POLICY RESEARCH WORKING PAPER

Measuring Pro-Poor Growth

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New tools allow one to study the incidence of economic growth by initial level of income, and to measure the rate of pro-poor growth in an economy. An application is provided using data for China in the 1990s.

Summary findings

It is important to know how aggregate economic growth or contraction was distributed according to initial levels of living. In particular, to what extent can it be said that growth was "pro-poor?" There are problems with past methods of addressing this question, notably that the measures used are inconsistent with the properties that are considered desirable for a measure of the level of poverty.

Ravallion and Chen provide some new tools for assessing to what extent the aggregate growth process in an economy is pro-poor. The key measurement tool is the "growth incidence curve," which gives growth rates by quantiles (such as percentiles) ranked by income. Taking the area under this curve up to the headcount index of poverty gives a measure of the rate of pro-poor growth consistent with the Watts index for the level of poverty.

The authors give examples using survey data for China during the 1990s. Over 1990–99, the ordinary growth rate of household income per capita in China was 7 percent a year. The growth rate by quantile varied from 3 percent for the poorest percentile to 11 percent for the richest, while the rate of pro-poor growth was around 4 percent. The pattern was reversed for a few years in the mid-1990s, when the rate of pro-poor growth rose to 10 percent a year—above the ordinary growth rate of 8 percent.

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1. Introduction

A number of countries have been successful in maintaining a high growth rate in average incomes in the 1990s. Other countries have seen aggregate contraction. The question often arises as to how this growth or contraction was distributed according to initial levels of living. In particular, to what extent can it be said that growth has been "pro-poor"?

To assess whether 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 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 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

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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.

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 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, 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.[4] 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.[5]

3.   Measuring pro-poor growth

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

Axiom 1. The measure should be consistent with the way the level of aggregate poverty is measured in that a reduction (increase) in poverty must register a positive (negative) rate of pro-poor growth.[6]

Axiom 2. The measure of poverty implicit in the measure of pro-poor growth should satisfy the standard axioms for poverty measurement, following Sen (1976). We take three such axioms to be essential, namely the focus axiom (the measure is invariant to income changes for the non-poor), the monotonicity axiom (any income gain to the poor reduces poverty), and the transfer axiom (inequality-reducing transfers amongst the poor are poverty reducing).

The headcount index clearly fails the monotonicity and transfer axioms. Amongst the numerous measures satisfying all three axioms, we focus on the Watts (1968) index:

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

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[4]   This follows, under mild assumptions, from well-known results on tax progressivity and inequality; see for example Eichhorn et al., (1984).

[5]   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.

[6]   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.

where $H_t = F_t(z)$ is the headcount index of poverty and z is the poverty line. (Zheng, 1993, gives an axiomatic derivation of the Watts index.) To find a measure of growth consistent with the Watts index, differentiate (3) with respect to time and note that $y_t(H_t) = z$:

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

This is approximately minus one times the integral of the GIC up to the headcount index.

Equation (4) motivates measuring the pro-poor growth rate (*PPG*) by the mean growth rate for the poor:

$$PPG_t \equiv \frac{1}{H_{t-1}} \int_0^{H_{t-1}} g_t(p) dp \qquad (5)$$

We 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.)

Notice that the measure in (5) is not the same as the growth rate in the mean income of the poor (as often used in applied work). The 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.[7] Urban and Rural

Consumer Price Indices have been applied to the urban and rural distributions prior to

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.

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.

Table 1 gives our measure of the rate of pro-poor growth (equation 5, using numerical

integration) 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.

We repeated these calculations for sub-periods, 1990-93, 1993-96, 1996-99. All GIC's

showed the same pattern except 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

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[7]   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).

around the 20th percentile.[8] 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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[8]   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

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(y-axis) Annual growth in income per person (%)

Growth in mean

Median

(x-axis) Percentile of the population ranked by household income per person
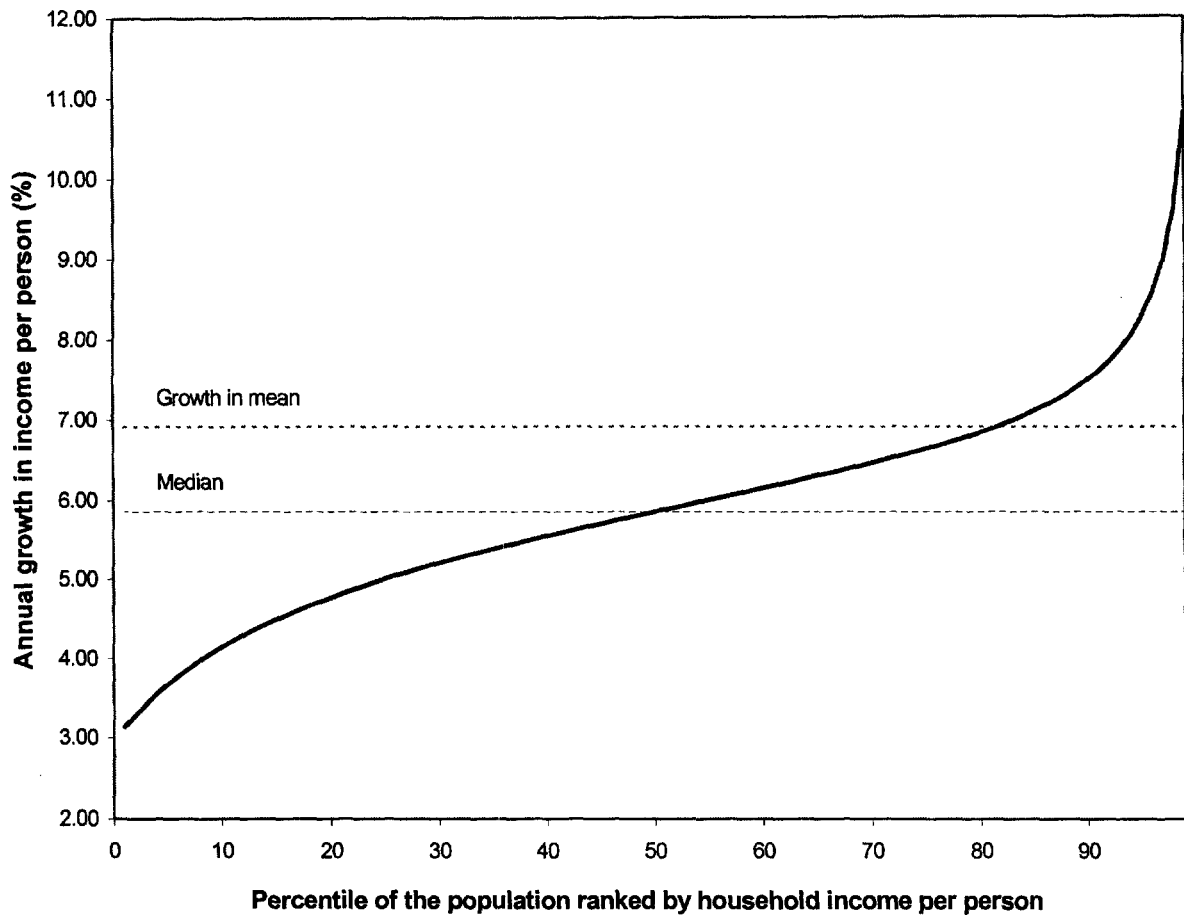
Table 1: Growth rates

	1990-99	1993-96
	Growth rate in the mean (% per annum)	
	6.9	8.4
Headcount index (%)	Rate of pro-poor growth (% 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

10

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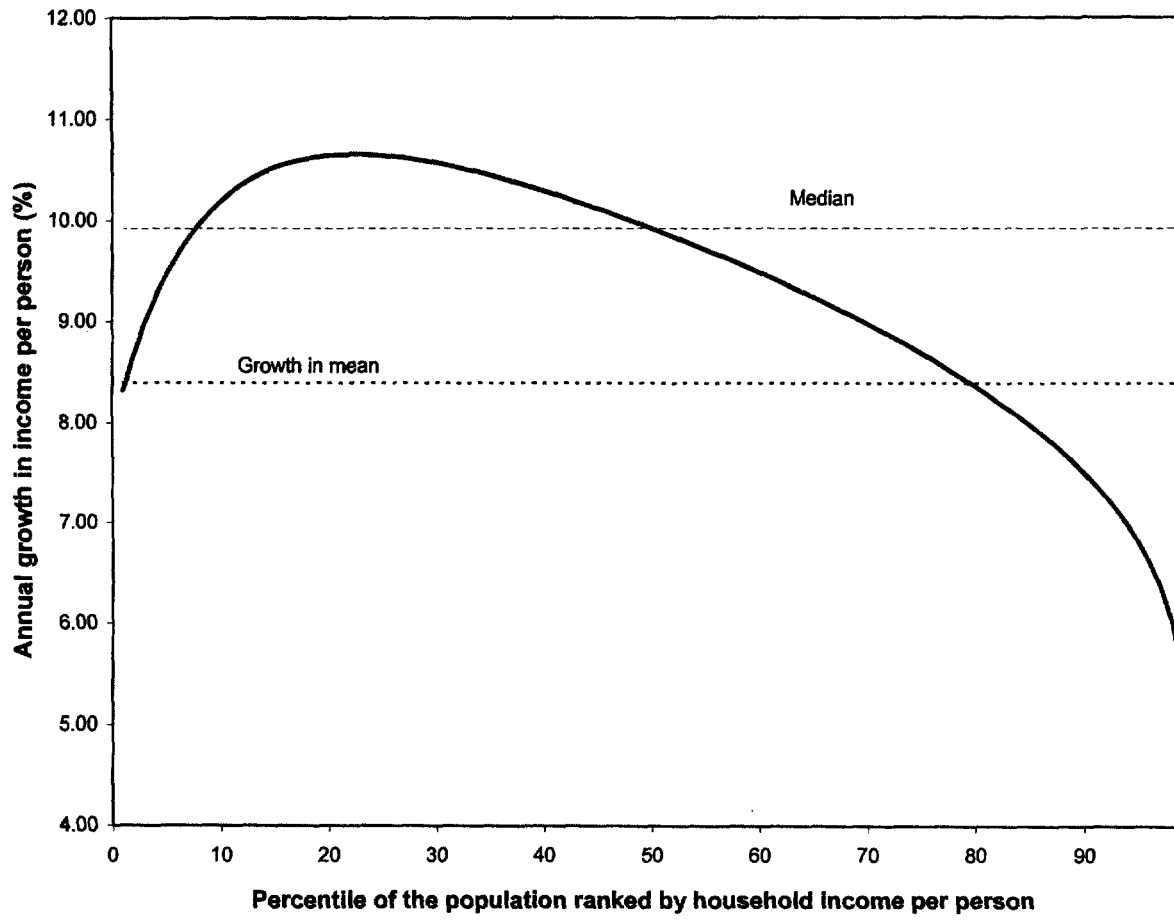
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