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How Should We Measure Global Poverty in a Changing World?

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Abstract

Before effective anti-poverty policy can be designed and implemented, the extent, trend and distribution of poverty must be identified. In this sense, poverty measurement is a crucial intermediate step in public policymaking and development planning. This paper asks whether the estimated proportion of the world's population with income below US$1 (adjusted according to purchasing power parity) per day is a good measure of trends in global poverty. We argue that the answer depends on two important issues in the measurement of poverty—the definition of the poverty line, and how best to summarize the level of poverty In this paper, we survey the literature on poverty measurement, demonstrate the importance of considering poverty incidence, depth and inequality jointly, present a simple but powerful graphical representation of the Sen and SST indices of poverty intensity (the *poverty box*) which is the FGT index of order 1 and extend our empirical work to China using the commonly accepted international poverty line definition of one half median equivalent income.

Keywords: development, poverty, measurement, China, rural, urban

JEL classification: O150, I320

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Acronyms

CHIP Chinese Household Income Project
FGT Foster-Greer-Thorbecke decomposable poverty indices
LST linear scaling technique of standardization
MDGs Millennium Development Goals
PPP purchasing power parity
SST Sen-Shorrocks-Thon index of poverty

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1 Introduction

One of the primary targets of the UN Millennium Development Goals (MDGs) is the poverty rate or headcount ratio, i.e., the proportion of population with income below the US$1 poverty line. As a measure of poverty, this has the enormous advantage of simplicity. The poverty line—one US dollar per day—seems immediately understandable as an indicator of absolute deprivation. The calculation of the percentage of people who are poor is similarly straightforward. This measure can therefore easily be used in public debates—even though it implicitly embodies the assumption that the degree, and inequality, of deprivation of the poor is not important.

According to the UNIDO *International Development Report* (2004), the proportion of the world population with income below US$1 (adjusted according to purchasing power parity)[1] per day[2] has dropped from 40 per cent in 1981 to 21 per cent in 2001. However, the question this paper asks is: is this alone a good indicator of global anti-poverty progress?

A secondary indicator of MDGs is the poverty gap ratio (also called the average poverty gap of the population (see Xu and Osberg 2002: 140) or the poverty gap index (see Lipton and Ravallion 1995: 2579) which is the mean distance for the entire population of income shortfalls below the poverty line as a proportion of the poverty line (Chen and Ravallion 2001: Table 3). The poverty rate and the average poverty gap ratio[3] are the two most used poverty measures in many countries and international organizations, largely because they can be easily understood and, as a consequence, *actually used* in the broader public debate.

A third dimension of poverty measurement (although not calculated widely[4]) is the inequality of poverty. Although this is not part of the MDGs, economists such as Amartya Sen have argued for the use of poverty measures which jointly incorporate the incidence, depth and inequality of poverty. In this paper, we explore such possibilities, and possible simplifications.

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1 Aten and Heston (2004) note that since the consumption of the poor is more heavily weighted to food than the consumption of the population as a whole, and since food is relatively high-priced in developing countries, the PPP adjustment appropriate for comparison of GDP per capita is inappropriate for comparisons of absolute poverty. They argue that a more appropriate poverty line PPP would substantially increase the global poverty rate. However, this issue is beyond the scope of this paper.

2 Chen and Ravallion (2001: 285) note that initially the US$1 per day standard was set in 1985 prices, but they use US$1.08 in 1993 prices.

3 Two closely related poverty measures are the average poverty gap ratio of the population (where the deprivation of the nonpoor is taken to be zero—see Equation 2.3) and the average poverty gap ratio of the poor (or the income gap ratio), which is defined as the average income shortfall below the poverty line as the proportion of the poverty line for the poor—see equation 2.2 (see Lipton and Ravallion 1995: 2579; Ray 1998: 255, and Xu and Osberg 2002: 140). Clearly, the average poverty gap ratio of the population equals the product of the average poverty gap ratio of the poor and poverty rate.

4 The Philippines is one of the few developing countries which reports inequality regularly as a part of official poverty statistics.

Measures of the incidence, depth and inequality of poverty presuppose specification of the poverty line. In common language usage, poverty is about deprivation of necessities: the primary dictionary definition of 'poverty' is 'want of the necessities of life' (see Oxford 1998: 1135). However, any operational criterion for poverty measures necessarily involves some approximation in the measurement of individuals' command over resources, and some balancing of the risks of misclassification. For any given poverty line, there is some probability that a person who is actually deprived may not be identified as a poor person (Type I error) and there is also some chance that a non-deprived person may be identified as poor (Type II error)—minimizing these errors, in particular Type I error, is important. As well, analysts have often debated whether to measure poverty in terms of a generalized command over resources (i.e., income) or in terms of command over specific commodities, i.e., a minimum food and nonfood basket.

A poverty line or threshold can be established based on either an absolute or relative criterion. Typically, an absolute poverty line has been used in developing countries, often based on the minimum food consumption basket for a specific level of calories (say 2200) and a minimum non-food consumption basket. However, economic growth means that even absolute poverty lines tend to change over time, as consumption items which were considered non-essential in the past, are considered essentials now. The rapid economic growth in recent years in some countries suggests that in this changing world, the absolute poverty line methodology may be becoming less appropriate in these countries.[5]

In affluent countries, extreme deprivation may be rare, and in practice poverty research in most developed countries uses an explicitly relative definition of the poverty line[6] (often defined as a fraction, usually 50 per cent, of median income). An absolute poverty line (such as US$1 per day) has been more common in research on developing countries. However, some developing countries are very rapidly becoming more affluent—at least in average incomes. Hence, although many researchers would agree that absolute deprivation remains the important issue in countries with very low per capita incomes, this division of focus has become harder to justify in recent years. Rapid economic growth in countries such as China, Maldives, Thailand, and some others (comprising a large fraction of the world's population) raises the question: how should we measure poverty when average income is growing rapidly?

Amartya Sen (1985) has noted that there is the broader question of whether a poverty line income threshold can be representative of other dimensions of capacities. Also, at the operational level, researchers need to decide which measurement units to use. The recipient unit—individuals or households—must be defined and identified, as is culturally appropriate. Researchers must also decide whether *income* or *consumption* or

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5 For example, in Maldives, Thailand, and some regions in China, no absolute poverty exists if the absolute poverty line were used in 2003-04.

6 See, for example, the recent OECD study by Förster and Mira d'Ercole (2005). Even when the rhetoric of an 'absolute' poverty line is used, the redefinition over time of a 'subsistence' consumption bundle in developed economies often means that the poverty line is implicitly, if periodically, drawn relative to prevailing norms of consumption (see Fisher 1995 and Osberg 2000). The USA is an exception, since the social security poverty line initially set in 1963 at three times the level of a 'subsistence' food budget has been adjusted only for price increases since then.

expenditure is the most appropriate concept to use in assessing *command over resources* and how exactly each concept can be best approximated in the real world of statistical practice. But given these research decisions, poverty still has to be summarized by some index—and one example of current practice is given by Chen and Ravallion (2001), who use the headcount ratio and poverty gap ratio based on the international absolute consumption poverty lines (the 1993 PPP-adjusted US$1.08 and US$2.15, respectively).

In the economic literature, many poverty measures have been proposed primarily based on the axiomatic approach advocated by Sen (1976).[7] However, most are not actually used in practice. The more communicable and often-used poverty measures are the headcount ratio, poverty gap ratio, income gap ratio, and Foster-Greer-Thorbecke (FGT) indices of different orders. (See Lipton and Ravallion 1995; Ray 1998, and Todaro and Smith 2003.) Although perhaps desirable from a theoretical perspective, more complex poverty measures such as the Sen and SST indices that measure poverty incidence, depth and inequality jointly appear more difficult to calculate and harder to communicate in their original forms. Hence, it is the simpler poverty measures that tend to be actually used despite their insensitivity towards distribution among the poor, which is considered important by Sen (1976); Foster, Greer, and Thorbecke (1984); Shorrocks (1995); Lipton and Ravallion (1995), among others.

In this paper, we analyse the benchmark poverty measures such as the Sen and SST indices of poverty intensity in order to (i) find their simplified representations, (ii) relate them to an illustrative tool called the *poverty box*, which combines the incidence and depth of poverty in a two-dimension space, and (iii) apply these measures to a developing country (China). Osberg and Xu (2000) find that in the developed countries, where the poverty rate is relatively low (typically considerably less than 20 per cent), inequality among the poor is small and fairly constant over time and across jurisdictions. Hence Osberg (2000) and Xu and Osberg (2000) advocate the *poverty box* approach as a way of simplifying communication and facilitating comparative studies.[8] This approach offers a solution on how to measure poverty incidence and depth jointly and graphically, and gives the poverty gap ratio a geometric interpretation. This paper addresses the issue of whether the same should be done in developing countries such as China, where the poverty rate is much higher and the regional variations in inequality of poverty are greater.

Section 2 of the paper reviews what we have learned from the literature on a set of useful poverty measures. Section 3 provides some empirical evidence from China. Section 4 concludes.

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7 See Zheng (1997) for a review.

8 Fields' study (1977: 576 or 1980: 26 and 212) on Brazil's poverty, includes a figure in which the poverty rate and average poverty gap in local currency are shown in a coordinate system, but for international comparison, one needs to use the poverty gap ratio. Based on international data in 1987 and 1998, Chen and Ravallion (2001) note that the poverty rate based on the 1993 PPP US$ 1.08 (or 1993 PPP US$2.15) poverty line, poverty rate is higher than 40 per cent (70 per cent) in South Asian and Sub-Saharan Africa.

2 What have we learned about poverty measurement?

The most common measure of poverty is the proportion of the population whose incomes are below a designated poverty line. If we use N for the size of a population and Q for the number of the poor, then the *poverty rate* is given by

$$H = \frac{Q}{N}. \tag{2.1}$$

This 'headcount' measure presupposes the definition of recipient unit (individual or family or household) and income concept, and the specification of a poverty line (z), below which the income of an individual i (y_i) is unacceptably low. However, the poverty *rate* cannot show the depth of poverty—identical poverty rates in two countries or the same country at two different points in time will not convey any information on average income levels or shortfalls below the poverty lines. More disturbingly, if the poverty rate is used as the main measure of the effectiveness of anti-poverty policy, policymakers may be tempted by 'cream-skimming', because the most cost effective way to reduce poverty is to give a small transfer to the richest of the poor, in order to lift his or her income just above the poverty line.

Concern with the depth of poverty motivates two closely related measures—the average poverty gap ratio of the poor and that of the total population. The former is denoted by

$$I = \frac{1}{Q}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right) \tag{2.2}$$

and the latter

$$HI = \frac{Q}{N}\frac{1}{Q}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right) = \frac{1}{N}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right), \tag{2.3}$$

where the poverty gap ratio is set to zero for the nonpoor population because they have zero deprivation of income.

These measures of the incidence and average depth of poverty cannot reveal whether deprivation differs substantially among poor people. Further, the average poverty gap ratios are not sensitive to whether poverty alleviation targets the poorest of the poor or those who are only marginally poor. In 1976 Amartya Sen proposed a set of fundamental axioms as the basis for poverty measurement[9] which, although refined further later (see Shorrocks 1995; Chakravarty 1997), has formed the foundation for subsequent poverty measures. One of the key points made by Sen is that all the existing poverty measures at that time were insensitive to the distribution aspect of poverty.

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9 Similar to the debate in establishing inequality measurement, where the Pigou-Dalton transfer principle became a guidepost or an axiom (see Dalton 1920 for the original work and Xu 2003 for an intuitive explanation).

The seven best known axioms or principles for evaluating poverty measures are:[10]

i) *Focus Axiom* (F): the poverty measure should be independent of the nonpoor population.

ii) *Weak Monotonicity Axiom* (WM): a reduction in a poor person's income, holding other incomes constant, must increase the value of the poverty measure.

iii) *Impartiality Axiom* (I): A poverty measure should be insensitive to the order of incomes.

iv) *Weak Transfer Axiom* (WT): An increase in a poverty measure should occur if the poorer of the two individuals involved in an upward transfer of income is poor and if the set of poor people does not change.

v) *Strong Upward Transfer Axiom* (SUT): An increase in a poverty measure should occur if the poorer of the two individuals involved in an upward transfer of income is poor.

vi) *Continuity Axiom* (C): The poverty measure must vary continuously with incomes.

vii) *Replication Invariance Axiom* (RI): The value of a poverty measure does not change if it is computed based on an income distribution that is generated by the *k*-fold replication of an original income distribution.

For some observers, these axioms or principles are pre-conditions to judge the reasonableness of a poverty measure. Of course, as shown later, some axioms impose stronger conditions than other axioms do (WT versus SUT or with or without C).

The poverty rate *H* satisfies the Focus, Impartiality, and Replication Invariance axioms but it violates the Weak Monotonicity, and Weak Transfer axioms. Hence, many economists find the poverty rate unacceptable as a poverty index, since it captures the incidence of poverty but is insensitive to the depth of poverty. The average poverty gap ratio of the poor *I* satisfies the Focus, Weak Monotonicity, and Impartiality axioms but not the Weak Transfer axiom, which means that *I* captures the depth of poverty but is insensitive to the distribution aspect of poverty. Because of these deficiencies in the poverty rate and average poverty gap ratio, Sen (1976) proposes two versions of the same poverty measure. The first is

$$S_0 = H\left[1-(1-I)\left(1-G(y_p)\right)\left(\frac{Q}{1+Q}\right)\right], \tag{2.4}$$

where $G(y_p)$ is the Gini index of the distribution of the poor. As the population size gets larger, $\frac{Q}{1+Q} \to 1$. Thus another version is given by

$$S = H\left[I+(1-I)G(y_p)\right]. \tag{2.5}$$

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[10] See Hagenaars (1986, 1991) or Xu and Osberg (2001) in Chinese; English version is available at www/economics.dal.ca/RePEc/dal/wparch/sensw.pdf.

These two versions of the Sen indices will satisfy the other axioms but not the Strong Upward Transfers and Continuity axioms. S_0 does not satisfy the Replication Invariance axiom while *S* does. Clark, Hemmings and Ulph (1981) apply equation (2.5) in their empirical study.

Shorrocks (1995) proposes a modified Sen index which is identical to the limiting case of the Thon index (1979, 1983), and can be called the Sen-Shorrocks-Thon (SST) index of poverty, defined as

$$S_{SST} = \frac{1}{N^2} \sum_{y_i<z} (2N - 2i + 1)\left(\frac{z - y_i}{z}\right). \tag{2.6}$$

Note that the poverty gap ratio for the nonpoor $\left(\frac{z - y_i}{z}\right)$ is set to zero. The application of this poverty index can be found in Xu (1998).

Foster, Greer and Thorbecke (1984) propose a class of decomposable poverty indices (the FGT indices) of the form:

$$FGT_\alpha(y, z) = \frac{1}{N} \sum_{y_i<z} \left(\frac{z - y_i}{z}\right)^\alpha, \tag{2.7}$$

where *y* represents the income distribution and y_i represents the income of individual *i*. Within this family of indices, the FGT index with some values of α ($\alpha = 0,1$) does not satisfy all of the above axioms. However, higher order FGT indices (i.e. α > 1) do satisfy Weak Monotonicity, Weak Transfer and Strong Upward Transfer axioms. As can be seen below, the FGT family of indices include some that are criticized by Sen (1976).

When $\alpha = 0$,

$$FGT_0(y, z) = \frac{1}{N} \sum_{y_i<z} \left(\frac{z - y_i}{z}\right)^0 = \frac{Q}{N} = H. \tag{2.8}$$

The FGT index of order 0 is the poverty rate. When $\alpha = 1$,

$$FGT_1(y, z) = \frac{1}{N} \sum_{y_i<z} \left(\frac{z - y_i}{z}\right) = HI. \tag{2.9}$$

The FGT index of order 1 is the average poverty gap ratio of the population, which equals the product of the poverty rate and the average poverty gap ratio of the poor.

FGT indices of an order higher than 1 are distribution-sensitive. For example, when $\alpha = 2$,

$$FGT_2(y, z) = \frac{1}{N} \sum_{y_i<z} \left(\frac{z - y_i}{z}\right)^2. \tag{2.10}$$

In this formulation, when $\alpha > 1$, a larger poverty gap ratio $\left(\frac{z-y_i}{z}\right)>0$ receives more than proportionately higher weight in the FGT index. Schady (2002) is an example where the FGT index of order 2 is used. Researchers often face the question as to what value should be assigned to α. It is unclear how to weight each of the FGT indices in terms of relative importance. This family of indices itself does not provide any guidance on this issue. However, as Osberg (2004) notes, in the FGT family of indices, when the Luxembourg Income Study data on affluent countries are used, it appears that over the range $\alpha = 2, 3, \ldots, 6$ index values tend to be clustered and there is not much additional gain of information. We consider below whether a similar conclusion is warranted in the very different circumstances of rural China.

It is somewhat surprising to see that the FGT indices are applied more widely in empirical poverty studies than the Sen indices, S_0, S, and S_{SST}, although the latter were proposed earlier and have been improved upon over time (see Osberg 2004). Fields (1980: 170) notes that it is sometimes impossible to calculate S because of the unavailability of data on income inequality. Although the FGT index of order $\alpha < 2$ does not satisfy many of the important axioms, the FGT indices are considered attractive by many analysts, in particular for their additive subgroup decomposability. Osberg and Xu (1999, 2000); Osberg (2000); and Xu and Osberg (2001, 2002) argue that the Sen indices may not seem as simple to the policy analysts, but should and can be substantially simplified. Indeed, as soon as these simplifications become known, the Sen indices, in particular the SST index, become a powerful tool in policy analysis as shown by Myles and Picot (2000).

In particular, we have argued[11] that the Sen index S and the SST index S_{SST} (given in equations (2.5) and (2.6) respectively) should, and can, be simplified into their multiplicative components - the poverty rate, average poverty gap ratio of the poor, and a measure that is related to the Gini index of poverty gap ratios of the poor (for the Sen index) or of the population (for the SST index).

Formally, let x_p represent the poverty gap ratios $\left(\frac{z-y_i}{z}\right)$ for the poor and x those of the population. The Sen index given in equation (2.5) can be written as

$$S = HI\left[1+G(x_p)\right]. \tag{2.11}$$

Note that in order to calculate $G(x_p)$, one can use the regular Gini index formula[12] with

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11 See Osberg and Xu (1999, 2001); Osberg (2000), and Xu and Osberg (2001, 2002).

12 For a dataset $\{y_1, y_2, \ldots, y_N\}$, the Gini index or coefficient is given by $G(y) = 1 - \frac{1}{N^2\overline{y}}\sum_{i=1}^{N}(2N-2i+1)\,y_i$, when $\{y_1, y_2, \ldots, y_N\}$ are sorted in non-decreasing order. Alternatively, $G(y) = \frac{\sum_{i=1}^{N}\sum_{j=1}^{N}|\,y_i - y_j\,|}{2N^2\overline{y}}$, where $\{y_1, y_2, \ldots, y_N\}$ do not have to be sorted. Note that $\overline{y}$ is the mean of $\{y_1, y_2, \ldots, y_N\}$. See Xu (2003) for more details.

poverty gap ratios sorted in non-decreasing order (see Xu and Osberg 2002: 143). The higher is the value of $1+G(x_p)$, the greater is inequality among the poor. A verbal expression of equation (2.11) above is:

The Sen index = [the poverty rate]×[the average poverty gap ratio of the poor]
x [the inequality of poverty gap ratios of the poor].

The interpretation of the above is that the Sen index measures poverty incidence, depth and inequality *jointly* while permitting decomposition into commonly used poverty measures. Poverty is high when the incidence of poverty is high (a higher poverty rate), or when the depth of poverty is increasing (a higher average poverty gap ratio), and or when the poverty gap ratios of the poor are more unequal [a higher $1+G(x_p)$]. When poverty gap ratios of the poor are identical, then the Sen index becomes:

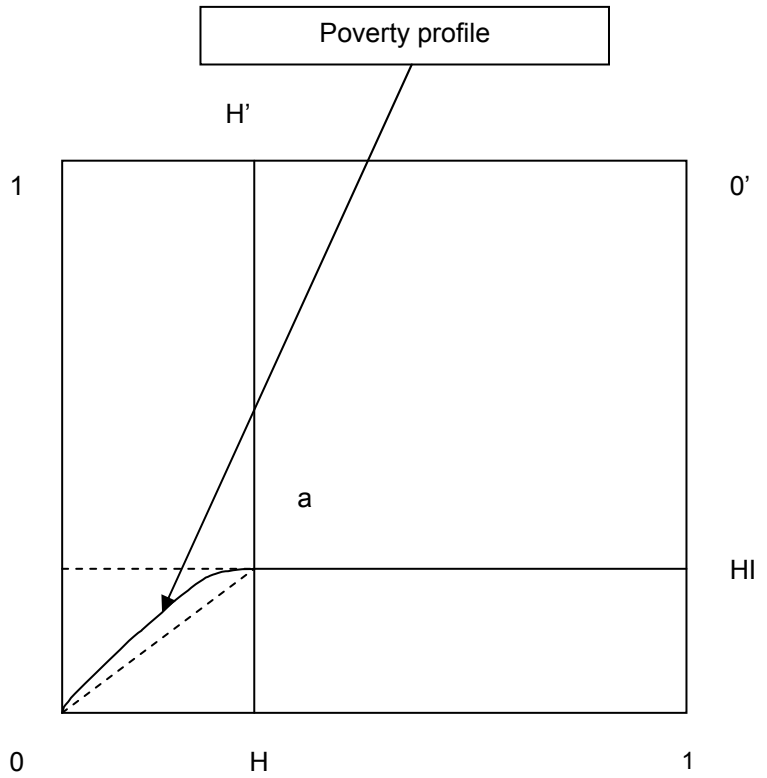
The Sen index = [the poverty rate] x [the average poverty gap ratio of the poor]

because the poor are approximately equally deprived, $G(x_p)=0$, so $1+G(x_p)=1$. The Sen index thus collapses to the FGT index, with α = 1. As well, when the inequality of poverty gap ratios is a constant, the major sources of changes in poverty can be expressed as the sum of changes in the poverty rate and the average poverty gap ratio of the poor alone. Hence, when either when the inequality of poverty is constant or changes little, the combination of two simple concepts—the *rate* and *average depth* of poverty—would be sufficient from a comparative analysis (over time or across countries/regions/social groups). This leads to a powerful illustrative tool: the *poverty box*. Under the same condition, the size of *poverty box* can represent the welfare loss caused by poverty and the change in the box size can be interpreted as the change in welfare loss.

The poverty box is, in fact, related to the poverty profile (originally due to Jenkins and Lambert 1997), which we show in Figure 1. In this coordinate system, the poverty profile draws the curve of cumulative percentage of poverty gap ratios, for the total population, from the highest to the lowest (zero ratio for the nonpoor) corresponding to the percentage of the population. The poverty profile curve rises from the origin (at point 0) at a faster rate, increases at a decreasing rate, reaches a plateau (at point a) when the last and least poor individual's poverty gap ratio is added, and then becomes flat to the end (at point HI) when zero poverty gap ratios of the nonpoor are add to the cumulative percentage. When the inequality of poverty gap ratios is nil, the curved segment of the poverty profile becomes a straight line.

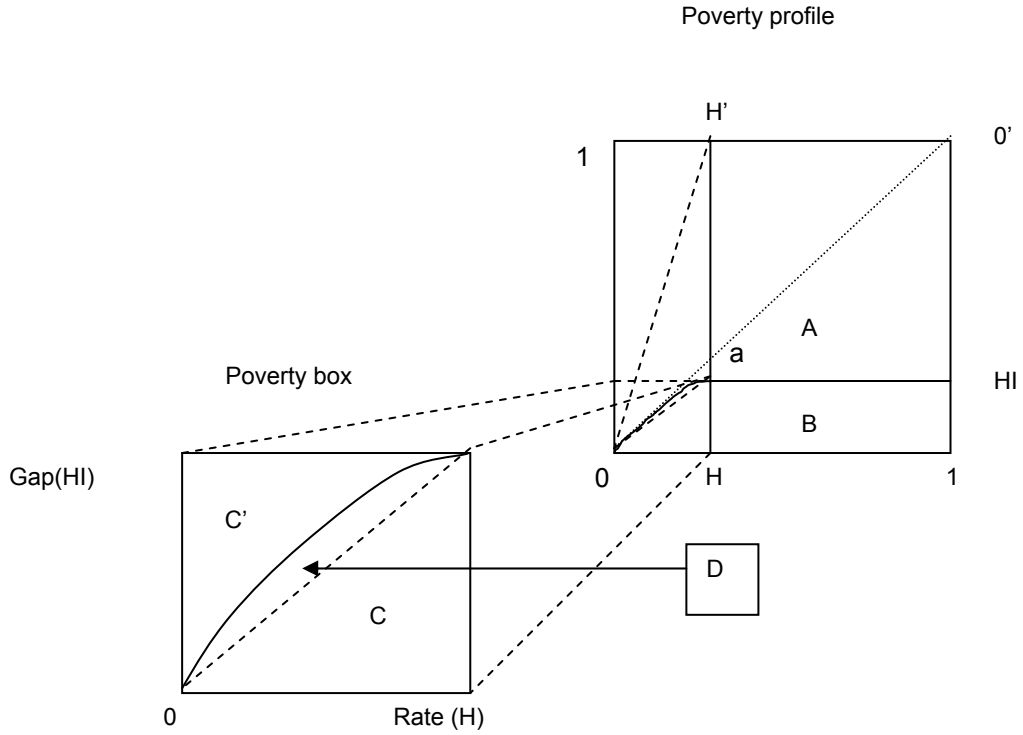
As shown in Figure 2, the geometric interpretation of the Sen index with reference to the poverty profile curve according to Xu and Osberg (2002), is as shown in the upper-right panel. Let the triangle area of OHH' be Area E. The Sen index is given by the sum of Areas C and D divided by Area E. Hence the Sen index will take the curvature (in relation to Area C) into account. In the lower-left panel of Figure 2, the poverty box is drawn in relation to the poverty profile. In the event that there is no curvature in the poverty profile curve or when the curved segment varies little in a relative sense, the poverty box can convey all the information needed for poverty comparisons.

Figure 1
Geometry of the poverty profile



Source: Xu and Osberg (2002).

Figure 2
Geometry of the Sen index and *poverty box*



Source: Xu and Osberg (2002).

As shown in Osberg and Xu (1999, 2000), the SST index (equation (2.6)) proposed by Shorrocks (1995) following Sen (1976), can be simplified into

$$S_{SST} = HI(1+G(x)), \tag{2.12}$$

where x represents the poverty gap ratios of the total population. A less mathematical expression of the above is

The SST Index = [the poverty rate]×[the average poverty gap ratio of the poor] × [the inequality of poverty gap ratios of the population].

As shown previously for the Sen index, the SST index also measures the welfare loss caused by poverty and it can measure poverty incidence, depth and inequality *jointly* while permitting the SST index to be decomposed into commonly used poverty measures. The difference between the Sen and SST indices is the Gini index of poverty gap ratios. Unlike $G(x_p)$ which is in the Sen index and can take value zero when all the poor are equally poor—i.e., have the same poverty gap ratio, $G(x)$, which is in the SST index, cannot be zero simply because even if the poor are equally poor, the nonpoor have zero poverty gap ratios. As shown in Xu and Osberg (2002: 145: Equation 24), $G(x) = 1 - H$ when the poor have an identical poverty gap ratio. For example, if the poverty rate is 15 per cent and the poor are equally poor, the Gini index of poverty gap ratios of the population will be 1-0.15 = 0.85. The inequality component in the SST index will then be $1 + G(x) = 1 + 0.85 = 1.85$. Any inequality in poverty gap ratios among the poor will add to [1 + $G(x)$] but with an upper bound value 2—so there is a fairly narrow possible range, particularly if the poverty rate is relatively low.

The 'common sense' explanation for the small role that inequality among the poor plays in an aggregate measure of poverty intensity is that the differences in income among the poor are relatively small when compared to income differences among the nonpoor. The upper bound on the incomes of poor people is the poverty line. The lower bound, leaving measurement error aside, is subsistence. The money value of the difference is not large, particularly when compared to the differences in income observed among the nonpoor population.

When the inequality of poverty gap ratios of the population changes little over time and across countries/regions/social groups, the value of the SST index is in proportion to ($\propto$) the product of the poverty rate and the average poverty gap ratio of the poor; that is

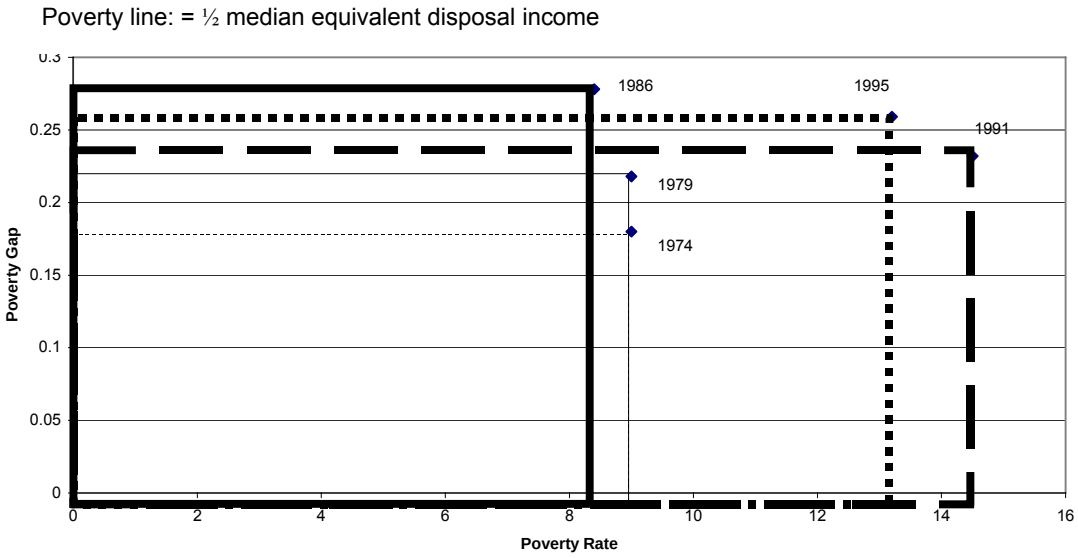
The SST Index $\propto$ [the poverty rate]×[the average poverty gap ratio of the poor].

To a logarithmic approximation, the percentage change in the SST Index is then equal to the sum of the percentage changes in the poverty rate and the average poverty gap ratio of the poor.

The geometric interpretation of the SST index, according to Xu and Osberg (2002) is as follows. Let the lower triangle of the poverty profile box in the upper-right panel of Figure 2 be surrounded by O, O', HI, 1, and H be Area A, which is the half of the unit

box. The SST index is the ratio of the sum of Areas B, C, and D to Area A. Hence, the poverty box is directly connected to the poverty profile.

Figure 3
The *poverty box* for the United Kingdom in 1974, 1979, 1986, 1991 and 1995



Source: Osberg (2004).

For both Sen and SST indices,[13] it appears that the inequality of the poor in developed countries is fairly constant, and thus plays little role in comparisons—either internationally or over time (Osberg and Xu (2000). Hence a two-dimensional poverty box can present poverty reasonably accurately and can be used for across country/region/social group comparisons. The *poverty box* is formed by the poverty rate *H* and the average poverty gap ratio of the poor *I* (see Xu and Osberg 2001 and Osberg 2004).

Why is the *poverty box* a useful analytical and illustration tool? Figure 3 illustrates its potential usefulness for comparisons of poverty in the context of the United Kingdom (see Osberg 2004), where the average poverty gap ratio and the poverty rate moved in different directions over time. An assessment of poverty policy in the UK which looked only at the poverty *rate* would score the 1979 to 1986 period as a success, since the poverty rate fell (from 9 per cent to 8.4 per cent), but would miss completely the significant increase in the average poverty gap of the poor (which rose from 21.8 per cent of the poverty line to 27.8 per cent). This divergence between trends in the poverty

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13 The Sen and SST indices are closely related. According to Xu and Osberg (2002): $S_{SST} = HS + 2H(1-H)I$.

That is, given *H* and *I* , it is always possible to compute S_{SST} from *S* and vice versa. For example, if we know S_{SST} , *H*, and *I* based on the data, we can compute *S* using

$$S = \frac{S_{SST} - 2H(1-H)I}{H} = \frac{S_{SST}}{H} - 2(1-H)I.$$

rate and average poverty gap ratio is not uncommon in developed nations (see Osberg 2002: 18), but is crucial for the assessment of poverty policy 'success'. If there is little change in inequality among the poor, the *poverty box* represents the welfare loss clearly and is precisely the poverty gap ratio index ($H \times I$) advocated by the United Nations as the secondary indicator of poverty. Having established the link between the poverty box and the Sen and SST indices, the remaining question for this paper is whether or not the poverty box approach can be effectively used in analysing poverty in developing countries—and to assess this issue we turn to evidence from China.

3 How should we measure poverty trends in China?

In assessing the level and trend of global poverty, a crucial variable is the rate of growth of the Chinese economy. With 1.29 billion citizens, roughly 20 per cent of the world's population, China dominates global poverty trends in Asia and the world—and in recent years, the Chinese economy has been growing strongly.[14] In 1980, GDP per capita in China was US$708 (PPP, constant 1995 international dollars),[15] but by 2003 that had risen six-fold to US$4,344.[16] Over the 1995-2003 period, the average annual growth rate of per capita GDP was 7.55 per cent. Extrapolation of these recent trends would imply that in 2023, per capita GDP in China would be about US$20,000 in 1995 PPP terms—a level of income that is well above the income levels in Europe at the time when a 'relative income' conception of poverty became recognized as appropriate.[17]

At current exchange rates, the US dollar value of China's per capita GDP is far lower—at US$1,024 in 2003. Clearly, when the ratio between PPP and the exchange rate is of the order of 4:1, adjustment for PPP has an enormous impact on the estimated level of average real income of 1.29 billion people. In fact, the calculation of PPP values can be done in a number of ways—each with its own advantages and disadvantages. Hill (2000: 294) compares the range of estimates of PPP adjusted average income levels that thirteen available methodologies imply, noting that calculated average income ratios can nearly double, depending on the PPP methodology chosen.[18] Hence, one has to worry that estimates of the extent of global poverty are extremely sensitive to very technical choices about the PPP methodology. Because the income distribution is typically very dense in the region of the poverty line, even small changes in the calculation of the poverty line can affect the measured poverty status of fairly large fractions of the

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14 India's 1.06 billion inhabitants, faster rate of population growth, and lower level of average income (GDP per capita of US$2529 in 2003—PPP constant 1995 international dollars) mean that India's growth rate is also crucial to global poverty trends: between 1995 and 2003, growth in GDP per capita in India averaged 4.3 per cent, with strong acceleration in most recent years (8 per cent GDP growth in 2003).

15 Unless otherwise noted, all aggregate data in this section are based on the PPP constant 1995 dollars, drawn from the World Bank website, available at: www//devdata.worldbank.org/dataonline/.

16 To put this in context, the comparable per capita GDP of Portugal in 1975 was US$7,499.

17 The GDP per capita (PPP, constant 1995 international dollars) of Canada was US$23,842 in 2003.

18 For example, although (when evaluated at observed exchange rates) the ratio of per capita income in the USA in 1990 to that of Turkey was 8.1 to 1, the range of PPP income ratios was between 3.3 to 1 and 6.4 to 1 (with the Geary-Khamis price index method favoured by the ICP project generating a ratio of 3.7 to 1). See Hill (2000).

population. The technical uncertainties involved in PPP calculations, and their enormous impact on poverty measurements, are a strong argument for the use of a relative income criterion of the poverty line, measured in own currency units—on the grounds of transparency and robustness. As well, developing countries such as China are moving rapidly from the group of nations in which absolute poverty is the key concern to the group of countries in which relative poverty will be in the spotlight. While it is still possible to continue to calculate the absolute US$1 per day poverty line, the concept of relative poverty is becoming steadily more socially relevant.

The usual methodology for international comparisons of poverty among developed countries is to use microdata on the incomes of individual households (from a dataset such as the Luxembourg Income Study) in order to calculate the equivalent income of individuals and to draw the poverty line relative to median equivalent income—most commonly at 50 per cent of median individual equivalent income. Typically, all individuals within households are assumed to share equally in household resources, and have no claim on the resources of other households.[19] The LIS definition of total family money income after tax (disposable income)[20] is often used as the basis for calculation of the after-tax money 'equivalent income' of all individuals within families. The concept of equivalent income is used to reflect the fact that members of larger households can benefit from economies of scale in their consumption expenditure. In the literature, a number of equivalence scales have been used to account for the economies of scale of household consumption (see Burkhauser, Smeeding and Merz 1996, and Phipps and Garner 1994, among others) but recent literature[21] has predominantly used the LIS equivalence scale, which calculates the equivalent income of each household member as

$$y_i = \frac{y_f}{n_f^{0.5}} \tag{3.1}$$

where y_f is total household income after tax,[22] and n_f is the number of persons in the household.[23]

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19 Admittedly, these are strong assumptions about the social context of income flows since the effective resources available to each person depend on the degree of inequality in the intra-household distribution of consumption. See Phipps and Burton (1995: 194).

20 Disposable income consists of the sum of gross wages and salaries, farm self-employment income, nonfarm self-employment income, cash property income, sick pay, disability pay, social retirement benefits, child or family allowances, unemployment compensation, maternity pay, military/veteran/war benefits, other social insurance, means-tested cash benefits, near cash benefits, private pensions, public sector pensions, alimony or child support, other regular private income, and other cash benefits; minus mandatory contributions for self employed, mandatory employee contribution, and income tax.

21 See, for example, Buhmann *et al.* (1988), Coulter, Cowell and Jenkins (1992), Burkhauser, Smeeding and Merz (1996), and Figini (1998) for comparison of the LIS, OECD and other equivalence scales. Figini (1998: 2) notes that 'OECD and other two-parameter equivalence scales empirically used show a similarity of results (in measurement of inequality) to one parameter equivalence scales with elasticity around 0.5'.

22 'Disposable personal income' in the LIS datasets.

This methodology lies behind the poverty estimates for the UK discussed in section 2 (and much of the broader literature on poverty in affluent nations), but this paper started with a discussion of global poverty trends using an absolute poverty line concept (specified as the local currency equivalent, in purchasing power parity terms, of US$1 per day). How does the relative poverty line methodology compare with the absolute US$1 standard for China in 1995?

To assess this, we use data from the 1995 Chinese Household Income Project (1995 CHIP)[24] whose purpose was to measure and estimate the distribution of personal income in both rural and urban areas of the People's Republic of China. The concept of 'income' used was considerably broader than that used in most studies of OECD nations. It included both cash payments and a broad range of additional components: payments in kind valued at market prices, agricultural output produced for self-consumption valued at market prices, the value of food and other direct subsidies, and the imputed value of housing services.[25/26] Although calculation of the value of in-kind or own account self-production is arguably an appropriate adjustment to the context of rural China, none of the nations whose data are included in the LIS makes an imputation of the rental value of owner-occupied housing.[27] Thus, maintaining a comparable estimate of poverty implies similarly disregarding the imputed value of housing services.

The 1995 CHIP dataset is based on a survey of 7,998 rural households (representing together 34,739 individual household members) in 19 provinces plus 6,931 urban households (with 21,698 members) in 11 provinces. Eliminating observations with negative incomes produces 7,988 rural and 6,929 urban households. Table 1 presents estimates, based on one-half the median equivalent income (in local currency) as the poverty line, of the SST index, poverty rate, average poverty gap ratio, and inequality of poverty gap ratios. The top panel uses the comprehensive definition of income, while the bottom panel excludes the imputed value of owner-occupied housing.

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23 Note two important special cases of the 'equivalent income' calculation $y_i = \frac{y_f}{n^\alpha}$ .Household income is assigned to each individual if $\alpha = 0$ and per capita income is assigned if $\alpha = 1$.

24 See Riskin, Renwei, and Shi (2000). The CHIP is a joint research effort sponsored by the Institute of Economics, Chinese Academy of Social Sciences, the Asian Development Bank and the Ford Foundation. Additional support was provided by the East Asian Institute, Columbia University.

25 Disposable rural household income = income from wage pensions and other compensations received by individual members of the household + household income from township, village, collective and other types of enterprise (other than compensation for labour) + cash income from farming and industrial and subsidiary activities + gross value of self-consumption of farm products + income from property + rental value of housing equity + net transfer from/to collective and state entities + miscellaneous income (including private transfers) + net cash income from the sale of farm products + net income from nonfarm subsidiary activities.

26 Disposable urban household income = cash income of the working members + income of the retired members + income of the non-working members + income from private/individual enterprises + income from property + miscellaneous income (including private transfers and special income) + subsidies less taxes (except housing subsidy and ration coupon subsidy) and income in-kind + ration coupon subsidy + housing subsidy + rental value of owner occupied housing equity.

27 The method used in the 1995 CHIP is to assume an 8 per cent return on the respondent-estimated value of home equity.

Table 1
SST and components, China 1995

Poverty line = ½ the median for the country

Region	Poverty line (½ median equivalent income)	SST	Poverty rate	Relative poverty gap	1 + Gini of gap	No. of poor observations
Income: includes imputed return owner-occupied housing						
All	2555	0.100	0.189	0.282	1.886	2474
Urban	2555	0.0063	0.014	0.225	1.993	94
Rural	2555	0.154	0.298	0.283	1.818	2380
Income: excludes home wealth						
All	2289	0.118	0.204	0.309	1.875	2677
Urban	2289	0.0065	0.013	0.255	1.993	86
Rural	2289	0.180	0.323	0.310	1.801	2591

Source: Calculated by the authors.

If the comprehensive definition of income is adopted, then half the median equivalent income is 2,555 yuan (Renminbi). At the official exchange rate of 8.28 yuan per US$1, this is equivalent to a poverty line of US$308.57, or US$0.85 per day. However, excluding the imputed value of owner-occupied housing implies that half the median income is 2,289 yuan, which is equivalent to US$276.44 per year (US$ 0.76 per day) at official exchange rates. Clearly, however, the official exchange rate is a poor guide to relative purchasing power. If the PPP exchange rate is 1.9 yuan per US$1,[28] this implies that calculating a relative poverty line of half the median equivalent income produces a poverty line equivalent to US$1,344 per year (US$3.68 per day) using the comprehensive income concept, or US$1,204 per year (US$3.30 per day) excluding the imputed value of home ownership. In 1995, therefore, a relative poverty line would be set substantially above the US$1 or US$2 absolute standard.

Of course, if incomes at the bottom end of the income distribution in China were to have grown over the period 1995 to 2003 at the same 7.55 per cent rate as per capita GDP, a person earning US$1 in 1995 would be making US$1.83 in 2003, and someone making US$2 per day in 1995 would make US$3.66 in 2003. Hence, a relative poverty line of one half median equivalent income in 1995 is, in absolute terms, about what somebody who was just at the US$2 per day income level in 1995 would now be making, *if* their incomes had grown at the national average rate—*which implies that in China in 2003 a relative poverty line may not actually have been so different from an absolute (US$2 per day) poverty line, in practice.* Of course, one clear concern about the path of China's development is precisely this assumption—that people at the bottom of the income distribution are sharing in the benefits of economic growth.[29]

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28 See World Bank (2003: 282-5).

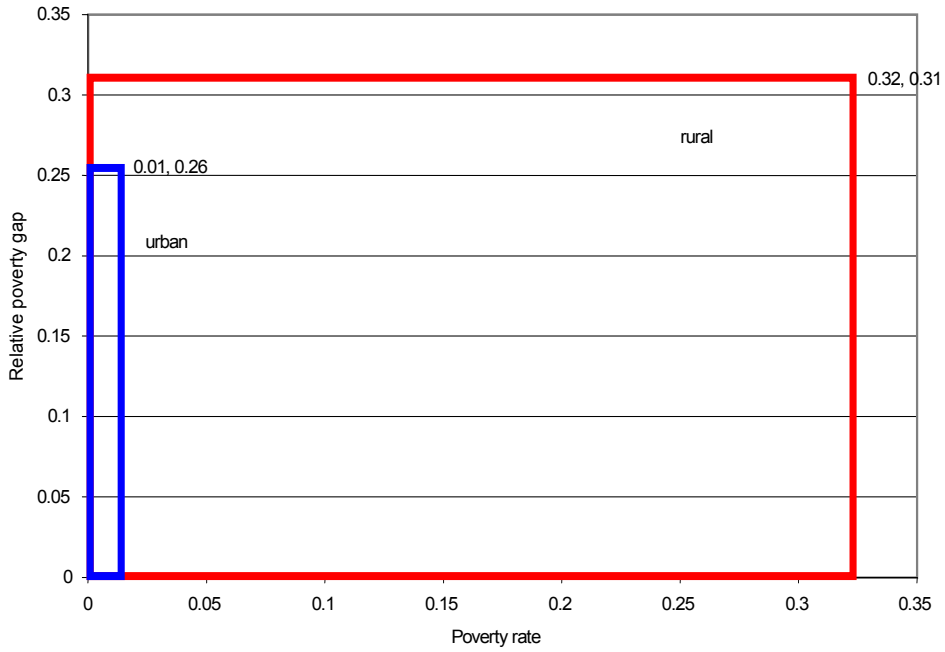
29 Gustafsson and Zhong (2000) similarly adopt one-half of median equivalent disposable income as poverty line in 1988, but they update to 1995 using only consumer price inflation. Using this fixed poverty line, they find the impact of aggregate growth on poverty to be more than offset by rising inequality—leaving demographic change as the cause of the slight decline in poverty.

Implicitly, the use of a common national poverty line criterion for poverty measurement in developed countries is based on the idea that the nation as a whole is the relevant comparison group for the assessment of interpersonal equity. The motivation for this idea is not really a sociological presumption that individuals in all parts of the nation actually compare themselves with each other—survey evidence indicates that interpersonal comparisons tend to be highly local in all countries,[30] and China is the world's largest. However, the nation-state is the political entity within which redistribution of income, or other forms of antipoverty policy might conceivably occur, and it is the political unit within which any expressions of political discontent with poverty outcomes will primarily be managed.

If a common national poverty line is used, one clear implication of Table 1 is the concentration of poverty in China in rural areas. Focussing on the lower panel of Table 1, we see that by this definition of the poverty line, the SST index of poverty in urban areas is approximately 18 times larger in rural areas than in urban China (0.1180 compared to 0.0065)—not primarily because the depth of poverty in rural areas is so much greater (the average rural poverty gap is 0.309, compared to an average urban poverty gap of 0.255) but because the rate of poverty is so very much higher (32.3 per cent in rural areas, compared to just 1.3 per cent in urban areas). The poverty box for the information in Table 1 is given in Figure 4. As can be seen in Figure 4, the divide between rural and urban China is huge.

Table 2 shows that if rural and urban China are analysed separately, i.e., the urban poverty line is drawn at half the median equivalent income *of urban areas*, and the rural poverty line is drawn at half the median equivalent income *of rural areas*, the poverty

Figure 4
The *poverty box* for China in 1995: urban and rural



note: Income excludes home wealth.

Poverty line = 1/2 median for country

30 See Kluegel *et al.* (1995: 20) or Evans and Kelley (2003).

line would be set over twice as high in urban areas (3,862 yuan) as in rural China (1,527 yuan). Interestingly, the level of poverty in rural China would still be twice as high as in urban areas (a rural SST index of 0.072 compared to an urban index of 0.036). This is again illustrated clearly in Figure 5, which shows the differences between the poverty box between rural and urban China when each is evaluated by its own poverty standards.

However, since the CHIP data go to some lengths to account for possible sources of in-kind income that might reduce the money cost of living in rural areas, there seems to be little technical reason why rural and urban incomes cannot be compared. If Chinese

Table 2
SST and components, China 1995

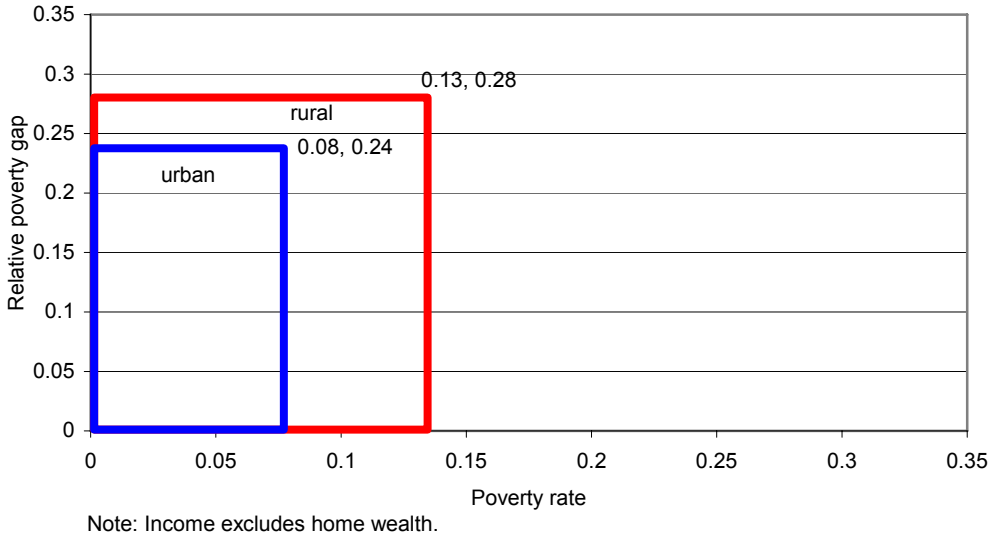
Poverty lines = 1/2 the urban median for the urban areas; 1/2 the rural median for the rural regions

Region	Poverty line (½ median equivalent income)	SST	Poverty rate	Relative poverty gap	1 + Gini of gap	No. of poor observations
Income: includes imputed return owner-occupied housing						
Urban	4159	0.033	0.073	0.230	1.958	494
Rural	1753	0.057	0.120	0.245	1.931	974
Income: excludes home wealth						
Urban	3862	0.036	0.076	0.238	1.956	515
Rural	1527	0.072	0.133	0.281	1.924	1084

Source: Calculated by the authors.

Figure 5
The *poverty box* for China, 1995: urban and rural comparison

Poverty lines = 1/2 median for urban regions; 1/2 median for rural regions



Note: Income excludes home wealth.

Source: Based on the authors' calculations.

society comprises a common polity, the application of a common national poverty line to both urban and rural China therefore seems defensible. Thus, Table 3 compares the SST index of poverty across the rural areas of the sampled provinces of China. Even leaving aside the capital region Beijing, because of its absolutely low fraction of rural dwellers, there is a huge range of variation in the SST index of poverty intensity—with large differences across provinces in all three components of the SST index. As Table 3 indicates, the rural poverty rate (excluding Beijing) is as high as 61.9 per cent and as low as 9.7 per cent. The average rural poverty gap ranges from about 38.9 per cent to about 7 per cent of the poverty line. These differences—of the order of a 5:1 ratio—are huge, so large as to swamp the observed differences in inequality of the poverty gap in the population—which varies between 1.567 and 1.962. The variations in $(1+G(x))$ across the rural areas of Chinese provinces are relatively large compared to the variation observed across other datasets in developed countries, but small compared to the variation in poverty rate or poverty gap—which may indicate the usefulness of the poverty box emphasis on poverty incidence and depth of poverty.

Since one of the purposes of poverty measurement is to rank the severity of the problem of poverty in different jurisdictions, one can ask to what extent using the 'normalized poverty gap' (FGT1) or poverty box concept[31] will alter the ranking of rural poverty among Chinese provinces based on the SST index and to what extent using higher order

Table 3
SST and components, rural China 1995 by province

Poverty lines = 1/2 the median for the country (including urban areas)

Region	Poverty line (2 median equivalent income)	SST	Poverty rate	Relative poverty gap	1 + Gini of gap	No. of poor observations
11 - Beijing	2289	0.023	0.021	0.558	1.985	2
13 - Hebei	2289	0.184	0.312	0.328	1.801	159
14 - Shanxi	2289	0.342	0.559	0.373	1.643	166
21 - Liaoning	2289	0.166	0.288	0.316	1.820	92
22 - Jilin	2289	0.146	0.253	0.312	1.848	75
32 - Jiangsu	2289	0.303	0.220	0.070	1.962	36
33 - Zhejiang	2289	0.052	0.129	0.210	1.918	53
34 - Anhui	2289	0.117	0.247	0.256	1.853	112
36 - Jiangxi	2289	0.108	0.252	0.231	1.852	88
37 - Shandong	2289	0.142	0.249	0.307	1.850	178
41 - Henan	2289	0.129	0.271	0.258	1.847	203
42 - Hubei	2289	0.194	0.279	0.381	1.828	111
43 - Hunan	2289	0.229	0.412	0.319	1.741	204
44 - Guangdong	2289	0.059	0.097	0.310	1.946	46
51 - Sichuan	2289	0.248	0.485	0.301	1.697	388
52 - Guizhou	2289	0.272	0.547	0.301	1.657	165
53 - Yunnan	2289	0.215	0.472	0.268	1.701	146
61 - Shanxi	2289	0.308	0.578	0.328	1.625	177
62 - Gansu	2289	0.378	0.619	0.389	1.567	190

Source: Calculated by the authors.

31 Although the FGT1 does not satisfy the transfer axiom, it does possess the socially desirable property of easy comprehensibility and subgroup decomposability and is equal to the area of the poverty box.

FGT indices would alter the ranking based on the SST index. As noted earlier, in equation (2.7), the Sen and SST indices are well justified poverty measures which contain, as their components, both the FGT index of order—the poverty rate (*H*)—and the FGT index of order 1—the average poverty gap of poor people (*I*)—times the poverty rate (*H*).

Table 4 reports the computed level of rural poverty for each region/province of China for which data are available in the CHIP, using as measure the SST index and FGT α = 0…6. One way of evaluating the loss of information entailed by using the poverty box is to see how much the ranking of the provinces based on the SST index is altered by using the poverty box (the poverty rate times poverty gap or FGT(1). Similarly, one way of thinking about how much the FGT index of a higher order (i.e., FGTα when $\alpha > 1$) matters relative to the benchmark SST index is to see how much the poverty ranking of the provinces based on the SST index can be altered by the FGT index of a higher order ($\alpha > 1$). As explained previously, the FGT index of a higher order can be interpreted as giving larger poverty gaps higher weights in the weighted sum in the FGT index so as to incorporate more aversion to poverty inequality.

Table 4
Comparison: SST and components versus FGT indices of order 1 to 6
Rural China 1995 by provinces

Poverty line = 1/2 the median for the country (including urban)
Income excludes home wealth

				FGT					
Province	poverty rate	poverty gap	SST	alpha=2	alpha=3	alpha=4	alpha=5	alpha=6	alpha=1 rate*gap
11 - Beijing	0.021	0.558	0.023	0.0085	0.0067	0.0053	0.0042	0.0034	0.012
13 - Hebei	0.312	0.328	0.184	0.0472	0.0254	0.0152	0.0099	0.0070	0.102
14 - Shanxi	0.559	0.373	0.342	0.1094	0.0687	0.0479	0.0355	0.0274	0.209
21 - Liaoning	0.288	0.316	0.166	0.0415	0.0224	0.0134	0.0085	0.0056	0.091
22 - Jilin	0.253	0.312	0.146	0.0371	0.0213	0.0139	0.0098	0.0074	0.079
32 - Jianhsu	0.070	0.220	0.303	0.0060	0.0031	0.0019	0.0012	0.0008	0.015
33 - Zhejiang	0.129	0.210	0.052	0.0081	0.0029	0.0012	0.0005	0.0002	0.027
34 - Anhui	0.247	0.256	0.117	0.0247	0.0117	0.0062	0.0036	0.0022	0.063
36 - Jiangxi	0.252	0.231	0.108	0.0209	0.0094	0.0050	0.0030	0.0020	0.058
37 - Shandong	0.249	0.307	0.142	0.0359	0.0212	0.0145	0.0109	0.0087	0.076
41 - Henan	0.271	0.258	0.129	0.0297	0.0164	0.0105	0.0075	0.0057	0.070
42 - Hubei	0.279	0.381	0.194	0.0586	0.0374	0.0258	0.0188	0.0141	0.106
43 - Hunan	0.412	0.319	0.229	0.0597	0.0318	0.0187	0.0118	0.0079	0.131
44 - Guangdong	0.097	0.310	0.059	0.0155	0.0099	0.0071	0.0055	0.0045	0.030
51 - Sichuan	0.485	0.301	0.248	0.0636	0.0338	0.0206	0.0138	0.0100	0.146
52 - Guizhou	0.547	0.301	0.272	0.0710	0.0368	0.0217	0.0142	0.0101	0.165
53 - Yunnan	0.472	0.266	0.215	0.0485	0.0230	0.0127	0.0079	0.0054	0.125
61 - Shanxi	0.578	0.328	0.308	0.0849	0.0460	0.0275	0.0179	0.0123	0.190
62 - Gansu	0.619	0.389	0.378	0.1204	0.0695	0.0444	0.0305	0.0221	0.241
Minimum	0.021	0.210	0.023	0.0060	0.0029	0.0012	0.0005	0.0002	0.012
Maximum	0.619	0.558	0.378	0.1204	0.0695	0.0479	0.0355	0.0274	0.241

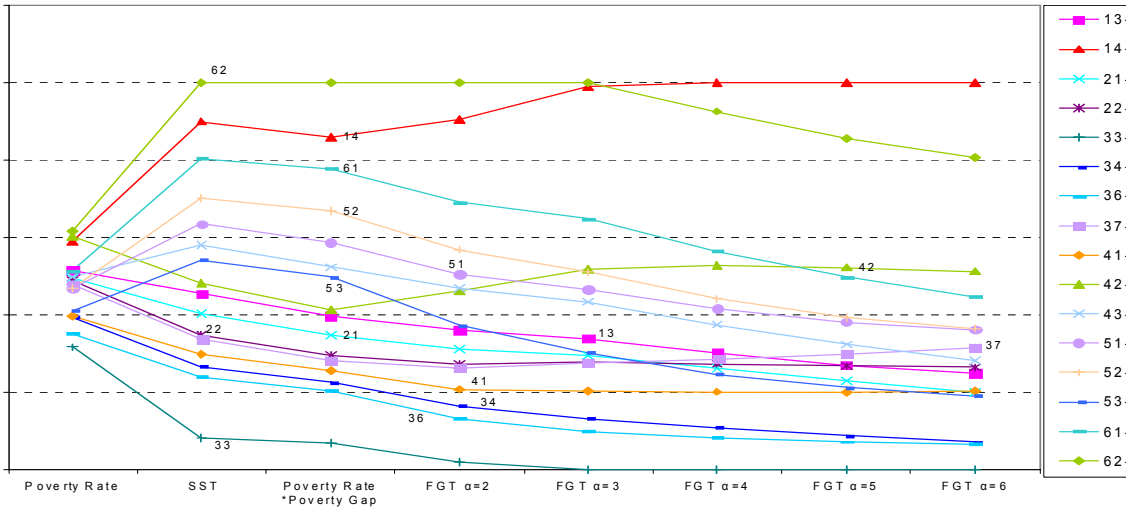
Source: Calculated by the authors.

For many purposes it is not so much the absolute level, but rather the comparative level, of a poverty index that matters. For example, in allocating funds for development purposes, one might want to know which Chinese province has the severest rural poverty. Since the various poverty indices discussed thus far have different ranges, it is not very useful to compare their numeric value, so this paper adopts the 'linear scaling technique' (LST) to standardize the range of all poverty measures. To do this, the high and low observed values are taken to represent the possible range of a poverty measure for all countries, and denoted min and max, respectively. The data are then scaled according to these values. Figure 6 then reports for each province[32] the value for each poverty index scaled according to the formula $(value - \min)/(\max - \min)$.

Figure 6 indicates that the ranking of the provinces based on the poverty rate is sometimes very different from the ranking based on the benchmark SST index (e.g., the province of Yunnan). However, the ranking of the provinces based on the poverty box is consistent with the ranking based on the benchmark SST index, which indicates that the poverty box is a good approximation of the benchmark SST index.[33] The FGT indices of order higher than 2 give increasing weights to inequality in poverty and hence may change the ranking of provinces based on the benchmark SST index substantially, in particular among the middle ranked provinces. A case in point again is Yunnan (code 53), which has the most prominent decline in ranking if the order of the FGT

Figure 6
Comparison of poverty rate, SST index and FGT index
Rural China 1995 by province

Poverty line = 1/2 the median for the country (including urban)
Income excludes home wealth



Source: Based on the authors' calculations.

32 More exactly, Figure 6 presents the data for provinces included in the CHIP data with 50 or more poor observations.

33 Although this paper does not report the ranking based on the Sen index, it is shown in Footnote 14 of this paper that when I and H are known, the Sen index and SST index have a one-to-one correspondence relationship. Hence, both Sen and SST indices can be used as benchmarks.

index is increased. Yunnan province ranks 7th in poverty intensity based on both the SST index and poverty box. But as the order of the FGT index increases from 2 to 6, Yunnan experiences a rapid decline in the poverty ranking to the 8th, 9th, 11th, 11th, and 13th, respectively. However, for the most poverty-stricken provinces such as Gansu (code 62) and Shanxi (code 14) and the least poverty-stricken provinces such as Zhejiang (code 33) and Jiangxi (code 36), the higher order FGT indices do not provide any additional information in terms of relative rankings to those based on the benchmark SST index. Hence, Figure 6 can be read as indicating that there is relatively little gained in inter-provincial poverty comparisons if one uses 'higher order' [$FGT_{\alpha=2\ldots6}$] poverty indices.

4 Summary and conclusion

This paper started by asking whether the estimated proportion of the world's population with income below US$1 (adjusted according to PPP) per day is a good measure of trends in global poverty. We have argued that the answer depends on two important issues in the measurement of poverty—the definition of the poverty line, and how best to summarize the level of poverty.

4.1 What poverty line?

In common language usage, poverty is about deprivation of necessities; the primary dictionary definition of 'poverty' is the deprivation of 'the necessities of life' (see Oxford 1998: 1135). Adam Smith's views on this were drafted at a time—more than 200 years ago—when all nations had much lower incomes than presently, but their relevance endures:

> Under necessaries, therefore, I comprehend not only those things which nature, but those things which the established rules of decency have rendered necessary to the lowest rank of people. (Vol. 2, Bk. V, Ch. II, Pt II, Art IV—1961: 400)

In thinking about what 'the established rules of decency' might be, on a global scale, the criterion of US$1 per day—US$, PPP—has the enormous virtue of seeming simplicity, and hence communicability to a global public. However, a good deal of technical complexity sits behind the calculation of US$1 per day in purchasing power parity terms—and the issue is crucial to the evaluation of the level of global poverty.

As well, the rapidity of economic growth in China, and in India and South East Asia, means that for a very substantial fraction of the world's population, the problem of absolute deprivation of commodities is being replaced by a more subtle type of poverty. As Sen (1992: 115) puts it:

> *Relative* deprivation in the space of *incomes* can yield *absolute* deprivation in the space of *capabilities.* In a country that is generally rich, more income may be needed to buy enough commodities to achieve the *same social functioning*, such as 'appearing in public without shame'. The same applies to the capability of 'taking part the life of the community'.

In international poverty comparisons among developed countries, the norm is to calculate the poverty line as a fraction of median income, and to use local currency units throughout, which avoids entirely the problem of the uncertain value of PPP conversions. For the above reasons, this paper argues that more attention should be given to *relative deprivation* (i.e., equivalent incomes less than half the median) as well as *absolute deprivation* (i.e., incomes below US$1 or $2 per day).

4.2 The summarization of poverty outcomes

The Sen and SST indices of poverty intensity measure the welfare loss caused by the incidence, depth and inequality of poverty, have desirable axiomatic properties and can be calculated and decomposed easily. Furthermore, they have simple geometric interpretations that are related directly to an easily communicated illustrative tool, the poverty box. As demonstrated in the empirical example in this paper, the poverty ranking of regions based on the poverty box is remarkably consistent with that based on the benchmark SST index, which has a one-to-one correspondence relationship with the Sen index. The 'higher order' poverty FGT indices (FGT $\alpha = 2\ldots6$) do not change the rankings of most and least poverty-stricken provinces but will shift the middle range regions primarily due to the overweighting of inequality in poverty. Hence, in addition to being subject to arbitrariness in selecting the order, $\alpha = 2\ldots6$, the higher order FGT indices add relatively little to comparisons among jurisdictions, whether in comparisons of rural poverty in China, or of affluent nations. Hence, the poverty box is indeed appealing as a useful illustrative tool for poverty analysis—particularly since it represents two major components of the Sen and SST indices and is equivalent to the FGT index of order 1 (the poverty rate and the poverty gap ratio of the poor or simply poverty rate and gap. We argue that poverty rate and gap should be the primary target UN Millennium Development target and should receive more attention.

When we apply our *poverty box* and the SST index to the Chinese data, our results confirm the huge urban-rural divide in the incidence, depth and inequality of poverty. As 1.3 billion Chinese try to modernize their economy in a period of a few decades, the rural/urban divide is huge. Although rapid economic growth has eliminated absolute poverty in some parts of Asia, there remains much to be done for rural China.

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