How Should We Measure Poverty in a Changing World? Methodological Issues and Chinese Case Study

by

Lars Osberg & Kuan Xu

Dalhousie University

Working Paper No. 2007-02

February 2007

DEPARTMENT OF ECONOMICS

DALHOUSIE UNIVERSITY
HALIFAX, NOVA SCOTIA, CANADA
B3H 3J5

MS#

"How Should We Measure Poverty in a Changing World? Methodological Issues and Chinese Case Study"
REVIEW OF DEVELOPMENT ECONOMICS

BY: LARS OSBERG
- Dalhousie University
KUAN XU
- Dalhousie University
Contact: Kuan Xu
E-mail: kuan.xu@dal.ca
Postal: Department of Economics, Dalhousie University, Halifax, NS, Canada B3H 3J5
Phone: (902) 494-2026
Fax: (902) 494-6917
Co-Auth: Lars Osberg: lars.osberg@dal.ca

This paper asks whether, in a rapidly changing world, the estimated proportion of the world's population with income below US $1 (adjusted according to purchasing power parity) per day is still a good measure of trends in poverty. It argues that strong economic growth in nations such as China implies that the commonly accepted international poverty line definition of one half median national equivalent income is increasingly relevant and that poverty intensity (the normalized deficit or Foster Greer Thorbecke (FGT) index of order one) is a better summary index. This index has a convenient graphical representation — the "poverty box". Using the proposed poverty line and the example of ranking the level of rural poverty in Chinese provinces, the paper demonstrates how poverty intensity replicates the poverty rankings of the Sen family of poverty indices and captures most of the information content of higher order FGT indices.

JEL Classifications: O150; I320

REVIEW OF DEVELOPMENT ECONOMICS
Manuscript No: #

How Should We Measure Poverty in a Changing World? Methodological Issues and Chinese Case Study*

Lars Osberg
Kuan Xu

Abstract

This paper asks whether, in a rapidly changing world, the estimated proportion of the world's population with income below US $1 (adjusted according to purchasing power parity) per day is still a good measure of trends in poverty. It argues that strong economic growth in nations such as China implies that the commonly accepted international poverty line definition of one half median national equivalent income is increasingly relevant and that poverty intensity (the normalized deficit or Foster Greer Thorbecke (FGT) index of order one) is a better summary index. This index has a convenient graphical representation — the "poverty box". Using the proposed poverty line and the example of ranking the level of rural poverty in Chinese provinces, the paper demonstrates how poverty intensity replicates the poverty rankings of the Sen family of poverty indices and captures most of the information content of higher order FGT indices.

*Osberg and Xu: Dalhousie University, Halifax, Nova Scotia, B3H 3J5, Canada. We would like to thank Nan Geng, Zhouran Zhou, Lynn Lethbridge and Cheryl Stewart for their excellent assistance, SSHRC for its financial support (Grant 410-2001-0747), and anonymous referees, Patricio Aroca, Mark Brenner, Björn Gustafsson, Min-Dong Lee, Shi Li, Zhicheng Liang, Xin Meng, Tony Shorrocks, Terry Sicular, Guanghua Wan, Meiyan Wang, Xiaolu

Wang, Xiaobo Zhang, Yin Zhang, and other participants at UN's conferences (2004 in Manila and 2005 in Helsinki) for their constructive comments.

JEL Classification Number(s): O150; I320

Abbreviations: UN, US, FGT, F, WM, WT, SUT, C, RI, SST, GDP, PPP, CHIP, OECD
Number of Figures: 4 Number of Tables: 4
Date: February 23, 2007
Address of Contact Author: Kuan Xu, Department of Economics, Dalhousie University, Halifax, Nova Scotia, Canada B3H 3J5, Tel. (902) 494-2026, Fax (902) 494-6917, E-mail kuan.xu@dal.ca.

1. Introduction

One of the primary targets of the UN Millennium Development Goals is the global poverty rate, defined as the proportion of world's population with income below the US $1 poverty line. According to the United Nations (UN) International Development Report (2004), the proportion of the world's population with income below US $1 per day[1] dropped from 40% in 1981 to 21% in 2001. As a measure of poverty, this "headline number" has the enormous advantage of seeming simplicity. The poverty line – one US dollar per day (adjusted according to purchasing power parity) – seems immediately understandable as an indicator of absolute deprivation. The calculation of the percentage of people who are poor is similarly straightforward. This measure of global poverty 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. However, is this indicator sufficient for measuring global anti-poverty progress?

The "less than $1 per day head count" embodies both a *criterion* of poverty and a *statistical summarization* of the extent of poverty. This paper argues that it is questionable on both counts – particularly in rapidly growing countries such as China. The paper argues that the poverty line in China should be drawn relative to median Chinese income and it attempts to contribute to the debate on world poverty by outlining the conceptual links between different indices of poverty, suggesting a useful graphic tool to compare poverty outcomes and using Chinese micro data to demonstrate that little is lost in the inter-provincial ranking of poverty outcomes if poverty intensity, also known as the simple "normalized poverty gap ratio," is used for comparisons.

In common language usage, poverty is about deprivation of necessities - the primary dictionary definition of "poverty" is "want of the necessities of life" (Oxford, 1998, p.1135). However, it has long been noted that definition of the "necessities of life" must be relative to the norms of a particular society at a specific point in time. Adam Smith's views on this were drafted at a time – more than 200 years ago – when all nations had very 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, p. 400)

The $1 per day poverty line is, by contrast, an example of an absolute income criterion of poverty – to be applied in all countries at any time – whose value in local currency units is to be adjusted only to account for estimated variation in commodity prices. A variation on the same theme is that poverty should be measured in terms of command over specific commodities – e.g., a minimum food and non-food basket – rather than in terms of a generalized command over resources (such as money income or total consumption expenditure). Absolute poverty lines have often 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 (World Bank, 2005).

Reddy and Pogge (2005) are among those who have criticized strongly both the arbitrariness of the initial $1 per day criterion and the plausibility of purchasing power parity conversions across countries and over time. Moreover, the rapidity of economic growth in recent years in some countries also suggests that an absolute poverty line methodology may be becoming less appropriate in some countries in this changing world. For example, in Maldives, Thailand, and some regions in China, no absolute poverty exists if an absolute

poverty line of $1 per day were used in 2003-04. In developed economies it has long been noted that even when the rhetoric of an "absolute" poverty line is used, redefinition over time of a "subsistence" consumption bundle means that the poverty line is implicitly, if periodically, redrawn relative to prevailing norms of consumption (Fisher, 1995; Osberg, 2000). Economic growth has meant that "absolute" poverty lines have changed, in practice, over time, as consumption items (e.g., indoor plumbing, refrigerators, telephones) which were initially considered non-essential have been reclassified as "necessary."

In affluent countries, extreme deprivation (by the $1 per day standard) is rare. It still occurs, but its occurrence is seen as part of the inequality of deprivations in a context where the prevailing conception of poverty is that: "Individuals, families and groups in the population can be said to be in poverty when they lack the resources to obtain the types of diet, participate in the activities and have the living conditions and amenities which are customary, or at least widely encouraged or approved, in the societies to which they belong (Townsend, 1979)." Poverty research in most developed countries therefore uses an explicitly relative definition of the poverty line[2] (often defined as a fraction – usually 50% - of median income). Although an absolute poverty line (such as $1 US per day) has been more common in research on developing countries, some developing countries are very rapidly becoming much more affluent – at least in average incomes. The rapid economic growth of countries such as China and India raises the question: how should we draw the poverty line in countries where average living standards are growing rapidly?

Given a definition of the poverty line, how should the extent of poverty be summarized? Although the poverty rate is the "headline number," a secondary indicator of Millennium Development Goals is the normalized poverty gap ratio (also called poverty

intensity or the average poverty gap of the population or the poverty gap index), which is the mean distance for the entire population of income shortfalls below the poverty line as a proportion of the poverty line. Both the poverty rate and poverty intensity[3] are used in many countries and international organizations, but these measures, and the Millennium Development Goals, neglect a third dimension of poverty measurement - the inequality of poverty.

In the academic literature, inequality among the poor has been considered important by Sen (1976), Foster, Greer, and Thorbecke (1984), Shorrocks (1995), Lipton and Ravallion (1995) and others – and many poverty measures have been proposed based on the axiomatic approach pioneered by Sen (1976). Zheng (1997) provides a review of this literature. Although the Foster-Greer-Thorbecke (FGT) indices of different orders (Foster et al.,1984; Lipton and Ravallion, 1995; Ray, 1998; and Todaro and Smith, 2003) and the Sen family of poverty indices (Sen, 1976 and Shorrocks,1995) both implicitly consider inequality among the poor, these indices appear difficult to interpret and are not often used in public debates. However, rapid growth in countries like China and India has both changed the consumption norms of the broader society (causing relative deprivation) and left some citizens behind with very low absolute income. This combination of emerging relative deprivation and persistent absolute deprivation makes it important to examine how much inequality in deprivation might matter to poverty measurement. In public debates, it is the simpler poverty measures that tend to be actually used, despite their insensitivity towards distribution among the poor. Since the whole point of measuring poverty is to influence the debate on public policy in order to reduce poverty, this non-use of more complex distribution-sensitive measures raises the question – what is the optimal level of complexity in poverty measurement?

In this paper, Section 2 reviews what we have learned from the literature on a set of useful poverty measures – specifically the Sen family of poverty indices. Section 3 uses micro data from China to analyze the information gained in using these measures. Osberg and Xu (2001) find that in the developed countries, where the poverty rate is relatively low (typically considerably less than 20%), inequality among the poor is small and fairly constant over time and across jurisdictions. Hence Osberg (2000) and Xu and Osberg (2001) advocate the "poverty box" approach which combines the incidence and depth of poverty in a two-dimension space as a way of simplifying communication and facilitating comparative studies.[4] 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. Concluding remarks are given in Section 4.

2. What Have We Learned about Poverty Measurement?

2.1 Indices of Poverty and Their Properties

The most common measure of poverty is the proportion of the population whose economic resources (either income or consumption) 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 "head count" 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 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, policy makers 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 by

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

where the poverty gap ratio is set to zero for the nonpoor population because they have zero deprivation of income. Watts (1968) and Rodgers and Rodgers (1991) call *HI* the "normalized deficit."

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 and those who are only marginally poor. In 1976 Amartya Sen proposed a set of fundamental axioms as the basis for poverty measurement, which are refined further by Chakravarty (1997) and Shorrocks (1995), have 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.

The seven best-known axioms or principles for evaluating poverty measures (Hagenaars 1986, 1991) are:

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

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

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

(4) 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.

(5) 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.

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

(7) 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.

2.2 The Sen Family of Poverty Indices

Because of these deficiencies in the poverty rate and average poverty gap ratio, Sen (1976) proposed two versions of the same poverty measure. The first is

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

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

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

These two versions of the Sen index satisfy most of 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 et al. (1981) applied equation (2.5) in their empirical study.

Shorrocks (1995) proposed a modified Sen index which is identical to the limiting case of the Thon index (1979, 1983), and hence is 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) and Osberg and Xu (2002).

Osberg (2000), Osberg and Xu (1999, 2001), and Xu and Osberg (2001, 2002) have argued that both 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 represents 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

$$S = HI\left[1+G(x_p)\right]. \qquad (2.7)$$

Note that in order to calculate $G(x_p)$, one can use the regular Gini index formula with poverty gap ratios sorted in non-decreasing order (Xu and Osberg, 2002, p. 143). The higher is the value of $1+G(x_p)$, the greater is inequality among the poor. A verbal expression of equation (2.7) above is that the Sen Index is equal to [the poverty rate]×[the average poverty gap ratio of the poor] ×[the inequality of poverty gap ratios of the poor].

Hence, 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, $G(x_p)=0$, so $1+G(x_p)=1$ and the Sen index is equal to *HI* = [poverty rate]× [average poverty gap ratio

of the poor]. When the poor are equally deprived, the Sen Index thus collapses to the average poverty gap ratio, which, as discussed below, is the FGT index with $\alpha = 1$.

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 the inequality of poverty either 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).

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

$$S_{SST} = HI(1+G(x)), \tag{2.8}$$

where x represents the poverty gap ratios of the total population. That is, the SST Index is equal to [the poverty rate]×[the average poverty gap ratio of the poor] × [the inequality of poverty gap ratios of the population]. 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.

As shown previously for the Sen index, the SST index 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 $G(x_p)$ in equation (2.7), $G(x)$ in equation (2.8) cannot be zero. As

shown in Xu and Osberg (2002, p. 145, equation 24), $G(x) = 1 - H$ when the poor have an identical poverty gap ratio. For example, if the poverty rate is 15% 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 aside measurement error, is subsistence. The money value of the difference is not large, particularly when compared to the differences in income observed among the nonpoor population.

2.3 The FGT Family of Poverty Indices

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

$$FGT_{\alpha}(y,z) = \frac{1}{N}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right)^{\alpha}, \qquad (2.9)$$

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. More specifically, the

FGT family of indices include some that are criticized by Sen (1976). When $\alpha = 0$,

$$FGT_0(y,z) = \frac{1}{N}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right)^0 = \frac{Q}{N} = H. \tag{2.10}$$

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

$$FGT_1(y,z) = \frac{1}{N}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right) = HI. \tag{2.11}$$

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, and is one of the Millennium Development Goals.

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

$$FGT_2(y,z) = \frac{1}{N}\sum_{y_i<z}\left(\frac{z-y_i}{z}\right)^2. \tag{2.12}$$

In this formulation, when α > 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.

The question is: what value should be assigned to α? The FGT family of indices themselves do not provide any clear guidance on this issue, but by requiring the analyst to specify a value for the poverty aversion parameter α, the FGT index does recognize the possibility that analysts may differ in the aversion that they have to extreme poverty.[5] Those who have an ethical concern with the well-being of the least well off will want to assign a higher weight to an income deprivation among the severely disadvantaged than among the

marginally poor. In principle, the higher the value of α the analyst specifies, the greater is the weight assigned to the deprivation of the very least well-off individuals, and the closer the analyst comes to a purely Rawlsian perspective on outcome evaluation. Analysts who choose to use the Sen family of poverty indices avoid having to make an explicit choice of weights, but using $G(x)$ does imply a specific implicit weighting scheme for inequality among the poor. Lambert notes (1989, pp. 124-28) that, in general, an additively separable social welfare function in which inequality is summarized by the Gini index is consistent with an underlying individual utility function which depends on relative deprivation – which may have either an envious or an altruistic motivation. The implications of summarizing inequality in poverty gaps by $G(x)$ – rather than by, for example, $CV(x)$ – are not transparent.

In practice, however, Osberg (2004) has argued that the choice of α may not matter much empirically. When 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. The issue we consider below is whether a similar conclusion is warranted in the very different circumstances of rural China.

2.4 The Poverty Box

When the inequality of poverty gap ratios of the population changes little over time or across countries/regions/social groups, in practice the SST index will vary in proportion to *HI* - the product of the poverty rate and 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 *H* and the average poverty gap ratio of the poor *I*. For both Sen and SST indices, it appears that the inequality of the poor in developed countries is fairly constant, and thus plays a minor 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 a graphic tool that embodies the poverty rate *H* and the average poverty gap ratio of the poor *I* (Osberg, 2004; Xu and Osberg, 2001).

Why might the poverty box be a useful analytical and illustrative tool? Figure 1 illustrates its potential usefulness for comparisons of poverty in the context of the United Kingdom (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% to 8.4 %), but would miss completely the significant increase in the average poverty gap of the poor (which rose from 21.8 % of the poverty line to 27.8 %). This divergence between trends in the poverty rate and average poverty gap ratio is not uncommon in developed nations (Osberg, 2002, p.18), but is crucial for the assessment of poverty policy "success."

Note that Figure 1 conveys more information than simply reporting the product of the poverty rate and poverty gap (i.e., *HI*). There is a real dilemma in ranking outcomes in which *fewer* people experience *deeper deprivation* (such as when comparing, in Figure 1, the UK in 1995, compared to 1991). The poverty box does not hide this – indeed it highlights the issue visually and enables observers both to judge when aggregate deprivation (*HI*) increases and when changes in aggregate deprivation are, or are not, accompanied by deeper average deprivation of the poor (*I*). Subramanian (2005, p.2) has noted that in Sen's measure "*HI* may be taken to represent a measure of the *quantity* of deprivation, *I* a measure of its *quality*, and *G* a measure of *inequality* in its interpersonal distribution." Also, he notes "problems of

(philosophical) coherence in accommodating considerations of quantity and quality in an assessment of human wellbeing."

In poverty measurement, if inequality in deprivation *G* does not (in practice) vary much, one can often simplify issues by concentrating attention on *H* (the poverty rate) and *I* (the average poverty gap ratio). However, in real societies, *both* can vary at the same time – the advantage of a visual representation of the poverty box (as in Figure 1) is that although it cannot resolve the *quantity/quality* ethical dilemma, it can help illustrate the size of such a dilemma, if and when it exists.

As well, if there is little change in inequality among the poor, the area of the poverty box is precisely the poverty gap ratio index (*HI*) advocated by the United Nations as the secondary indicator of poverty. The remaining question for this paper is whether or not the poverty box approach adds usefully to the analysis of poverty in developing countries – and to assess this issue we turn to evidence from China.

3. Poverty in China

3.1 Drawing the poverty line

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% of the world's population, China has a huge impact on global poverty trends – and in recent years, the Chinese economy has been growing strongly. In 1980, GDP per capita in China was $708, (World Bank Purchasing Power Parity (PPP), constant 1995 international $[6]), but by 2003 that had risen six-fold to $4,344. Over the 1995-2003 period, the average annual growth rate of per capita GDP was 7.55 %. To put this in the context of the income levels in Europe at the time when a "50% of median income" conception of the poverty line became widely recognized as

appropriate, the comparable per capita GDP of Portugal was at $7,499 in 1975 – extrapolation of recent trends implies that China will reach that level of income in 2010.

At current exchange rates, the US dollar value of China's per capita GDP is far lower – at $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, p. 294) has compared 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 PPP methodology chosen. Reddy and Pogge (2005, p.24) have shown that "large fluctuations in the level of headcount poverty in particular countries and regions were caused simply by the choice of PPP conversion factors associated with one base year rather than another. These massive fluctuations reveal the sensitivity of aggregate poverty estimates to the PPP factors chosen." In addition, they note that different statistical methodologies and commodity coverage also imply large changes in PPP estimated local currency equivalent values. Hence, estimates of the extent of global poverty are extremely sensitive to very technical choices about 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 population – and different PPP calculations often imply large fluctuations in local currency equivalent values.

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. A militant defender of poverty relativism would also argue that when Adam Smith was writing, roughly 230 years ago, the absolute living standard of Europe was probably[7] not very different from the average income in less developed countries in recent years, and that the "established rules of decency" which he discussed then have always been relative to prevailing income norms. Less militant defenders of poverty line relativism might argue that if z_A is an "absolute" (however defined) poverty line, and z_R a "relative" (as a fraction of median equivalent income) poverty line, the poverty line z which is chosen[8] should be $z = max[z_A, z_R]$ – and that several developing countries (such as China) are clearly moving rapidly from the group of nations in which absolute poverty might be the key concern to the group of countries in which relative poverty is the socially relevant issue for poverty line definition. While it is still possible to continue to calculate the absolute $1 per day poverty line, economic growth means that this becomes an indicator of extreme deprivation, or of inequality among the poor, as social norms of deprivation evolve when "average" incomes rise.

Many poverty researchers agree with Sen that:

> *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 in the life of the community." (Sen, 1992, p. 115).

In this conception, the poverty line should be drawn relative to median incomes because the median is a reliable indicator of the central tendency of the distribution of incomes and as such represents an approximation to the general command over resources which determines social norms of consumption.

Two caveats must be considered. First, in normal times, current annual income may be a good predictor of consumption norms, but a country that experiences a sudden drop in *all* incomes is a country in which social norms of consumption have been largely built on past income experiences. Even if the percentage of people with current annual incomes below half the current median income remains unchanged, reasonable people would say that the poverty rate increases in this situation – at least until consumption norms change to reflect any long-term change in incomes. In such situations, a moving average (e.g., over 5 years) of median income may be the most appropriate referent for the poverty line. Second, most poverty researchers would agree that there is some standard of absolute deprivation (z_A in the terminology used above) below which deprivation of basic commodities (e.g., drinking water) becomes primal – but there is considerable evidence that social norms matter enormously to people, even at very low income levels, and hence there is much controversy over the point at which relative income deprivation becomes more important. Neither of these two caveats applies in the case of China.

The usual methodology for international comparisons of poverty among developed countries is to use micro-data on the incomes of individual households (from a data set 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% 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. 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 (Phipps and Burton, 1995, p. 194).

The LIS definition of total family money income after tax (disposable income) 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 (Burkhauser et al., 1996; Phipps and Garner, 1994; and others) but recent literature[9] 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, and n_f is the number of persons in the household.

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?

3.2 Measuring Poverty in China

This paper uses data from the 1995 Chinese Household Income Project (1995 CHIP)[10] 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.[11]/[12] 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 is included in the Luxembourg Income Study make an imputation of the rental value of owner occupied housing.[13] 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 (together representing 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.

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 2289 Yuan, which is equivalent to $276.44 per year ($ 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,[14] this implies that calculating a relative poverty line of

half the median equivalent income produces a poverty line equivalent to $1,344 per year ($3.68 per day) using the comprehensive income concept, or $1,204 per year ($3.30 per day) excluding the imputed value of home ownership. In 1995, therefore, a relative poverty line would be set substantially above the $1 or $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 % rate as per capita GDP, a person earning $2 per day in 1995 would make $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 $2 per day income level in 1995 would be making in 2003, *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 ($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.[15]

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 a political or sociological presumption that individuals in all parts of the nation actually compare themselves with each other – survey evidence[16] indicates that interpersonal comparisons tend to be highly local in all countries including China, which is a vast country. But subjective awareness is not the appropriate criterion for poverty definition. As Sen and others have noted, when individuals can be indoctrinated, or kept in ignorance, one should not accept as a criterion of injustice the subjective awareness by individuals of that injustice –

rather one should ask whether a disinterested and well informed observer would judge outcomes to be equitable. The nation state is the entity that makes the political decisions (on everything from tax and transfer policy to agricultural price supports) that help determine the distribution of income. This paper argues that a disinterested observer would see all citizens as presumptively equally capable of benefiting from the consumption of commodities and the nation state as the political entity within which redistribution of income among citizens, or other forms of anti-poverty policy, might conceivably occur. Furthermore, the leaders of the Chinese state often appeal to a common sense of shared national goals – one of which is a reduction in national poverty.[17]

3.3 The Rural / Urban Divide – A Poverty Box Illustration

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 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 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 % in rural areas, compared to just 1.3% in urban areas). The poverty box for the information in Table 1 is given in Figure 2. As can be seen in Figure 2, the divide between rural and urban China is huge.[18]

Table 2 shows that if rural and urban China are analyzed 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 line would be set over twice as high in urban areas (3862 Yuan) as in rural China (1527 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 3, which shows the differences between the poverty box between rural and urban China when each is evaluated by its own poverty standards.

Table 3 compares the SST index of poverty across the rural areas of the sampled capital region and 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 – 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 % and as low as 9.7%. The average rural poverty gap ranges from about 38.9% to about 7% 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 variation in $(1+G(x))$ across the rural areas of Chinese provinces are relatively large compared to the variation observed across other data sets in developed countries, but small compared to the variation in poverty rate or poverty gap.

3.4 The Information Content of Poverty Inequality

As Section 2 noted, the inequality of deprivation among the poor has been a major concern of the academic literature on poverty measurement – and it is clear that the headlong growth of China and India has left some citizens far behind, along with others who struggle to keep up

with rising social norms of consumption. If there is substantial inequality in deprivation, how much might we be missing if we focus our attention on the poverty box of Figures 2 or 3?

For many purposes it is not so much the absolute, but the comparative, level of a poverty index that matters. For example, in allocating funds for development purposes one might want to know which province of China has the greatest problem of rural poverty. Is it likely, in practice, that neglecting inequality in deprivation "makes a difference"? If the purpose of poverty measurement is to influence policy and if policy priorities can be influenced by the relative severity of the problem of poverty in different jurisdictions, it is important to know whether using a particular poverty measurement concept is likely to alter the ranking of jurisdictions. Specifically, we want to explore what extent using different poverty measures (the "average poverty gap ratio" , the SST index, or higher order FGT indices) changes the ranking of Chinese provinces in poverty standing.

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 zero [the poverty rate *H*] and the FGT or the poverty box index of order one [*HI* or the poverty box]. Since these measures are nested in complexity, one can order poverty indices in their conceptual complexity.

Table 4 reports, for each province of China whose data is available in the CHIP, the computed level of rural poverty, using as measure the SST index and FGT $\alpha = 0\ldots.6$. If we take the ranking of the provinces based on the SST index as the benchmark, one way of evaluating any loss of information entailed by using other indices is to see how much rankings are altered by using the poverty rate ($H = FGT_{\alpha=0}$), or the average poverty gap ratio ($HI = FGT_{\alpha=1}$), or the FGT index of a higher order (i.e., FGT_{α} when $\alpha > 1$).

Since the various poverty indices discussed thus far have different ranges, it is not very informative to compare their numeric values – so we adopt 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 provinces, and denoted "min" and "max," respectively. The data (*value*) is then scaled according to the formula $(value - \min)/(\max - \min)$. Figure 4 then reports the scaled values for each province.

Figure 4 indicates that the ranking of the provinces based on the poverty rate *H* is sometimes very different from the ranking based on the benchmark SST index (e.g., Yunnan Province) – which implies that the simplicity of the poverty rate concept is obtained at the cost of ignoring information that could significantly alter policy priorities. However, the ranking of the provinces based on the average poverty gap ratio *HI* is consistent with the ranking based on the benchmark SST index – which indicates that the average poverty gap ratio *HI* is a good approximation of the benchmark SST index.[19] 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 Province (code 53), which has the most prominent decline in ranking as one increases the order of the FGT index. Yunnan province is ranked the 7th in poverty intensity based on both the SST index and poverty box. But as one increases the order of the FGT index from 2 to 6, Yunnan province 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, in identifying the best-off and worst-off provinces, there is relatively little gain in inter-provincial poverty comparisons if one uses "higher order" [$FGT_{\alpha=2,\ldots,6}$] poverty indices.

4. Summary and Conclusion

Is the estimated proportion of the world's population with income below US $1 (adjusted according to PPP) per day a good measure of trends in global poverty? We have argued in this paper that the answer depends on the definition of the poverty line and how best to summarize the level and trend of poverty.

In thinking about what "the established rules of decency" might be, on a global scale, the criterion of $1 per day – US$, 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 $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. 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 – and thereby avoid entirely the problem of the uncertain value of PPP conversions. For the above reasons, we argue that more attention should be given to *relative deprivation* (i.e., equivalent incomes less than half the median). Our results using a 50% of median equivalent income poverty line

confirm the huge urban-rural divide in the incidence, depth and inequality of poverty in China. 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.

The Sen and SST indices of poverty intensity incorporate 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 a useful illustrative tool - the poverty box. As demonstrated in this paper, the poverty ranking of rural areas of Chinese provinces based on the average poverty gap ratio of the population, or the area of 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 $\alpha = 2\ldots.6$) do not change the rankings of most and least poverty-stricken provinces and will only occasionally shift the middle range regions primarily due to the changed weighting of inequality in poverty. Hence, in addition to being subject to arbitrariness in selecting the order, $\alpha = 2\ldots.6$, the higher order FGT indices add relatively little to comparisons among jurisdictions – in comparisons of rural poverty in China, or of affluent nations. Hence, the average poverty gap ratio of the population ($HI = FGT_{\alpha=1}$), which has a poverty box representation, is indeed appealing as a useful tool for poverty analysis – particularly since it is a major component of the Sen and SST indices and a special case of the FGT index. Although it is listed as one of many UN Millennium Development targets, we argue that it should be the primary target and that it should receive more attention than the useful – but sometimes misleading – poverty rate.

References

Aten, Bettina and Alan Heston, "Use of Penn World Tables for International Comparisons of Poverty Levels: Potential and Limitations," A paper presented at Session 5, International Association for Research in Income and Wealth Twenty-Eighth General Conference, Cork, Ireland, August 22-28, 2004.

Bourguignon, François and Satya R. Chakravarty, "The Measurement of Multidimensional Poverty," *Journal of Income Inequality* 1 (2003):25-49.

Chakravarty, Santya R, "On Shorrrock's Reinvestigation of the Sen Poverty Index," *Econometrica* 65(5) (1997):1241-42.

Chen, Shaochua and Martin Ravallion, "How Did the World's Poorest Fare in the 1990s?" *Review of Income and Wealth* 47(3) (2001):283-300.

Clark, Stephen, Richard Hemmings and David Ulph, "On Indices of the Measurement of Poverty," *Economic Journal* 91(362) (1981):515-26.

Cowell, Frank A., *Measuring Inequality*, Harvester Wheatsheaf, Hemel Hempstead, 1995 (2nd ed.).

Evans, M. D. R. and Jonathan Kelley, "Subjective Social Location: Data From 21 Nations," *International Journal of Public Opinion Research* 16 (2004):3-38.

Fields, Gary, "Who Benefits from Economic Development? A Reexamination of Brazilian Growth in the 1960's," *American Economic Review* 67(4) (1977):570-82.

—, *Poverty, Inequality, and Development*, New York: Cambridge University Press, 1980.

Fisher, Gordon M., "Is There Such a Thing as an Absolute Poverty Line Over Time? Evidence from the United States, Britain, Canada, and Australia on the Income Elasticity of the Poverty Line," A paper presented at the Sixteenth Annual Research Conference of the

Association for Public Policy Analysis and Management in Chicago, Illinois, October 28, 1994, http://www.census.gov/hhes/poverty/povmeas/papers/elastap4.html, 1995.

Förster, Michael and Marco Mira d'Ercole, "Income Distribution and Poverty in OECD Countries in the Second Half of the 1990s," OECD Social, Employment and Migration Working Papers No. 22, DELSA/ELSA/WD/SEM(2005)1, February 18, 2005.

Foster, James, Joel Greer and Erik Thorbecke, "A Class of Decomposable Poverty Measures," *Econometrica* 52(3) (1984):761-66.

Gini, Corrado, *Variabilità e Mutabilità*, Bologna: Tipografia di Paolo Cuppini, 1912.

—, "Measurement of Inequality of Income," *Economic Journal* 31(121) (1921):124-26.

Gustafsson, Björn and Wei Zhong, "How and Why Has Poverty in China Changed? A Study Based on Microdata for 1988 and 1995," *The China Quarterly* 164 (2000):984-1006.

Hagenaars, A.J.M., "The Definition and Measurement of Poverty," in L. Osberg (ed.), *Economic Inequality and Poverty: International Perspectives*, Armonk: M.E. Sharpe, 1991.

—, *The Perception of Poverty*, Amsterdam: North Holland, 1986.

Hill, Robert J., "Constructing Bounds on Per Capita Income Differentials across Countries," *The Scandinavian Journal of Economics* 102(2) (2000):285-302.

Jenkins, Stephen P. and Peter J. Lambert, "Three 'I's of Poverty Curves, with an Analysis of UK Poverty Trends," *Oxford Economic Papers* 49 (1997):317-27.

Kluegel, James R., Gyorgy Csepeli, Tamas Kolosi, Antal Orkeny, and Maria Nemenyi, "Accounting for the Rich and the Poor: Existential Justice in Comparative Perspective," in James R. Kluegel, David S. Mason, and Bernd Wegener (eds.), *Social Justice and Political Change, Public Opinion in Capitalist and Post-Communist States*, Berlin and New York: De Gruyter, 1995, pp. 179-207.

Lambert, Peter, *The Distribution and Redistribution of Income: A Mathematical Analysis*, Cambridge, Massachusetts: Basil Blackwell Publishers, 1989.

Lipton, Michael and Martin Ravallion, "Poverty and Policy," in J. Hehrman and T.N. Srinivasan (eds.) *Handbook of Development Economics, Volume III*, Amsterdam: Elsevier, 1995, pp. 2551-657.

Meng, Xin, Robert Gregory, and Youjuan Wang, "Poverty, Inequality, and Growth in Urban China: 1986-2000," Discussion Paper No. 1452 (2005) IZA, Germany.

Myles, John and Garnett Picot, "Poverty Indices and Policy Analysis," *Review of Income and Wealth* 46 (2000):161-79.

Osberg, Lars, "Poverty in Canada and the United States: Measurement, Trends, and Implication," *Canadian Journal of Economics* 33(4) (2000):847-77.

—, "Trends in Poverty: The UK in International Perspective - How Rates Mislead and Intensity Matters," *Working Papers of the Institute for Social and Economic Research*, Paper 2002-10, Colchester: University of Essex, 2002.

—, "Assessing 'Success' in Anti-Poverty Policy: Some Measurement Choices that Matter – And Some that May Not," Paper presented at CERF Conference on *Helping People Out of Low Income*, Toronto, Ontario, June 3, 2004.

Osberg, Lars and Kuan Xu, "Poverty Intensity: How Well Do Canadian Provinces Compare?" *Canadian Public Policy* 25(2) (1999):179-95.

—, "International Comparison of Poverty Intensity: Index Decomposition and Bootstrap Inference," *Journal of Human Resources* 35(1)(2001):51-81. Errata, *Journal of Human Resources* 35(3), 2001.

United Nations, *Industrial Development Report 2004*.

Ray, Debraj, *Development Economics*, New Jersey: Princeton University Press, 1998.

Reddy, Sanjay G. and Thomas W. Pogge, *How Not to Count the Poor*, Version 6.2, October 29, 2005, mimeo, Barnard College, New York.

Rodgers, John L. and Joan R. Rodgers, "Measuring the Intensity of Poverty among Subpopulations: Applications to the United States," *Journal of Human Resources* 26(2) (1991):338-61.

Schady, Norbert R., "Picking the Poor: Indicators for Geographical Targeting in Peru," *Review of Income and Wealth* 48(3) (2002):417-33.

Sen, Amartya Kumar, "Poverty: An Ordinal Approach to Measurement," *Econometrica* 44(2) (1976):219-31.

—, *Inequality Re-examined*, Russell Sage Foundation, New York: Harvard University Press, 1992.

Shorrocks, Anthony F., "Revisiting the Sen Poverty Index," *Econometrica* 63(5), (1995):1225-30.

Subramanian, S., "Poverty Measurement and Theories of Beneficence," Research Paper No. 2005/62, UNU World Institute for Development Economics Research (UNU-WIDER), November 2005.

Thon, Dominique, "On Measuring Poverty," *Review of Income and Wealth* 25 (1979):429-40.

—, "A Poverty Measure," *The Indian Economic Journal* 30 (1983):55-70.

Todaro, Michael P. and Stephen C. Smith, *Economic Development*, Boston: Addison-Wesley, 2003.

Townsend, Peter, *Poverty in the United Kingdom*, Middlesex, England: Penguin Books, 1979.

Watts, H. W., "An Economic Definition of Poverty," in D. P. Moynihan (ed.) *On Understanding Poverty*, New York: Basic Books, 1968.

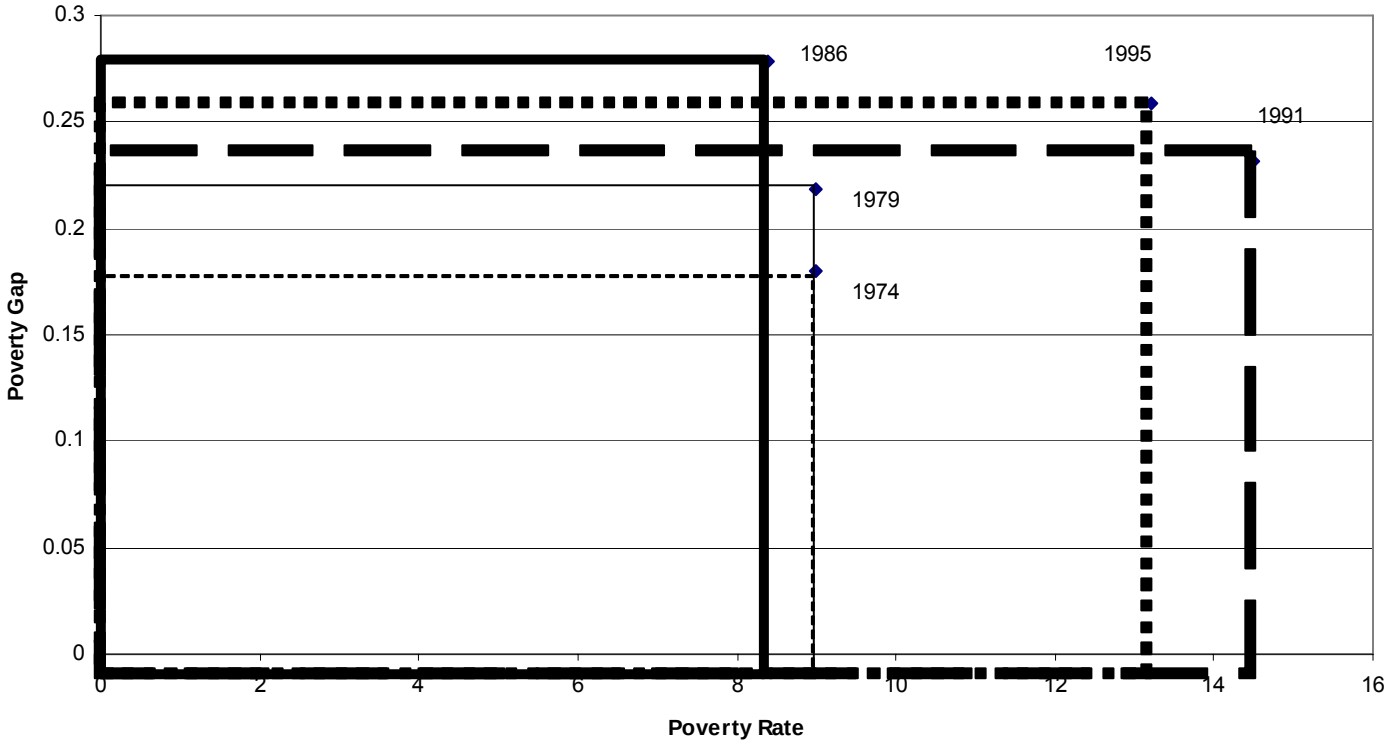
World Bank, *Introduction to Poverty Analysis*, World Bank Institute, 2005.

Xu, Kuan, "The Statistical Inference for the Sen-Shorrocks-Thon Index of Poverty Intensity," J*ournal of Income Distribution* 8(1) (1998):143-52.

Xu, Kuan and Lars Osberg, "On Sen's Approach to Poverty Measures and Recent Developments," *China Economic Quarterly* 1(1) (2001):151-70.

—, "The Social Welfare Implications, Decomposability, and Geometry of the Sen Family of Poverty Indices," *Canadian Journal of Economics* 35(1) (2002):138-52.

Zheng, Buhong, "Aggregate Poverty Measures," *Journal of Economic Survey* 11(2) (1997):123-62.



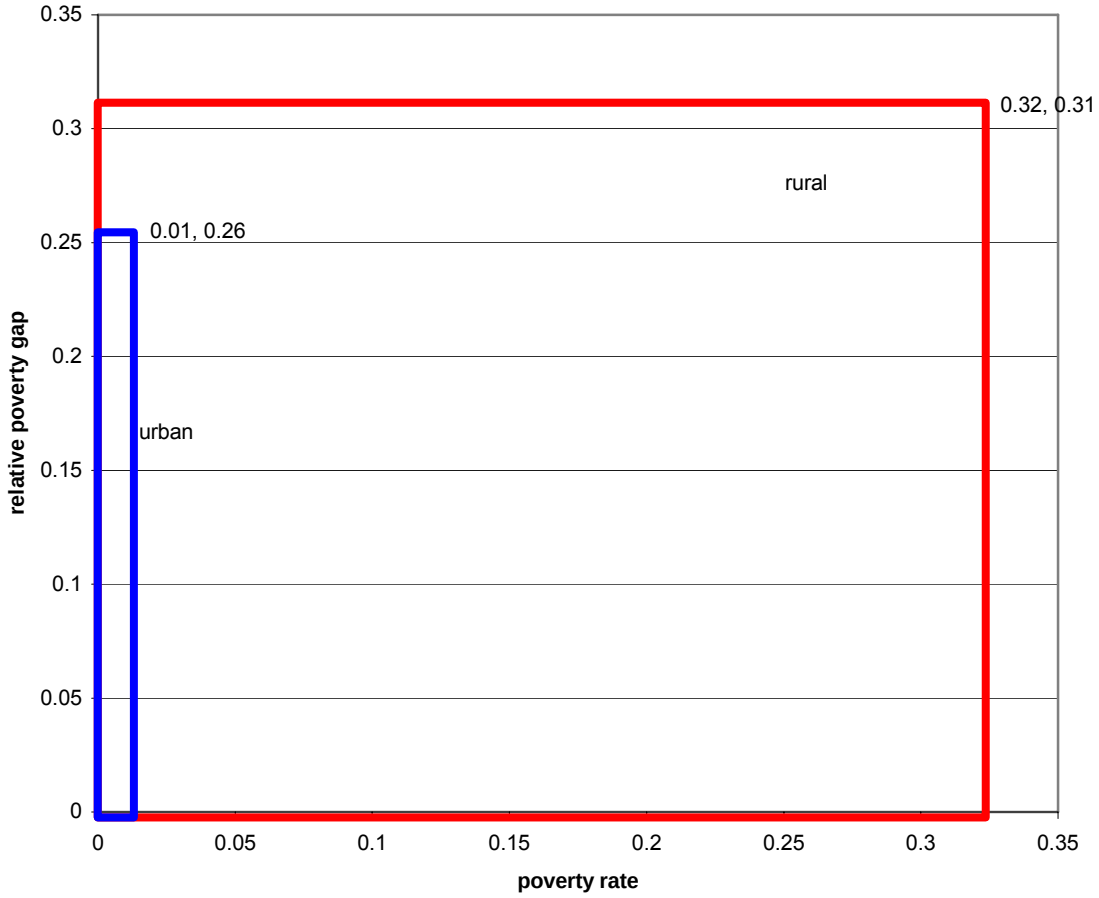
Note: The poverty line is set at the 1/2 median equivalent disposable income. The figure is from Osberg (2004).

Figure 1: The Poverty Box for the United Kingdom - 1974, 1979, 1986, 1991, and 1995

Region	Poverty Line (½ Median Equivalent Income)	SST Index	Poverty Rate	Relative Poverty Gap among Poor	1 + Gini Index of Gaps (1+$G(x)$)	Number 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

Note: The poverty line is set at the 1/2 median income for the country.

Table 1: SST and Components – China 1995



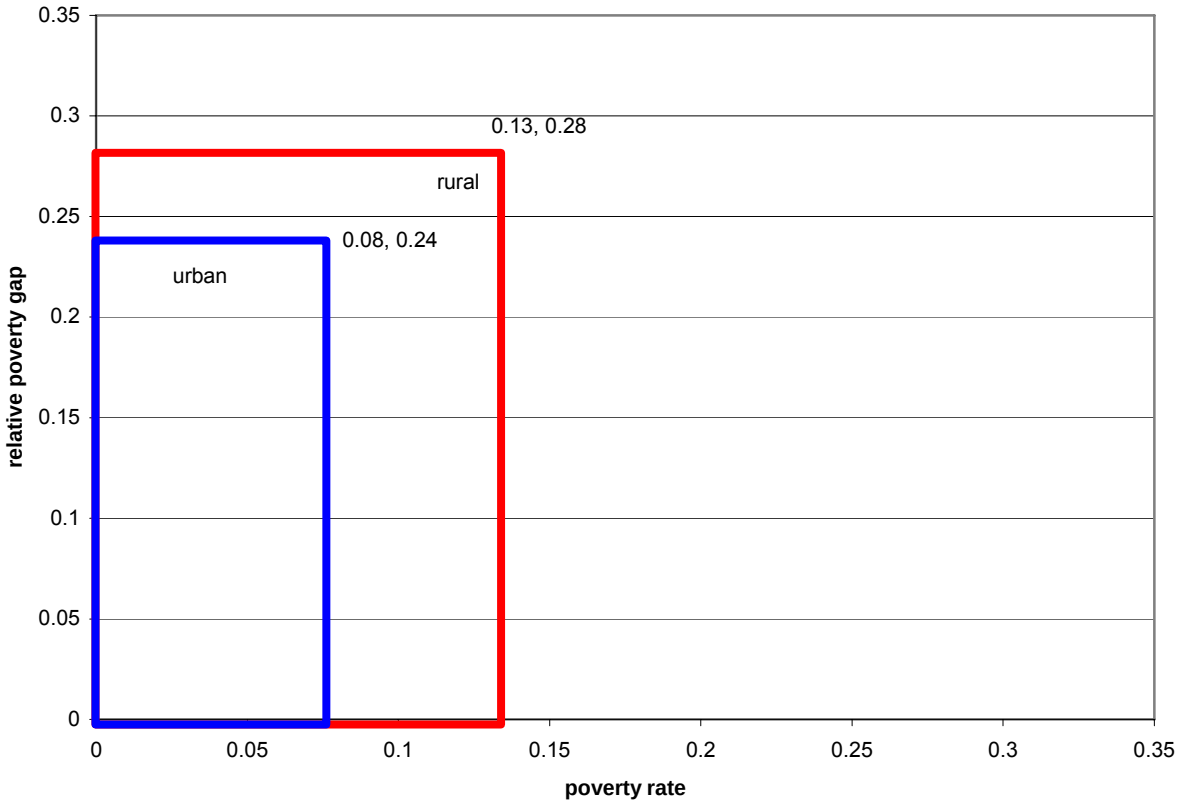
Note: The poverty line is set at the 1/2 median income for the country. Income excludes home wealth.

Figure 2: The Poverty Box for China in 1995: Urban and Rural

Region	Poverty Line (½ Median Equivalent Income)	SST Index	Poverty Rate	Relative Poverty Gap among Poor	1 + Gini Index of Gaps $(1+G(x))$	Number 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

Note: The poverty lines are set at the 1/2 urban median income for the urban area and the 1/2 rural median income for the rural area, respectively.

Table 2: SST and Components - China 1995



Note: The poverty lines are set at the 1/2 urban median income for the urban area and the ½ rural median income for the rural area, respectively. Income excludes home wealth.

Figure 3: The Poverty Box China 1995: Urban and Rural Comparison

Region	Poverty Line (½ Median Equivalent)	SST Index	Poverty Rate	Relative Poverty Gap among Poor	1 + Gini Index of Gaps (1+$G(x)$)	Number of Poor Observations
11 - Beijing (Capital Region)	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

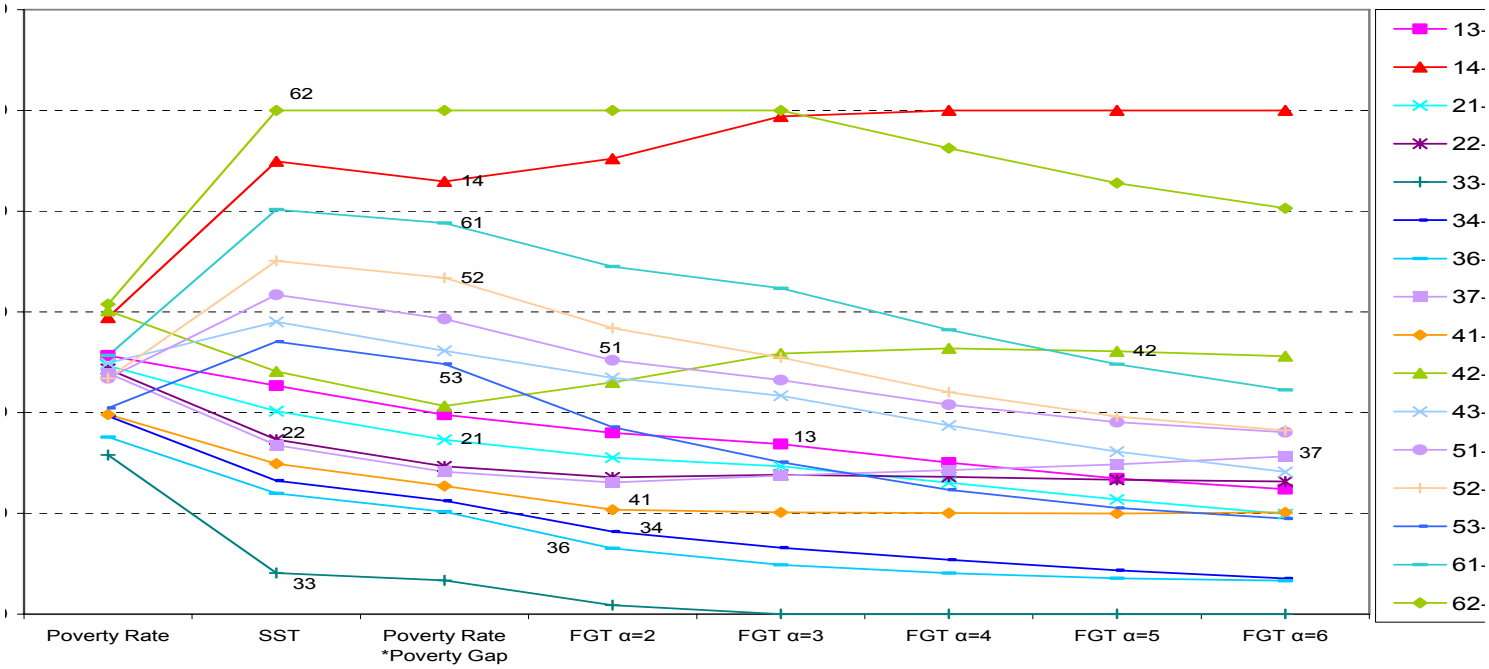
Note: The poverty line is set at the 1/2 median income for the country (including urban area). Income excludes home wealth.

Table 3: SST and Components: Rural China 1995 by Province

Region	Poverty Rate	Poverty Gap	SST Index	FGT Index α=2	α =3	α =4	α =5	α =6	α =1 Rate*Gap
11 - Beijing (Capital Region)	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

Note: Only those provinces with 50 or more poor household observations are selected. "Rate*Gap" is also referred to as the poverty box. The poverty line is set at the 1/2 median income for the country (including urban area). Income excludes home wealth.

Table 4: Comparison: SST Index and Components versus FGT Indices of Orders 1 to 6
Rural China 1995 by Province



Note: Only those provinces with 50 or more poor household observations are selected. "Poverty Rate * Poverty Gap" is also referred to as poverty intensity or the normalized poverty deficit. It also has a poverty box representation. The poverty line is set at the 1/2 median income for the country (including urban area). Income excludes home wealth. The provinces have the following codes: Code 13 = Hebei; code 14 = Shanxi; code 21 = Liaoning; code 22 = Jilin; code 33 = Zhejiang; code 34 = Anhui; code 36 = Jiangxi; code 37 = Shandong; code 41 = Henan; cod 42 = Hubei; code 43 = Hunan; code 51 = Sichuan; code 52 = Guizhou; code 53 = Yunnan; code 61 = Shanxi; and code 62 = Gansu.

Figure 4: Comparison: Poverty Rate, SST Index and FGT_α Index $\alpha = 1, \ldots, 6$ for Rural China 1995 by Province

Notes

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

2. See, for example, the recent OECD study by Forster (2005). 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.

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 below) 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 below (Chen and Ravallion, 2001, Table 3's note); Lipton and Ravallion, 1995, p. 2579; Raj, 1998, p. 255; Xu and Osberg, 2002, p.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. Fields' (1977, p. 576 or 1980, p. 26 and p. 212) study of 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% (70%) in South Asian and Sub-Saharan Africa.

5. In practice, published research almost never reports estimates of the FGT index for values of α greater than two – Phipps (1993) is an exception – perhaps because poverty researchers face a trade off between their ethical concern for the very disadvantaged and their

scientific concern for data reliability, since very low incomes will dominate the aggregate index when α increases, but may have large measurement errors.

6. Unless otherwise noted, all aggregate data in this section are based on the PPP constant 1995 $, drawn from the World Bank web site, http://devdata.worldbank.org/dataonline/.

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 highly priced in developing countries, the PPP adjustment appropriate for comparisons of GDP per capita is inappropriate for comparisons of absolute poverty – a more appropriate poverty line PPP would increase substantially the global poverty rate.

7. GDP per capita, PPP (current international $) in 1990 in India was $1,388 and in Indonesia $1,851, according to the World Development Indicators database. Maddison (2003, p. 59) puts the average GDP per capita (in 1990 international Geary-Khamis dollars) in 12 Western European countries in 1820 at $1,245 [with the UK at $1,706 and the Netherlands at $1,838 at the top and Finland ($781), Norway ($1,104) and Switzerland ($1,090) at the bottom].

8. We owe this formulation of the issue to an anonymous referee.

9. See, for example, Buhmann et al. (1988), Burkhauser et al. (1996), Coulter et al. (1992), and Figini (1998) for comparison of the LIS, OECD and other equivalence scales. Figini (1998, p. 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."

10. Riskin, Carl, Zhao Renwei, and Li Shi. Chinese Household Income Project, 1995 (computer file). ICPSR version. Amherst, MA: University of Massachusetts, Political Economy Research Institute (producer), 2000. Ann Arbor, MI: Inter-university Consortium for Political and Social Research (distributor), 2000. The Chinese Household Income Project 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.

11. Disposable rural household income = Income from wages 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 labor) + 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 transfer) + Net cash income from the sale of farm products + Net income from non-farm subsidiary activities.

12. 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 transfer 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.

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

14. See World Bank, *World Development Indicators 2003*, pp. 282-85.

15. 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.

16. See Evans and Kelley (2003) or Kluegel et al. (1995, p. 20).

17. "China pledges greater efforts in poverty elimination in next 5 years" People's Daily Online, see http://english.people.com.cn/ 08:38, May 26, 2006.

18. Meng et al. (2005) argue that poverty in urban China increased during the period 1986-2000 as the growth gain was offset by price changes caused by radical reform measures.

19. Although this paper does not report the ranking based on the Sen index, it can be shown 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.