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A short history of global inequality: The past two centuries ☆

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ABSTRACT

Using social tables, we make an estimate of global inequality (inequality among world citizens) in early 19th century. We then show that the level and composition of global inequality have changed over the last two centuries. The level has increased reaching a high plateau around 1950s, and the main determinants of global inequality have become differences in mean country incomes rather than inequalities within nations. The inequality extraction ratio (the percentage of total inequality that was extracted by global elites) has remained surprisingly stable, at around 70% of the maximum global Gini, during the last 100 years.

1. Introduction

1.1. Pre-industrial global inequality

The studies of global, and a fortiori, global pre-industrial inequality are a relatively recent phenomenon and they are few in numbers. Obviously, the reason is the lack of household survey data that are needed to estimate global inequality, that is, income. The lack of household surveys and their variable quality are problems that plague even *contemporary* studies of global inequality. They are much more severe for the studies of past inequality. But even the very concept of global inequality – that is, of measuring and comparing incomes of (theoretically) all individuals in the world – is a new one, both because the idea of such a study had to wait for a more advanced stage of globalization to take hold, and because it crucially depends on the availability of purchasing power parity estimates that are needed to convert incomes expressed in national currencies into a single global numeraire.

There are only two long-run empirical historical studies of global inequality. The first and seminal work was done by François Bourguignon and Christian Morrisson in their 2002 *American Economic Review* paper which estimated global inequality from 1820 to 1992. The estimates were made at more or less regular twenty-year intervals. The Bourguignon–Morrisson approach relied on two building blocks. The mean incomes of countries were taken from Maddison (2004 or earlier) while 33 income distributions of uneven qualities and coverage were put together by Christian Morrisson to represent various parts of the globe. "Similar" countries were allocated the same income distribution, coming from a country for which such data were available. This has, for obvious reasons, led to many simplifications. In addition, Bourguignon and Morrisson used in many cases the 20th century distributions to "interpolate" (backward predict) the 19th century distributions for the countries for which 19th century data were unavailable. Thus, the number of data points (fractiles of the distributions) which they show for each benchmark year, say, 1820, 1850 etc. (33

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"countries" times 11 fractiles [1]) are not all really independent and contemporary data points but estimates based on posterior data.[2] Although their approach was in several respects less than ideal, it was, at that time, perhaps the only possible since historical income distributions are so scarce.

More recently, van Zanden, Baten, Foldvari and van Leeuwen (2010) [in the rest of the text ZBFL] have expanded and improved on the Bourguignon and Morrisson approach by using for the countries for which actual income distribution data were lacking either (i) an estimate of inequality based on the evolution of the unskilled wage/GDP ratio,[3] or (ii) by substituting for the missing income distributions, the data on the distribution of individual heights. For (i), if unskilled wage-to-GDP ratio increases, the assumption is that income inequality declines; for (ii), if there is a strong correlation between distribution of individual heights and distribution of income, then we can "enrich" the dataset on countries' income distributions by adding the data on countries for which we possess the distributions of heights.[4] In that way, the Bourguignon–Morrisson "backward projections" are not used at all. The other building block of the exercise, the reliance on Maddison's GDP per capita data, remained. [5]

In this paper, I proceed to do three things. First, I use social tables from thirteen 18th and 19th century countries to estimate global inequality for the early 19th century. Social tables have not been used for such a purpose before. Second, I present the evolution of global inequality from the beginning of the 19th to the beginning of the 21st century that at its two end-points relies on my own estimates, and uses Bourguignon–Morrisson or ZBFL estimates for the years in-between. Third, I apply the concept of the inequality extraction ratio, used earlier by Milanovic (2006), and Milanovic, Lindert and Williamson (2007, 2011) for a within-country framework, to the global scale. In other words, I ask how close global inequality to its maximum feasible amount during the last two centuries was. I conclude the paper with some speculative notes.

2. Global inequality in the early XIXth century

2.1. The data

Let us start with the two building blocks. For GDP per capita, I too use Maddison's data for all countries for which they are available. I do this, to some extent, *faute de mieux* because Maddison's data may be in the need of serious revisions on account of new, and for China, India, Indonesia etc. dramatically different, estimates of the domestic price levels by the 2005 International Comparison Project. The upward revisions of domestic price levels led to the corresponding reduction of these countries' current PPP (purchasing power parity) "real" incomes. This *level* change then carries over to the historical income levels which are calculated by applying past domestic real growth rates to the 2005 level.[6] However, since these revisions have not yet been done by the economic historians who are in charge of expanding and updating the Maddison series nor by anyone else. I use Maddison's, 2004 GDP per capita data expressed in Geary-Khamis 1990 international dollars.

The second building block, the income distribution data, comes from the social tables for 13 countries that have been calculated by different authors and put together within a single framework by Milanovic, Lindert and Williamson (2007, 2011) [in the rest of the text MLW]. The social tables are our unique source of information about income distributions in pre-industrial societies where neither household surveys nor tax censuses were conducted. Following upon the first social table created by Gregory King for England and Wales in 1688, social tables list salient social classes and give estimates of their average incomes and number of people or households who belongs to them. Some social tables are more detailed and cover the entire range of the income pyramid, from the top (e.g. high nobility) to the bottom (vagrants and beggars). Others are, of course, more parsimonious or simple and may include just a few classes (nobility, merchants and urban population, and farmers). MLW (2011) studied pre-industrial inequality using twenty eight such social tables, some of which were created by the contemporary authors and others by economic historians. (Detailed explanation of all social tables is available in an annex to MLW papers.)

For the "early" 19th century, I use the "time window" of 1750–1880. The time window is wide. This is due to the fact that, in order to have a sufficiently comprehensive coverage of the world, I need to include both India and China. Now, the social table for the Moghul India is available for the year 1750, while the first available social table for China is for the year 1880. The dates of these two social tables therefore frame our time window. In-between, from Europe, I have social tables from Old Castille 1752, France 1788, England and Wales 1801, the Netherlands 1808, and Kingdom of Naples 1811; from Latin America, I have Nueva España (Mexico, California and South-West of the United States) 1790, Chile 1861, Brazil 1872 and Peru 1876. Finally, there is an additional social table from Asia (Java 1880), and one from Africa (Maghreb 1880).

As this list makes clear, the future advanced (developed) countries have their social tables up to the early 19th century only. That was intentionally done in MLW paper, which dealt with pre-industrial inequality, so as to limit the investigation to not yet industrialized countries. As is conventionally believed, after the end of the Napoleonic wars, Great Britain, France, Belgium and the Netherlands already

[1] For 33 "representative" distributions, Bourguignon and Morrisson give 11 data points per country (nine bottom deciles and two top ventiles). However, these are the already "processed" data and it is not clear how many actual independent data points the authors had. For example, if only a Gini is available for a given country/year and the authors assume a lognormal distribution, then there is not a single fractile datum, but just an overall statistic (the Gini) available. It is also possible, that, basing themselves on published quintiles, Bourguignon and Morrisson estimated deciles. None of that is very clear.

[2] The point was made by van Zanden, Baten, Foldvari and van Leeuwen (2010).

[3] The approach was pioneered by Williamson (1998). It was used most recently by Prados de la Escosura (2008).

[4] The approach was introduced by Baten (2000).

[5] ZBFL also introduce GDPs per capita calculated using the "new" 2005 PPPs. They are obtained by the application of the real growth rates from the standard Maddison series to the 2005 benchmark GDPs (expressed in 2005 PPPs).

[6] See Milanovic (forthcoming).

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engaged into industrialization. But for other countries, MLW collected social tables up to a much later date (since these countries were still pre-industrial). In the context of this paper, it means that one can argue that treating the whole sample as giving a snapshot of pre-industrial global inequality, around early to mid-19th century, does not involve a significant bias. This is because GDP per capita of countries that enter our sample at later dates (the three Latin American countries, Maghreb, Java and China) registered no appreciable economic progress between the early 19th century and 1860–1880 when they enter the sample. According to Maddison (2004), China's GDP per capita decreased from $PPP 600 in 1820 to $PPP 530 in 1870 (no datum for 1880 is given). For Indonesia, the change was from $PPP 612 in 1820 to $PPP 654 in 1880. For Brazil, from $PPP 647 in 1820 to $PPP 718 in 1870. Since most of the global inequality after 1820 was driven by fast growth of the industrializing nations while economies and income distributions of other nations were basically stagnant between the early 19th century and 1870–1880 when they enter the sample, we can assume that our sample gives a reasonable snapshot of global inequality for the period around 1820. This particular approach, where data from different years are supposed to "represent" the situation in one selected year, is made unavoidable in such empirical studies due to the fact that income distribution data for the past are both fragmentary (we do not have full income distributions) and sparse (we have such fragmentary data only for a few disparate years). "Anchoring" them in one "central" year thus becomes the only way to create a "global" distribution. [7]

The social tables from the period 1750–1880 include 650 million people. According to Maddison, total world population increased from almost 1 billion in 1820 to 1.1 billion in 1850 to 1.2 billion in 1870. Therefore an average population at any point in time between 1750 and 1880 can be estimated at around a billion. Our time-window therefore comprises around 2/3 of the world population living at any point between 1750 and 1880.

Now, we need to address two important issues brought up by these data. First, are social tables an acceptable source to estimate inequality in pre-industrial societies, and second, how is the currency conversion into a single international dollar done?

2.2. Can social tables be used to estimate national inequalities in pre-industrial societies?

It is important to emphasize that social tables are used only for pre-industrial societies, that is for the future advanced economies, up to the period of the Napoleonic wars, and for the rest of the world up to 1880. It is also the case that since no distributional data exist for these countries and periods (neither tax data, nor household surveys), social tables are probably the best (or perhaps, the only) source of data. They have recently been used for the first half of the 20th century Indonesia even in preference to the expenditure surveys which exist (van Leeuwen and Foldvari, 2010). The implicit assumption that validates the use of social tables is that their creators have focused on salient economic groups, that is on social groups that were distinct in terms of their income. This is a reasonable assumption since it is difficult to believe that the authors' intention was to blur the distinctions and present a distibutional muddle rather than a sharp picture of social stratification and inequality.

But even if salient classes indeed are included, social tables still undoubtedly suffer from two biases which both reduce the estimated inequality below the "true" one. First, the number of classes can be small. This bias would naturally tend to be reduced as the number of social groups increases.[8] (Ultimately, a distribution across individuals can be seen as a distribution where each individual represents own separate social class.) In some testing of how Gini coefficient is sensitive to the number of social classes from which it is calculated, MLW finds that this effect is relatively small (the *p*-ratio on the coefficient on the number of social classes is never below 0.3). They however correct upwards the estimated Ginis by the heuristic correction suggested by Deltas (2003) for the case when Ginis are calculated from very few observations.

The second problem is more fundamental: each social class, even if well-defined and "salient", contains within it people with various incomes that are not solely dispersed around the class mean but "spill over" to the neighboring social classes, so that some people from a mean-poorer class (say, traders) can have incomes that are higher than incomes of some people who belong to a mean-richer class (say, nobility). In other words, each class average, by the very construction, "conceals" the actually-existing variability of incomes within that class. This problem has recently been addressed by Jorgen Modalsli (2011) who creates around each class-mean a lognormal distribution such that (1) its variance increases with the average income of the group, and (2) the maximum within-class variance is bounded from above by the extent of between-group variance of incomes. The assumption (1) creates around each class mean a distribution of individual incomes that are allowed to spill over to the neighboring (poorer and riches) classes. The assumption (2) limits that variability by setting a reasonable limit to even the most diverse group such that diversity of incomes within it must not exceed diversity of incomes that is observable *between* groups. This seems quite reasonable since diversity between salient social groups ought to be the largest as it underlies the creation of a social table. Formally, each within-group variance (s_i) is expressed as:

$$s_i = \alpha y_i^{\beta} \tag{1}$$

where α and β are the parameters to be estimated and y_i = mean income of *i*-th group. In addition, $s_t = G_b$ where G_b is total between-group inequality and *t* is a subscript denoting the richest class. This latter constraint allows us, once we set β to retrieve α. Since the constraint will vary from one social table to another (G_b is obviously social-table specific) so will α. Also, if we wish to make within-group variance increase with mean income of the group, β must be greater than 0. We use here Modalsli's results for three βs: 0.5, 0.75 and 1.[9] The results differ very little as between different β's.

[7] The same approach is used by both Bourguignon and Morrisson (2002) and ZBFL (2010).

[8] The terms "social class" and "social group" are used interchangeably.

[9] Under the specific assumption of "well-apportioned classes" (see Modalsli, 2011, pp.12–13).

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Modalsli-corrected Ginis increase significantly compared to the original situation where we calculate inequality across mean class incomes alone. On average, Ginis rise by some 15 points, and in the extreme cases by as much as 19 Gini points.[10] To be somewhat conservative, even if the differences are minimal, we use the version with $\beta = 0.5$ and (obviously) with α's varying across social tables. Modalsli-type introduction of within-class variability allows us to estimate an overall "stretched-out" distribution for each country—based on discrete incomes of each social class but, thanks to the adjustment, rendered continuous.[11] This, in turn, allows us to create deciles (or any other fractile) of income distribution. Thus we introduce much greater variability in our initial county distributions and are able to go beyond the use of social class mean incomes. These results are further discussed in Section 2.4 below.

2.3. How are average social group and decile incomes converted into equivalent 1990 PPPs?

The 13 social tables that we use have in total 591 social groups or classes. That means that we have average incomes, expressed in national currencies, for 591 social groups. (One such social table for England and Wales 1801–03 is given in the Annex 1.) These national currency incomes per social group are converted into 1990 PPP dollars by two methods: (*a*) using Maddison GDP per capita data, and (*b*) for the countries for which Maddison's data are unavailable, using the ratio between the average income from social tables and the estimated subsistence minimum with the latter priced at $PPP 300 per year. According to the first method, the social class income estimates in international dollars are made by linking overall national currency mean income (calculated across all social groups) to GDP per capita in 1990 international dollars from Maddison. To explain: from the social table for (say) Brazil in 1872, we calculate that the average per capita income is 311 *milreis*. From Maddison's (2004) GDP per capita data, we know that the estimated GDP per capita for Brazil in 1872 is $PPP 721. By linking the two, we obtain the conversion ratio of 1872 *milreis* into 1990 international dollars (1 *milreis* is worth $PPP 2.3 of the year 1990). This then enables us to directly convert *milreis* income of every social class into its 1990 $PPP equivalents. For a few countries, the procedure (as per *b*) is different: when we do not have Maddison's GDP per capita data, we need to get an estimate of the subsistence minimum in local currency (of the time). Thus, for example for the Kingdom of Naples 1811, the estimated subsistence minimum is 31 *ducats* per capita annually (from Malanima, 2006). Since the subsistence minimum is by assumption priced at $300 PPP dollars at 1990 prices, we get the conversion factor (1 *ducat* from the year 1811 = $PPP 9.67 in year 1990). Using this conversion factor, we convert contemporary *ducat* incomes of each social class into 1990 $PPP equivalents.

We thus obtain $PPP-equivalent average incomes for all 591 social groups that are included in our sample. The number of groups and their population sizes vary between the countries. The number of social groups ranges from only 3 for China in 1880 and Nueva Espaňa in 1790 to 375 for Brazil 1872. The average number of social groups per country is 45 (without Brazil, the average number of groups drops to 18). Overall, the number of groups is sufficiently large to provide a reasonable estimate of inequality within each nation.[12] In addition, thanks to Modalsli's approach, we can also create deciles for all of our thirteen distributions by introducing within-class income variability as implied by Eq. (1). We have 130 such data points (13 countries *times* 10 deciles), and mean income for each decile is converted into 1990 $PPP equivalents using the same procedure as just explained for mean incomes per social class.

2.4. Global inequality in the early XIX century

The average income for our sample is $PPP 600. The country with the highest mean income is England and Wales in 1801–03 with $PPP 2000, the country with the lowest, Moghul India in 1750 with $PPP 530.

Inequality indices for the sample are given in Table 1. The global Gini calculated from 13 social tables alone is 38.5 (see column 1). Table 1 also compares this result with Bourguignon and Morrison calculations for 1820. The Gini of 38.5 is significantly lower than the Bourguignon–Morrison value of 50. An obvious reason is smaller coverage of our dataset. It provides the coverage for 2/3 of the world population. But for all the missing countries, we supplement our data with the data from Bourguignon and Morrisson (16 countries),[13] we increase the coverage to about 90%, the number of independent data points to 767, and the global Gini goes up to 43.3 (see column 3 in Table 1).

If we use the "stretched-out distributions" which, as mentioned, imply higher inequality for every country compared to what we obtain from the social tables directly, the global Gini increases to 50.6, the value which is remarkably stable regardless of the β that is used in the derivation of the "stretched-out" distributions. Finally, if we combine these "stretched-out distributions" with Bourguignon and Morrisson's data, the Gini rises further to almost 55 points. For the most complete sample of 29 countries that comprises 90% of the world population, our global Gini estimates thus range between about 43 and 55 points, the lower value when we use the data from the social tables assuming within-group inequality to be zero, and the higher value when we impose

[10] The increases are the greatest in the countries with very rich and small top income groups.

[11] This new distribution will not be lognormal as most real-world distribution are (or are close to), since the distribution of income each social group is assumed to be lognormal. The "accumulation" of such lognormal distributions does not produce an overall lognormal distribution. (We cannot speak of a "summation" because the total distribution is not obtained as $x + y$, but rather as the "piecing together" of a number of separate lognormal distributions that are supposed to hold for incomes of each social group.)

[12] However, for the discussion of this point see Milanovic, Lindert and Williamson (2011).

[13] The "countries" are Austria–Czechoslovakia–Hungary, Australia–Canada–New Zealand, the Balkans, Ivory Coast–Ghana–Kenya, Germany, Egypt, Japan, Korea–Taiwan, Nigeria, Philippines–Thailand, Poland, Russia, Scandinavia, Turkey, USA and South Africa.

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Table 1
Global inequality in the early 19th century.

	This paper				Bourguignon and Morrisson	ZBFL
	Using social tables only, 1750–1880		Combining social tables 1750–1880 with Bourguignon and Morrisson database			
	No within-group inequality	With "stretched-out distributions"	No within- group inequality	With "stretched-out distributions"	1820	1820
	(1)	(2)	(3)	(4)	(5)	(6)
Gini	38.5	50.6	43.3	54.7	50.0	48.0
Theil (0)	60.9	51.9	57.9	56.3	52.2	56.3 [a]
Average income of population included (in 1990 $PPP)	600		646		652 [b]	687
Total population included (in m)	650		861		1057	921
Population coverage (%)	~66		~90		~100	89
Number of countries [c]	13		29		33	42
Number of independent income fractiles	591	130	767	426	<363 [d]	n.a.

[a] Calculated by using the data kindly provided by Bas van Leeuwen.
[b] Calculated directly from the Bourguignon–Morrisson tables, Data_WD19.xls (supplied by the authors separately from the paper). The 100% coverage by Bourguignon and Morrisson has to be taken with a grain of salt since the data were "forced" (through generous use of estimates) to cover 100% of the population.
[c] The number of countries is not fully comparable. For example, Bourguignon and Morrisson, treat Bangladesh/Pakistan and India as two countries; we treat them as one because the 1750 data refer to the entire subcontinent.
[d] See footnote 2 in the text.

variability in within-group incomes (see columns 3 and 4 in Table 1). This is a rather large span that includes both ZBFL (2010) estimate of 48 (see their Table 5A) and Bourguignon's and Morrisson's estimate of 50.

Theil coefficient however lies in a much more narrow range, between about 52 and 61, and with the "stretched-out" distributions, inequality measured by the Theil is lower than with distributions that assume no within-group inequality.[14] That may seem odd at first because the assumption of no inequality within social groups seems a fairly conservative one (biasing inequality down). It was that precise reason that has lead researchers like Modalsli to introduce some variability of incomes within social groups. But on further reflection, the result makes sense: the deciles calculated from the "stretched-out" distributions do have a potential dampening effect on inequality. This is because with social groups alone, some very small social groups, numbering often less than 1% of the population, and generally found at the top or bottom of the income pyramid, will be included in the calculations while in Modalsli's approach income of these groups will be "averaged-out" as the part of the top or bottom decile. Since Theil is particularly sensitive to the extreme values, such extreme values present in social tables, will drive Theil up while that effect will be absent in a calculation over the deciles. This explains the apparently unexpected finding of lower Theils in columns (4) and (2) than in columns (3) and (1) (see Table 1).

Whatever value from that range that we choose, global inequality in the period 1750–1880 was much lower than today. The most recent global inequality estimate calculated from individual household survey data around year 2002, is 65.7 Gini points (using the "old" PPPs which are based on the same "old" benchmark as the 1990 PPPs used by Maddison).[15] This is obviously outside the range of Gini [43.3–54.7] that we have established for the period 1750–1880. Similarly, Theil for 2002 is 83.4, more than 20 points above its maximum value for the period 1750–1880.

Moreover, if we use the more recent PPP values, obtained from the 2005 International Comparison Project, present-day global Gini is around 70 and Theil reaches almost 100 (Milanovic, forthcoming, Table 4). The difference between these two estimates, the one based on "old" PPPs and the other based on the 2005 PPPs, is due to a significant reduction of GDPs per capita and average household incomes for China, India and several other relatively poor Asian countries.

Finally, it is interesting to focus on the highest incomes in our sample, those precisely that we have found responsible for driving Theil values up. Incomes above $PPP 70,000 per capita, which would place such individuals into the top global income percentile *today*, are registered in the Netherlands, Java (which was a Dutch colony then), Chile and, in practically negligible numbers, in Brazil. The total number of people with such high incomes is minute however. It was less than 5000 (out of 650 million people). Yet it is clear that enormously rich people, by today's standards, lived then too.

3. The changing composition of global inequality, 1820–2002

3.1. The relationship between international and global inequality

While the social tables and the survey data for the early 19th century are not fully available so that global inequality must always be estimated quite approximately, Maddison's GDP data allow us to compute with much more precision international population-weighted inequality. The latter is an inequality index computed across GDPs per capita of countries at a given point in time, where each country's GDP per capita is weighted by country's population (see Milanovic, 2005). This is inequality that would

[14] We use throughout Theil (0) known also as mean logarithmic deviation.
[15] Milanovic (forthcoming), (Table 4),

exist if each individual had the mean income of his/her country, i.e. all individual country distributions were egalitarian. It is the same thing as the between-country component of global inequality. The between-country and global inequality are, in the case of Gini, linked as in relation (2). The within component (the part of global inequality due to income inequalities within each country and the "overlap" component L) is the rest of expression (2).

$$\text{Global inequality} = \underbrace{\frac{1}{\mu}\sum_{i}^{n}\sum_{j>i}^{n}\left(y_j - y_i\right)p_i p_j}_{\text{Between-country inequality}} + \sum_{i}^{n} G_i \pi_i p_i + L \qquad (2)$$

where y_i = GDP per capita of country i, p_i = population share, π_i = income share (country i-th share in global income), G_i = Gini coefficient of country i, μ = global average per capita income, and L = overlap term. The overlap term can be treated as part of the within component: it is greater than zero any time there are people from a mean-poorer country who are better off than some people from a mean-richer country. Such cases will be more common when countries' distributions are wider (more unequal).

Because of huge differences in countries' per capita GDPs, the between component accounts for at least 80% of global inequality today. It is "worth" more than 50 Gini points.[16] But was this the case in the past?

Table 2 (row 1) gives between-country inequality computations for four dates in the 19th century for which Maddison provides a sufficient number of countries' GDPs per capita. We may focus on years 1820 and 1870 when Maddison's data are most complete. Between these two dates, the population-weighted international Gini more than doubled passing from about 15 to 32. This reflects the well-known phenomenon of income divergence that started in the 19th century. Between-country inequality continued to rise throughout the first half of the 20th century, then stabilized at a rather high plateau of 55–60 Gini points between the end of World War II and 1990s. It has been decreasing however in the last twenty years thanks to the high growth rates of China and India. In conclusion, the between-country inequality was much less in the early 19th century than today.[17]

3.2. Composition of global inequality

What is striking however is not solely that the between-country inequality was much lower in 1820 than now but that the composition of global inequality was so much different. Using our estimate of global inequality for the early 19th century, which includes both the "stretched-out" income distributions from the social tables and Bourguignon–Morrisson dataset, and whose Gini is 54.7, we find that the between inequality accounted for only 28% of global inequality, that is, 15.2 Gini points out of 54.7 Gini points. Even when we use the lowest estimate for global inequality around 1820 (38.5 Gini points), its share would not exceed 40%. (If we use Theil, the percentage is even smaller.) In 2002, when global inequality was about 65 Gini points, the between component accounted for the lion's share of total inequality: 80% as measured by the Gini or 61% as measured by the Theil index (see lines 10 and 11 in Table 2).[18]

We can summarize the results by writing out the composition of global inequality in the early 19th and 21st century as follows:

Early 19th century: Inequality between individuals in the world: Gini around 50, = about 30% due to differences in average country incomes (15 Gini points) + about 70% due to within-national income differences (35 Gini points).

Early 21st century: Inequality between individuals in the world: Gini around 65, = about 80% due to differences in average country incomes (53 Gini points) + about 20% due to within-national income differences (12 Gini points).

These two simple relationships describe the change that has occurred globally during the last two centuries: inequality between individuals is much higher today than 200 years ago, but – more dramatically – its composition has totally reversed: from being predominantly driven by within-national inequalities (that is, by what could be called "class" inequality), it is today overwhelmingly determined by the differences in mean country incomes (what could be called "location" or citizenship-based inequality). This latter, "locational", element was "worth" 15 Gini points in the early 19th century; it is "worth" more than 50 Gini points today.

The evolution of the share of between-country inequality in global inequality is shown in Fig. 1. The calculations are based on my estimates of global inequality for 1820 and 2002, and Bourguignon and Morrisson's for all points in-between. With ZBFL estimates of global inequality, which are for the 19th century lower by about 2 to 3 Gini points than Bourguignon and Morrisson's (see Table 2, line 8), the share of between-country inequality in the 19th century would be slightly higher. The trend would not be affected however.

[16] See Milanovic (2005, Chapter 9).

[17] It should be noted that in the 19th century, we calculate between-country inequality across only 60 countries while today we do it over twice as many. Everything else being the same, we would expect that the mere increase in the number of countries may "cause" greater calculated between-country inequality. However even when we keep the number of countries in the calculation constant, the increase remains (results available from the author on request).

[18] See Milanovic (2009 and 2011). The "correct" 2002 global inequality, based on "new" PPPs, is 70.6 Gini points and the between component is 59.9 (see the last column in Table 2). I use the Gini of 65.4, based on the "old" PPPs that are compatible with Maddison's historical data.

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Table 2
International population-weighted inequality and global inequality.

	Using Maddison's GDP per capita and 1990 PPPs								Using WDI GDPs and "old" 1990 benchmark PPPs	Using WDI GDPs and "new" 2005 PPPs
	1820	1850	1870	1913	1929	1950	1960	1980	2002	2002
(1) Between-country Gini	15.2	25.9	31.9	44.3	48.0	55.0	54.0	56.8	52.6	59.9
(2) Between-country Theil	4.55	12.0	17.1	32.6	39.3	54.4	53.5	62.7	50.6	69.2
(3) Global average income (in $PPP)	689	916	911	1599	1941	2111	2778	4520	7099	8123
(4) Total population included (in m)	941	623	1178	1666	1775	2518	3030	4423	5775	6004
(5) Estimated world population	1057	1201	1266	1719	2042	2518	3030	4423	6172	6172
(6) Population coverage: (4)/(5) in%	89	52	93	97	87	100	100	100	94	99
(7) Number of countries included	53	24	63	66	53	141	141	141	114	153
(8) Global inequality (Gini)	54.7 (48)	53.2 (50)	56.0 (53)	61.0 [a] (59) [a]	61.6 (63)	64.0 (65)	63.5 (64)	65.7 (65)	65.4 (64) [b]	70.6
(9) Global inequality (Theil 0)	56.3	48.5	54.4	66.8 [a]	69.0	77.5	76.6	85.0	83.4	99.8
(10) Share of between inequality in global Gini: (1)/(8) in%	28	49	57	73	78	86	85	86	80	85
(11) Share of between inequality in global Theil: (2)/(9) in%	8	25	31	49	57	70	70	74	61	66

Note: Between-country Ginis and Theils are population-weighted. Sources: All population-weighted international inequality statistics calculated from Maddison's, 2004 data, except for 2002, calculated from World Development Indicators (WDI). Estimated global population from Bourguignon and Morrisson (2002, Table 1). Global inequality estimates (line 8). Period 1850–1980 are from Bourguignon and Morrisson (2002, Table 1); year 1820, as calculated here in Table 1; year 2002, Milanovic (2009, Table 2, p. 13) and Milanovic (forthcoming), (Table 4). Line 8 (between brackets): van Zanden, Baten, Foldvari and van Leeuwen (2010, Table 5A).

[a] Refers to year 1910 for both Bourguignon and Morrisson, and ZBFL.

[b] Refers to year 2000 for ZBFL (2010, Table 5A).

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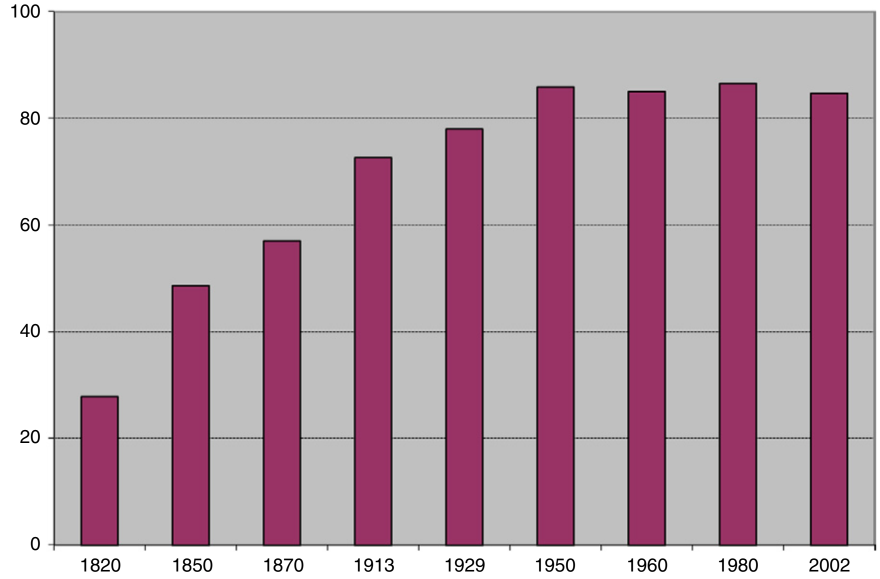

Fig. 1. Share of between-country inequality in global inequality: selected years, 1820–2002 (in percent). Source: Table 2.

4. Did global inequality extraction ratio decline?

4.1. Definition of the inequality extraction ratio

MLW (2007) has developed the concept of the inequality possibility frontier. Simply put, this is the maximum Gini that is achievable at a given level of mean income provided that all population but an infinitesimally small elite live at the subsistence minimum. To understand the concept intuitively, imagine a society whose mean income is just barely above subsistence. Then the maximum Gini, however small the elite (at the extreme, the elite could be composed of one individual), cannot be high because a vast majority (99.999% etc.) of bilateral income comparisons that enter into the creation of a Gini will yield zeros (since all other

Table 3
Global inequality extraction ratio, 1820–2002.

	Using Maddison GDP data and global inequality estimate from this paper	Using Maddison GDP per capita at 1990 PPPs, and Bourguignon–Morrisson global inequality estimates							Using WDI GDPs, household surveys and "old" benchmark PPPs
	1820	1850	1870	1913	1929	1950	1960	1980	2002
(1) Global average GDP per capita (in $PPP)	689	916	911	1599	1941	2111	2778	4520	7099
(2) Global average income to subsistence (ratio)	2.30	3.05	3.04	5.33	6.47	7.04	9.26	15.07	23.66
(3) Maximum feasible Gini (in%)	56	67	67	81	85	86	89	93	96
(4) Maximum feasible Theil (in%)	83	112	111	167	187	195	223	271	316
(5) Estimated global Gini	54.7	53.2	56.0	61.0	61.6	64.0	63.5	65.7	65.4
(6) Estimated global Theil (0)	56.3	49	54	67	69	78	77	85	82.5
(7) Estimated global Gini inequality extraction ratio (5/3), in%	97	79	83	75	73	75	71	70	68
(8) Estimated global Theil inequality extraction ratio (6/4), in%	68	43	49	40	37	40	34	31	26

Sources: lines 1, 5 and 6, from Table 2.

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individuals but the elite have the same subsistence income). As the average income grows, the constraint on the maximum Gini is relaxed. The inequality possibility frontier, the locus of maximum Ginis as mean income rises, is given by Eq. (3):

$$G(\alpha)^* = \frac{\alpha-1}{\alpha}(1-\varepsilon) \tag{3}$$

where α = average income of a community expressed in terms of subsistence, G^* = maximum feasible Gini, and ε = the share of the elite in total population (see MLW, 2011, pp. 257–9). Clearly as $\varepsilon \to 0$, Eq. (3) simplifies to:

$$G(\alpha)^* = \frac{\alpha-1}{\alpha} \tag{4}$$

Thus, for example, if the average income of a community is twice the subsistence, the maximum feasible Gini will be 50 points ((2–1)/2 expressed in percentage terms). But if, as in modern rich societies, the average income is some 100 times the subsistence, than the maximum feasible Gini is 99, very close to what we tended to regard (before the introduction of G^*) as the maximum Gini regardless of the average income level.

A similar calculation can be done for Theil (0). For Theil (0), the maximum feasible inequality is[19]:

$$T(\alpha)^* = \ln(\alpha). \tag{5}$$

The ratio between the actual (measured) Gini, G, and the maximum feasible Gini G^* (G/G^*) gives the inequality extraction ratio which can be interpreted as the share of maximum inequality extracted by the elite. (The same, of course, holds for the T/T^* ratio.) Clearly, as that percentage increases, the elite can be said to have become more successful in extracting the surplus. The approach has been applied by MLW to 28 pre-industrial societies, running from the Imperial Rome in year 14 to Siam and Kenya in 1927, and quite exceptionally India in 1938, not long before its independence. The average extraction ratio over these twenty-eight societies is 75%. For seven societies (six of them colonies), the extraction ratio was around 100%—that is, the inequality was pushed close to its maximum level compatible with the physiological survival of the society. (Note that the measured Gini can even exceed the maximum if some people temporarily survive at less than the subsistence. In the medium term, the extraction ratios above 100% are possible only if population decreases.)

The stylized, but also very consistent picture, for modern developed societies is that of a decreasing inequality extraction ratio with rising mean per capita income. For example, for England and Wales (later United Kingdom) for which we have the most complete data, the inequality extraction ratio drops from 70% in 1290 (when England's α was 2.1) to about 55% in 1688 and 1759 (α's of respectively 4.7 and 5.9), briefly increases to 60% in 1801 (α = 6.7), and then begins a more or less steady decline to 38% today (α = 66).[20] In other words, over the last century, Gini-measured inequality in developed countries generally decreased, or even when it went up, it did so less than the maximum feasible inequality.

4.2. Global results

Now, the question can be asked: can the same methodology be applied globally? The answer is yes, but with one important caveat. When this methodology is applied to individual countries, it makes sense as it implicitly assesses how rapacious or successful is the elite in extracting the surplus. Combined with an analysis of the class structure of a given society (e.g., the share of the middle classes), it provides an insight into the social and political structure of a polity. At the global level, however, there is no single elite and no single government (then or now), and the application of the methodology makes sense certainly in an accounting sense, but perhaps much less as a tool that would enable us to gain further insight into the social structure of a given society (with society being here “the world”). Yet, perhaps depending on one's perspective (e.g., taking a “world-systems” perspective) the global inequality extraction ratio could be seen as more than an accounting tool. In effect, the results obtained below will, to some extent, lead us to pose that question.

The “accounting” part is useful because we may want to know whether the relatively low measured global Gini in the early 19th century can in part be “explained” by the overall low level of income. Or differently, whether the increase in global inequality that we observe in the last two centuries is associated with the removal of the constraint that low income sets to the maximum feasible inequality.

Using the data on global GDP per capita from Table 2 (line 3) and assuming the subsistence minimum to be $PPP 300, we can directly calculate G^* and T^* (see Table 3).

The striking fact, revealed by these numbers, is that the Gini-based global inequality extraction ratio today is at almost the same level as one hundred years ago. After being close to the maximum 100% in the early 19th century – meaning that global inequality then, even if much lower than today, was close to the maximum feasible inequality at the time – the inequality extraction ratio decreased to about 75% before the outbreak of World War I and stabilized around that magnitude ever since. The average world income has increased meanwhile more than fourfold, pushing up the maximum feasible Gini from 81 points to 95 points. But the

[19] For the derivation, see Annex 2.
[20] See MLW (2011, Table 2).

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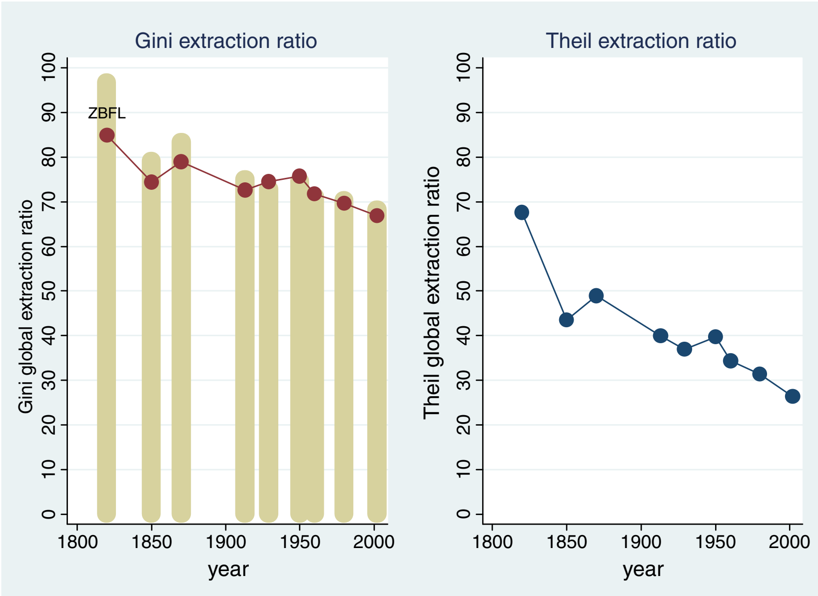

Fig. 2. Global inequality extraction ratio 1820–2002 (in percent).
Source: Left panel. Bars: Table 3, line 7. Dots based on global inequality calculations of van Zanden, Baten, Foldvari and van Leeuwen (2010). Right panel: Table 3, line 8.

observable global Gini has risen almost *pari passu* with the maximum feasible Gini, thus holding the inequality extraction ratio constant. Not surprisingly in the light of close correspondence between the global Ginis obtained by Bourguignon and Morrisson (2002) and ZBFL (2010), the trend in the inequality extraction ratio is very similar regardless of the source of data we use (see Fig. 2, left panel). It is a bit different if we use the Theil-based inequality extraction ratio (Fig. 2, right panel). This is because with a given increase in α, the maximum feasible Theil rises faster than the maximum feasible Gini and the measured Theil has failed to match up to the increases of the maximum Theil. The downward movement in the extraction ratio is much clearer in this case.[21] (Note that the maximum Theil is not bounded from above while the maximum Gini is.) The same evidence is shown against the Inequality Possibility Frontier in Fig. 3.

Combining this with the earlier finding that the composition of global inequality has shifted from being "caused" by internal factors, like domestic income distributions, to "external" like differences in mean country incomes, we can conclude that the main "inequality extractors" today are not (within)-national elites, but an elite which is predominantly composed of the citizens of rich countries.

We can summarize the change that occurred over the last century as follows:

Early 20th century: Global mean income was 5.3 times the subsistence. Maximum feasible global Gini was 81 points while the actual global Gini was 61. Thus, actual inequality "exhausted" ¾ of maximum inequality.

Early 21st century: Global mean income is 23.7 times the same physiological subsistence. Maximum feasible global Gini is 96 while the actual global Gini is around 65.[22] Thus, actual inequality "exhausted" more than two-thirds of maximum inequality.

Conclusion. The level of inequality extraction has remained remarkably constant throughout the 20th century, with a slight decline only more recently, around the turn of the 21st century.

Why is world income distribution such that during the last century, the rich have extracted a constant of about 70% of global maximum inequality measured by the Gini? This is a question that, due to its complexity, cannot be answered in this paper. However, regarding the future we may hazard some projections. Since global mean income is already quite high, almost 27 times the subsistence, the increase in the maximum feasible Gini will be quite limited. This means that the only venue for the reduction in global inequality extraction ratio remains an effective reduction in measured global inequality. And for it to go down, inter-country differences in mean incomes must decrease, and in particular those between poor and rich populous countries. Thus, both global inequality and global

[21] The Gini-based Inequality Possibility Frontier is much more concave than the Theil-based Inequality Possibility Frontier. It can be readily verified from Eqs. (3) and (4) that the slope of the former is $1/\alpha^2$ while the slope of the Theil-based IPF is $1/\alpha$ (compare also the shapes of the two frontiers in Fig. 3).
[22] See however footnote 18 above.

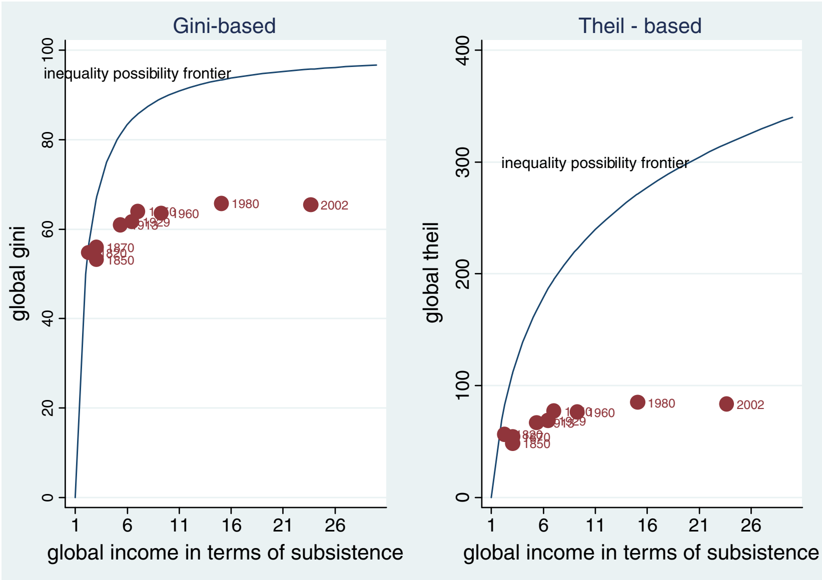

Fig. 3. Global inequality possibility frontier and global inequality, 1820–2002.
Source: Table 3.

inequality extraction ratio fundamentally depend on what was called elsewhere (Milanovic, 2005), the relationship within the triangle of China, India and the United States. If the mean-normalized absolute distance between China and India, on the one hand, and the US, on the other, decreases, then we are likely to observe favorable developments in this century. [23]

5. Conclusions

Using 13 social tables from pre-industrial societies that provide data on incomes and population sizes of different social groups, and after modeling some additional income variability in the tables, we estimate global inequality between citizens of the world in the early 19th century to have been in the range of 50–55 Gini points. Since then, it has steadily increased to reach 65–70 Gini points today. However, more remarkable than its today's much higher level (which might have just peaked) is that the composition of inequality changed rather dramatically: from being driven by class differences within countries to being driven by locational income differences, that is, by the differences in mean country incomes. The latter accounted for only 15 Gini points around 1820, but account for more than 50 Gini points today.

Over the same period of two centuries, the increase in average income in most countries combined with same or decreasing within-national inequalities, has meant that the inequality extraction ratios have steadily and often dramatically decreased within individual countries (see MLW, 2011). This is particularly obvious in the case of today's advanced countries which are much richer than they were two centuries ago (the order of magnitude is about 30 times richer for the USA and 15 times richer for Great Britain) and also less unequal. But very different is the situation on the global level. While global mean income had risen as well (about 10 times since the early 19th century), the increase in global inequality was sufficiently strong to make the global inequality extraction ratio decline but very moderately. Moreover, it was broadly stable in the last 100 years. This means that during the last century global inequality has increased at about the same rate as the maximum feasible inequality leaving the Gini-based global inequality extraction ratio hovering around 70%.

The implication of (a) changing composition of global inequality toward "locationally-driven inequality", and (b) broadly stable inequality extraction ratio is that the main "inequality extractors" today are citizens of rich countries rather than individual national elites as was the case two hundred years ago.

[23] Note that for the Gini to go down, it is not sufficient that China grows faster than the US. China must grow sufficiently fast to reduce the *absolute* distance, normalized by the world mean income, with the United States. Suppose that the world mean income is constant, and US grows by 1% per capita per annum. For the US-China Gini component to be reduced, China needs to grow by 7% per capita per annum (since its mean per capita income is about 1/7th of the US).

ANNEX 1. Social table for England and Wales 1801-03.

Social group	Number of people	Percentage of population	Per capita income (in £ per annum)	Income in terms of per capita mean
Paupers	1040716	11.5	2.5	0.11
Persons imprisoned for debt	10000	0.11	6	0.27
Laborers in husbandry	1530000	16.9	6.9	0.31
Hawkers, pedlars, duffers	4000	0.04	8	0.36
Laborers in mines, canals	180000	1.99	8.9	0.41
Vagrants	175218	1.94	10	0.46
Artisans, mechanics, laborers	2005767	22.16	12.2	0.56
Clerks and shopmen	300000	3.31	15	0.68
Freeholders, lesser	600000	6.63	18	0.82
Farmers	960000	10.6	20	0.91
Innkeepers and publicans	250000	2.76	20	0.91
Lesser clergymen	50000	0.55	24	1.09
Dissenting clergy, itinerants	12500	0.14	24	1.09
Education of youth	120000	1.33	25	1.14
Military officers	65320	0.72	27.8	1.27
Common soldiers	121985	1.35	29	1.32
Naval officers	35000	0.39	29.8	1.36
Shopkeepers and tradesmen	372500	4.11	30	1.37
Tailors, milliners, etc.	125000	1.38	30	1.37
Confined lunatics	2500	0.03	30	1.37
Freeholders, greater	220000	2.43	36.4	1.66
Marines and seamen	52906	0.58	38	1.73
Lesser offices	52500	0.58	40	1.82
Engineers, surveyors, etc.	25000	0.28	40	1.82
Merchant service	49393	0.55	40	1.82
Keeping houses for lunatics	400	0.004	50	2.28
Theatrical pursuits	4000	0.04	50	2.28
Liberal arts and sciences	81500	0.9	52	2.37
Law, judges to clerks	55000	0.61	70	3.19
Eminent clergymen	6000	0.07	83.3	3.8
Gents	160000	1.77	87.5	3.99
Shipowners, freight	25000	0.28	100	4.56
Higher civil offices	14000	0.15	114.3	5.21
Lesser merchants, by sea	91000	1.01	114.3	5.21
Building & repairing ships	1800	0.02	116.7	5.32
Warehousemen, wholesale	3000	0.03	133.3	6.08
Manufacturers	150000	1.66	133.3	6.08
Knights	3500	0.04	150	6.84
Esquires	60000	0.66	150	6.84
Educators in universities	2000	0.02	150	6.84
Baronets	8100	0.09	200	9.12
Eminent merchants, bankers	20000	0.22	260	11.86
Spiritual peers	390	0.004	266.7	12.16
Temporal peers	7175	0.08	320	14.59
Total	9053170	100	21.93	1

Source: Milanovic, Lindert and Williamson (2007, Appendix 1).

ANNEX 2. Derivation of the maximum feasible Theil (Theil 0, or mean log deviation)

The definition of Theil (0) is:

$$T(0) = \frac{1}{n}\sum_{i} \ln \frac{1/n}{y_i/mn} \tag{A1}$$

where n = number of income recipients, y_i = income of *i*-th recipient, m = mean income.

Assume two groups of people: the poor who number n(1-ε) people where ε is very small and all with income equal to subsistence (y = s), and the rich whose number is εn people with income y_h. The latter can be easily calculated:

$$yh = \frac{nm - n(1-\varepsilon)s}{\varepsilon n} = \frac{nm - ns + n\varepsilon s}{\varepsilon n} = \frac{m - s + \varepsilon s}{\varepsilon}. \tag{A2}$$

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Replace Eq. (A2) into (A1)

$$T = \frac{n(1-\varepsilon)}{n}\ln\frac{1/n}{s/mn} + \frac{\varepsilon n}{n}\ln\frac{1/n}{\frac{m-s+\varepsilon s}{\varepsilon}/mn} = (1-\varepsilon)\ln\frac{mn}{sn} + \varepsilon\ln\frac{mn\varepsilon}{n(m-s+\varepsilon s)}$$

$$T = (1-\varepsilon)\ln\alpha + \varepsilon\ln\frac{m\varepsilon}{m-s+\varepsilon s} = (1-\varepsilon)\ln\alpha + \varepsilon\ln\frac{\alpha s\varepsilon}{\alpha s-s+\varepsilon s} = (1-\varepsilon)\ln\alpha + \varepsilon\ln\frac{\alpha\varepsilon}{\alpha-1+\varepsilon}.$$

When the proportion of the rich tends to 0, we get the maximum feasible Theil (0). It is:

$$\lim \mathrm{T}^{*} \text{when } \varepsilon\to 0, T^{*} = \ln\alpha + \varepsilon\ln\frac{\alpha\varepsilon}{\alpha-1+\varepsilon}$$

The second term in the last expression can be solved by applying L'Hôpital's rule

$$\frac{\ln\frac{\alpha\varepsilon}{\alpha-1+\varepsilon}}{\frac{1}{\varepsilon}} = \frac{\left\{\frac{\alpha}{\alpha-1+\varepsilon} - \frac{\alpha\varepsilon}{[\alpha-1+\varepsilon)]^2}\right\}\frac{\alpha-1+\varepsilon}{\alpha\varepsilon}}{\frac{-1}{\varepsilon^2}} = \frac{\frac{\alpha A-\alpha\varepsilon}{A^2}\frac{A}{\alpha\varepsilon}}{\frac{-1}{\varepsilon^2}} = \frac{-(A-\varepsilon)\varepsilon}{A}. \tag{A3}$$

Where $A = \alpha - 1 + \varepsilon$.
When $\varepsilon \to 0$, $A \to \alpha$-1.
When $\varepsilon \to 0$, the whole term tends to $\frac{-(\alpha-1)\varepsilon}{(\alpha-1)} = -\varepsilon = 0$.
Consequently, the maximum Theil (0) for a given alpha is $T^* = \ln \alpha$.
Note that when $\alpha = 1$, the maximum $T^* = 0$.

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