PRELIMINARY VERSION

GLOBAL WORLD INEQUALITY: ABSOLUTE, RELATIVE OR INTERMEDIATE?

by

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Abstract

In this paper we examine how the conclusions on the evolution of global income inequality might be affected by abandoning the relative inequality criterion. We examine methodological issues and discuss classes of measures that combine the relative and absolute criterion. We then present the results from applying these different measures to the distribution of income in the world. We first discuss international inequality and then give illustrative results on global inequality, where "global" differs from "international" in that within-country inequality is accounted for.

JEL Classification: D31, C80.

Keywords: global income inequality, absolute vs. relative inequality.

Contents

1. Introduction[1]

In 2002 the real per capita income of China was 4,390 U.S. dollars, or 1/8 of the 35,060 U.S. dollars of the United States (World Bank, 2003, table 1, pp. 252-3). This means that China has to grow 8 times as fast as the United States to obtain the same *absolute* increase in the production of goods and services per head. Even if China grows faster in relative terms, the absolute gap may be widening. For example, with annual per capita growth rates of 5 per cent in China and 2 per cent in the United States, the absolute income gap between the two countries would widen for a further 41 years before starting to narrow, to finally disappear after 72 years.[2] Concern for the absolute dimension of economic growth has far-reaching implications for the assessment of its distributive consequences. As put by Livi Bacci, in commenting Dollar and Kraay's (2002) conclusions on the "pro-poor" effect of economic growth, "… it is not much of a relief for somebody living with a dollar per day to see that his income up by 3 cents is growing as much as the income of the richest quintile" (2001, p. 114; our translation).

Livi Bacci's observation points to a fundamental question in inequality measurement. Is inequality unchanged when all incomes are increased in the same proportion (the *relative* criterion, or *scale invariance*) or when an equal amount is added to all incomes (the *absolute* criterion, or *translation invariance*)? Or a combination of the two? Or else? The answer of course is a value judgement: there is no a priori reason to rank one criterion over the other. As we shall see in the next Section, the issue has received some attention in the theoretical literature on the measurement of inequality, especially in the last ten years or so. At the empirical level, however, the acceptance of the relative criterion is almost unconditional. We

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[1] Some of the ideas discussed in this paper have been presented in a seminar on the distributive impact of globalisation held at Istituto di Studi e Analisi Economica in Rome on 12 November 2002 (see Brandolini, 2002). We thank Federico Giorgi for excellent research assistance. The views expressed here are solely those of the authors; in particular, they do not necessarily reflect those of the Bank of Italy.

[2] After the first version of this paper was completed, we came across the article by Svedberg (2004) which has a very similar example, except for comparing India, rather than China, to the United States.

have never seen official publications reporting estimates of absolute inequality, and even academic studies are rare (e.g. Blackorby et al., 1981; Del Río and Ruiz-Castillo, 2001).

The question takes on a new significance in the study of the *world* income distribution. Even if we agreed on adopting relative measures in within-country analysis, we might still wonder whether it is reasonable to apply the same approach in the investigation of nations at widely different levels of development. Is it appropriate to use the same valuation rod for rich and poor countries? Should not the valuation criterion vary with per capita income (or some other indicator of development)? Looking at the way economic poverty is generally measured, we might be led to opt for the second solution, for it is common practice to rely on absolute measures for developing countries but to employ relative measures for developed countries.[3] However, the dichotomy found in poverty measurement has no parallel in the rapidly growing literature on global income inequality. The absolute/relative issue has been basically overlooked so far. Chotikapanich et al. (1997), Schultz (1998), Dowrick and Akmal (2001), Bhalla (2002), Bourguignon and Morrisson (2002), Milanovic (2002) and Sala-i-Martin (2002), for example, address several methodological points and often take different routes, but they agree in considering only relative measures of inequality. Firebaugh (2003, pp. 72-3) briefly deals with the question to make it clear that "[i]nequality pertains to proportionate share of some item – not to size differences", and to avoid confusion he introduces the terms "widening and narrowing gaps" to refer to changing absolute differences. Only Svedberg (2004), to our knowledge, highlights the importance of looking at the absolute distribution of income across countries, but he does not attempt to measure how it has changed over time. Indeed, he concludes that "[t]o pay more heed to the growing

[3] Notice that these two approaches need not be in conflict. As suggested by Atkinson and Bourguignon (1999), they can be brought together by supposing that there is a hierarchy of two levels of capability, where physical survival comes first, and social functioning comes next: "The first capability concerns physical survival, and requires a bundle of goods that is broadly fixed in absolute terms; such as nutrients or shelter. These have priority. A second capability concerns social functioning and requires a basket of goods which depends on the mean level of income. On this basis, we have two (or more) measures of poverty. The first applies an absolute standard, such as $1 a day, and measured poverty is largely found in developing countries. The second applies a relative measure, identifying those who are below the relative poverty line applicable to their country" (pp. 185-6).

absolute income gaps between rich and poor countries, and their consequences, seems an urgent task for future research into growth and distribution" (p. 28).

The aim of this paper is to study how the conclusions on the measurement of global income inequality might be affected by abandoning the relative criterion, i.e. the assumption that the degree of inequality is left unchanged by equal proportional increases of all personal incomes. In the next Section we review the theoretical literature and discuss classes of measures that satisfy different inequality-invariance criteria. In Section 3 we examine how these measures modify the picture on the evolution of international inequality – where "international" differs from "global" in that the disparities inside each country are ignored – using data from the Penn World Table (Heston, Summers and Aten, 2002). Section 4 brings in the within-country income distribution. We take the data constructed by Bourguignon and Morrisson (2002) for inequality among world citizens, and present illustrative estimates of the extent of absolute and intermediate global inequality. Section 5 concludes.

2. Measurement theory

The absolute/relative question goes back to the foundations of inequality measurement. The *relative* criterion presumes that inequality is unchanged when all incomes are increased (or decreased) in the same proportion; the *absolute* criterion assumes that inequality is unaffected by an equal addition to (or subtraction from) all incomes. The absolute criterion was advocated by Kolm (1976) with the following argument:

> "In May 1968 in France, radical students triggered a student upheaval which induced a workers' general strike. All this was ended by the Grenelle agreements which decreed a 13% increase in all payrolls. Thus, laborers earning 80 pounds a month received 10 pounds more, whereas executives who already earned 800 pounds a month received 100 pounds more. The Radicals felt bitter and cheated; in their view, this widely increased income inequality. … In other countries (I have been quoted examples from England and The Netherlands), trade unions are more clever and often insist on equal absolute, rather than relative, increases in remuneration, so as to avoid the above effect. And I have found many people who feel that it is an equal absolute increase in all incomes which does not augment inequality" (p. 419).

Kolm's example loses much of its apparent appeal when we consider reductions rather than increase of incomes.[4] The counterexample cited by Atkinson (1983, p. 6) is the case of the sailors of the British Navy, Atlantic Fleet, at Invergordon who in 1931 opposed a shilling a day reduction in their pay on the grounds that "… they did not regard it as fair that they should bear a bigger proportionate cut than the officers".

The important point is that there is no a priori reason to rank the relative over the absolute criterion, or vice versa. They are both equally acceptable and the choice is a value judgement. As a matter of fact, people do differ in their views on inequality, and their evaluation patterns are more complicated than the simple relative/absolute dichotomy. Amiel and Cowell (1999a, 1999b) report the results of experiments conducted in universities in Europe, Oceania, Israel and the United States where groups of students were asked verbal and numerical questions to elicit their views on inequality. The relative approach was found to be shared by a third of respondents, the absolute approach by a sixth (1999a, table 4.1, p. 38). Hence a considerable fraction of interviewees appeared to reject either approach: some backed an intermediate criterion between absolute and relative; others took more extreme stances, like the supporters of the "Anti-Dalton position" who, regardless of the way income was augmented, coherently answered that inequality was going up; few provided answers which were internally inconsistent (see Ballano and Ruiz-Castillo, 1993, for roughly similar evidence in Spain). The experiments by Amiel and Cowell also reveal that people's views about the effect of income transfers on inequality depend on the initial (real) level of income: "There is a clear switch away from support for the view that an across-the-board addition to income (in any of the three [alternative ways]) will reduce inequality as one looks at successively higher income levels" (1999b, p. 219).

A good way to illustrate the different positions is to show how a given amount can be split in a two-person distribution so as to leave the degree of inequality unaffected. In Figure 1, point A represents the initial distribution. Let us suppose that an additional sum has to be

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[4] This weakness was implicitly recognised by Kolm when he specified that "[t]he topic was an equal increase in all incomes rather than an equal decrease in them. But it is the first point which is relevant in our progressive societies" (Kolm, 1976, p. 419, fn. 5).

distributed. The feasible allocations lie along the segment BC, with all the extra income given to person 1 in B and person 2 in C. If we adopt a relative measure, inequality is unchanged when this extra is divided proportionally to original incomes, i.e. when the point D, which lies on the ray through the origin, is chosen. On an absolute criterion, inequality is unchanged where the additional amount is split equally between the two persons. This differs unless the initial incomes are equal. In the case drawn in Figure 1, person 1 has the larger initial income, so that the equal split, which corresponds to the point F on the 45 degree line originating in A, gives more to person 2 than the point D. Any point between D and F, like E, coincides with an "intermediate" distribution, that is a linear combination of the absolute and relative splitting.

If we generalise this reasoning, we can draw the "iso-inequality contours" corresponding to the three cases just illustrated (top panel of Figure 2). The relative case (scale independence) and absolute case (translation independence) are straightforward. In the intermediate case, the iso-inequality contours have a slope less than 45 degrees when person 1 has a larger income, and a slope greater than 45 degrees when person 2 has a larger income. In all three cases, the line of equal incomes obviously generates an iso-inequality contour, and this is indeed the only "fixed point". The contours may otherwise take a variety of forms. In particular, there is no reason why they should be linear. Krtscha (1994, p. 115) draws them as parabolas, as it is the case for some configurations of the Kolm's centrist measure discussed below (bottom panel of Figure 2). Indeed, the experimental evidence summarised above suggests that a certain addition of income is evaluated differently at different levels of mean income, making the contours non linear.

The theoretical literature has focused on various ways to formalise the alternative views about the way income increases, or decreases, are to be distributed to leave the degree of inequality unaltered. These different formalisations have led to different "non-relative" measures of inequality. In the remaining of the Section, we present the indices that will be used in the following analysis.[5]

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[5] This literature is rapidly growing. In addition to the work referred to below see Krtscha (1994), Seidl and Pfingsten (1997), Del Río and Ruiz-Castillo (2000), Zoli (1999, 2003), and Zheng (2001).

Let us suppose that there are n persons (households) i's ranked by their income y_i, from the lowest y_1 to the highest y_n; μ denotes mean income. In his original contribution, Kolm (1976) proposed the following class of absolute measures of inequality:

$$K = \frac{1}{\kappa}\ln\left[\frac{1}{n}\sum_{i=1}^{n} e^{\kappa(\mu - y_i)}\right] \qquad \kappa > 0 \tag{1}$$

where κ is a free parameter which captures inequality aversion.[6] The larger κ, the higher the weight attributed to the lowest incomes; when κ tends to infinity, K tends to the difference $(\mu - y_1)$ between the mean income and the minimum income y_1. Like the relative measure proposed in Atkinson (1970), this can be interpreted as giving the equally distributed equivalent income y_e. If incomes were equally distributed, then the same level of social welfare could be achieved with the lower level of mean income y_e. The index K expresses the cost of inequality in terms of the absolute amount of income that could be subtracted from the mean without affecting the level of social welfare, i.e. $K = \mu - y_e$ (see also Blackorby and Donaldson, 1980). At the same time, as Kolm (1976, pp. 437-8) notes, the cost of inequality can be expressed relative to the mean income. With an absolute as well as a relative measure, we can say that inequality "costs" x per cent of total income. (The reason why we can normalise the cost in this way is that we are considering a subtraction from an equal distribution, and, as we have seen, in this case inequality-neutral changes in the distribution are identical under both approaches – and any intermediate approach.)

When all incomes y_i's are increased by the same amount, the index K does not change. On the other hand, a proportional increase of all incomes leads to a rise of K, while it would leave unaltered any relative measure. As this observation shows, the Kolm index (and more generally any non-relative measure) is not *unit invariant*: a change in the unit of account of the incomes affects measured inequality, even if the underlying distribution is unaltered. This has to be taken into account in the choice of κ. It may be noted that the elasticity of the social marginal value of income accruing to person i is equal to κy_i, which provides a guide to

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[6] We restrict the values of free parameters to exclude that an index is identically equal to 0 whatever the underlying distribution. In the case of (1), this means to assume that κ is positive rather than nonnegative.

interpreting the value of κ in the context of a specific choice of units for income. If κ were to equal the reciprocal of mean income, then the elasticity of the marginal valuation of income would be equal to 1 at the mean (and equal to 0.5 at half the mean income).

Kolm labelled the class of measures (1) "leftist" as opposed to the class of "rightist", i.e. relative, measures. He also proposed a class of "centrist" measures which have the property – later to be known as "compromise property" – of decreasing when all incomes are augmented by the same amount and of increasing when all incomes go up in the same proportion. Unlike (1) this is a two-parameter class:

$$C = \begin{cases} \mu + \xi - \left[\frac{1}{n} \sum_{i=1}^{n} (y_i + \xi)^{1-\varepsilon} \right]^{1/(1-\varepsilon)} & \varepsilon > 0,\ \varepsilon \neq 1,\ \xi \geq 0 \\ \mu + \xi - \prod_{i=1}^{n} (y_i + \xi)^{1/n} & \xi \geq 0 \end{cases} \qquad (2)$$

where ξ is measured in the unit of account of y_i. The index C tends to $(\mu - y_1)$ when ε tends to infinity (for any finite ξ). It declines as ξ rises and it goes to 0 when ξ tends to infinity (for any finite ε). The index C tends to the absolute measure K when both ε and ξ tend to infinity and their ratio ε/ξ tends to a finite value (which gives the value of κ in (1)).

If we denote by Ψ an index of inequality, by $\boldsymbol{y}$ the n-dimensional vector of incomes y_i's and by $\boldsymbol{1}$ the n-dimensional vector made of ones (expressed in income units), each inequality measure of the class (2) satisfies the property $\Psi[\lambda(\boldsymbol{y} + \vartheta\boldsymbol{1}) - \vartheta\boldsymbol{1}] = \lambda\Psi[\boldsymbol{y}]$, where ϑ and λ are real numbers such that the income vector obtained from the transformation of the original vector $\boldsymbol{y}$ is admissible. The corresponding properties for absolute and relative measures are $\Psi[\boldsymbol{y} + \vartheta\boldsymbol{1}] = \Psi[\boldsymbol{y}]$ and $\Psi[\lambda\boldsymbol{y}] = \Psi[\boldsymbol{y}]$, respectively. The centrist criterion coincides with the absolute criterion when ϑ goes to infinity but it collapses to $\Psi[\lambda\boldsymbol{y}] = \lambda\Psi[\boldsymbol{y}]$, and not to the relative criterion, when $\vartheta = 0$. Bossert and Pfingsten (1990) argued that "it is counterintuitive that a parametric 'compromise' between two extreme views does *not* approach the respective limits as the value judgement parameter varies" (p. 122).[7] Hence, they reformulated the

[7] A second criticism raised by Bossert and Pfingsten (1990, pp. 124-5) is that there are inequality measures (e.g. the absolute Gini index) that satisfy the centrist property but violate the compromise property.

intermediate property as $\Psi[\boldsymbol{y}+\lambda(\vartheta\boldsymbol{y}+(1-\vartheta)\boldsymbol{1})]=\Psi[\boldsymbol{y}]$, where $0\le\vartheta\le 1$ and the absolute and the relative criteria correspond to the extremes of ϑ (0 and 1, respectively). By requiring an inequality index to satisfy this property, they characterised the following class of measures:

$$I=\begin{cases}(1+\xi)\left[1-\left[\dfrac{1}{n}\displaystyle\sum_{i=1}^{n}\left(\dfrac{y_i+\xi}{\mu+\xi}\right)^{1-\varepsilon}\right]^{1/(1-\varepsilon)}\right] & \varepsilon>0,\ \varepsilon\neq 1,\ \xi\ge 0\\ \\ (1+\xi)\left[1-\displaystyle\prod_{i=1}^{n}\left(\dfrac{y_i+\xi}{\mu+\xi}\right)^{1/n}\right] & \xi\ge 0\end{cases} \tag{3}$$

where ε and ξ are parameters to be determined, with ξ measured in the unit of account of y_i. The index I turns into Atkinson's relative index for $\xi=0$ and it approaches Kolm's absolute index (1) when ξ tends to infinity. Also for the class of measures (3), we can see the index I as expressing the cost of inequality in terms of the absolute amount of income that could be subtracted from the mean without affecting the level of social welfare, provided that it is rescaled by the factor $(\mu+\xi)/(1+\xi)$, i.e. the equally distributed equivalent income is now defined by $y_e=\mu-I(\mu+\xi)/(1+\xi)$ (see Bossert and Pfingsten, 1990, pp. 125-6). Notice that both C and I tend to behave more and more like a relative measure when total income rises.[8]

In spite of their resemblance, the use of C or I is not equivalent in empirical analysis. Using the same values for ε and ξ in both indices, we have the relationship:

$$I=\left(\frac{1+\xi}{\mu+\xi}\right)C. \tag{4}$$

Thus, for given ξ, the rate of change of I is lower (higher) than that of C whenever mean income μ grows (declines). As we shall see in the next Section, the two indices can give conflicting results on the dynamics of inequality: the Bossert and Pfingsten's index may signal

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[8] Intuitively, in (3) the relative weight of ξ declines as incomes y_i's rise, and the index tends to become a function of the income ratios y_i/μ. This feature is seen as a serious flaw in recent work by Seidl and Pfingsten (1997) and Del Río and Ruiz-Castillo (2000, 2001).

a fall while the Kolm's measure indicates a rise, if income growth is sufficiently large. By using (4), it is easy to see that C represents the absolute cost of inequality, i.e. $y_e = \mu - C$.

Lastly, we mention the class of intermediate Gini indices proposed by Bossert and Pfingsten (1990). They show that every relative inequality index can be transformed into an intermediate measure by a simple change of variable. By using this result, they derive the intermediate Gini index as

$$G_\vartheta = \frac{\mu}{1-\vartheta+\vartheta\mu} G \qquad 0 \le \vartheta \le 1 \tag{5}$$

where G is the standard (relative) Gini index of inequality, which is obtained for $\vartheta = 1$. When $\vartheta = 0$, expression (5) gives the absolute version of the Gini index, i.e. μG.[9]

3. International income inequality

In this Section we investigate how measured trends in world income inequality are modified by abandoning the relative inequality criterion. We examine the "international" rather than the "global" distribution of income since we study differences across countries in per capita GDP weighting each observation by the country's population, but making no allowance for the distribution of income within the country.

We draw real per capita GDP (RGDPCH) and population size (POP) for all countries and years in the period 1970-2000 for which both variables are available from the Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002). Notice that our estimation of absolute and intermediate indices is fully legitimate since we use *real* incomes expressed in U.S. constant dollars. It is beyond the scope of this paper to address the controversial issue of which set of purchasing power parities is more appropriate to deflate nominal incomes. Suffice it to say that the choice may significantly affect the evidence on world inequality trends (e.g. Dowrick, 2002; Dowrick and Akmal, 2001).

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[9] Using a different axiomatic framework, Zoli (1999, p. 438, fn. 17) characterises the class of intermediate Gini indices as $G_{\lambda,\vartheta}=[(1+\vartheta)/(\mu+\vartheta)]^{\lambda}\mu G$, where $0\le\lambda\le1$ and $\vartheta\ge0$.

Our full sample comprises 152 countries, but not all countries have a continuous run of data from 1970 to 2000: there are 30 or 31 observations for 106 countries, between 21 and 29 for another 27, and 15 or less for the remaining 29. The number of observations rises steadily from 113 in 1970 to 152 in 1996 and it then declines to 132 in 2000. To avoid that measured trends reflect changes in country coverage, we concentrate on the sub-sample composed of the 106 countries with 30 or 31 observations. It includes 27 of the 30 countries which are currently member of the Organisation for Economic Co-operation and Development (the Czech Republic, Poland and the Slovak Republic being those excluded), and all the most populous nations but for Russia and Vietnam (i.e. China, India, Indonesia, Brazil, Pakistan, Nigeria, Philippines, Thailand, Iran, Egypt, Ethiopia). This sub-sample is highly representative of the full sample, in terms of economic and population size. In general, our results for the closed sample carry over to the full sample.

To compute the Kolm index, we must choose a value for the free parameter κ, which is only restricted to be positive by the theory. We may first observe that the index *K* can not be computed in our dataset when κ is greater than 0.1, since for some *i*'s the term $\kappa(\mu - y_i)$ is too large to be calculated. Nothing is lost if these values are ignored, because for $\kappa = 0.1$ the index *K* is practically equal to $(\mu - y_1)$, i.e. the absolute gap between the mean income and the income of the poorest country. However, even $\kappa = 0.1$ is nonsensical in economic terms. As κy_i is the elasticity of the social marginal value of income accruing to person *i*, $\kappa = 0.1$ entails that this elasticity is as large as 433 at the mean real per capita income in 1970 (4,332 dollars), or 761 at the mean in 2000 (7,614 dollars). These values imply an extreme aversion to inequality. In terms of the Okun's (1975) "leaky bucket experiment", they mean that all money taken from a rich person may be lost during the transfer to a poorer person, except for an infinitesimal fraction, and still the transfer be seen as socially desirable. We must therefore restrict further the values of κ, setting them in relation to the unit of accounts. One way to pin down these values is by resorting to estimates of the social preferences implicit in taxation systems. Christiansen and Jansen (1978) estimated the elasticity of the social marginal value of income implicit in the Norwegian system of indirect taxation in 1975 to be equal to 1.7 or to 0.9, depending on the model specification. Stern (1977) suggested an elasticity around 2 for the British income taxation system of the early 1970s. Hence, by restricting the elasticity of the social marginal value of income to be in the interval [0.3,3.0], we should cover a wide range of social preferences. We take this interval to hold for the elasticity computed at the grand mean μ and we consider values of κ comprised between $0.3/\mu$ and $3/\mu$. Since μ equals 5,881 dollars in our closed sample, the actual range of κ is from 0.00005 to 0.0005.[10]

In Figure 3, we show how the index *K* varies with the elasticity of the social marginal value of income in four selected years (1970, 1980, 1992 and 2000). The level of the Kolm index varies with the elasticity: in 2000, for instance, it goes from 1,568 to 4,304. However, whatever the value of the elasticity, between 1970 and 2000 the absolute inequality of the international distribution of real per capita GDP unambiguously rises.

How does this trend compare with that of relative inequality? In Figure 4 we plot three relative inequality indices (the mean logarithmic deviation, the Gini index and the Theil index), together with the absolute Gini index and the Kolm index for four different values of the elasticity. Since the various indices differ in level and we are mostly interested in movements over time, we have transformed each measure into the form of an index with basis equal 100 in 1970. The Gini and the Theil indices show some fluctuations around a flat trend until 1990 and then a declining tendency in the next decade; the overall pattern is similar for the mean logarithmic deviation, but the fall starts about ten years earlier. The Gini index goes down from 0.579 in 1970 and 0.570 in 1990 to 0.530 in 2000. On the contrary, all absolute measures exhibit a strong tendency to rise, which has strengthened after 1982. Between 1970 and 2000, the absolute Gini increases by 61 per cent (from 2,504 to 4,036) and the Kolm index with elasticity equal to 1 by 103 per cent (from 1,544 to 3,134). The rising tendency is sharper for lower values of the elasticity and hence of κ, suggesting that the process is highly influenced by the richest countries. (The smaller κ, the higher the contribution to the total index of these countries.) Given a growth of mean income in the same period by 76 per cent

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[10] The aim of this procedure is to determine the magnitude of κ. Once chosen, the value of κ is kept fixed over time. As income grows, the *actual* elasticity of the social marginal value of income must also rise. For instance, choosing a priori an elasticity of 1 at the grand mean μ gives $\kappa=1/\mu$. If $\mu(\tau)$ is the mean income in year τ, in the same year the actual elasticity is $\kappa\mu(\tau)$, or $\mu(\tau)/\mu$. Thus, in our sample, the elasticity of the social marginal value of income at the mean increases from about 0.7 in 1970 to 1.3 in 2000. To keep the elasticity constant over time, we should make κ inversely proportional to $\mu(\tau)$. However, this would change the nature of the index *K*, that would no longer be translation invariant (see (1)).

(from 4,322 to 7,614 dollars), the "cost" of inequality as measured by the Kolm index has gone up not only in absolute terms, but also as a ratio to mean income.

The story becomes somewhat more complex when we adopt an intermediate notion of inequality. As seen in Section 2, the measures C and I proposed by Kolm, and Bossert and Pfingsten have two parameters, ε and ξ. The formulation of both indices suggests that the magnitude of ξ should be commensurable to the level of incomes, otherwise the influence of the parameter would be negligible. Indeed, Kolm (1976) observes:

> "On practical grounds, … [i]f we compare distributions with the same average $\bar{x}$, the choice $\xi = \bar{x}$ seems reasonable. If not, a ξ which is the average of averages weighted by population (i.e., the average income for a population which is the gathering of the compared ones) may also be suggested as suitable" (p. 437, fn. 15).

Bearing in mind these considerations, we have experimented with eight different values for ξ. Four values are time-invariant: 365 and 730 dollars, i.e. the annual incomes corresponding to the absolute poverty lines adopted by international organisations (1 and 2 dollars a day, respectively); 5,881 dollars, i.e. the grand mean μ suggested by Kolm, or the population-weighted average taken across all countries and all years in the period 1970-2000; 1,176 dollars, or a fifth of the grand mean. Four values vary over time since they are set as a fixed proportion (0.2, 0.5, 1 and 2) of the annual mean incomes $\mu(\tau)$'s. Since the world income grows steadily almost over the whole period 1970-2000 (the only exceptions being 1974-75 and 1982), setting a value of ξ proportional to $\mu(\tau)$ implies that ξ rises over time and the index I of intermediate inequality gradually becomes less relative and more absolute. The choice of ε is more straightforward as it parallels that of κ in the absolute Kolm index. For both indices C and I the elasticity of the social marginal valuation of the income accruing to person i is equal to $\varepsilon y_i/(y_i + \xi)$. Given an elasticity comprised between 0.3 and 3 as before, ε can be supposed to vary between $0.3(\mu+\xi)/\mu$ and $3(\mu+\xi)/\mu$, which implies that both the lower and upper bounds are multiplied by a factor greater than 1. In the computations below we assume values of ε ranging from 0.5 to 5.

Kolm's centrist measure basically confirms the pattern shown by Kolm's absolute measure: international income inequality has been rising for most of the period from 1970 to 2000; it fell slightly only in 1975, in the early 1980s, and in the early 1990s (Figure 5). These long-run tendencies are common to all specifications of the index C. Movements over shorter periods, however, may differ across alternative combinations of the parameters ε and ξ. For instance, if we set ξ equal to 365 dollars (or another relatively low value), we find a steep ascent of inequality throughout the 1990s when $\varepsilon > 1$, and a slight decline followed by a moderate rise when $\varepsilon \leq 1$. Why this divergence? Values for ε well above 1 attribute much greater importance to the more populous among poorest countries. Thus, with $\varepsilon = 5$ in 2000 three African countries (Tanzania, Nigeria and Ethiopia) account for 69 per cent of the summation inside the square bracket in (2). This means that the dynamics of the index C over time for high values of ε is largely determined by the absolute gap in GDP per head between the average and the poorest countries – which has considerably widened over the whole period. (Recall that C approaches the difference $(\mu(\tau) - y_1(\tau))$, where τ denotes the year, when ε grows without bound.) On the other hand, the more ε is below 1, the larger the relative contribution of countries which are higher in the income scale, and the less sensitive the index to the widening gap between the mean and the bottom incomes. For instance, with $\varepsilon = 0.5$ in 2000 China accounts for 20 per cent of the summation inside the square bracket in (2), and India and the United States for 13 per cent each.

In Figure 6 we plot the time series for the Bossert and Pfingsten's index I calculated for the same combinations of parameters ε and ξ used for C. When ξ is set as a fixed proportion α of the annual mean income, the index I is approximately equal to C rescaled by the constant factor $\alpha/(1+\alpha)$ (substitute $\alpha\mu$ for ξ in (4)). Thus, unsurprisingly, the four bottom panels of Figure 6 look like the corresponding panels in Figure 5, and confirm the long-run tendency towards higher inequality. The patterns of I and C are also similar when $\xi = \mu$, although income disparities increase more with the latter from 1970 to 2000. The results are more ambiguous when the value for ξ is constant and relatively low, as the index I signals some narrowing for low values of ε and a widening only when ε is close to the upper bound. The reasons are similar to those discussed in the corresponding cases of C.

In most cases the cost of intermediate inequality relative to the annual mean income – which is the same whether evaluated with I or C – declined or stayed about constant; it only rose, very slightly, for low ξ and very high ε (see Figure 7 for $\varepsilon = 1$ and $\varepsilon = 5$).

To sum up, when we adopt a relative view of inequality, the world distribution of real per capita GDP's appears to have noticeably narrowed from 1970 to 2000. However, this conclusion does not survive to a move towards non-relative conceptions of inequality. We find evidence of a substantial increase of international inequality, whether we adopt an absolute or an intermediate conception, regardless of the measure chosen, and for most of the values of free parameters ε and ξ. Only the Bossert and Pfingsten's index I computed for relatively low values of ξ and ε suggests that intermediate inequality has significantly fallen.

4. Global income inequality

In the previous section we took no account of within-country differences in income. By narrowing the range of incomes, this may give a misleading impression of the consequences of adopting an absolute or an intermediate approach. We now try to bring in within-country inequality by drawing on the data for the world distribution of income constructed by Bourguignon and Morrisson (2002), available at www.delta.ens.fr/XIX. Their method is to use evidence on the national distribution (or the distribution for a grouping of countries) about the income shares of decile groups, and the top 5 per cent. The groups are treated as homogeneous, which means that the degree of overall inequality is under-stated, but their data provide a valuable starting point. The distributional data are then combined with estimates of national GDP per head, expressed in constant purchasing power parity dollars (at 1990 prices), which are in turn derived from the historical time series constructed by Maddison (1995). As before, we do not discuss here the issues raised by such a method; nor do we consider more generally the issues of data reliability.[11] We take their estimates simply for illustrative purposes.

In Figure 8 we compare relative, absolute and intermediate measures of the world income inequality. In the top panel we plot our estimates of three relative measures, which are

[11] See, for instance, Deaton's critical remark: "… the differences in coverage and definition between [National Accounts] and survey means that, even if everything were perfectly measured, it would be incorrect to apply inequality or distributional measures, which are defined from surveys which measure one thing, to means that are derived from the national accounts, which measure another" (2003, p. 35). On the reliability of international compilations of income distribution statistics see Atkinson and Brandolini (2001).

virtually identical to those reported by Bourguignon and Morrisson in their Table 1 (2002, pp. 731-2). The Gini index and the mean logarithmic deviation indicate a steady and considerable rise of inequality from 1820 to 1950 and a much more moderate increase after 1950. The rise of the Theil index is sharper during the 19th century, but it basically terminates by 1910. Between 1970 and 1992, all three indices exhibit some modest widening of income disparities across world citizens. Accounting for the within-country distribution, however imperfectly, has therefore the effect of reversing the trend found earlier for international income inequality. The dynamics of the absolute Kolm's and Gini's indices (mid panel of Figure 8) and of the Bossert and Pfingsten's intermediate index (bottom panel)[12] are very similar: inequality rose continuously over the entire period, at a faster pace between 1950 and 1980.

In Figure 9 we concentrate on the evolution of intermediate inequality, as measured by the Bossert and Pfingsten's index, in 1970, 1980 and 1992. Over the entire period, income disparities go up, whatever the combination of parameters ε and ξ. However, when ε is larger than 1 and ξ is constant and relatively low (i.e. equal to 365, 730 and 901 dollars), the overall increase is smaller, and virtually nil between 1980 and 1992. This evidence matches that discussed in the previous section: for this specific configuration of the parameters ε and ξ, after 1980 "international" income inequality fell but "global" income inequality remained about the same. Loosely speaking, the closing of income gaps *across* countries was offset by the evolution of income gaps *within* countries.

As before we can evaluate the cost of inequality as a ratio to the annual mean income. According to all specifications of the intermediate indices, in the long run the fraction of mean income that could be subtracted leaving social welfare unaffected has increased (Figure 10).

In brief, the secular movement of the world income distribution does not change whether we look at relative or non-relative measures – inequality has been rising. The story is

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[12] The mean μ used to compute the intermediate indices in Figures 8-10 is not the (population-weighted) overall mean, but that taken over the last three available years: 1970, 1980 and 1992. The dynamics of the Kolm's centrist measure are similar to those of the Bossert and Pfingsten's index with time-varying ξ and are not discussed.

somewhat different, however, after the Second World War: the modest positive slope of relative inequality is matched by a steep ascent of absolute and intermediate inequality.

5. Conclusions

The effects of "globalisation" on world income inequality have been much debated in recent years. Some commentators have stressed the impressive growth performance of some emerging economies, like China, India and other countries in South East Asia, and have concluded that world inequality must have decreased. Others have countered that these impressive rates of growth have not yet translated into absolute increases of size comparable to that of developed economies, given the very different levels of GDP per head. Thus, international income gaps must have risen.

This difference in emphasis may be seen as reflecting alternative views on how income growth should be distributed to leave inequality unaltered. According to the relative view – which is the standard approach in empirical analysis – inequality is unchanged when all incomes are raised in the same proportion. With the absolute view inequality is unaffected by equal additions to all incomes. A compromise view is to assume that inequality decreases when all incomes are augmented by the same amount and increases when all incomes go up in the same proportion. This issue has been studied in the theory of inequality measurement, leading to the specification of alternative inequality measures. Taking advantage of this theoretical literature, we have examined how the measured evolution of world income inequality is affected by a shift from relative to non-relative approaches.

The international distribution of real per capita GDP (i.e. ignoring within-country disparities) narrowed from 1970 to 2000 if we adopt a relative view of inequality; it widened considerably if we assume an absolute or an intermediate conception, regardless of the index chosen and for most of the values of free parameters. Only the Bossert and Pfingsten's index for some combinations of the free parameters suggests a fall of intermediate inequality.

When we adjust for the within-country distribution of income, the evidence is almost unequivocally of a rise in income inequality from 1970 to 1992, whatever the underlying conception of inequality. If we extend the time horizon to the whole post-war period, the results are more ambiguous, since the modest positive slope of relative inequality is matched by a steep ascent of absolute and intermediate inequality. On a secular basis, from 1820 to 1992, the evidence is again one of a movement towards higher inequality both with relative and non-relative measures.

Figure 1

DIVISION OF AN EXTRA INCOME IN A TWO-PERSON DISTRIBUTION

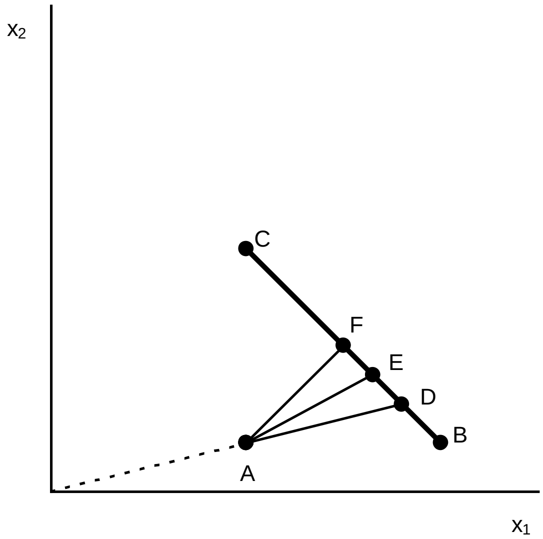


Figure 2

ISO-INEQUALITY CONTOURS FOR DIFFERENT INDEPENDENCE CRITERIA

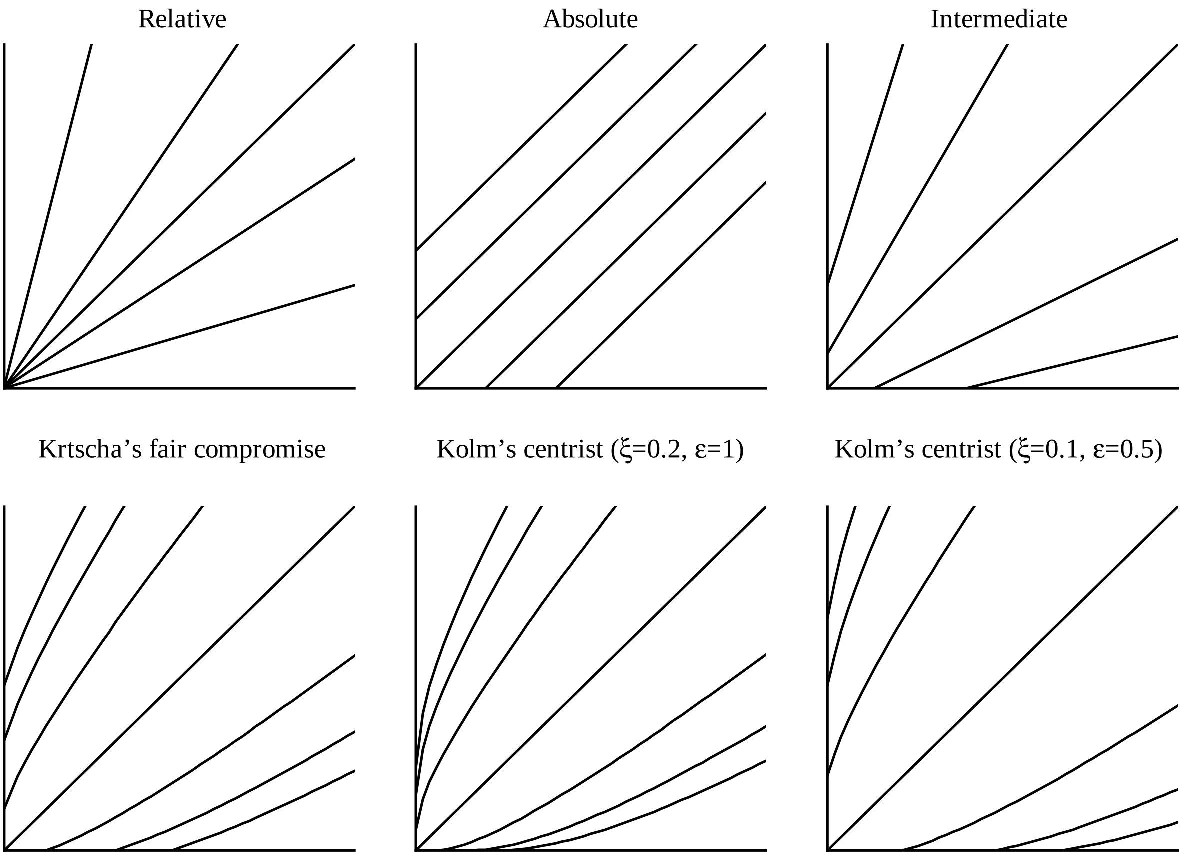
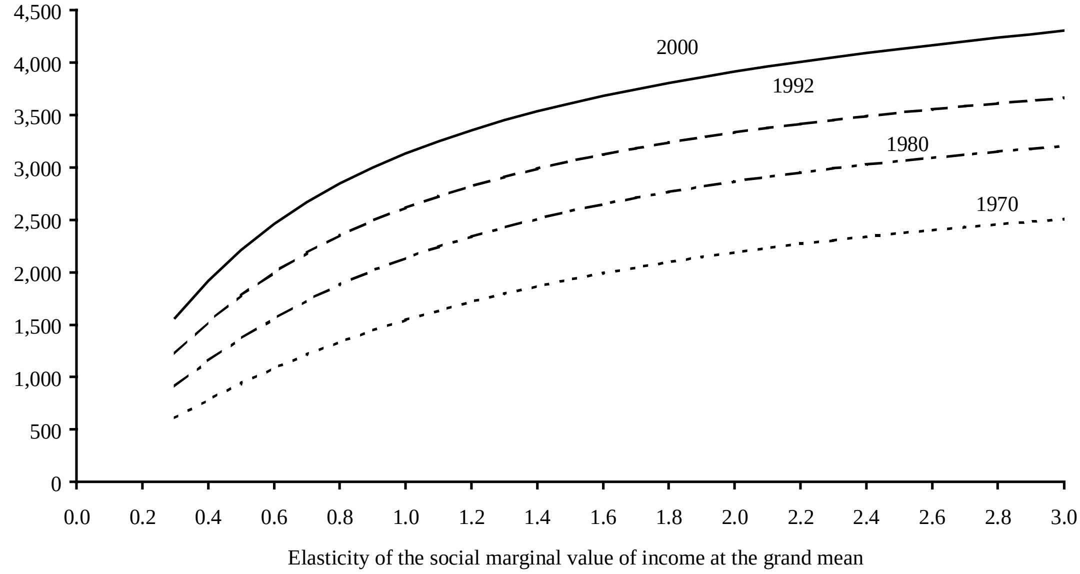


Figure 3

INTERNATIONAL INCOME INEQUALITY, 1970, 1980, 1992 AND 2000: KOLM INDEX FOR ALTERNATIVE SOCIAL PREFERENCES

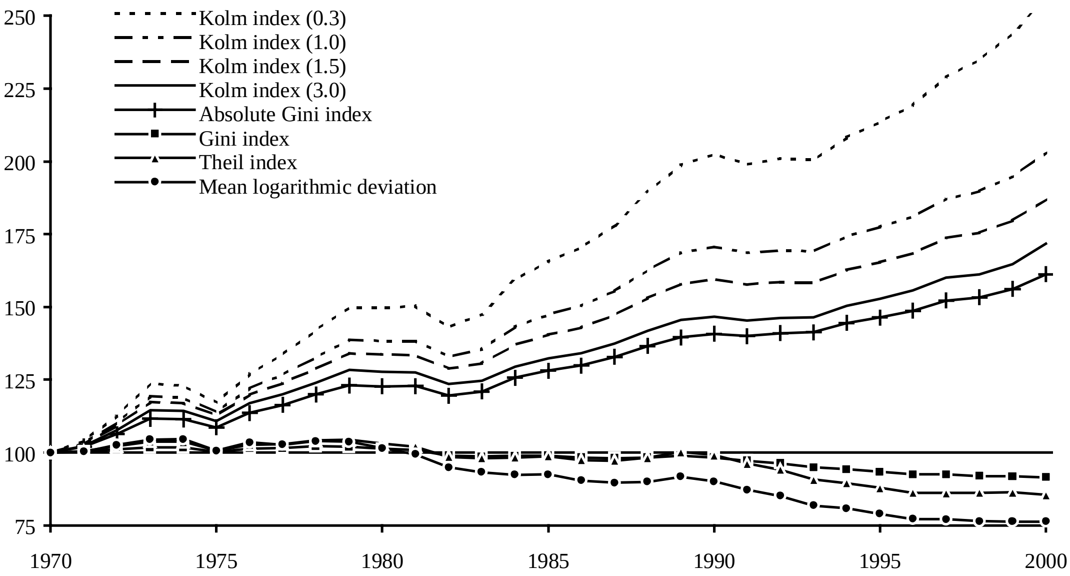


Source: authors' elaboration on data drawn from Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002).

Figure 4

INTERNATIONAL INCOME INEQUALITY, 1970-2000: RELATIVE AND ABSOLUTE INDICES

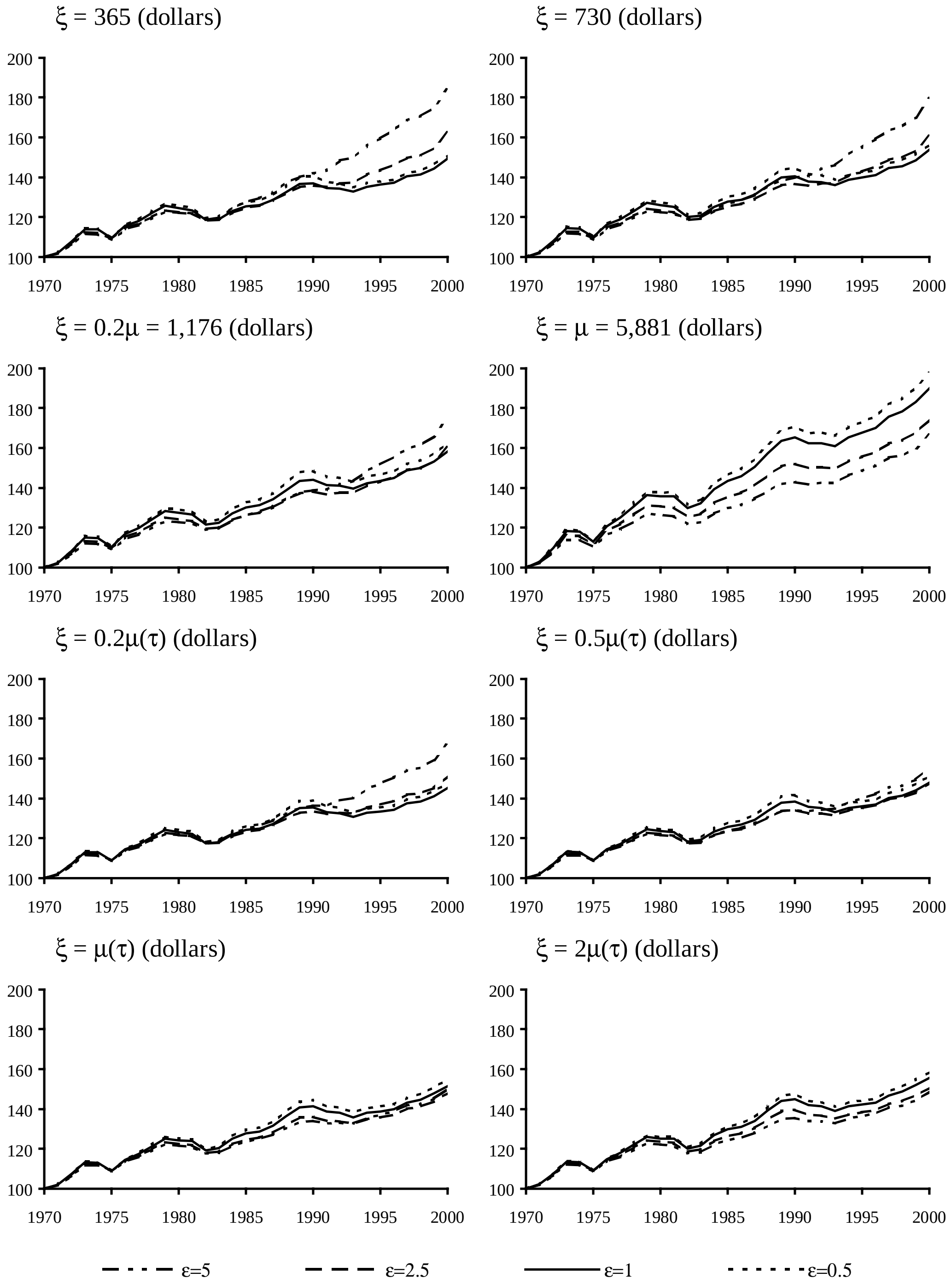
(Indices: 1970=100)



Source: authors' elaboration on data drawn from Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002). The value in parentheses for the Kolm index is the elasticity of the social marginal value of income at the grand mean.

Figure 5

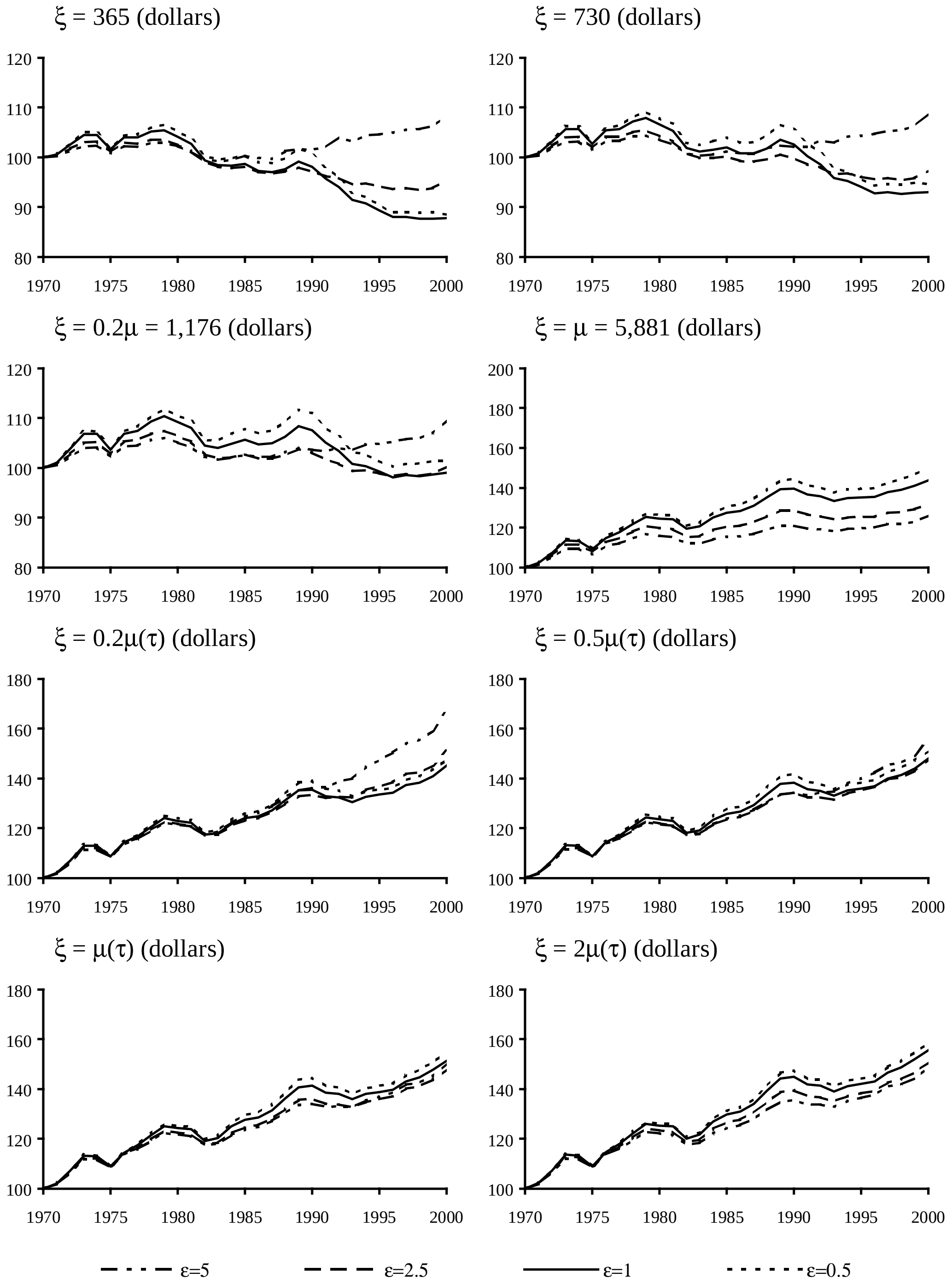
INTERNATIONAL INCOME INEQUALITY, 1970-2000:
KOLM'S CENTRIST INDEX
(Indices: 1970=100)



Source: authors' elaboration on data drawn from Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002). μ is the population-weighted mean of per capita incomes over the whole period; $\mu(\tau)$ is the population-weighted mean of per capita incomes in year τ.

Figure 6

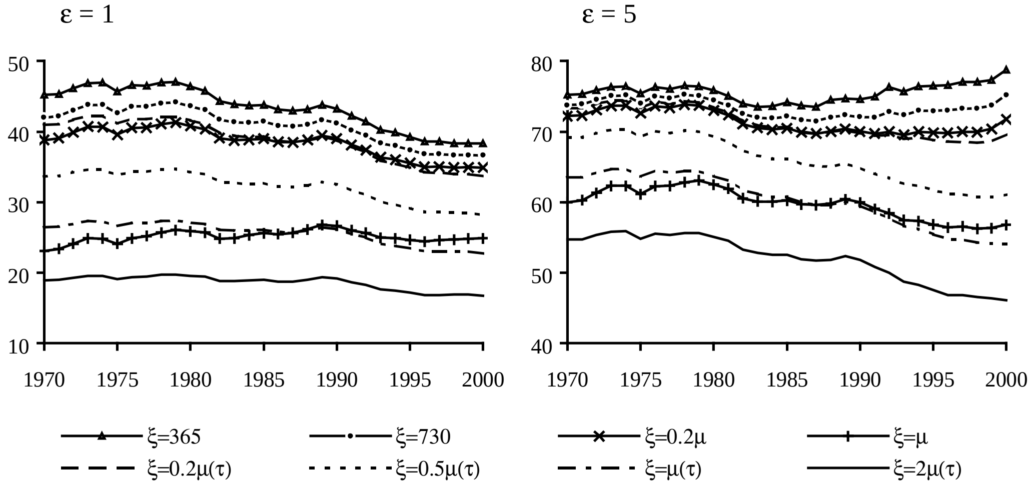
INTERNATIONAL INCOME INEQUALITY, 1970-2000:
BOSSERT-PFINGSTEN'S INTERMEDIATE INDEX
(Indices: 1970=100)



Source: authors' elaboration on data drawn from Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002). μ is the population-weighted mean of per capita incomes over the whole period; $\mu(\tau)$ is the population-weighted mean of per capita incomes in year τ.

Figure 7

**THE COST OF INTERNATIONAL INCOME INEQUALITY, 1970-2000:
KOLM'S CENTRIST AND BOSSERT-PFINGSTEN'S INTERMEDIATE INDICES**
(Percentage ratio to the mean)

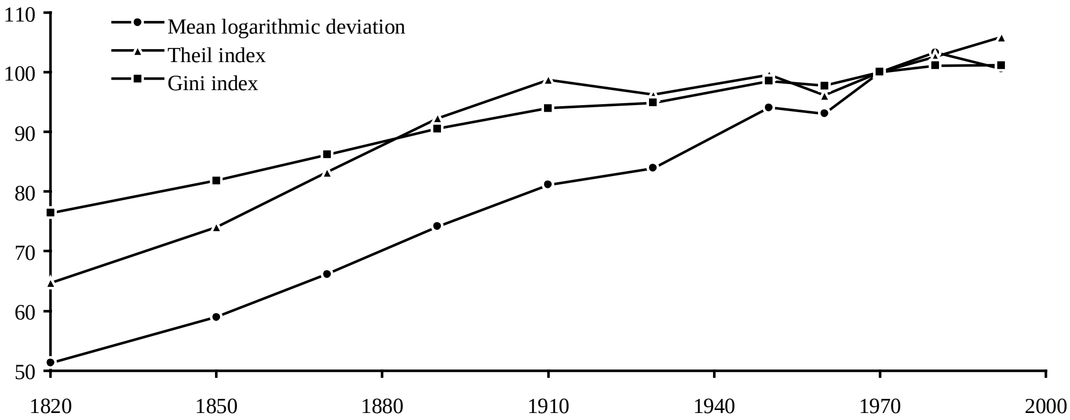


Source: authors' elaboration on data drawn from Penn World Table, Version 6.1 (Heston, Summers and Aten, 2002). μ is the population-weighted mean of per capita incomes over the whole period; μ(τ) is the population-weighted mean of per capita incomes in year τ.

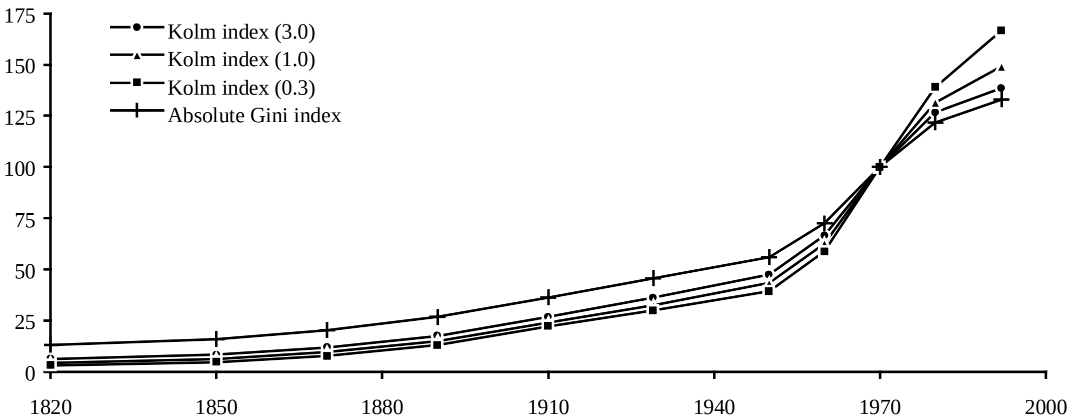
Figure 8

GLOBAL INCOME INEQUALITY, 1820-1992
(Indices: 1970=100)

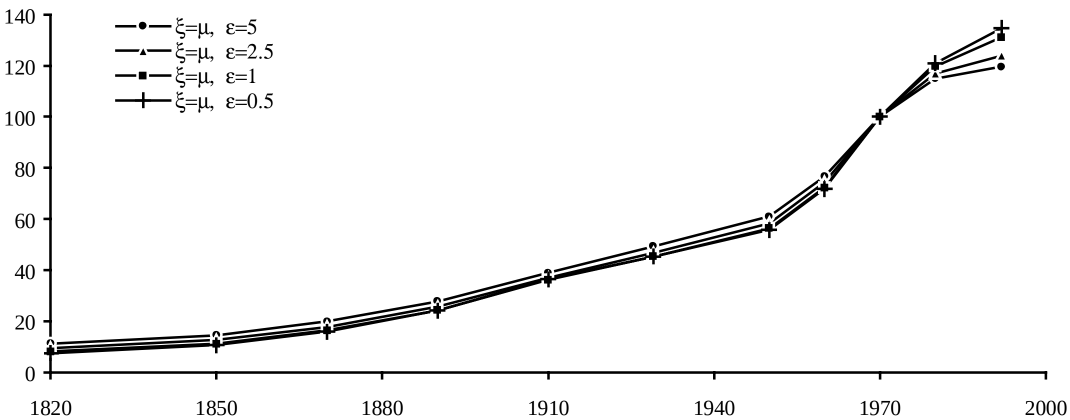
Relative inequality indices



Absolute inequality indices



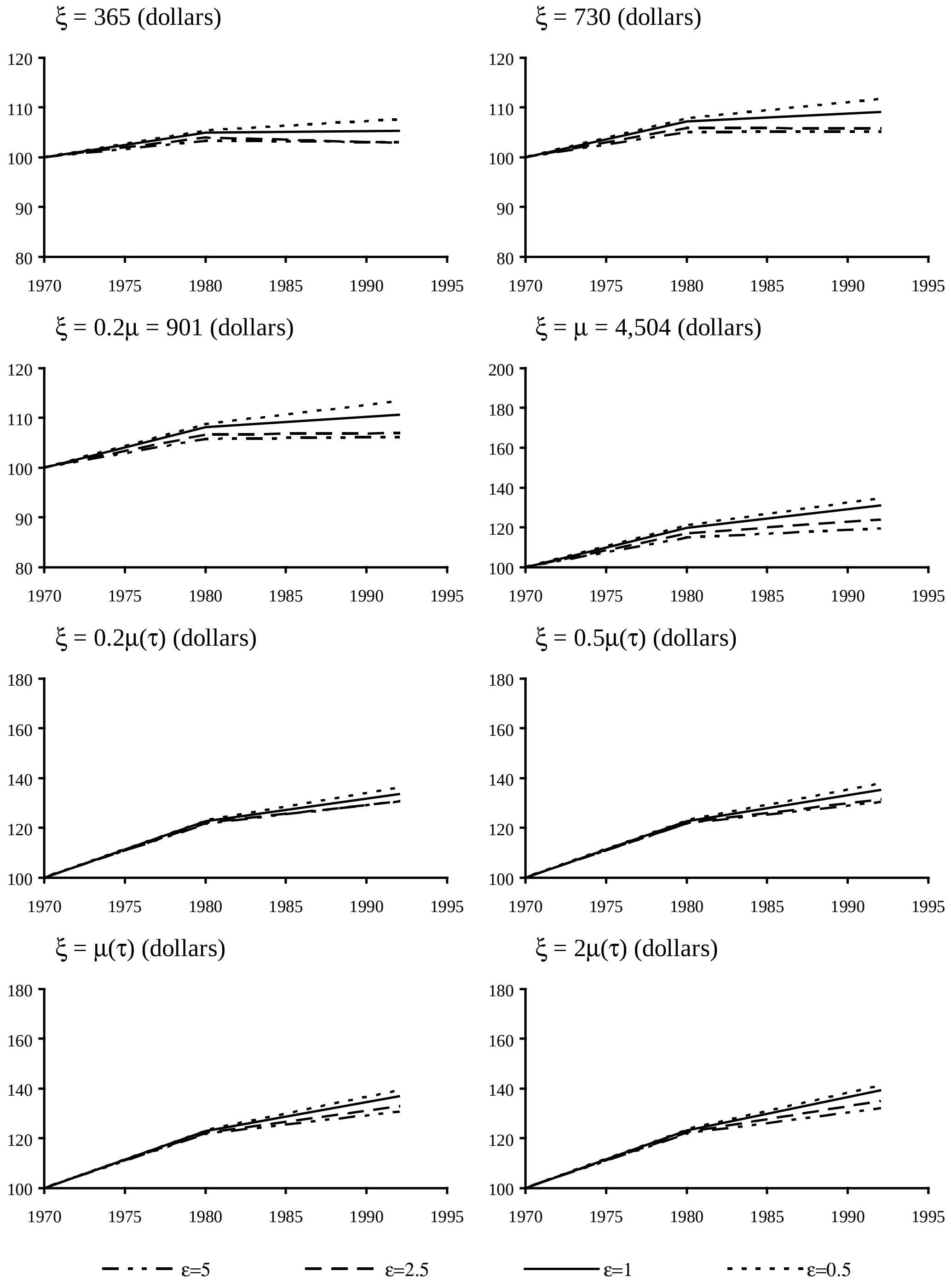
Bossert-Pfingsten's intermediate inequality index



Source: authors' elaboration on data drawn from Bourguignon and Morrisson (2002). The value in parentheses for the Kolm index is the elasticity of the social marginal value of income at the grand mean. μ is the population-weighted mean of per capita incomes in the years 1970, 1980 and 1992.

Figure 9

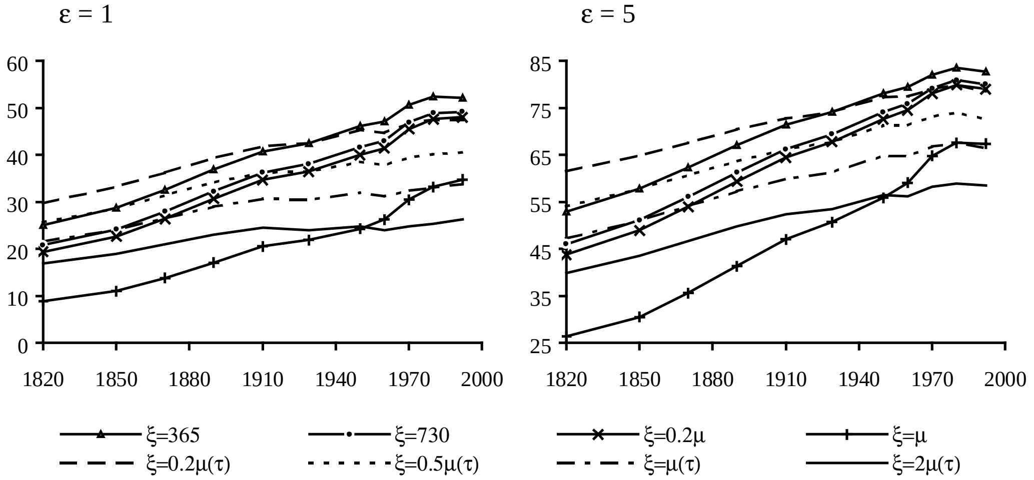
GLOBAL INCOME INEQUALITY, 1970, 1980, 1992:
BOSSERT-PFINGSTEN'S INTERMEDIATE INDEX
(Indices: 1970=100)



Source: authors' elaboration on data drawn from Bourguignon and Morrisson (2002). μ is the population-weighted mean of per capita incomes in the years 1970, 1980 and 1992; $\mu(\tau)$ is the population-weighted mean of per capita incomes in year τ.

Figure 10

THE COST OF GLOBAL INCOME INEQUALITY, 1820-1992:
KOLM'S CENTRIST AND BOSSERT-PFINGSTEN'S INTERMEDIATE INDICES
(Percentage ratio to the mean)



Source: authors' elaboration on data drawn from Bourguignon and Morrisson (2002). μ is the population-weighted mean of per capita incomes in the years 1970, 1980 and 1992; μ(τ) is the population-weighted mean of per capita incomes in year τ.

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