# Has world poverty *really* fallen during the 1990s?[1]

**Sanjay G. Reddy[2] and Camelia Minoiu[3]**

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**Abstract.** We evaluate the claim that world consumption poverty has fallen during the 1990s in light of alternative assumptions about the extent of initial poverty and the rate of subsequent poverty reduction in China, India, and the rest of the developing world. We assess the extent of poverty using two indicators: the aggregate poverty headcount and the poverty headcount ratio, and consider two international poverty lines that are widely used ($1.08/day and $2.15/day 1993 PPP). We find that under some of the assumptions considered, world poverty has risen. We conclude that, because of uncertainties in relation to the extent and trend of poverty in China, India, and the rest of the developing world, world poverty may or may not have increased. The extent of the increase or decrease in world poverty is critically dependent on the assumptions made. Our conclusions suggest the importance of improving the quality of global poverty statistics.

**Keywords :** world poverty, sensitivity analysis, China, India
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[2] Dept. of Economics, Barnard College, Columbia University and University Center for Human Values, Princeton University
Email: sr793@columbia.edu. Tel. 212-854-3790, Fax. 212-854-8947
[3] Dept. of Economics, Columbia University. Email: cm2036@columbia.edu
[4] Updates of this paper will be available on www.columbia.edu/~sr793/sensitivityanalysis.pdf

# I. Introduction

A series of influential studies has advanced the conclusion that world poverty has fallen substantially since the early 1990s (see, for example, Bhalla (2002), Chen and Ravallion (2001, 2004) and others). Furthermore, it is widely thought, on the basis of national poverty estimates and studies based on the international poverty lines, that poverty has fallen in India and China in the 1990s. However, the present extent of poverty and the recent pace of poverty reduction in these two countries with the largest populations in the world are still debated and debatable. Estimates of the extent and trend of poverty in the rest of the developing world are much less favorable and also questionable. This gives rise to unsettling concern as to whether world poverty has actually fallen.

This question takes on special importance in light of the UN's first Millennium Development Goal, which calls for the halving of the percentage of the developing country population living under the World Bank's "$1 per day" international poverty line between 1990 and 2015. Whether this goal is likely to be achieved has been a central concern in recent debates. For example, Bhalla (2002) avers gushingly that "Toward that goal…15 years *hence*, and *already achieved today*, resources are used to fight the non-existent poverty of tomorrow." (pp. 92-93). Chen and Ravallion (2004) conclude that "if the trends over 1980-2001 continue then the aggregate $1 per day poverty rate for 1990 will be almost halved by 2015, though East and South Asia will be the only regions to more than halve their 1990 poverty rates." However, they also find a low rate of reduction in the "$1 per day" headcount ratio measure of poverty in Latin America between 1990 and 2001 (from 11.3 percent to 10.5 percent)[5] and increases in the same measure of poverty in Sub-Saharan Africa during the period (from 44.6 percent to 45.7 percent).[6] A cautious stance is taken by Deaton (2002), who highlights the uncertainties surrounding global poverty estimates.

Recent debates on whether the world is on the right track in regard to poverty have frequently centered on whether the poverty reduction thought to have taken place in China and in India in the 1990s has been sufficiently to caused a decrease in poverty worldwide, despite the possibly poor record of poverty reduction elsewhere.[7] In order to assess this question, we undertake a sensitivity analysis. Specifically, we assess whether the conclusion that world poverty has fallen between 1990 and 2001 is robust to alternative assumptions concerning the extent of initial poverty and the rate of subsequent poverty reduction in China, India, and the developing world outside China and India (henceforth, 'non-China-India'). For each set of assumptions concerning initial poverty headcounts in China, India, and the remainder of the developing world, and concerning subsequent rates of poverty reduction in China and India, we determine the maximum non-China-India poverty headcount ratio in 2001 that is consistent with the hypothesis that world poverty has not risen between 1990 and 2001. If non-China-India poverty

[5] The regional average reported is for Latin America and the Caribbean.
[6] Chen and Ravallion (2004) find that there has been a sustained increase in the headcount ratio in Sub-Saharan African countries from 1993 onwards.
[7] See for example Wade and Wolf (2002).

headcount ratios were higher than this maximum at the end of the period then world poverty must be concluded to have increased between 1990 and 2001.

We draw on the literature estimating poverty in China, India and world as a whole to identify alternative estimates of the initial extent of poverty and subsequent rates of poverty reduction. The extent of poverty is assessed using two indicators: the poverty headcount ratio (HCR) and the aggregate poverty headcount (HC), and two widely accepted (if weakly conceptualized) international poverty lines: $1.08/day and $2.15/day of 1993 "international dollars".[8]

We find that under at least some plausible assumptions, world poverty must be concluded to have increased in the 1990s. More generally, the analysis draws attention to the need to assess claims regarding the extent and trend of global poverty in light of their robustness to alternative reasonable specifications of underlying assumptions. The assumptions made influence both the extent of poverty reduction each country is thought to have experienced and the relative weight attached to each such experience when determining the aggregate poverty trend.

The paper is structured as follows: in the next section, we briefly discuss the role of the aggregate headcount and the headcount ratio in poverty assessment. In section III we describe the data sources and literature that we employ in constructing the alternative specifications that we examine of the initial extent of poverty in India, China and the non-China-India developing world and of subsequent poverty reduction experiences in China and in India. In section IV we identify for each such specification, the maximum non-China-India poverty headcount ratio in 2001 that is consistent with concluding that world poverty has not increased. Section V concludes.

## II. How should we assess the 'extent of poverty'?

The most widely-used poverty indicators are the poverty headcount ratio (the share of persons identified as poor in a population) and the aggregate poverty headcount (the number of persons identified as poor in a population).[9]

Each of these indicators captures a feature of a social state which is of independent normative interest. The aggregate poverty headcount is a measure of the total number of persons suffering deprivations in a population as a result of income inadequacy, and is therefore surely relevant to assessing the degree of badness of a state of the world containing such deprivations. In contrast, the headcount ratio is a measure of the likelihood that a person identified arbitrarily in a population is poor and is therefore an indicator of the deprivations experienced by members of a population. As such, it is surely also relevant to assessing the degree of badness of a state of the world containing such deprivations. Attempting to do away with one of these indicators altogether can lead

[8] See Chen and Ravallion (2001).

[9] The merits and demerits of each of these indicators are thoughtfully examined by Subramanian (2002) who presents relevant axioms for their assessment. We describe these in Appendix A.

to blindnesses to the salient features of a social state which are captured by the other indicator, and as a result to insupportable conclusions.

For example, the poverty headcount ratio depends on the size of the non-poor population. As a result, the 'extent of poverty' as measured by the indicator can be made to be arbitrarily small if the size of the non-poor population is made to be sufficiently large. As a result, interventions which influence the number of non-poor persons but do not affect the consumption levels of the poor may be found to "reduce poverty". In contrast, the aggregate poverty headcount is insensitive to the size and incomes of the non-poor population. As a result interventions that reduce the likelihood that a member of a population is poor may fail to be considered to be poverty reducing, according to this indicator. A single minded focus on either measure may lead to "repugnant conclusions" such as these.

Of course, both indicators fail to possess several other desirable properties: for example both are unchanged when the consumption level of a person who is already poor falls further, or when a regressive transfer takes place among the poor.[10] It may be concluded that the indicators are not only independently insufficient to adequately assess the 'extent of poverty' but that they are jointly insufficient. Nevertheless, both indicators are informative. The relative significance to be attached to the two indicators or indeed others in the course of both descriptive and normative assessments inevitably depends on the researcher's own judgments as to what features are desirable in a poverty indicator required for a specific purpose. Normative judgments may also be required in the detailed specification of each indicator. For example, the "denominator" of the headcount ratio depends on the choice of an appropriate reference population. As shall be discussed further below, this choice is of great importance in the current debate on global poverty.

## III. Poverty in China, India and the rest of the developing world

In this section we draw on the literature to construct alternative plausible scenarios regarding the extent and trend of consumption poverty in China, India and the rest of the developing world. It is important to note that we do not necessarily take any of the examined estimates to be correct, nor do we necessarily endorse any of the international poverty lines that are currently widely used in global poverty analysis and that we accordingly employ here (i.e., $1.08/day and $2.15/day 1993 PPP).[11] A discussion of the uncertainties associated with poverty estimates for China can be found in Riskin (2004) and Reddy and Minoiu (2005). A discussion of the debate on Indian poverty estimates can be found in Deaton (2004) and in Sen and Himanshu (2004). Finally, Reddy and Pogge (2003) discuss uncertainties associated with poverty estimates for the world as a whole.

[10] See Sen (1983), Appendix C.

[11] Indeed the money-metric approach to international poverty estimation of which these are a part has elsewhere been criticized by one of the authors (see e.g. Reddy and Pogge (2003)).

### a. Poverty Estimates for China

There are few poverty estimates for China, especially on the basis of the international poverty lines of $1.08 and $2.15 per day. This may be for at least two distinct reasons: the lack of publicly available large household consumption or income surveys at multiple points in time, and the country's non-participation in the International Price Comparison Program (which precludes the use of PPPs derived on the basis of an official benchmark survey). In this paper, the studies on which we draw to obtain Chinese poverty estimates are Chen and Ravallion (2004) (henceforth, 'CR') and Reddy and Minoiu (2005) (henceforth, 'RM').

#### i. International poverty line: $1.08/day

Using tabulated data from underlying household surveys, CR find that the $1.08/day poverty headcount ratio has fallen in China from 33 percent in 1990 to 16.6 percent in 2001. The corresponding aggregate poverty headcounts are 374.8 million (1990) and 211.6 million (2001). These estimates are obtained by (1) translating the international poverty lines into 1993 local currency units using a 1993 consumption PPP of 1.4185 Yuan/$, (2) translating the resulting poverty lines into the local currency units of each survey year using the official consumer price index for rural and urban areas, and (3) using the World Bank's POVCAL software to estimate income distributions based on grouped consumption data originating in household surveys and provided to CR by the Chinese National Statistical Bureau.

RM propose several sets of poverty estimates for China in the 1990s, based on alternative plausible assumptions concerning: (a) consumption PPPs ; (b) true private per capita incomes; (c) consumption to income ratios and (d) consumer price indices. RM use income shares for different years in the 1990s to produce poverty estimates resulting from different plausible combinations of underlying assumptions, identifying certain combinations as most plausible.

To simplify the representation of poverty scenarios for China, we use the same notation as RM to describe each alternative set of poverty estimates by a vector of four parameters which specifies the assumptions underlying the estimates: $[PPP, \widehat{Y_P}, \theta, \pi]$. $PPP$ is a consumption purchasing power parity conversion factor used in translating an international poverty line into its national currency "equivalent". $\widehat{Y_P}$ refers to the method employed to estimate *true* per capita private income (and can be either *NAICE* = national accounts income-based consumption estimates, or *SICE* = survey income-based consumption estimates). $\theta$ is the method of estimating the fraction of *true* per capita private income devoted to consumption by each income group (which can be identified either with the total household expenditure to GDP ratio as drawn from the national accounts, $\theta_{NA}$ or from surveys, $\theta_S$ ). Finally, $\pi$ is the consumer price index used to describe consumption levels (and poverty lines) in constant prices (and can be either the official consumer price index, $\pi_{off}$ , or an "adjusted" consumer price index, $\pi_{adj}$ , that may be viewed as more appropriate for the poor).

We present the Chinese poverty estimates drawn from RM in Table 1. Poverty estimates RM(1) to RM(3) are obtained from a national accounts based consumption to income ratio for each year which is applied invariantly constant across the income spectrum to obtain a consumption profile of the population in that year, and from using the official consumer price index to express the consumption means for each income group in constant 1993 currency units. The alternative estimates are labeled according to their underlying assumptions, by the set of parameters ($\theta_{NA}, \pi_{off}$).

Poverty headcount ratios RM(4) and RM(5) use survey-based, decile-specific shares of consumption in income to obtain the consumption profile from the income distribution and income mean, and decile-specific adjusted inflation rates to express these in constant 1993 prices. Therefore, they correspond to the set of parameters ($\theta_S, \pi_{adj}$).[12]

**Table 1 China's $1.08/day Poverty headcount ratios**

| Scenario | Sets of underlying parameters | | 1990 | 2001 |
|---|---|---|---|---|
| CR | $PPP_{INTERMEDIATE}, \pi_{off}$ [13] | | 33.0 | 16.6 |
| RM (1) | $\theta_{NA}, \pi_{off}$ | $(PPP_{LOW}, NAICE)$ | 13.2 | 4.9 |
| RM (2) | | $(PPP_{HIGH}, NAICE) = (PPP_{LOW}, SICE)$ | 50.8 | 23.0 |
| RM (3) | | $(PPP_{HIGH}, SICE)$ | 88.0 | 54.0 |
| RM (4) | $\theta_S, \pi_{adj}$ | $(PPP_{HIGH}, NAICE) = (PPP_{LOW}, SICE)$ | 32.3 | 6.1 |
| RM (5) | | $(PPP_{HIGH}, SICE)$ | 75.1 | 31.9 |

Source: Reddy and Minoiu (2005) and authors' estimations using POVCAL, Generalized Quadratic interpolation method.

In conclusion, for the $1.08/day poverty line, we use six scenarios for China's poverty: CR, and RM(1) through RM(5).

[12] Note that we exclude from this table one set of poverty estimates corresponding to the following combination of underlying parameters: ($PPP_{LOW}, NAICE, \theta_S, \pi_{adj}$). The reason for its exclusion is that it results in a headcount ratio of 2.95 percent in 1990 and 0 percent in 2001. Based on evidence from the literature, we deem this poverty level for China to be too low to be credible. Note also that RM do not report headcount ratios for 1990 due to a failure of the World Bank's POVCAL software to estimate poverty based on the 1990 consumption profile for China corresponding to ($\theta_S, \pi_{adj}$). This malfunction has been recognized by the authors of the software (at the World Bank) but the source of the problem has not been identified. Since the 1990 poverty estimates are needed in this paper, we estimate them by replacing the 1990 income shares with those of 1992, and computing the 1990 income profile by applying the 1990 per capita GDP to the (1992) income shares. The 1990 consumption profile thus obtained is reported in Appendix B.

[13] $PPP_{INTERMEDIATE}$ refers to the World Bank default 1993 consumption PPP of 1.4185 Yuan/$ for China.

### ii. International poverty line: $2.15/day

The first set of poverty estimates that we consider for China corresponding to the $2.15/day poverty line are drawn from CR , according to which Chinese poverty as defined by this poverty line has fallen from 72.6 percent (1990) to 46.7 percent (2001).[14]

We supplement these figures with 1990 and 2001 headcount ratios computed using the consumption profile for 1990 presented in Appendix B as well as that for 2001 obtained from publicly available income shares for that year. [15] As noted above, the consumption profiles are constructed so as to reflect the possibility of using either China's national accounts and or surveys to identify consumption to income ratios, the possibility of using either official or 'adjusted' inflation rates, the possibility of using either national accounts or surveys to estimate income means and alternative possible consumption PPPs that may be used to translate the international poverty line into local currency units. The $2.15/day headcount ratios for China that correspond to different combinations of underlying assumptions are reported in Table 2.[16]

**Table 2 China's $2.15/day poverty headcount ratios**

| Scenario | Sets of underlying parameters | | 1990 | 2001 |
|---|---|---|---|---|
| CR | | $PPP_{INTERMEDIATE}, \pi_{off}$ | 72.6 | 46.7 |
| RM (1)* | $\theta_{NA}, \pi_{off}$ | $(PPP_{LOW}, NAICE)$ | 48.5 | 21.8 |
| RM (2)* | | $(PPP_{HIGH}, NAICE) = (PPP_{LOW}, SICE)$ | 86.9 | 52.4 |
| RM (4)* | $\theta_S, \pi_{adj}$ | $(PPP_{LOW}, NAICE)$ | 30.3 | 5.1 |
| RM (5)* | | $(PPP_{HIGH}, NAICE) = (PPP_{LOW}, SICE)$ | 73.3 | 30.4 |
| RM (6)* | | $(PPP_{HIGH}, SICE)$ | 96.3 | 65.2 |

Source: Authors' calculations using POVAL, Generalized Quadratic interpolation method.

In conclusion, for the $2.15/day poverty line, we use six Chinese poverty scenarios: CR, and RM(1)*, RM(2)*, RM(4)*, RM(5)* and RM(6)*.

[14] Another set of $2.15/day poverty headcount ratios can be obtained for 1990 and 2001 using the World Bank's POVCALNET on-line database (using the default consumption PPP of 1.4185 Yuan/$). However, the results are very close to those reported by CR, and we thus do not report them here.

[15] The consumption profile for 2001 is drawn from RM (2005, pp. 13), and is not reported here.

[16] Note that we exclude from this table one set of poverty estimates corresponding to the following combination of underlying parameters: $(PPP_{HIGH}, SICE, \theta_{NA}, \pi_{off})$ . The poverty line associated with this combination of parameters is outside the admissible bounds given by POVCAL. We consider this poverty line to be so high as to lack credibility as a poverty line that is appropriate to employ in international comparisons and do not therefore consider it further.

### b. Poverty Estimates for India

#### i. International poverty line: $1.08/day

Indian poverty estimates during the 1990s have been the subject of an extended debate primarily due to changes in survey methodology in the 1999/2000 thick round of India's National Sample Survey relative to previous rounds, which led to difficulties in comparing estimates across rounds (for a detailed account of the debate, see Deaton (2004)).

Views on the extent of poverty reduction in the 1990s vary widely: for example, Bhalla (2000) takes the optimistic view that the national poverty headcount ratio in India fell by 50 percent between 1990 and 1998 (namely, from 26 percent to 13 percent; pp. 31). In contrast, the analysis of Sen and Himanshu (2004) leads them to the conclusion that between 1993/94 ($50^{th}$ round) and 1999/00 ($55^{th}$ round) the poverty headcount ratio fell by no more than 3 percentage points (from 35.97 percent to 32.97 percent; pp. 4259) and the aggregate headcount may have well increased over the period. We may call this view pessimistic by contrast to that of Bhalla, without any suggestion that either is correct. Official poverty estimates indicate that the national poverty headcount ratio was 35.11 percent in 1990/91 (based on a thin round) and 35.97 percent in 1993/94 ($50^{th}$ thick round). The estimates are based on the national poverty line, which is approximately 80 percent of the $1.08/day international standard. Deaton and Dreze (2002) posit a rate of poverty reduction that is in an intermediate range. They conclude based on their most comprehensive assessments, that between 1987-88 and 1990-00 the poverty headcount ratio fell from 39.4 to 26.3 percent in rural areas and from 22.5 to 12 percent in urban areas (pp. 3730). We do not take a view here on what has actually happened in India. Rather, we examine the implications of alternative assumptions concerning what has happened for conclusions concerning the trend of global poverty in the 1990s.

To determine Indian poverty headcounts for 1990 for purposes of this analysis, we consider three alternative baseline (1990) poverty levels: 42.10 percent (CR), 40 percent (which we deem to be a plausible baseline poverty headcount ratio given that the 1993/94 official headcount ratio is 35.97 percent, that the official poverty line is 80 percent of the rupee equivalent of the $1.08/day threshold[17], and that official statistics show little poverty reduction in the period from 1990 to 1993/94), and 35.11 percent (i.e., the official estimate based on the 1990/91 thin round, using the national poverty line).

To obtain Indian poverty headcounts for 2001, we assume two alternative poverty reduction rates and apply them to the assumed initial headcount ratio. These are an optimistic poverty reduction scenario of 50 percent (corresponding to Bhalla (2000)) and a pessimistic poverty reduction scenario of 10 percent. Our "pessimistic" rate of reduction of 10 percent is nevertheless more optimistic than that proposed by Sen and Himanshu (2004), who claim that the highest decrease in the national headcount ratio that is suggested by the survey data is 8.34 percent (or 3 percentage points) between 1993/94 and 1999/00.

[17] As translated using a World Bank provided 1993 consumption PPP for India.

The six resulting scenarios for the extent and trend of poverty in the 1990s in India are presented in Table 3.

**Table 3 India's $1.08/day Poverty headcount ratios**

| Scenario | 1990 poverty headcount | Rate of poverty reduction | 1990 | 2001 |
|---|---|---|---|---|
| (1) | CR | Optimistic: 50 percent | 42.1 | 21.05 |
| (2) | | Pessimistic: 10 percent | 42.1 | 37.89 |
| (3) | Based on 1993/94 official headcount ratio (thick round) adjusted to accord with international poverty line | Optimistic: 50 percent | 40.0 | 20.0 |
| (4) | | Pessimistic: 10 percent | 40.0 | 36.0 |
| (5) | Based on 1990/91 official headcount ratio (thin round) and national poverty line | Optimistic: 50 percent | 35.11 | 17.56 |
| (6) | | Pessimistic: 10 percent | 35.11 | 31.06 |

### ii. International poverty line: $2.15/day

For the $2.15/day international poverty line, we use only one set of headcount ratio estimates drawn from CR: 86.1 percent in 1990 and 79.9 percent in 2001, as there are no alternative estimates for a poverty line in a corresponding range that are available in the literature on Indian poverty.

## c. Poverty estimates for the developing world outside China and India

The baseline $1.08/day and $2.15/day non-China-India headcount ratios that we employ for 1990 are those of CR (20.14 percent and 46.16 percent, respectively). However, in order to reflect uncertainties about these estimates, we allow for the possibility that the level of the headcount ratio in 1990 judged according to alternative means or better data may have been higher or lower, by multiplying the headcount ratio provided by CR by a range of plausible factors (0.5, 0.75, 1, 1.5 and 2). By doing so, we allow the $1.08/day aggregate headcount in the developing world outside India and China to vary between 243.15 million and 972.6 million (CR's estimate is 486.3 million) so as to explore the impact of alternative assumptions.[18]

[18] For a variety of reasons, it seems reasonable to identify some (necessarily imprecise) 'confidence bounds' to reflect the uncertainties associated with these estimates. For example, the total population that is not covered by household surveys is around 400 million people. Poverty headcount ratios for this population are imputed by C-R from regional averages for countries for which they do have surveys. Based on population statistics for 2001, the following percentages of the population of different regions were not directly represented by household surveys or tabulated data in CR's poverty estimates: 25.95 percent (Middle East and North Africa), 22.14 percent (Sub-Saharan Africa), 4.69 (Latin America and Caribbean), and smaller percentages for East Asia, Eastern Europe and Central Asia, and South Asia. For the countries for which there is no data, it is assumed by CR that the country's poverty headcount ratio is the same as the regional average. The regional average is computed by dividing the aggregate headcounts for the countries for which data was available by the population of these countries. The regional 'average' headcount ratio is then imputed to countries for which data is not available. We presume that a new regional average was

## IV. **Findings**

We compute the maximum 2001 non-China-India poverty headcount ratio (and correspondingly, the maximum increase in the non-China-India headcount ratio between 1990 and 2001) that is consistent with the hypothesis that world poverty has not increased, for each set of assumptions that we admit. The method by which we obtain the minimum non-China-India 2001 poverty headcount ratios that are consistent with non-decreasing world poverty (henceforth, 'threshold non-China-India headcount ratios') when the extent of poverty is measured by both the world poverty headcount ratio, and the world aggregate poverty headcount, is described in Appendix C.

It is evident from the expressions derived there that a higher initial headcount ratio in India or China entails higher threshold non-China-India headcount ratios. Similarly, a lower final headcount ratio (i.e. a higher rate of reduction of poverty over the period) in India or China entails higher threshold non-China-India headcount ratios. The reasons that this is so are straightforward. A higher initial headcount ratio in India or China entails that poverty reduction in these countries contributes a greater relative "weight" in the calculation of the global poverty headcount (or headcount ratio). Since poverty decreased in both of these countries over the period, the higher are these weights, the larger is the increase in poverty required in the non-China-India developing world to "counteract" the lowering of the poverty headcount ratio in India and China. A lower final headcount ratio (i.e., a higher rate of reduction of poverty over the period) in India or China similarly entails that the rate of increase of poverty in the non-China-India developing world must be higher in order to "counteract" the decrease in global poverty arising from these two countries. The assumed initial extent f poverty in the developing world outside of China and India is also crucial, as it too influences the relative weight that is attached to the poverty reduction experiences in China, India and the rest of the world in the assessment of aggregate poverty reduction experience.

If rates of poverty reduction were relatively high in the countries in which the initial poverty headcount was relatively high, an estimated aggregate poverty reduction will be consequently high. The threshold non-China-India headcount ratio will be highest when the initial poverty headcount in China and in India is assumed to be high relative to that in other countries, and poverty reduction in China and in India is assumed to have been high in absolute terms. The rate of increase in poverty in the non-China-India developing world needed to reverse the conclusion that world poverty has fallen will be of a large magnitude in such a case.

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afterwards computed (and is reported in the paper), though this is not explicitly stated in CR. Other reasons for concern regarding the validity and precision of poverty estimates for the developing world are outlined in Reddy and Pogge (2003). They include the lack of price surveys on the basis of which to construct PPPs for many countries, the inappropriateness of the PPPs that are constructed, and the lack of alignment of survey years and estimation years.

The results concerning the threshold non-China-India headcount ratios are presented in Tables 1D-5D (for the headcount ratio measure of the extent of world poverty) and in Tables 6D-10D (for the aggregate headcount measure of the extent of world poverty).

We assess the world poverty headcount ratio as a percentage of the developing world population, following CR. We do this in order to maintain comparability with their results, although it is far from obvious that this is an appropriate choice. From a normative standpoint, there is good reason to hold that the share of the entire *world population* that is poor is of greater interest. Specifying the headcount ratio in this way will lead to a lower estimated headcount ratio and also to a lower estimated rate of reduction of the headcount ratio (since the developing world population has grown at a faster rate than the world population as a whole).[19] Correspondingly, the threshold non-China-India headcount ratios will be lower when the world population is taken to be the denominator than when the developing world population is taken to be the denominator of the world poverty headcount ratio. Although we do not report below the threshold non-China-India headcount ratios for this case, it can be inferred that they lie between those we do report (for the case in which the extent of world poverty is assessed by the aggregate headcount and for the case in which it is assessed by the headcount ratio taking the developing country population as the denominator). The reason why is clear. The threshold associated with the aggregate headcount is the same as that associated with the headcount ratio when 'world' population growth is nil (see Appendix C). Since the function that describes the relation of the threshold to underlying parameters is continuous and is an increasing function of world population growth, the threshold associated with the world headcount ratio when population growth is positive and small is lower than that associated with the world headcount ratio when population growth is positive and large. Since developing world population growth has been higher than world total population growth, it follows that the threshold associated with the headcount ratio when the 'world' is taken to be the entire world lies between that arising when the 'world' is taken to be the developing world (as in CR) and that associated with the aggregate headcount. The case in which the world population is taken as the denominator of the headcount ratio is of great normative interest. In that case, the extent of the increase in poverty outside China and India that is needed to overturn the conclusion that poverty has fallen will lie in an intermediate range between the two thresholds that we do identify.

### a. Has the $1.08/day world poverty headcount ratio *really* fallen between 1990 and 2001?

We initially consider the possibility that the CR non-China-India headcount ratio for 1990 is correct. It is apparent from Table 1D that under this assumption, regardless of the poverty reduction scenario for India, the scenario in which the extent of poverty in China in 1990 is lowest (RM(1)) is that in which the country's contribution to global poverty

[19] For further discussion of this point in relation to the first Millennium Development Goal, see Pogge (2004).

reduction has the smallest weight, and in which accordingly it is easiest to reverse the conclusion that world poverty has fallen.

Under the assumption that the CR 1990 headcount ratio outside China and India is correct, the *highest* threshold non-China-India headcount ratio arises in the scenarios in which high poverty reduction takes place from a high initial level in India (from 42.10 to 21.05 percentage points, i.e. the 'optimistic' scenario) and in China (from 75.1 to 31.9 percentage points, i.e., RM(5)). When countries that possess large numbers of poor persons experience a high rate of poverty reduction, the increase in poverty elsewhere that is needed to overturn this conclusion must also be high.

Naturally, as Tables 1D-5D show, the higher the assumed non-China-India poverty headcount in 1990, the easier it becomes to reverse the conclusion that world poverty has decreased between 1990 and 2001. If the absolute headcount outside China and India in 2001 were 972.6 million instead of CR's estimate of 486.3 million (i.e., twice higher), then an increase in the non-China-India poverty headcount ratio of only 11 percent (or 4.35 pp) by 2001 would be consistent with world poverty having increased, despite reductions in poverty in both India and China (see Table 5D).

### b. Has the $1.08/day world aggregate poverty headcount *really* fallen between 1990 and 2001?

It is substantially easier to reverse the conclusion that the number of poor persons in the world has decreased than it is to reverse the same conclusion using the poverty headcount ratio as the relevant poverty indicator, due to increases in the population of the developing world in the period considered. (See Tables 6D-10D.)

Under some plausible specifications of underlying assumptions, the total number of "$1.08 per day poor" must be concluded to have increased between 1990 and 2001 even though there have been reductions in the poverty headcount *ratios* in China, India, and indeed, very possibly outside China and India. This is simply because the increase in the population of the developing world gives rise to a cleavage between the two measures of the extent of poverty.

What do current estimates tell us about the evolution of world poverty? Can the CR estimates themselves be consistent with the conclusion that world poverty has actually increased in the 1990s? CR report a reduction in the $1.08/day poverty headcount ratio outside China and India from 20.14 percent (1990) to 18.29 percent (2001), i.e. a decrease of 1.9 percentage points. Based on the alternative specifications of underlying assumptions that we consider, if we measure the extent of poverty by the headcount ratio and maintain that CR's 1990 non-India-China poverty headcount estimate is correct (at 20.14 percent) then the extent of world poverty could **not** have increased (Tables 1D-5D). However, Table 6D shows that a fall in the world headcount ratio from 20.41 percent to a level *higher* than 18.91 percent (i.e., by at most 1.5 percentage points) is consistent with the number of "$1.08 per day poor" having increased under some of the assumptions

considered. Thus, a reduction in the non-China-India headcount index of less than 1.5 percentage points (given the estimates of CR for China and India and for the initial non-China-India headcount ratio) would be consistent with the number of "$1.08 per day poor" in the developing world having *increased*. Even a moderate error in CR's estimated rate of reduction could ensure this result.

If we assume that the non-China-India CR estimate of the 1990 headcount ratio is incorrect and is higher than what CR report it becomes still easier to sustain the conclusion of a rising aggregate world poverty headcount. In particular, if we assume that the 1990 Non-China-India headcount ratio is twice that reported by CR, then to maintain the conclusion that the number of "$1.08 per day poor" has fallen between 1990 and 2001, it suffices to assume that the fall in the headcount ratio outside of China and India was less than 12 percent (see Table 10D, assuming a reduction in Indian poverty from 42.10 to 37.89 and RM(1) estimates for China). A reduction in the non-China-India poverty headcount ratio of less than 12 percent is, under appropriate assumptions concerning poverty trends in India and China, consistent with the conclusion that the number of "$1.08 per day poor" has risen.

The speculation that CR's non-China-India estimate for 1990 is "low" may not be unreasonable, especially if we have in mind that the international poverty line should be aligned with a norm of adequacy that is roughly related to prevailing standards in poor countries (as is claimed on behalf of the $1/day international poverty line by CR). In this respect, it is informative to compare the nutritionally based poverty estimates produced by the Economic Commission on Latin America (ECLA) following the methodology of Altimir (1979) with those produced by CR using their lower poverty line. As will be seen from this comparison (summarized in Appendix E) Latin American poverty headcounts based on the ECLA approach are substantially higher than those of CR in certain countries. Moreover, the regional average reported by ECLA is notably higher. The discrepancies between estimates produced by these two methodologies draw attention to the uncertainties attached to current regional and global poverty estimates (arising as a result of diverse factors, as pointed to by Reddy and Pogge (2003)).[20]

Another conclusion which emerges from Tables 1D-10D is that the threshold non-China-India headcount ratio is more sensitive to the assumptions that are made concerning China than it is to the assumptions that are made concerning India. This fact illustrates the potential value of further research producing poverty estimates for China that are reliable and internationally comparable.

### c. Has $2.15/day world poverty *really* fallen between 1990 and 2001?

For the $2.15/day international poverty threshold, the conclusions are similar. (See Appendix F.) It is easiest to reverse the conclusion that the $2.15/day world poverty headcount ratio has fallen if the initial non-China-India poverty headcount index is

[20] On which, see also footnote 18 above.

assumed to have been underestimated by CR, and if the rate of poverty reduction in China is assumed to be comparatively low. The $2.15/day non-China-India headcount ratio has remained virtually unchanged according to CR's estimates at approximately 46 percent (its 1990 level). However, the world headcount ratio has fallen between 1990 and 2001 from 60.8 percent to 52.9 percent. This poverty reduction must have been driven, therefore, by poverty reduction in China and India. Table 1F shows that under some assumptions regarding initial Chinese and Indian poverty levels and the subsequent pace of poverty reduction, an increase as small as 13 percent in the non-China-India headcount ratio would reverse the conclusion that world poverty (by the $2.15/day international poverty threshold) has fallen.

This "falling poverty" conclusion is easiest to reverse, again, when the extent of world poverty is assessed according to the aggregate headcount ratio. CR themselves report an increase in the number of "$2.15 per day poor" from 2,653.8 million (1990) to 2,735.6 million (2001). Table 2F shows that, under various scenarios for China and assuming an underestimation of the 1990 non-China-India poverty headcount by a factor of two, *reductions* in the non-China-India poverty headcount as large as 10 percent are consistent with *increases* in the number of worldwide "$2.15 per day poor".

## V. Conclusions

In this paper we have scrutinized the conclusion widely put forward that world poverty headcounts and headcount ratios have fallen during the 1990s. We have examined the robustness of this conclusion to alternative assumptions concerning the initial extent of poverty and subsequent poverty reduction experience in China, India and the rest of the developing world, informed by the literature on poverty estimates for these countries and for the world as a whole. We have considered two international poverty lines: $1.08/day and $2.15/day (1993 PPP) which are widely used within the currently dominant "money-metric" approach to international poverty assessment.

We found that under many assumptions, the developing world headcount ratio has decreased in the 1990s. However, under some plausible assumptions, the developing world headcount ratio, and especially the developing world aggregate headcount, may well have increased in the period. It may be concluded that the magnitude of the increase or decrease in the extent of world poverty is also crucially dependent on the assumptions made. In any event, the relatively slow rate of reduction of poverty outside China and India, and especially in Latin America and Sub-Saharan Africa, gives great reason for concern that goals of reducing poverty will fail to be met in these regions, even if they are met on a global basis.

Our results call for caution in coming to the conclusion that world poverty has fallen in the 1990s, and that global poverty reduction goals are on their way to being achieved. They also point to the need for international investment in more credible approaches to global poverty monitoring.

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## Appendix A. An axiomatic approach to the comparison of the aggregate headcount and the headcount ratio

Subramanian (2002) proposes the following axioms:

(1) The **Strong Focus Axiom** states that the extent of poverty should be the same for two income vectors if their sub-vectors of incomes corresponding to poor persons are identical. This does not require that the two income vectors are of the same dimension. A weaker version of the axiom (the **Focus Axiom**) would require that the dimension of the two income vectors be the same.

(2) The **Weak Poverty Growth Axiom** requires that adding an individual with an income level lower than the poverty line to the society should lead to an increase in the poverty indicator, if there is already at least one non-poor person in the society.

(3) The **Replication Invariance Axiom** demands that a *k*-fold replication of the income vector should leave the value of the poverty indicator unchanged. This axiom expresses the view that poverty should be regarded as a property that is properly assessed relative to the size of the population. A weaker version of this axiom is **Replication Scaling**, which requires that a poverty indicator should increase by the factor *k* when a *k*-fold replication of the incomes of the poor occurs.

Subramanian (2002) proves an impossibility result: No poverty indicator can be simultaneously consistent with Strong Focus, Weak Poverty Growth, and Replication Invariance.

The poverty headcount ratio is consistent with the following three axioms: Focus, Weak Poverty Growth, and Replication Invariance. The aggregate poverty headcount, in turn, is consistent with the following three axioms: Strong Focus, Weak Poverty Growth, and Replication Scaling.

## Appendix B. China's income shares and consumption profiles for 1990 and 1992

Columns [2] and [3] report income shares for 1990 and 1992. Column [4] reports the 1990 consumption profiles corresponding to a 'least refined' and a 'most refined' set of underlying parameters. The least refined set of parameters include the national accounts consumption to income ratios (i.e., the share of total household expenditure in GDP) which is constant across the income deciles, as well as decile-constant official CPI). The most refined set of parameters are the survey-based shares of consumption in income, which vary across the income spectrum, and decile-specific adjusted CPIs. However, the set of consumption means presented in column [4'] cannot be entered into the World Bank's POVCAL software to estimate poverty due to a software failure. Column [5'] reports the 'most refined' 1990 consumption profile constructed using the **1992** income shares and the 1990 per capita GDP.

| | | | **1990 consumption profiles** | | |
|---|---|---|---|---|---|
| [1] | [2] | [3] | [4] | [4'] | [5'] |
| Income decile | 1990 income shares (% share of GDP) | 1992 income shares (% share of GDP) | based on 1990 income shares 'least refined' | based on 1990 income shares 'most refined' | based on 1992 income shares 'most refined' |
| Bottom 10% | 3.08 | 2.57 | 308.3 | 627.7 | 523.7 |
| 10% | 4.25 | 3.6 | 425.4 | 666.9 | 564.9 |
| 10% | 5.36 | 4.64 | 536.4 | 808.3 | 699.7 |
| 10% | 6.49 | 5.73 | 649.5 | 925.8 | 817.4 |
| 10% | 7.65 | 6.95 | 765.6 | 1060.1 | 963.1 |
| 10% | 8.97 | 8.34 | 897.7 | 1389.3 | 1291.7 |
| 10% | 10.55 | 10.1 | 1055.9 | 1548.0 | 1482.0 |
| 10% | 12.66 | 12.51 | 1267.0 | 1831.8 | 1810.1 |
| 10% | 16.01 | 16.55 | 1602.3 | 2186.0 | 2259.7 |
| Top 10% | 24.98 | 29.01 | 2500.1 | 2799.9 | 3251.6 |

Source: Columns [4] and [4'] are from RM (2005). Column [5']: Authors' calculations.

**Appendix C. Computing the maximum poverty level outside China and India in 2001 consistent with the hypothesis that world poverty has not increased between 1990 and 2001**

Denote the headcount ratios by $\theta$. $P$ denotes the size of the population (indexed by *t* for the world, *i* for India and *C* for China).

The world poverty headcount ratio has not decreased between 1990 ($\theta_{world1}$) and 2001 ($\theta_{world2}$) if $\theta_{world1} \le \theta_{world2}$. This is equivalent to writing:

$$\frac{\theta_{C1}P_{C1} + \theta_{i1}P_{i1} + \theta_{nci1}P_{nci1}}{P_{t1}} \le \frac{\theta_{C2}P_{C2} + \theta_{i2}P_{i2} + \theta_{nci2}P_{nci2}}{P_{t2}}$$

$$\Rightarrow \frac{P_{t2}}{P_{t1}}(\theta_{C1}P_{C1} + \theta_{i1}P_{i1} + \theta_{nci1}P_{nci1}) \le (\theta_{C2}P_{C2} + \theta_{i2}P_{i2} + \theta_{nci2}P_{nci2})$$

$$\Rightarrow \theta_{nci2}P_{nci2} \ge \frac{P_{t2}}{P_{t1}}(\theta_{C1}P_{C1} + \theta_{i1}P_{i1} + \theta_{nci1}P_{nci1}) - \theta_{i2}P_{i2} - \theta_{C2}P_{C2}$$

$$\Rightarrow \theta_{nci2}P_{nci2} \ge \theta_{nci1}P_{nci1}\frac{P_{t2}}{P_{t1}} + \left[\theta_{C1}P_{C1}\frac{P_{t2}}{P_{t1}} - \theta_{C2}P_{C2}\right] + \left[\theta_{i1}P_{i1}\frac{P_{t2}}{P_{t1}} - \theta_{i2}P_{i2}\right]$$

$$\Rightarrow \theta_{nci2} \ge \theta_{nci1}\frac{P_{nci1}}{P_{nci2}}\frac{P_{t2}}{P_{t1}} + \left[\theta_{C1}\frac{P_{C1}}{P_{nci2}}\frac{P_{t2}}{P_{t1}} - \theta_{C2}\frac{P_{C2}}{P_{nci2}}\right] + \left[\theta_{i1}\frac{P_{i1}}{P_{nci2}}\frac{P_{t2}}{P_{t1}} - \theta_{i2}\frac{P_{i2}}{P_{nci2}}\right] \quad (*)$$

The world poverty aggregate headcount has not decreased between 1990 ($\theta_{world1}$) and 2001 ($\theta_{world2}$) if $\theta_{world1}P_{t1} \le \theta_{world2}P_{t2}$. This is equivalent to writing:

$$\theta_{C1}P_{C1} + \theta_{i1}P_{i1} + \theta_{nci1}P_{nci1} \le \theta_{C2}P_{C2} + \theta_{i2}P_{i2} + \theta_{nci2}P_{nci2}$$

$$\Rightarrow \theta_{nci2}P_{nci2} \ge (\theta_{C1}P_{C1} + \theta_{i1}P_{i1} + \theta_{nci1}P_{nci1}) - \theta_{i2}P_{i2} - \theta_{C2}P_{C2}$$

$$\Rightarrow \theta_{nci2}P_{nci2} \ge \theta_{nci1}P_{nci1} + \left[\theta_{C1}P_{C1} - \theta_{C2}P_{C2}\right] + \left[\theta_{i1}P_{i1} - \theta_{i2}P_{i2}\right]$$

$$\Rightarrow \theta_{nci2} \ge \theta_{nci1}\frac{P_{nci1}}{P_{nci2}} + \left[\theta_{C1}\frac{P_{C1}}{P_{nci2}} - \theta_{C2}\frac{P_{C2}}{P_{nci2}}\right] + \left[\theta_{i1}\frac{P_{i1}}{P_{nci2}} - \theta_{i2}\frac{P_{i2}}{P_{nci2}}\right] \quad (**)$$

Inequality (**) can be obtained from (*) by setting $\frac{P_{t2}}{P_{t1}} = 1$.

## Appendix D. Results (Poverty Line: $ 1.08 / DAY)

The maximum non-China-India poverty headcount ratio in 2001 which is consistent with the hypothesis that the extent of world poverty (measured by the headcount ratio) has not increased between 1990 and 2001 is reported in the upper part of each of the tables below. It is also expressed as a share of the non-China-India 1990 poverty headcount ratio in the lower part of each table. The figures in the lower part of each table can therefore be interpreted as the factors by which world poverty outside India and China would have had to increase to leave world poverty unchanged between 1990 and 2001 under each set of assumptions considered. If the specified assumptions are maintained and if it is assumed that the headcount ratio outside India and China increased by a factor higher than that reported in the tables, then it must be concluded that world poverty has increased.

Table 1D. Assumption: the non-China-India 1990 poverty headcount ratio is correct: 20.41 percent

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| **China ↓** | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| RM (1) | 31.32% | 25.23% | 30.96% | 25.18% | 30.13% | 25.05% |
| CR | 35.41% | 29.32% | 35.05% | 29.27% | 34.22% | 29.14% |
| RM (4) | 39.75% | 33.67% | 39.40% | 33.61% | 38.56% | 33.49% |
| RM (2) | 40.92% | 34.83% | 40.56% | 34.78% | 39.72% | 34.65% |
| RM (3) | 44.59% | 38.50% | 44.23% | 38.44% | 43.39% | 38.32% |
| RM(5) | 48.37% | 42.28% | 48.01% | 42.23% | 47.17% | 42.10% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| **China ↓** | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| RM (1) | 1.53 | 1.24 | 1.52 | 1.23 | 1.48 | 1.23 |
| CR | 1.73 | 1.44 | 1.72 | 1.43 | 1.68 | 1.43 |
| RM (4) | 1.95 | 1.65 | 1.93 | 1.65 | 1.89 | 1.64 |
| RM (2) | 2.00 | 1.71 | 1.99 | 1.70 | 1.95 | 1.70 |
| RM (3) | 2.18 | 1.89 | 2.17 | 1.88 | 2.13 | 1.88 |
| RM(5) | 2.37 | 2.07 | 2.35 | 2.07 | 2.31 | 2.06 |

Table 2D. Assumption: the non-China-India 1990 poverty headcount ratio is 0.5 x 20.41%=10.21%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 21.26% | 15.18% | 20.07% | 14.99% | 20.07% | 14.99% |
| CR | 25.35% | 19.26% | 24.99% | 19.21% | 24.16% | 19.08% |
| RM (4) | 29.70% | 23.61% | 29.34% | 23.56% | 28.50% | 23.43% |
| RM (2) | 30.86% | 24.77% | 29.67% | 24.59% | 29.67% | 24.59% |
| RM (3) | 34.53% | 28.44% | 33.33% | 28.26% | 33.33% | 28.26% |
| RM (5) | 38.31% | 32.22% | 37.95% | 32.17% | 37.11% | 32.04% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 2.08 | 1.49 | 1.97 | 1.47 | 1.97 | 1.47 |
| CR | 2.48 | 1.89 | 2.45 | 1.88 | 2.37 | 1.87 |
| RM (4) | 2.91 | 2.31 | 2.87 | 2.31 | 2.79 | 2.30 |
| RM (2) | 3.02 | 2.43 | 2.91 | 2.41 | 2.91 | 2.41 |
| RM (3) | 3.38 | 2.79 | 3.27 | 2.77 | 3.27 | 2.77 |
| RM (5) | 3.75 | 3.16 | 3.72 | 3.15 | 3.64 | 3.14 |

Table 3D. Assumption: the non-China-India 1990 poverty headcount ratio is 0.75 x 20.41%=15.31%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 26.29% | 20.20% | 25.93% | 20.15% | 25.10% | 20.02% |
| CR | 30.38% | 24.29% | 30.02% | 24.24% | 29.19% | 24.11% |
| RM (4) | 34.73% | 28.64% | 34.37% | 28.58% | 33.53% | 28.46% |
| RM (2) | 35.89% | 29.80% | 35.53% | 29.75% | 34.70% | 29.62% |
| RM (3) | 39.56% | 33.47% | 39.20% | 33.42% | 38.36% | 33.29% |
| RM (5) | 43.34% | 37.25% | 42.98% | 37.20% | 42.14% | 37.07% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.72 | 1.32 | 1.69 | 1.32 | 1.64 | 1.31 |
| CR | 1.98 | 1.59 | 1.96 | 1.58 | 1.91 | 1.58 |
| RM (4) | 2.27 | 1.87 | 2.25 | 1.87 | 2.19 | 1.86 |
| RM (2) | 2.34 | 1.95 | 2.32 | 1.94 | 2.27 | 1.93 |
| RM (3) | 2.58 | 2.19 | 2.56 | 2.18 | 2.51 | 2.17 |
| RM (5) | 2.83 | 2.43 | 2.81 | 2.43 | 2.75 | 2.42 |

Table 4D. Assumption: the non-China-India 1990 poverty headcount ratio is 1.5 x 20.41%=30.62%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 41.38% | 35.29% | 41.02% | 35.24% | 40.19% | 35.11% |
| CR | 45.47% | 39.38% | 45.11% | 39.33% | 44.27% | 39.20% |
| RM (4) | 49.81% | 43.73% | 49.45% | 43.67% | 48.62% | 43.54% |
| RM (2) | 50.98% | 44.89% | 50.62% | 44.84% | 49.78% | 44.71% |
| RM (3) | 54.64% | 48.56% | 54.29% | 48.50% | 53.45% | 48.37% |
| RM (5) | 58.42% | 52.34% | 58.07% | 52.28% | 57.23% | 52.16% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.35 | 1.15 | 1.34 | 1.15 | 1.31 | 1.15 |
| CR | 1.49 | 1.29 | 1.47 | 1.28 | 1.45 | 1.28 |
| RM (4) | 1.63 | 1.43 | 1.62 | 1.43 | 1.59 | 1.42 |
| RM (2) | 1.67 | 1.47 | 1.65 | 1.46 | 1.63 | 1.46 |
| RM (3) | 1.78 | 1.59 | 1.77 | 1.58 | 1.75 | 1.58 |
| RM (5) | 1.91 | 1.71 | 1.90 | 1.71 | 1.87 | 1.70 |

Table 5D. Assumption: the non-China-India 1990 poverty headcount ratio is 2 x 20.41%=40.82%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 51.44% | 45.35% | 51.08% | 45.30% | 50.24% | 45.17% |
| CR | 55.53% | 49.44% | 55.17% | 49.38% | 54.33% | 49.26% |
| RM (4) | 59.87% | 53.79% | 59.51% | 53.73% | 58.68% | 53.60% |
| RM (2) | 61.03% | 54.95% | 60.68% | 54.89% | 59.84% | 54.77% |
| RM (3) | 64.70% | 58.62% | 64.34% | 58.56% | 63.51% | 58.43% |
| RM (5) | 68.48% | 62.40% | 68.12% | 62.34% | 67.29% | 62.21% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.26 | 1.11 | 1.25 | 1.11 | 1.23 | 1.11 |
| CR | 1.36 | 1.21 | 1.35 | 1.21 | 1.33 | 1.21 |
| RM (4) | 1.47 | 1.32 | 1.46 | 1.32 | 1.44 | 1.31 |
| RM (2) | 1.50 | 1.35 | 1.49 | 1.34 | 1.47 | 1.34 |
| RM (3) | 1.59 | 1.44 | 1.58 | 1.43 | 1.56 | 1.43 |
| RM (5) | 1.68 | 1.53 | 1.67 | 1.53 | 1.65 | 1.52 |

The maximum non-China-India poverty headcount ratio in 2001 which is consistent with the hypothesis that the extent of world poverty (measured by the aggregate poverty headcount) has not increased between 1990 and 2001 is reported in the upper part of each of the tables below. it is also expressed as a share of the non-China-India 1990 poverty headcount ratio in the lower part of each table. The figures in the lower part of the tables can be interpreted as the factors by which world poverty outside India and China would have had to increase to leave world poverty unchanged between 1990 and 2001 under the specified assumptions. If the specified assumptions are maintained and if it is assumed that world poverty outside India and China increased by a factor higher than that reported in the tables, then it must be concluded that world poverty has increased.

Table 6D. Assumption: the non-China-India 1990 poverty headcount ratio is correct: 20.41 percent

| | **India** | | **India** | | **India** | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 25.00% | 18.91% | 24.75% | 18.97% | 24.18% | 19.11% |
| CR | 27.66% | 21.57% | 27.41% | 21.63% | 26.84% | 21.77% |
| RM (2) | 31.88% | 25.79% | 31.64% | 25.85% | 31.06% | 25.99% |
| RM (4) | 32.05% | 25.97% | 31.81% | 26.03% | 31.24% | 26.16% |
| RM (3) | 32.86% | 26.77% | 32.62% | 26.83% | 32.05% | 26.97% |
| RM (5) | 37.57% | 31.49% | 37.33% | 31.55% | 36.76% | 31.68% |

| | **India** | | **India** | | **India** | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic 42.10 to 21.05** | **Pessimistic 42.10 to 37.89** | **Optimistic 40 to 20** | **Pessimistic 40 to 36** | **Optimistic 35.11 to 17.56** | **Pessimistic 35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.22 | 0.93 | 1.21 | 0.93 | 1.18 | 0.94 |
| CR | 1.36 | 1.06 | 1.34 | 1.06 | 1.32 | 1.07 |
| RM (2) | 1.56 | 1.26 | 1.55 | 1.27 | 1.52 | 1.27 |
| RM (4) | 1.57 | 1.27 | 1.56 | 1.28 | 1.53 | 1.28 |
| RM (3) | 1.61 | 1.31 | 1.60 | 1.31 | 1.57 | 1.32 |
| RM (5) | 1.84 | 1.54 | 1.83 | 1.55 | 1.80 | 1.55 |

Table 7D. Assumption: the non-China-India 1990 poverty headcount ratio is 0.5 x 20.41%=10.21%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 16.49% | 10.40% | 16.24% | 10.46% | 15.67% | 10.60% |
| CR | 19.15% | 13.06% | 18.90% | 13.12% | 18.33% | 13.25% |
| RM (2) | 23.37% | 17.28% | 23.12% | 17.34% | 22.55% | 17.48% |
| RM (4) | 23.54% | 17.46% | 23.30% | 17.51% | 22.72% | 17.65% |
| RM (3) | 24.35% | 18.26% | 24.10% | 18.32% | 23.53% | 18.46% |
| RM (5) | 29.06% | 22.98% | 28.82% | 23.04% | 28.25% | 23.17% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.62 | 1.02 | 1.59 | 1.02 | 1.54 | 1.04 |
| CR | 1.88 | 1.28 | 1.85 | 1.29 | 1.80 | 1.30 |
| RM (2) | 2.29 | 1.69 | 2.27 | 1.70 | 2.21 | 1.71 |
| RM (4) | 2.31 | 1.71 | 2.28 | 1.72 | 2.23 | 1.73 |
| RM (5) | 2.85 | 2.25 | 2.82 | 2.26 | 2.77 | 2.27 |
| RM (3) | 2.39 | 1.79 | 2.36 | 1.80 | 2.31 | 1.81 |

Table 8D. Assumption: the non-China-India 1990 poverty headcount ratio is 0.75 x 20.41%=15.31%

| | India | | India | | India | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 20.74% | 14.66% | 20.50% | 14.71% | 19.93% | 14.85% |
| CR | 23.40% | 17.31% | 23.16% | 17.37% | 22.59% | 17.51% |
| RM (2) | 27.62% | 21.54% | 27.38% | 21.60% | 26.81% | 21.73% |
| RM (4) | 27.80% | 21.71% | 27.55% | 21.77% | 26.98% | 21.91% |
| RM (3) | 28.61% | 22.52% | 28.36% | 22.58% | 27.79% | 22.71% |
| RM (5) | 33.32% | 27.23% | 33.07% | 27.29% | 32.50% | 27.43% |

| | India | | India | | India | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.35 | 0.96 | 1.34 | 0.96 | 1.30 | 0.97 |
| CR | 1.53 | 1.13 | 1.51 | 1.13 | 1.48 | 1.14 |
| RM (2) | 1.80 | 1.41 | 1.79 | 1.41 | 1.75 | 1.42 |
| RM (4) | 1.82 | 1.42 | 1.80 | 1.42 | 1.76 | 1.43 |
| RM (3) | 1.87 | 1.47 | 1.85 | 1.48 | 1.82 | 1.48 |
| RM (5) | 2.18 | 1.78 | 2.16 | 1.78 | 2.12 | 1.79 |

Table 9D. Assumption: the non-China-India 1990 poverty headcount ratio is 1.5 x 20.41%=30.62%

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 33.51% | 27.42% | 33.26% | 27.48% | 32.69% | 27.62% |
| CR | 36.17% | 30.08% | 35.92% | 30.14% | 35.35% | 30.28% |
| RM (2) | 40.39% | 34.31% | 40.15% | 34.36% | 39.58% | 34.50% |
| RM (4) | 40.56% | 34.48% | 40.32% | 34.54% | 39.75% | 34.67% |
| RM (3) | 41.37% | 35.29% | 41.13% | 35.34% | 40.56% | 35.48% |
| RM (5) | 46.09% | 40.00% | 45.84% | 40.06% | 45.27% | 40.19% |

| | India | India | India | India | India | India |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.09 | 0.90 | 1.09 | 0.90 | 1.07 | 0.90 |
| CR | 1.18 | 0.98 | 1.17 | 0.98 | 1.15 | 0.99 |
| RM (2) | 1.32 | 1.12 | 1.31 | 1.12 | 1.29 | 1.13 |
| RM (4) | 1.32 | 1.13 | 1.32 | 1.13 | 1.30 | 1.13 |
| RM (3) | 1.35 | 1.15 | 1.34 | 1.15 | 1.32 | 1.16 |
| RM (5) | 1.51 | 1.31 | 1.50 | 1.31 | 1.48 | 1.31 |

Table 10D. Assumption: the non-China-India 1990 poverty headcount ratio is 2 x 20.41%=40.82%

| | India | | India | | India | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 42.02% | 35.93% | 41.78% | 35.99% | 41.20% | 36.13% |
| CR | 44.68% | 38.59% | 44.43% | 38.65% | 43.86% | 38.79% |
| RM (2) | 48.90% | 42.82% | 48.66% | 42.88% | 48.09% | 43.01% |
| RM (4) | 49.08% | 42.99% | 48.83% | 43.05% | 48.26% | 43.18% |
| RM (3) | 49.88% | 43.80% | 49.64% | 43.86% | 49.07% | 43.99% |
| RM (5) | 54.60% | 48.51% | 54.35% | 48.57% | 53.78% | 48.71% |

| | India | | India | | India | |
|---|---|---|---|---|---|---|
| **Scenario →** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** | **Optimistic** | **Pessimistic** |
| | **42.10 to 21.05** | **42.10 to 37.89** | **40 to 20** | **40 to 36** | **35.11 to 17.56** | **35.11 to 31.6** |
| **China ↓** | | | | | | |
| RM (1) | 1.03 | 0.88 | 1.02 | 0.88 | 1.01 | 0.89 |
| CR | 1.09 | 0.95 | 1.09 | 0.95 | 1.07 | 0.95 |
| RM (2) | 1.20 | 1.05 | 1.19 | 1.05 | 1.18 | 1.05 |
| RM (4) | 1.20 | 1.05 | 1.20 | 1.05 | 1.18 | 1.06 |
| RM (3) | 1.22 | 1.07 | 1.22 | 1.07 | 1.20 | 1.08 |
| RM (5) | 1.34 | 1.19 | 1.33 | 1.19 | 1.32 | 1.19 |

## Appendix E. Comparison between ECLA and World Bank poverty estimates for Latin American countries

We present below estimates of the headcount ratios published by the UN Economic Commission for Latin America (ECLA) for a set of Latin American countries for two poverty lines: an upper nutritionally-based poverty line and a lower nutritionally-based poverty line (see Altimir (1979)).[21] Only those countries for which the poverty headcount ratios are reported by ECLA for a year that is within five years of 1990 are included in the table below. We compare these with the estimates of the $1.08/day headcount ratio for the same countries and closest years as estimated by the CR methodology and the World Bank's on-line POVCALNET database.[22] Poverty headcount ratios for the region as a whole in 1990 are as reported by ECLA, and as estimated by POVCALNET by using the CR methodology.[23]

| | CR | | ECLA | | |
|---|---|---|---|---|---|
| **Country** | Year | 1990 Poverty headcount ratio<br><br>Poverty line: $1.08/day | Year | Poverty headcount ratios | |
| | | | | Upper poverty line | Lower poverty line |
| Brazil | 1990 | 14.04 | 1990 | 41 | 18 |
| Chile | 1990 | 4.85 | 1990 | 33 | 11 |
| Colombia | 1991 | 2.82 | 1991 | 50 | 23 |
| Costa Rica | 1990 | 5.24 | 1990 | 24 | 10 |
| El Salvador | 1995 | 25.05 | 1995 | 48 | 19 |
| Guatemala | 1987 | 47.04 | 1986 | 68 | 43 |
| Honduras | 1990 | 37.83 | 1990 | 75 | 54 |
| Mexico | 1989 | 8.32 | 1989 | 39 | 14 |
| Panama | 1991 | 11.81 | 1991 | 36 | 16 |
| Peru | 1985.5 | 1.14 | 1986 | 52 | 25 |
| Venezuela | 1990 | 2.97 | 1990 | 34 | 12 |
| **Latin America** | **1990** | **11.64** | **1990** | **41** | **18** |

[21] The Economic Commission for Latin America *Social Panorama of Latin America, 1990-2000* (Spanish version), pp. 269-270. http://www.eclac.cl/publicaciones/SecretariaEjecutiva/8/lcg2068/Anexos_2000.pdf (accessed 05.26.2005).

[22] The database is available at: http://iresearch.worldbank.org/PovcalNet/jsp/index.jsp

[23] The ECLA headcount ratio for Latin America is as reported in Table 14 of the *Social Panorama of Latin America, 1990-2000*. The CR headcount ratio for Latin America was calculated using POVCALNET for 1990, aggregating exactly the same set of countries as included in the ECLA table to produce a regional headcount ratio. Default PPPs were used.

## Appendix F. Results (Poverty line: $ 2.15 / day)

Table 1F. Minimum 2001 non-China-India poverty headcount ratio consistent with the world poverty headcount ratio having increased between 1990 and 2001. The lower part of the table contains the ratio between the 2001 non-China-India HCR and the assumed 1990 HCR, i.e., the maximum increase in poverty outside China and India consistent with the conclusion that world poverty has fallen.

| **1990 Non-China-India HCR (CR)[24] multiplied by a factor of →** | **0.5** | **0.75** | **1** | **1.5** | **2** |
|---|---|---|---|---|---|
| **China: ↓** | | | | | |
| RM (4)* | 36.09% | 47.46% | 58.83% | 81.58% | 104.33% |
| RM (1)* | 37.20% | 48.57% | 59.95% | 82.69% | 105.44% |
| CR 2004 | 37.43% | 48.80% | 60.18% | 82.92% | 105.67% |
| RM (6)* | 40.32% | 51.70% | 63.07% | 85.82% | 108.57% |
| RM (2)* | 41.61% | 52.98% | 64.35% | 87.10% | 109.85% |
| RM (5)* | 45.01% | 56.39% | 67.76% | 90.51% | 113.26% |
| | | | | | |
| RM (4)* | 1.56 | 1.37 | 1.27 | 1.18 | 1.13 |
| RM (1)* | 1.61 | 1.40 | 1.30 | 1.19 | 1.14 |
| CR 2004 | 1.62 | 1.41 | 1.30 | 1.20 | 1.14 |
| RM (6)* | 1.75 | 1.49 | 1.37 | 1.24 | 1.18 |
| RM (2)* | 1.80 | 1.53 | 1.39 | 1.26 | 1.19 |
| RM (5)* | 1.95 | 1.63 | 1.47 | 1.31 | 1.23 |

[24] 46.16 percent.

Table 2F. Minimum 2001 non-China-India poverty headcount ratio consistent with the world aggregate poverty headcount having increased between 1990 and 2001. The second part of the table contains the ratio between the 2001 non-China-India HCR and the assumed 1990 HCR, i.e. the maximum increase in poverty outside China and India consistent with the conclusion that world poverty has fallen.

| **1990 Non-China-India HCR (CR)[25] multiplied by a factor of →** | **0.5** | **0.75** | **1** | **1.5** | **2** |
|---|---|---|---|---|---|
| **China: ↓** | | | | | |
| CR 2004 | 24.03% | 33.66% | 43.28% | 62.53% | 81.78% |
| RM (6)* | 25.22% | 34.84% | 44.46% | 63.71% | 82.96% |
| RM (1)* | 25.54% | 35.17% | 44.79% | 64.04% | 83.29% |
| RM (4)* | 25.75% | 35.37% | 45.00% | 64.24% | 83.49% |
| RM (2)* | 27.18% | 36.80% | 46.43% | 65.68% | 84.93% |
| RM (5)* | 31.57% | 41.19% | 50.82% | 70.07% | 89.32% |
| | | | | | |
| CR 2004 | 1.04 | 0.97 | 0.94 | 0.90 | 0.89 |
| RM (6)* | 1.09 | 1.01 | 0.96 | 0.92 | 0.90 |
| RM (1)* | 1.11 | 1.02 | 0.97 | 0.92 | 0.90 |
| RM (4)* | 1.12 | 1.02 | 0.97 | 0.93 | 0.90 |
| RM (2)* | 1.18 | 1.06 | 1.01 | 0.95 | 0.92 |
| RM (5)* | 1.37 | 1.19 | 1.10 | 1.01 | 0.97 |

[25] 46.16 percent.