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Dollar a Day Revisited

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Abstract

The paper presents the first major update of the international "$1 a day" poverty line, first proposed in 1990 for measuring absolute poverty by the standards of the world's poorest countries. In a new data set of national poverty lines we find that a marked economic gradient only emerges when consumption per person is above about $2.00 a day at 2005 purchasing power parity. Below this, the average poverty line is $1.25, which we propose as the new international poverty line. Relative poverty appears to matter more to developing countries than has been thought. The authors' proposed schedule of relative poverty lines is bounded below by $1.25, and rises at a gradient of $1 in $3 when mean consumption is above $2.00 a day.

Dollar a Day Revisited

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1. Introduction

It has long been recognized in the literature on poverty measurement that people at different levels of living tend to hold different views about what "poverty" means.[2] The critical level of spending that a poor person would deem to be adequate in order to escape poverty is likely to be lower than the level a rich person would deem adequate to avoid becoming poor.

Does this economic gradient in the standards used to define poverty hold between countries, as well as within a given country? Ravallion, Datt and van de Walle (RDV) (1991) studied how poverty lines varied with mean consumption when both were converted to a common currency at purchasing power parity (PPP) (meaning that the currency conversion rate is intended to assure a common purchasing power over commodities). Amongst the poorest countries, poverty lines tend to be low, and they show little or no economic gradient. However, RDV also found that, above a critical level of mean consumption, the national poverty line tends to rise sharply with mean consumption, with an elasticity approaching unity in rich countries. It can thus be argued that absolute poverty (whereby the poverty line has constant real value) is the more relevant concept in poor countries, while relative poverty (in which the poverty line is proportional to the mean) is more salient in rich countries.

Why do national poverty lines have this economic gradient? Poverty lines are typically anchored to nutritional requirements, which tend to be similar between people in poor and rich countries. So differences in nutritional requirements are probably not the reason. More plausibly, as living standards rise generally, there is a change in the prevailing notions of what (food and non-food) consumption needs should be met if one is to not be deemed "poor;" people are expected to be able to afford more expensive calories (more meat and vegetables and higher quality foodgrains), have more varied diets, and be better clothed and housed. By this view, poverty is a socially-specific concept, whereby the consumption needs for escaping poverty in a given society depend on what people generally consume in that society.

How then should we judge the extent of poverty in the world as a whole? One might use the poverty lines that prevail in each country (or that one would expect given the country's mean consumption). But then the resulting aggregate poverty measures would not be treating people at the same level of real consumption the same way. And by treating absolutely poor people

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

similarly to relatively poor people one would risk diverting the focus away from what is surely the highest priority: to raise the living standards of the poorest in the world. An absolute measure is also defensible on welfarist grounds under the common assumption that individual welfare depends on own-consumption.[3] But what absolute line should be used? Prior to RDV, absolute poverty lines for global poverty measurement had been set in an arbitrary way.[4]

Motivated by these observations, RDV and World Bank (1990) proposed that global poverty should be measured by the standards of the poorest countries. The latest available estimates of the extent of poverty by this measure used an international poverty line of $32.74 per month, or $1.08 a day, at 1993 PPP, based on the original set of national poverty lines in RDV (Chen and Ravallion, 2001). In 2004, about one in five people in the developing world (one billion people) were deemed to be poor by this standard (Chen and Ravallion, 2007).

This is clearly a conservative basis for measuring global poverty. One could hardly argue that the people in the world who are poor by the standards of the poorest countries are not in fact poor. This gives the global poverty line a salience in focusing on the world's poorest that a higher line would not have. At the other extreme, suppose one judged poverty in developing countries by (say) US standards. Learning that (possibly) 95% or more of the population is poor by such a standard is unlikely to have much relevance, given that US standards of living are not within the foreseeable reach of most people in a typical developing country.[5]

Relative poverty measures can also be defended if one believes poverty should ultimately be measured in the space of welfare <u>and</u> that relative deprivation matters to a person's welfare.[6] Chen and Ravallion (2001, 2004) provide estimates of relative poverty measures in which a person is not poor if she meets a "$1 per day" absolute consumption standard and consumes more than one third of the mean consumption in the country of residence; a coefficient of one third gave the best fit to the RDV data set on poverty lines (Chen and Ravallion, 2001).[7] But

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[3]   This is unlikely to be a sufficient statistic; supplementary measures will be needed to capture other aspects of welfare, notably access to non-market goods (such as health and schooling). These supplementary measures should aim to capture those things that are missing from a standard consumption aggregate, and one should try to avoid double counting; for further discussion see Ravallion (1996).

[4]   Prior to RDV the World Bank had used explicitly arbitrary lines; see Ahluwalia (1974).

[5]   For example, Pritchett (2006) proposes a poverty line of around $10 a day; we calculate (using *PovcalNet*: http://econ.worldbank.org/povcalnet) that 95% of the developing world's live below this line.

[6]   For further discussion of the theory and evidence on this point see Ravallion (2008).

[7]   This simple structure for a schedule of relative poverty lines was proposed by Atkinson and Bourguignon (2001), who discuss the rationale further.

notice that even by this approach to measuring poverty, the precise location of the "$1 a day" line is of relevance as a lower bound to the relative lines.

This paper revisits the problem of setting an international poverty line in the light of a great deal of new data. There are two important sources of that data. The first is the new set of PPP's produced from the 2005 round of the *International Comparison Program* (ICP) (World Bank, 2008a). This is the most ambitious round to date of the ICP (which began in 1968), and it is expected to entail a substantial improvement in data quality. The second source is a new data base of national poverty lines across developing countries (compiled for the purpose of this paper). Past work has been based on the compilation of poverty lines for the 1980s used by RDV. Our new data set covers the period since 1990, drawing on the large number of new country-specific poverty studies for developing countries that have been done since 1990 under the World Bank's program of country *Poverty Assessments*.

We begin with a simple model of a socially-specific poverty line, which helps motivate and interpret our empirical analysis. We present in section 3 our new compilation of national poverty lines across countries. The pattern predicted by our theoretical analysis is in evidence: the national poverty line rises with mean consumption, although with a low elasticity at low consumption. Based on these empirical results, our proposed new poverty lines are discussed in section 4, including both absolute and relative lines. Section 5 compares our proposed new international poverty lines to past lines. Section 6 discusses how our main results change with alternative PPP's. Section 7 concludes.

2.   The social subjective poverty line

An important strand of the literature on welfare and poverty measurement has formalized the idea of what can be termed a "social subjective poverty line" (SSPL): the point in the income space above which people tend to think they are not poor in a given society, and below which they tend to think they are poor.[8] Underlying the idea of a SSPL is the premise that an individual's own idea of what it means to be "poor" depends on that individual's own level of living. There is now a large body of evidence consistent with that premise.[9]

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[8]   Contributions include Groedhart, Halberstadt, Kapteyn and van Praag (1977), Hagenaars and van Praag (1985), Kapteyn, Kooreman and Willemse (1988) and Pradhan and Ravallion (2000).
[9]   See the previous footnote for examples.

It can also be postulated that there is a <u>social effect</u> on the idea of what poverty means to an individual at given own income. Psychologists, sociologists and some economists have argued that the circumstances of the individual relative to others in the relevant setting influence perceptions of well-being.[10] Most of this literature has concerned (explicitly or not) developed countries. Whether such a social effect on the concept of what "poverty" means is also relevant in developing countries remains an open question.

Poverty lines found at the country level do not explicitly claim to be SSPL's. More commonly they are based on the estimated cost of a set of basic consumption needs, typically anchored to nutritional requirements for good health. However, there is ample scope in the practice of poverty measurement to choose the parameters of a poverty line such that the resulting line is likely to be socially accepted in the given setting. Indeed, it would seem unlikely that any national poverty line would be accepted in practice if it differed significantly from the SSPL. In other words, it can be argued that the SSPL is the more fundamental concept underlying the "objective" poverty lines found in practice.

We postulate that the poverty line used in a given county <u>is</u> the country's SSPL.[11] Each individual has a personal poverty line (z) that depends on own consumption or income (y). This relationship is specific to a given country. Quite generally, we can postulate that the functional form relating z to y is country specific. We specialize this further by postulating that the relationship depends on mean consumption in the country at large (C), which is taken to capture the social effect on personal subjective poverty lines. We write this relationship as:

$$z = \varphi(y, C) \ \text{ for } \ y \in [y^{\min}, y^{\max}] \tag{1}$$

A unique national poverty line can be derived if we make three assumptions about φ: (i) the function is continuously differentiable in y and C and strictly increasing and continuous in y and non-decreasing in C; (ii) the poorest person thinks that she is poor ($\varphi(y^{\min}, C) > 0$) while the richest person does not ($\varphi(y^{\max}, C) < y^{\max}$); and (iii) an increase in own income reduces the subjective poverty gap, i.e., that $\varphi_y(y, C) < 1$. These assumptions imply (on invoking the intermediate value theorem) a unique SSPL (Z), defined implicitly by the fixed point:

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[10]   Runciman (1966) provided an influential exposition, and supportive evidence. Also see the discussions in Scitovsky (1978), Easterlin (1995) and Oswald (1997).

[11]   In the empirical implementation we will allow for a country-specific error term, encompassing idiosyncratic differences in the data and methods used as well as measurement errors.

$$Z = \varphi(Z,C) = f(C) \tag{2}$$

Note that $f'(C) \geq 0$ for all C (under assumption iii).

As a special case, suppose that the social effect on personal subjective poverty only emerges when the mean consumption of the society in which one lives is above some critical level, C^*; i.e., $\varphi(y,C) = \varphi(y)$ for $C \leq C^*$ and $\varphi(y,C)$ is strictly increasing in C for $C > C^*$. The interpretation is that in very poor countries levels of living are so low generally that there is little scope for personal feelings of relative deprivation.[12] Then it is evident that the aggregate relationship between the SSPL and mean consumption will have the property that $f'(C) = 0$ for $C \leq C^*$. The value of $Z^* = f(C^*)$ is the lower bound to national poverty lines.

The rest of this paper studies the relationship between national poverty lines and mean consumption, to see whether there is evidence of a social effect and (if so) whether there is an identifiable (positive) lower bound to the poverty line. This matters for both a relative measure of global poverty—the lower bound to the poverty line in the world is then taken to be the lower bound to any set of relative poverty lines—as well (of course) to an absolute poverty measure. We begin by presenting our new cross-country data set on poverty lines in developing countries.

3.   National poverty lines across developing countries

The set of national poverty lines collected by RDV covered 33 countries (both developed and developing) and drew on specialized, country-specific, mostly academic, studies of poverty spanning 1980-90. Clearly, this data set is now rather old.[13]

Since RDV, there has been considerable expansion in research and analysis on poverty in developing countries through the World Bank's country-level *Poverty Assessments* (PA's), which have now been done for many developing countries (though there were very few PA's available in 1990). These are core reports within the Bank's program of analytic work at country level; each report describes the extent of poverty and its causes in that country. The Bank's PA

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[12]   Ravallion and Lokshin (2007) provide survey-based evidence for one of the poorest countries, Malawi, indicating that relative deprivation is not a welfare concern to the bulk of the population, though they do find that it matters to better off groups in urban areas. For a theoretical analysis in a model combining risk sharing with positional goods see Ravallion (2008a).

[13]   The only prior update was done by Ravallion (1998), who tested the effect of including a number of new observations for Africa (which was clearly under-represented in the Ravallion et al., 1991, data set). The main result of the earlier study by RDV on the relationship between poverty lines and mean consumption was found to be quite robust to including these extra observations.

for a given country is done in consultation with the government and most PA's can claim government ownership. Most low-income countries have also done *Poverty Reduction Strategy Papers* (PRSP's). A PRSP is actually done by the government, though often with some financial support from aid donors. A large share of the work on either a PA or (though less so) a PRSP typically goes into the poverty measurement aspects (including poverty profiles). Both a PA and PRSP will typically lay out what is known about poverty in each country (the poverty profile as well as the aggregate poverty statistics and how they have changed over time). The PA's and PRSP's are clearly an important source of information on the accepted national poverty lines in developing countries (though they are confined to developing countries).

For the purpose of this paper we compiled a new data set of 88 national poverty lines from the most recent PA's, PRSP's and other sources over 1990-2005. The Appendix (Table A1) provides details. (In no case do the sources overlap with RDV.) In the source documents, each poverty line is given in the prices for a specific survey year (for which the subsequent poverty measures are calculated). In about three-quarters of the sample observations the poverty line was calculated from the same survey; in other cases (such as India) a pre-existing national poverty line was updated using the consumer price index.

The fact that the PA is a World Bank report raises two concerns. Firstly, it might be conjectured that these are external poverty liens, rather than poverty lines that are accepted by each country, thus raising a doubt about their interpretation as SSPL. However, the process of producing a PA entails (often extensive) consultation with the government of that country, including discussion is about the most appropriate poverty line. Thus, this new set of poverty lines has a stronger claim to be national poverty lines than those used by RDV, which were largely based on academic studies.

Second, it might be thought that the poverty lines that World Bank reports and PRSP's use might be biased toward the Bank's international poverty line. This is not a serious concern in our view. The PA's (and PRSP's) typically either use a pre-existing national poverty line or derive a new line, and in both cases the line has no obvious origins in the Bank's "$1 a day" poverty line. Their aim is to use a poverty line appropriate to that country. In 80% of cases, some version of the "cost of basic needs" method has been used.[14] By this method, the food component of the poverty line is the expenditure needed to reach a food bundle, specific to each

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[14]   This method, and alternatives, are discussed in detail in Ravallion (1994, 2008a).

country (or each region) that yields a stipulated food energy requirement; a common figure is 2100 calories per person per day. To this is added an allowance for non-food spending, which is typically anchored to the non-food spending of people whose food spending (or sometimes total spending) is near the food poverty line. There is considerable scope for discretion in setting such a poverty line. Although the stipulated food-energy requirements are similar, there are (of course) multiple food bundles that can yield a given food energy intake, and some will be preferable to others in any given context. The non-food spending that is deemed adequate will also vary. The judgments made in setting the various parameters of a poverty line are likely to reflect prevailing notions of what poverty means in each country setting.

In converting these lines to a common currency we use the household consumption PPP's from the 2005 ICP, as documented in World Bank (2008a) (although we consider alternative PPP's later).[15] The 2005 ICP is clearly the most complete assessment to date of how the cost of living varies across countries. The ICP collected primary data on a region-specific list of prices for 600-1000 (depending on the region) goods and services, grouped under 155 "basic headings" deemed to be comparable across the 146 countries (including OECD countries). The prices were obtained from a large sample of outlets in each country. The world was divided into six regions for the 2005 ICP with different product lists for each. All regions participated, but the participation rate was lower for Latin America.

The 2005 ICP is a clear improvement over 1993—the last year used for global poverty measurement. The number of countries participating in the price survey is larger (146, as compared to 117 in 1993) and the surveys have been implemented on a more scientific basis. New methods were used for measuring government compensation and housing. Adjustments were also made for the lower average productivity of the public sector workers in developing countries (lowering the imputed value of the services derived from public administration,

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[15]   The ICP price surveys started in 1968. Prior to 2000, the Penn World Tables (PWT; see, Summers and Heston, 1991) were the main source of the PPP rates for consumption derived from the ICP, as used in the Bank's global poverty measures. In 2000 we switched to the 1993 PPPs estimated by the Bank's Development Data Group; the most recent results are reported in World Bank (2008). There are methodological differences in these two sets of PPPs. The PWT used the Geary-Khamis (GK) method, while the Bank used the EKS method, which is the multilateral extension of the bilateral Fisher index. On the differences between the GK and EKS methods and implications for global poverty measures see Ackland et al. (2006). There were also improvements in country coverage and data quality in the 1993 PPPs as compared to PWT. However, there were also a number of problems in the implementation of the 1993 ICP round in developing countries, as discussed in Ahmed (2003).

education and health). Ring comparisons (linking regional PPP estimates through global prices) were done for more countries (18 in all—a marked improvement over past ICP rounds). The 2005 data were also subject to more rigorous supervision and validation methods than the 1993 round, including stricter standards in defining internationally comparable quality standards for the goods identified in the ICP price surveys. Otherwise, the PPP's calculated from the ICP data (and in World Bank, 2008a) follow standard methods; as in the past, the Bank uses a multilateral extension of the bilateral Fisher price index.[16]

For each country, the national poverty line was converted to 2005 $'s using the individual consumption PPP from World Bank (2008a). The 2005 PPP was not available for 11 of the 88 countries (due mainly to the poor ICP coverage in Latin America) and was deemed unreliable for one country (Zimbabwe).[17] Allowing for missing PPPs and other data problems, we have 75 poverty lines.[18] (The Appendix gives details on the countries with missing data.) Figure 1 gives the density function of the poverty lines (using a normal kernel). The national poverty lines at 2005 PPP range from $19.05 to $275.71 per month, with a mean of $87.59 and median of $60.81. (The standard deviation is $66.22.) The mode is slightly under $50 per month.

While the ICP aimed to survey prices that were nationally representative, this was not always the case. The main source of sampling bias appears to be that the surveys were confined to urban areas in a number of countries. For example, in the case of China, the ICP survey was confined to 11 cities. Although the survey included some surrounding rural areas, it cannot be considered representative of rural China (Chen and Ravallion, 2008a). Based on ICP sampling information we treat the 2005 consumption PPP's as an urban PPP's for the following countries: Argentina, Brazil, Bolivia, Cambodia, Chile, China, Colombia, Ecuador, Pakistan, Peru, Thailand and Uruguay. For these countries, the poverty line is an urban poverty line.

We follow RDV in using private consumption expenditure (PCE) per capita from the National Accounts (NAS) as the measure of economic welfare. (More precisely we use what is termed "Household Final Consumption Expenditure.") The sample mean PCE is $209.40 per

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[16] As was argued in Ravallion et al. (1991), the weights attached to different commodities in the conventional PPP rate may not be appropriate for the poor. Results reported in Deaton and Dupriez (2008) do not suggest that the re-weighting needed to derive a "PPP for the poor" will have much impact on the aggregate consumption PPP. Later we test sensitivity to using the Deaton-Dupriez PPP.

[17] The 2005 consumption PPP implies a poverty line of $6 per month, which is very hard to believe.

[18] One country, Madagascar, was dropped because of large inconsistencies in the data from various sources (national accounts aggregates reported by the Bank versus the International Monetary Fund). Using the Bank's estimate of PCE, the poverty line was almost three times mean consumption.

month ($6.89 per day) at 2005 PPP; 15 of our sampled countries have PCE less than $60 per month, or about $2.00 a day; the poorest country is Malawi with a PCE per capita of $1.03 a day. Figure 1 also gives the density function for PCE per capita; the modes are not far apart, but otherwise the distributions are very different, with PCE showing much greater spread.

The alternative to PCE from the NAS is to use mean household consumption or income from the relevant survey. However, in many cases the poverty line was calculated from that same survey, so the relationship seen between the national poverty line and the survey mean may be spurious, being driven by common measurement errors. Consider, for example, the most popular method of setting a national poverty line, in which a predetermined food bundle is valued in the country (or each region) and an allowance added for non-food spending based on the food Engel curve. An under-estimation of non-food spending in the survey will shift the Engel curve and so automatically adjust the poverty line downwards. The measurement error will generate a positive correlation between the poverty line and the survey mean.[19] As long as the measurement errors in the NAS are largely independent of those in the surveys, PCE will be a better indicator. However, we also test the sensitivity to using the survey means instead.

Figure 2 plots the poverty lines against log PCE for the survey year. The least squares estimate of the elasticity of the poverty line to PCE is 0.655 (with a t-ratio of 13.68, based on a robust standard error).[20] This is significantly less than unity (t=7.21), as used in some relative poverty lines for developed countries,[21] although, our elasticity is similar to some past estimates based on subjective poverty lines for developed countries.[22] However, Figure 2 suggests that the economic gradient only emerges strongly once mean consumption is above a critical level. Figure 2 also gives a nonparametric regression of the national poverty lines against log mean consumption.[23]

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[19]   The same would happen if the poverty line is derived by the alternative method of finding the total consumption expenditure level at which predetermined food-energy requirements are met on average. If non-food spending is underestimated by the survey then the poverty line will be automatically adjusted downwards, reflecting the measurement error. A spurious correlation will result.

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

[21]   A poverty line of half the mean or median is not uncommon in comparative studies of poverty in developed countries; see, for example, Smeeding et al. (1990) and Atkinson (1998).

[22]   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.

[23]   All nonparametric regressions in this paper use STATA's Locally Weighted Scatter Plot Smoothing method with the default bandwidth (0.8). We also tested alternative bandwidths in the interval

Figure 3 gives the graph corresponding to Figure 2, but using the survey mean instead of PCE. The pattern is similar to Figure 2, although the least squares elasticity of the poverty line is now even higher at 0.804 (t=15.97).

So the same pattern found by RDV using the older compilations of national poverty lines is evident in Figure 2, with the poverty line rising with mean consumption, but with a low elasticity initially. By interpretation, absolute poverty appears to be the dominant concern in poor countries, with relative poverty emerging at higher consumption levels. However, it is notable how high the overall elasticity is for developing countries.

The nonparametric regression in Figure 2 can be used to test for any regional effects by seeing whether the observations for any region tend to lie systematically above or below the expected value at given consumption, as given by the nonparametric regression line. The most striking regional pattern is that the observations for Asia (both East Asia and South Asia) tended to lie below the regression line; this was true of 11 out of the 12 observations for Asia (all but one of the seven observations for East Asia and all of the five for South Asia had low poverty lines conditional on mean consumption. No other regional patterns emerged so strongly.

The economic gradient in the poverty lines comprises a component due to food needs and one for non-food needs, although we can only quantify this difference for a sub-set of the national poverty lines. For a sub-sample of 28 countries we have complete data for also separating the food from the non-food components of the national poverty lines. The mean food share at the poverty line is 0.564 (with a range from 0.260 to 0.794). We find that the elasticity of the _food_ component of the poverty line to mean consumption is 0.471 (t=9.55), while it is almost twice as high for the non-food component, for which the elasticity is 0.910 (t=8.97). (The overall elasticity for this sub-sample is 0.679, t=11.02, as compared to 0.655 for the full sample.)

So the economic gradient in national poverty lines evident in Figure 2 is driven more by the gradient in the non-food component of the poverty lines (which accounts for about 60% of the overall elasticity), although it is notable that there is still an appreciable share attributable to the economic gradient in food poverty lines. By interpretation, the social effect on national poverty lines is determined more by the allowances made for non-food needs than food needs.

(0.2, 0.9). The mean of the predicted values in the poorest 15 countries ranged from $37.52 to $38.11 (although the regression line was clearly under-smoothed at bandwidths below about 0.5).

4.   Setting an international poverty line

Using our new compilation of national poverty lines we can now return to the basic idea behind the "$1 a day" poverty line, which was chosen to be representative of the poverty lines found amongst poor countries. We explore a number of ways one might set a new international poverty line consistent with this idea.

The median poverty line across the full sample (n=75) of $60.81 per month is equivalent to almost exactly $2.00 per day; the mean is higher at about $2.90 per day. However, the presence of the marked economic gradient in Figure 2 implies that the mean will be well above the poverty lines found amongst the poorest countries.

The poverty line for Malawi—the lowest PCE per capita in the sample—is $26.11 per month. However, like all specific data points in a sample, this is susceptibly to measurement error and the country-specific error term could be large. It is notable that, although the relationship in Figure 2 is quite flat at low PCE, there is still a sizable variance. No doubt, idiosyncratic differences in the data and methods used for setting national poverty lines are playing a role; there are measurement errors and methodological differences between countries in how poverty lines are constructed, which can be interpreted as noise in the mapping from the underlying welfare space into the income space. Some averaging is clearly called for, as is normal in economic measurement. A better method is to use the expected value of the poverty line in the poorest country, based on how the poverty lines vary with mean consumption. Table 1 gives a number of parametric specifications (including the forms used by RDV and Chen and Ravallion, 2001), and the implied estimates of the poverty line for the poorest country.

Three concerns can be raised about the estimates in Table 1. First, the results may be driven by the specific parametric form, and there are signs of this in Table 1, notably in the fact that the semi-log model (Z_i regressed on a quadratic function of $\ln C_i$) gives a much higher predicted Z for the poorest country that. But this is deceptive, since the turning point of the quadratic function is above the lowest consumption; this is clearly an artifact of the parametric form, since there is no sign of a negatively sloped segment at low PCE in Figure 2. Ignoring this specification, the results in Table 1 suggest that a poverty line of around $1 a day is defensible if one measures poverty in the world by the standards of the poorest country in the world.

Second, a parametric model need not estimate well at all levels of consumption. For example, the linear regression of Z_i on C_i has a very good overall fit, with a correlation of

0.995 with the fitted values in Figure 2 and a correlation of 0.836 with the data. However, the linear projection based on this regression under-predicts Z amongst the poorest dozen or so countries.[24] The nonparametric regression in Figure 2 provides a more flexible method of averaging, given that the regression is assured to have reasonably good fit over the full range of the data, including amongst the poorest countries. The predicted value at Malawi's PCE per person is $37.16 per month ($1.22 a day).

The third concern is that it is unclear why one would want to focus exclusively on the poorest single country in our sample; the result may well be vulnerable to measurement error in consumption. Arguably, it would be better to focus on a reference group of poor countries; let that reference group be defined as those countries with PCE per capita less than C^*.

In the light of these observations, we can suggest an empirical model of the national poverty lines in Figure 2 that is consistent with our theoretical model in section 2. Allowing for measurement errors and idiosyncratic differences in the data and methods used in setting national poverty lines, we let $E[Z|C = C_i] = f(C_i)$ denote the expected value of the national line at PCE per capita C_i; as in section 2, $Z^* = f(C^*)$ is the lower bound absolute poverty line though now it is an average value for countries with $C_i \leq C^*$. The empirical model is then:

$$Z_i = f(C^*)I_i + f(C_i)(1 - I_i) + \varepsilon_i \qquad (3)$$

where I_i is a dummy variable taking the value unity if i is a member of the reference group and zero otherwise, and $E[\varepsilon_i|C = C_i] = 0$. (The coefficient on I_i is the conditional mean poverty line for the reference group.) For continuity, the reference group should comprise those countries for which $C_i \leq C^*$. When this holds we say that we have a consistent reference group. We check this after the estimation.[25]

Our reference group is the sampled countries with PCE per capita less than $60 per month, namely: Malawi, Mali, Ethiopia, Sierra Leone, Niger, Uganda, Gambia, Rwanda, Guinea-Bissau, Tanzania, Tajikistan, Mozambique, Chad, Nepal and Ghana. PCE for this group

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[24] Based on the linear projection, the mean predicted Z for the poorest 15 countries (ranked by C) is $34.61; by contrast the mean poverty line for the poorest 15 countries is $37.98, while the mean of the predicted values from the nonparametric regression is $37.98.

[25] One can iterate the estimation if the consistency check fails, until it passes. This was not required in this case, so we treat I_i as data (rather than as a function of C^*) in calculating the standard errors.

ranges from $31.34 to $56.90 per month with a mean of $42.46 (or about $1.40 per day) and median of $41.33. The mean poverty line is $37.98 or $1.25 a day. (The median is $38.51.)

On trying various parametric forms, the linear specification was as good as, or better than, others in terms of fit.[26] The estimated regression corresponding to equation (3) is then (with t-ratios in parentheses based on robust standard errors):

$$Z_i = \underset{(12.55)}{37.983}\, I_i + (\underset{(2.99)}{19.388} + \underset{(11.15)}{0.326}\, C_i)(1 - I_i) + \hat{\varepsilon}_i \quad R^2 = 0.890, \ n = 74 \tag{4}$$

The robust standard error of the $37.98 per month ($1.25 per day) estimate is $3.03 ($0.10 per day). The rising segment has a slope of about $1/3$.[27] (The aforementioned under-prediction at low consumption by the linear regression is corrected for by using the $1.25 line as the lower bound.) To check whether our reference group is consistent, we back out the estimated value of $\hat{C}^*$ such that $\hat{Z}^* = \hat{f}(\hat{C}^*)$, which gives $\hat{C}^* = 59.50$ (t=3.26). So our choice of the reference group as all countries with $C_i < \$60$ is internally consistent with our estimate of (4).

The $1.25 line is fairly robust to changes in the reference group. The mean poverty line is $37.27 ($1.22 a day) if one focuses instead on the poorest 10 countries and it is $38.33 ($1.26) if one sues the poorest 20. However, these were not consistent reference groups. If instead we focus on the subset of our 15 reference countries for which the poverty line is "current," in that it was derived from the same survey (rather than updated from a prior line allowing only for inflation), then the mean rises slight to $38.89 (n=11). If one focus on the poorest 10 countries for which the poverty line is current then the mean is $37.22.

With a little rounding off, we can also propose a parsimonious schedule of <u>relative</u> poverty lines, with a lower bound of $1.25 a day, but rising above a critical consumption level with a gradient of 1:3, which is in close accord with our regression model in (4).[28] More precisely, our schedule of relative poverty lines is (in $'s per day):

$$Z_i^R \equiv \max[\$1.25,\ \$0.60 + C_i/3] = \$0.60 + \max[\$0.65, C_i/3] \tag{5}$$

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[26] The coefficient on a squared term in PCE per capita was not significantly different from zero; t=0.71. Regressing Z on a quadratic function of log PCE performed as well as the linear model in terms of R^2, and gave a very similar estimate of Z^*; we opted for the parsimonious linear model.

[27] The use of the same PPP for converting both the poverty line and PCE could create a spurious correlation (given that a common measurement error term appears in both variables). To check this, we used PCE at 1993 PPP as the instrumental variable for PCE at 2005 PPP (assuming the measurement errors are uncorrelated); this gave a slope of 0.347 (t=8.42) with a slightly smaller sample (n=70); the corresponding poverty line was $37.41 (t=11.73).

[28] Statistically, the joint restriction on (4) performs extremely well (F(2.71)=0.014; prob=0.986).

The lower bound of $1.25 is binding for the same 15 poorest countries used in setting our absolute line. The point at which the poverty line rises is at C=$1.95 per day.

This schedule of relative poverty lines has a high correlation with the fitted values in Figure 2 (r=0.994) as well as with the data on national poverty lines (r=0.836). Indeed, the precision in predicting the national poverty lines is actually slightly greater using equation (5) than the nonparametric regression in Figure 2.[29] Nor are either the fitted values from the latter regression or a cubic polynomial in C significant when added to a regression of Z on Z^R.[30]

5.   Comparisons with past poverty lines

The method of measuring global poverty used by Chen and Ravallion (2001, 2004, 2007) does not assume comparability across ICP rounds. The salient features of their method are that the international poverty line is converted to local currency units in the ICP base year (using the same consumption PPP used for the national poverty lines) and is then converted to the prices prevailing in the relevant survey year using the best available CPI for that country. The PPP conversion is only done once, and all estimates are revised back in time. Thus, at no point will the new PPP's from the 2005 ICP round be compared with those from previous ICP rounds. Nonetheless, it is of interest to compare our new poverty liens for 2005 with past lines, both absolute and relative.

Absolute poverty lines: Comparisons with past international lines are complicated by methodological changes in PPPs and changes in the data and methods used for setting an international line. However, the practice of looking for an average line amongst the poorest countries has been present throughout the various revisions. Based on the 1985 PPPs from Penn World Tables, RDV had used two poverty lines, one of which was the predicted poverty line in the poorest country which gave a line of $23 per month at 1985 PPP, while the higher line was $31 per month, which was the line found in six countries (Indonesia, Bangladesh, Nepal, Kenya, Tanzania and Morocco) and was considered more representative of the lines found in low income countries. Using the 1993 PPPs, Chen and Ravallion (2001) used instead the median line

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[29]   The standard deviation of the error is $36.13 for the relative poverty lines versus $36.55 for the fitted values from Figure 1. Note that a (sufficiently) less smoothed nonparametric regression would do better than our piece-wise linear model.

[30]   The joint F test of the null that the three parameters in the cubic function of C are all zero in the regression of Z on Z^R 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.

for the lowest 10 lines in the RDV data set, giving the line of $32.74 per month or $1.08 per day, though using they showed that using the predicted line in the poorest country gave virtually the same value ($1.05 per day).

From our study, the most comparable estimate to these is the predicted line for the poorest country. In Table 1, the regression of log poverty line on a quadratic function of consumption per capita is the same specification used by Chen and Ravallion (2001) and this gives $33.76 per month ($1.11 per day) in 2005 prices on our new data set. However, as also noted above, a more robust estimate is that based on the non-parametric regression, which gives $37.16 per month or $1.22 per day. As also argued above, a good case can be made for using instead the average of the poorest 15 countries, giving $1.25 per day.

It is clear that our proposed new international poverty line of $1.25 has a lower value in the US than our old lines. The $US value in 1993 of our new international poverty line of $1.25 a day is $0.92 a day—15% lower than the Chen and Ravallion (2001, 2004) poverty line of $1.08 a day at 1993 PPP. The $1.25 line in 2005 is equivalent to exactly $1.00 a day in the US in 1996. To put the point another way, if we simply updated the old 1993 line for inflation in the US then we would get a line of $1.45 a day in 2005; the 2005 value of the predicted poverty line in the poorest country—estimated as $1.05 per day by Chen and Ravallion (2001)—is $1.42 per day.[31] These lines are significantly higher than our $1.25 line (t=2.08; prob.=4%).

However, these calculations are deceptive, given that the PPP's from different ICP rounds are not strictly comparable. There were substantial revisions to the PPP's in the 2005 ICP round relative to 1993. Probably the most important difference for the present purposes is that it is believed that the 1993 ICP for developing countries used less rigorous standards of specifying the quality of commodities than the 2005 ICP, such that a lower quality of goods were priced than would have been found in the US market.[32] The goods priced by the 1993 ICP tended to be more typical of the items available in local markets.

Some large changes in the PPPs are evident if we convert a given national poverty line into $'s at both 1993 and 2005, and then compare the results, as given in Figure 4 for the 72

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[31]   The ratio of the 2005 CPI for the US to the 1993 CPI is 1.352.
[32]   Heston and Summers (2008) describe the ways in which the 2005 ICP was an improvement over past ICP rounds, and point specifically to the "…quantum improvement in the way regional comparisons were linked together from the standpoint of reviewing price collection" (p.3). Also see World Bank (2008b).

countries with both PPPs available. The mean poverty line using the 1993 PPPs is $91.25 (as compared to $87.59 using the 2005 PPPs), and the median is $66.70 (as compared to $60.81). It is notable from Figure 4 that the 2005 ICP has tended to entail an even larger downward revision (in proportionate terms) in the $ value of the lowest stratum of poverty lines. This is clear from the density functions of the national poverty lines evaluated at the alternative PPPs given in Figure 5. (The Figure gives the national lines at 1993 PPP in both 1993 prices and 2005 prices, adjusting for US inflation.) The mean poverty line of the poorest 15 countries ranked by consumption per capita at 1993 PPP is $44.19, as compared to $37.98 using the 2005 PPPs. This is to be expected given that the revisions introduced by the 2005 ICP have tended to increase the PPP's of developing countries, thus lowering the $ values of their poverty lines.

Based on Figure 4, what is the mean poverty line in 2005 PPP amongst countries with poverty lines around the $1.08 figure at 1993 PPP? In other words, what is the estimated value of $E[Z_i^{05}|Z_i^{93} = \$32.74]$ where Z_i^t denotes the poverty line in PPP $'s in country i using ICP round t? A simple way this can be answered is by estimating the parameter a in the following linear regression based on the data in Figure 4:

$$Z_i^{05} = a + b(Z_i^{93} - 32.74) + \varepsilon_i \tag{6}$$

where it is assumed that $E[\varepsilon_i | Z_i^{93}] = 0$. We find that $\hat{a}_i = 36.06$ (t=8.85) and $\hat{b}_i = 0.857$ (t=10.69). This implies a poverty line of $1.19 a day at 2005 PPP. The estimate of a is not significantly different from our new $1.25 line (t=0.48).[33] But nor is it significantly different from the old line; we cannot reject the null that a=32.74 (t=0.81). However, it is significantly lower than $1.45 a day, as obtained by updating the $1.08 line for inflation in the US; the t-ratio on the null that a=$44.26 is 2.01, which is significant at the 5% level. A possible concern with this calculation is sensitivity of the linear regression to the outliers evident in Figure 4. Instead, we tried a nonparametric regression of Z_i^{05} on Z_i^{93}, and linearly interpolated between the predicted values for the two closest observations for Z^{93}, either side of $32.74; this method gave $\hat{E}[Z_i^{05}|Z_i^{93} = \$32.74] = \$34.50$ or $1.13 a day—similar to (6). Of course, this would not be a defensible poverty line for 2005 since it assumes that the data that gave the old 1993 line were

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[33]   In calculating the standard error we ignore the statistical imprecision of the $1.25 line, but that is unlikely to change the conclusion.

right. However, the calculation does serve to confirm that the $US values of low national poverty lines have fallen with the 2005 ICP.

There are a number of possible explanations for why the mean 2005 line corresponding to the 1993 line is so much lower than that implied by simply updating for inflation in the US. We cannot rule out the possibility that the inflation rates are substantially miss-measured, but it seems more likely that the problem lies with the 1993 PPPs. Weaker standards used in defining comparable goods in the 1993 ICP price surveys (relative to 2005 ICP) could easily produce the kind of upward revisions to the 1993 PPPs implied by the above findings.

The implied revisions are substantial for poor countries. To see this, let $PPP_i^{t^*}$ denote the true PPP exchange rate derived from the ICP round for date t. Under the purchasing power parity principle, the PPP rate for a given country changes over time according to differences in that country's rate of inflation and that for the numeraire country, the US, i.e.,

$$\frac{PPP_i^{05^*}}{PPP_i^{93^*}} = \frac{D_i^{05^*} / D_i^{93^*}}{D_{US}^{05^*} / D_{US}^{93^*}} \qquad (7)$$

where $D_i^{t^*}$ is the true deflator to convert that country-specific poverty line to the PPP reference date, t. While equation (7) holds for the true values of all variables, our measurements are based instead on the observed values, PPP_i^t and D_i^t. To focus on the implications for the errors in the historical PPP data for developing countries we assume that the 2005 PPP and the deflators are accurate. Under these assumptions, the revision to the PPP for 1993 that is implied by the observed data can be readily derived as follows:

$$\frac{PPP_i^{93^*}}{PPP_i^{93}} = \left(\frac{D_{US}^{05} / D_{US}^{93}}{D_i^{05} / D_i^{93}} \right) \frac{PPP_i^{05}}{PPP_i^{93}} \qquad (8)$$

The sample mean of this variable is 1.568 (with a standard error of 0.068; n=72). Thus a sizable underestimation of the 1993 PPP is implied by the new PPP data and the data on rates of inflation. Furthermore, the extent of this underestimation tends to be greater for poorer countries. Figure 6 plots the implied values of $PPP_i^{93^*} / PPP_i^{93}$ against log PCE per person at 2005 PPP. We see a marked negative gradient; the correlation coefficient is -0.472, which is significant at the 1% level (t=-4.70). Amongst the poorest countries in terms of PCE the data suggest a marked upward revision is required to the 1993 PPP. In other words, the 1993 ICP round underestimated the price level in these countries, relative to the US. This is consistent with

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expectations based on the view that the weaker standards of specifying the quality of goods and supervision in poor countries had entailed that, particularly for the poorest countries, the 1993 ICP was using a lower quality of goods than would have been found in the US market.

These observations are at best suggestive. The data problems are unlikely to be confined to the 1993 PPPs; errors in the 2005 PPPs and the inflation rates are no doubt also present. But these results are at least consistent with the interpretation that less rigorous specification and monitoring of quality standards in the 1993 ICP entailed that lower quality goods had been priced in poor countries, leading to an underestimation of the PPP for many of the poorest countries, or (equivalently) that the true cost-of-living had been underestimated.

Note that these findings do not do not cast doubt on the so-called "Penn effect;"[34] the ratio of the PPP to the market exchange rate tends to be lower in poorer countries (see World Bank, 2008a, Figure 5). What they suggest, however, is that the extent of this effect has been somewhat overstated, such that the PPPs of poor countries are higher than has been thought.

Relative poverty lines: It is also of interest to compare our new set of relative poverty lines with those of Chen and Ravallion (2001, 2004), who used a line of the form $Z = \max(Z^*, kC_i)$ where $0 < k \leq 1$. Following Atkinson and Bourguignon (2001), this can be rationalized by arguing that a non-poor person must have <u>both</u> an absolute minimum income and not be relatively deprived, which is assumed to require an income above some proportion k of the mean. Chen and Ravallion chose $Z^* = \$1.08$ a day and k=1/3, which gave a good fit with the RDV poverty lines at 1993 PPP.

The constant of proportionality is the same, but our new poverty lines require that a fixed increment of $0.60 a day is required above one third of mean consumption (equation 3) to not be relatively deprived. Two points are notable about this property. First, the elasticity of our relative poverty line to mean consumption never reaches unity (the elasticity is zero below $1.95 a day and $1/(1+1.80/C_i)$ above that value, and only reaches unity in the limit, as C goes to infinity). Thus our relative poverty lines avoid the anomalous feature of poverty lines that are set at a constant proportion of the mean (including those described above, when consumption is above

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[34]   This is the empirical observations that the PPP exchange rate is less than the market exchange rate in developing countries. This is usually attributed to the Balassa-Samuelson effect, namely that the market rate only brings the prices of internationally traded goods into parity, while non-traded goods are an important component of consumption in developing countries and these tend to be cheaper than in developed countries.

Z^*), namely that an equal proportionate increase in all consumptions leaves measured poverty unchanged.

Second, the consumption level at which the kink occurs in the Chen-Ravallion schedule of relative poverty lines is appreciably higher than for our proposed new schedule. For the Chen-Ravallion relative poverty lines the kink was at a consumption level of $3.24 per day at 1993 PPP, while the new schedule of relative poverty lines proposed in the last section has a kink at $1.95 a day at 2005 PPP. If we had instead chosen $\max(\$1.25, C_i/3)$ 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. There are 18 countries with PCE 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. Alternatively, if we use $\max(\$1.20, C_i/3)$ as the relative poverty line (given that $1.20 is our estimate of the mean poverty line at 2005 PPP corresponding to $1.08 at 1993 PPP) then we find that there is an extra 16 countries for which the absolute line is no longer binding.

So our new data on national poverty lines suggest that relative poverty is a more prominent concern amongst a number of developing countries than found by RDV. This echoes our earlier 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.

6.   PPP's for the poor

The above calculations have used PPP's constructed for international comparisons of mean consumption, not for comparing poverty lines. In principle, it would be better to have PPPs weighted to the average consumption bundle of people near the poverty line (as was argued by RDV). It is unclear how much this matters for measuring poverty lines in the poorest countries, since national poverty lines tend to be approximately equal to mean consumption in those countries. In the context of our new data set on national poverty lines, it should first be recalled that we also find that the national poverty lines tend to be roughly equal to mean consumption for our reference group of the poorest countries. However, that does not mean that the PPP for aggregate consumption is appropriate for those countries, since the underlying prices are expenditure weighted, not population weighted. Even so, it remains likely that it will be at higher income levels that the divergence between aggregate consumption PPP and a "PPP for the

poor" (PPPP) is a greater concern. That raises the issue of how the use of a PPP that is more appropriate for comparing poverty lines would affect the economic gradient in Figure 2.

Intuitively, the impact on the gradient depends on the correlation between mean consumption and the error made in using the aggregate PPP for the poverty lines rather than the PPP for the poor.[35] It is unclear what one would expect on *a priori* grounds; possibly we might even find that the economic gradient in poverty lines largely vanishes if we use a PPPP. In this section we try to test to see how the use of various PPPP's might affect our results.

One candidate for a PPPP is the food component of the aggregate consumption PPP's for 2005, as available in World Bank (2008a). It has been argued by Reddy and Pogge (2008) that it would be better to use the PPP for food consumption alone. This is not obvious; as we have noted, the mean food share for the national poverty lines (mean ratio of food component to total poverty line) is 0.564 (n=28), while the mean for the poorest 20 countries (ranked by PCE) is 0.653 (n=7). So the food PPP leaves out a sizable share of consumption by people living near the national poverty lines, even in the poorest countries. Nonetheless, it is of interest to see how this alternative PPP affects our results.

Figure 7 gives the corresponding graph to Figure 2 using the food PPP's. We use the same PPP for measuring PCE in international $'s; the claim that this PPP is appropriate for mean consumption from the NAS is not at issue—rather the issue is what PPP is most appropriate for measuring poverty. The pattern in Figure 7 is similar to Figure 2, with a marked economic gradient in the poverty lines above a critical level of consumption, although the poverty lines are generally lower. On re-estimating equation (3) for *f* linear, we found that the consistent reference group using this PPP needed to be slightly larger (n=17) (the estimated cut-off point is $64.26; t=4.07), the slope is slightly lower (0.292, t=11.23) and the estimated value of Z^* is appreciably lower at $22.74 (t=13.62). The least squares elasticity of the poverty line to mean consumption rises slightly; the regression coefficient of log poverty line at the food PPP to log PCE per capita is 0.78 (t=15.63), as compared to 0.65 using the mean consumption PPP.

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[35] Consider (for example) the least squares elasticity of the national poverty line to mean consumption. It is readily verified that if the log of the ratio of the PPP for the poor to the PPP for mean consumption is positively (negatively) correlated with log PCE per capita (at PPP) then the elasticity of the poverty line to mean consumption will be over (under) estimated by our analysis. Essentially the log ratio of the two PPP's is an omitted variable in the regression of log poverty line on log PCE.

Rather than setting the weight on nonfood goods to zero, it is better to set a weight more appropriate to spending by poor people. Deaton and Dupriez (DD) (2008) are attempting to do this in a consistent way by re-weighting the consumption bundle to accord with consumption patterns in a neighborhood of an implicit international poverty line that is essentially a weighted average of the national poverty lines (as used in the present paper) when converted to a common currency using their PPP. In forming the common poverty line, DD used all developing countries in our data set of national poverty lines for which they had access to suitable household surveys. This means that the DD PPP's are only available for 46 of our 75 countries. In forming an average line, DD use the national poverty lines of all of these countries, rather than focusing on the poorest as we have done. DD chose to weight by the size of the poverty population in forming their average line, although the poorest countries are not, as a rule, the largest, so there can be no *a priori* presumption that the DD PPP's embody consumption weights that are appropriate for the poorest countries.[36] However, it remains of interest to see whether the pattern in Figure 2 is robust to switching to their PPP's. DD give estimates for the Fisher, Tornqvist and Country-Product Dummy (CPD) methods of forming the price index.[37]

Figure 8 gives the results using their Fisher method. Again the pattern is similar to Figure 2. This was also true for the Tornqvist and CPD methods. The DD PPP's call for a slightly smaller reference group (n=13). The estimated poverty lines for this smaller reference group are \$31.72 (t=8.80), \$33.37 (t=9.59) and \$41.56 (t=9.70) for Fisher, Tornqvist and CPD respectively. For the Fisher and Tornqvist methods, the slope coefficients (above these lower bounds) are slightly lower than for the aggregate PPP; the regression coefficients are 0.276 (t=8.13), 0.300 (t=7.72) respectively. However, for the CPD method the slope is higher at 0.374 (t=8.83). There is little affect on the estimated elasticities.[38]

So the pattern in Figure 2 is robust. For measuring global poverty by the standards of the poorest countries, the PPPP's using either the Fisher or Tornqvist indices suggest a lower international line—close to \$1 a day—while the CPD method suggests a line of \$1.37 a day.

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[36]   Using the poverty rates corresponding to the national poverty lines, we find is no significant difference between the mean number of poor for countries in our reference group and the rest (t=0.50); nor is there any significant correlation between population size and PCE per capita (r=-0.10;t=-0.88).

[37]   For further discussion of these methods see Deaton (2006).

[38]   The estimated slopes are 0.272 (t=8.73), 0.297 (8.37) and 0.368 (t=9.37) while the least squares elasticities are 0.613 (t=8.00), 0.624 (t=8.27) and 0.623 (t=8.17) for the Fisher, Tornqvist and CPD methods respectively.

7.   Conclusion

The original "$1 a day" poverty line aimed to assess poverty in the world as a whole by the standards of what poverty means in the poorest countries. We have revisited this idea armed with a new set of national poverty lines for low- and middle-income countries, drawing on the World Bank's country-specific *Poverty Assessments* and the *Poverty Reduction Strategy Papers* done by the governments of the countries concerned. We have converted these national poverty lines to a common currency using the new set of consumption PPP's estimated from the 2005 round of price surveys done by the *International Comparison Program*.

We find that, across countries, national poverty lines tend to rise with mean consumption above a critical level, but that the relationship is quite flat below that level. This pattern in the data is consistent with our interpretation of a national poverty line as a "social subjective poverty line," defined as the level of consumption below which people in that country tend to think they are poor, and above which they do not.

We find that marked upward revisions to the PPPs of the poorest countries are implied by the results of the 2005 round of the ICP of price surveys. As a consequence, simply updating the old international poverty line for inflation in the US gives a poverty line that is well above the lines found amongst the poorest countries at 2005 PPP. To be consistent with the poverty lines found in poor countries the international poverty line in real $'s has to be revised downwards given the upward revisions to the purchasing power parities of poor countries. We propose instead a new international poverty line of $1.25 a day for 2005 (equivalent to $1.00 a day in 1996 US prices), which is the mean of the lines found in the poorest 15 countries in terms of consumption per capita. The fact that this has a lower real value in the US than our old "$1 a day" line does not mean that global poverty measures will also be revised downwards, given that the purchasing power of household incomes in poor countries is also lower with the new PPPs. On balance the global poverty count will tend to rise, given that larger proportionate revisions to the PPPs are implied for poorer countries.

Our results suggest that relative poverty is a more important concern than was the case 20 years ago. More countries are found in the region where the poverty line rises with mean consumption. Across our sample of developing countries, the overall elasticity of the poverty line to mean consumption is around 0.7—close to the values found for developed countries. We have also proposed a parsimonious schedule of relative poverty lines, consistent with our data on

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national poverty lines. The proposed relative poverty lines have a lower bound of $1.25, which applies to the aforementioned reference group, but then rise according to mean consumption with a gradient of one-in-three. This offers a very good fit with our data on national poverty lines.

In Chen and Ravallion (2008b), new global poverty measures for the period 1981-2005 are estimated from 675 surveys spanning 116 countries using the new international line of $1.25 per day in 2005 prices proposed in this paper, but otherwise using similar estimation methods to those outlined in Chen and Ravallion (2001, 2004). Chen and Ravallion also test robustness of the main qualitative results to the choice of poverty line, and provide estimates over the range $1.00-$2.50 per day.

Table 1: Estimated poverty line for the poorest country for various parametric models

Specification	Predicted poverty line for the poorest country in 2005 PPP \$'s per month (C_i=\$31.34 for Malawi)
$Z_i = \alpha + \beta C_i + \varepsilon_i$	\$31.04 (8.53)
$Z_i = \alpha + \beta_1 C_i + \beta_1 C_i^2 + \varepsilon_i$	\$29.32 (6.59)
$Z_i = \alpha + \beta_1 \ln C_i + \beta_1 \ln C_i^2 + \varepsilon_i$	\$44.22 (6.89)*
$\ln Z_i = \alpha + \beta_1 \ln C_i + \beta_1 \ln C_i^2 + \varepsilon_i$	\$33.76; $\ln \hat{Z}$ =3.52 (33.51)
$\ln Z_i = \alpha + \beta_1 C_i + \beta_1 C_i^2 + \varepsilon_i$	\$32.63; $\ln \hat{Z}$ =3.49 (47.16)

Note: t-ratios in parentheses based on robust standard errors;
*: the turning point $\ln C = 4.04$ —above the lowest consumption.
The predicted value of Z_i at the turning point is \$36.05 (t=13.61).

Figure 1: Density of national poverty lines for 74 developing countries
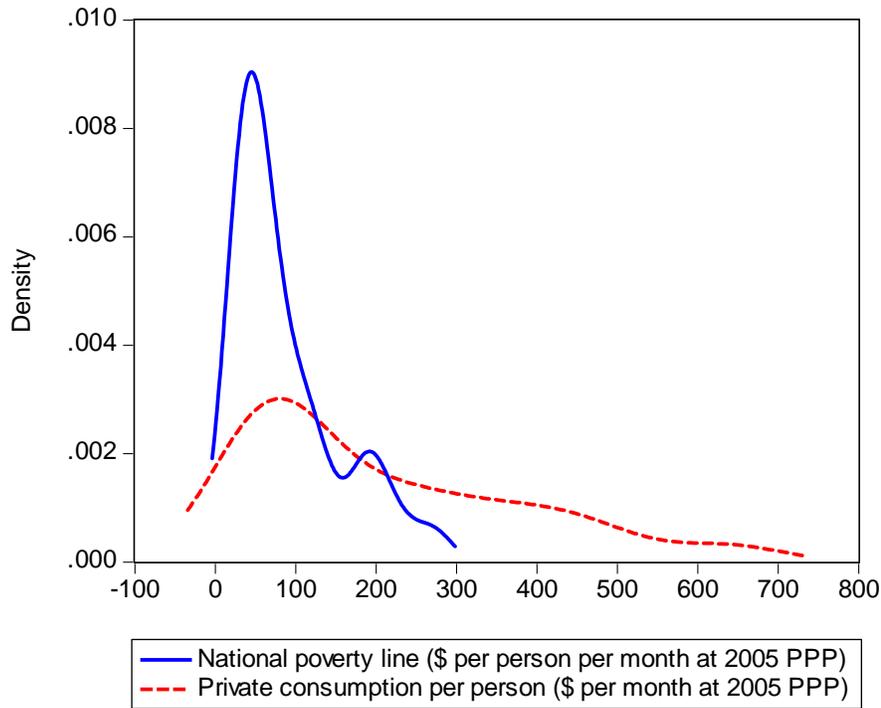
Figure 2: National poverty lines plotted against mean consumption

Note: Fitted values use a lowess smoother with bandwidth=0.8
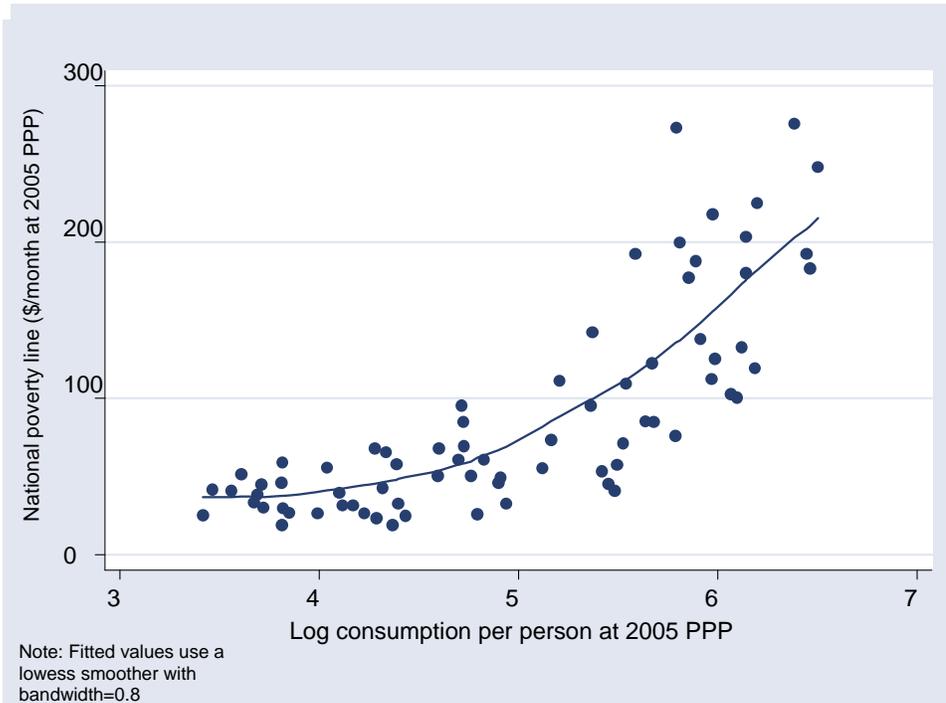
Figure 3: Poverty lines plotted against survey mean

Note: See Figure 1

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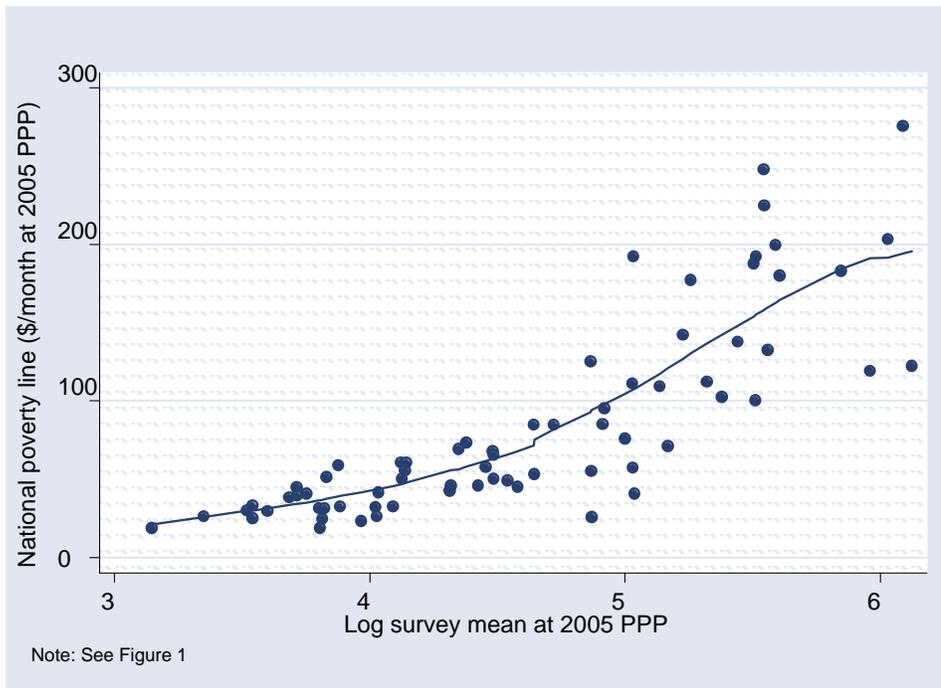
Figure 4: Revisions to the PPP $ value of national poverty lines
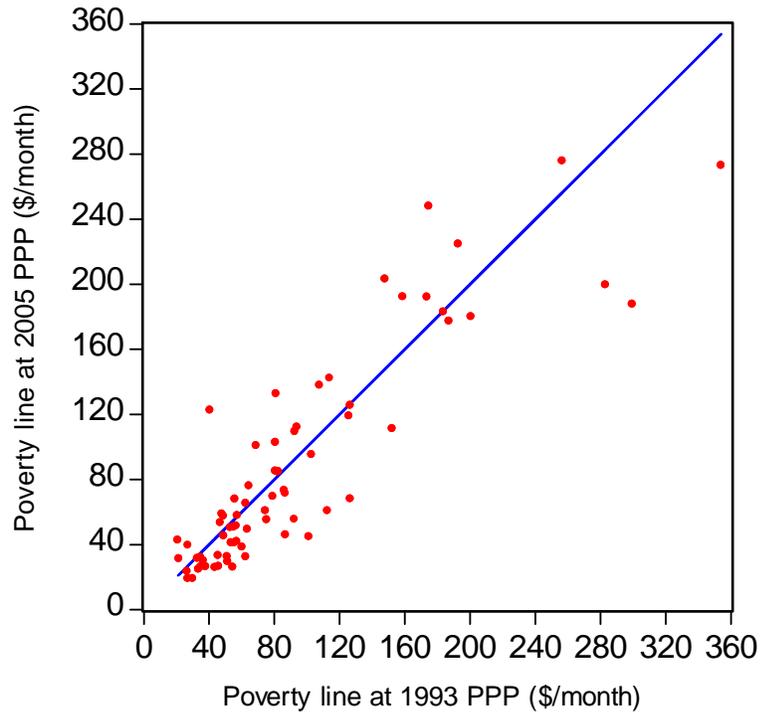
Figure 5: Densities of national poverty lines at 1993 and 2005 PPP
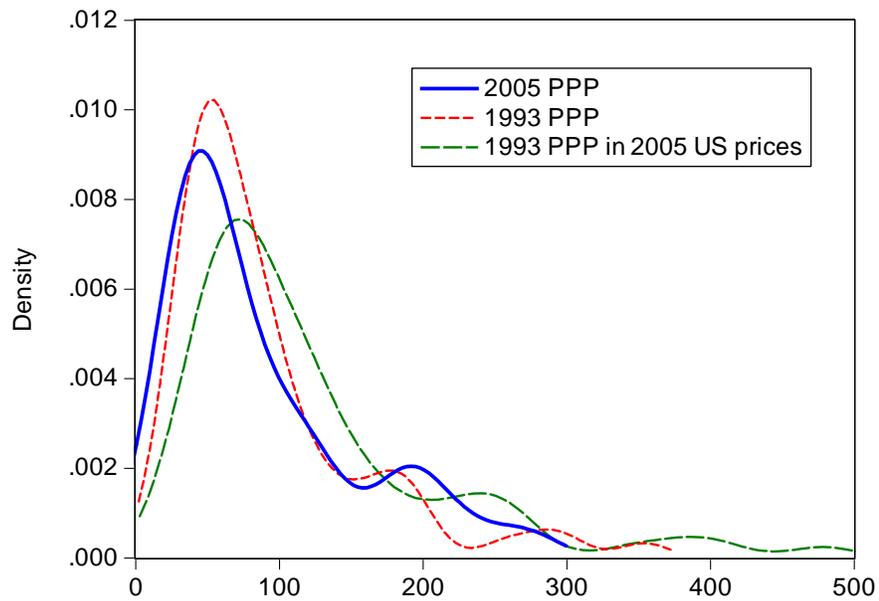
Figure 6: Implied revisions to the 1993 PPP
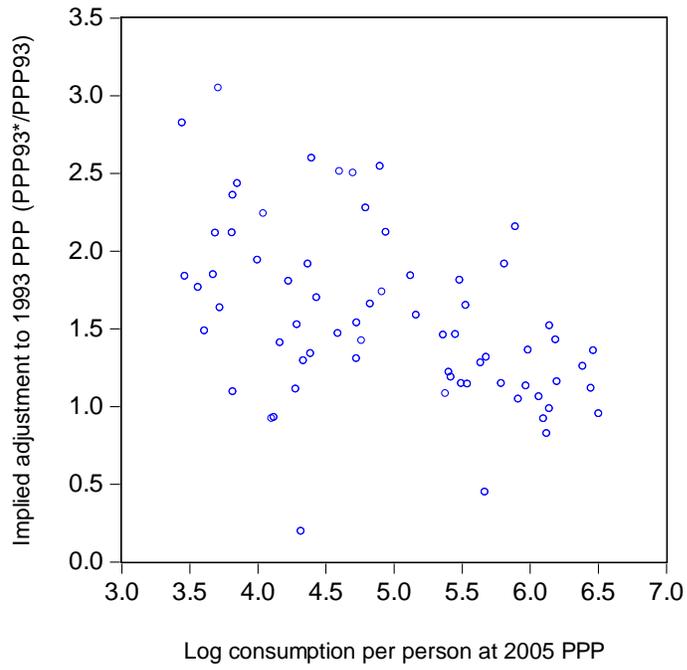
Figure 7: National poverty lines using food consumption PPP

Note: See Figure 1
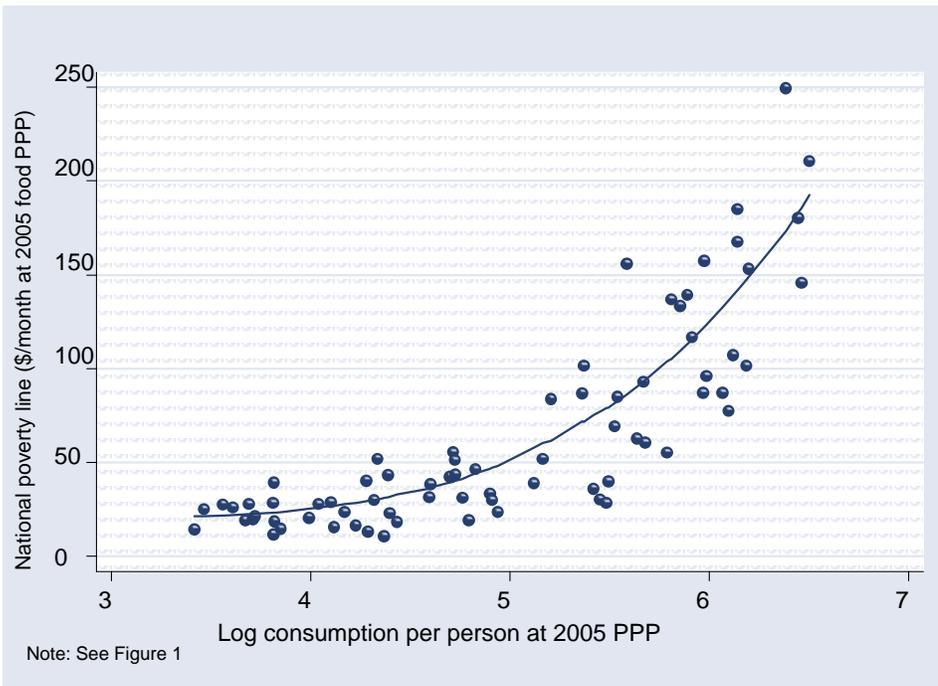
Figure 8: National poverty lines using the Deaton-Dupriez PPPP (Fisher method)

Note: See Figure 1
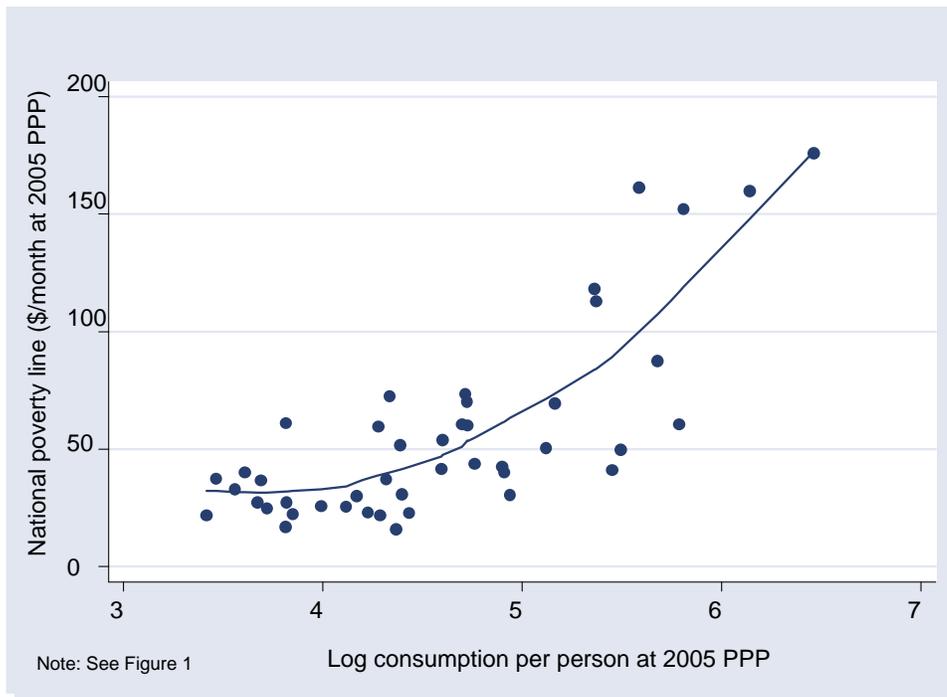
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Data appendix

Table A1: National poverty lines

Country	Source documents	Page for poverty lines	Survey year	PCE per capita per month for survey year in 2005 PPP $'s	Poverty line per capita per month 2005PPP $'s	Notes on methods used to set national poverty line in source document
Albania	Albania: Poverty Assessment, June 28, 2003, per cap per month.	11	2002	280.71	85.18	1
Algeria	Democratic and Popular Republic of Algeria: Growth, Employment and Poverty Reduction: Main Report, January 20, 1999.	3	1995	n.a.	n.a.	1,4,5
Argentina*	Crisis and Poverty 2003: A Poverty Assessment, vol. II, adult equivalent poverty line for metro Buenos Aires.	14	1999	641.90	183.07	1, 6
Armenia	Armenia Poverty update December 9, 2002, Report #24339-AM.	13	1998/99	174.84	73.36	1, 5, 6
Azerbaijan	Azerbaijan Republic: Poverty Assessment, Vol II, The main report, June 2003	3	2001	292.23	84.80	1
Bangladesh	Poverty in Bangladesh: Building on progress, December 2002, Report # 24299-BD	Micro data file	2000	64.34	31.46	1, 4
Belarus	Belarus: Poverty Assessment; Vol 1; Main report, January 2004	3	2002	362.04	187.73	1, 4, 5
Benin	Benin Poverty Reduction Strategy Paper 2003-2005	12	1999/00	72.82	23.57	1
Bolivia*	Poverty Assessment: Establishing the Basis for More Pro-Poor Growth, December 15, 2005, report #: 28068-BO	69	2001	216.66	142.39	1, 4, 5
Bosnia & Herzegovina	Bosnia & Herzegovina: Poverty Assessment Vol. I, Main Report , November 2003	5	2001	393.95	217.65	1
Brazil*	Measuring Poverty using household consumption, September 2006 draft, January 2008 Final Report #: 36358-BR	21	2002/03	465.45	180.14	1, 4, 5

Country	Source		Year			
Bulgaria	Bulgaria Poverty Assessment October 2002, Report #: 24516-BUL	2	2001	445.70	100.77	7
Burkina Faso	Burkina Faso: Reducing Poverty with Sustained Equitable Growth; Poverty Assessment, June 2005	14	2003	68.54	26.27	1, 5
Cambodia*	Cambodia: Halving Poverty by 2015, poverty assessment 2006	21	2004	75.06	42.80	1, 4, 5
Cameroon	Joint IDA-IMF Staff Assessment and PRSP, July 2003	10	2001	112.96	69.62	1, 4, 5, 6
Chad	National Poverty Reduction Strategy Paper, June 2003	20	1995/96	47.04	26.60	1
Chile*	Chile urban poverty line from the working file of Ezequiel Molina, a data coordinator of LAC region at the World Bank.		2000	487.08	119.00	7
China	"Memo on poverty lines," National Bureau of Statistics, China, 2002	1	2002	120.78	25.89	1,2
Colombia*	Colombia: Poverty Report Vol. 1, November 2002, Table A1	102	1999	334.47	199.56	1, 5, 6
Congo, Rep	Enquete Congolese après des menages (ECOM 2005), Centre National de la Statistique et des Etudes Economiques, April 2006	Viii	2005	72.13	67.99	1, 5, 6
Costa Rica	Costa Rica: Identifying the social needs of the poor: An update, Annex 3, May 1997	40	1992	n.a.	n.a.	1
Cote d'Ivoire	Document de strategie pour la reduction de la pauvrete - interimaire, January 2002	26	1998	117.07	50.36	3
Djibouti	Profil De La Pauvrete A Djibouti, December 2002	42	2002	111.70	95.61	1, 6
Dominican Rep	Dominican Rep: Poverty Assessment: Achieving more pro-poor growth, Oct 2006	6	2004	n.a.	n.a.	1, 4
Ecuador	Ecuador: Poverty Assessment, April 2004	26	2001	289.72	122.62	7
Egypt	Arab Republic of Egypt poverty reduction in Egypt: diagnosis and strategy, June 2002	12	1999/00	225.68	53.43	1, 5

El Salvador	El Salvador: Poverty Assessment: Strengthening Social Policy, Dec 2005	5	2001	n.a.	n.a.	1
Estonia	Estonia: Living Standards during the transition, June 1996, Page 10, poverty line is the minimum pension in July 1995	10	1995	431.16	102.78	7
Ethiopia	Ethiopia PRSP, 2002	6	1999/00	35.22	41.04	1
Gambia	Gambia: PRSP and Joint Assessment, June 2002	appendix 1	1998	40.88	44.92	1
Georgia	Georgia Poverty and Income Distribution 1999	3	1997	182.79	111.24	1, 6
Ghana	Ghana: Joint IDA-IMF Staff assessment of the PRSP, March 2003	13	1998/99	56.90	55.65	6
Guatemala	Guatemala: Poverty in Guatemala February 2003,	8	2000	n.a.	n.a.	1
Guinea Bissau	Republic of Guinea Bissau: Poverty Assessment and Social Sectors Strategy Review, June 1994	6	1991	45.12.	45.96	3
Haiti	Haiti: The Challenges of Poverty Reduction, Volume II Technical Papers, March 1998	3	1996	n.a.	n.a.	7
Honduras	Honduras: Country Economic Memorandum/Poverty Assessment Nov 1994, Annex table: C:11	66	1993	n.a.	n.a.	1, 5
Hungary	Hungary Long Term Poverty, Social Protection and the Labor Market, vol. 1, April 2001, subsistence minimum for 1997	2	1997	668.31	247.87	6
India	Official poverty lines for India from Planning Commission, Government of India	131	2004/05	84.24	26..82	2
Indonesia	Poverty Reduction in Indonesia: Constructing a New Strategy, Oct 2001	2	1999	139.96	32.63	1, 4, 5
Jamaica	Jamaica Survey of Living condition, 2002	25	2002	n.a.	n.a.	1
Jordan	Jordan Poverty Assessment, Vol.1, December 2004, report # 33802	8	2002/03	251.59	71.47	1,5

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Kazakhstan	Kazakhstan: Living Standards during Transition, March 1998, Report # 17520-KZ	12	1996	213.41	95.32	7
Kenya	2003 Country Economic Memorandum for Kenya	18	1997	112.80	84.71	1
Kyrgyz	Kyrgyz Republic Poverty Updates, August 2005, Report # 36602 - KZ,	50	2003	109.85	60.81	1, 5
Lao	Poverty in Lao PDR During the 1990s, May 2002, Annex 2, Table 2.7	47	1997/98	n.a.	32.10	1, 4, 5
Latvia	Latvia: Poverty Assessment, Vol. 1, June 2000	3	1995	370.11	137.91	3
Lesotho	PRSP and Joint Staff Advisory notes, July 2005	9	1994/95	135.84	49.37	7
Macedonia	FYR Macedonia: Focusing on the Poor; Vol. II, June 1999, Report # 19411 - MK	11	1994	348.96	177.25	1
Malawi	"Note on Construction of Expenditure Aggregate and Poverty Lines for IHS2," October 2005	8-9	2004/05	31.34	26.11	7
Mali	Assessment of Living Conditions, June 1993, Report # 11842 – MLI	8	1988/89	31.96	41.89	3
Mauritania	Poverty Reduction Strategy Paper: Action Plan 2006-2010, October 2006	16	2000	99.63	68.16	7
Mauritius	Mauritius: Country Economic Memorandum: Sharpening the Competitive Edge, April 1995, report # 13215 – MAS	70	1991/92	328.33	272.99	3
Mexico	Poverty in Mexico, 2004, Report # 31115, table 1.1	8	2002	630.73	192.22	1
Moldova	"Living Standards and Poverty in Moldova" by Kathleen Beegle, June 2004	2 (footnote)	2001	124.89	60.81	1
Mongolia	Mongolia Poverty Assessment, April 2006, Report # 35660 – MN	18	2002/03	80.55	57.88	7
Morocco	Kingdom of Morocco: Poverty Update, Annex; March 2001, Report # 21506 – MOR	3	1998/99	167.73	55.33	1, 4, 5
Mozambique	Mozambique 2002/03 data file in STATA received from Louise Fox	Micro data file	2002/03	45.52	29.54	7

Nepal	Nepal Resilience Amidst Conflict, June 2006, Report # 34834 - NP, table 4a	125	2003/04	54.55	26.43	1, 4, 5
Nicaragua	Nicaragua: Poverty Assessment; Raising Welfare and Reducing Vulnerability, Dec 2003, Box 1.1, Report # 26128 – NI	2	2001	n.a.	n.a.	1, 4
Niger	Niger: Poverty Assessment, June 1996	35	1993	39.34	33.35	3
Nigeria	The Evolution of Poverty and Welfare in Nigeria, 1985-92, Table A1.1, January 1997	13	1985	61.49	31.38	3
Pakistan*	Pakistan Poverty Assessment, Oct 2002, table A-2-2, per adult equiv, Report # 24296 – PAK	132	1998/99	98.31	50.67	1, 5, 6
Panama	Panama Poverty Assessment, June 1999; Vol 2, Annex 2.	6	1997	n.a.	n.a.	1, 4
Paraguay	Paraguay Capital city poverty line from the working file of Ezequiel Molina, LAC region, World Bank. (Poverty line from capital city.)	Work file	2002	222.27	192.14	1
Peru*	Peru: Opportunities for All -- Poverty Assessment, Dec 2005, Report # 29895 – PE	161	2000	326.61	76.10	1, 5
Philippines	Philippines: An Opening for Sustained Growth, Vol. II, April 1993, Report # 11061 - PH	331	1988	134.17	46.02	7
Poland	Poverty in Poland, Vol 1, Sept 1994, Report # 13051 – POL	14	1993	465.05	203.23	5
Romania	Romania Poverty Assessment, Vol. II, Background Paper, September 2003, Report # 26169 – RO	6	1994/01	397.77	125.57	1, 6
Russia	Russian Federation Reducing Poverty Through Growth and Social Policy Reform, Feb 2005, Report # 28923 – RU	12	2002	455.72	132.67	7
Rwanda	A Profile of Poverty in Rwanda, Feb 2002, Ministry of Finance & Economic Planning, National Poverty Reduction Program & Stat Dept.	5	1999/01	41.33	30.17	5, 6

Senegal	Senegal an Assessment of Living Conditions, Vol. 2, May 1995, Report # 12517 – SE	A 11	1991	78.92	19.05	1, 4, 5, 6
Sierra Leone	Sierra Leone, Poverty Reduction Strategy Paper: A National Program For Food Security, Job Creation And good Governance (2005-207).	57	2003/04	36.94	51.54	1, 6
Sri Lanka	Announcement of the Official Poverty Line-- Department of Census and Statistics, Jun 2004, ISSN 1391-4693	5	2002	233.05	45.38	1, 5
Tajikistan	Republic of Tajikistan, Poverty Assessment, June 2000, Report # 20285 – TJ	17	1999	45.49	58.83	7
Tanzania	Household Budget Survey 2000/01, July 2002, National Bureau of Statistics Tanzania	78	2000/01	45.26	19.20	1, 5, 6
Thailand*	Thailand: Growth, Poverty and Income Distribution, Dec 1996, Report # 15689	7	1992	243.52	57.58	7
Trinidad & Tobago	Trinidad and Tobago: Poverty and Under-employment in an Oil Based Economy; Oct 1995, Report # 14382-TR	4	1992	n.a.	n.a.	1
Tunisia	Tunisia: Social and Structural Review 2000, Middle-East and North Africa Region, World Bank	63	1995	240.63	41.17	7
Turkey	Turkey: Joint Poverty Assessment Report, August 2005, Report # 29619 – TU	7-8	2002	391.42	112.26	1, 6
Uganda	Change in Poverty in Uganda, 1992-1997, Centre for the Study of African Economies, Oxford University, May 1999	17	1993/98	40.01	38.51	1, 5, 6
Ukraine	Ukraine Poverty Assessment (PULSE report), 2005	3	1999/02	254.62	109.43	1, 4, 5
Uruguay	Uruguay Maintaining Social Equity in a Changing Economy, July 2001	3	1998	593.71	275.71	1
Uzbekistan	Relative Food Poverty Line: Uzbekistan Living Standards Assessment; May 2003, Report # 25923 – UZ	10	2000/01	n.a.	n.a.	2, 4, 5

Venezuela	Venezuela Poverty Study: From Generalized Subsidies to Targeted Programs, 1991	17 footnote	1989	492.30	224.73	1
Vietnam	Vietnam Development Report 2004:Poverty, Report # 27130	19	2002	81.18	32.52	7
Yemen	Republic of Yemen: Poverty Update, vol. 1, main report; June 2002, Report # 24422	3	1998	76.37	65.37	1, 4, 5
Zambia	Zambia: Poverty and vulnerability assessment: discussion draft, June 2005, Report 32573	37	2002/03	60.40	39.69	1, 6

Notes: * Urban poverty lines are used since the PPP 2005 rates were from urban centers for these countries.

1. The codes for methods (last column) are: Cost of basic needs=1; Food energy intake method=2; Relative poverty line=3; Same food basket=4; Regional price index used=5; Per adult equivalent =6; Information not available=7

2. Based on ICP sampling information we treat the 2005 consumption PPPs as an urban PPPs for the following countries: Argentina, Brazil, Bolivia, Cambodia, Chile, China, Colombia, Pakistan, Peru, Thailand and Uruguay. For these countries, both poverty line and food poverty lines are urban poverty lines. Ecuador and Venezuela have national poverty lines since urban lines are not available. For further discussion of the sources of sampling bias in the China ICP for 2005 see Chen and Ravallion (2008a).

3. When we only have rural and urban poverty lines for a country, the national poverty line is calculated as the weighted mean of the urban and rural poverty lines, using urban and rural real consumption (or income) shares as the weights, and using the poverty lines as the deflators. Thus the national line is

$$Z = w_u Z_u + w_r Z_r \text{ where } Z_u \text{ and } Z_r \text{ are the urban and rural poverty lines, } w_u \equiv (n_u \overline{Y}_u / Z_u) / [(n_u \overline{Y}_u / Z_u) + (n_r \overline{Y}_r / Z_r)] \ (w_u + w_r = 1), n_u,$$

n_r are the populations shares ($n_u + n_r = 1$), and $\overline{Y}_u$ and $\overline{Y}_r$ are the survey mean nominal income/consumptions for urban and rural areas and This formula was used to calculate the national poverty line for India, Benin, Ethiopia, Gambia, Kenya, Macedonia, Mexico, Mozambique, Niger and Senegal.

4. For Paraguay, the poverty line is for the capital city only since the 2005 ICP survey only covered the capital city.

5. **Brazil**: Urban poverty line was a simple average of metropolitan and other urban poverty lines. **Cambodia**: Urban poverty line was a simple average of Phnom Penh and other urban poverty lines. **Colombia**: Simple average of 7 urban regions' poverty lines. **Costa Rica**: Food poverty line was multiplied by 2 to get total poverty line. **Cote d'Ivoire**: Relative poverty line. **Guinea Bissau**: Total poverty line was derived from urban and rural poverty line using urban rural population share as a weight (since it does not have urban rural mean, the method mentioned in note 3 was not applicable). **Kazakhstan**: Poverty line is equal to average subsistence minimum. **Mali**: Relative poverty line. **Peru**: Urban poverty line was derived as a simple average of urban Costa, urban Selva and urban Sierra of Peru.

Table A2: Countries with missing data

	1993 PPP	PCE	2005 PPP	Food PL
Algeria	yes	yes	no	yes
Bosnia-Herzegovina	no	yes	yes	yes
Chad	yes	no	yes	no
Congo, Rep	yes	yes	yes	no
Costa Rica	yes	yes	no	yes
Djibouti	no	yes	yes	no
Dominican Rep	yes	yes	no	yes
El Salvador	yes	yes	no	yes
Guatemala	yes	yes	no	yes
Guinea Bissau	no	yes	yes	no
Haiti	yes	yes	no	no
Honduras	yes	yes	no	yes
Jamaica	yes	yes	no	no
Lao	yes	no	yes	no
Mauritius	yes	no	yes	no
Nicaragua	yes	yes	no	yes
Panama	yes	yes	no	yes
Trinidad & Tobago	yes	yes	no	no
Uzbekistan	no	no	no	yes
Number of "yes"	15	16	7	10
Number of "no"	4	3	12	9