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Global Absolute Poverty: The Evolution of its Measurement

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Abstract

In estimating the incident of global poverty, both contemporarily and historically, one needs to reach far into the domain of assumptions and second best approaches. This paper navigates through this methodological jungle. This discussion of the literature, although extensive is not exhaustive, as several of the problems discussed below can fill lengthy chapters on their own. The focus is solely on the absolute poverty concept from the perspective of the dollar-a-day approach, which is the dominant in the global poverty literature.

A critical literature review

The standard rule in this literature, since the early 90's, is the application of international dollars as the reference currency for the international Poverty Line (iPL) (Ravallion et al., 1991a).[1] All contributions rely on estimates based on purchasing power parity (PPP) exchange rates. Those exchange rates express the dollar purchasing power equivalent of –currently– almost all currencies around the globe, and they differ from the market exchange rates since they account for the fact that in less economically developed countries local currency has higher purchasing power due to the relative cheaper non-tradeable goods (such as rents and various services) which are not reflected in market exchange rates that depend on tradeables.

A few years ago, Dhongde and Minoiu (2011) summed up the activity regarding estimates of global poverty, and table 1 partially reproduces it, and provides an update based on new articles since. Dhongde and Minoiu (ibid) conclude that studies of global poverty estimates are not comparable. Methodological differences, countries in the sample and sources used, result in occasionally vast different estimates. Even when the same poverty line is applied, this is done only in name. The choice of the data that this poverty line is applied to has decisive impact on the final result. For example, some authors favor the use of income while others favor consumption. Both may be taken from National Account Statistics (NAS) or taken from the household surveys that also provide the data on the distribution of income or consumption. Since those variables are typically far from identical, by choosing among them one practically identifies substantially different population groups as living in conditions of poverty (Deaton, 2005).

Pioneering the research field

Ahluwalia et al. (1979) pioneered the field of objective global poverty measurement, and provided estimates for 36 developing countries in 1975. The poverty line (PL) applied was equivalent to the income per head of the 46^{th} percentile of Indian population. India was selected to form the basis of the poverty line because it was the largest country in the sample, and "one of the best studied developing countries"

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[1]There has been one partial exception in Chen and Ravallion (2010) who add the "PPPs for the poor" calculated in international rupees by Deaton and Dupriez (2009).

(p.304, ibid). To obtain data on income the country's per capita real GNP was used, and for converting between various currencies to common dollar denomination the results of the International Comparison Project as published in Kravis et al. (1978) were used. Thus all per capita GNP levels were converted in dollars in 1970 U.S. prices. This translated the selected poverty line to be 200 PPP dollars in 1970 U.S. prices. The most populous country at the time, China, was not included in the study. For 25 out of the 36 countries distributional data were at the time available, and for the remaining 11 the authors imputed the distributional values by using the Kuznets hypothesis[2]. Their measure of poverty throughout the developing world resulted in an estimated rate of 38% for 1975.

Table 1: Chronology of global poverty studies

Global poverty study	Years Covered	No. of countries & Focus [a]	Database [b]
Ahluwalia et al. (1979)	1975	25, Developing	World Bank Data Bank
Ravallion et al. (1991a)	1985	22, Developing	World Bank
Chen et al. (1994)	1985-1990	44, Developing	World Bank / WDR
Ravallion and Chen (1997)	1987-1993	67, Developing	World Bank / WDR
Chen and Ravallion (2001)	1987-1998	88, Developing	World Bank
Bourguignon and Morrisson (2002)	1820-1992	Groupings[c], Global	WIID, Historical
Bhalla (2002)	1950-2000	149, Developing	World Bank, PWT
Chen and Ravallion (2004)	1981-2001	97, Developing	World Bank
Sala-i Martin (2006)	1970-2000	81 (138[d]), World	WIID, DS, PWT
Pinkovskiy and Sala-i Martin (2009)	1970-2006	191, World	DS, PovcalNet, WIID
Chen and Ravallion (2010)	1981-2005	115, Developing	WIID, PWT
Zanden van et al. (2011)	1820-2000	39-99[e], World	WIID, Historical
Pinkovskiy and Sala-i Martin (2016)	1992-2010	39-99[f], World & Developing	PovcalNet, WDI

[a] Countries for which distributional data is imputed are not included. It also refers to the maximum number of countries in the sample, which does not mean that for each year a study covers there are surveys available for all the countries in their sample. Focus refers to whether the paper focuses on global poverty, or on a mix of developing and developed countries, or more explicitly on poverty in the developing world.

[b] Note that all articles rely on various additional imputations; PWT: Penn World Tables; DS: Deininger and Squire (1996);WDR: World Development Report; WIID: UNU-WIDER World Income Inequality Database; Historical: various research studies; PovcalNet: online poverty calculator by the World Bank.

[c] Varies with the observation year.

[d] For 81 countries the author has data for more than 1 observation year, and the remaining country-years are imputed. An additional 29 countries have at least one distribution available for the entire period, and the remaining country-years are imputed. To reach the total 138, an additional group of 28 countries is included with pure imputation techniques.

[e] Varies with the observation year.

[f] Imputation is used extensively.

Household Survey based poverty

In their 1991 dollar-a-day poverty line reference paper, Ravallion et al. (hereafter also RDV) added a twist to the Ahluwalia et al. approach in their attempt to estimate poverty in developing countries for 1985. Being unsatisfied by the use of only one country to define the poverty line, they proposed instead to use the average of a bundle of low-income countries for which data were available at the time, thus limiting the sensitivity of the results to the variation of the poverty line in one country. Based on the 1985 PPP exchange rates by Summers and Heston (1988) and data on the national poverty lines from a group of 33 developing and developed countries, their econometric estimation predicts a 0.76$-a-day minimum absolute poverty line (in 1985 prices), which is marginally higher than the poverty line of

[2] Kuznets hypothesis posits that at the initial stage of development where a transition from agriculture to an industrial economy takes place, there is a natural increase in inequality that–as development continues–it will eventually be brought down at the long run equilibrium for inequality. See the discussion by Zanden van (1995) and Milanovic (2016), and also Kuznets (1955) for the original idea.

India. However, they point that the "absolute poverty line for low-income countries is $31[3], which (to the nearest dollar) is shared by" Indonesia, Bangladesh, Nepal, Kenya, Tanzania, Morocco, Philippines and Pakistan. Thus they settle for an average PL of countries that had their national poverty lines (NPLs) closely grouped according to their PPP dollar converted value.[4]

Their methodological framework starts from the premise that every national poverty line consist of two components: the absolute, which is fixed through time and countries, and the relative component which evolves as a result of economic development. Thus the original goal the authors set for themselves is to isolate the absolute component and use it as the iPL. However, their decision to settle for an average is in itself a deviation from the original goal of their paper.[5]

Contrary to Ahluwalia et al. (1979), who used GNP per capita from the National Accounts Statistics (NAS), RDV use consumption as reported by household surveys (HHS), or income as a second best choice if consumption was not available. Since not all the distributional data available were for the year 1985, they extrapolated distributions from nearby years using an econometric model with a set of social indicators for 64 additional countries on top of the 22 for which they had timely distributional data.[6]

Overall, RDV estimate that for 86 developing countries in 1985, the poverty rate was 33%, with a 95% confidence interval between 27.9 and 39.2%.[7] They also take good care to warn the reader about the overall accuracy of the results, characterizing them as "rough estimates only". They also find that their aggregate poverty estimates are especially sensitive to errors in the PPP exchange rate for China. They calculate that a 10% overestimation in the measurement of the PPP rate for China, would result in a 5% overestimation of the aggregate poverty headcount, or 1 percentage point, which translates to 35 million people. This becomes particularly worrisome since the PPP source they rely upon did not include PPP exchange rates for China[8], and they estimated the PPP values by extrapolation over the other available countries. In deriving the error terms of their estimation, however, they assume that the estimates which are based on actual distributional data do not contain any error component, no error term is linked to the PPP estimates, and no errors are included from the use of distributional data from different years (by imputation).

A few years later, Chen et al. (1994) revisited the problem of poverty with an increased sample of distributions reaching 44 countries "between 1981 and 1992, 19 of which have observations for two points in time within this period". Compared to the RDV paper, the authors refrain from econometrically estimating the poverty rates in countries with no distributional data in their sample. Although they do make econometric estimations for missing distributional data when they have at least one distributional point for a country.

They also discuss the inappropriateness of simply using the national poverty lines and poverty rates for international comparisons. The point being that this way one can conclude that poverty rates between high-income and low-income countries is occasionally the same, such as in the case of their example of USA and Indonesia which both have 15% poverty rate in 1990 according to each country's national poverty line. At the same time, they recognize the drawbacks of the use of PPP exchange rates, referring to the bias towards the prices of rich countries, and the problems in comparability of quality. They opt to the use of the dollarized international poverty line as estimated in RDV.

[3]Which translates to $1.02/day and it is what will eventually be called the dollar-a-day poverty line.

[4]Revisions of PPP rates show that those clustered NPLs are not as close to one another as found by the PPP rates being available to the authors. For instance, due to the revision of India's PPP rate in Summers and Heston (1991) the case that the Indian PL at 1985 was closer to the dollar-a-day value that thought of at the time.

[5]One implication with potential to bias the global poverty estimates is that as a result that deviation the iPL was set roughly 50% higher than the Indian NPL, by far the most populous country in their dataset.

[6]Follow-up articles abandoned this econometric approach; see below for details.

[7]The only source of error they consider is the one introduced by the econometric model used in the extrapolation method to estimate the aggregate poverty for countries without distributional data. In their own words: "Allowing solely for imprecision due to the need to predict the poverty measures for those countries for which suitable distributional data are unavailable" (Ravallion et al., 1991b, Table 2, p. 354)

[8]Nor for Burma.

Regarding the welfare measure they apply, it is either the consumption as it is captured by the consumption based household surveys (26 of the 63 surveys), or income reported by income based household surveys multiplied by the ratio of private consumption to the GNP of the survey year (Chen et al., 1994, p.365). They also draw the reader's attention to the fact that this later approach only adjusts the mean, but since possible changes in the actual distribution remain unaccounted for, the impact of this approach on the estimate of poverty is unclear. Chen et al. tested econometrically for any potential significant bias possibly introduced by including income based surveys, and concluded that there is none in their data set.

Again, since the household surveys do not necessarily coincide with the two years of comparison (1985 and 1990 in this case), the authors make the typical–in this strand of research– assumption that the survey closest to those dates is the best predictor for the actual distribution of those two years. They simply adjust the level of mean consumption by multiplying with the ratio of private consumption from the national accounts statistics between the year of survey and the year that survey was actually used for.[9]

In any case, several dollarized PLs were used, none of which showed any marked improvement in poverty rates in any region between the two observations years 1985 and 1990. Keeping the same dollar-a-day iPL as their poverty yardstick, they estimate almost the same figure as in the previous paper for the aggregate, namely 33.88% for 1985.[10] For 1990 the estimate "drops down", by 0.36% which arguably is well within the error margins of the 1985 estimate, therefore one would be uncertain about any identified trends from the point estimates. The similarity in the aggregate poverty results between the two papers vanishes in the regional comparisons. The difference in the case of Middle East and North Africa (MENA) is the most prominent one, dropping from 31% to 4% in the later study. The previous estimate for MENA relied upon one actual survey for Morocco, and on extrapolation for the remaining, while the new estimate used 4 countries with surveys. The authors also attribute the big change in South Asia (SA), from 51% down to 37%, mainly to the updated PPP exchange rates in Summers and Heston (1991) compared to Summers and Heston (1988) for India.

An instructive approach is used to investigate potential bias from the countries included in the dataset for MENA and Sub-Saharan Africa (SSA), the two regions with particularly low population coverage. They find that the countries included in their sample have higher population weighted real consumption growth, compared with the ones left out and for which data exist. This indicates that the very low estimate for MENA may very well be downward biased. However, as the authors acknowledge, there is simply no information about the initial poverty levels in those countries. So by assuming, that the group of countries in the dataset was representative of the region in the initial date, and that growth is distribution neutral in the excluded countries to "correct" the bias simply falls short to make the problem vanish.[11] Importantly, this time no error estimates of the main results are provided, and this unrecommended habit still persists to this day by other contributors and the official World Bank statistics on global poverty.

In 1997, Ravallion and Chen, updated their dataset and included for the first time countries from Eastern Europe and Central Asia (EECA). This posed an additional methodological issue since, as the authors readily acknowledge, if one applies an international poverty line relevant to low-income coun-

[9]Only surveys that covered the entire population were used, with the exception of Ethiopia which had only one survey in the 80s and covered rural population only. However, 87% of the country were living in rural areas even in 1990 as the authors point out. Moreover, PPP exchange rate data for Eastern European and ex-Soviet countries were either unavailable or unreliable according to the authors. If PPP exchange rates were provided by Summers and Heston (1991) then the country was used. Similarly to their previous paper, the PPP estimates for China in Summers and Heston (1991) were indirect. China did not participate in the PPP estimates before 2005.

[10]Although the inclusion of two decimal points in the results implies a level of certainty in the results not warranted by the data or the method.

[11]Using more recently available data, the coverage for all regions is now considerably higher. However, the problem of missing distributional data still persists today and no perfect solution exists.

tries, this would yield very low poverty rates for EECA, while choosing a PL relevant to that region would give very high poverty rates to the low-income countries. Overall, using 1985 PPP dollars, absolute poverty in 1987 was found at 33.9%, in 1990 32.9% and in 1993 31.9%.[12]

On aggregate, the Chen et al. (1994) and Ravallion and Chen (1997) do not differ much for 1990, however, in a per region basis the results diverge considerably. For East Asia (EA), the rates are doubled from 15% to 29%. For Latin America and the Caribbean (LAC) there is a drop from 28% to 23%. In MENA the rate marginally increases from 3% to 4%, which still is a 33% increase. In SA the rates go from 59% down to 43%. And in SSA from 53% down to 39% all for the year 1990. Most importantly, this article identifies a 6-fold increase between 1987 and 1993 for EECA to a 3.5% poverty rate at the end of the period.

Those differences for the same year in 1990 emerge from a number of factors. One factor is the new available data. Another is that no extrapolation method was applied to include countries with no distributional data. Rescaling was applied when the survey was income based, and this was done by multiplying with the ratio of real consumption in the national accounts. For currency conversion the PPP exchange rates from PWT version 5.6 were used. According to the authors, here lies the source that shifts the estimates for EA so radically. Namely the upward revision for the PPP rate for China: If one uses PWT 5.0 the result for EA would be 14% instead of 29%. A revision for the PPP rates for India is also of important influence and brings down the SA aggregate. Other PPP revisions for MENA countries also drive the estimates downwards. Again, no error estimates of the main results are provided.

Arguably, in light of such big changes one should ask if under the same methodological strand, the repeat of the exercise of 1991 paper would be warranted for estimating a new iPL, instead of recycling the old one. Those largely influential revisions of various PPP rates could imply shifts in the underlying poverty yardstick. A re-investigation of this would have been expected, however this will have to wait until the follow-up paper in 2001 on which we turn to next.

Chen and Ravallion (2001) expand considerably the dataset of surveys used to 297 surveys across 88 countries, and the PWT is abandoned as the source for PPP rates, and the PPPs from the World Bank Development Data Group are used instead. The underlying data for the 1993 ICP[13] round cover 110 countries, compared to the 60 countries represented in PWT 5.6 that was used in Ravallion and Chen (1997).[14] Similarly to Ravallion and Chen (1997), no imputation for countries without at least one survey was made and those countries were simply left out. For time alignment of the surveys the same method as in Ravallion and Chen (1997) was used.

In broad terms the same principle used in Ravallion et al. (1991a) was used to re-estimate the poverty line to be in line with the new ICP round data. In 1991, the dollar a day line was selected because for 6 low-income countries[15] the values of their respective NPLs in PPP terms were –to the nearest dollar (per month)– identical at $31, and 2 other low-income countries[16] were close. Now this approach changes and the median of the ten lowest poverty lines is used instead. Those countries are different from the 8 countries of the 1991 paper, because of the new 1993 PPP exchange rates. Now the countries defining the international poverty line are: Bangladesh, China, India, Indonesia, Nepal, Pakistan, Tanzania, Thailand, Tunisia, and Zambia, and their median NPL is $1.08 in 1993 prices.

Running the regression from the 1991 paper again, with a somewhat different structure, the absolute poverty line obtained is $1.05 in 1993 prices. From this result they conclude that the $1.08 poverty

[12] Those are the aggregate results that exclude EECA in order to have a more comparable mix of countries that are used also in Chen et al. (1994).

[13] The International Comparison Program (ICP) operates under the auspices of the World Bank, and is the authority that is produces the PPP exchange rates.

[14] However, for Ghana, Mauritania, Nicaragua, the Philippines, and Uganda, the PWT 5.6 PPPs are used instead of the World Bank's, because the application of the World Bank's PPPs implies poverty rates that are implausibly low (Chen and Ravallion, 2004).

[15] Indonesia, Bangladesh, Nepal, Kenya, Tanzania, and Morocco.

[16] Philippines and Pakistan.

line they derived is a "close approximation to the poverty line one would expect to find in the poorest country." This translates to setting the dollar-a-day international absolute poverty line to $1.08 in 1993 prices.

For the 88 countries in their dataset, 20 are represented with one survey, 18 with two and 50 with three or more within the 1980-1998 period; and their results cover the 1987-1998 period. As in Ravallion and Chen (1997) whenever there is only one survey the authors impute the estimates by shifting the mean consumption or income based on private consumption growth from the national accounts, and keep the Lorenz curve fixed.[17]

Overall, 181 out of 265 surveys were consumption based, and for the remaining surveys two strategies were applied. Most were re-scaled using the "one minus the national saving rate", while about a quarter of them had mean consumption estimates available with which they replaced the average income of the surveys. This however falls short in accounting for the distributional differences among income based and consumption based distributions.[18]

The differences between Chen and Ravallion (2001) and previous estimates are substantial for the regional estimates. The most marked differences are for SSA, where the poverty estimates have risen to 50% up from 39% for 1993. The authors attribute this to the inclusion of additional countries with high poverty (Central African Republic, Gambia, Mali, Sierra Leone) and to the re-evaluations brought by the 1993 PPPs. On the contrary, the estimates in LAC decreased from 24% to 15% for 1993, and similarly for 1987 and 1990. For MENA the new 1993 estimate is half the old one, from 4% to 2%.

The next consumption based article on poverty covering the developing world comes by the same authors, albeit in different order, (Chen and Ravallion, 2004). Here for the first time the estimates go back to 1981, and end in 2001.[19] This paper covers 97 countries represented by 454 surveys.[20] As time coverage in this paper expands, it places additional pressure on the already limited data. For 1981 the coverage is quite low, with only 15 surveys up to 1983, and similarly for the last years of the period the number of surveys also drops. The problem can be also summarized by the population weighted mean date of surveys used for the years 1981 and 1984, which for EECA, SSA and MENA is actually 1988 (rounded to the nearest year).

The 1993 PPPs used in Chen and Ravallion (2001) are also applied here, but not all 97 countries in the dataset were covered in the 1993 PPP round. For some 26 countries the PPP estimates are based on interpolations from cross-country regressions as described in Ahmad (2003), while for India an update of the 1985 PPP round is used, and for China price levels from 10 cities are used.[21]

For the definition of the absolute poverty line the median of the 10 lowest poverty lines with the new PPP rates among the poverty lines available in Ravallion et al. (1991a) is used, providing a value identical to the $1.08/day line from Chen and Ravallion (2001). It is not clear why the authors only focus on the poverty lines from the original set of 33 countries from Ravallion et al. (1991a), given the substantial new amount of new data on NPLs they have at their disposal.

The rescaling practice for the mean income when only one income distribution was available – followed in Chen and Ravallion (2001)– is now abandoned. The authors further show that comparing distributional data for both consumption and income that were available for 27 countries, gave no sig-

[17] For Kazakhstan, Kyrgyz, Latvia, Lithuania, Moldova, and Turkmenistan, instead of the unavailable NAS consumption data, GDP growth rates were used.

[18] The consumption distribution is substantially smoother than income distributions (Lopez and Servén, 2006).

[19] This paper works also with the 55th round of NHS in India, but due to some methodological issues related with what is called the "recall period" of the survey, the adjusted version of the survey's results from Deaton (2003). The authors report that using the official 55th round data the poverty rate for 2000 in India is 32.3%, and with Deaton's adjusted data the poverty estimate becomes 34.7%. See Chen and Ravallion (2004) for more details on the issue.

[20] This translates to 59% coverage of the 776 surveys needed for a complete coverage, assuming that the surveys match the 8 benchmark years of the paper; however there is frequently a mismatch between benchmark and survey years.

[21] Again as in Chen and Ravallion (2001) and for the same five countries mentioned previously, the PWT 5.6 PPPs are used instead of the World Bank's.

nificant differences in terms of poverty rates.[22]

With respect to survey data availability, there are 9 countries with only one survey in the 1981-2001 period, 19 with two, and the remaining 69 countries have at least three. Again, when only one survey is available for a country, then the Lorenz curve is assumed fixed, and the average income or consumption is assumed to grow with the growth rate of real private consumption per person as recorded in the national accounts. When more surveys are available, then the same method is applied as in Chen and Ravallion (2001), with one difference: to estimate the poverty rate at a year between surveys they take the time-weighted average estimate from those two distributions after shifting their means using the real private consumption per person from NAS, with the distribution closest to the year of the estimate taking a proportionally higher weight.

The results of Chen and Ravallion (2004) show that the poverty rate with respect to the $1.08/day poverty line has dropped by half during the 1981-2001 period throughout the developing world. Comparing with the results by Chen and Ravallion (2001), for the years these studies have in common, their similarity on the aggregate level is clear. They only deviate by one or two percentage points from 1990 onward, but with an increasing time trend on their difference. On a regional level there are several differences with Chen and Ravallion (2001).[23] Estimates for South Asia after 1990 diverge considerably with about 3 percentage points reduction in 1990 and 1993, and a drop from 42.3 to 36.6 in 1996. The almost 8 points reduction in 1999 is attributable in part to the different reference year,[24] although this alone should not be able to explain the entire difference.

In Sub-Saharan Africa the estimates are also lower by 2 to 5.5 percentage points in the period 1990-1999. A downward revision is also brought about for Latin America and the Caribbean, which is most prominent in the period of 1987-1996, with a drop of about 4.5 points. As the authors mention, this drop is largely attributable to the absence of rescaling the mean income mentioned above. Smaller deviations in percentage points, but larger on a percent basis, appear for EECA, especially for 1987 and 1990.[25] MENA and EA differ less between the two studies. Overall the differences are the combined result of the new survey data, new countries that are included, and the non-rescaling of the mean income for countries that have only one available distribution.

Chen and Ravallion (2010) is the latest contribution in this literature from these two authors, that uses consumption based surveys to estimate the poverty rates on the entire developing world. In addition it makes the transition to the then latest ICP round of 2005. The 2005 PPP exchange rates they apply are the ones for "individual consumption expenditure by households" according to the 2005 ICP round of the World Bank (2008).[26] Those PPP exchange rates are different from those applied for the economy as a whole and are estimated specifically for the average household consumption. Every dollarized international poverty line is converted to the local currency in 2005, and then it is shifted in time correcting for price effects as they are captured by CPI, in order to be applied in a given country for a year other than the ICP benchmark year. The quality and the relevance of the "best available Consumer Price Index" to poverty estimates in each country naturally varies. The authors point to the fundamental role of CPIs, and acknowledge that since "the PPP conversion is only done in 2005, estimates may well become less reliable earlier in time, depending on the quality of the national CPIs".[27]

[22] It is likely that this is done in response to the remarks on the use of both consumption and income distributions by Deaton (2001).

[23] See section of the appendix for the detailed tables.

[24] The year 1998 is reported in Chen and Ravallion (2001) instead of 1999, and the same mismatch of course occurs in all other regions as well for that year.

[25] Whether or not those differences are of some statistical significance is not obvious, since the standard errors are not reported.

[26] Previous articles discussed here used the PWT PPPs for consumption, with the exception of Chen and Ravallion (2001) which used the ICP consumption PPPs.

[27] Obviously the same concern applies for all the calculations that estimate global poverty with a method that uses PPP exchange rates, as it is done in the papers already covered here.

The 2005 ICP round brought dramatic revisions to previous PPPs, which in turn brought similarly dramatic changes in the global absolute poverty rates.[28] This is the first time that India and China participated in the price surveys of an ICP round. In the 1993 round estimates for India were based on extrapolation from 1985 with the use of CPIs, and for China non-ICP sources were used with additional extrapolations similar to those used for India. Still a number of concerns remain for issues regarding the domestic representativeness of commodities, substantial "urban bias" in some countries, inappropriateness of the weights for the consumption habits of the poor, and for the fact that PPPs are national averages. Partially addressing those issues for big countries, the authors split China, India and Indonesia in rural and urban areas and estimate different poverty lines for each. For China, since the ICP survey was carried out in urban areas only (covering 11 cities), they consider the ICP PPPs as urban PPPs and apply the urban/rural poverty line ratio for estimating a rural poverty line in local currency units (LCUs). For India and Indonesia the approach is similar in purpose, but less straight forward.[29]

A new ICP round requires for a new estimation of the poverty line within the dollar-a-day methodological tradition. The article by Chen and Ravallion utilizes the work done in Ravallion et al. (2009) (also referred to as RCS in the remaining of this text), covering 75 developing countries, much more than the 33 national poverty lines used in RDV almost twenty years before. Where possible national average poverty lines were included, compared to the use of rural poverty lines in RDV.[30] RCS estimate the international poverty line at $1.25. They estimate this value as the mean poverty line of the group of countries with average personal consumption expenditure below $60/month.[31] Alternative averages of poverty lines of the 10 or 20 poorest countries yield similar estimates for the international poverty line, namely $1.22 and $1.26 respectively.

The distributional data they rely upon consist of 675 nationally representative surveys covering 115 countries.[32] Least well covered are the regions of EECA and SSA during the 1980s. Due to the overall incidence of poverty in SSA the lack of data in the region carries more weight, and the projections used should be considered cautiously as they could bring bias to the estimates.

It is important to note that the estimates of the number of poor per region they provide are based on the assumption that the "countries without surveys are a random subsample of the region". No further investigation of this claim is offered, such as the approach used by Chen et al. (1994, see above). To control for the possibility that some countries are no longer within the group of developing countries, the grouping of a country in 2005 World Development Indicators as a developing one is used throughout the 1981-2005 period they cover.

Since the PPP estimates are calculated for the final year of the period, the time distance that one needs to cover back to 1981 using various CPIs becomes longer than ever before. This implies that the estimates may become less reliable the further back we go, to the extend that the average CPI mismatches with the price changes that those living in conditions of poverty face.

The new international poverty line of $1.25/day shows a much larger incidence of poverty throughout the aggregate estimates, compared to the $1.08/day in 1993 PPP (see the comparative table 2 in the appendix). However, the estimates show that the percentage of the population of the developing world

[28] The title of the Chen and Ravallion (2010) article is quite telling in this regard: "The Developing World is Poorer than We Thought, But No Less Successful in the Fight Against Poverty".

[29] See Ravallion (2008); Chen and Ravallion (2010) for more details.

[30] When rural and urban poverty lines are available, without an official NPL, the NPL used in is calculated as the weighted mean of the urban and rural poverty lines, using urban and rural real consumption (or income) shares as the weights , and using the poverty lines as the deflators . This formula was used for India, Benin, Ethiopia, Gambia, Kenya, North Macedonia, Mexico, Mozambique, Niger and Senegal.

[31] The relevant countries are, starting from the country with the lowest personal consumption expenditure: Malawi, Mali, Ethiopia, Sierra Leone, Niger, Uganda, Gambia, Rwanda, Guinea-Bissau, Tanzania, Tajikistan, Mozambique, Chad, Nepal and Ghana.

[32] This translates to 65.2% coverage of the 1035 surveys needed for a complete coverage, assuming that the surveys match the 8 benchmark years of the paper; although this is not the case as a considerable number of them has to be shifted so that its used at a nearby benchmark year.

living in absolute poverty was halved over the 25-year period between 1981 and 2005, falling from 52% to 25%. Their results also show a "bunching up" of people just above the poverty line. This translates to a high sensitivity of the aggregates that may result from a future "aggregate economic contraction (including real contraction due to higher prices)". The champion of the poverty reduction is by far China. In 1981 the estimates show the incidence of poverty at 73.5% and by 2005 this number has been reduced to 8.1%. On the contrary, in SSA the poverty rates contracted marginally from 54% in 1981 to 51% in 2005.

The authors also provide a thorough investigation of the effect that the various changes in the underlying data have on their estimates. The contribution of the new PPPs, the new national poverty lines, and the new surveys are analyzed. The partial effect of new surveys is found very limited. Using the new survey database for 2005 with the old 1993 PPPs and old poverty line of $1.08, then the initial rate of 17.6%, with the old database, is brought down slightly to 17.2%. Then, using the new poverty line data that move the international poverty line upward move the estimate from 17% to 29%. Incorporating the new 2005 PPPs have a net effect of -4% bringing the estimate to 25%. This net effect of the new PPPs is the result of two partial effects. One operating via the change in the global distribution that pushes the estimates upwards (+17 percentage points to 46%) and a balancing effect via the PPP revisions of the international poverty line that pushes the poverty rate downwards by 21% to the final 25%.[33]

Ferreira et al. (2015) offers the latest contribution within this strand of the global poverty literature, and updates the iPL using the latest ICP PPP round from 2011. Apart from the update of the iPL value to $1.9/day in 2011 prices, no remarkable changes occurred on the global aggregate in this PPP round as it happened with the previous one. Counter-intuitively Ferreira et al. did not repeat the entire exercise as described in Ravallion et al. (2009), but instead used the same countries, same "reference group" in their respective jargon, and took the average value of their NPLs. Other authors (Kakwani and Son, 2016; Sillers, 2015; Jolliffe and Prydz, 2016) have tried several other methods to estimate a global poverty line for the 2011 PPP round and all got values very close if not identical to the 1.9 estimation of Ferreira et al. (2015). This is what has also been called a "strange alignment of stars" by the at the time World Bank's chief economist Kuashik Basu (Atkinson, 2016, p.19). In any case, by choosing the same reference group as in Ravallion et al. (2009) their approach becomes a hybrid one with respect to the PPPs ICP round, as the reference group has been defined using the 2005 PPPs.

Mixed HHS/NAS global poverty research

After a long period of HHS consumption based estimations of global poverty, Bhalla (2002) revisits the NAS-consumption-based approach. He is effectively building on the steps of Ahluwalia et al. (1979) in working with NAS data for anchoring the mean level of the distributions, but this time using consumption data instead of income. This is also the first attempt of estimating global poverty by a researcher not affiliated with the World Bank. Contrary to the previous contributions, his geographical domain is all countries with available data[34] regardless of their state in terms of economic development.

Bhalla argues that in order to estimate poverty rates using consumption data from National Accounts Statistics (NAS), one needs to consider how to correct for the notorious gap between the consumption based survey means and the consumption as they are captured in NAS.[35] He argues that the best way forward is to begin with a benchmark poverty line corresponding to the the 46th percentile of the Indian population distribution, as in Ahluwalia et al. (1979). Recalculated in 1985 prices it takes a value

[33] Chen and Ravallion (2010) offer estimates using the "PPPs for the poor" (P4s) provided by Deaton and Dupriez (2009) for a subset of countries. On aggregate those estimates do not differ considerably from the benchmark estimates, though the regional estimates differ more.

[34] His dataset includes 149 countries with varying coverage.

[35] It is well known that there is a divergence among income (and consumption) measured by surveys and income (and consumption) based by national accounts statistics. See discussions by Ravallion (2000, 2003b); Sundaram and Tendulkar (2003); Koser (2010); Deaton and Zaidi (2002); Deaton (2010) for more details, and table 7.1 in Bhalla (2002).

of $1.25-a-day (not to be confused with the $1.25 iPL of the World Bank which given in 2005 PPP terms). Next, he updates this line to $1.30-a-day in 1993 prices by adjusting for the inflation in prices of U.S.[36]. His final figure for the international poverty line is $1.5-a-day in 1993 prices after making some adjustments to bridge the methodological gap between using a consumption based poverty line and income based distributions (see below). The adjustments try to address under-reporting in the HHS, and the issue of the "missing rich". Those are the rich households that are missed by the researchers who execute the household surveys (e.g. living in gated communities), and instead are substituted by less than ideal substitute households in terms of overall household representativeness.

It is worth noting that the jump from the $1.25/1.30-a-day line to the $1.5-a-day, raises some methodological questions.[37] First, this 15% increase is based on the analysis of only one HHS for India in 1993/94, and its differences with the corresponding NAS consumption aggregates. Then this correction factor is imposed for every one of the 149 countries in his dataset, and for every year in a 51-years period. On the one hand, it is very unlikely that all countries for 1993/4 would require the same correction factor. And on the other, the application of this correction constantly in time goes against findings in the literature which identify an increasing trend in the divergence between NAS and HHS (Deaton, 2001, p.132). Arguably, what could be correct for India in 1993/94, may well overestimate or underestimate poverty in 1980 India, or China for 1990 or 2000 no matter which single adjustment one favors. If more surveys were used these corrections may have been less questionable.[38]

Second, to decide the necessary increase to account for under-reporting and "missing rich", Bhalla takes two steps. As a first step, he assumes that the "missing rich" are a constant 2% of the population.[39] As a second step, he assumes further that this constant %2 is consuming a constant 10% of NAS consumption. This claim is based on his calculation that the "average median consumption share of the top percentile in developing countries for the past 20 years is 7.5 percent; the average median share for the 99th percentile is 3.6 percent" and "[t]hus, a very safe assumption is that 10 percent of NAS consumption does not accrue to the surveyed population at all" Bhalla (2002, p.120). No details are provided for those median figures, and the data from which they are obtained.[40] Of course if one assumes that it is 2% of the population that is missing, one has to estimate how much this upper 2% is consuming which is also missing from the HHS consumption data. Nevertheless, Bhalla adjust his PL by dividing $1.3 with 0.9 to account for the missing 10% of NAS consumption from the "missing rich", getting a PL of $1.44-a-day. The rationale behind inflating his iPL is that this way the bias from using income from

[36]This is one of several methodological issues in Bhalla's approach, as pointed out in Ravallion (2003a), whose reservations I find very convincing, but discussing them thoroughly is beyond the scope of this paper. Regarding this particular step Ravallion writes:"Bhalla's preferred approach of simply adjusting the old line upwards for inflation in the US ignores the fact that there has been (in effect) a PPP devaluation in poor countries relative to the US over the period. For example, China's and Indonesia's poverty lines at 1985 PPP are almost identical to their poverty line at 1993 PPP; India's poverty line at 1993 PPP is only 17 percent higher than its poverty line at 1985 PPP. Yet adjusting the 1985 $1/day line for US inflation would entail an upward increase of roughly 50 percent. In other words, if one simply adjusts the $1/day line for inflation in the United States between 1985 and 1993, then one obtains a poverty line that is well above those found in poorest countries. That would entail a re-calibration of the ruler." And regarding the Bhalla's approach to substitute HHS income or consumption information with NAS data he adds that "for decades, as have those for India (with the exception of a period in which a switch was made to the method Bhalla favors–the government of India was severely criticized within India at the time for cooking the books to show an artificial drop in poverty). And just about every other country in the world measures poverty this way [using the HHS micro-data]."

[37]I will only mention three issues here and for more details the reader may turn to the sources cited in the previous footnote. Of course the selection of the Indian PL per se is also questionable, as there is no clear reason why it would be a poverty line that would correspond to the same welfare level in other countries.

[38]Interestingly when Sundaram and Tendulkar (2003) investigate the differences NAS/HHS for the same HHS, they reach different conclusions for the adjustment necessary for the poor end of the distribution, and conclude in favor of using HHS instead of NAS for this particular year to count poverty.

[39]Interestingly, this is something that he calls a "fact", without any sufficient evidence Bhalla (2002, p.120), as his argument is that "[i]t is likely that such households constitute less than 2 percent of the population" Bhalla (2002, p.119).

[40]e.g. if they come from raw data, and how many data-points are available, or they obtain from the imputed Lorenz curve method that he is using as explained below.

NAS instead of HHS based information will be accounted for.

The third issue, is the correction for the under-reporting differential among the bottom and the upper halves of the distribution. Bhalla gets his $1.5-a-day PL by dividing with one minus how much more the top half of the population understates its expenditures compared to the bottom half. The "if"-statement that gives the exact figure has as follows: "[i]f the top half of the population understates its expenditures by 3.5 percent more than the bottom half". The first and less important problem is that this 3.5% is not the right figure, if one follows his argumentation and his data, the actual figure is close to 6%.[41]

To estimate the figures of under-reporting of each income decile group Bhalla uses an approach that "preserve[s] the original pattern of distribution". Clearly this method is neglecting a vital element: that under-reporting is higher per se for higher income groups, and for this reason the proportions in the original distribution cannot be the ones applied for the distribution of the unallocated difference among NAS and HHS.[42]

For estimating the number of poor under his $1.5-a-day PL (in 1993 prices), Bhalla introduces a method he calls Simple Accounting Procedure (SAP). This procedure takes the raw distributional data in the form of quantiles and deciles and approximates a continuous Lorenz function. However, Bhalla picks a specific functional form for the Lorenz function, without a substantial testing procedure. It is tested for India, in the sense that it gives "low mean estimate error" for the Gini index of the Lorenz curve. Bhalla's test for the percentile error of the SAP method is hard to be conclusive without testing other functional forms, and without an appreciation of the final error on the poverty estimate those errors imply. As noted by Ravallion (2003a), "a Lorenz curve model might come very close for the Gini index, say, but be way off for the poverty rate", depending of course on where those errors of the estimated distribution are located.

Edward and Sumner (2013) point at two additional issues over the SAP approach. First that using a continuous function to model the Lorenz curve may loose information contained in the original data, in the sense that the resulting shares of deciles and quantiles may not be the same as in the original distribution. And second that attributing to each percentage of the population in a country the same mean income may lead to an underestimation of inequality, because the inequality within each percent of the population is by implication zero. In a population of 6 billion, a one percent deviation is 60 million more or less poor individuals.

Since one of the main purposes in Bhalla's book is to provide poverty estimates for most countries (covering 149 of them) for a period of 51 years, imputation is required for the many income distributions that are missing. Indeed, as Ravallion (2003a) puts it, commenting on Bhalla's coverage figures for the 1950-1980 period: "by Bhalla's reckoning a country is deemed to have 100 percent coverage if it has just one survey over this 30-year period". For countries with one survey the distribution remains constant in the entire period, and for countries with two or more distributions linear interpolation and extrapolation is used. In cases where only income distributions are available they are converted to a "consumption" distribution by a simple regression. No details are disclosed regarding this regression.

[41] According to figure 7.2 in Bhalla (2002), the average correction required for the bottom half is 34.8%, and for the upper half 46.4%. This implies a 32% understatement for top (derived from: $1 - 1/1.464 = 0.32$) and a 26% for bottom half (from $1 - 1/1.348 = 0.26$). This in turn is a 6 percentage points of difference in absolute terms, and more in relative terms, but in any case not 3.5%.

[42] A clear indication of this can be found for example in his figure 7.1, showing that the mismatch between national accounts and food grains is only 10%, compared to 25% to 60% for other categories, and keeping in mind that the poor are more dependent on staple food than any other income group. In addition, the differences in the other categories imply that the between income groups differential is considerable and far from negligible. An additional argument in favor of an increasing under-reporting gradient is offered by Pinkovskiy and Sala-i Martin (2016) operating via the opportunity cost of the interviewee since the evident under-reporting in food items may be the result of the very time consuming procedure to document all the items in the questionnaire. For other less time consuming parts of questionnaires (e.g. health, education, etc) this under-reporting is not observed. Further, as Anand and Segal (2014) points out: "[f]ollowing Banerjee and Piketty's (2010) finding that in India a significant part of the discrepancy between estimates of consumption expenditure in the national accounts and in household surveys can be accounted for by missing or under-reported top incomes".

For some countries without any distributional data the average regional quantiles were used for imputing these data. Finally, Ravallion (ibid) is very critical on Bhalla's methodological choice of pooling together "distributions that differ in unknown ways in terms of their ranking variable (household or per capita) and in whether their observation unit is the person or the household".

For estimating the level of consumption the NAS data from WDI were used, and when such data were not available PWT 5.6 was used instead to extract the consumption share from the GDP component in the WDI data. A missing observation was replaced with the most recent available, and when no consumption data were available then an average of the regional consumption share was used for imputing the data.

Bhalla's preferred specification for measuring poverty, namely $1.5-a-day in co-junction with NAS consumption data, demonstrate the fastest poverty reduction among all the PLs he is using.[43] The decrease in poverty rates that his results show is remarkable. From about 63% in 1950's to down to about a 25% by 1990, and then another reduction by half by 2000 down to about 13%. Although the previous contributions discussed above focus on the developing world, and Bhalla provides world-wide estimates, a comparison with the results of (Chen and Ravallion, 2001) is still informative. Poverty reduction in Bhalla's results takes place much faster for the $1.08-a-day PL which is the only PL used by both studies. Since the coverage in Bhalla's work includes the OECD countries with negligible poverty rates at such international PL's, this implies that the corrections used by Bhalla, along with the use of NAS consumption, are decisive for his final results, although these corrections are not well supported by the empirical evidence he discusses.

The second independent study comes from Sala-i Martin (2006) who estimates the world distribution of income in the period 1970 to 2000, and subsequently calculates annual poverty rates using a variety of dollarized iPLs. The fundamental difference with the literature previously discussed is his strict preference to income distributions instead of consumption.[44] The article contains no discussion whether this approach is more appropriate, in comparison with other approaches, for deriving the global poverty rates. Further, he practically circumvents the conclusions by Deaton (2005) that survey consumption should be used in poverty measurement instead of NAS consumption, on the grounds that Deaton's point is specific for NAS consumption, and not to income that he uses. This response ignores the fact that typically NAS income is higher than NAS consumption and therefore Sala-i-Martin by choosing GDP per capita from NAS he only underestimates poverty even further; ergo Deaton's point is more relevant than in the consumption case.

The distributional data he applies are derived from Deininger and Squire (1996) and UNU-WIDER data as they were available at the time. The criterion of choice for the distribution data is to be income based, without further specification.[45] Also, as in Bhalla (2002), both individual and household based surveys are used indistinguishably, making Ravallion's criticism on Bhalla applicable here as well. Given that the total number of country-year distributional data are falling by far short to be available for every country-year, Sala-i-Martin when more than one surveys are available for a country he predicts the quantiles of the unavailable distributions for that country.

For countries with only one year of available distributional data, the country is included, but its distribution is assumed fixed throughout. As the author mentions, those countries tend to be poor countries. For countries that have no distributional data available, the average quantile income shares of the "neighboring region" as he defines it, are used. On the complete dataset of imputed and survey based quantile income shares, they estimate the smooth income distribution by applying a Kernel Density Estimator.[46] In the end of this experiment a dataset that covers 138 countries on a yearly basis in the period

[43] Bhalla offers poverty estimates at several PL's: $1.25 and $1.5 in 1993 PPP terms using NAS consumption, and $1.08 and $1.3 PLs with HHS consumption data.

[44] Income data are not taken from the survey data, but from the Penn World Tables 6.1 (Heston et al., 2002) in PPP-adjusted GDP per capita (and thus this paper is using the 1996 PPP benchmark year).

[45] For example gross income, net income, monetary income, etc.

[46] This estimation method does not assume a specific functional form, and one needs only to specify the bandwidth for the estimate that functions as a smoothing factor.

1970-2000 is constructed.[47] A methodological issue here is that, as Anand and Segal (2008) point out, the necessary conditions for applying a KDE are not fulfilled for the data used by Sala-i-Martin.

With the world distribution of income at hand, Sala-i-Martin uses several dollarized poverty lines to estimate global poverty rates. Since the paper is building around the 1996 PPP benchmark year, the relation with the poverty lines used in the consumption based literature covered above is not straightforward. No attempt is done to re-estimate the poverty line using the method in Ravallion et al. (1991a). Despite not following the defined methodology for international poverty lines, he makes the conversion of the $1.02/day or $372.3/year in 1985 prices from the original Ravallion et al. (ibid) to $495/year or about $1.36/day in 1996 prices. This conversion of course assumes that the changes induced by the change of the benchmark year on a per country basis follow the average U.S. price inflation. One needs to actually test this assumption to gain confidence over this conversion.[48] This is the line he refers to as the "WB Poverty Line or $1/day".

Sala-i Martin also follows Bhalla (2002), and adds 15% on top of this poverty line $1.36/day in 1996 prices to correct for the use of national account per person data. This results to $570/year or about $1.5/day in 1996 PPP exchange rates. However, Bhalla is using consumption data for substantiating his adjustment, as we saw previously, while Salla-i-Martin is using income data, that despite the aforementioned methodological issues would in addition require more extensive adjustment if one follows Bhalla's rationale. This use of income data becomes the a main source of divergence among their findings (the exact values shown in section of the Appendix).

Trends in Sala-i Martin using those two lines are almost identical, since within the dollar a day methodology the most important factor for defining the trends is the evolution of the CPIs used (Klasen, 2009). The rate of poverty in the world is 20.2% in 1970 driven down to 7% by 2000 following the $1.5/day line. While, according to the "WB Poverty Line or $1/day" the rates are 15.4% and 5.7% respectively. In regional level, the differences with other estimates in the literature are considerably large.[49] Different poverty lines and PPPs, along with income based distributions and survey means anchored at NAS GDP per capita, result to a very positive picture of poverty, even compared to Bhalla's work. The only exception is SSA for which the improvements are not as impressive as in the other regions.

Pinkovskiy and Sala-i Martin (2009) follow up on this work and expand coverage to 191 countries, this time using the well known log normality assumption to estimate the global income distribution between 1970 and 2006,[50] and from that the global poverty rate. Again the Deininger and Squire (1996) inequality database is used, along with an expanded version of the UNU-WIDER dataset. Similar to Chen and Ravallion (2010), they split India and China in rural and urban sections, and estimate each independently. The GDP data the PWT version 6.2 are taken as income for the baseline estimates (based on 2000 PPP benchmark year; Heston et al. (2006)), along with the ICP 2005 PPP round of the World Bank which the authors use for comparison.[51]

There are 1069 income distributions used in total, 85 of which lie outside the period they covered, but they were used to allow for interpolation, instead of extrapolation. This leaves the investigation with 984 distributions for an exercise that requires 7067 distributions for 37 years and 191 countries,

[47] For more details on the imputation methods one can consult Sala-i Martin (2002a) and Sala-i Martin (2002b), along with a critical review from Milanovic (2002), and cautionary note for the use of secondary sources by Atkinson and Brandolini (2001).

[48] For a critical review of this approach see also Atkinson (2016).

[49] See the appendix for the exact values, tables 2-9.

[50] This approach assumes that income distribution follows a log-normal distribution. See Lopez and Servén (2006) for an empirical investigation of this assumption, which supports its use for income based distributions, but not for consumption based.

[51] It should be noted that extending the PPP conversion for China back to 1970, using the old World Bank growth rates, implies that GDP per capita in China was $308 in 2005 prices, a figure thought to be much lower than the income adequate for bare bones survival. For the use of this concept see Milanovic et al. (2007). However, as Moatsos (2017) shows, the value of the necessary goods to achieve bare bones survival could be substantially lower than a dollar-a-day poverty line.

offering less than 14% coverage.[52] For this approach Milanovic (2002) has argued that the extensive use of interpolations has worn out any variability in the sample. An argument that applies in all similar attempts that take this necessary step in estimating global poverty on a yearly frequency.

The authors use two basic poverty lines. One applies a literal dollar-a-day for 2006 and converting it to $0.85 in 2000 prices.[53] And the second is a $554 poverty line, that they obtain from the conversion of the original dollar-a-day in 1985 prices to U.S. prices in 2000.[54]

All the resulting global poverty rate trajectories show decreasing poverty rates throughout the examined period. The lower the PL the stronger the decrease observed.[55] The main point is that, as discussed above, the GDP-based global poverty estimates that the authors offer are typically lower in terms of levels, compared to HHS-based estimates, and faster in their speed of poverty reduction. Also, having results for a family of dollarized poverty lines leaves one question unanswered: What is the meaning of each additional line, and to what extend those higher PLs are capturing global poverty with common standards for every country? Or to put it differently to what extend the averaging nature of a dollarized international PL, meaning the vague link to a particular living standard in any country, becomes better or worse by increasing its level.[56]

The latest addition in the strand of mixed HHS/NAS global poverty research is provided by the same co-authors in Pinkovskiy and Sala-i Martin (2016). This paper is unique in its attempt to reconcile the differences among HHS (income or consumption) and NAS means (GDP per capita). This is done by using what they call a "trusted third party" of data as a reference point. Namely the nightlight images from the National Oceanic and Atmospheric Administration (NOAA).[57]

For their calculations they use as income the GDP per capita in 2005 PPPs from the World Bank National Account Statistics. Using their model with nightlight data they make an average among GDP data and HHS mean (heavily tilted towards GDP). For covering the 1992-2010 period, they use 701 income or consumption surveys from the PovcalNet database at the World Bank. This translates in using distributions with lower gradients (or lower inequality, such as those obtained typically from consumption data (Lopez and Servén, 2006)) combined with higher income per capita from the NAS. It is therefore expected to obtain the very low poverty rates they report (see section of the appendix for the tables that compare the results).

A few additional points on the various methodological matters involved are worth noting here. First, the poverty line chosen is the World Bank's $1.25-a-day line in 2005 PPPs. As we have seen the dollar-a-day approach is a consumption based poverty line Ravallion et al. (1991a, 2009). No attempt to update this line in a way fit for the use of GDP data is done, leading to tentative underestimation compared to other global poverty rates in the literature. Basic methodological consistency implies that if someone

[52]To estimate distributions via extrapolation a variety of methods are used, and the details disclosed by the authors do not allow for a better understanding of which observations come from which method.

[53]Since $365/day in 2006 is $312 in 2000 U.S. prices, again raising the same methodological concern previously touched upon regarding the use of USA inflation rates to shift the value of the iPL in time.

[54]Pinkovskiy and Sala-i Martin (2009) convert a-1985-literally-dollar-a-day, so $365 in 1985 prices, instead of $1.02/day in 1985 prices that was used in Ravallion et al. (1991a), to $554 in 2000 U.S. prices. However, according to `http://data.bls.gov/cgi-bin/cpicalc.pl`, $365 in 1985 U.S. prices are $584.14 in 2000 U.S. prices (conversely $1.02∗365=$372.3 in 1985 U.S. prices are $595.82 in 2000 U.S. prices). The same $584.14 in 2000 U.S. prices result obtains from the World Bank's WDI at `http://data.worldbank.org/indicator/FP.CPI.TOTL`. In addition they deliver their results for a family of poverty lines in 2000 U.S. prices, namely $1108, $1662, $2770, $4155 and $5540 a year, corresponding to $2, $3, $5, $7.50 and $10 a day in 1985 U.S prices; the same year as the one used by the WB initial dollar-a-day poverty line.

[55]I will refrain here from detailed comparison of the results with others in the literature. For the tables that make this comparison see section in the Appendix.

[56]Moatsos (2017) provides the empirics in support of the underlying claim.

[57]In particular they use the data from the DMSP-OLS satellite program. Details of the econometric approach to attempt to empirically identify the ideal compromise, or the "true income" in the authors' jargon, between the HHS and NAS sources will not be discussed here. Instead, I will focus on the overall methodological framework, the data used and the definitions of their concepts.

would want to switch from the consumption domain of measuring poverty to the income domain, and still use a dollarized international poverty line, any re-use or re-estimation according to the approach of Ravallion et al. (1991a, 2009) is questionable unless the calculation of the iPL is repeated from scratch for income data based on the broad dollar-a-day framework as described in RDV and RCS.[58]

Second, the lognormal assumption is used in the calculations although now the underlying data from the PovcalNet website were made available at the time by Dykstra et al. (2014b,a), and that assumption is found to be erratic when applied to consumption distributions (Lopez and Servén, 2006). Third, and perhaps most important, the distributional implications of the shift in everyone's income introduced by the use of the "true income", receive no attention by the authors. As we saw also in the case of Bhalla, there is no reason to assume that when correcting the difference between NAS and HHS means one should only change the average without changing "appropriately" the distribution as well. To implicate things even more than Bhalla does, the authors also use consumption based distributions together with largely NAS income data, further underestimating poverty, as consumption distribution are generally more egalitarian than income distributions (Lopez and Servén, ibid).

Finally, from this discussion stems an overarching lesson. Combining an iPL that is built to measure consumption-based international poverty, with welfare data from NAS is in all methodological likelihood not a proper way of estimating poverty.[59] Further underestimation obtains by using smoother distributions, such as those of consumption, in combination with NAS income data that contain irrelevant components, while at the same time one ignores the under-reporting differentials of the various income groups. Such use of GDP data implies that everyone gets equi-proportionally more, which is a point that needs to be demonstrated rather than assumed.

Historical Research

There are two important articles that both follow an HHS/NAS mixing strategy and are unique in the sense that they have a long run historical approach starting in 1820. The works of Bourguignon and Morrisson (2002) and Zanden van et al. (2011) span across two centuries. For the first 150 years of that period almost no consumption based data are available. In this regard there are not many options other than to combine the best available sources.

In 2002, Bourguignon and Morrisson, compiled together income distribution information over the long run to estimate the "Inequality Among World Citizens: 1820-1992". This kind of data of course are relatively scarce even for present day needs, and for the period before the second world war only a few direct estimates exist. The dataset was augmented backwards in the 19th century mostly by extrapolation from 20th century data (Zanden van et al., 2013). Beyond the uncertainty introduced by the imputation, there are also several important details and definitions that change in the underlying methodology of the available HSS during this long period. These distributions are combined with data on GDP per capita, in 1990 PPPs, and population from the work of Maddison (1995).

The poverty lines they use are such that their results are equal to the estimates (at the time) made available by World Bank researchers for the $1 and $2-a-day poverty lines in 1985 PPP; the former line provides for estimates on "extreme poverty" and the later for "poverty". This anchoring is done in order to roughly account for the differences between the methodology that estimates the poverty line, and the fact that they are using income distributions throughout. A main issue with this approach is

[58] In addition, the national poverty lines used in those articles to estimate the iPL are mostly estimated using caloric requirement plus some minimal additional consumption for necessities (see Ravallion et al. (2009) for details). Additional income e.g. from imputed income rents has to be incorporated properly both in the poverty line estimation and in the increase in income of each individual or household. In that respect Deaton (2005) has argued that imputed rents explain much of the discrepancies between the consumption means of HHS and NAS. If, as in the case of Pinkovskiy and Sala-i Martin (ibid), only the imputation takes place on the income side and iPL stays the same then a considerable underestimation of poverty is expected.

[59] Despite the fact that two of the above articles are published in a top ranking journal (Sala-i Martin, 2006; Pinkovskiy and Sala-i Martin, 2016).

that estimating poverty for such a long run reach using a fixed set of PPPs is highly unlikely not to add deviations from the price levels that are relevant for those living in conditions of poverty. Possible differences in trends between consumption and income surveys are not considered by the authors.

It is important to mention that this article by Bourguignon and Morrisson (2002), is the only one of the two articles discussed here that estimate global poverty in which the authors make an effort to provide their estimates with an appreciation of the involved uncertainties.[60] However, they consider uncertainty only in the underlying GDP per capita measures as a source of error in their estimates, and ignore any other, e.g. lack of country coverage, imputation of values, errors of the income distributions which are rough estimates for most of the early period, errors in the population data, the PPP exchange rates, etc.[61]

Zanden van et al. (2011)[62] work similarly as Bourguignon and Morrisson (2002) and use GDP per capita from the Maddison (2010) dataset[63], together with a gross income dataset they compile for their long run analysis. Historical sources, combined with WIID data[64], and a variety of imputation methods to estimate missing distributional observations which are used for the more distant years, are all combined to construct the most complete gross income inequality dataset at its time. As expected, the poverty estimates are the lowest for most of the years throughout the comparison tables among the articles discussed in this section, and are shown in section of the appendix. One should anticipate such a result since no calibration, or any other method, was applied to mitigate the methodological discrepancies between the WB dollarized PLs and the gross income distribution / GDP per capita approach that they apply.

Conclusions

This paper discusses the nuts and bolts of the state-of-the-art in measuring global absolute poverty. The vast majority of the articles on the topic are presented in some detail. In sum, the literature on global absolute poverty has largely stagnated around the dollar-a-day concept, and has not evolved in its core methodological underpinnings. From the relatively small global poverty literature, in comparison to the vast literature on poverty per se, there are a number of points useful to rehearse here.

First, the important work done by the pioneers in the field has allowed us to have a first estimation of the levels and trends in global poverty (Ahluwalia et al., 1979; Ravallion et al., 1991a; Bourguignon and Morrisson, 2002). The growing availability of distributional information on consumption (or income) both contemporary, as well as historically, expands our ability to estimate poverty with an increased coverage of global population.

Second, the literature on global poverty measurement remains entirely focused on the rather handy measure of the dollar-a-day with limited theoretical foundations. It is not clear how large the effect of the aforementioned limitations of this method is on global poverty estimates, unless we have another approach to compare it with. Such an alternative method is the cost of basic needs approach that has not been used in the global poverty literature up to this point. Key scholars of the field strongly recommend its use for global poverty measurement (Reddy and Pogge, 2010; Atkinson, 2016; Allen, 2017).

Third, the findings in the literature indicate a reduction of poverty in the recent years, particularly due to the economic growth of China. Depending on how exactly each researcher measures global

[60] The other one being Ravallion et al. (1991b), albeit considering only one error source.

[61] See Atkinson (2016) for a discussion of the various sources of uncertainty in global poverty estimates.

[62] In part due to the recognition of the shortcomings of the method mixed HHS/NAS as discussed here, the published version of the paper in Zanden van et al. (2013) does not contain the estimate for poverty, this is why I discuss here the working paper version of their article.

[63] The Maddison dataset is used to derive to two separate series of results: one with the "traditional" 1990 PPP, and for comparison, one also in the –latest available back then– 2005 ICP round.

[64] See `https://wid.world/`.

poverty the exact levels and trends differ; at times substantially. The main elements at play that define the level, but also the trend, are the value of the poverty line and the choice between using the HHS mean values or substituting them with an NAS statistic. HHS show slower progress and higher levels of poverty, while the use of NAS statistics show faster reduction and lower levels of poverty at the present. At the same time the higher the international poverty line used in PPP terms –mechanically– translates to an increase in poverty levels, but also lower progress made (slower reduction).

Fourth, the unrecommended habit of not reporting (or perhaps not even estimating) the uncertainty of global poverty estimates, should be avoided, and methods for accounting the impact of all sources of uncertainty in those estimates should be developed (Atkinson, 2016).

Fifth, there are two variations of the global absolute poverty literature that have not been addressed in this review. A few publications that follow the cost of basic needs method instead of the dollar-a-day approach, provide a promising alternative (Moatsos, 2017; Allen, 2017; Moatsos, 2020). Moreover, there are a handful of exceptions in terms of using a non-strictly absolute global poverty definition (Atkinson and Bourguignon, 2001; Ravallion and Chen, 2011, 2017). Instead, those articles follow a blended absolute and relative approach to global poverty measurement.

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Appendix: Comparative Global, Regional and Populous Country Poverty Tables

Table 2: Comparison of Poverty Rate of Aggregate Estimates

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$0.55/day@1970PPP, Consumption/Survey Based																	
Ahluwalia et al. (1979), D	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-	
$1.02/day@1985PPP, Consumption/Survey Based																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	33[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	27.9∼39.2[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994), D	-	-	-	-	-	-	-	-	33.88[1985]	-	33.52	-	-	-	-	-	-
Ravallion and Chen (1997), D	-	-	-	-	-	-	-	-	-	30.7	-	29.4	-	-	-	-	-
(ibid)[1]	-	-	-	-	-	-	-	-	-	33.9	32.9	31.9	-	-	-	-	-
$1.08/day@1993PPP, Consumption/Survey Based																	
Chen and Ravallion (2001)[2], D	-	-	-	-	-	-	-	-	-	28.31	28.95	28.15	24.53	25.56[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	40.4	32.8	28.4	27.9	26.3	22.8	21.8	21.1[2001]	-	-
$1.25/day@2005PPP, Consumption/Survey Based																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	51.8	46.6	41.8	41.6	39.1	34.4	33.7	30.6	25.2	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	36.5	-	-	29.1	-	-	14.5[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	26.8	23.3	15.7	11.2	8.9	8.2	8.0	7.2	6.5	6.2	5.6	-
(ibid)	-	-	-	-	-	45.2	43.1	37.8	33.2	27.5	24.9	23.6	19.9	16.8	15.5	13.7	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	37.1	-	-	29.1	-	-	12.7[2012]
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	42.12	39.23	35.33	35.88	33.99	29.44	28.62	25.49	20.71	9.98
PovcalNet (Jan 17, 2020), D	-	-	-	-	-	-	-	51.70	47.80	42.76	43.17	40.69	35.09	33.98	30.16	24.42	11.59

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
1990 PPPs, but PLs are those that give roughly equal poverty rates at $1&$2/day@1985PPP for 1992; Income/NAS Based														
Bourguignon and Morrisson (2002)	83.9	75.4	65.6	54.8	44	35.6	-	31.5	-	23.7[1992]	-	-	-	-
(ibid)	94.4	89.6	82.4	71.9	64.3	60.1	-	55	-	51.3[1992]	-	-	-	-
$1.08&$1.30/day@1993PPP, Consumption/Survey Based														
Bhalla (2002), D	-	-	-	58.2	46.4	40.2	-	38.0	-	20.0	-	11.4	-	-
(ibid), D	-	-	-	65.8	55.4	49.3	-	46.5	-	29.0	-	18.2	-	-
$1.25&$1.50/day@1993PPP, Consumption/NAS Based														
(ibid), D	-	-	-	55.8	43.9	37.9	-	35.0	-	17.7	-	9.1	-	-
(ibid), D	-	-	-	63.2	52.5	46.4	-	43.5	-	25.4	-	13.1	-	-
$1.50/day@1996PPP, Income/NAS Based														
Sala-i Martin (2006)	-	-	-	-	-	20.2	18.5	15.9	12.1	10.0	8.0	7	-	-
(ibid), D	-	-	-	-	-	25.3	22.7	19.7	14.8	11.9	9.5	8.3	-	-
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	26.8	23.3	17.5	10.	8.2	7.7	6.4	5.6	-
(ibid)	-	-	-	-	-	45.2	43.1	38.7	31.3	24.9	21.4	16.2	13.7	-
$1&$2/day@1990PPP, Income/NAS Based														
Zanden van et al. (2011)	40	34	23	27	16	11	10	6	6	5	6	5	-	-
(ibid)	73	66	51	46	40	34	33	24	18	17	18	14	-	-
$1&$2/day@2005PPP, Income/NAS Based														
(ibid)	34	28	20	26	14	9	8	4	5	4	5	4	-	-
(ibid)	66	57	45	43	36	31	31	22	17	15	15	13	-	-

D stands for developing world only, otherwise the intended coverage is global; 1. Excluding Easter Europe and Central Asia; 2. Excluding China.

Table 3: Comparison of Poverty Rate Estimates for: Sub-Saharan Africa, SSA

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP, Consumption/Survey Based																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	46.9[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	18.6∼75.7[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994), D	-	-	-	-	-	-	-	-	51.40[1985]	-	52.89	-	-	-	-	-	
Ravallion and Chen (1997), D	-	-	-	-	-	-	-	-	-	38.5	39.3	39.1	-	-	-	-	-
$1.08/day@1993PPP, Consumption/Survey Based																	
Chen and Ravallion (2001), D	-	-	-	-	-	-	-	-	-	46.61	47.67	49.68	48.53	48.05[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	41.6	46.3	46.8	44.6	44.1	45.6	45.7	46.4[2001]	-	-
$1.25/day@2005PPP, Consumption/Survey Based																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	53.7	56.2	54.8	57.9	57.1	58.7	58.2	55.1	50.9	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	56.8	-	-	59.4	-	-	46.9[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	39.9	38.2	39.9	43.2	44.1	42.1	42.2	41.5	39.6	37.4	33.1	-
(ibid)	-	-	-	-	-	65.2	63.7	64.7	67.1	67.0	65.6	67.1	66.6	65.4	64.5	60.9	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	56.8	-	-	58	-	-	44.4[2012]
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	-	-	-	54.7	59.7	58.9	58.3	55.3	50.8	41.4

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002), D	-	-	-	59.3	53.2	52.2	-	49.9	-	55.3	-	54.8	-	-
(ibid), D	-	-	-	70.2	65.4	63.4	-	62.3	-	67.1	-	66.8	-	-
$1.50/day@1996PPP, Income/NAS Based														
Sala-i Martin (2006)	-	-	-	-	-	35.1	36.0	37.2	42.6	43.7	50.5	48.8	-	-
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	39.9	38.2	39.9	43.1	42.1	42.8	38.3	33.1	-
(ibid)	-	-	-	-	-	65.2	63.7	64.8	66.9	65.6	67.9	65.2	60.9	-
$1&$2/day@2005PPP, Income/NAS Based														
Zanden van et al. (2011)	67.8	48.5	37.9	35.9	30.7	19.4	-	13.3	-	13.8	-	14.6	-	-
(ibid)	95.4	75.8	63.1	60.0	54.6	42.6	-	32.6	-	36.0	-	35.5	-	-

D stands for developing world only, otherwise the intended coverage is global.

Table 4: Comparison of Poverty Rate Estimates for: South Asia, SA

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	50.9[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	49.8∼52.6[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994), D	-	-	-	-	-	-	-	-	60.84[1985]	-	58.60	-	-	-	-	-	-
Ravallion and Chen (1997), D	-	-	-	-	-	-	45.4	43.0	43.1	-	-	-	-	-	-		
$1.08/day@1993PPP																	
Chen and Ravallion (2001), D	-	-	-	-	-	-	-	-	-	44.94	44.01	43.39	42.26	40.00[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	51.5	46.8	45.0	41.3	40.1	36.6	32.2	31.1[2001]	-	-
$1.25/day@2005PPP																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	41.9	38.0	36.6	34.0	29.3	29.1	26.9	26.5	23.7	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	54.1	-	-	45	-	-	24.5[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	20.1	19.0	11.1	8.5	5.7	4.3	4.6	4.9	3.3	3.3	2.9	-
(ibid)	-	-	-	-	-	58.7	57.3	46.6	41.5	34.2	28.8	28.3	25.2	17.0	14.4	11.2	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	50.6	-	-	-	-	-	18.8[2012]
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	55.7	53	50	47.3	44.9	40.3	-	38.6	33.7	16.2[2013]

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002), D	-	-	-	44.3	37.2	32.1	-	34.4	-	18.5	-	7.8	-	-
(ibid), D	-	-	-	64.3	58.1	55.2	-	56.3	-	39.3	-	21.1	-	-
$1.50/day@1996PPP														
Sala-i Martin (2006)	-	-	-	-	-	30.3	29.7	26.7	17.8	10.3	5.7	2.5	-	-
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	20.1	19.0	12.2	7.1	4.3	5.1	3.7	2.9	-
(ibid)	-	-	-	-	-	58.7	57.3	48.5	38.6	28.8	26.7	16.5	11.2	-

D stands for developing world only, otherwise the intended coverage is global; 1. South and South-East Asia.

Table 5: Comparison of Poverty Rate Estimates for: East Asia, EA

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	21.2[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	21.1∼21.5[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994)[1], D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ravallion and Chen (1997)[1], D	-	-	-	-	-	-	-	-	-	29.7	28.5	26.0	-	-	-	-	-
$1.08/day@1993PPP																	
Chen and Ravallion (2001)[1], D	-	-	-	-	-	-	-	-	-	26.6	27.58	25.24	14.93	14.71[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	57.1	38.9	28	29.6	24.9	16.6	15.7	14.9[2001]	-	-
$1.25/day@2005PPP																	
Chen and Ravallion (2010)[1], D	-	-	-	-	-	-	-	66.8	49.9	38.9	39.1	35.4	23.4	23.5	17.8	9.3	-
Ferreira et al. (2016)[1], D	-	-	-	-	-	-	-	-	-	-	57	-	-	35.9	-	-	7.9[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	58.8	48.9	29.7	15.5	9.5	8.0	6.6	3.7	2.9	2.4	1.8	-
(ibid)	-	-	-	-	-	80.2	75.0	65.0	51.7	38.2	32.4	27.0	16.3	11.9	9.7	7.6	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016)[1], D	-	-	-	-	-	-	-	-	-	-	60.6	-	-	37.5	-	-	7.2[2012]
PovcalNet (Jan 6, 2020)[1]	-	-	-	-	-	-	-	80.5	70.1	59.2	61.3	53.7	40.9	38.5	29.7	18.9	2.3

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002), D	-	-	-	86.6	77.5	71.1	-	67.2	-	31.3	-	6.0	-	-
(ibid), D	-	-	-	91.1	86.0	82.0	-	78.3	-	49.2	-	16.1	-	-
$1.50/day@1996PPP														
Sala-i Martin (2006)	-	-	-	-	-	32.7	27.8	21.7	13.0	10.2	3.8	2.4	-	
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	58.8	48.9	34.9	12.5	8.0	4.6	2.6	1.8	-
(ibid)	-	-	-	-	-	80.2	75.0	67.1	47.6	32.4	19.8	10.7	7.6	-

D stands for developing world only, otherwise the intended coverage is global; 1. East Asia and Pacific.

Table 6: Comparison of Poverty Rate Estimates for: Eastern Europe and Central Asia, EECA

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	7.8[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	7.3∼9.7[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994), D	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ravallion and Chen (1997), D	-	-	-	-	-	-	-	-	-	0.6	-	3.5	-	-	-	-	-
$1.08/day@1993PPP																	
Chen and Ravallion (2001), D	-	-	-	-	-	-	-	-	-	0.24	1.56	3.95	5.12	3.75[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	0.7	0.5	0.4	0.5	3.7	4.3	6.3	3.6[2001]	-	-
$1.25/day@2005PPP																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	0.7	0.6	0.5	0.9	2.1	2.5	3.1	2.7	2.2	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	1.5	-	-	3.8	-	-	0.5[2011]
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	1.9	-	-	7.8	-	-	2.1[2012]
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	-	-	-	-	5.2	7.3	7.9	6	4.9	1.5

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002)[1], D	-	-	-	17.8	9.2	3.3	-	1.7	-	0	-	0	-	-
(ibid), D	-	-	-	28.4	16.4	6.7	-	2.8	-	3.2	-	3.1	-	-
$1.50/day@1996PPP														
Sala-i Martin (2006)	-	-	-	-	-	1.3	0.5	0.4	0.1	0.4	1.0	1.0	-	-
$1&$2/day@2005PPP, Income/NAS Based														
Zanden van et al. (2011)	21.1	9.1	3.3	0	0	0	-	0	-	0	-	0	-	-
(ibid)	42.9	28.4	12.5	0.7	0.2	0	-	0	-	0	-	0.1	-	-

D stands for developing world only, otherwise the intended coverage is global; 1. Eastern Europe only

Table 7: Comparison of Poverty Rate Estimates for: Middle East and North Africa, MENA

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	31[1985]	-	-	-	-	-	-	-	
95% CI	-	-	-	-	-	-	-	-	13.3∼50.9[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994), D	-	-	-	-	-	-	-	-	4.49[1985]	-	2.52	-	-	-	-	-	-
Ravallion and Chen (1997), D	-	-	-	-	-	-	-	-	-	4.7	4.3	4.1	-	-	-	-	-
$1.08/day@1993PPP																	
Chen and Ravallion (2001), D	-	-	-	-	-	-	-	-	-	4.30	2.39	1.93	1.83	2.11[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	5.1	3.8	3.2	2.3	1.6	2.0	2.6	2.4[2001]	-	-
$1.25/day@2005PPP																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	3.3	2.4	2.3	1.7	1.5	1.6	1.7	1.4	1.6	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	5.8	-	-	4.8	-	-	1.7[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	8.4	7.0	4.3	2.2	2.3	4.0	4.1	2.4	1.4	1.1	5.2	-
(ibid)	-	-	-	-	-	25.3	23.2	17.4	12.1	11.6	14.3	14.1	11.9	10.7	9.4	12.9	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	6	-	-	4.2	-	-	-
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	-	8.9	8.1	6.2	7	6.2	3.8	3.4	3	4.2

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002), D	-	-	-	26.3	24.3	13.4	-	4.3	-	5.2	-	7.8	-	-
(ibid), D	-	-	-	40.3	37.2	23.3	-	10.4	-	10.2	-	14.0	-	-
$1.50/day@1996PPP														
Sala-i Martin (2006)	-	-	-	-	-	10.7	9.2	3.6	1.6	1.2	0.7	0.6	-	-
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	8.4	7.0	4.2	2.1	4.0	3.3	1.3	3.8	-
(ibid)	-	-	-	-	-	25.3	23.2	16.0	11.9	14.3	13.4	10.2	12.9	-
$1&$2/day@2005PPP, Income/NAS Based														
Zanden van et al. (2011)	30.4	28.6	20.4	8.1	8.2	4.3	-	2.0	-	2.5	-	1.8	-	-
(ibid)	62.6	56.2	44.7	28.3	26.7	16.9	-	9.0	-	10.5	-	7.3	-	-

D stands for developing world only, otherwise the intended coverage is global.

Table 8: Comparison of Poverty Rate Estimates for: Latin America and the Caribbean, LAC

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP																	
Ravallion et al. (1991a), D	-	-	-	-	-	-	-	-	19.1[1985]	-	-	-	-	-	-	-	-
95% CI	-	-	-	-	-	-	-	-	14.0∼28.9[1985]	-	-	-	-	-	-	-	-
Chen et al. (1994)[1], D	-	-	-	-	-	-	-	-	23.07[1985]	-	27.77	-	-	-	-	-	-
Ravallion and Chen (1997), D	-	-	-	-	-	-	-	-	-	22.0	23.0	23.5	-	-	-	-	-
$1.08/day@1993PPP																	
Chen and Ravallion (2001), D	-	-	-	-	-	-	-	-	-	15.33	16.80	15.31	15.63	12.13[1998]	-	-	-
Chen and Ravallion (2004), D	-	-	-	-	-	-	-	9.7	11.8	10.9	11.3	11.3	10.7	10.5	9.5[2001]	-	-
$1.25/day@2005PPP																	
Chen and Ravallion (2010), D	-	-	-	-	-	-	-	7.7	9.2	8.9	6.6	6.0	7.3	7.4	7.7	5.6	-
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	12.6	-	-	11	-	-	4.6[2011]
$1.52&$3.04/day@2000PPP, Income/NAS Based																	
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	11.6	6.2	4.2	4.8	4.5	5.2	5.1	4.9	4.8	4.7	3.3	-
(ibid)	-	-	-	-	-	25.6	17.0	12.8	14.2	13.5	14.9	14.6	14.2	13.9	13.7	10.7	-
$1.9/day@2011PPP, Consumption/Income/Survey Based																	
Ferreira et al. (2016), D	-	-	-	-	-	-	-	-	-	-	17.8	-	-	13.9	-	-	5.6[2012]
PovcalNet (Jan 6, 2020)	-	-	-	-	-	-	-	13.5	16.5	13.5	14.9	14	13.7	13.5	11.8	9.9	3.9

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.5&$2/day@1993PPP, Income/NAS Based														
Bhalla (2002), D	-	-	-	22.0	16.0	9.4	-	3.6	-	5.3	-	5.2	-	-
(ibid), D	-	-	-	31.3	24.5	15.4	-	8.2	-	10.8	-	10.4	-	-
$1.50/day@1996PPP														
Sala-i Martin (2006)	-	-	-	-	-	10.3	5.6	3.0	3.6	4.1	3.8	4.2	-	-
$1.52&$3.04/day@2000PPP, Income/NAS Based														
Pinkovskiy and Sala-i Martin (2009)	-	-	-	-	-	11.6	6.2	4.0	4.8	5.2	4.9	4.5	3.3	-
(ibid)	-	-	-	-	-	25.6	17.0	12.6	14.1	14.9	14.3	13.2	10.7	-
$1&$2/day@2005PPP, Income/NAS Based														
Zanden van et al. (2011)	32.9	22.9	5.5	2.6	4.8	3.0	-	1.0	-	1.4	-	1.4	-	-
(ibid)	56.3	48.7	20.5	11.5	13.7	9.7	-	4.3	-	5.3	-	4.7	-	-

D stands for developing world only, otherwise the intended coverage is global.

Table 9: Comparison of Poverty Rate Estimates for: India

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP, Consumption Survey Based																	
Ravallion et al. (1991a)	-	-	-	-	-	-	-	-	55[1985]	-	-	-	-	-	-	-	-
$1.08&2.15/day@1993PPP, Consumption Survey Based																	
Chen and Ravallion (2001)[1]	-	-	-	-	-	-	-	-	-	44.94	-	-	-	40	-	-	-
(ibid)[1]	-	-	-	-	-	-	-	-	-	86.3	-	-	-	83.93	-	-	-
Chen and Ravallion (2004)	-	-	-	-	-	-	-	54.4	49.8	46.3	42.1	42.3	42.2	35.3	34.7[2001]	-	-
$1.25/day@2005PPP, Consumption Survey Based																	
Chen and Ravallion (2010)	-	-	-	-	-	-	-	42.1	37.6	35.7	33.3	31.1	28.6	27.0	26.3	24.3	-
$1.9/day@2011PPP, Consumption Survey Based																	
PovcalNet (Jan 7, 2020)	-	-	-	-	-	-	-	-	54.8[1983]	48.9[1987.5]	-	45.9[1993.5]	-	-	-	38.2[2004.5]	21.3[2011.5]

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.50/day@1996PPP														
Sala-i Martin (2006)[1]	-	-	-	-	-	(30.3)	(29.7)	(26.7)	(17.8)	(10.3)	(5.7)	(2.5)	-	-

1. Estimates for the entire region of South Asia instead of India.

Table 10: Comparison of Poverty Rate Estimates for: China

Study	1820	1870	1910	1950	1960	1970	1975	1981	1984	1987	1990	1993	1996	1999	2002	2005	2015
$1.02/day@1985PPP, Income (1980s) / Consumption Survey Based																	
Ravallion et al. (1991a)	-	-	-	-	-	-	-	-	21.1[1985]	-	-	-	-	-	-	-	-
$1.08/day@1993PPP, Income (1980s) / Consumption Survey Based																	
Chen and Ravallion (2004)	-	-	-	-	-	-	-	63.8	41.0	28.5	33.0	28.4	17.4	17.8	16.6[2001]	-	-
$1.25/day@2005PPP, Income (1980s) / Consumption Survey Based																	
Chen and Ravallion (2010)	-	-	-	-	-	-	-	73.5	52.9	38.0	44.0	37.7	23.7	24.1	19.1	8.1	-
$1.9/day@2011PPP, Income (1980s) / Consumption Survey Based																	
PovcalNet (Jan 7, 2020)	-	-	-	-	-	-	-	88.1	75.2	60.4	66.2	56.6	41.7	40.2	31.7	18.5	0.7

	1820	1870	1910	1950	1960	1970	1975	1980	1985	1990	1995	2000	2005	2015
$1.50/day@1996PPP														
Sala-i Martin (2006)[1]	-	-	-	-	-	(32.7)	(27.8)	(21.7)	(13.0)	(10.2)	(3.8)	(2.4)	-	-

1. Estimates for the entire region of East Asia instead of China.