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Growth and Redistribution Components of Changes in Poverty Measures

A Decomposition with Applications to Brazil and India in the 1980s

Martin Ravallion and Gaurav Datt

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The World Bank
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ABSTRACT

We show how changes in poverty measures can be decomposed into growth and redistribution components, and we use the methodology to study poverty in Brazil and India during the 1980s. Redistribution alleviated poverty in India, though growth was quantitatively more important. Improved distribution countervailed the adverse effect of monsoon failure in the late 1980s on rural poverty. However, worsening distribution in Brazil, associated with the macroeconomic shocks of the 1980s, mitigated poverty alleviation through the limited growth that occurred. India's higher poverty level than Brazil is accountable to India's lower mean consumption; Brazil's worse distribution mitigates the cross-country difference in poverty.

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1. INTRODUCTION

There is often an interest in quantifying the relative contribution of growth versus redistribution to changes in poverty measures. For example, one might want to know whether shifts in income distribution helped or hurt the poor during a period of overall economic contraction. Unfortunately, the numerous existing inequality measures are not particularly useful here. One certainly cannot conclude that a reduction in inequality (by any measure satisfying the usual Pigou-Dalton criterion) will reduce poverty. And even when a specific reduction (increase) in inequality does imply a reduction (increase) in poverty, the change in the inequality measure can be a poor guide to the quantitative impact on poverty. A time series of an inequality measure can be quite uninformative about how changes in distribution have affected the poor.

This paper shows how changes in poverty measures can be rigorously decomposed into growth and distributional effects, and it illustrates the methodology with recent data for India and Brazil.[1]

The recent history of poverty in these two countries is of interest from a number of points of view. In Brazil, the 1980s witnessed much lower income growth rates than the 1970s. The effect on poverty of this aggregate stagnation is of particular concern in the light of the widely held belief that inequality in Brazil has also worsened in the 1980s. The effects on the poor of the macroeconomic shocks and adjustments of the 1980s in Brazil are of concern. By contrast, reasonable growth rates were sustained in India during the 1980s, and (unlike many developing countries) India survived the period without significant macroeconomic disturbances. However, the mid to late 1980s saw lower GDP growth rates overall, due to the low or negative growth rates in agriculture. Monsoon failures were accompanied by concerted efforts to protect the poor, though we know of no empirical evidence as to whether or not those efforts were successful in avoiding an increase in poverty in the late 1980s, and, if so, what contribution distributional changes made.

The decomposition methodology proposed here is a descriptive tool which can help answer these questions. The following section discusses the decomposition in theory, while section 3 discusses how the theory can be implemented using parameterized poverty measures and Lorenz curves. Section 4 then gives an application to recent data on consumption distributions for rural and urban India. In addition to the substantive issues of interest about poverty in that country, we use these data to investigate a number of more methodological issues of interest about the decomposition. Section 5 gives analogous results for Brazil over a similar period, while section 6 uses the methodology to compare poverty levels between the two countries at one point in time. Some concluding comments are offered in Section 7.

2. A DECOMPOSITION FOR ANY CHANGE IN POVERTY

We confine attention to poverty measures which can be fully characterized in terms of the poverty line, the mean income of the distribution, and the Lorenz curve representing the structure of relative income inequalities. The poverty measure P_t at date (or region/country[2]) t is written as

$$P_t = P(z/\mu_t, L_t) \qquad (1)$$

where z is the poverty line, μ_t is the mean income and L_t is a vector of parameters fully describing the Lorenz curve at date t. (Homogeneity in z and μ is a common property of poverty measures.) The level of poverty may change due to a change in the mean income μ_t relative to the poverty line, or due to a change in relative inequalities L_t. For now we can delay discussion of the poverty measure's precise functional form, or of the Lorenz curve's parameterization.

The growth component of a change in the poverty measure is defined as the change in poverty due to a change in the mean while holding the Lorenz curve constant at some reference level L_r. The redistribution component is the change in poverty due to a change in the Lorenz curve while keeping the mean income constant at the reference level μ_r. A change in poverty over dates t and t+n (say) can then be decomposed as follows:

$$P_{t+n} - P_t = G(t,t+n;r) + D(t,t+n;r) + R(t,t+n;r) \qquad (2)$$

growth component; redistribution component; residual

in which the growth and redistribution components are given by

$$G(t,t+n;r) \equiv P(z/\mu_{t+n}, L_r) - P(z/\mu_t, L_r)$$

$$D(t,t+n;r) \equiv P(z/\mu_r, L_{t+n}) - P(z/\mu_r, L_t)$$

while R( ) in (2) denotes the residual. In each case, the first two arguments in the parentheses refer to the initial and terminal dates of the decomposition period, and the last argument makes explicit the reference date r with respect to which the observed change in poverty is decomposed.

The residual in (2) exists whenever the poverty measure is not additively separable between μ and **L**, i.e., whenever the marginal effects on the poverty index of changes in the mean (Lorenz curve) depend on the precise Lorenz curve (mean). In general, the residual does not vanish. Nor can it be apportioned between the growth and redistribution components, as some recent attempts at poverty decomposition have sought to do. For example, Kakwani and Subbarao (1990) present results of a decomposition of poverty measures over time for India into "growth" and "inequality" components in which the latter is determined as the difference between the actual change in poverty and the growth component. The residual is thus allocated to the redistribution component. This is entirely arbitrary, and also gives the false impression that the decomposition is exact. Similarly, Jain and Tendulkar (1990) make the residual appear to vanish by not using consistent reference dates for evaluating the "growth" and "distribution" components. In effect, this also amounts to arbitrarily allocating the residual to either the redistribution or the growth component, though which one depends on the reference dates chosen. Of course, the main issue here is not that the residual must always be separately calculated, but that the growth and redistribution components must be evaluated consistently.

However, the residual itself does have an interpretation. To see this, it is instructive to note that, for r=t, the residual in (2) can be written

$$\begin{aligned} R(t,t+n;t) &= G(t,t+n;t+n) - G(t,t+n;t) \\ &= D(t,t+n;t+n) - D(t,t+n;t) \end{aligned} \qquad (3)$$

The residual can thus be interpreted as the difference between the growth (redistribution) components evaluated at the terminal and initial Lorenz curves (mean incomes) respectively. If the mean income or the Lorenz curve remains unchanged over the decomposition period, then the residual vanishes.[3]

Separability of the poverty measure between the mean and Lorenz parameters is also required for the decomposition to be independent of the choice of the reference (μ_r, L_r). That choice is arbitrary; the reference point need not even be historically observed. The initial date of the decomposition period is a natural choice of a reference, and this is what we use in the empirical work.

Since it is arbitrary, we shall also investigate the sensitivity of the decomposition to the choice of reference. For that purpose, the result in (3) is useful. It tells us that the residual using date t as the reference also gives the change in both the growth component and the redistribution component which would result from switching the reference to date t+n. The decomposition using the initial year as the reference contains all the information necessary to calculate the decomposition using the final year as the reference, and vice versa.

The decomposition can also be applied to multiple periods (more than two dates), though a word of caution is needed. A desirable property for such a decomposition scheme is that the growth, redistribution and residual components for the sub-periods add up to those for the period as a whole. However, this property will not hold in general if we use the initial date of each sub-period as the reference. The problem is easily rectified on noting that the violation occurs because the reference (μ, L) keeps changing over the sub-periods. The remedy is to maintain a fixed reference date for all decomposition periods, and again the initial date of the first decomposition period is a natural choice. Sub-period additivity is then satisfied. Suppose we have another sub-period from date t+n to t+n+k, say, in addition to the one from t to t+n considered above. Then:

$$G(t,t+n;r) + G(t+n,t+n+k;r) = G(t,t+n+k;r)$$

$$D(t,t+n;r) + D(t+n,t+n+k;r) = D(t,t+n+k;r)$$

$$R(t,t+n;r) + R(t+n,t+n+k;r) = R(t,t+n+k;r)$$

as required for sub-period additivity.[4]

The interpretation of the residual in the multi-period context is similar to that for a single decomposition period. For a sequence of dates (0,1,..t,..T), let R_t denote the residual R(t-1,t;0). The analogue to (3) can then be written in terms of cumulative components

$$\begin{aligned} \sum_{t=1}^{T} R_t = R(0,T;0) &= G(0,T;T) - G(0,T;0) \\ &= D(0,T;T) - D(0,T;0) \end{aligned} \qquad (4)$$

Thus, the cumulative residual measures the change in both the cumulative growth and redistribution components that would result from switching the reference from date 0 to date T.

3. IMPLEMENTATION USING PARAMETERIZED LORENZ CURVES AND POVERTY MEASURES

The decomposition can be readily implemented using standard data on income or consumption distributions for two or more dates. Explicit functional forms for $P(z/\mu_t, L_t)$ are derivable for a wide range of existing poverty measures and parameterized Lorenz curves. We shall use three common poverty measures, the headcount index H given by the proportion of the population who are poor, the poverty gap index PG given by the aggregate income short-fall of the poor as a proportion of the poverty line and normalized by population size, and the Foster-Greer-Thorbecke (FGT) P_2 measure, similar to PG but based on the sum of squared proportionate poverty deficits. In fact each of these measures is a member of the FGT class of measures P_α defined by

$$P_\alpha = \sum_{y_i<z} [(z-y_i)/z]^\alpha/n$$

where y_i is the income or consumption of the i'th household or individual, z is the poverty line, n is the population size, and α is a non-negative parameter. H is obtained when $\alpha=0$; PG is obtained when $\alpha=1$; P_2 is obtained when $\alpha=2$.

From any valid parameterized Lorenz curve L(p), H is calculatable using the aforementioned fact that $\mu L'(H)=z$. (Noting that L'(p) is invertible - either explicitly or numerically - for any valid Lorenz curve.) The poverty gap index is then calculated as $PG = (1 - \mu^p/z)H$, where $\mu^p = \mu L(H)/H$ denotes the mean income or consumption of the poor. P_2 is obtained as the integral of $[1-(\mu/z)L'(p)]^2$ over the interval (0,H).

We have derived formulae for the FGT poverty measures for each of two parametric specifications of the Lorenz curve, namely the Kakwani (1980) model and the elliptical model of Villasenor and Arnold (1989). Table 1 gives the functional forms of these Lorenz curves, and the implied poverty measures. The derivations of P_2 use standard methods of integration. The elliptical

Table 1: Poverty Measures for Alternative Parameterizations of the Lorenz Curve

	Kakwani Lorenz Curve	Elliptical Lorenz Curve
Equation of the Lorenz curve (L(p))	$L(p) = p - \theta p^{\gamma}(1-p)^{\delta}$	$L(1-L) = a(p^2-L) + bL(p-1) + c(p-L)$ or, $L(p) = -[bp + e + (mp^2+np+e^2)^{1/2}]/2$
Headcount index (H)	$\theta H^{\gamma}(1-H)^{\delta}[\frac{\gamma}{H} - \frac{\delta}{1-H}] = 1-z/\mu$	$H = -[n + r(b+2z/\mu)\{(b+2z/\mu)^2-m\}^{-1/2}]/(2m)$
Poverty gap index (PG)	$PG = H - (\mu/z)L(H)$	$PG = H - (\mu/z)L(H)$
Foster-Greer-Thorbecke (P_2)	$P_2 = (1-\mu/z)[2PG - (1-\mu/z)H] + \theta^2(\mu^2/z^2)[\gamma^2 B(H,2\gamma-1,2\delta+1) - 2\gamma\delta B(H,2\gamma,2\delta) + \delta^2 B(H,2\gamma+1,2\delta-1)]$	$P_2 = 2PG - H - (\mu^2/z^2)[aH + bL(H) - (r/16)\ln\{(1-H/s_1)/(1-H/s_2)\}]$
Note:	$B(k,r,s) = \int_0^k p^{r-1}(1-p)^{s-1}dp$	$e = -(a+b+c+1)$; $m = b^2 - 4a$; $n = 2be - 4c$; $r = (n^2 - 4me^2)^{1/2}$; $s_1 = (r-n)/(2m)$; $s_2 = -(r+n)/(2m)$

model gives somewhat easier computational formulae (generating explicit forms for all poverty measures; the Kakwani specification requires numerical methods for inverting L'(H) and tabulations of incomplete Beta functions). Subject to consistency with the theoretical conditions for a valid Lorenz curve, the choice of Lorenz curve specification was made according to goodness of fit.[5] The estimated Lorenz curves for both India and Brazil used in the following sections tracked the data extremely well; R-squares ranged between 0.995 and 1.000 for the two functional forms. (Such values of R-square are not uncommon for these functional forms of the Lorenz curves.) Imprecision associated with the Lorenz curve estimation seems unlikely to be of serious concern.[6]

4. POVERTY IN INDIA, 1977-1988

We have estimated poverty measures and their decompositions for rural and urban India from the National Sample Surveys (NSS) of 1977-78, 1983, 1986-87, and 1988. There are a number of problems of comparability across these surveys. The following points should be particularly noted:

i) Doubts have been raised about the 1977-78 survey estimates of expenditures on consumer durables, which greatly exceeded estimates for other years, particularly in rural areas.[7] The problem is most serious at high consumption levels, and so may not have much effect on poverty measures. However, the associated distortions in the fitted Lorenz curve could still have a significant effect on the decomposition.

ii) The 1988 distribution is based on a sample which only covered the last six months of that year, while the rest are for a full year. (The survey was also done in the first half of 1990, but the results are not yet available.)

iii) The 1986-87 and 1988 samples were much smaller than those for the other years. 25,800 households were sampled in 1986-87 and 12,000 in 1988 (half year) versus 157,900 and 117,900 in 1977-78 and 1983 respectively.[8] But they still appear to be large enough to give adequate precision.[9]

We are able to take corrective action only with regard to i). Results for all years are reported here for both total consumption expenditure, and consumption net of durables.[10] Our calculations have used the Planning Commission (Sixth Plan) poverty line up-dated by Minhas et al. (1987) to a per capita monthly expenditure of Rs 89 at 1983 all-India rural prices. The Consumer Price Index for Agricultural Laborers (CPIAL) and The Consumer Price Index for Industrial Workers (CPIIW) are used as deflators over the entire period for rural and urban areas respectively.[11] [12] An estimate of the all-India urban-rural price differential for 1973-74 is derived from Bhattacharya et al (1980), which is updated for the period 1977-78 to 1988 using CPIAL and CPIIW. The Kakwani Lorenz curve performed well on these data, and passed all necessary conditions for a locally valid Lorenz curve. The

initial year was used as the reference, fixed over all dates to ensure sub-period additivity, as discussed above.

Table 2 gives our estimated poverty measures for India (as well as those for Brazil, to be discussed later). Results are reported for the distributions of consumption net of durables - those for total consumption were very similar, and are available from the authors. However, as we will see, the treatment of durables makes far more difference to the decomposition results.

All poverty measures fell over the period, though not all continuously, with an increase in the headcount index in rural areas between 1986-87 and 1988. However, the increase is small, and (given the lower sample sizes in the latter two surveys) it is probably not significant statistically at a reasonable level.[13] Both the poverty gap index and the theoretically preferred P_2 declined over all sub-periods in rural areas. The pattern is similar for urban areas. There was a particularly sharp fall in rural poverty between 1983 and 1986-87.

The comparison of poverty measures across sectors is also of interest. Historically, poverty lines adjusted for cost of living differences have shown higher poverty measures in rural areas than in urban areas, and this is common in developing countries (World Bank, 1990, chapter 2). This is confirmed for the two earlier years of our study period. However, the results for the latter two years suggest a reversal in the poverty ranking of the two sectors, with generally higher measures in urban areas. (The exception being the headcount index for 1988 which returns to being higher in rural areas, though the difference is small; see Table 2.) The contribution of the urban sector to total poverty has increased quite dramatically over the period. For example, using the Foster-Greer-Thorbecke P_2 index, the proportion of total poverty accountable to the urban sector increased from 20.1% in 1977-78 to 29.8% in 1988, with the sharpest increase occurring between 1983 and 1986-87, largely reflecting the aforementioned fall in rural poverty.

Table 2: Poverty in India and Brazil Since the late 1970s

Poverty/ inequality measure	1977-78	1981	1983	1985	1986-87	1987	1988
			Rural India				
H	52.68	-	45.13	-	36.84	-	38.66
PG	16.03	-	12.74	-	9.44	-	9.40
P_2	6.67	-	4.97	-	3.48	-	3.25
Gini index	0.299	-	0.289	-	0.283	-	0.283
			Urban India				
H	46.80	-	39.69	-	38.32	-	37.12
PG	14.20	-	10.91	-	10.46	-	10.49
P_2	5.93	-	4.17	-	3.98	-	3.91
Gini index	0.318	-	0.323	-	0.339	-	0.328
			Brazil				
H	-	26.46	32.14	26.23	-	24.23	26.47
PG	-	10.07	13.09	9.90	-	9.46	10.71
P_2	-	4.96	6.81	4.82	-	4.79	5.58
Gini index	-	0.580	0.591	0.593	-	0.597	0.615

Note: Poverty measures in percent; those for India are based on consumption excluding expenditure on durables (see text).

Tables 3 and 4 give our estimates of the decomposition of changes in rural poverty, for total consumption and consumption net of durables respectively. Tables 5 and 6 give the corresponding results for urban India. The Tables give the increments in percentage points, both in the aggregate and by components and sub-periods. For example, the rural headcount index (including consumer durables) is estimated to have started at 53.92% in 1977-78, falling by 15.86 points to 38.06% in the latter half of 1988. By sub-periods, this was made up of a fall in the index of 8.97 points over 1977-78 to 1983, 8.08 points between 1983 and 1986-87, and it rose by 1.46 points between 1986-87 and 1988. By components, distributionally neutral growth

accounted for 9.74 points, distributional shifts accounted for 6.05 points, with the residual making up the balance of 0.07 points.

Table 3: Decompositions for Rural India (Including Consumer Durables)

Period	Growth component	Redistribution component	Residual	Total change in poverty
		(Percentage points)		
		Headcount index (H)		
1977-8 to 83	-2.58	-6.51	0.12	-8.97
1983 to 86-7	-8.61	0.19	0.34	-8.08
1986-7 to 88	1.46	0.27	-0.54	1.19
1977-8 to 88	-9.74	-6.05	-0.07	-15.86
		Poverty gap index (PG)		
1977-8 to 83	-1.18	-2.09	0.14	-3.13
1983 to 86-7	-3.52	-0.18	0.42	-3.28
1986-7 to 88	0.55	-0.54	-0.14	-0.13
1977-8 to 88	-4.14	-2.81	0.41	-6.54
		Foster-Greer-Thorbecke index (P_2)		
1977-8 to 83	-0.57	-0.90	0.08	-1.39
1983 to 86-7	-1.61	-0.11	0.23	-1.49
1986-7 to 88	0.24	-0.46	-0.04	-0.26
1977-8 to 88	-1.94	-1.47	0.30	-3.11

A number of points are noteworthy from the results of Tables 3 and 4:

i) The adjustment for durables makes considerable difference to the decompositions, particularly for the period 1977-78 to 1983. When durables are included, the redistribution component dominates the growth component for all poverty measures. However, the ranking is fully reversed when durables are excluded (Table 4). The growth component now dominates for all measures. As doubts can be raised about the 1977-78 durables expenditures in the NSS, we suspect the results of Table 4 to be closer to the truth, and we will confine our attention to those results in the following discussion.

Table 4: Decompositions for Rural India (Excluding Consumer Durables)

Period	Growth component	Redistribution component	Residual	Total change in poverty
		(Percentage points)		
		Headcount index (H)		
1977-8 to 83	-6.45	-1.18	0.09	-7.54
1983 to 86-7	-7.33	-0.72	-0.24	-8.29
1986-7 to 88	1.04	1.44	-0.66	1.82
1977-8 to 88	-12.74	-0.46	-0.82	-14.02
		Poverty gap index (PG)		
1977-8 to 83	-2.82	-0.53	0.06	-3.29
1983 to 86-7	-2.87	-0.54	0.11	-3.30
1986-7 to 88	0.39	-0.19	-0.24	-0.04
1977-8 to 88	-5.31	-1.26	-0.06	-6.63
		Foster-Greer-Thorbecke index (P_2)		
1977-8 to 83	-1.40	-0.34	0.04	-1.70
1983 to 86-7	-1.34	-0.28	0.13	-1.49
1986-7 to 88	0.17	-0.37	-0.03	-0.23
1977-8 to 88	-2.56	-0.99	0.13	-3.42

ii) While the growth component dominates the redistribution component in all sub-periods, the relative importance of the two can vary greatly according to which measure of poverty is used. This is most striking for the last period, 1986-87 to 1988. For the headcount index we find that both the growth and redistribution components contributed to the increase in poverty. However, for the other two measures, changes in distribution mitigated the adverse effect of the decrease in the mean. Roughly speaking, people with consumption around the poverty line became worse off over this sub-period, while the poorest became better off. However, the problems of comparability between these NSS rounds should be recalled, though we do not know what direction of bias, if any, may be attributed to those problems.

iii) The residuals in the decomposition vary a good deal in size. Our results suggest it would be hazardous to assume the residual is zero, or simply lump it into the redistribution component. For example, for the headcount index (excluding durables) over the whole period, 1977-78 to 1988, the residual exceeds the redistribution component (in absolute value), and by a wide margin. However, in all other cases the residual is small relative to both growth and redistribution components. Thus the decomposition is generally quite insensitive to a change of reference from the initial to final year. (Using the results of Section 2, the changes involved in making such a switch for the whole period can be obtained easily from Tables 3 and 4 by simply adding the residual to the growth and redistribution component. The residual using the final year as the reference is simply the additive inverse of the reported residual for the initial year.)

iv) Our results also illustrate that a conventional inequality index can be a poor guide to the way distributional shifts can affect poverty measures. For example, the Gini index is unchanged to three decimal places between 1986-87 and 1988 (excluding durables; the index value is .283). However, distributional shifts over that sub-period did have a sizable impact on both the headcount index and the Foster-Greer-Thorbecke P_2 measure, albeit in opposite directions (Table 4).

v) The rather sharp fall in rural poverty over the whole period, particularly between 1983 and 1986-87, warrants further comment. 1986-87 was not a good agricultural year; indeed, it was a bad one in much of Western India, with below normal rainfall and a decline in output. It is arguable that the CPIAL may have under-estimated the rate of inflation; the CPIAL increased by 13 percent over this period while wholesale prices increased by 19 percent. Similar concerns about the use of CPIAL as a deflator for the period 1973-74 to 1983 have been expressed by Minhas et al. (1987). The poverty measures are quite sensitive to changes/measurement errors in the deflator. For instance, an under-estimation of inflation over the period 1983 to 1986-87 by 1 percent would result in underestimating the headcount, the

poverty gap, and the Foster-Greer-Thorbecke P_2 indices of poverty for 1986-87 by 2.1, 2.9 and 3.4 percent respectively. However, only the growth component of the decomposition is affected; since the initial year's mean consumption is used as the reference, the redistribution component is independent of real mean consumption on subsequent dates.

Some of the above points are also borne out in our results for urban India in Tables 5 and 6. The growth component is again dominant over the period as a whole, though shifts in distribution were important in certain sub-periods. However, by most measures, shifts in urban distribution mitigated poverty alleviation within that sector. This was largely due to a worsening in distribution between 1983 and 1986-87. For the headcount index, this was substantially offset by favorable distributional effects between 1986-87 and 1988 (a fall in inequality is also indicated by the Gini index; see Table 2). However, the other poverty measures suggest a continued worsening in distribution from the point of view of the urban poor. In all cases, distributionally neutral growth would have enhanced the rate of poverty alleviation over the period as a whole. The urban results seem more robust to the treatment of durables.

Table 5: Decompositions for Urban India (Including Consumer Durables)

Period	Growth component	Redistribution component (Percentage points)	Residual	Total change in poverty
		Headcount index (H)		
1977-8 to 83	-3.15	-1.30	-0.04	-4.49
1983 to 86-7	-4.41	3.02	0.03	-1.36
1986-7 to 88	-0.36	-1.91	1.01	-1.26
1977-8 to 88	-7.92	-0.18	0.98	-7.12
		Poverty gap index (PG)		
1977-8 to 83	-1.33	-0.96	0.02	-2.27
1983 to 86-7	-1.75	1.48	-0.16	-0.43
1986-7 to 88	-0.14	-0.05	0.15	-0.04
1977-8 to 88	-3.22	0.46	0.02	-2.74
		Foster-Greer-Thorbecke index (P_2)		
1977-8 to 83	-0.65	-0.65	0.03	-1.27
1983 to 86-7	-0.83	0.76	-0.11	-0.18
1986-7 to 88	-0.06	-0.02	-0.02	-0.10
1977-8 to 88	-1.55	0.09	-0.09	-1.55

Table 6: Decompositions for Urban India (Excluding Consumer Durables)

Period	Growth component	Redistribution component (Percentage points)	Residual	Total change in poverty
		Headcount index (H)		
1977-8 to 83	-8.35	1.26	-0.03	-7.12
1983 to 86-7	-3.26	1.79	0.10	-1.37
1986-7 to 88	-0.79	-1.95	1.54	-1.20
1977-8 to 88	-12.41	1.11	1.62	-9.68
		Poverty gap index (PG)		
1977-8 to 83	-3.47	0.30	-0.12	-3.29
1983 to 86-7	-1.24	0.99	-0.20	-0.45
1986-7 to 88	-0.29	0.10	0.22	0.03
1977-8 to 88	-5.00	1.39	-0.10	-3.71
		Foster-Greer-Thorbecke index (P_2)		
1977-8 to 83	-1.69	-0.01	-0.06	-1.76
1983 to 86-7	-0.57	0.55	-0.17	-0.19
1986-7 to 88	-0.13	0.13	-0.07	-0.07
1977-8 to 88	-2.40	0.67	-0.29	-2.02

5. POVERTY IN BRAZIL, 1981-1988

The period 1981-1983 was one of recession and macroeconomic adjustment in Brazil, achieved through a combination of tighter monetary policies, exchange rate policies, and some fiscal restraint, with the burden of adjustment falling heavily on the private sector (Fox and Morley, 1991). An attempt was made to buffer the poor from the burden of adjustment by improving distribution using wage policies; in particular full indexation of wage rates (and, indeed, more than full indexation at low wage rates) was allowed in the early 1980s (Fox and Morley, 1991). The mid-1980s saw signs of a return to the higher growth rates of the 1970s, though progress in the late 1980s was quite uneven, with some large year-to-year fluctuations.

We have estimated the poverty measures and the decomposition using new data on five household income surveys for Brazil during the 1980s, the data being made available to us in an unusually detailed partition of income groups; the data are for tabulations of income shares for 40 income groups.[14] An urban-rural split is not available. The distributions for Brazil in the 1980s are for household income per capita (rather than consumption expenditure as for India[15]). Labor incomes are thought to be measured well by these surveys, but not other sources, such as (probably most importantly in this context) the value of income from own farm production (Fox, 1990). For the poverty line we have used a household income per capita of one quarter of the minimum wage rate and have adjusted for inflation using the INPC index for a low-income consumption bundle; in both respects we follow the practice of Fox and Morley (1991) and Fox (1990) who discusses these points further. Poverty estimates for Brazil in this period are undoubtedly sensitive to likely measurement errors in estimating rates of inflation, though the index we have used appears to be the most reliable one available (Fox, 1990). The elliptical model of the Lorenz curve was preferred for our Brazil data.[16]

Table 2 also gives our estimates of the three poverty measures for Brazil. The measures show no sign of either a trend increase or decrease in poverty over the period. There is considerable variation across sub-periods,

with a sharp increase from 1981 to 1983 by all measures, followed by a similar decline to 1987, with an increase indicated from 1987 to 1988. The pattern broadly follows the ebb and tide of the macroeconomic aggregates over this period (Fox and Morley, 1991); it is clear that the fortunes of Brazil's poor are tied to changes in national income.

Table 5 gives the sub-period decompositions for Brazil, again using the initial year as the fixed reference. Over the full period we find that, underlying the negligible change in the poverty measures, both the growth and redistribution components were strong, with roughly opposite effects. Changes in distribution tended to increase poverty, but there was sufficient growth in the mean income per person to counteract their effect. The main mechanism for the observed adverse redistributional component of poverty change during the 1980s seems to have been the relatively slow growth of employment in the formal sector (particularly the private formal sector) and the consequent overcrowding in the informal sector, where average incomes were only about half of those in the formal sector even during the closing years of the 1980s (Fox and Morley, 1991). The bulk of the adverse distributional effect was in the two sub-periods when poverty increased, namely 1981 to 1983 and 1987 to 1988. Both a decline in mean income and adverse distributional shifts contributed to the increase in poverty during the recession period 1981-83, though the former factor was quantitatively more important. Attempts to improve distribution during the recession did not prove successful. The recovery of 1983-85 saw poverty measures fall by about the same amount they had increased over the previous sub-period. This was due almost entirely to distributionally neutral growth.

A few points of interest emerge from the comparison of India and Brazil. Unlike India, Brazil did not experience a trend decline in poverty during the 1980s. And the two countries differ dramatically in terms of the relative contributions of growth versus redistribution. For Brazil, distributional effects were adverse in their poverty alleviation impact over the 1980s; the poor did not participate fully in the growth that occurred.

The headcount index of poverty would have fallen by a 4.5 percentage points over the period if only growth had been distributionally neutral. By contrast, distributional effects contributed to the alleviation of poverty in India between 1977 and 1988, though growth accounted for the bulk of the improvement, including that for the Foster-Greer-Thorbecke P_2 measure.

6. A COMPARISON OF POVERTY IN BRAZIL AND INDIA

In the preceding two sections, we have used local poverty lines for each country. These will not generally imply the same standard of living; local assessments of what constitutes "poverty" will naturally vary. For example, local poverty lines tend to be positively correlated with the average incomes of countries (Ravallion et al., 1991). In comparing poverty measures across countries (or, indeed, across regions of the same country) one would like to control for this variation, by imposing the same real poverty line.

We also need to control for the fact that while the Brazilian poverty line refers to per capita income, the Indian one refers to per capita consumption. A related adjustment is required for the survey means. For the purpose of this comparison we have used the Summers and Heston (1988) estimate of purchasing power parity (PPP) adjusted consumption per capita for Brazil relative to India, rather than the mean income from the survey. An equivalent consumption poverty line for Brazil is then derived such that when used with the PPP adjusted consumption per capita it results in the same level of poverty as is obtained using income data with the income poverty line.

Table 8 gives poverty estimates for Brazil and India in 1983, using each country's poverty line alternately.[17] At either poverty line, and for either measure, poverty is significantly higher in India than Brazil.[18]

Applying the methodology outlined above, we now ask how much of this difference in poverty is due to the difference in means across the two countries (the "growth" component) and how much is due to differences in distribution (the "redistribution" component). There are some potentially important caveats. Recall that the Brazil survey is for household income while India's is for consumption. While we have attempted to address the non-comparability of the survey means above, we have no choice but to use the survey Lorenz curves, though one should note that Brazil's income Lorenz curve would probably show greater inequality than one would find in a consumption distribution, if such were available. This would no doubt lead to an over-

estimation of the difference in poverty attributable to the difference in distribution between the two countries.

Table 7: Decompositions for Brazil

Period	Growth component	Redistribution component	Residual	Total change in poverty
		(Percentage points)		
		Headcount index (H)		
1981 to 83	3.96	1.65	0.07	5.68
1983 to 85	-5.84	0.02	-0.10	-5.91
1985 to 87	-2.61	0.46	0.15	-2.00
1987 to 88	-0.01	2.33	-0.08	2.24
1981 to 88	-4.49	4.46	0.04	0.01
		Poverty gap index (PG)		
1981 to 83	2.18	0.72	0.11	3.02
1983 to 85	-3.18	0.15	-0.16	-3.19
1985 to 87	-1.34	0.92	-0.01	-0.44
1987 to 88	0.00	1.39	-0.15	1.24
1981 to 88	-2.34	3.19	-0.21	0.64
		Foster-Greer-Thorbecke index (P_2)		
1981 to 83	1.39	0.37	0.09	1.85
1983 to 85	-2.00	0.15	-0.14	-1.99
1985 to 87	-0.81	0.87	-0.09	-0.03
1987 to 88	0.00	0.93	-0.14	0.79
1981 to 88	-1.42	2.31	-0.27	0.62

Table 8: Poverty Measures for Brazil and India, 1983

Poverty measure	Poverty line: India		Brazil	
	India	Brazil	India	Brazil
H	43.87	14.00	86.01	32.14
PG	12.29	3.79	39.00	13.09
P_2	4.77	1.35	21.20	6.81

Table 9: Decomposition of the Difference in Poverty Between Brazil and India in 1983

Poverty line	Reference	Growth component	Redistribution component	Residual	Difference in poverty
		(Percentage points)			
		Headcount index (H)			
India	India	43.77	-22.09	8.19	29.87
	Brazil	51.96	-13.90	-8.19	29.87
Brazil	India	84.81	2.68	-33.62	53.87
	Brazil	51.19	-30.94	33.62	53.87
		Poverty gap index (PG)			
India	India	12.25	-24.98	21.23	8.50
	Brazil	33.48	-3.75	-21.23	8.50
Brazil	India	38.77	-16.54	3.68	25.91
	Brazil	42.45	-12.86	-3.68	25.91
		Foster-Greer-Thorbecke index (P_2)			
India	India	4.74	-20.38	19.06	3.42
	Brazil	23.80	-1.32	-19.06	3.42
Brazil	India	21.11	-20.63	13.91	14.39
	Brazil	35.02	-6.72	-13.91	14.39

Table 9 gives the decomposition estimates, for each poverty line/measure and each country as the reference. The results should now be self-explanatory, though particular attention should be drawn to two points:

i) The redistribution component is generally negative (and the one exception is small). Thus, the difference between the two countries' Lorenz curves is such that, holding either mean constant, poverty would be <u>higher</u> in Brazil than India. Alternatively, the actual difference in poverty between the two countries is less than the difference expected on the basis of their mean consumption levels alone; the latter is mitigated by the relatively more "adverse" distribution in Brazil.

ii) In a number of cases, the residual turns out to be large. Clearly, ignoring the residual could give quite misleading results. For

example, with the headcount index, using Brazil for both the poverty line and the reference, virtually all of the difference in poverty may seem attributable to the difference in means. However, that does not imply that the redistribution component is negligible; indeed, it is large enough to cancel out roughly 60 percent of the "growth" component.

7. CONCLUSIONS

In the voluminous literature on the relationship between growth, distribution and poverty, the following empirical question has remained begging: how much of any observed change in poverty can be attributed to changes in the distribution of income, as distinct from growth in average incomes? Standard inequality measures can be misleading in this context. The decomposition proposed here offers a tool for rigorously quantifying the contribution of distributional changes to poverty alleviation, controlling for growth effects, and the contribution of growth, controlling for relevant distributional changes. Our approach differs from some recent attempts at poverty decomposition by not confounding the residual component with either the growth or the redistributional component. However, like any descriptive tool, the proposed decomposition has its limitations. For example, the decomposition cannot tell us if an alternative growth process with better distributional implications would have been more effective in reducing poverty. That would require an appropriate model of growth and distributionl change.

We have illustrated the decomposition with a comparative analysis of the recent evolution of poverty measures for Brazil and India, using newly available data, largely for the 1980s. India's performance in poverty alleviation was better than Brazil's over this difficult period. For example, toward the end of the 1980s, the two countries had an almost identical poverty gap index (though Brazil's being for a local poverty line with higher purchasing power), while India's index of 10 years earlier had been about 50% higher than Brazil's had been at the beginning of the 1980s. India's progress over the 1980s has been uneven across sectors, with the urban sector contributing a rising share of aggregate poverty.

In comparing these countries, our results indicate quite different impacts on the poor of distributional changes over the 1980s, though the differences are more marked in some sub-periods than others. Over the longest periods considered here, distributional shifts have aided poverty alleviation

in India at a given mean consumption, while they have hindered it in Brazil. Without any change in the mean, India's poverty gap would still have fallen quite noticeably (from 16% of the poverty line to 11% in rural areas) while Brazil's would have increased equally sharply (from 10% to 13%). With Brazil's worsening distribution (from the point of view of the poor), far higher growth rates than those of the 1980s would have been needed to achieve the same impact on poverty as India attained over this period.

Growth and distributional effects on poverty were quite uneven over time in both countries, and the effects of instances of negative growth were notably different between the two. Contraction in the mean due to the poor agricultural years of 1986 and 1987 was associated with a (modest) improvement in distribution in India, such that poverty continued to fall (at least by the distributionally sensitive P_2 measure). Contraction in Brazil due to the macroeconomic shocks of the 1980s was associated with a marked worsening in distribution, exacerbating the adverse effect on poverty.

India's higher poverty level than Brazil's (at poverty lines with constant purchasing power) is largely attributable to the former country's lower mean. Indeed, at a <u>given</u> mean, Brazil would be the country with higher poverty by most measures. We find sizable differences in both means and distributions between the two countries. For example, with India's Lorenz curve of the mid-1980s, virtually all of the 44% of the population who did not attain the poverty line we have used would have escaped poverty at Brazil's mean. But nearly twice as many would be poor in India if it had Brazil's Lorenz curve. On the other hand, while 32% of Brazil's population fell below that country's poverty line in 1983, the proportion would have been negligible (about 1%) at the same mean with India's Lorenz curve, while it would have risen to over 80% at India's mean with Brazil's Lorenz curve.

Plainly, such calculations cannot also tell us whether a shift in distribution (or mean) is politically or economically attainable at a given mean (distribution). For example, it might be argued that a shift to India's Lorenz curve by Brazil would entail a significant loss of mean income, with

ambiguous net effects on poverty, or that rapid growth to Brazil's mean by India might entail a significant worsening in distribution. But the decompositions do at least allow us to quantify the relative importance to the poor of the existing differences in means and inequalities.

NOTES

1. The first application of the method proposed here is Ravallion and Huppi (1989), drawing on results of this paper. A simplified version of our method is used in the latest World Development Report (World Bank, 1990). Alternative decomposition techniques have been used by Kakwani and Subbarao (1990) and Jain and Tendulkar (1990) on data for India. However, there are potentially important theoretical differences between these methods and that proposed here, which we will discuss below.

2. Throughout this exposition we shall only refer to differences in poverty measures over time. However, the decomposition can also be used to better understand differences in poverty measures between countries or regions. We shall illustrate this type of application later.

3. Note that $R(t,t+n; t) = - R(t,t+n; t+n)$. Thus it is also possible to make the residual vanish by simply averaging the components obtained using the initial and final years as the reference. But this is arbitrary.

4. The poverty decompositions proposed by Kakwani and Subbarao (1990) and Jain and Tendulkar (1990) do not satisfy sub-period additivity.

5. We also tried a non-linear maximum likelihood estimator of the elliptical model on the India data for 1983, but found that this gave almost identical results to OLS on the linear-in-parameters specification in Table 1. (Estimates of the poverty measures were within 0.1% of each other.)

6. On the suggestion of a referee, we looked into the possibility of obtaining the standard errors of the decompositions, but this seemed intractable. The problem is two-fold. First, one cannot dismiss the possibility that disturbance terms associated with Lorenz functions may be distributed non-spherically. This does not pose a problem for the estimation of the poverty measures (and hence the decompositions) as the OLS estimates of the Lorenz parameters are still unbiased, but it does create a problem for the estimation of the standard errors of the poverty measures. Second, while the poverty measures are a function of the Lorenz parameters as well as the mean income, the estimates of the Lorenz parameters are constructed differently to that for mean income. The former are estimated econometrically while a sample estimate of the latter is taken directly from published reports. In this context, it is not obvious how the sampling distribution of the poverty measure can be defined.

7. For further discussion see Jain and Tendulkar (1989).

8. Smaller samples are now being collected on an annual basis, together with the larger samples at five yearly intervals. Results for the full sample of 1987-88 were not available at the time of writing.

9. For a random sample, the standard error of the headcount index can be readily calculated using well-known results on the sampling distribution of proportions; the standard error of the headcount index H is $\sqrt{[H(1-H)/N]}$ where N is the sample size. The standard error for the smallest rural (urban) sample (1988) is 1.5% (1.9%) of our estimated headcount index; for 1986-87 the corresponding figure is 1.0% (1.3%), while for both of the earlier years it is less that .5% (.6%).

10. Jain and Tendulkar (1989) attempt to deal with this problem by revising the NSS data. We have not done so here for two reasons: i) the best way of making such revisions is quite unclear, and ii) in any case it could reasonably be argued that consumption net of durables is a better indicator of living standards for poverty measurement.

11. These are perhaps not ideal price indices for poverty analysis, as for instance argued by Minhas et al., (1987, 1988) who also develop alternative indices. But as their indices end in 1983 and their data are unavailable we have used the CPIAL and CPIIW as deflators over the whole period of our analysis. (We note some reservations on these price indices below.)

12. We ignore spatial price differentials. Elsewhere we have made allowance for inter-state price differentials in poverty assessments for India in 1983, building the all-India estimates up from the state level estimates (Datt and Ravallion, 1990). The aggregate results for rural India are very similar to those estimated here, so the simplification does not appear to be worrying.

13. Using the usual formula for the standard error of the difference between two population proportions,

$$se(H_1-H_2) = \sqrt{\{[H_1(1-H_1)/N_1] + [H_2(1-H_2)/N_2]\}}$$

one finds that $[H_1-H_2]/se(H_1-H_2) = 1.8$ between the 1986-87 and 1988 surveys using total consumption. The difference is more significant when consumer durables are excluded (2.7), though the durables estimates for these latter years are not in doubt.

14. We are grateful to Louise Fox for providing us with the distributional data for Brazil.

15. There has not been a national expenditure survey for Brazil since 1974-75.

16. For these data, the Kakwani specification violated the aforementioned theoretical conditions for a locally valid Lorenz curve.

17. A further technical problem in making this comparison is that we have separate consumption distributions for rural and urban India, but do not have an all-India distribution. This does not matter if we are only interested in comparing poverty <u>levels</u>, since the FGT poverty measures are sub-group decomposable. However, if we want to simulate poverty for alternative means or Lorenz curves, as we will be doing below, then we would require country-specific Lorenz curves. The all-India Lorenz curve is estimated from the rural and urban Lorenz curves and means as follows. Given rural and urban Lorenz curves, $L_R(p_R)$ and $L_U(p_U)$, for any p_R in the interval (0,1), the corresponding p_U is obtained as the solution of $L_U(p_U) = \mu_R L_R(p_R)/\mu_U$. For any pair (p_R,p_U) thus obtained, the cumulative population proportion for the country as a whole is of course their population-weighted average, <u>viz</u>., $p_C = w_R p_R + w_U p_U$. The cumulative proportion of income or expenditure corresponding to p_C is obtained as

$$L_C = [w_R\mu_R L_R(p_R) + w_U\mu_U L_U(p_U)]/\mu_C$$

where μ_C is the mean income or expenditure for the country as a whole. We thus generate a set of points on the countrywide Lorenz curve which can be parameterized as before.

18. Note that the simulated all-India Lorenz curve performs quite well in estimating poverty. The poverty measures in Table 8 approximate those obtained as population-weighted sums of rural and urban measures of table 2 to the third significant digit. The rural and urban population weights, .76 and .24, are derived using the assumption that the growth in rural and urban populations during the 1981-83 has been at the same rate as during the inter-censal period 1971-81.

REFERENCES

Bhattacharya, N., P.D.Joshi and A.B. Roychoudhury, 1980, Regional Price Indices Based on NSS 28th Round Consumer Expenditure Survey Data, Sarvekshana 3, 107-121.

Datt, G., and M. Ravallion, 1990, Regional Disparities, Targeting, and Poverty in India, Policy, Planning and External Affairs Working Paper 375, The World Bank, Washington D.C.

Foster, J., J. Greer, and E. Thorbecke, 1984, A Class of Decomposable Poverty Measures, Econometrica 52, 761-765.

Fox, M.L., 1990, Poverty Alleviation in Brazil, 1970-1987, Brazil Country Department, The World Bank, Washington, D.C., (processed).

Fox, M.L., and S.A. Morley, 1991, Who Paid the Bill? Adjustment and Poverty in Brazil, 1980-1995, Background Paper for the World Development Report 1990, PRE Working Paper 648, The World Bank, Washington, D.C.

Jain, L.R., and S.D. Tendulkar, 1989, Inter-Temporal and Inter-Fractile-Group Movements in Real Levels of Living for Rural and Urban Population of India: 1970-71 to 1983, Journal of Indian School of Political Economy 1, 313-334.

Jain, L.R., and S.D. Tendulkar, 1990, Role of Growth and Distribution in the Observed Change of Headcount Ratio-Measure of Poverty: A Decomposition Exercise for India, Technical Report No. 9004, Indian Statistical Institute, Delhi.

Kakwani, N., 1980, On a Class of Poverty Measures, Econometrica 48, 437-446.

Kakwani, N., 1990, Testing the Significance of Poverty Differences with Applications to Cote d'Ivoire, LSMS Working Paper 62, The World Bank, Washington, D.C.

Kakwani, N., and K. Subbarao, 1990, Rural Poverty and its Alleviation in India, Economic and Political Weekly 25: A2-A16.

Minhas, B.S., L.R. Jain, S.M. Kansal, and M.R. Saluja, 1987, On the Choice of Appropriate Consumer Price Indices and Data Sets for Estimating the Incidence of Poverty in India, Indian Economic Review 22: 19-49.

Minhas, B.S., L.R. Jain, S.M. Kansal, and M.R. Saluja, 1988, Measurement of General Cost of Living for Urban India, Sarvekshana 12, 1-23.

Ravallion, M., G. Datt, and D. van de Walle, 1991, Quantifying the Absolute Poverty in the Developing World, Review of Income and Wealth, (forthcoming).

Ravallion, M., and M. Huppi, 1989, Poverty and Undernutrition in Indonesia During the 1980s, Policy, Planning and Research Working Paper 286, World Bank, Washington DC.

Villasenor, J., and B. C. Arnold, 1989, Elliptical Lorenz Curves, Journal of Econometrics 40, 327-338.

World Bank, 1990, World Development Report 1990: Poverty, Oxford University Press for The World Bank, Washington DC.

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