What do we know about global income inequality?

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1. Introduction

The last few years have seen a spate of papers estimating global income inequality. Their appearance is in part motivated by a desire to understand the effects of 'globalization', and has been made possible by recent increases in the availability of data on income distributions within countries. Controversy centres on whether inequality has increased or decreased in the recent past. The direction and magnitude of change have been highly charged questions with some authors arguing that globalization has benefited the rich disproportionately, while others argue that it has reduced world income inequalities. Various findings are cited in the media, including the financial press, typically to support one or another position on globalization.

In this paper we will review the literature on global interpersonal inequality, including the studies by Bhalla (2002), Bourguignon and Morrisson (2002), Chotikapanich, Valenzuela and Rao (1997), Dowrick and Akmal (2005), Dikhanov and Ward (2002), Korzeniewicz and Moran (1997), Milanovic (2002, 2005), Sala-i-Martin (2006), and Schultz (1998). These studies cover different time periods up to the 1990s or later (1989 in the case of

Schulz 1998), use different methods of estimation, and rely on different datasets. They all estimate the level of and change in global interpersonal income or consumption inequality, using a variety of inequality measures. Earlier papers have also estimated global inequality, such as Berry, Bourguignon and Morrisson (1983) and Grosh and Nafziger (1986), but they were based on very limited income distribution data and in this regard the literature has advanced considerably.[1] Several other papers look solely at trends in within-country inequality around the world. For example, Cornia and Kiiski (2001) examine changes in income and consumption inequality within countries, and Galbraith et al. (1999) measure the evolution of industrial earnings inequality. Yet other studies, such as Firebaugh (1999, 2003) and Boltho and Toniolo (1999), estimate between-country inequality only, while Melchior et al. (2000) estimate between-country inequality and report trends in regional Gini coefficients. However, none of these studies constructs a measure of global inequality which takes account of both between- and within-country inequality, and are therefore outside the scope of this review.

The changes in inequality found in these studies have often been adduced as evidence for or against the benefits of increased international economic integration. Quite apart from the problem of attributing causality,[2] we contend that the measured changes do not appear to be statistically significant on the basis of the standard errors estimated in some of the studies. Some changes, such as in Milanovic (2002), appear large for the time

[1] Berry et al. (1983: 219) use data from "the developed countries and about forty less developed countries", stating that "[F]or many L.D.C.s data at the national level is either non-existent or extremely weak." Even as late as 1992 income distribution estimates were available for only 41 out of 185 countries listed in the World Bank's (1992) *World Development Report*.

[2] For example, much of the increase in incomes of the poor in China occurred as a result of changes in government policy on domestic foodgrain prices in the early 1980s and mid 1990s, and had little if anything to do with increased international economic integration (Riskin 2006).

period over which they are measured, but they are nonetheless small relative to plausible standard errors. Other sources of uncertainty (e.g. measurement and estimation problems) that are not incorporated in the estimated standard errors would lead to even wider confidence intervals. Such uncertainty, combined with the disagreement among the studies, leads us to the view that we cannot tell whether global inequality has increased or decreased in the recent past on the basis of existing findings.

The paper proceeds as follows. Section 2 begins by asking what kind of global inequality we want to measure, and why. In section 3 we present an overview of the studies. Section 4 discusses each study in turn and critically reviews the data and methodology used. Section 5 discusses the decomposition of global inequality into between-country and within-country components, and the significance of China and India. In section 6 we discuss methodological and data questions, including the use of purchasing power parity (PPP) versus market exchange rates, measurement error, and the role of national accounts data. Section 7 is in conclusion.

2. What do we want to measure and why?

There are many reasons to be interested in global inequality. Three angles of interest, ranging from the moral to the explanatory, can be readily identified. First, we may be interested in global inequality intrinsically, as large disparities in individuals' incomes may be considered unjust. Secondly, we may be interested in global inequality as an explanation for, or predictor of, some phenomenon of interest. Thus, unequal voting or bargaining power in international institutions may be a reflection of income inequalities among countries; or migration may be partly determined by global income inequalities as relatively poor people migrate to raise their living standards. Finally, we may be interested in global inequality as a predicted outcome of a theory, such as the convergence in per capita incomes across countries predicted by neoclassical growth theory, or the divergence predicted by dependency theory.

The appropriate definition of 'global inequality' depends on the purpose at hand. Milanovic (2005) provides a useful distinction between three concepts of world income inequality. Concept one is inequality among countries in their levels of average per capita income, with each country counting as a unit. Concept two is what we refer to as *between-country inequality*, which is inequality among individuals in the world with each individual assigned the average per capita income of his or her country of residence. Concept three is *global interpersonal inequality*, or *global inequality* for short, which is inequality among individuals in the world with each individual assigned his or her own (per capita household) income. Concept two can readily be seen as the same as the 'between-country component' of global inequality. It measures what global inequality would be if incomes were to be equally distributed among individuals within each country. Finally, to Milanovic's three concepts we would add a 'concept zero inequality', which refers to inequality among countries ranked by total (not per capita) income. The population unit of concepts zero and one is the country, while that of concepts two and three is the individual.[3] In all cases it remains to choose an appropriate 'income' concept, e.g. consumption expenditure or income, assigned to the population

[3] Concepts two and three inequality could in principle also be defined across households rather than individuals.

unit in question (country or individual). This is important because, for instance, concept three inequality applied to income could move in a different direction from concept three inequality applied to consumption expenditure. This issue is discussed later.

To measure global inequality we must also choose a set of exchange rates with which to convert national currencies into a common numeraire. The options are, broadly speaking, market exchange rates (say, relative to the US dollar) versus purchasing power parity (PPP) exchange rates.[4] PPP exchange rates take into account price differences across countries. They allow for the fact that a dollar's worth of rupees, bought on the currency markets, will buy more of most goods and services in India than the same dollar would buy in the US. For developing countries, incomes measured using PPP exchange rates can be three or four times higher than when measured at market exchange rates.

Wade (2001) suggests that market exchange rates are more appropriate than PPP exchange rates "for most of the issues that concern the world at large", including "migration flows" and "the extent of marginalization of developing countries in the world polity; and, more broadly, the economic and geopolitical impact of a country (or region) on the rest of the world". It seems more plausible to us that relative incomes measured at PPP exchange rates would be the better predictor of migration flows. Remittances sent by migrants are indeed exchanged into national currencies on the market, but to the extent that people migrate to raise their own standard of living, it is PPP exchange rates that matter. On the other hand, market exchange rates do seem to be more appropriate in

[4] The two options are broad in the sense that choices remain within each: there will be different methods of smoothing market exchange rates over the year, and there are different methods for calculating PPP exchange rates. We consider PPP exchange rates in more detail later in the paper.

measuring "the economic and geopolitical impact of a country (or region) on the rest of the world". In this case the variable of interest is presumably total income, not per capita income. This is one of the factors that underlies China's significance in world politics, and makes India and Brazil important in international trade negotiations. The appropriate inequality concept here would seem to be concept zero inequality, or gross national income across countries measured at market exchange rates.

Other questions call for different combinations of inequality concept and exchange rate. Consider the question of convergence between countries. This is based on concept one inequality where the country is the population unit, assigned its level of per capita income. As the variable of interest is the level of output per head, it is natural to use PPP exchange rates (e.g. Pritchett 1997).

These questions are not our concern in this paper. The studies reviewed here are concerned with global inequality from two points of view. First, it is of interest intrinsically, as a measure of the distribution of goods or resources among individuals in the world. Within countries, high levels of inequality are often taken to indicate a lack of fairness in society and governments act to reduce inequality – for example, through progressive tax-benefit policies. At the global level there are some redistributive mechanisms, e.g. foreign aid. Moreover, rules governing economic interactions between rich and poor countries, e.g. intellectual property rights over pharmaceuticals, will affect global inequality. A concern for "global justice" will lead to an interest in concept three inequality.

Secondly, changes in global inequality are sometimes portrayed as consequences of 'globalization'. As trade and financial flows among countries increase, mediated by governments and international institutions that substantially influence the terms of these exchanges, questions of distribution across countries immediately arise. Thus the evolution of global inequality may tell us something about globalization. Although several of the studies reviewed here attribute changes in global inequality to globalization, none presents any causal analysis. Nonetheless, measuring trends in global inequality would be an important preliminary for such an analysis.

Since our main concern is inequality of real income (or consumption) among individuals, it is natural to use PPP exchange rates. However, from a technical point of view the difference between inequality as measured at PPP rates and at market exchange rates is itself of interest. The divergence reported by studies between trends in inequality at different exchange rates may imply something about economic structure, which we discuss later. Thus we also report global interpersonal inequality at market exchange rates.

We have so far said nothing of concept two inequality, which assigns to each individual in the world the per capita income of his or her country. As the between-country component in the decomposition of concept three inequality, it is useful for explaining the sources of global interpersonal inequality and its changes over time. In addition, some studies (e.g. Firebaugh 1999, 2003) have used it as a downward-biased estimator for concept three inequality.

3. An overview of global inequality

As a first cut at estimating international inequality, UNDP (1999) and World Bank (2000) report changes in the ratio of per capita GDP of the richest countries to that of the poorest countries. This is a measure of concept one inequality as it takes the country as the unit of analysis and per capita GDP (at PPP exchange rates) as the income concept. World Bank (2000: 51) reports that in 1960 the per capita GDP of the 20 richest countries was 18 times that of the 20 poorest countries, while in 1995 the ratio had grown to 37. UNDP (1999: 38) notes that the ratio of the per capita GDP of the richest country to that of the poorest country grew from 35 in 1950, to 44 in 1973, and 72 in 1992.[5] Like Pritchett's well-known (1997) analysis, this represents "divergence, big time".

Matters are not so simple, however, when we turn to concept three global interpersonal inequality. All studies agree that the *level* is very high: for example, estimates of the Gini coefficient using standard purchasing power parity income (sourced from the World Bank, Maddison, or the Penn World Tables) in the 1990s lie within the range of 0.609 to

[5] Both Bhalla (2002) and Australian Treasury (2001) object to this procedure, claiming that because it uses different countries in the two years of comparison, the measure is biased. They claim that the correct procedure would be to compare the relative incomes of the same groups of countries in the two years, and that this results in a decline in inequality. Bhalla (2002: 24) states that the income ratio between the richest 20 and poorest 20 countries in 1960 is 23, and that the ratio between these same two groups of countries falls to 9.5 in 2000. This criticism is mistaken. It is an axiom of inequality measures that they are 'anonymous', i.e. they do not distinguish between individuals (countries) other than by their income levels. That is, inequality measures are functions of the vector of incomes, which are invariant to permutations of the vector, i.e. they are independent of the individual (or country) names attaching to the incomes. The World Bank and UNDP methodology satisfy this axiom, while Bhalla's does not.

0.686. These levels are comparable to those found within the most unequal countries, such as Namibia and Botswana, with Ginis of 0.707 and 0.630 respectively, according to World Bank (2002).

In contrast, no consensus emerges concerning the direction of *change* in global inequality in the last twenty to thirty years. For example, Dowrick and Akmal (2005) find that the Gini falls from 0.659 in 1980 to 0.636 in 1993 when using standard PPP conversion factors, but that it rises slightly from 0.698 to 0.711 using their own 'Afriat' PPP conversion factors (on which more below). Sala-i-Martin (2006) finds it to decrease from 0.660 in 1980 to 0.637 in 2000, and Bhalla (2002) records a reduction from 0.686 in 1980[6] to 0.651 in 2000. In contrast, Bourguignon and Morrisson (2002) find no change in the Gini between 1980 and 1992, which remains at 0.657, while their estimate of the Theil T index increases from 0.829 to 0.855. Milanovic (2005) finds that the Gini coefficient increases from 0.622 to 0.641 between 1988 and 1998.

Several studies estimate what they call the 'Theil' measure of inequality. Unfortunately, the authors are not referring to the same (Theil) inequality index. In Chotikanapich et al. (1997), Milanovic (2002, 2005), and Dikhanov and Ward (2002),[7] the 'Theil index' refers to the Theil L measure or the mean logarithmic deviation (Anand 1983: 89-91), but in Bourguignon and Morrisson (2002), Dowrick and Akmal (2005), Korzeniewicz and

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[6] This information can be roughly read off the graph in figure 11.1 of Bhalla (2002). This number is also given in Table 5.2 on p. 80 of the third draft of Bhalla (2002), circulated in December 2001, but the table and this number do not appear in the final published version.

[7] In discussing the 'Theil' index, Dikhanov and Ward provide the formula for the Theil L measure. They also estimate what they call the 'Theil 2' index but do not provide any formula for it. We assume it refers to the Theil T index.

Moran (1997), and Sala-i-Martin (2006, 2002a, b), the Theil index refers to the Theil T entropy measure.[8]

Estimated changes in the Theil indices are typically larger in proportional terms than those in the Gini. Given that both Theil indices are more sensitive than the Gini to changes at the extremes of the distribution, one explanation might be that changes in the incomes of the richest relative to those of the poorest have been more significant than those in the middle of the distribution. The findings in Milanovic (2002) that the ratio of the income of the richest 5% to the poorest 5% increased from 78 in 1988 to 114 in 1993, and in Bourguignon and Morrisson (2002) of an increase in the global income share of the top 5% between 1980 and 1992, are consistent with this explanation.

Four of the studies also calculate global inequality at market exchange rates. The level found is, not surprisingly, substantially higher than when PPP incomes are used, and all four studies also report an increase over time. Dowrick and Akmal find that the Gini rises from 0.779 to 0.824 between 1980 and 1993, Milanovic (2002) from 0.782 to 0.805 between 1988 and 1993, Korzeniewicz and Moran from 0.749 to 0.796 between 1965 and 1992, and Milanovic (2005) from 0.778 to 0.794 between 1988 and 1998.

With increasing globalization one would expect market exchange rates to move closer to PPP exchange rates (as countries trade larger proportions of their GDP). The apparent divergence over time between inequality measured at market and at PPP exchange rates

[8] Milanovic (2002) does not specify which Theil index he uses, so we contacted the author directly for this information.

thus requires some explanation. Dowrick and Akmal (2005) attempt to address this question (discussed below), but in our view the relationship between changes in global inequality at PPP and at market exchange rates merits further research.

4. The studies

The studies reviewed here make use of a variety of methods, measurements and datasets. In this section we describe the findings and distinguishing features of each study, and comment on their calculations. Table 1 and Figures 1 and 2 summarize their results; Table 2 summarizes their sources. Issues that arise in relation to several or all of the papers are discussed in Sections 5 and 6.

Milanovic (2002, 2005)

Milanovic (2002) uses income or expenditure taken directly from national household surveys to construct a 'true', in the sense of directly observed, world distribution of income/consumption. Using PPP exchange rates for consumption, from both the Penn World Tables (PWT) and the World Bank, he finds that inequality increases over the five-year period 1988-1993 (see our Table 1). Moreover, the 1988 distribution Lorenz-dominates the 1993 distribution, and hence will show less inequality for all measures in the Lorenz class of indices (Anand 1983: 339-40). His later book, Milanovic (2005), updates the estimates to 1998. He finds that inequality falls over 1993-98, but remains some two Gini points higher in 1998 than in 1988 (see our Table 1).

Milanovic's (2002) data comprise a total of 216 country surveys benchmarked to the two years 1988 and 1993, which are obtained from the World Bank and other sources.[9] Milanovic's (2005) study, which includes the benchmark year 1998, has a sample of 345 country surveys. Unlike every other study, Milanovic constructs inequality estimates over time for a *common sample* of countries. The common sample is slightly different in the two studies but in both cases covers about 84% of the world's population. Most of his within-country distributions are described by at least ten quantile shares or income groups, and he assumes that each individual or household within a group has the same income.

Milanovic's estimates raise a number of questions. First, countries in the common sample have different numbers of income groups in the different benchmark years, with the average number of data points (income groups) per country-year standing at 10.8 in 1988, 11.4 in 1993, and 15.1 in 1998. Hence the under-estimation due to the assumption of equal incomes within income groups would be expected to be different in each year. Secondly, the measured distribution within China is of concern. Milanovic (2002) has several income groups in rural China each containing more than 100 million people, with the largest containing 180 million in 1993 (and 175 million in 1990 for the benchmark

[9] The sample that is common to both 1988 and 1993 consists of 91 countries; in addition, for 1988 he has data for another 10 countries, and for 1993 for another 28 countries. Thus the total number of countries in 1988 is 101 and in 1993 it is 119. The total of 220 country-years is larger than the 216 country surveys. This may be due to his splitting of four large countries (China, India, Bangladesh and Indonesia) into urban and rural areas in both years and treating them as different countries. He similarly splits Pakistan in 1988 but not in 1993. However, even when we count these observations as distinct surveys for different country-years we are unable to make the numbers tally.

year 1988).[10] The presence of such large groups could lead to possibly-substantial downward biases in measured inequality.

Thirdly, to achieve finer-grained distributions Milanovic (2002: 60) states that he splits four large countries in 1993 and five in 1988, including China and India, into rural and urban areas (for which he has separate distributions) and treats these observations as different 'countries'.[11] However, in two of these countries – Bangladesh[12] and Indonesia – the corresponding urban and rural income groups have near-identical mean incomes for all but the top and bottom income groups (presumably because the same absolute income intervals were used to code urban and rural incomes). Hence, even though the urban and rural population shares in each income group are different, the urban-rural disaggregation adds almost no information.[13] Note that this is not the case for India and China, where it would really matter: their income groups have different mean incomes in rural and urban areas.

Milanovic (2002: 61) also reports using different PPP rates for rural and urban China to take account of price differences between the strata: "For China, in 1993, I use the rate reported in the International Comparison Programme (ICP) for urban areas only (since

[10] This largest group is equal in size to the combined populations of the 50 smallest countries in his dataset, which between them have more than 500 income groups.
[11] This implies that his 'between-country' component of global inequality actually includes some within-country inequality.
[12] In his on-line (2002) dataset we could find Bangladesh split into urban and rural areas only in 1988, not 1993.
[13] In his dataset the income distribution for Egypt in 1988 is also shown separately by urban and rural areas, with five income groups in each area. The income groups are shown as quantiles (bottom two quintiles, middle 40%, and top two deciles) for each sector. Surprisingly, the second-to-top decile for the urban and rural sectors have identical mean incomes, and for all quantiles other than the bottom quintile the urban and rural mean incomes are very close. Effectively this means he only has five or six income groups for Egypt, not ten.

the rate itself was obtained from surveys conducted in two cities: Guangdong and Shanghai), and reduce the price level in rural areas by an estimated 20% (see Yao and Zhu 1998, p. 138)". Yao and Zhu (1998: 138) themselves suggest adjusting rural incomes upwards relative to urban incomes by "15 per cent for low cost of living in the countryside". This is equivalent to adjusting rural prices relative to urban prices down by 13%, not 20%.

Bourguignon and Morrisson (2002)

Bourguignon and Morrisson (2002) estimate global inequality back to the 19th century, starting in 1820 and ending in 1992. They assemble data for 33 countries or groups of countries, where 15 countries with large populations or economies (such as China, India, Italy and the US) are considered individually, and all other countries are clustered into 18 country groups. For each country or country group they combine data on GDP per capita in PPP$ with income shares for 11 quantiles – the bottom nine deciles and the top two vigintiles (5% of population).[14] Thus their estimates of global inequality for each year are based on 363 (33x11) data points. Like Milanovic, they assume incomes to be equally distributed within each quantile. Unlike Milanovic, who takes incomes or expenditures directly from household surveys, they scale within-country distributions to per capita GDP, recognizing that "[b]ecause of the obvious discrepancy between household purchasing power and GDP per capita, using GDP per capita in place of mean

[14] They use per capita GDP data from Maddison (1995) and describe filling in gaps in GDP and population data by applying "growth rates observed for comparable neighbouring countries over the same period" (Bourguignon and Morrisson 2002: 729). Income distribution data are obtained from a variety of sources. For countries without data, the "distribution was arbitrarily assumed to be the same as in a similar country for which some evidence was available for the appropriate period" (Ibid.: 730).

personal income may bias the estimation of the evolution of world inequality. Correcting for the share of non-household income in GDP or the share of non-consumption expenditures or taking into account the effects of changes in the terms of trade on the purchasing power of national agents proved impossible for the historical period. For comparability reasons, the GDP per capita convention was retained even after 1950, though a better approximation of international differences in mean living standards would have been possible" (Ibid.: 730).

They find that inequality increases between 1820 and 1950, according to all measures, and that the subsequent trend varies by inequality measure (see our Table 1). All indices except the standard deviation of log-income are higher in 1992 than in 1970. The income shares of the top quintile, decile and vigintile increased uniformly from 1970 to 1992, the top decile increasing its share from 50.8% in 1970 to 53.4% in 1992. The share of the bottom 20% was the same in 1992 (2.2%) as in 1970, with a slight trough in 1980 (2.0%).

They decompose the Theil T and the mean log deviation (MLD) into between- and within-'country group' components, but their use of 33 country groups rather than individual countries to decompose inequality makes their decompositions not comparable with those in other studies.

Sala-i-Martin (2006)

Sala-i-Martin (2006) estimates global income distributions using within-country quintile shares scaled to per capita GDP in PPP$.[15] He uses quintile share data from Deininger and Squire (1996 updated), extended with UNU-WIDER data, and takes per capita GDP in PPP$ from the Penn World Tables 6.0 (Heston, Summers and Aten 2002, and known as PWT). He presents estimates for global inequality for each year between 1970 and 2000 based on observed and estimated data for 138 countries, representing 93% of the world's population in 2000. For those countries with survey data for more than one year, representing 84% of the world's population, he uses "a simple linear time-trend forecast" (p. 358) to fill in quintile shares for missing years. For countries with data for only one year he assumes a linear trend based on an average for "neighboring countries" (p. 359), defined as those belonging to the same World Bank region, which have surveys for more than one year. For countries with no survey data, he imputes average quintile shares and estimated trends from neighbouring countries.

With these quintile shares Sala-i-Martin estimates for each country-year a smoothed density function using a Gaussian kernel with the same bandwidth in every case. Each kernel density function is normalized by population size and scaled to per capita GDP from PWT. These within-country distributions are aggregated to construct a world income distribution.[16] For every measure he finds inequality to be higher in 1980 than in

[15] This paper follows two previously-circulated working papers (Sala-i-Martin 2002a, b).
[16] Sala-i-Martin (2002b) uses the same procedure to estimate a world income distribution, while in Sala-i-Martin (2002a) he arrays the quintile data points for 125 countries to form a 'spiked' world distribution which is then smoothed by means of a Gaussian kernel density function.

1970, but lower in 2000 than in 1980 (see our Table 1). For the variance of log-income inequality is higher in 2000 than in 1970, but for other measures it is lower.

Sala-i-Martin defends his use of per capita GDP as the mean for within-country distributions, instead of using mean incomes from surveys, by observing that surveys are available for only few years. He objects that “we would have to somehow forecast these survey means for the missing country/year cells” (p. 357). But missing values for quintile shares for most years did not deter him from ‘forecasting’ within-country distributions. More importantly, as Bourguignon and Morrisson (2002: 730) point out, GDP per capita has obvious failings as a measure of household income. We discuss the question of scaling within-country distributions to national accounts categories later in Section 6. For now, note that while the national accounts category of household consumption expenditure is different from household income, GDP is also different from household income as it includes several components of non-household income.[17]

Sala-i-Martin (2006: Table IV, p. 390) reports the within- and between-country components for the MLD and the Theil T index. For both measures between-country inequality comprises about 70% of global inequality in 1970, falling to just over 60% in 2000. This is due to an absolute rise in within-country inequality and an absolute decline in the between-country component. Sala-i-Martin’s (2006: 388) definition of the “within-country” component is “the amount of inequality that would exist in the world if all countries had the same income per capita (that is, the same distribution mean) but the

[17] Sala-i-Martin (2006: 357, fn 5) cites Deaton (2005) in describing some of the disadvantages of using household consumption from national accounts. However, Deaton’s point is that these are disadvantages relative to the use of survey means, and not relative to GDP.

actual within-country differences across individuals" (see also his note to Table IV, p. 391). While this is correct for the within-country component of the MLD measure, it is *not* correct for that of the Theil T index, both of which are presented in his Table IV. We discuss this further in Section 5 below.

In addition to presenting his own analysis of global income inequality, Sala-i-Martin (2006: 382) comments on the discussion of the subject in the 2001 Human Development Report (HDR) of the United Nations Development Programme (UNDP 2001). He writes that it "argues that global income inequality has risen based on the following logic:

> Claim 1: 'Income inequalities within countries have increased.'
>
> Claim 2: 'Income inequalities across countries have increased.'
>
> Conclusion: 'Global income inequalities have also increased.'"

Sala-i-Martin points out that if Claim 2 refers to what we described as concept one inequality, which counts each country as a unit, then the conclusion does not follow, stating that "[B]y adding up two different concepts of inequality to somehow analyze the evolution of world income inequality, the UNDP falls into the fallacy of comparing apples to oranges" (p. 382). However, UNDP (2001) does not make this argument, and makes no reference to changes in global interpersonal inequality.[18]

[18] It states that "World inequality is very high" (UNDP 2001: 19). Sala-i-Martin (2006: 382, fn. 26) also refers to HDR 2003, but that publication states that trends in global income inequality are "ambiguous" (UNDP 2003: 39), not that they are rising.

Bhalla (2002)

Bhalla (2002) constructs annual estimates of global inequality for income and consumption separately for each year during 1950-2000. He finds that the global income Gini increases from the late 1950s to the early 1970s (late 1970s for consumption), and then decreases until 2000 (2002: Fig. 11.1, p. 174).

Bhalla scales within-country distributions to per capita GDP for his measurement of global income inequality,[19] and to household final consumption expenditure (HFCE) from national accounts (NA) for consumption inequality,[20] both measured at PPP (the sources of which are unclear—see below). According to his Figure 11.1 on p. 174, his sources for within-country inequality are Deininger and Squire (1996); World Income Inequality Database (WIID, available at www.wider.unu.edu/wiid); World Bank, *World Development Indicators*, CD-ROM; Asian Development Bank (2002).[21] There is some confusion regarding the number of surveys he uses to construct his global inequality estimates. Table A.1 on p. 209 records that there are 317 surveys (income and expenditure) for the period 1950-1980, and 604 for the period 1980-2000, for a total for 921. But in the text he writes that "Construction of the dataset required the use of data for more than 1,000 household surveys" (2002: 38). Whatever the precise number may

[19] This is nowhere stated explicitly, as far as we can tell, but we deduce it from his comments that "published national accounts figures, provided the best basis for estimating world inequality" (2002: 173) and that "household income has to be approximated by per capita GDP" (Ibid.: 103-4, footnote 1).

[20] In fact, consumption distributions are constructed by scaling within-country distributions to 0.867 times HFCE from NA (2002: 128), but since this scaling is uniform across the world it makes no difference to his estimates of inequality (the deflation is for the purpose of estimating absolute income poverty).

[21] Yet on pp.212-3 he refers only to the first three and to the *World Development Indicators* website. Still elsewhere, on p. 208, he mentions that the Deininger and Squire (1996) and WIID datasets "have been supplemented by data available from the Web (World Bank poverty monitor, worldbank.org/research/povmonitor; and Milanovic's data on Eastern European countries), as well as data gathered for 18 Asian countries (Asian Development Bank 2002)". From such documentation it is unclear exactly which sources have been used by Bhalla to provide his within-country distributions.

be, he has to impute within-country distributions for the majority of his 7,599 country-years (149 countries times 51 years). Moreover, there is concern regarding the quality of the surveys that he uses. Ravallion (2002: 8) observes that only "[a]bout half of Bhalla's 600 distributions over 1980-2000 would pass the quality standards applied to the [World] Bank's calculations".

Like Sala-i-Martin (2006) Bhalla uses the quintile share data to estimate continuous within-country distributions, employing what he calls the "simple accounting procedure (SAP)" (2002: 6). Whereas Sala-i-Martin (2006) uses non-parametric density estimation, Bhalla uses regression to fit a three-parameter Lorenz curve to the quintile shares (comprising four independent observations, since they add up to 1), using a functional form due to Kakwani (1980). However, he does not stop here. He states that "The basic equation results are then *filtered* by SAP to satisfy the theoretical boundary constraints (i.e., the sum of the estimated shares of each quintile is actually equal to the *observed* shares, and the share of each percentile is equal to or larger than the share of the previous percentile). The filtering is done through an iterative procedure, whereby at the end of the first round, the shares of each individual percentile in the first quintile get estimated and fixed, then the next quintile, then the next, and so on. (The only somewhat "arbitrary" and somewhat "flexible" percentiles are the first and the last, and this flexibility shows up in the errors; see below.)" (pp. 133-4, emphasis in original). We are unable to decipher exactly what the procedure entails.[22] If his object is to force the estimated Lorenz curve through the four observed cumulative quintile shares, then there

[22] This procedure is described even more opaquely in Appendix B, p. 212.

are many ways to achieve this while satisfying his constraint that the curve be convex.[23] Moreover, it is not clear what role the initial fitted Lorenz curve is playing in this procedure. Given the inadequate documentation it is impossible to replicate his results independently, violating the first criterion for empirical research.

Bhalla reports accuracy tests of his estimation method against unit-level data from India and against published data on “selected percentiles, and the Gini” for the US. For India he claims that “The SAP method is seen to be shockingly accurate. The constructed Ginis are within 1 percent of the true value in almost 90 percent of the cases” (2002: 214). For the US he claims “[T]he constructed and original Ginis are within a whisker of each other for all the years” (Ibid.: 134). He concludes that “[t]he tests above suggest that the SAP method is accurate both at the aggregate Gini level (very, very accurate) and at the individual percentile level (very accurate)” (Ibid.: 134). Without knowing how the SAP method works it is not possible for us to comment on these tests. For all the reader can tell, the method could have been constructed in order to fit the US and Indian data, implying that its accuracy in these cases tells us nothing about its potential accuracy in other cases. Ravallion (2002: 14-5) writes “[T]he fact that one specific Lorenz curve model gives a good fit for one country does not mean it will fit well for others. Indeed, we find that very different models of the distribution (either Lorenz curves or density estimation) are needed in different countries, and even different dates for the same country”.

[23] That is, “the share of each percentile is equal to or larger than the share of the previous percentile”.

After estimating within-country distributions, Bhalla scales these to per capita GDP and per capita HFCE measured in PPP$. His use of PPP sources is problematic. On p. 207 he reports using "Penn World Tables, 1985-base PPP prices, referred to as PWT 5.6; *WDI* 1998, which has PPP data, 1987 base, at both constant and current prices; PPP data, 1975 base, from Summers and Heston (1988), Heston and Summers (1991), referred to as HS; and IMF, *International Financial Statistics* CD-ROM, 2002" in addition to *WDI* (edition not specified) and Maddison (2001). These sources are inconsistent for two reasons. First, the sources use different methods for calculating PPP rates. For instance, recent World Bank estimates in the *WDI* follow the EKS method (Ahmad 2003), while PWT uses the GK method. These methods are quite different, as we discuss in Section 5. Secondly, PPPs estimated for different base years are also inconsistent. PPPs are estimated in the International Comparison Programme (ICP) in a given year t. To calculate GDP in PPP$ in year $t+n$ one has to scale GDP in year t up or down by the country's real growth rate (nominal growth minus a price deflator).[24] GDP in PPP$ in year $t+n$ calculated in this manner can be very different from that obtained by use of an ICP conducted in year $t+n$.[25,26] Without more information on which source is used for which countries in which years it is impossible to infer the bias caused by Bhalla's confounding of sources.

[24] In the case of PWT there is a further stage of reconciliation after this updating.
[25] When a country has more than one ICP survey some sort of reconciliation procedure must be used; see Section 5 below.
[26] Bhalla laments (2002: 96) that the World Bank's consumption PPPs—that is, PPP rates based on the consumption component of GDP—are available only for 1993, in contrast to their GDP PPP rates that are available for many years. But, as just described, GDP PPP rates are constructed by measuring relative prices in one year only, and then scaling up and down across years using domestic price deflators. He could therefore have followed the same procedure using 1993 consumption PPPs to construct consumption PPPs for other years.

Despite these and other questions that arise in relation to calculations of PPP exchange rates (see our Section 6), Bhalla seems to disregard any controversy concerning PPP estimates. He writes: “No one—not the official source of poverty figures, or any institution, or any outside researcher—is questioning the PPP estimates. This is not because everyone believes that these figures are accurate; it is only because no one has the capacity, or the resources, to come up with a ‘better’ estimate of the PPP exchange rate” (2002: 94). Yet Reddy and Pogge (2005) question the PPP estimates, and Dowrick and Akmal (2005) present an alternative PPP exchange rate (discussed in our Section 5). Earlier versions of both papers are cited in Bhalla’s references.

In assessing the accuracy of his Simple Accounting Procedure, Bhalla comments: “Is there a particular bias in the SAP method? There cannot be, because, as the name suggests, the procedure is one of simple counting, and simple accounting” (Ibid.: 181-2). The simplicity of the method will certainly elude the reader, as will the sense in which his global inequality calculations involve mere “accounting”. Moreover, the lack of transparency regarding the method and sources preclude the possibility of judging the extent of bias. Finally, it should be noted that even simple procedures can be biased.

Dowrick and Akmal (2005)

This study follows the approach of Bourguignon and Morrisson (2002) and Sala-i-Martin (2002a) in pooling within-country quantiles, in this case quintile shares from Deininger and Squire (1996),[27] scaled up to GDP per capita. When country GDP is measured using the standard Geary-Khamis (GK) PPP rates in PWT, they find that all the measures they estimate (Gini, Theil T, squared coefficient of variation, variance of log-income) decrease from 1980 to 1993 (see our Table 1). What is novel in their paper is the use of an alternative PPP exchange rate based on Afriat (1984), which they argue gives a better measure of comparative purchasing power across countries. When country GDP is measured using Afriat PPP rates, inequality increases by all measures over the period 1980-1993. They also estimate global inequality at market exchange rates, which they find to be both considerably higher than when measured at either PPP rate, and to increase faster than the increase at Afriat PPPs.

They argue that inequality measured at market exchange rates suffers from a "traded sector bias" and inequality measured at PWT PPPs suffers from a "substitution bias". Traded sector bias refers to the fact that exchange rates are affected by the prices of traded goods across countries but do not reflect domestic prices of non-traded goods. Since the relative price of non-traded to traded goods tends to be lower in poorer than in richer countries, valuing domestic incomes at market exchange rates will undervalue incomes in poorer relative to richer countries and lead to an upward bias in measured inequality. Substitution bias, also known as the Gerschenkron bias, refers to the fact that valuing the output of country A at country B's prices will lead to an overestimation of the income of country A relative to the income of country B (also valued at B's prices). In the case of PWT PPPs the use of the GK method leads to a vector of "international

[27] When only Ginis and not quintile share data were available in Deininger and Squire (1996), they estimate the single-parameter functional form for the Lorenz curve suggested by Chotikapanich (1993) and thereby obtain quintile shares.

prices" whose structure is closer to that of prices in richer than in poorer countries (Nuxoll 1994). They state that this leads to the incomes of poorer countries being overestimated relative to richer countries, and hence to a downward bias in inequality.

Dowrick and Akmal further argue that diverging price structures can explain both the rise in inequality using market exchange rates and the fall using PWT PPP rates. They estimate trends in price similarity across countries and find that price structures became less similar over the period 1980 to 1991 (2005: Fig. 5, p. 213), arguing that this would cause both traded sector and substitution bias to increase. Inequality at Afriat PPPs does not suffer from either traded sector or substitution bias, lies between the other two estimates, and rises only slightly over time. Thus the rise in market exchange rate inequality and the fall in PWT PPP inequality could both in principle be explained by increases in the two biases.

We have reservations about the argument regarding traded sector bias. The claim that this bias increases as "price structures" become less similar assumes that the price structure in question is the relative price of traded to non-traded goods. However, the price vector that Dowrick and Akmal use to measure price divergence across countries comprises the relative prices of private consumption, investment, and government consumption (2005: 212). These three categories each comprise both traded and non-traded goods, so their empirical exercise does not establish divergence in relative prices of traded to non-traded goods across countries. With globalization, moreover, we would expect the traded sector to expand relative to the non-traded sector, which would contribute to a decline in the bias. The finding of a rise in global inequality at market exchange rates would thus seem to require further explanation.

Dowrick and Akmal also run simulations based on generated lognormal distributions to estimate by how much the assumption of equal incomes within quintiles understates inequality within a country. They find that the variance of log-income for data grouped by quintiles is 90% of the actual value, while grouping by deciles yields more than 95% of the actual value (2005: Fig. 8, p. 224). They conclude that “the quintile income shares that we and other researchers have used are likely to come close to capturing the full contribution of intra-country inequality to world inequality” (2005: 224). Supposing that within-country inequality accounts for 35% of global inequality, as measured by varlog, then a 10% underestimation of within-country inequality in each country would imply a 3.5% underestimation of global inequality. However, Sala-i-Martin estimates global inequality using pooled quintile shares from his sample of countries in his (2002a) paper, and smoothed within-country distributions in (2002b), both papers using the same dataset (which is different from his 2006 dataset). His estimate of the global variance of log-income in 1998 is 7.7% higher when he uses smoothed within-country distributions. Moreover, Dowrick and Akmal’s experiment can tell us little about the impact on other measures of inequality.

Dikhanov and Ward (2002)

This study takes distributions of incomes and expenditures from Milanovic’s (2002) dataset for “45 of the largest countries…where reasonably consistent distributions were available for more than one reference year" (Dikhanov and Ward 2002: 6). They estimate smoothed within-country distributions by interpolating third-degree polynomials between observed points of the cumulative distribution function. They then scale these within-country distributions to what they refer to as the national accounts category of "personal consumption expenditure" from World Bank databases, converted into EKS PPP$. "Finally, a global picture was built up by taking the available income distributions from the eight largest countries in each 'continental' region (for South Asia only five countries are used as the number of countries in the region is small and the five countries chosen comprise more than 90% of the total population) and filling the remaining gaps (about 1/6 in terms of global income and population) according to observed regional pattern" (Ibid.: 6). They do not explain how they estimate values for missing years. In particular, they do not explain how they extrapolate backwards to 1970 from Milanovic's "benchmark" 1988 data and forwards to 1999 from his "benchmark" 1993 data.

The direction and magnitude of change in inequality depend on the inequality measure used (see our Table 1). The income share of the bottom decile remains constant at 0.5% while that of the top decile increases slowly and steadily from 48.5% in 1970 to 54.3% in 1999. Despite the ambiguity in their measures, the authors conclude that "during the last three decades, the global income distribution became less equal (both between country and within country)" (Ibid.: 12).

Schultz (1998)

Schultz (1998) uses GDP PPP data from the Penn World Tables 5.5, covering 120 countries with 93% of the world population in 1960 and 92% in 1989. He takes quintile shares for countries from Deininger and Squire (1996), using data only on those countries for which there are at least two nationally representative samples since 1950. This yields 509 observations across 56 countries. He then runs regressions on these observations with log per capita GDP, per capita GDP squared, year, and dummies for type of survey distribution and region in order to estimate within-country inequality for country-years without data.

He uses the variance of log-income (varlog) as his measure of inequality in order to construct global interpersonal inequality as the sum of within-country inequality and between-country inequality. However, there appears to be a problem with his procedure. The variance of log-income is decomposable into "between-country" and "within-country" inequality only if "between-country" inequality is calculated by assigning to everyone within a country the country's *geometric* mean income, not its *arithmetic* mean income (Anand 1983: 201, 330-1). The "between-country" component thus calculated can then be added to the population-weighted within-country varlogs to give the global varlog. However, the "between-country" component calculated by Schultz is based on the per capita GDP of countries, i.e. their arithmetic mean incomes. He is evidently aware of this issue and points out that "the national income variable should refer to the mean of the logarithms of income" rather than "arithmetic mean income that is logged in this analysis of intercountry income inequality" (endnote 8). However, the problem remains, and the figures that Schultz reports do not refer to the global variance of log-income.

Chotikapanich, Valenzuela and Rao (1997)

This study estimates lognormal income distributions for countries from Gini coefficients reported in Deininger and Squire (1996), which are then scaled to per capita GDP in PPP$ from PWT 5.6. Their sample of Gini coefficients comprises 36 countries, for which they estimate lognormal distributions for the years 1980, 1985, and 1990. However, Africa is represented by only Tunisia and Mauritius, comprising 1.5 percent of that continent's population. The virtual omission of sub-Saharan Africa, with about 10 percent of the world's population, is a major problem for their estimates of changes in global inequality. Since sub-Saharan Africa includes many of the poorest countries in the world, and the per capita GDP of this region fell by 10 percent over 1980-90 (*World Development Indicators Online*), its omission will lead to a downward bias in changes in measured global inequality.

Korzeniewicz and Moran (1997)

This study estimates global inequality in 1965 and 1992 at market exchange rates only. Korzeniewicz and Moran estimate global inequality using quintile shares for 46 countries, mostly from World Bank (1994), scaled to per capita GNP at market exchange rates. They estimate the Gini and Theil T, finding both to have risen (see our Table 1).

The income share of the poorest 30 percent declined dramatically from 2.1 to 1.0 percent, while the top 20 percent enjoyed a rise in their share from 82.0 to 88.9 percent.

5. Decomposing global inequality

Inequality between and within countries

Many studies that estimate global income inequality "decompose" overall world inequality into between- and within-country components. Thus, Milanovic (2002) states that between-country inequality is 88% of global interpersonal inequality as measured by the Gini coefficient.

The impression conveyed by such "decompositions" is that some 80% to 90% of global inequality (depending on the measure and year) arises from differences in mean income between countries. An obvious and perhaps common understanding of such decompositions is that if between-country differences in mean income were eliminated (i.e., if concept 2 inequality were zero), but within-country inequality in each country were kept constant, then global inequality would only be some 10% to 20% of its measured value. Unfortunately, this is *not* the correct interpretation of the decompositions presented in the studies. Moreover, the meaning and relevance of what is presented is not always clear.

Doing the counterfactual exercise of eliminating between-country inequality but keeping within-country inequality constant in each country will generate a world income distribution with substantially more inequality than the implied residual in the Gini decomposition. For example, it is shown in Anand (1983: 319-26) that the overall Gini is always greater than or equal to both a population-weighted average of subgroup Ginis and an income-weighted average of subgroup Ginis. Hence, the Gini coefficient of the hypothetical world income distribution where each country's mean income is equalized but relative inequality (the Gini) in each country is kept constant, will be at least as large as the population-share weighted average of country Ginis. Dowrick and Akmal (2003: 18; an earlier version of Dowrick and Akmal 2005) find the population-weighted average Gini across 47 countries, covering "over two thirds of the world's population", to be 0.364 in 1993. This is about 55% of the level of most estimates of the global interpersonal Gini (about 0.65), not 10% to 20%. Thus, within-country inequality according to this interpretation will account for at least 55% of global interpersonal inequality.

Dikhanov and Ward (2002), Dowrick and Akmal (2005), and Sala-i-Martin (2006) also decompose the Theil T index and estimate that between-country inequality accounts for between 64% and 76% of overall global interpersonal inequality. Unlike the Gini coefficient, the Theil T index *is* additively decomposable into between- and within-country components. However, the weights on the within-country Theil T indices are *income* and not population shares of the countries. Eliminating between-country inequality by equalizing the mean incomes of countries will therefore also change the measured within-country component: the elimination will leave a *population*-weighted average of the Theil T indices of countries, not the original income-weighted average. Like the Gini coefficient, the Theil T index thus also has a problem in interpretation of its between-country component. Of the inequality indices presented in the studies, only the Theil L measure (mean logarithmic deviation), which is additively decomposable with population-share weights, has a consistent interpretation of its between- and within-group components (see Anand 1983, pp. 198-202).

Restricting ourselves to the two ‘decomposable’ Theil measures, all estimates but one find that within-country inequality has risen since 1970 (see our Table 3). The exception is the Theil T GK PPP estimate of Dowrick and Akmal for the period 1980-1993. However, when Dowrick and Akmal refer to “intra-country inequality” they appear to mean global inequality less population-weighted between-country inequality (this is what we report in Table 3). As we have just seen, this residual is not within-country inequality according to the decomposition of the Theil T index. Moreover, using Dowrick and Akmal’s preferred ‘Afriat’ PPP estimate, even this residual shows an increase.

The relatively uniform finding that within-country inequality has risen is also consistent with Cornia and Kiiski’s (2001) analysis of the World Income Inequality Database, which covers 80% of the world’s population and 91% of world GDP. They find that inequality has risen in the recent past in countries representing 59% of their sample population, and fallen in countries representing only 5% of their sample.

China and India

China and India, with respectively 21% and 17% of the world's population (UNPOP 2002), are likely to be significant determinants of global inequality. China's growth rate has been substantially higher than the world average since 1977 and, given its low initial income, it could be expected to act as an equalizing force. To a lesser extent the same may be true of India, which has grown less fast than China but still faster than the world average since 1980.

While there is little doubt that per capita GDP in China has grown very fast over the last thirty years, there appears to be a scholarly consensus that official estimates overstate it (e.g. Maddison 1998). The estimates in Maddison (2001) and in the PWT (see Heston 2001) therefore show lower rates of growth than the official figures. Apart from Bourguignon and Morrisson (2002), all studies that use national accounts data use the downward-adjusted growth rates of PWT or Maddison (2001).[28]

Both Schultz (1998) and Sala-i-Martin (2006) test the extent to which China influences their results. Schultz finds that without China, between-country inequality would have risen during 1960-1989 by 27%,[29] while excluding India makes little difference to the trend. Sala-i-Martin (2006) finds that without China global inequality rises from a Gini

[28] While Dikhanov and Ward (2002) use World Bank GDP and growth estimates in most cases, they report using growth rates from Maddison (2001) "[I]n some cases, for example China" (Ibid.: 14).
[29] Calculation based on Table 1, p. 316.

coefficient of 0.620 to 0.648 over 1970-2000, in contrast to the decline he finds with China.

While the exercise of excluding China or India is instructive from the point of view of accounting for global inequality and its evolution, it should be clear that it has no implications for global welfare. One cannot draw any conclusions about global welfare by use of a less-than-global sample that is unrepresentative.

6. Methods and data

Scaling distributions

The primary methodological difference between Milanovic (2002, 2005) and the other studies is that he uses the incomes from household surveys directly – without scaling them – to construct his world distribution of income. This parallels the World Bank's method for calculating poverty (Chen and Ravallion 2001). All other studies combine estimates of within-country inequality (based on household surveys) with independent estimates of per capita GDP or household final consumption expenditure (HFCE) from national accounts, and thus effectively scale within-country incomes so that their mean is equal to the country's per capita GDP or HFCE.

There are two issues here. The first is whether national accounts (NA) estimates of mean income (or consumption) are preferable to estimates obtained directly from the surveys.

The second issue is whether GDP is the appropriate national accounts category to scale up to.

Considering the second question first, the relevant choice is between GDP and household final consumption expenditure (HFCE). Following the 1993 System of National Accounts, many countries do not include a category of aggregate personal or household income in their published national accounts, while HFCE is reported in the IMF's *International Financial Statistics*. GDP is equal to HFCE plus investment and government expenditure (assuming balanced trade). Investment expenditure is not part of current household consumption, but government expenditure does include items such as health and education spending, as well as public goods, which benefit households. However, we typically do not have a measure of the distribution of the benefits of government expenditure across households.

Scaling within-country distributions to per capita GDP requires the assumption that the value of the components of GDP additional to HFCE are distributed in proportion to income or expenditure as measured in surveys, an assumption which has little basis. Per capita GDP is a poor measure of household income (or consumption), and scaling within-country distributions to per capita GDP is inappropriate. If one wishes to scale distributions to an NA category, then per capita HFCE would seem to be more appropriate than per capita GDP. Per capita HFCE has been used by Dikhanov and Ward, and by Bhalla in his estimates of global consumption inequality.

This brings us to the first issue, viz. should one use NA estimates at all. What is the difference between using surveys directly, and scaling to per capita HFCE in NA? This matters because in some countries mean expenditure as measured by surveys is not only different from per capita HFCE as measured in NA, but is diverging from it in proportionate terms. Deaton (2005: 8) finds that the ratio of survey consumption to NA consumption in India has been declining over time, from 0.68 in 1983 to 0.56 in 1999/2000. He finds a similar decline in this ratio in Chinese data over the 1990s, from a peak of 95 percent in 1990 to 80 percent in 2000. However, the lower NA growth rates of total GDP estimated by Maddison (2001), among others, would appear to eliminate the divergence in this case (Deaton 2005: 8). Milanovic (2005: 118) finds that if he estimates between-country inequality using GDP per capita from NA rather than income or consumption means from surveys, then his 1993 estimate changes little but the 1988 estimate rises by nearly 2 Gini points while his 1998 estimate falls by 0.6. This approximately halves his estimated increase in the Gini over 1988-93, and the rise of 1.8 Gini points over 1988-98 becomes a fall of 0.6 points.

Survey household expenditure differs from the NA category of HFCE in both concept and method of estimation. In terms of concept, HFCE includes imputed values of financial intermediation services and consumption by ‘non-profit organizations serving households’. The latter includes expenditure by organizations such as political parties and religious associations[30] whose welfare impact on households is dubious. HFCE also includes imputed rents from owner-occupied housing, which is rarely estimated in

[30] Havinga et al. (2003).

household surveys. It should be noted that neither survey expenditure nor HFCE includes imputed values of government-provided health or education services.[31]

The two categories differ radically in their method of estimation.[32] To calculate HFCE the NA typically starts with an estimate of national production of a commodity such as rice from crop-cutting data, aerial or farm surveys, etc. As such surveys are conducted infrequently, gross production figures may have to be estimated without up-to-date information. Moreover, the methods used to arrive at these figures are not applied uniformly and can be unreliable. From an estimate of national production thus generated, government consumption and firms' consumption are subtracted. The residual is attributed to households. Data on government consumption may be adequate, but firms' consumption is typically poorly estimated. It is often based on outdated firm surveys and extrapolations or assumed changes over time. In India the divergence between survey and NA mean expenditure is partly due to the underestimation by NA of firms' consumption of intermediate goods. This has led to double-counting where, for instance, the edible oil consumed in restaurant meals was attributed to HFCE under both the 'edible oil' category and the 'restaurant meals' category.[33]

NA estimates of HFCE are thus indirect and subject to three sources of error: the initial estimate of aggregate production, the estimate of government consumption, and the estimate of firms' consumption. There is no reason to suppose that the data and methods

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[31] Aten and Heston (2004: 6) state that the latest PWT, version 6.1, includes expenditures on health and education by government and non-profit institutions in "Household Actual Final Consumption" for OECD countries, but not for other countries.
[32] Much of this paragraph closely follows Deaton (2003: 367-8).
[33] Deaton (2005: 15) and Tendulkar (2003).

used to estimate these, which include surveys of various kinds, are more reliable than household surveys. Moreover, their sources and methods are generally less well-documented (in terms of the surveys used, how and when they were conducted, etc.) than household surveys. Finally, as it is defined a residual, the errors in the estimate of HFCE will tend to get compounded.

Household surveys measure personal income or expenditure directly. Two major problems with household surveys are that the rich disproportionately fail to respond, and when they do respond they tend to underreport their income and expenditure. On the other hand, the very poor and marginalized, particularly the homeless or those living in remote rural areas, tend to be excluded from the sample frame and are thus likely to be underrepresented. In most countries the net result is that mean income or expenditure in surveys is lower than per capita HFCE in NA (Deaton 2005). In India there has been heated debate on the size and source of the divergence between survey and NA means in the context of poverty estimation (e.g. Bhalla 2002, Deaton 2005, Ravallion 2000). One factor explaining the divergence is that when within-country inequality rises, and with it the income share of the rich, as has occurred in both India and China, undersampling of and underreporting by the rich implies a growing underestimation of average household income and expenditure.

Underreporting by the rich will also lead to a downward bias in measured within-country inequality, although the effect of undersampling is ambiguous (Anand 1983: 343-4). The impact of underestimating mean income or expenditure in countries will depend on how the degree of underestimation varies with the level of the actual mean, which will determine the direction and magnitude of the bias in between-country inequality. We are not aware of any attempts to estimate the bias in measured global inequality due to undersampling and underreporting of incomes in household surveys.

Both methods of estimating global inequality—taking incomes or expenditures directly from surveys (Milanovic 2002, 2005), or using NA means and within-country distributions from surveys—suffer from the underestimation of within-country inequality. The reason is that both methods use (the same) household surveys for their estimates of within-country distribution. It is between-country inequality that is affected by the choice of method. If the use of NA means entails scaling-up survey means proportionately more (less) for poorer than for richer countries, then between-country inequality based on NA means will be lower (higher) than that based on survey means.[34]

It is clear that there are estimation errors in both sources of data. We do not know their relative magnitude, and in particular there is little reason to believe that NA are more accurate than surveys in measuring household consumption. Given that we take within-country distributions from surveys, it seems odd that we should seek an alternative source for the *means* of these distributions.

To address both the undersampling and underreporting problems, a possible route may be to estimate parametrically within-country distributions from the unit-record information

[34] As mentioned above, Milanovic (2005) finds that scaling up survey means to GDP per capita increases measured between-country inequality in 1988 (but not in 1993 or 1998). We are not aware of any attempts to compare global inequality estimated using survey means with that estimated using HFCE.

contained in each household survey. For example, one could specify a distribution for each country that incorporates a plausible upper tail and estimate it from the household survey data. The estimated distribution would then provide us with corrected estimates for both average income and the level of inequality. This would appear to be superior to the scaling-up procedure which applies the same multiplicative factor to adjust all incomes in the survey.

The choice between survey and NA mean, and that between HFCE and GDP, have not been adequately addressed in the literature on global income inequality. Bhalla (2002) discusses some of the issues and argues that in the case of India HFCE is more accurate than consumption expenditure from household surveys. Deaton (2003), Sundaram and Tendulkar (2003), and Ravallion (2000) disagree with this conclusion. Milanovic (2002) discusses the choice between survey mean and GDP per capita and, as stated earlier, reports the difference that this choice makes to estimated inequality (Milanovic 2005). Sala-i-Martin (2002b) briefly discusses the choice between income and consumption in the measurement of poverty but not in the measurement of inequality, and in Sala-i-Martin (2006: 357, fn. 5) he makes a reference to Deaton (2005) on the subject. For his estimates of global income inequality Sala-i-Martin resorts to GDP per capita.

PPP exchange rates

Purchasing power parity (PPP) exchange rates are so called because they are supposed to reflect purchasing power better than do market exchange rates. But few users have a good idea of how they are constructed or how to interpret them. In fact, there are two types of commonly-used PPP rate, and a third that was introduced recently by Dowrick and Quiggin (1997) and has been used to measure global inequality by Dowrick and Akmal (2005).

The two commonly-used methods for constructing PPP rates are due to Geary-Khamis (GK) and Eltetö-Köves-Szulc (EKS), respectively. The GK method is used by the Penn World Tables and by Maddison (1995, 2001) and was formerly used by the World Bank, while the EKS method has been used by the World Bank for its more recent estimates of PPP incomes. The GK method consists in estimating an "international price vector" for commodities at which the vector of outputs of each country is valued to yield its real GDP. The EKS method estimates a PPP exchange rate by generalizing the Fisher index between countries and does not involve the construction of a set of "international prices" (see Ahmad 2003 and Deaton et al. 2004 for further details).

The GK and EKS methodologies are very different, and in particular Ackland et al. (2004) find that the GK method overvalues the incomes of poorer countries relative to EKS. If per capita GDP from GK is regressed on per capita GDP from EKS then the slope is 0.94 and is significantly less than 1, and the intercept is significantly greater than zero. Following Dowrick and Akmal (2005), they argue that GK overestimates the incomes of poor countries because of substitution bias, as discussed earlier. Since the international price vector in the GK method is constructed by weighting the output price in each country with the country's share in world output, the resulting prices will be closer to those obtaining in richer than in poorer countries. Using the GK index with data in PWT 5, Nuxoll (1994: 1431) finds that "income indexes based on international prices closely resemble indexes based on the prices of some moderately prosperous country. The closest fit is Hungary; the second closest is Yugoslavia". Dowrick and Akmal (2005) claim that this results in the incomes of poor countries being overestimated by more than the incomes of rich countries, and that global inequality will therefore be biased downwards. We saw above that this argument requires further assumptions, but it is at least consistent with the fact that the estimates in Dikhanov and Ward (2002), the only study to use EKS PPPs uniformly, are higher in almost all years and according to all indices than the estimates based on GK PPPs—viz., those in Chotikapanich et al. (1997), Dowrick and Akmal (2005), Schultz (1998), Bourguignon and Morrisson (2002), and Sala-i-Martin (2006) (see our Table 1). Dikhanov and Ward also find a greater increase in inequality according to most measures than the studies using GK PPPs.

Although EKS is not subject to the same substitution bias as GK, Dowrick and Akmal (2005) use a third method for constructing PPP incomes that is also not subject to this bias—the 'Afriat' PPP (Dowrick and Quiggin 1997, Dowrick 2002). The papers by Dowrick et al. make much use of Afriat's (1981) theorem that the existence of a set of Afriat PPPs is equivalent to the existence of a representative consumer with a common homothetic utility function, which rationalizes all of the observed consumption baskets across countries. While this may appear to be a satisfying justification for Afriat PPPs, the problem, as Ackland et al. (2004: 18) find, is that in the 1996 ICP only 80 of 115 countries can be aggregated into a set that does not violate the possibility of common homothetic preferences. No set of Afriat PPPs exists for all 115 countries and, as

Ackland et al. point out, “The fact that nearly one third of the ICP countries do not satisfy the test is a major weakness in applying the Afriat approach to constructing a comprehensive multilateral index” (p. 18). The inapplicability of the Afriat approach to a third of countries in the ICP significantly undermines its supposed advantages.

Any study of global inequality must choose a set of consistent PPP exchange rates. A particular concern is that two of the studies actually mix PPP rates from different sources. We saw above that Bhalla is unclear about his sources, but appears to have used both World Bank and PWT PPPs. Milanovic (2002) apparently also uses both PWT and World Bank PPP data.[35] It is not clear what effect this mixing of PPPs based on different methodologies will have on estimated global inequality, but the PPPs from different sources are simply not comparable. Milanovic suggests that the use of GK PPPs in his 1988 estimate of global inequality may be biased downwards owing to the substitution bias discussed above, which may explain some of his measured increase over the period 1988-1993.[36]

It should be apparent from our discussion that the construction and use of PPPs is more complicated than many researchers acknowledge. EKS does not suffer from the problems faced by GK or Afriat discussed above, and thus appears to be the more appropriate methodology for the calculation of PPPs. More generally, inadequate recognition of the basis of different PPP exchange rates and their inappropriate mixing will add another layer of doubt to estimates of global inequality.

[35] Milanovic (2002: 62, note to Table 6) cites sources just for four countries, the sources being both PWT 5 and the World Bank (cited as “ICP tables provided by Yonas Biru (World Bank)”).
[36] Private correspondence with the author.

What distribution?

Most studies refer to the 'global income distribution', but ambiguity remains regarding the distribution that is being estimated. Any distribution must be defined with respect to a given income concept and population unit, but the household surveys used to construct global distributions are a mixture of distributions of income and consumption, defined with respect to individuals and households. It is therefore not clear exactly what type of global distribution emerges from combining these surveys. Concept three global interpersonal inequality takes the individual as the population unit, but the income concept is not specified in several studies. In this sense their global distributions are not well-defined, and it is unclear whether their final estimates are of consumption or income inequality.[37] This is important because consumption inequality can move in a different direction from income inequality.

To expand their datasets the studies mix different types of within-country survey distributions, with the result that the data used are not comparable in various respects. Some distributions are of income, others of consumption expenditure. In some country surveys incomes are gross-of-tax and in others net-of-tax; for some they refer to cash incomes and for others certain items of income-in-kind are included. The rental value of owner-occupied housing is imputed in some surveys but not in others. The population unit of the distribution can be individuals or households (sometimes families), and these

[37] Bhalla (2002) is an exception in that he estimates global income and consumption distributions separately. Schultz (1998) also includes a dummy variable in his regression to estimate within-country inequality to indicate whether a survey is an income or consumption survey.

units may be ranked in a variety of ways—for example, individuals ranked by income received, individuals ranked by household income per capita (or per equivalent adult), households ranked by household income per capita (or per equivalent adult), households ranked by total household income. The population unit and ranking concept used to construct the distribution can make a huge difference to measured inequality. For example, Anand (1983) found that the income share of the lowest 40% varied from 9.6% to 17.7% for differently-defined distributions of income from the *same* Malaysian household survey.

Atkinson and Brandolini (2001) discuss some of these issues in their review of 'secondary' datasets used in studies of income inequality. On the basis of a detailed analysis of distribution data for OECD countries they find that problems of comparability, including those described above, are present even in the 'high quality' subset of the Deininger and Squire (1996) compilation. Atkinson and Brandolini (2001: 777-8) conclude that: "users could be seriously misled if they simply download the Deininger and Squire 'accept' series [i.e. the 'high quality' subset]. Moreover, if the user goes on to utilize the variable in econometric work, then it may make a significant difference to empirical findings". In addition to comparability problems across countries, Atkinson and Brandolini find that changes in survey definitions over time within a given country "may affect not just the *level* but also the *trend* in inequality" (Ibid., p. 780). The Deininger and Squire (1996) dataset is used by Bhalla (2002), Chotikapanich et al. (1997), Dowrick and Akmal (2005), Sala-i-Martin (2006, 2002a, b), and Schultz (1998).

Similar issues arise in respect of the other studies, whose distribution datasets are also subject to non-comparabilities.

Estimation errors

Most of the studies contain little discussion of potential sources of error in their estimates. Milanovic (2002), Bourguignon and Morrisson (2002), and Dowrick and Akmal (2005) all estimate standard errors of one kind or another, but in our view none of the studies accounts for the entire range of possible sources of error.

Milanovic (2002: 72) estimates standard errors in the Gini using the ‘jacknife’ technique described in Sandström et al. (1988: 116), which is based on dropping each ‘observation’ in turn and re-estimating the Gini. The estimated standard errors for the common sample estimates are 0.031 in 1988 and 0.027 in 1993. Hence the confidence interval with two standard errors on either side of Milanovic’s estimate is (0.566, 0.690) for 1988, and (0.606, 0.714) for 1993. The measured change over the period would therefore appear to be insignificant. In Milanovic (2005) the corresponding confidence intervals for 1988 and 1998 are (0.586, 0.658) and (0.603, 0.679) respectively, and hence the change during 1988-98 is also insignificant. However, the ‘jacknife’ technique is intended for estimating standard errors due to sampling variance—that is, the error arising from the sample not being representative of the population. But Milanovic’s Gini coefficients are based on incomes estimated for all individuals in the world (in fact, 84% of them in his common sample). His world income distribution comprises deciles (or other quantiles) of countries’ populations, whose incomes are estimated from surveys. While each survey is subject to sampling variance, his world income distribution is not based on a sample of the world population. In other words, he has a *constructed* population and not a *random sample* of the world population. Errors in his estimation procedure, therefore, are not based on sampling variance, and the interpretation of his estimated standard errors remains unclear.

Regarding estimation errors more generally, there are at least two levels at which data problems can arise in the studies that estimate global inequality. The first level is error in the data generated by the surveys and NA themselves. The second is measurement or estimation error in the PPP conversion rates used to construct a global distribution.

We have already discussed several sources of error in the NA and surveys. NA suffer from out-of-date sources for their benchmark data and unreliable imputations and extrapolations for current estimates. Surveys suffer from sampling error (undersampling at both ends of the distribution), and from underreporting of the incomes and expenditures of the rich.

Bourguignon and Morrisson (2002: 730) simulate uncertainty in GDP figures and in within-country distributions, and estimate standard errors for global inequality on this basis. For GDP they assume that the data are normally distributed with "mean unity" (the mean of the multiplicative factor we presume) and a standard deviation of 10% during the 19th century, 5% during 1900-29, 2.5% during 1950-80, and 0% in 1992. For within-country distributions they calibrate stochastic errors in observed decile shares so that the resulting standard deviations of country Ginis average 2 Gini points in the 19th century and 1 Gini point in the 20th century. Based on these assumptions, the resulting standard errors on the global Gini turn out to be small: in 1820 the standard error is 0.9 Gini points, in 1950 it is 0.2 Gini points (0.002 in the Gini scale of 0 to 1), and in 1992 it is 0.1 Gini points.

The small size of these estimated standard errors is a consequence of the assumptions about errors in the underlying data. Given the potential sources of error in the NA discussed above, these assumptions seem over-optimistic. A 2.5% standard deviation in the measurement of per capita GDP implies that its true value lies within 5% of its observed value in 95% of cases (including in underdeveloped regions of the world). Bourguignon and Morrisson's assumption of zero error in per capita GDP in 1992 seems even more optimistic. The errors assumed for the 19th century yield a 95% confidence interval of ±1.8 Gini points. If the same assumptions were made in the 20th century and yielded the same confidence interval, then the estimated change in global inequality between 1950 and 1992 would be insignificant.

Apart from Milanovic (2002) and Bourguignon and Morrisson (2002), no other study seriously considers the implications of measurement error in within-country distributions. Schultz (1998: 326) simply reports that his "estimates of intracountry household inequality are subject to a wide margin of error or uncertainty". Several other studies make reference to the unreliability of within-country estimates of inequality, but none investigates its implications.

In addition to errors due to sampling and underreporting by the rich in household surveys, the assumption made in estimating within-country inequality of equal incomes within quantiles or income intervals is another source of error. This leads to a downward bias in within-country inequality in those studies which make this assumption—Milanovic, Bourguignon and Morrisson, Dowrick and Akmal, and Korzeniewicz and Moran. An analysis of the sensitivity of estimates to different assumed degrees of inequality within quantiles or income groups might be attempted. Specifically, it would be interesting to calculate by how much within-country inequality would increase if the distribution within income intervals were assumed to be maximally unequal. We could thereby construct an upper bound for within-country inequality in addition to the existing lower bound. The resulting 'uncertainty' intervals would allow a better assessment of whether observed changes are significant.[38]

In addition to error in the national accounts and in within-country distributions, measurement or estimation error will be present in PPP exchange rates. These exchange rates are estimated on the basis of data from price surveys undertaken in countries through the International Comparison Programme (ICP). PWT 5.6 had price data for only 85 of the 152 countries for which they present real income estimates (PWT 5.6, Help/Country and Variable Description), an increase over the 77 countries in PWT 5 for which they had price data (Summers and Heston 1991: 341). The latest version of PWT, i.e. version 6.1, has ICP price data for 115 countries. The countries with ICP price data

[38] The assumption of zero inequality within income groups is as implausible as the assumption of maximal inequality.

are known as ‘benchmark countries’. For non-benchmark countries, PPP rates are estimated on the basis of regressions of indices of living costs in major cities carried out by a number of different organizations (Aten 2002: 3-4).

PWT estimate PPP exchange rates for benchmark countries in non-benchmark years using domestic price indices. However, as Aten and Heston (2004: 29) report, “[W]hen countries have multiple benchmarks, the relative PPPs of two countries in two benchmarks usually differs from what would be predicted from relative price movements in the two countries”. That is, suppose global ICP surveys are carried out in two benchmark years and used to calculate the PPP exchange rates between two countries in these years. Then the PPP exchange rate in the second benchmark year will not in general be equal to the exchange rate calculated by applying the two countries’ domestic price indices to the PPP exchange rate in the first year. Hence going forwards from one benchmark year using domestic price indices will give a different result from going backwards from a subsequent benchmark year. Thus, for years in between benchmarks they “average the different PPP estimates and this is done by giving more recent estimates somewhat greater weight” (Ibid.: 29). Maddison and the World Bank do not follow this “reconciliation process”, and there does not appear to be an accepted procedure for making PPP income comparisons over time. This introduces another layer of uncertainty in estimates of global inequality.

PPP exchange rates for benchmark countries will be subject to the standard sampling errors that arise from a (price) survey. For non-benchmark countries matters can be considerably worse. The authors of PWT 5 write that for non-benchmark countries "[T]he percentage accuracy, to be interpreted in 0.95 confidence interval terms, is guessed to range from 60 percent up or down for countries with GDPs per capita less than a tenth of the United States, to 19 percent up or down for countries between half and seven-tenths of the United States; and 15 percent for countries as close as seven-tenths of the United States" (Summers and Heston 1991: 341).

China and India pose particular problems for PPP comparisons. China has never been a benchmark country, while India was last benchmarked in 1985. As China has never participated in the International Comparison Programme[39] the Chinese PPP conversion factors in PWT are estimated on the basis of a regression equation. Dowrick and Akmal (2003: 21) examine the implications of this estimation for global inequality. They calculate a confidence interval for Chinese GDP in GK PPP$ (as in PWT), taking two standard errors on either side of the point estimate. Inserting the bounds of these estimated confidence intervals into their calculations of global inequality, they find that the resulting confidence intervals for global inequality in 1980 and 1993 overlap, and suggest that their estimated changes in global inequality are not robust to the estimation error in Chinese GDP. Milanovic (2002, 2005) uses Chinese price data directly, but these data are based on surveys of only two cities in China and hence will be subject to large sampling error.

[39] Price data are available for only two cities (Heston 2001, Milanovic 2002), which are not nationally representative.

A detailed study by Deaton et al. (2004) finds that both PWT and the World Bank substantially underestimate India's per capita GDP relative to that of Indonesia in 1999, in comparison to the authors' own bilateral PPP estimates. Their findings imply that India is at least 40 percent richer relative to Indonesia than PWT data would suggest, and at least 60 percent richer than the World Bank data would suggest.

Finally, there is the problem of assuming a single PPP price level for each country. If prices faced by households within a country are correlated with their incomes then assuming a single price level will bias estimates of within-country inequality. Prices and incomes may be positively correlated if, for instance, both rural prices and incomes are lower than their urban counterparts. Not adjusting for price differences within the country will in this case lead to an upward bias in measured inequality. Conversely, income and prices may be negatively correlated if the poor face higher unit prices owing to their inability to buy in bulk (Aten and Heston 2004: 7-9), which will lead to a downward bias in inequality. If relative prices within countries change over time then this may also lead to bias in estimated changes in inequality.

Evidently there are numerous sources of uncertainty—from errors in underlying data to biases arising from the assumptions and methods used to construct estimates of global inequality. Sensitivity analysis should be undertaken to assess the possible impact of these errors and assumptions, even if there is insufficient information to estimate statistical confidence intervals. The standard errors estimated in the literature do not address these concerns. If uncertainty intervals were constructed taking into account all these sources of possible error in estimates, they would in our view tend to render insignificant the measured changes in global inequality over the last thirty years of the twentieth century.

7. Conclusion

We have seen that studies of global inequality in general provide inadequate discussion of their methodology. Some studies are regrettably opaque and require considerable detective work to unearth the methods they employ. Even those that provide clear descriptions of their methods sometimes contain insufficient justification of the chosen method or discussion of its implications.

On the basis of our examination of the literature, we contend that it is not possible to reach a definitive conclusion regarding the direction of change in global inequality over the last three decades of the twentieth century. The different studies arrive at widely varying estimates of both the level of, and changes in, global interpersonal inequality. Estimates of the Gini in PPP$ in the 1990s range from 0.609 (Sala-i-Martin 2002a) to 0.711 (Dowrick and Akmal 2003) while estimates of the Theil T range from 0.716 (Sala-i-Martin 2002a) to 0.907 (Dikhanov and Ward 2002). Estimated changes over time range from a decline in the Gini of 0.04 over 1970-2000 (Bhalla 2002) to a rise in the Gini of 0.015 over 1970-1999 (Dikhanov and Ward 2002). Bourguignon and Morrisson (2002) and Dikhanov and Ward (2002) find a rise in the Theil T from 1970 to the 1990s, while Sala-i-Martin (2006) finds a decline. Dowrick and Akmal (2005), studying the period 1980-1993, find a rise using Afriat PPPs and a decline using GK PPPs. Even confining ourselves to estimates of the Gini using GK PPPs we find contradictory trends—from Sala-i-Martin's (2006) decline of 0.026 over 1970-2000 to Bourguignon and Morrisson's rise of 0.07 over 1970-1992 (and no change over 1980-1992). Finally, different inequality measures estimated for the same [constructed] global income distribution can imply contradictory trends, such as Dikhanov and Ward's estimate of a rise in the Theil T of 0.04 and a fall in the Theil L of 0.09 over 1980-1999. The one point of agreement among all studies is that the level of global inequality is very high, with all estimates of the Gini lying at or above 0.63 (except one due to Sala-i-Martin 2002a, an unpublished working paper). Most estimates also find that within-country inequality has risen since 1970 or 1980.

The diversity of the findings across studies is the result of varying data sources and methodologies. Studies use national accounts data from the Penn World Tables, Maddison (1995, 2001), or the World Bank—each of which employs a different PPP estimation methodology. Some assign a country its per capita GDP, some its per capita household consumption expenditure from NA, while others eschew national accounts altogether and use mean income or expenditure from household surveys (converted into PPP$ by one method or another). Within-country distributions may be constructed by assigning equal incomes within quintiles (or other quantiles), or may be "smoothed" using parametric or non-parametric methods.

We have provided arguments for preferring some choices over others in the many decisions that must be made in the construction of estimates of global inequality. We have argued that household surveys—the only source of estimates for within-country distribution—are likely to be more appropriate than national accounts for estimating the corresponding mean income. If within-country distributions must be scaled to a national accounts category, then household final consumption expenditure seems more appropriate than GDP. We have also suggested reasons to prefer EKS PPP estimates to GK or Afriat estimates, but more research is required on their relative merits. In our view, two of the more serious problems are the scaling of incomes to per capita GDP, and the mixing of different and incommensurate PPPs. Dikhanov and Ward (2002) is the only study that commits neither of these errors.

Moreover, all studies suffer from a variety of sources of uncertainty which include *inter alia*: measurement error in national accounts, in household surveys, and in within-country price data used for PPP estimation (particularly serious for non-benchmark countries including China); standard index number and multilateral comparison problems with PPP estimates; and non-comparability of household surveys. We do not know whether these errors will simply add noise or also lead to bias, but in either case they reduce our confidence in measured changes in global interpersonal inequality.

Given these uncertainties, and the range of estimates of the direction and magnitude of change in global inequality, we conclude that there is insufficient statistical evidence to reject the null hypothesis of no change in global interpersonal inequality over 1970-2000.

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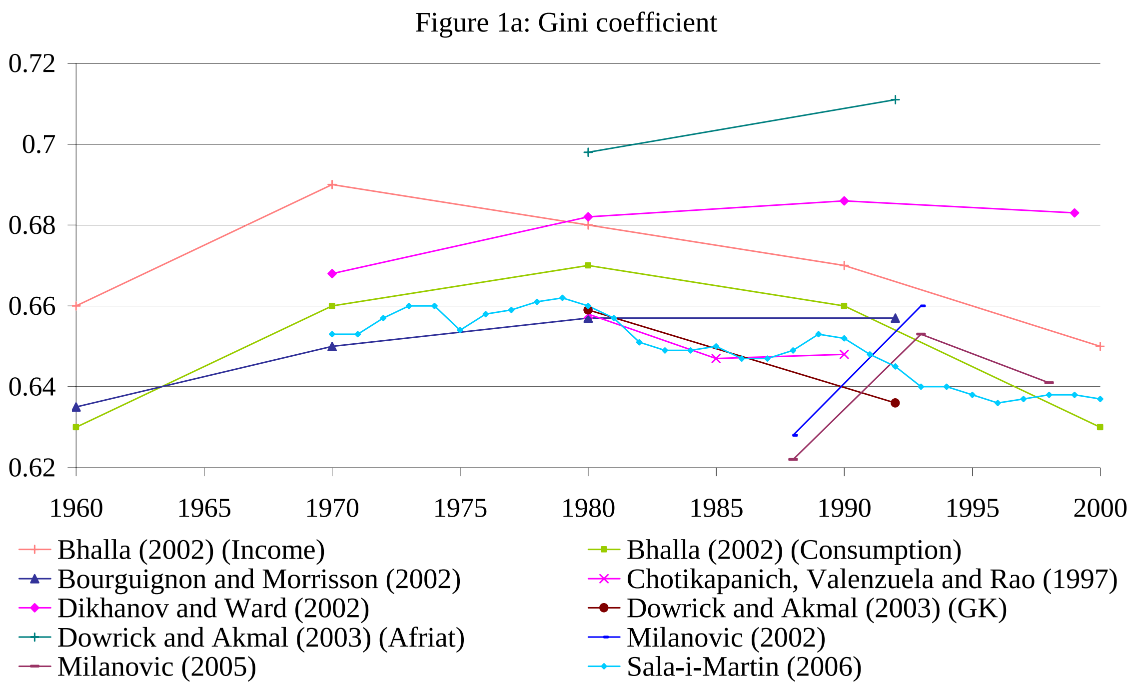
Figure 1: Estimates of Global Interpersonal Inequality at PPP$



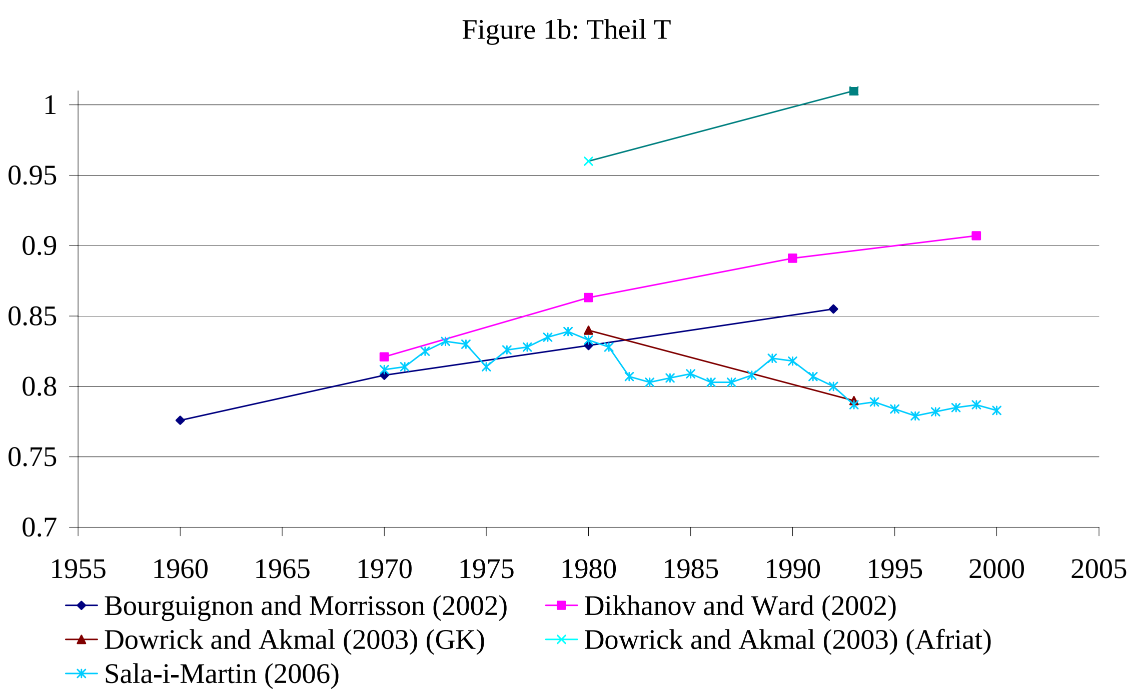


Table 1: Estimates of Global Interpersonal Inequality

PPP exchange rates

Gini coefficient	**1960**	**1970**	**1980**	**1985**	**1988**	**1990**	**1992**	**1993**	**1998**	**1999**	**2000**
Bhalla (2002) (Income)[a]	0.66	0.69	0.68			0.67					0.65
Bhalla (2002) (Consumption)	0.63	0.66	0.67			0.66					0.63
Bourguignon and Morrisson (2002)	0.635	0.650	0.657				0.657				
Chotikapanich, Valenzuela and Rao (1997)			0.658	0.647		0.648					
Dikhanov and Ward (2002)		0.668	0.682			0.686				0.683	
Dowrick and Akmal (2005) (GK)			0.659					0.636			
Dowrick and Akmal (2005) (Afriat)			0.698					0.711			
Milanovic (2002)					0.628[b]			0.660[b]			
Milanovic (2005)					0.622[b]			0.653[b]	0.641		
Sala-i-Martin (2006)		0.653	0.660	0.650	0.649	0.652	0.645	0.640	0.638	0.638	0.637

[a] Bhalla specifies numerical estimates only for world income inequality in 1960, 1973, and 2000. However, in Figure 11.1 (p. 174) he plots Ginis for world income and consumption inequality for each year during 1950-2000. From this figure we have read off the Gini values to two decimal places for the years reported here.

[b] The estimates for 1988 and 1993 in Milanovic (2005) differ from those in Milanovic (2002) because the common sample is slightly different.

PPP exchange rates (continued)

Theil T	**1960**	**1970**	**1980**	**1985**	**1988**	**1990**	**1992**	**1993**	**1998**	**1999**	**2000**
Bourguignon and Morrisson (2002)	0.776	0.808	0.829				0.855				
Dikhanov and Ward (2002)		0.821 [74.3%]	0.863 [74.4%]			0.891 [74.2%]				0.907 [70.5%]	
Dowrick and Akmal (2005) (GK)			0.84 [70.9%]					0.79 [70.4%]			
Dowrick and Akmal (2005) (Afriat)			0.96 [71.5%]					1.01 [71.4%]			
Sala-i-Martin (2006)		0.812 [68.6%]	0.833 [68.6%]	0.809 [67.8%]	0.808 [67.8%]	0.818 [68.1%]	0.800 [66.6%]	0.787 [65.8%]	0.785 [64.4%]	0.787 [64.3%]	0.783 [63.8%]

Theil L (Mean Log Deviation)											
Chotikapanich, Valenzuela and Rao (1997)			0.855	0.803		0.806					
Dikhanov and Ward (2002)		0.996	1.061			1.021				0.971	
Milanovic (2002)					0.765[a] [75%]			0.873[a] [74%]			
Milanovic (2005)					0.727[a] [72%]			0.817[a] [72%]	0.789 [71%]		
Sala-i-Martin (2006)		0.861 [71.5%]	0.888 [71.1%]	0.847 [68.6%]	0.842 [67.6%]	0.855 [67.5%]	0.833 [65.6%]	0.819 [64.6%]	0.816 [62.0%]	0.819 [61.6%]	0.820 [61.1%]

[a] The estimates for 1988 and 1993 in Milanovic (2005) differ from those in Milanovic (2002) because the common sample is slightly different.
Figures in square brackets show between-country contribution where estimated.

PPP exchange rates (continued)

Variance of Log-Income (Varlog)	**1960**	**1970**	**1980**	**1989**	**1990**	**1993**	**1998**	**2000**
Dowrick and Akmal (2005) (GK)			1.74 [65.3%]			1.51 [62.8%]		
Dowrick and Akmal (2005) (Afriat)			2.21 [70.1%]			2.40 [63.4%]		
Sala-i-Martin (2006)		1.581	1.644	1.593	1.593	1.558	1.585	1.623
Schultz (1998)	1.416 [66.6%]	1.565 [70.7%]	1.524 [71.3%]	1.441 [70.2%]				

Market exchange rates

Gini index	**1965**	**1980**	**1988**	**1992**	**1993**	**1998**
Dowrick and Akmal (2005)		0.779 [90.9%]			0.824 [92.4%]	
Korzeniewicz and Moran (1997)	0.749 [91.1%]			0.796 [92.7%]		
Milanovic (2002)			0.782[a]		0.805[a]	
Milanovic (2005)			0.778[a]		0.799[a]	0.794
Theil T						
Dowrick and Akmal (2005)		1.25 [77.3%]			1.50 [79.0%]	
Korzeniewicz and Moran (1997)	1.145 [78.8%]			1.321 [85.6%]		
Theil L						
Milanovic (2005)			1.283 [86%]		1.380 [85%]	1.348 [83%]
Variance of Log-Income						
Dowrick and Akmal (2005)		3.67 [74.7%]			4.23 [72.2%]	

[a] The estimates for 1988 and 1993 in Milanovic (2005) differ from those in Milanovic (2002) because the common sample is slightly different.

Figures in square brackets show between-country contribution where estimated.

Table 2: Data Sources for Estimates of Global Interpersonal Inequality at PPP$

	Within-country inequality data	PPP source
Bhalla (2002)	Own dataset	GDP PPPs from *World Development Indicators* and PWT 5.6
Chotikapanich, Valenzuela and Rao (1997)	Deininger and Squire (1996)	PWT 5.6
Dikhanov and Ward (2002)	Milanovic (2002)	Consumption PPPs from World Bank
Bourguignon and Morrisson (2002)	Own dataset	GDP PPPs from Maddison (1995)
Dowrick and Akmal (2005) (PWT PPPs)	Deininger and Squire (1996)	GDP PPPs from PWT 5.6a
Dowrick and Akmal (2005) (Afriat PPPs)	Deininger and Squire (1996)	Own calculations of Afriat index for GDP PPPs
Milanovic (2002, 2005)	Own dataset	Consumption PPPs from PWT and World Bank
Schultz (1998)	Deininger and Squire (1996)	GDP PPPs from PWT 5.5
Sala-i-Martin (2006)	Deininger and Squire (1996) and UNU-WIDER	GDP PPPs from PWT 6.0

Table 3: Within-country inequality at PPP exchange rates

Theil T	1970	1980	1988	1990	1993	1998	1999	2000
Dikhanov and Ward (2002)[a]	0.211	0.221		0.230			0.267	
Dowrick and Akmal (2005) (GK)[b]		0.244			0.234			
Dowrick and Akmal (2005) (Afriat)[b]		0.274			0.289			
Sala-i-Martin (2006)	0.255	0.262	0.260	0.261	0.269	0.279	0.281	0.284
Theil L (Mean Log Deviation)								
Milanovic (2002)			0.194		0.224			
Milanovic (2005)			0.203		0.228	0.232		
Sala-i-Martin (2006)	0.246	0.256	0.273	0.278	0.290	0.310	0.315	0.319

[a] Dikhanov and Ward (2002: 11) report a decomposition of “the Theil”, but the two components sum to the total for their “Theil index 2”, not their “Theil index”.
[b] Calculated from Table 6, p. 223, as global inequality less the “between-country index” which, as we discuss in the text, is not the same as the income-weighted within-country component of the Theil T index.