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Weakly Relative Poverty

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Abstract: Prevailing measures of relative poverty are unchanged when all incomes grow or contract by the same proportion. This property stems from seemingly implausible assumptions about the disutility of relative deprivation and the cost of social inclusion. We propose "weakly relative" lines that relax these assumptions. On calibrating our measures to national poverty lines and survey data, we find that half the population of the developing world in 2005 lived in poverty, only half of whom were absolutely poor. The total number of poor rose over 1981-2005, despite falling numbers of absolutely poor. With sustained economic growth, the incidence of relative poverty became less responsive to further growth. The number of relatively poor rose, just as the numbers of absolutely poor fell.

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1. Introduction

The methods used to set poverty lines have differed radically between rich and poor countries. Poverty in the developing world is typically measured using absolute lines, which aim to have the same real value at different dates and places. Virtually all developing countries use such lines and, at the global level, the World Bank's "$1-a-day" line is an absolute line, aiming to have the same purchasing power in different countries and at different dates.[2] By contrast, the more common practice in OECD countries is to use what we shall call "strongly relative poverty lines," which are set at a constant proportion—typically 40-60%—of the (date and country-specific) mean or median income.[3]

This difference in how poverty lines are set matters greatly to the properties of the resulting poverty measures. The bulk of the literature has confined attention to measures that are homogeneous of degree zero between the mean and the poverty line for any given Lorenz curve.[4] Using an absolute line, such a poverty measure automatically falls when all incomes grow at the same rate, while any measure based on strongly relative lines will be unchanged.[5] So it is hardly surprising that this choice has been found to matter greatly to assessments of how poverty is changing over time,[6] as well as to cross-sectional poverty comparisons.[7]

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[2] The original "$1-a-day" was proposed by Ravallion et al. (1991) in a background paper for World Bank (1990); the latest update is Ravallion et al. (2008).

[3] Examples for OECD countries include Smeeding et al. (1990), Atkinson (1998), Saunders and Smeeding (2002), Fouarge and Layte (2005), Eurostat (2005), Nolan (2007) and OECD (2008, Chapter 5). An exception is the official poverty line for the US, which is three times the cost of a subsistence food basket, as first proposed by Orshansky (1963). However, there has been considerable dissatisfaction with this line; for a review of the debates see Blank (2008). There has been some debate about whether the poverty measure should be anchored to the mean or the median (Saunders and Smeeding, 2002; Easton, 2002; de Mesnard, 2007); poverty lines set as a constant proportion of the median can have perverse properties when the Lorenz curve shifts (as shown by de Mesnard, 2007). This is a legitimate concern but is not central to the present paper.

[4] This holds for the headcount index, poverty gap index, and indeed the entire class of Foster-Greer-Thorbecke (1984) measures, as well as the Watts index and many other measures. Note that the two types of measures are typically calculated on the same distribution of relative incomes, i.e., the same Lorenz curve.

[5] Note also that, for a given Lorenz curve, the median is directly proportional to the mean. Thus this strong relativity property also holds when the poverty line is a fixed proportion of the median.

[6] For example, the UNDP (2005, Box 3) (based on Nolan et al., 2005) showed how relative poverty measures for Ireland were rising despite higher absolute living standards for the poor; thus the UNDP (p. 334) warns that: "…when economic conditions change rapidly, relative poverty measures do not always present a complete picture of the ways that economic change affects people's lives." In another example, Easton (2002) argued that relative measures for New Zealand were deceptive in showed falling poverty despite lower levels of living for the poor.

[7] For example, OECD (2008, Chapter 5) reports the same poverty rate for the US as Mexico. In another example, the urban poverty line proposed by Osberg and Xu (2008) for China (set at half the median) is 2.4 times their rural line, or 1.7 times when deflated by the Ravallion and Chen (2007) absolute lines. The Osberg-Xu method suggests little difference in poverty incidence between urban and rural China, while the Ravallion-Chen method indicates far higher poverty measures in rural China.

Using an absolute line, any two people with the same purchasing power over commodities, but living in different countries, are treated the same way, in that both are either poor or not poor. However, relative poverty measures only treat them the same way if the two countries have the same mean income. Two main arguments can be identified in support of the use of relative lines.[8] The first views poverty lines as money-metrics of utility and claims that people attach value to their income relative to the mean in their country of residence. Since this presumes that relative income is a source of utility it can be described as "welfarist." While the idea that utility anchors poverty lines is not common in applied work, it is consistent with a strand of the literature on welfare measurement in economics whereby cost-of-living indices and equivalence scales are anchored to some reference level of utility.[9]

The second ("non-welfarist") argument is more common in practice. Essentially this says that poverty lines should allow for differences in the cost of social inclusion, which can be defined as the expenditure needed to cover certain commodities that are deemed to have a role in assuring that a person can participate with dignity in customary social and economic activities.[10] This argument does not rest on the view that social inclusion is a (direct or indirect) source of utility. Rather it is seen as a desired capability for not being deemed "poor" in a specific context. The most influential exponent of this line of argument has clearly been Sen (1983, 1985), who argued that it is a person's capabilities that should be seen as absolute; in the context of poverty measurement, this means that "…an absolute approach in the space of capabilities translates into a relative approach in the space of commodities" (Sen, 1983, p. 168). Relative poverty in the income space is then seen as the logical implication of absolute poverty in the capability space. If, additionally, the cost of social inclusion is directly proportional to mean income in the country of residence then one can justify a strongly relative poverty line.

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[8] A third justification sometimes heard is that strongly relative measures remove the effects of cross-country differences in survey methods and measurement practices; see, for example, UNDP (2005, Box 3). This only holds for distribution-neutral differences and if one accepts the following welfare justifications for strongly relative measures; if they are not accepted then it is unclear in what sense strongly relative lines are comparable across countries, given that their real values are likely to vary so much. The data justification is thus secondary.

[9] On the welfarist interpretation of a poverty line as a point on the consumer's cost function corresponding to a reference level of utility see Blackorby and Donaldson (1987). For a broader overview of economic approaches to welfare measurement see Slesnick (1998).

[10] It can be granted that "social inclusion" is a broader concept than this definition allows, and may well require more than commodities, including, for example, freedom from discrimination according to gender or ethnicity. However, the concern here is with the measurement of poverty in terms of command over commodities.

Both the welfarist and non-welfarist arguments can claim some support from past thinking and evidence. The idea that people care about relative income has a long history. It is sometimes called the theory of relative deprivation (RD), following Runciman (1966), although economists often refer to it as the "relative income hypothesis," following Duesenberry (1949). Some version of RD has often been invoked to explain observed behavior.[11] While early discussions lacked evidence on the existence of RD effects, there is now a body of supportive evidence from both observational studies and experiments, though mainly in developed-country settings. Experiments have suggested that relative position matters to behavior.[12] Regressions for self-reported "satisfaction with life" or perceived economic welfare have also found results broadly consistent with the idea of RD.[13] There has been much less research on whether very poor people care about RD; in one of the few studies, Ravallion and Lokshin (2007) found evidence for Malawi that, for very poor people, the positive externalities from having better-off friends and neighbors outweighed the negative externalities through RD, although this pattern reversed at higher income levels.

The idea that certain socially-specific expenditures can be deemed essential for social inclusion is also long-standing. Famously, Adam Smith (1776, Book 5, Chapter 2, Article 4) pointed to the social-inclusion role of a linen shirt in eighteenth century Europe:

> "A linen shirt, for example, is, strictly speaking, not a necessary of life. The Greeks and Romans lived, I suppose, very comfortably though they had no linen. But in the present times, through the greater part of Europe, a creditable day-labourer would be ashamed to appear in public without a linen shirt, the want of which would be supposed to denote that disgraceful degree of poverty which, it is presumed, nobody can well fall into without extreme bad conduct."

The social roles of certain forms of consumption have also been noted from research in poor countries. Anthropologists have pointed to the social roles played by festivals, celebrations and communal feasts; see, for example, Geertz (1976) and Fuller (1999, Chapter 6). Rao (2002) documents the importance of celebrations to maintaining the social networks that are crucial to coping with poverty in rural India. Banerjee and Duflo (2007) report seemingly high expenditures on celebrations and festivals by very poor people in survey data for a number of

[11] Easterlin (1974) used RD to explain why economic growth in the US has had little effect on the proportion of people who think they are happy. Other examples of the use of relativism to explain behavior can be found in Frank (1997), Oswald (1997), Fehr and Schmidt (1999), Walker and Smith (2001) and Hopkins (2008).

[12] See, for example, Fehr and Schmidt (1999) and Alpizar et al (2005).

[13] Examples include van de Stadt et al., (1985), Clark and Oswald (1996), Solnick and Hemenway (1998), Pradhan and Ravallion (2000), Ravallion and Lokshin (2002, 2007), McBride (2001), Blanchflower and Oswald (2004), Kingdon and Knight (2007), Ferrer-i-Carbonell (2005), Luttmer (2005) and Fafchamps and Shilpi (2009).

developing countries. In Yemen, participants at "qat sessions" discuss local economic and social affairs while chewing this mild stimulant; these sessions serve an important social role—and no less so for poor people—such that "refusing to take qat is tantamount to accepting ostracisation" (Milanovic, 2008, p.684). Clothing can also serve a social role. Friedman (1990) describes how poor Congolese acquired clothing with a conspicuous "designer label," which he interpreted as status-seeking behavior. A field experiment by van Kempen (2004) revealed that poor people in Bolivia were willing to pay a premium for a designer label, which (he argues) serves as a symbolic expression of social identity for the poor (van Kempen, 2004, p.222).[14]

In the light of such observations there is a case for asking what a global relative poverty measure for the developing world might look like, analogous to the widely cited "$1-a-day" absolute measures. The purpose of this paper is to provide such a poverty measure. However, we argue that neither the welfarist nor capabilities-based arguments above are fully convincing as justifications for strongly relative lines. We argue that the welfarist justification requires an implausibly high weight on relative position and the non-welfarist, capability-based, justification makes the implausible assumption that the cost of inclusion goes to zero in the limit as a person becomes very poor.

We propose instead that poverty measures should satisfy the following weak relativity axiom (WRA): *If all incomes increase (decrease) by the same proportion then an aggregate poverty measure must fall (rise).* In any standard poverty measure this will be satisfied as long as the elasticity of the poverty line to the mean does not exceed unity.

One can find antecedents to this idea in the literature. Research on social-subjective poverty lines—poverty lines based on responses to survey questions concerning the "minimum income to make ends meet" or perceived consumption adequacy[15]—has pointed to mean-income elasticities of the poverty line less than unity.[16] The proposals made by the 1995 panel of the National Research Council (NRC) for revising the official poverty line of the US would also be likely to generate poverty lines with a positive (though inter-temporally variable) elasticity less

[14] For a more general discussion of the social-symbolic roles that consumption can play see Khalil (2000).

[15] See Groedhart et al. (1977), Kapteyn, Kooreman and Willemse (1988) and Pradhan and Ravallion (2000).

[16] Hagenaars and van Praag (1985) estimate an elasticity of 0.51 for eight European countries. Kilpatrick (1973) estimated an elasticity of about 0.6 for subjective poverty lines in the US.

than unity.[17] Each of these approaches can be questioned.[18] However, most importantly for the present paper, these approaches are not operational for global poverty measurement. We need a schedule of weakly relative poverty lines with global applicability.

Past global poverty measures have been anchored to national poverty lines converted to international $'s at purchasing power parity (PPP). The original "$1-a-day" line was an average for low-income countries (Ravallion et al., 1991). Atkinson and Bourguignon (AB) (2001) proposed a schedule of global poverty lines also calibrated to national lines. These were hybrid lines, being absolute for low-income countries (set at the $1-a-day line) and strongly relative for middle income and developed countries.[19] We follow the same approach of using national poverty lines to identify our proposed schedule of weakly relative poverty lines.

The following section proposes our new measures of "weakly relative poverty." Section 3 discusses the identification assumptions, while section 4 describes key features of the data. Section 5 calibrates the parameters of our poverty lines to the observed relationship across countries between national poverty lines and mean consumption. Section 6 presents our estimates of the new measures of relative poverty. Section 7 concludes.

2. Revisiting the theory of relative poverty lines

An exclusive focus on absolute poverty is justified if one accepts two axioms: subgroup additivity and subgroup anonymity (Ravallion, 2008). The first says that aggregate poverty is the sum of all individual levels of poverty in the population, implying that if poverty increases in any subgroup, and does not change for any other group, then aggregate poverty must increase.[20] The practice of poverty measurement has largely been confined to such additive measures.[21] Less attention has been paid to subgroup anonymity, which says that moving a person between

[17] The panel recommended that US poverty lines should be anchored to median expenditures on food, clothing and shelter (Citro and Michael, 1995). Given that these goods tend to be necessities, they will have an elasticity with respect to mean income less than unity.

[18] For example, in the case of the proposal by the NRC panel it is unclear why concerns about relative poverty would apply only to necessities; it would seem more natural to assume that the income gradient in a poverty line stems from social inclusion needs that go beyond necessities in a country such as the US.

[19] Chen and Ravallion (2001, 2004) implemented a slight variation on the AB lines but their lines were still strongly relative above a critical level of consumption.

[20] This is the "subgroup monotonicity axiom" of Foster and Shorrocks (1991).

[21] Examples include the widely used Foster-Greer-Thorbecke (1984) class of measures. Atkinson (1987) reviews other additive measures in the literature. Additivity is not universally accepted; see the discussion in Foster and Sen (1997); Sen 's (1976) poverty measure is an example of a not additive.

groups, with no absolute loss to own consumption, cannot increase aggregate poverty. This precludes the possibility that a person's poverty depends on her income relative to her group.

As discussed in the introduction, both welfarist and non-welfarist arguments can be made for relaxing anonymity. The following discussion will show how weakly relative poverty lines can be derived consistently with both approaches.

The welfarist interpretation argues that poverty should be seen as absolute in the space of "welfare," rather than in the consumption or income space, and that welfare depends (positively) on both own income and relative income—own income relative to mean income in the country of residence.[22] It follows that for a poverty line to be a money-metric of welfare it must be an increasing function of mean income. To see this more formally, suppose that welfare depends on "own income," Y, and "relative income," Y/M, where M is the mean for the country of residence. Welfare is $V(Y, Y/M)$, which is taken to be smoothly non-decreasing in both Y and Y/M. The poverty line in income space is denoted Z and is defined implicitly by:

$$\bar{V} = V(Z,\ Z/M) \tag{1}$$

where $\bar{V}$ is the fixed poverty line in the welfare space. Letting η denote the elasticity of Z with respect to M, it is readily verified that:

$$\eta = \frac{1}{1\ +\ M.MRS} \quad (0 \leq \eta \leq 1) \tag{2}$$

where MRS is the marginal rate of substitution of relative income for own income ($MRS = V_Y / V_{Y/M}$), interpretable as the weight on own income divided by that on relative income. If η=0 then relative income does not matter (its weight is zero and so the MRS goes to infinity), while η=1 implies that <u>only</u> relative income matters (zero weight on own income). Thus we can state the following result:

> *<u>Proposition 1</u>: Welfarist poverty lines satisfy the Weak Relativity Axiom as long as both own income and relative income are valued positively.*

Notice that the elasticity of the poverty line (η) will only rise with the mean if the weight attached to relative income rises sufficiently. More precisely, η will be increasing in M if (and only if) the elasticity of the MRS with respect to M is less than -1.

[22] One can certainly question whether this is the appropriate reference group for relativist comparisons at the individual level; see, for example, the discussion of reference groups in Ravallion and Lokshin (2007) and references therein. However, it is the relevant group for the problem at hand of measuring global poverty.

The utility of relative income has not, however, been the main argument made for relative poverty lines. Rather, the case has been seen to rest on the view that there are certain demands on income that are socially determined and that a person is absolutely deprived if those demands cannot be met in a specific social context.

Atkinson and Bourguignon (2001) proposed a neat way of implementing this idea for the purpose of measuring global poverty. They postulated two key capabilities: physical survival and social inclusion. The former is the capability of being adequately nourished and clothed for meeting the physical needs of survival and normal activities. On top of this, a person must also satisfy certain social inclusion needs, which are assumed to be directly proportional to mean consumption in the country of residence. Each capability has a corresponding poverty line, giving the absolute and relative lines. The AB proposal is that one should only be deemed "not poor" if one is neither absolutely poor nor relatively poor. Letting Z^* be the minimum expenditure needed to assure that basic consumption needs are met, measured at purchasing power parity (PPP), the AB poverty line for country *i* is:

$$Z_i^{AB} = \max(Z^*, kM_i) \quad (0 < k < 1) \tag{3}$$

There are two unknown parameters in (3), Z^* and *k*. AB proposed that Z^* should be set at the World Bank's "$1-a-day" line, on the grounds that this can be considered a reasonably lower bound, since it is anchored to the poverty lines found in the poorest countries (Ravallion et al., 1991). AB then argued that the value of *k* could also be based on national poverty lines above those found in the poorest countries, by studying how those lines vary with man consumption in the original data base of poverty lines used by Ravallion et al. (1991) to set the "$1-a-day" line. By visual inspection of the Ravallion et al. (1991) data set on national poverty lines at 1985 PPP, Atkinson and Bourguignon set *k*=0.37. Subsequently, Chen and Ravallion (2001) found that *k*=1/3 gave a better fit with the Ravallion et al. (1991) data set at 1993 PPP.

However, the AB line fails the WRA in that it has an elasticity of unity for all countries with $M_i > Z^* / k$. This is surely implausible. The idea that distribution-neutral growth has no impact on the extent of poverty in new middle-income countries such as China would surely be very hard to accept (not least, we would conjecture, in China). The violation of the WEA stems from the seemingly implausible assumption that the cost of social inclusion is directly

proportional to the mean. While the costs of social-inclusion may be very low for very poor people, they are unlikely to vanish in the limit.

To address this concern, while preserving the neatness of the AB solution, we propose the following "generalized AB poverty line":

$$Z = \max(Z^*, \alpha + kM_i) \quad (4)$$

This adds a third parameter, $\alpha \geq 0$, which is the lower bound to social-inclusion needs. The elasticity is strictly less than unity for $\alpha > 0$. We can thus state:

Proposition 2: The generalized Atkinson-Bourguignon poverty lines satisfy the Weak Relativity Axiom as long as the cost of social inclusion has a positive lower bound.

3. Identification from national poverty lines

The original "$1-a-day" line was chosen to be representative of the national poverty lines found in the poorest countries (Ravallion, et al., 1991), and this principle has guided subsequent updates (Chen and Ravallion, 2001; Ravallion et al., 2009). We follow Atkinson and Bourguignon (2001) and Chen and Ravallion (2001) in also calibrating the whole schedule of relative poverty lines to data on how national poverty lines vary across countries. In other words, we assume that the differences in the real value of poverty lines between countries at different levels of mean consumption reflect differences in either the value attached to relative deprivation (following the welfarist approach outlined above) or differences in the costs of social inclusion needs (following the non-welfarist approach). Our empirical implementation makes the further assumption that our global (weakly) relative poverty lines change over time consistently with the cross-sectional variation seen between countries. This section reviews the arguments that can be made for and against these identifying assumptions.

From a welfarist perspective, it is plausible that absolute consumption needs dominate subjective welfare at very low levels of consumption but that, as countries become richer, people attach higher value to relative position, and there are both theoretical and empirical arguments that can be used to support that view (Ravallion and Lokshin, 2007; Ravallion, 2008). Similarly, it is plausible that perceptions of what it means to be socially excluded evolve with the overall level of economic development.

The issue here is whether these differences will be reflected in national poverty lines. Such lines must invariably pass a test of their social relevance in the specific country context.[23] A poverty line that is too frugal by the standards of society will no doubt be seen as such by those constructing that line, and so be rejected. Similarly, a line that is too generous will not be easily accepted either. As argued by Ravallion (1998, 2008b), the very process of setting a national poverty line entails enumerable choices that appear to be guided in large part by a desire for the line to be accepted in the specific context.

This argument would seem more plausible for the capabilities-based approach than the welfarist approach based on relative deprivation. Some set of "capabilities" is an (implicit or explicit) foundation for most poverty lines used in practice. Nutritional needs for good health and normal activities are commonly identified, although there is considerable discretion in terms of how such needs are mapped into the consumption space. In a poor country, it is socially acceptable, and common, to allow a poverty line to attain almost all of the stipulated nutritional requirements (2100 calories per day, say) with one or two starchy food staples, while in a middle-income or rich country the stipulated diet is far more diverse (and palatable). Allowances for non-food consumption introduce even more discretion, and it seems plausible that ideas about social inclusion needs in specific societies would come to play an important role, particularly (but not only) for the non-food allowances. It would hardly seem credible that the national poverty lines that emerge from the choices made in their calibration would not come to reflect prevailing views about what poverty means in the specific context.

The apparent stickiness of real national poverty lines over time sits uncomfortably with this view. While relative poverty lines used in OECD countries and by Eurostat are automatically adjusted over time in line with the changes in the mean (or median), it does not appear to be common to see official poverty lines in growing developing economies being revised upwards in real terms. However, it is not necessarily inconsistent with our approach to find that the real level of the poverty line is resistant to change in some growing economies. For one thing, it may well be the case that a (positive) minimum aggregate income gain to a low-income country is needed before upward pressure on the poverty line emerges; in fact that is implied by our weakly relative poverty lines based on equation (4). It must also be acknowledged that there can be a strong

[23] This is no less true of the poverty lines constructed for World Bank *Poverty Assessments*, which emerge out of close collaboration between the technical team (often including local statistical staff and academics) and the government of the country concerned.

political resistance to revising the poverty line.[24] The fact that actual poverty lines in practice are sticky is not a compelling reason against allowing them to vary for the purposes of measuring global relative poverty.

There are, of course, random differences in national lines at given mean consumption or income that one would not want to attach any normative significance to in measuring global poverty. The fact that there is political resistance to revising real poverty lines upwards, and that they are set at different times in different countries, will create random differences in the poverty lines found at given current mean consumption. There are also differences in methodologies used to set poverty lines in practice (as discussed in Ravallion et al., 2009). The issue here is whether there is a systematic pattern in the conditional mean national poverty line (conditional on mean consumption), such that it has a very low gradient amongst poor countries but then rises with mean consumption. Such a pattern was first found in national poverty lines by Ravallion et al. (1991) and we will confirm below that it is also evident in new data on national lines.

4. Data for measuring global relative poverty

In measuring relative poverty in the developing world we shall draw on three new data sources. The first is a new compilation of national poverty lines documented in Ravallion, Chen and Sangraula (RCS) (2009). This exploits the new analytic work on poverty at country level that has been done since 1990, when Ravallion et al. (1991) collected the data on national poverty lines used for setting the "$1-a-day" line (and by AB for setting their encompassing line). Much of the new work has been done under the World Bank's program of country *Poverty Assessments* and the program of *Poverty Reduction Strategy Papers* by national governments, often with assistance from the Bank or other governments or international agencies. There were very few of these studies available in 1990, but they have now been done for some 100 developing countries. Almost all include estimates of national poverty lines.

Second, we use the PPP of individual consumption by households from the latest (2005) round of the *International Comparison Program* (ICP) (World Bank, 2008). This is the most

[24] See, for example, the discussion in Blank (2008) on why the official poverty line in the US has not been updated, despite considerable dissatisfaction with the old line, proposed in 1963 and only updated for inflation since. Similarly, the poverty line in China has not been revised upwards in real terms for over 20 years, despite a four-fold increase in mean income. This has led many observers to question the relevance of their poverty lines to current conditions; see, for example, Osberg and Xu (2008). The government of China is in the process of revising upwards the country's official poverty lines. The Planning Commission of the Government of India is also revisiting the country's official poverty line.

ambitious round to date of the ICP and entailed a substantial improvement in data quality for estimating PPP's. For the purpose of measuring global poverty, an important feature of the 2005 ICP is that it did a much better job of collecting the prices needed to measure living costs. Reliable price surveys are quite difficult to do, particularly in poor countries where non-traded goods are a large share of spending. The new surveys done for the 2005 ICP used far more elaborate product descriptions to help identify comparable goods, so that we do not make the mistake of judging people to be better off because they consume lower quality (and hence cheaper) goods. However, there are also a number of concerns about the 2005 ICP round in this context.[25] These include a likely "urban bias" in the price surveys for some countries and the fact that the ICP is designed for comparing national accounts aggregates rather than poverty measurement.[26]

Third, we use our own compilation of 675 household surveys for 115 countries; the latest survey rounds cover a total of 1.23 million randomly sampled households. Chen and Ravallion (2008a) provide a listing of the countries and years; further details can be found in the *PovcalNet* site. The surveys were mostly done by governmental statistics offices. We have estimated all poverty measures from the primary (unit record or specially commissioned tabulations) survey data. Households are ranked by either consumption or income per person; we have preferred consumption, which is available for about 60% of the surveys. The distributions are weighted by household size and sample expansion factors. Thus our poverty counts give the number of people living in households with per capita consumption or income below the poverty line. Interpolation methods (described in Chen and Ravallion, 2004, 2008) are used to line up the survey-based estimates with the reference years at three-yearly intervals over 1981-2005.

Figure 1 plots the national poverty lines for developing countries against private consumption per capita from the National Accounts, both converted to international $'s using the 2005 household consumption PPP from the ICP. We see that the national poverty line tends to rise with mean consumption, which we call the "economic gradient." The least squares estimate of the elasticity of Z to M is 0.655 (with a t-ratio of 13.68, based on a robust standard error).[27] This is significantly less than unity (t=7.21). So these data are not consistent with strongly

[25] For an overview of the issues in constructing PPPs see Deaton and Heston (2008). On the impacts of some of the methodological choices on global poverty measures see Ackland et al. (2008).

[26] China is an important example of this urban bias; for further discussion and a description of how we have attempted to correct for this bias see Chen and Ravallion (2008b).

[27] The estimate is also robust to outliers; a median quantile regression gave 0.647 (t=9.57).

relative poverty in developing countries, but they are consistent with the weakly-relative poverty—a national poverty line that rises with mean consumption, but with an elasticity less than unity.

However, Figure 1 also suggests that the economic gradient only emerges once mean consumption is above a critical level. Figure 1 gives a nonparametric regression of the national poverty lines against log mean consumption.[28] So the same pattern found by Ravallion et al. (1991) using their compilations of national poverty lines for the 1980s is evident in Figure 1, with the poverty line rising with mean consumption, but with a low elasticity initially.

The data in Figure 1 will be used in the following section to calibrate our proposed schedule of weakly relative poverty lines.

5. Empirical implementation and implications

Recall that there are three parameters to our schedule of relative poverty lines in (4), namely Z^*, α and *k*. We set these to \$1.25 a day, \$0.60 a day and 1/3 respectively, giving the following schedule of relative poverty lines (in \$'s per day at the 2005 PPP for household consumption):

$$Z_i \equiv \max[\$1.25,\ \$0.60 + M_i / 3] = \$0.60 + \max[\$0.65,\ M_i / 3] \qquad (5)$$

The value of $\hat{Z}^*$ =\$1.25 a day is the international poverty line proposed by RCS, which is the average poverty line amongst the poorest 15 countries (although the line is quite robust to small changes in the number of countries, as shown by RCS). A visual inspection of the scatter plot in Figure 1 suggests that a positive slope starts to emerge at a log of monthly consumption of around 4, corresponding to about \$2 a day, and that the gradient is about one-in-three. The parameter choices in (5) were confirmed econometrically, using a suitably constrained version of Hansen's (2002) method for estimating a piece-wise linear ("threshold") model. (The variation on Hansen's model is that, in our case, the slope of the lower linear segment is constrained to be zero and there is no potential discontinuity at the threshold.) This gave $\hat{Z}^*$ =\$1.23 (t=6.36) and $\hat{k} = 0.325$ (t=12.70).[29]

[28] We use STATA's Locally Weighted Scatter Plot Smoothing method with the default bandwidth (0.8).

[29] By this method one essentially estimates (1) for each possible value of consumption in the data and picks the value that minimizes the residual sum of squares The variation on Hansen's model is that, in our case, the slope of the lower linear segment is constrained to be zero and there is no potential discontinuity at the threshold. We are grateful to Michael Lokshin for programming Hansen's method.

We can also provide a number of other statistical tests that confirm this choice. There is a high correlation between the poverty lines implied by (5) for our sample and the nonparametric regression function in Figure 1 (r=0.994) as well as with the data on national poverty lines (r=0.836). Equation (5) also outperforms a wide range of smooth parametric functional forms. Indeed, remarkably, the standard error in predicting the national lines is actually lower using equation (5) than the nonparametric regression in Figure 1; the standard deviation of the error is \$1.19 for our poverty lines versus \$1.20 for the fitted values using the smoothness parameter for the regression in Figure 1. (Of course, a sufficiently less smooth nonparametric regression would do better than our piece-wise linear model.) There is no correlation between the errors in predicting the national poverty lines using (5) and the fitted values of the nonparametric regression in Figure 1 (the correlation coefficient is 0.02). As a further test, neither the fitted values from the nonparametric regression in Figure 1 nor a cubic polynomial in *M* were significant when added to a regression of the national poverty lines on Z given by (5).[30]

The bold unbroken line in Figure 2 gives our weakly-relative schedule in (5). In our data set of national poverty lines, Z_i varies from \$1.25 a day to \$8 a day.[31] The fact that the rising portion of our poverty lines in (5) is not homogeneous immediately implies that the elasticity of the poverty line to mean consumption is below unity throughout (the elasticity goes to unity in the limit, as consumption goes to infinity). The elasticity is zero at $M < \$1.95$ and then rises from 0.5 to close to 1.0 over the sample range. The consumption level at which the kink (above which the poverty line rises with the mean) occurred in the Chen Ravallion (2001) version of the AB schedule of relative poverty lines is appreciably higher than for our new schedule. For the Chen and Ravallion (2001) relative lines the kink was at a consumption level of \$3.24 per day at 1993 PPP, while the new schedule of relative poverty lines in equation (5) has a kink at \$1.95 a day at 2005 PPP. If we had instead chosen $\max(\$1.25, M_i/3)$ as the relative poverty line at 2005 PPP, the kink would be at a consumption level of \$3.75 a day instead of \$1.95. This reflects

[30] The joint F test of the null that the three parameters in the cubic function of *M* are all zero in the regression of national poverty lines on *Z* given by equation (5) gave F(3,69)=0.14 (prob.=0.93) while the t-test on the coefficient on the fitted values when added to the same regression was t=0.44.

[31] There are three special cases: China, India and Indonesia. For these countries, we have separate rural and urban distribution data from 1981 to 2005. In addition, for China and India we have separate rural and urban CPI over time. We treat the relative poverty line based on (5) as the national line for India and Indonesia, and then back out the rural and urban poverty lines using the urban-rural differentials in national lines. For China, the 2005 PPP is an urban PPP, so we set the urban relative poverty line as the national line, and adjust the rural relative poverty line down according to the ratio of urban to rural poverty lines (following Chen and Ravallion 2008b).

the fact that our weakly relative measures allow $\alpha > 0$, thus shifting up the schedule (Figure 2). There are 18 countries with *M* in the interval ($1.95, $3.75), i.e., there are an extra 18 countries in the segment where the absolute line is no longer binding.

So our new data on national poverty lines suggest that relative poverty is a more prominent concern than past work indicated. This echoes our finding that the overall elasticity of the poverty line to the mean in our sample is quite high—less than unity but similar to some past estimates for developed countries.

What might we expect on *a priori* grounds about the trends over time in weakly relative poverty, as compared to absolute poverty? That will depend in part on how the distribution of relative incomes evolves. As a stylized fact, there is no correlation across countries between rates of growth and rates of change in a standard measure of relative inequality.[32] In other words, amongst developing countries, economic growth tends to be distribution-neutral on average.[33] This motivates a consideration of distribution-neutral growth as a benchmark case. To see how the trend rates of reduction in the poverty rate will differ using our relative poverty measure under distribution-neutral growth, let $F_i(Z_i)$ denote the proportion of the population of country *i* living below our weakly relative poverty line, while $F_i(Z^*)$ is the corresponding poverty rate using the absolute line. Under a distribution-neutral growth process it is readily verified that the proportionate rates of poverty reduction are:[34]

$$\frac{d\ln F_i(Z_i)}{dt} = \left[1 - \frac{d\ln Z_i}{d\ln M_i}\right].\frac{\partial \ln F_i(Z_i)}{\partial \ln M_i}.\frac{d\ln M_i}{dt} \text{ (for } Z_i > Z^*) \qquad (6.1)$$

$$\frac{d\ln F_i(Z^*)}{dt} = \frac{\partial \ln F_i(Z^*)}{\partial \ln M_i}.\frac{d\ln M_i}{dt} \qquad (6.2)$$

Here the partial elasticities, $\partial \ln F_i(Z_i)/\partial \ln M_i < 0$ and $\partial \ln F_i(Z^*)/\partial \ln M_i < 0$, hold both Z_i and the Lorenz curve constant. Since our relative poverty measures satisfy the WRA, the relative poverty rate will fall as long as the growth rate ($d\ln M_i / dt$) is positive. The absolute poverty rate will also fall with positive growth. Whether or not the relative poverty measure falls more

[32] Ferreira and Ravallion (2009) provide an overview of the evidence on this stylized fact.

[33] Growth can be distribution neutral within all countries, but not distribution neutral in the world as a whole, depending on how the rates of growth vary with initial mean incomes. Ravallion (2009) shows that the overall growth process in the developing world has not been distribution-neutral.

[34] We exploit the fact that $L_i'(F_i(Z_i)) = Z_i / M_i$ where *L* is the Lorenz curve. Thus $F_i(Z_i)$ is homogeneous of degree zero in Z_i and M_i, holding constant the Lorenz curve (and hence the function $L_i'(.)$).

slowly than the absolute measure depends on the relative size of the partial elasticities. This is an empirical issue. Ravallion (2009) shows that, for the developing world as a whole, the (absolute) elasticity falls monotonically as the poverty line increases over the range \$0.75 to \$13 a day, certainly encompassing the range of our relative poverty lines. Then relative poverty will fall at a slower rate than absolute poverty. Furthermore, as absolute poverty falls with economic growth the elasticity of the poverty line with respect to the mean ($d \ln Z_i / d \ln M_i$) increases while the partial elasticity ($\partial \ln F_i(Z_i) / \partial \ln M_i < 0$) tends to fall. Thus the rate of reduction in relative poverty will tend to fall as the level of absolute poverty falls. With population growth, after some point, the numbers of relatively poor will be rising, while the numbers of absolutely poor are falling. As we will see, this prediction is confirmed by our estimates.

6. Poverty measures for the developing world

We present our results for 1981-2005 at three yearly intervals. Table 1 give our estimates of the absolute poverty measures for the \$1.25 a day line at 2005 PPP for the developing world as a whole and the largest regions in terms of the number of poor.[35] We find that 25 percent of the population of the developing world, 1.4 billion people, lived below \$1.25 a day in 2005. Twenty-five years earlier (in 1981) the percentage was 52%. This rate of progress was sufficient to bring the count of the number of poor down from 1.9 billion to 1.4 billion. However, progress was highly uneven across regions, with dramatic declines in the poverty count for East Asia, but with much less progress in other regions, and rising numbers of absolutely poor in Sub-Saharan Africa (though with some sign of progress in the late 1990s).[36]

The corresponding relative measures are found in Table 2. The top panel gives the mean poverty lines by region. (The mean lines do not figure in the analysis but are still of interest.) In all regions and all years, the mean is above \$38 per month (\$1.25 a day), implying that the relative poverty line is generally dominant. (The \$1.25 line is binding for about 20% of countries and years.) In 2005, the inter-regional differences in relative poverty lines range from \$47 per month in Sub-Saharan Africa to \$151 per month in Latin America. The relative poverty lines rise over time with economic growth; in East Asia the average line goes from about \$40 per month in 1981 to over \$60 per month in 2005.

[35] We exclude the Middle East, North Africa, Eastern Europe and Central Asia. These account for only 2.1% of the absolute poverty count (and 10.4% of the relative poverty count).

[36] For further discussion see Chen and Ravallion (2008a).

The next two panels of Table 2 give the percentages below the line and numbers of poor. Through most of the 1990s, about half of the population of the developing world was relatively poor. The proportion fell over time, from 63% in 1981 to 53% in 1990 and 47% in 2005. But the decline was not continual; the aggregate incidence of relative poverty rose slightly in both the late 1980s and late 1990s. The trend rate of decline over the period as a whole is -0.56 percentage points per year (with a standard error of 0.10). Projecting this trend rate of decline over 1981-2005 forward to 2015, the proportion living in relative poverty would be 40.5% (standard error=2.4%).

The trend decline in the incidence of relative poverty has not been sufficient to reduce the number of poor by this measure, which rose from 2.3 billion to 2.6 billion over 1981-2005 (Table 2). The turning point appears to be around 1987.

Figure 3 shows the simultaneous rise in relative poverty and fall in absolute poverty. As one would expect, the proportion of the relatively poor that are also absolutely poor has fallen over time, given economic growth. In 1981, 82% of the relatively poor were absolutely poor; by 2005 the proportion had fallen to 53%.

South Asia saw the largest absolute increase in the number of relatively poor. East Asia experienced a falling count of both the absolutely poor and the relatively poor (though with a more rapid pace of progress against absolute poverty). Comparing Tables 1 and 2, we see changes in the regional profile of poverty, although it is notable that the two regions with the highest incidence of absolute poverty also have the highest relative poverty rate. In 2005, Sub-Saharan Africa (SSA) had the highest incidence of absolute poverty, with South Asia in second place (Table 1), but South Asia emerges as the region with the highest incidence of relative poverty (Table 2), with SSA second. Latin America and the Caribbean (LAC) had the third highest relative poverty incidence, but came fourth in absolute poverty. As expected, the share of global poverty in LAC rises from 3.3% to 9.6%. The largest decline in share is for SSA, which falls from 28.4% to 16.4%; South Asia's share falls from 43.3% to 36.1%.

Also comparing Tables 1 and 2, we find that the aggregate headcount index of relative poverty for 2005 is 1.88 times the aggregate index of absolute poverty; in 2002, the ratio was 1.63. It is of interest to compare these numbers to the corresponding ratios from Chen and Ravallion (2004), using their parameterization of the Atkinson-Bourguignon relative poverty lines. For the latest year in the Chen-Ravallion series (2001) the aggregate measure of relative

poverty was 1.36 times the aggregate measure of absolute poverty. This upward revision in the extent of poverty reflects the aforementioned fact that our weakly relative measures imply that the economic gradient in poverty lines emerges at a lower level than was found using the AB poverty lines calibrated on the Ravallion et al. (1991) data set.

7. Conclusions

While we can accept that people care about their relative position in society (at least above some level of living) it is very hard to accept that they only care about relative income. And while one can agree that certain goods have a social role it is hard to accept that the expenditure required to attain those goods is negligibly small for very poor people; recalling Adam Smith's example of the role of a linen shirt in eighteenth century Europe, a socially-adequate shirt would not presumably have cost any less to the poorest person than the richest. While poor people may be highly constrained in their spending on things that facilitate their inclusion, and so be more socially excluded, that does not mean that their social inclusion needs are negligible. Thus, the prevailing justifications for strongly relative poverty measures are hard to accept on theoretical grounds.

Our weakly relative poverty lines relax these assumptions. From a welfarist perspective, our measures place a natural upper bound on the weight attached to relative deprivation, namely that it cannot matter so much that measured poverty does not fall when all incomes increase by the same proportion. From a non-welfarist perspective, we impose a positive lower bound on the cost of social inclusion. Our poverty lines are calibrated to a new compilation of national poverty lines, drawing on a vast amount of new poverty studies done since the 1980s. A simple, data-consistent, schedule of relative poverty lines is shown to provide an excellent fit to these data on national lines, but with an elasticity that rises from zero to unity, but never reaches unity.

On implementing our weakly relative poverty lines using almost 700 surveys for 115 countries we find that there is more relative poverty in the developing world than has been thought and that the pace of progress against relative poverty over 1981-2005 is less encouraging than that against absolute poverty. We find that 47% of the population of the developing world lived in relative poverty in 2005, down from 53% in 1990 and 63% in 1981. This was not a sufficient rate of decline in the incidence of poverty to prevent a rise in the number of poor, in contrast to our absolute poverty measures that show falling poverty counts in the aggregate. With

economic growth, the relative poverty line tends to rise, and proportionately more as average income rises. Both the direct impact on the poverty line and the effect on the responsiveness of the poverty rate to economic growth tend to bring down the trend rate of decline in relative poverty. Slower progress against relative poverty is thus the "other side of the coin" to success against absolute poverty.

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Figure 1: National poverty lines plotted against mean consumption

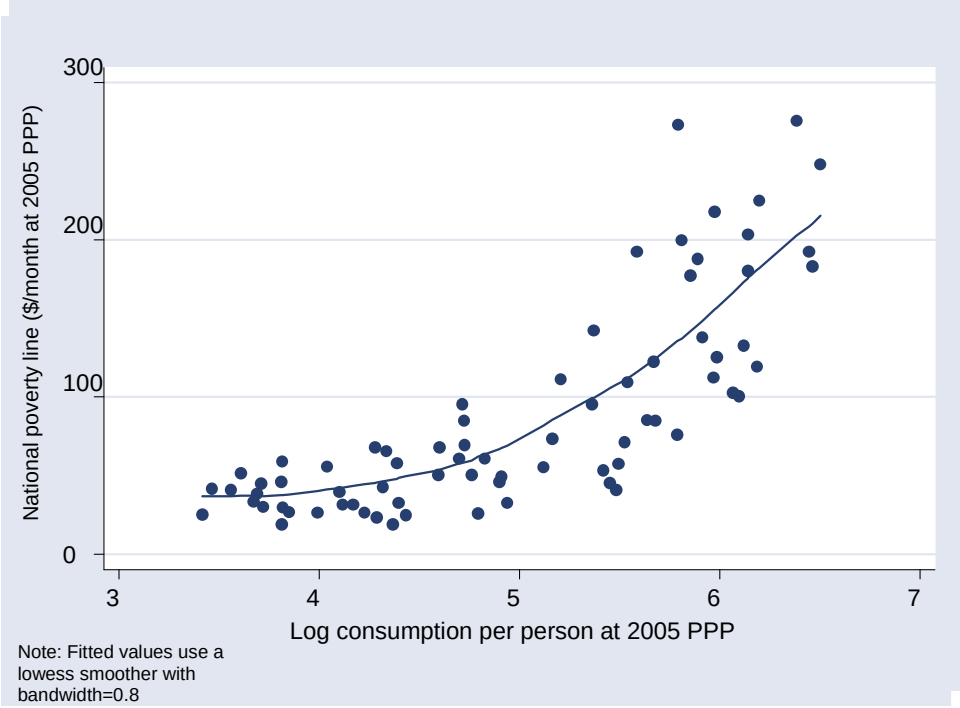

Figure 2: Weakly relative poverty lines

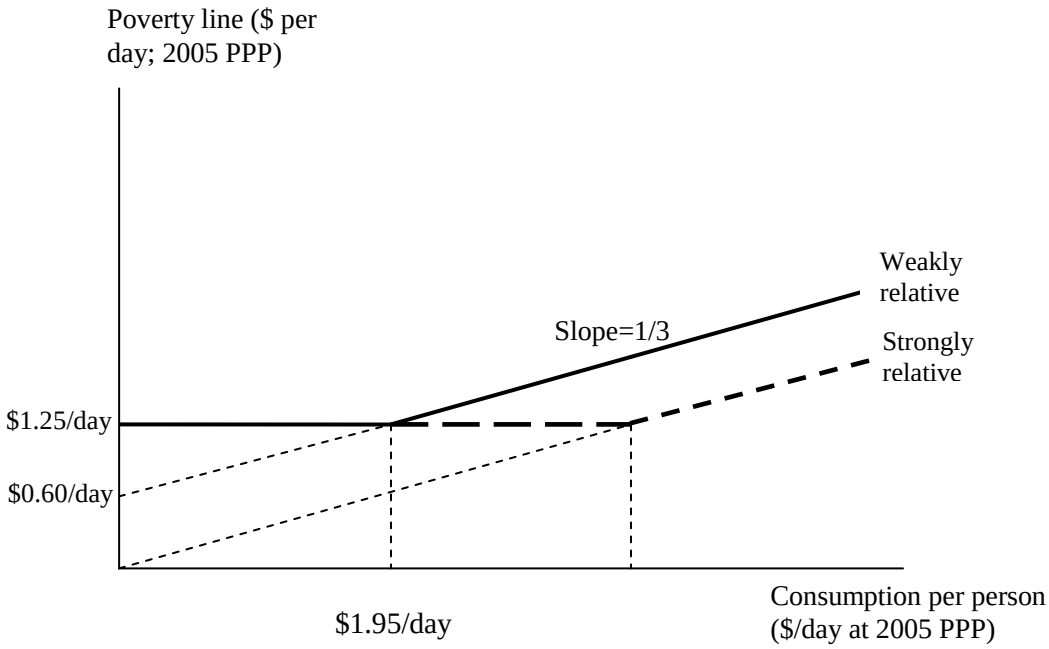

Figure 3: Numbers of absolutely poor and relatively poor

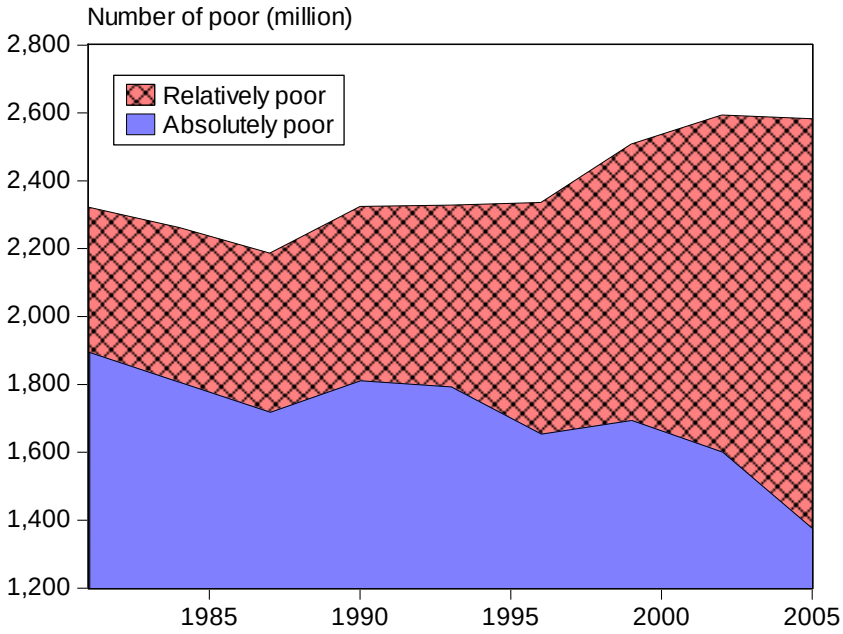

Table 1: Absolute poverty measures

	1981	1984	1987	1990	1993	1996	1999	2002	2005
				Percentage below poverty line					
	51.9	46.7	41.9	41.7	39.2	34.5	33.7	30.5	25.2
Of which:									
East Asia and Pacific	77.7	65.5	54.2	54.7	50.8	36.0	35.5	27.6	16.8
Latin America and Caribbean	12.9	15.3	13.7	11.3	10.1	10.9	10.9	10.7	8.2
South Asia	59.4	55.6	54.2	51.7	46.9	47.1	44.1	43.8	40.3
Sub-Saharan Africa	53.4	55.8	54.5	57.6	56.9	58.8	58.4	55.0	50.9
				Number of people below poverty line in millions					
	1899.8	1813.8	1722.8	1818.5	1798.6	1657.7	1697.7	1601.1	1373.7
Of which:									
East Asia and Pacific	1071.5	947.3	822.4	873.3	845.3	622.3	635.1	506.8	316.2
Latin America and Caribbean	47.1	59.5	56.7	49.6	46.6	53.1	55.3	56.6	45.3
South Asia	548.3	547.6	569.1	579.2	559.4	594.4	588.9	615.9	595.6
Sub-Saharan Africa	212.3	242.2	258.0	297.5	317.4	355.6	382.7	389.8	388.4

Note: The table gives the % of the estimated population living in households with consumption per person below $38 per month at 2005 PPP and the number of poor by this measure.
Source: Authors' calculations.

Table 2: Relative poverty lines and measures

	1981	1984	1987	1990	1993	1996	1999	2002	2005
Average poverty line ($PPP per person per month)									
	63.52	63.93	63.64	62.34	60.71	62.21	64.09	68.67	75.53
Of which:									
East Asia and Pacific	39.81	40.03	40.09	41.47	42.53	44.78	48.05	53.62	60.98
Latin America and Caribbean	140.75	131.90	136.26	119.57	123.13	134.22	136.94	137.31	151.40
South Asia	39.16	39.49	39.93	41.75	42.52	44.85	45.97	47.71	51.52
Sub-Saharan Africa	47.49	47.41	45.51	45.43	44.78	45.61	45.74	46.12	46.91
Percentage below poverty line									
	63.3	58.2	53.1	53.2	50.8	48.8	50.2	49.8	47.4
Of which:									
East Asia and Pacific	79.4	67.4	56.2	58.3	55.4	42.9	47.1	44.4	37.7
Latin America and Caribbean	52.5	55.5	50.1	43.3	43.4	48.9	48.6	49.5	45.1
South Asia	61.6	58.4	57.8	59.0	55.9	60.2	59.0	61.3	63.2
Sub-Saharan Africa	59.0	60.7	59.1	62.0	60.9	63.6	63.0	59.5	55.6
Number of people below poverty line in millions									
	2318.9	2259.2	2182.8	2320.0	2331.1	2348.9	2527.0	2613.4	2586.6
Of which:									
East Asia and Pacific	1095.5	975.3	853.0	930.0	922.5	741.6	842.7	815.6	709.5
Latin America and Caribbean	192.2	216.6	207.7	189.5	200.3	237.0	246.6	262.2	248.1
South Asia	568.6	575.4	607.6	660.4	665.8	760.7	786.8	861.8	932.5
Sub-Saharan Africa	234.5	263.4	279.9	320.1	339.6	384.8	412.9	421.6	424.2

Note: The table gives the % of the estimated population living in households with consumption per person below our relative poverty lines (equation 8) and the number of poor by this measure.
Source: Authors' calculations.