Measuring pro-poor growth

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1. Introduction

The question often arises as to how the gains from aggregate economic growth (or the losses from contraction) were distributed across households according to their initial incomes or expenditures. In particular, to what extent can it be said that growth has been "pro-poor"?

To see if the observed changes in the distribution of income were poverty reducing, one can calculate the distributional component of a poverty measure, as obtained by fixing the mean relative to the poverty line and then seeing how the poverty measure changes (Datt and Ravallion, 1992). This tells us if the actual rate of poverty reduction is higher than one would have expected without any change in the Lorenz curve.[2] However, it is possible that while the distributional changes were "pro-poor," there was no absolute gain to the poor. Equally well, "pro-rich" distributional shifts may have come with large absolute gains to the poor.

A more direct approach is to look at growth rates for the poor. It is common to compare mean incomes across the distribution ranked by income; this is sometimes called "Pen's parade" (following Pen, 1971). To assess whether growth is pro-poor, a natural step from Pen's parade is to calculate the growth rate in the mean of the poorest quintile (say).[3]

Taking this idea a step further, we define a "growth incidence curve", showing how the growth rate for a given quantile varies across quantiles ranked by income. The following section defines this curve and discusses its properties. Starting from the Watts (1968) index of the level of poverty, we derive in section 3 a measure of the rate of pro-poor growth by integration on the growth incidence curve. The measure can be interpreted as the mean growth rate for the poor (as

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[2] For example, Chen and Ravallion (2001) find that the rate of poverty reduction in the developing world as a whole over 1987-98 would have been slightly lower if not for the changes in the aggregate Lorenz curve. The slight improvement in overall distribution from the point of view of the poor was almost solely due to economic growth in China.

[3] For example, Dollar and Kraay (2001) test whether aggregate growth is "good for the poor" by calculating the growth rate in the mean of the poorest quintile.

distinct from the growth rate in the mean for the poor). Section 4 illustrates these ideas using data for China in the 1990s.

2. The growth incidence curve

Let $F_t(y)$ denote the cumulative distribution function (CDF) of income (or expenditure), giving the proportion of the population with income less than *y* at date *t*. Inverting the CDF at the *p*'th quantile gives the income of that quantile:

$$y_t(p) = F_t^{-1}(p) = L_t'(p)\mu_t \qquad (y_t'(p) > 0) \tag{1}$$

(following Gastwirth, 1971), where $L_t(p)$ is the Lorenz curve (with slope $L_t'(p)$) and μ_t is the mean; for example, $y_t(0.5)$ is the median. Letting *p* vary from zero to one yields a version of Pen's parade that is sometimes called the "quantile function" (see, for example, Moyes, 1999).

Comparing two dates, *t*-1 and *t*, the growth rate in income of the *p*'th quantile is $g_t(p) = [y_t(p)/y_{t-1}(p)] - 1$. Letting *p* vary from zero to one, $g_t(p)$ traces out what we will call the "growth incidence curve" (GIC). It follows from (1) that:

$$g_t(p) = \frac{L_t'(p)}{L_{t-1}'(p)}(\gamma_t + 1) - 1 \tag{2}$$

where $\gamma_t = (\mu_t / \mu_{t-1}) - 1$ is the growth rate in μ_t. It is evident from (2) that if the Lorenz curve does not change then $g_t(p) = \gamma_t$ for all *p*. Also $g_t(p) > \gamma_t$ if and only if $y_t(p)/\mu_t$ is increasing over time. If $g_t(p)$ is a decreasing (increasing) function for all *p* then inequality falls (rises) over time for all inequality measures satisfying the Pigou-Dalton transfer principle. (This follows from well-known results on tax progressivity and inequality; see for example Eichhorn et al., 1984.) If the GIC lies above zero everywhere ($g_t(p) > 0$ for all *p*) then there is first-order dominance (FOD) of the distribution at date t over t-1. If the GIC switches sign then one cannot in general infer whether higher-order dominance holds by looking at the GIC alone.[4]

3. Measuring pro-poor growth

We assume that a measure of the rate of pro-poor growth should satisfy the following conditions:

Axiom 1. The measure should be consistent with the way the level of poverty is measured in that a positive (negative) rate of pro-poor growth implies a reduction (increase) in poverty.[5]

Axiom 2. The measure of poverty implicit in the measure of pro-poor growth should satisfy the standard axioms for poverty measurement. In the literature following Sen (1976), three such axioms have been widely agreed to be essential, namely the focus axiom (the measure is invariant to income changes for the non-poor), the monotonicity axiom (any income loss to the poor increases poverty), and the transfer axiom (inequality-reducing transfers amongst the poor are poverty reducing). Other axioms identified in the literature include additive decomposability (aggregate poverty can be written as a population weighted mean of the poverty measures across disjoint subgroups).[6]

The popular headcount index of poverty is $H_t = F_t(z)$ where z is the poverty line. This clearly fails the monotonicity and transfer axioms. Amongst the numerous decomposable measures satisfying all three axioms, we focus on the Watts (1968) index:[7]

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4 An exception is when the overall mean rises and the GIC is decreasing in p; then there is clearly second-order dominance. More generally, second-order dominance is tested by integrating over either the quantile function (Shorrocks, 1983), or its inverse, the CDF.

5 In the context of the inter-temporal aggregation of growth rates, Kakwani (1997) argues that the growth rate should be consistent with an aggregate welfare function defined on mean incomes over time.

6 This implies sub-group consistency, namely that if poverty increases in any sub-group then it must increase in the aggregate ceteris paribus (Foster and Shorrocks, 1991).

7 Zheng (1993) provides a complete set of axioms for which the Watts index emerges as the unique poverty measure.

$$W_t = \int_0^{H_t} \log[z / y_t(p)]dp \quad (3)$$

To derive a measure of pro-poor growth consistent with the Watts index, differentiate (3) with respect to time, giving:

$$-\frac{dW_t}{dt} = \int_0^{H_t} \frac{d \log y_t(p)}{dt} dp = \int_0^{H_t} g_t(p)dp \quad (4)$$

(noting that $y_t(H_t) = z$). In words, the area under the GIC up to the headcount index gives (minus one times) the rate of change in the Watts index over time.

On dividing throughout by H_t, equation (4) motivates measuring the rate of pro-poor growth by the mean growth rate for the poor. This is not of course the same as the growth rate in the mean income of the poor, as often used in applied work. That latter measure does not satisfy either the monotonicity or transfer axioms. If an initially poor person above the mean escapes poverty then the growth rate in the mean for the poor will be negative; yet poverty has fallen. This problem is avoided if one fixes *H* over time, but then the measure fails the focus and transfer axioms.

4. An illustration for China in the 1990s

Figure 1 gives our estimate of China's GIC for 1990-99. We have calculated this from detailed grouped distributions for rural and urban areas separately; the distributions were constructed to our specification by China's National Bureau of Statistics.[8] Urban and Rural Consumer Price Indices have been applied to the urban and rural distributions prior to

[8] The distributions published distributions in the China Statistical Yearbook (for example, NBS, 2000) are less than ideal for our purpose since they do not give mean income by class intervals and are quite aggregated (more so in some years than others).

aggregation, assuming a 10% differential in the cost-of-living between urban and rural areas at the base date. (Sensitivity was tested to a 20% differential and zero differential, but these changes shifted the GIC only slightly.) We then used parameterized Lorenz curves to calculate mean income at each quantile; we tested both the general elliptical and the incomplete beta specifications (Datt and Ravallion, 1992), and found that the former gave a better fit. However, with household-level data one can calculate the GIC without using parameterized Lorenz curves or other interpolation methods.[9]

There is first order dominance. Thus poverty has fallen no matter where one draws the poverty line or what poverty measure one uses within a broad class (Atkinson, 1987; Foster and Shorrocks, 1988). The curve is also strictly increasing over all quantiles, implying that inequality rose. The annualized percentage increase in income per capita is estimated to have been about 3% for the poorest percentile, rising to 11% for the richest.

In calculating the mean growth rate for the poor with discrete data it makes sense to define the poor as those living below the poverty line at the initial date *t*-1, in keeping with the common practice of measuring performance relative to the base date. (This does not matter in (4), given that the calculus is based on infinitely small changes.) We also normalize by H_{t-1}, so that our measure can be interpreted as the mean growth rate for the poorest H_{t-1} people.

Table 1 gives our estimates for a range of poverty lines; for example, the rate of pro-poor growth is 3.9% for H=0.15. The mean growth rate over the entire distribution is 5.9%. The growth rate in the mean is 6.9% per annum.

[9] The empirical quantile function can be readily constructed from household-level data using, for example, the "pctile" command in STATA. A STATA program is available from the authors for doing all the calculations in this paper from household-level data.

We repeated these calculations for sub-periods, 1990-93, 1993-96, 1996-99. All GIC's showed the same pattern <u>except</u> 1993-96, which is given in Figure 2. The GIC changed dramatically in this period, taking on an inverted U shape, with highest growth rates observed at around the 20th percentile.[10] The rate of pro-poor growth for this sub-period is 9.8% per annum (H=0.15) — above the ordinary growth rate of 8.4%.

5. Conclusions

For the purpose of monitoring the gains to the poor from economic growth, the growth rate in mean consumption or income of the poor has the drawback that it is inconsistent with one or more standard axioms for measuring the level of poverty. This paper has argued that a better measure of "pro-poor growth" is the mean growth rate of the poor, which is consistent with a theoretically defensible measure of the level of poverty, namely the Watts index. The proposed measure of pro-poor growth can be readily derived from a "growth incidence curve" giving rates of growth by quantiles of the distribution of income. This curve is also of interest in its own right, as a means of describing how the gains from growth were distributed.

China's growth process in the 1990s has been used to illustrate the proposed measure of pro-poor growth. Over 1990-99, the ordinary growth rate of household income per capita was 7% per annum. The growth rate by quantile varied from 3% for the poorest percentile to 11% for the richest, while the rate of pro-poor growth was around 4%. The pattern was reversed for a few years in the mid-1990s.

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[10] A likely reason is the substantial increase in the government's purchase price for foodgrain in 1994 (World Bank, 1997). Arguably, this was not a sustainable change in relative prices. But it does appear to have entailed a substantial temporary shift in distribution, given that farmers are known to be concentrated around the lower end of the distribution of income in China (Ravallion and Chen, 1999).

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Figure 1: Growth incidence curve for China, 1990-1999

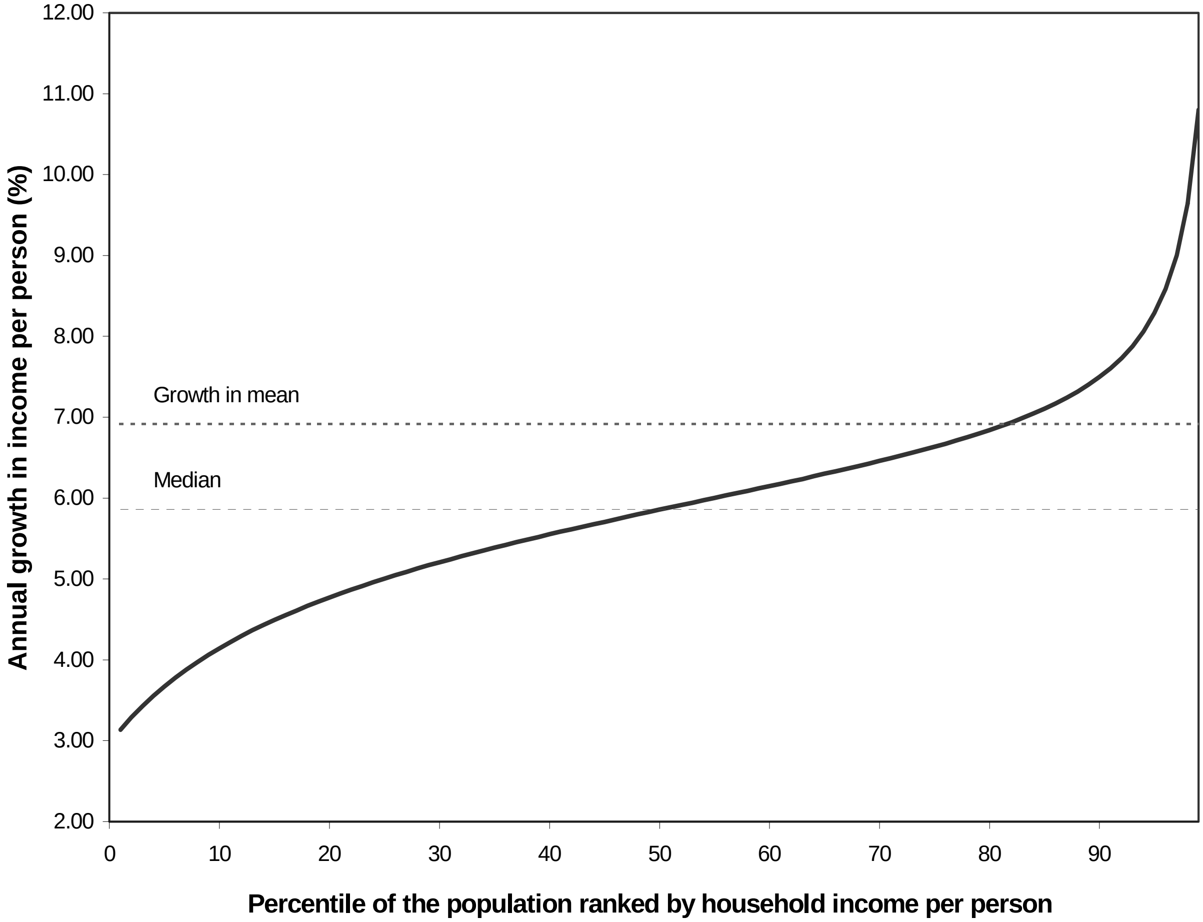

Table 1: Growth rates

	1990-99	1993-96
	Growth rate in the mean (% per annum)	
	6.9	8.4
p=	Mean growth rate for the poorest *p*% (% per annum):	
10	3.7	9.4
15	3.9	9.8
20	4.1	10.0
25	4.3	10.1
100	5.9	9.4

Figure 2: Growth incidence curve for China, 1993-1996