, calculated on disposable income basis, would be less than the top share calculated from tax data (which refer to gross income) even if household surveys did not undersample or underestimate income of the very rich.
Source: For United Kingdom and the Netherlands, Atkinson and Salvedra (2003, Table2NL and 2UK, pp. 21-24). For US and France, Piketty and Saez (2001,Figure 17). For Japan, Moriguchi and Saez (2007, Figure 4). For India, Banerji and Piketty (2005, Figure 4).

Figure 1

Derivation of the Inequality Possibility Frontier

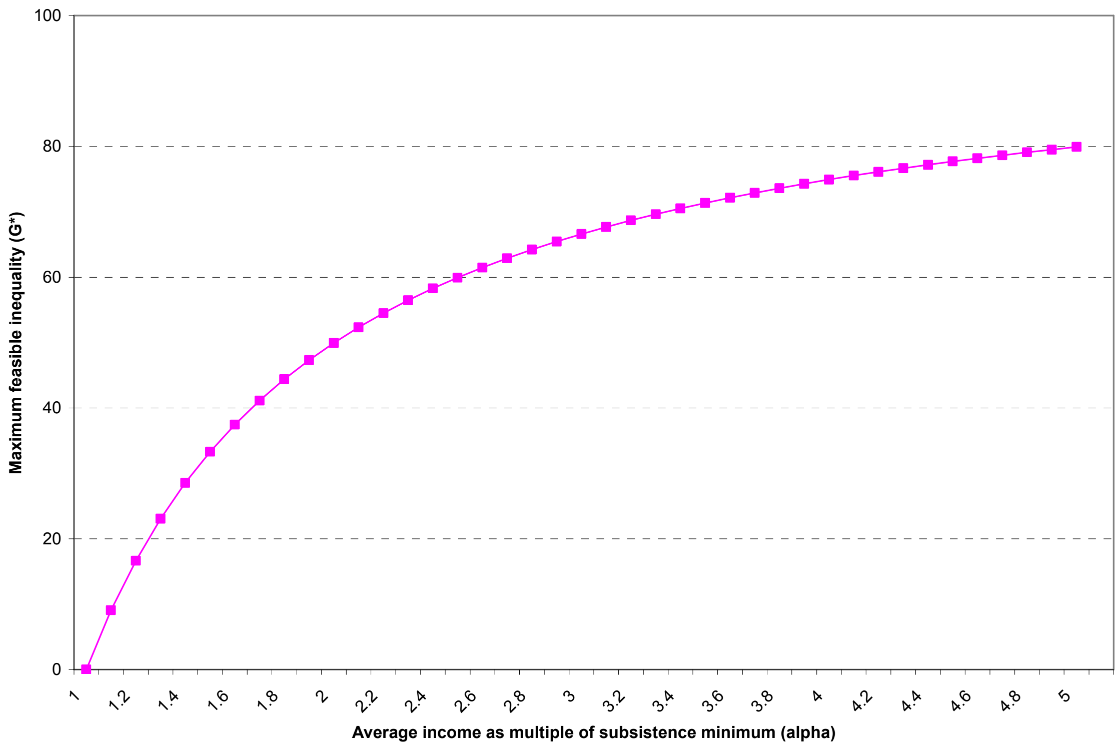
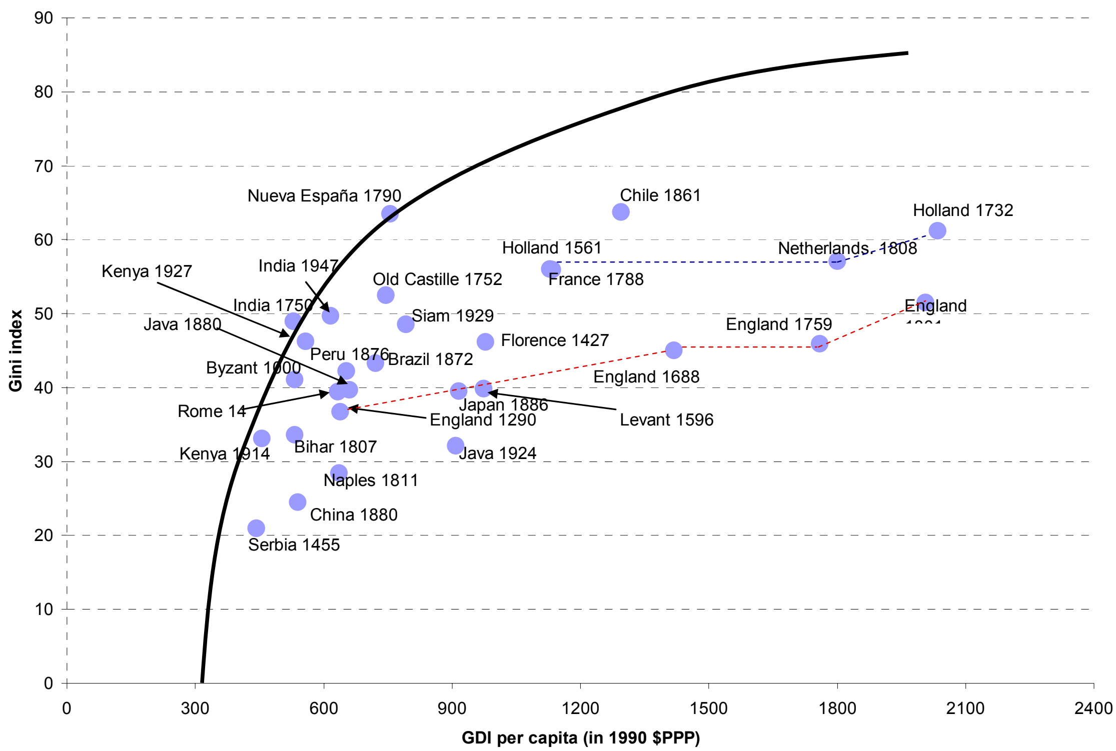
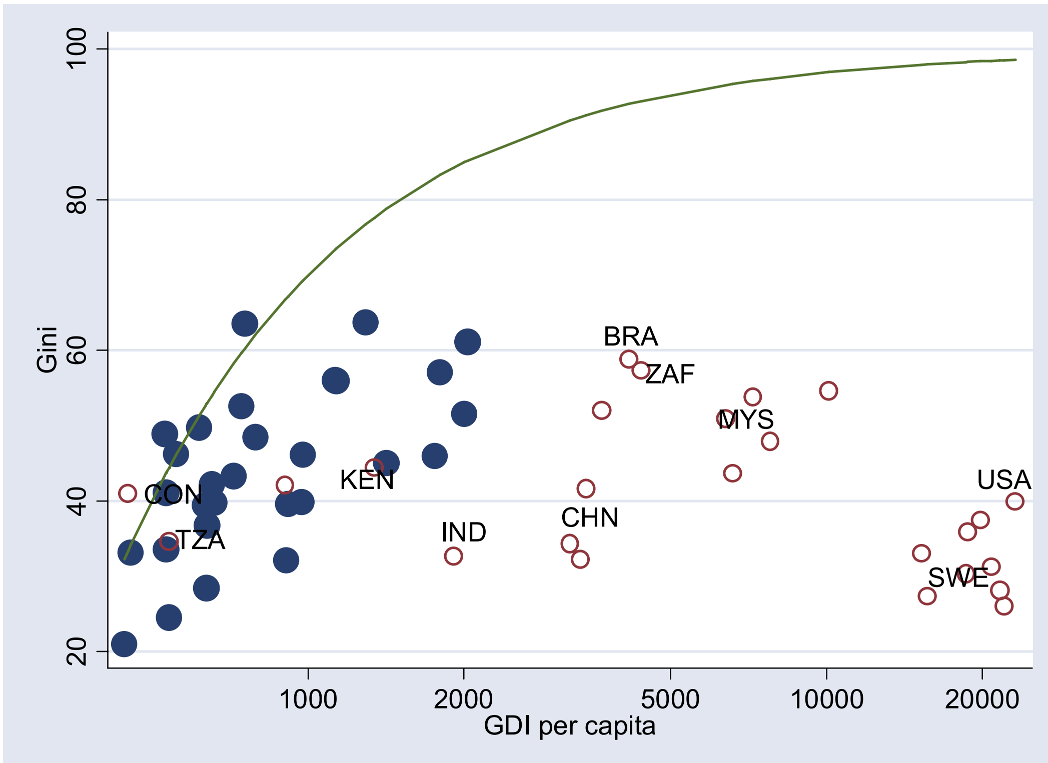


Figure 2
Ancient Inequalities: Estimated Gini Coefficients, and the Inequality Possibility Frontiers



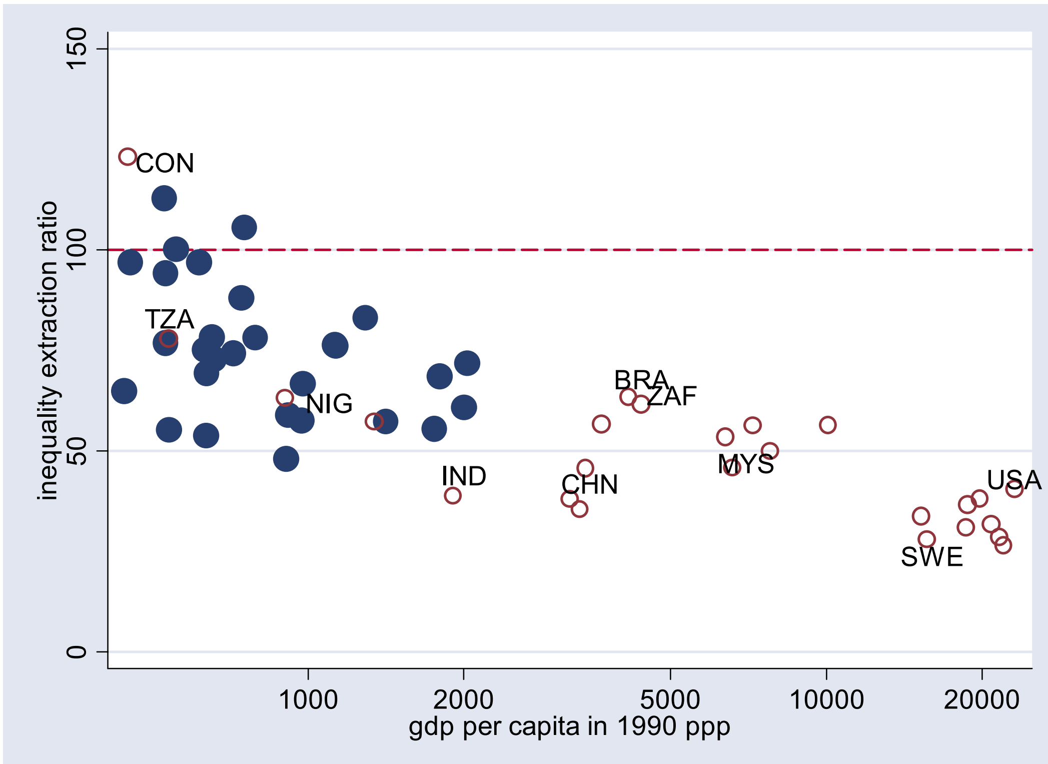
Note: The solid IPF line is constructed on the assumption that s=$PPP 300. The Gini index is estimated Gini2.

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 300 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

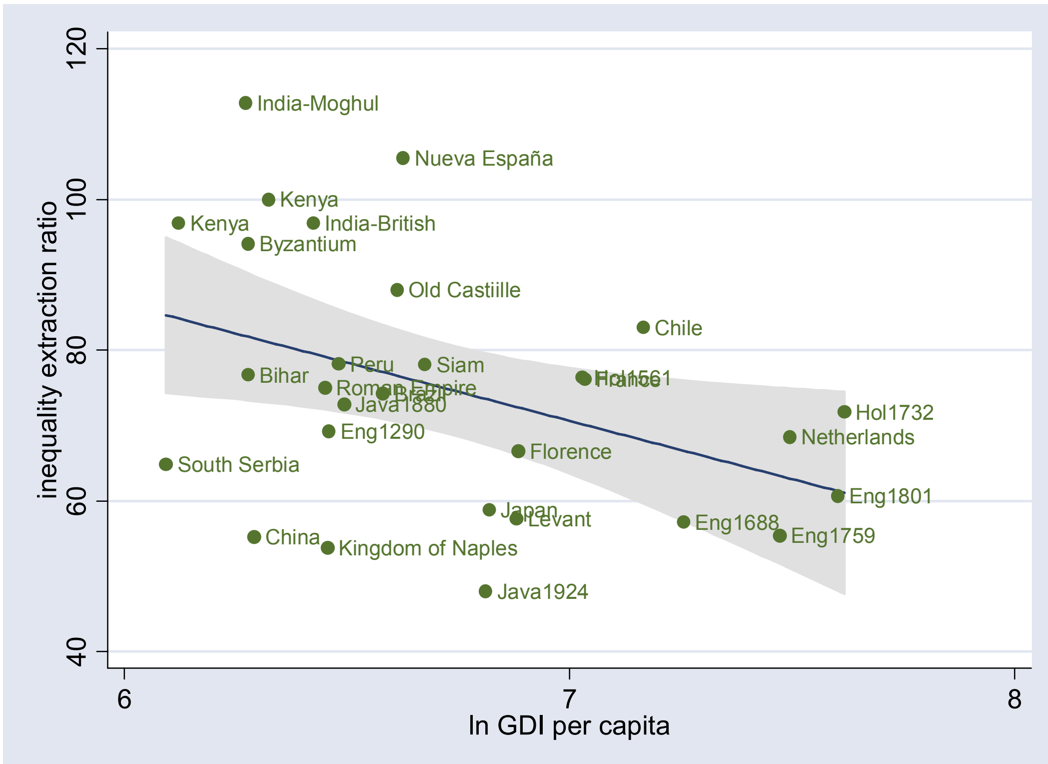
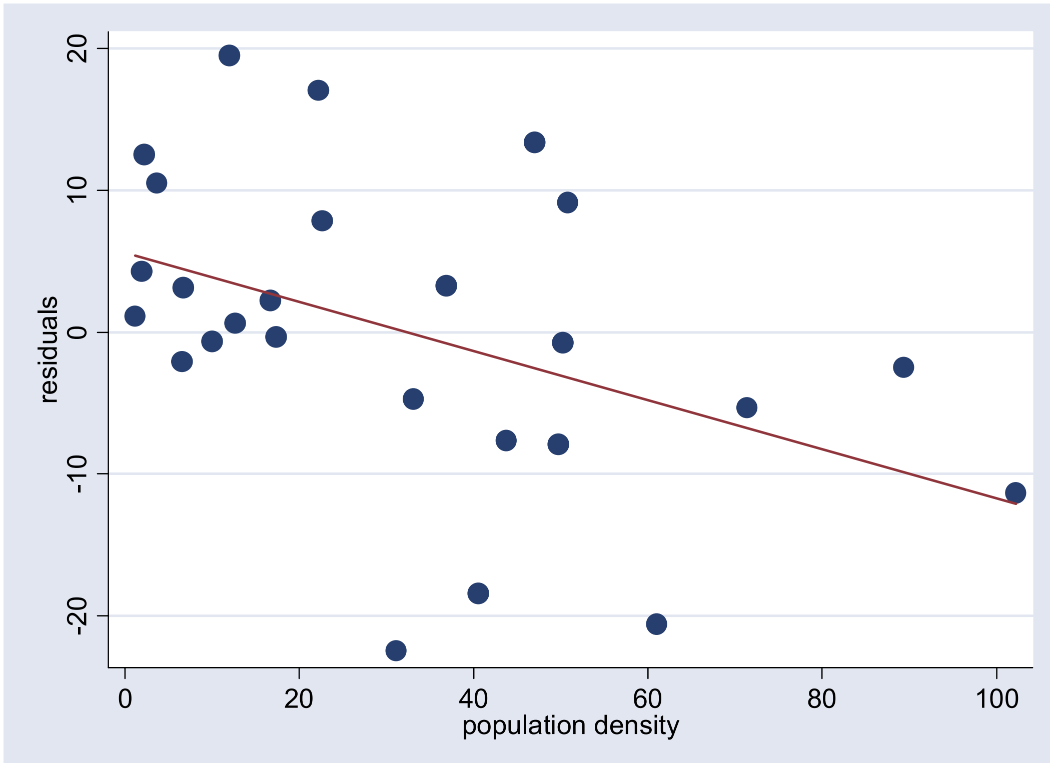


Figure 6. Population Density and Extraction Ratio
(conditional on control variables from Regression 6, Table 3)



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

Figure 7. Gini versus the y/w Ratio in an Ancient Sample of Fourteen