Decomposition of Change in Poverty by Growth and Redistribution Components

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Abstract:
This paper provides a robust nonparametric methodology for decomposition of change in poverty into growth and redistribution components. The decomposition is symmetric and free of residual terms. It presents an empirical application of the proposed methodology to recent data on consumption in rural and urban areas conducted by Statistical Centre of Iran (SCI) in 2000 and 2004 (the initial and the final year of the Islamic Republic’s third five-year plan). We find that both ‘pure growth’ and ‘redistribution’ components directly contributed to a striking reduction in poverty, especially among rural households.

Key words: Poverty, growth, redistribution, quantiles, decomposition, Iran, income inequality, policy, nonparametric.

1. Introduction
There is a common belief that economic growth is an effective way to eradicate poverty in developing countries. But there are dissenting views and empirical support
is not supportive of a simple consensus view. Some economists interpret the historical evidence as suggesting that the benefits of growth have not reached the poor. In contrast some economists and international institutions, notably the World Bank and the IMF, have supported growth-oriented economic policies, on the ground that they create opportunities for the poor to increase their incomes. They also emphasize that the pattern of growth plays an important role in determining the effect of growth on poverty (World Bank, 1990). The relation between changes in poverty and economic growth bears further thorough analysis and empirical examination. The experience of economic policies of developing countries suggests that incomes of “the poor” usually grow slower than the average (Kakwani, 1993). In an empirical study about the 1980s, Ravallion (1995) concluded that, in developing countries, the growth process typically had neither strongly adverse impact on the relative position of the poor, nor was it associated with a tendency for “inequality” to either increase or decrease. Much of this literature tends to take for granted the existing univariate definitions of “the poor” and poverty lines, and similar notions of “inequality”, typically in some measure of income. Recent literature on multi-attribute analysis of well-being has exposed the complex notion of “poverty frontiers” in many dimensions, revealing the challenges in the choice of dimensions of well being, and the technical issues surrounding the definition of multidimensional “quantile sets”, as well as the additional aggregation issues. See Maasoumi and Lugo (2008), Maasoumi and Racine (2010), and Maasoumi and Salehi (2009).

The decomposition of poverty changes into “pure growth” and “redistribution” components can shed some light on the relation between poverty and growth in a single dimension of well-being, or in a suitably chosen aggregator of several dimensions. The choice of such aggregators is discussed in Maasoumi (1986), Maasoumi and Lugo (2008), Maasoumi and Zendedel (2005), and in Maasoumi and Salehi (2008), the latter two being examinations of multidimensional well-being in Iran. As an empirical matter, to understand the impact of growth and redistribution on any observed changes in poverty, one needs to examine the separate impacts of growth in average income and of redistribution of income on poverty.

Several methods for decomposition of poverty changes have been proposed, for example by Kakwani and Subbarao (1990), Datt and Ravallion (1992), and Tsui (1996). Although Datt and Ravallion’s method has been used in several empirical
studies, it has some limitations. Firstly, the growth and redistribution effects are not symmetric with respect to the base and final years. Secondly, the decomposition is not exact and contains a third ‘residual’ component (see the next section). A more desirable decomposition method is one that exactly sums the contributions of determining factors of total changes. This paper proposes a simple method for decomposing a change in poverty into growth and redistribution components and illustrates the proposed approach with recent data for Iran.

The paper is organized as follows. Section 2 reviews Datt and Ravallion’s method of decomposing changes in poverty into “pure growth” and “redistribution” components. Section 3 proposes a new approach to decomposing these effects. Section 4 presents an empirical application of the proposed methodology to recent data on consumption in rural and urban areas in Iran in 2000 and 2004. Conclusions are in section 5.

2. Growth-equity decomposition of a change in poverty

Let $x$ denote income and $F(x)$ denote the cumulative distribution function and $L(F; p)$ denote the equation of the Lorenz curve, giving the fraction of total income that the holders of the lowest $p$-th fraction of incomes possess. If $L'(p)$ denotes the slope of the Lorenz curve, we can write (Kakwani, 1980a, p 31):

\[(1) \quad x = F^{-1}(p) = \mu L'(p)\]

where $\mu$ is mean income. The distribution function evaluated at the poverty line is the well-known “headcount ratio” poverty index (the poverty rate, $P_0$). Thus, as special case of (1) we can write:

\[(2) \quad L'(P_0) = z / \mu\]

From (2) it is clear that any change in the poverty rate $P_0$ is related to the change in the Lorenz curve, $L(F; p)$ and the mean income, $\mu$. An aggregate additive poverty measure can be expressed then in a general form by:
where \( z \) is the absolute poverty line, \( \mu_F \) is the mean income per capita and, \( L_F \) is the Lorenz curve. Datt and Ravallion (1992) point out that decomposition of changes in poverty between two dates \((t=1,2)\) can be written as the sum of a growth component \( (\Delta P^G) \), a redistribution component \( (\Delta P^R) \) and residual or error term \( (e) \),

\[
\Delta P = \Delta P^G + \Delta P^R + e
\]

where the initial year selected as the reference point. To implement this decomposition Datt & Ravallion (1992) proposed formulas based on the class of Foster, Greer and Thorbecke poverty indices \( (p, q) \) using a parametric form of the Lorenz curve. There are a number of ways of specifying a parametric form for the Lorenz curve (or the underlying distribution). Two examples are the Beta model of Kakwani (1980b) and the general quadratic (GQ) model of Villasenor and Arnold (2000) which Datt and Ravallion used in their paper.

One interpretation is that the residuals indicate miss-specified components in the decompositions. Indeed, the “residual” in Datt-Ravallion’s method shows the inability of the method to separate pure growth and redistribution components completely, in addition to the sensitivity of the various components to the parametric choice of the underlying distribution.

To demonstrate, consider a redistribution component of -1.95 from the results of Table 6 of Datt and Ravallion (1992), with the corresponding residual component

\[
\Delta P^G = \Delta P^R + e
\]
of 1.54. From their footnote 3, one may estimate the “redistribution component” to be -0.54, when we use the terminal date distribution as reference rather than the initial one. Since the total change in poverty is -1.20, this example shows that the redistribution component is sensitive to the choice of the reference date distribution. There is no strong reason to necessarily choose the “initial” distribution as the reference. To overcome the problem, one possible solution would be to take an average of two decompositions, one based on the initial period and the other based on the final period as the reference point, thus eliminating the residual.\textsuperscript{2} Compared with (4), the poverty changes between dates 1 and 2 can then be represented as:

\begin{equation}
\Delta P = P(z/\mu_2; L_2) - P(z/\mu_1; L_1) = \frac{1}{2}[G(1,2,r_1) + G(1,2,r_2)] + \frac{1}{2}[R(1,2,r_1) + R(1,2,r_2)]
= \Delta P^G + \Delta P^R
\end{equation}

where \( r \) refers to the reference date and G and R functions refers to growth and redistribution respectively. Equation (5) simply indicates that we only have two components. One does not need to be concerned with complicated functional decomposition for the poverty measures introduced by Datt and Ravallion (1992).

3. An alternative approach

The most commonly used measures of poverty are the headcount index, the poverty gap index, and the poverty sensitive index. These indices are completely defined by the cumulative distribution of income and a definition of poverty line.\textsuperscript{3} Hence given

\textsuperscript{2} Datt and Ravallion (1992) as a footnote mention this point. However, they claim this is arbitrary.

\textsuperscript{3} The additive class of poverty measure developed by Foster, Greer and Thorbecke (1984) can be expressed in a continuous form as:

\[ P_\alpha(F; z) = \frac{1}{z^\alpha} \int_0^F (z - F^{-1}(p)) dp, \quad \alpha > 0 \]

where \( \alpha \) measures the aversion to poverty among the poor. When this parameter equals zero, the above aggregate poverty measures collapses to the well-known head count index-- the percentage of people with an income below the poverty line. The headcount index is totally insensitive to differences in the depth of poverty. Concerns about the depth of poverty may be factored in just by getting the poverty aversion parameter to unity. This yields the poverty gap index which is a normalized sum of the
direct relationship between income distribution function (cdf) and the poverty measures, relying on the distribution function to make a decomposition analysis of poverty changes is better interpreted, and often better implemented empirically. This method is also more easily related to other fundamental concepts such as stochastic dominance. The latter type are partial rankings which avoid cardinal choice of both the distribution functions and poverty measures. Dominance rankings are also testable with new statistical procedures; see Davidson and Duclos (2007), and Linton, Maasoumi and Whang (2005, 2007).

An exact simple alternative approach to decompose a change in poverty into growth and redistribution components is introduced here based on the cdf. Denote the cdf and poverty line at time \( t \) by \( F_t \) and \( z_t \), respectively, so that \( F_t(x) \) represents the proportion of households with income less than or equal to \( x \) at time \( t \).

The change in a poverty index, \( P \), can be rewritten

\[
\Delta P = P(F_2; z) - P(F_1; z).
\]

We assume that incomes are expressed in real terms and that the poverty line is the same at both dates \( (z_1 = z_2 = z) \). Suppose “pure growth” effect is obtained by the ratio of changes in the two mean incomes. If all incomes in period 1 are scaled up by \( \lambda = \mu_2 / \mu_1 \) where \( \mu_1 \) and \( \mu_2 \) are the mean incomes, one can construct a new intermediate distribution \( F_1^{*} \). This is illustrated in Figure 1. \( F_2 \) first order stochastically dominates \( F_1 \) for two possible reasons, one is a possible mean shift, the other is a possible reduction in “inequality”. By constructing a potential distribution which differs from the original only by the mean shift, and no other distribution changes, one can sort out the two components of the movement between the two distributions. Suppose the initial income distribution, \( F_1 \) (with mean \( \mu_1 \)) shifts to the right in a distributionally neutral fashion, yielding \( F_1^{*} \) with the same mean \( \mu_2 \) as \( F_2 \).

Because \( F_1^{*} \) and \( F_2 \) have the same mean by construction, the graphs would cross each shortfalls of the poor. These two indices are not sensitive to the distribution among the poor. Considering a=2 overcome this problem which is a weighted sum of shortfalls of the poor, where the weights are the shortfalls themselves. Thus it attaches greater weight to lower incomes amongst the poor.
other if there are redistributions. For \( F_1^* \), the poverty line \( z \) implies a headcount ratio of \( H^* \) (equivalently by defining a new poverty line, \( z/\lambda \), with income growth factor \( \lambda \), referencing \( F_1 \)). The “pure growth” effect of poverty would be equal to \( H^* - H_1 \) and the redistribution effect is equal to \( H^2 - H^* \). Therefore,

\[
(7) \quad F_1^*(\lambda x) = F_1(x) \quad \text{for all } x
\]
equivalently:

\[
F_1^*(x) = F_1(x/\lambda)
\]

where \( F_1^* \) is the \( F_1 \) distribution only scaled up to the same mean as \( F_2 \). Thus, the poverty change may be additively decomposed into the growth and redistribution effects as follows:

\[
\Delta P = \Delta P^G + \Delta P^R
\]

\[
= \left[ P(F_1^*;z) - P(F_1;z) \right] \Delta \left[ P(F_2;z) - P(F_1^*;z) \right]
\]

We may further clarify how the cdf can be used to reveal a pure ‘redistribution’ effect. Recall that the Lorenz curve is a mean-normalized integral of the inverse of a distribution function

\[
(9) \quad L(p) = \frac{1}{\mu} \int_0^p F^{-1}(\pi) d\pi.
\]

Since \( F_2 \) and \( F_1^* \) have the same mean \( \mu_2 \) by construction, we can therefore write:

\[
(10) \quad \mu_2 \left[ L_2(p) - L_1^*(p) \right] = \int_0^p \left[ F_2^{-1}(\pi) - F_1^*^{-1}(\pi) \right] d\pi.
\]

This shows that redistribution of total income/(Lorenz changes) is captured by cdf changes when the mean is the same. Indeed, this is the drawback of Lorenz, compared
to Generalized Lorenz, as a means of considering Second Order stochastic dominance between distributions with unequal means! On this issue see Atkinson, 1970 and Shorrocks, 1983). Thus, we do not dispose of “the residual” by lumping it in with the redistribution component, as is done in Kakwani and Subbarao (1990). The redistribution (inequality) effect is defined as the change in poverty if the Lorenz curve was to change but mean income remained unchanged. Unlike other decompositions, the method proposed here satisfies this requirement. Note that the analysis does not depend on a first order dominance ranking as in Figure 1. Indeed, two other possible situations are straightforward extensions of this graphical depiction. One is when the first distribution crosses the second above any poverty line of interest with second order dominance. The other is when the crossing is sufficiently “high” for a second order ranking to hold. Note that when the distributions cross, existence of second order dominance depends on the concavity of the welfare function, that is its relative aversion to unequal distributions. Thus with crossing CDFs, ranking of poverty states, and decompositions, depend on areas under the CDF functions up to the poverty line. Later on in this paper we will offer the corresponding decompositions for the FGT family of poverty measures with different underlying degrees of distributional sensitivity. Statistical tests for second order rankings, possibly up to a desired poverty line, are given in the literature; e.g., see Linton et al (2005). One robust approach is to first test for statistically significant ranking of distributions, find the poverty line below which such ranking is uniform, and then compute the two components as offered in this paper. Such an approach will have an additional robustness property toward the choice of a poverty line. When rankings are established for points beyond any conventional poverty lines, discussion of an “ideal” poverty line is rendered moot.

Figure 1. A cdf based growth-redistribution decomposition of the change in poverty
To illustrate the approach more specifically, we focus on the headcount ratio. The change in headcount ratio can be written as:

\[
\Delta H = H(F_2; z_2) - H(F_1; z_1) = F_2(z_2) - F_1(z_1)
\]

Then the change in headcount ratio attributable to the growth effect, denoted by \( \Delta H^G \), is represented by:

\[
\Delta H^G = H(F_1^*; z) - H(F_1; z)
\]

\[
= F_1^*(z) - F_1(z) = F_1(z/\lambda) - F_1(z)
\]

\[
= F_1(z\mu_1/\mu_2) - F_1(z)
\]

Similarly, the contribution of headcount ratio attributable to the redistribution, denoted by \( \Delta H^R \) is:

\[
\Delta H^R = H(F_2; z) - H(F_1^*; z)
\]
The analysis so far has taken $F_1$ to be the reference distribution and regarded the growth effect as a proportional increase in all incomes. Suppose now that $F_2$ is taken as the reference distribution and the growth effect assumes a proportional decrease in all incomes. In that case, if all incomes are scaled down proportionately by $\lambda$, then we have a new distribution $F_2^*$ defined as:

\[(14) \quad F_2^*(x/\lambda) = F_2(x) \text{ for all } x\]

or equivalently

\[F_2^*(x) = F_2(\lambda x).\]

where $F_2^*$ is $F_2$ distribution scaled down to the same mean as $F_1$. We can now decompose the poverty change as:

\[(15) \quad \Delta P = \Delta P^G + \Delta P^R = \left[ P(F_2; z) - P(F_2^*; z) \right] - \left[ P(F_1; z) - P(F_1^*; z) \right].\]

Thus, there are two possibilities for decomposition: one using the initial distribution and the other using final distribution as the reference point. To avoid this index-numbers issue I propose taking an average of (8) and (15) in a unique formula rather than taking $F_1$ or $F_2$ as the reference point. Thus contributions of growth and redistribution on poverty changes over time can be expressed symmetrically as follows:

\[(16) \quad \Delta P^G = \frac{1}{2} \left[ P(F_1^*; z) - P(F_1; z) + P(F_2; z) - P(F_2^*; z) \right];
\]

\[\Delta P^R = \frac{1}{2} \left[ P(F_2^*; z) - P(F_1^*; z) + P(F_2; z) - P(F_1; z) \right].\]

or equivalently as:

\[^4\text{Shorrocks (1999) also derives a similar average result by appeal to Shapley value.}\]
This turns out to be exactly the same as (5) but with different derivation. There is no residual intrinsically, i.e., this is an exact decomposition in which eliminating one of the two components directs all contribution to the remaining component. Importantly, there is no need to use a parametric form of the Lorenz curve for its implementation. Empirical cdf or smoothing by nonparametric methods may be employed for robust inferences.

3.1 The decomposition in a special case

Let us take a particular parametric for changes in the Lorenz curve and derive the decomposition formulae in this case. Kakwani (1993) suggests that the Lorenz curve change can be summarised by

\[
\Delta P^G = \frac{1}{2} \left[ P(z / \mu_2, L_1) - P(z / \mu_1, L_1) + P(z / \mu_2, L_2) - P(z / \mu_1, L_2) \right] = \frac{1}{2} \left[ G(1,2, r_1) + G(1,2, r_2) \right]
\]

\[
= \frac{1}{2} \left[ P(F_1; z / \lambda) - P(F_1; z) + P(F_2; z) - P(F_2; \lambda z) \right] \quad \forall \lambda = \mu_2 / \mu_1
\]

\[
\Delta P^R = \frac{1}{2} \left[ P(z / \mu_2, L_2) - P(z / \mu_2, L_1) + P(z / \mu_1, L_2) - P(z / \mu_1, L_1) \right] = \frac{1}{2} \left[ R(1,2, r_1) + R(1,2, r_2) \right]
\]

This turns out to be exactly the same as (5) but with different derivation. There is no residual intrinsically, i.e., this is an exact decomposition in which eliminating one of the two components directs all contribution to the remaining component. Importantly, there is no need to use a parametric form of the Lorenz curve for its implementation. Empirical cdf or smoothing by nonparametric methods may be employed for robust inferences.

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\[
L_2(p) = L_1(p) - \gamma [p - L_1(p)]
\]

which suggests that when \( \gamma > 0 (\gamma < 0) \), it shows a downward (upward) shift in the Lorenz curve resulting in higher (lower) inequality. Kakwani argues that \( \gamma \) is equal to proportional change in the Gini index of inequality. If \( \gamma = 0.01 \) (-0.01), it indicates that the Gini index has risen (fallen) one percent.

The slope of Lorenz curve in the final distribution evaluated at the poverty line can be represented as:

\[
L_2' (H^2) = \frac{z}{\mu_2}
\]
Differentiating of (18) with respect to $p$ at $p = H^2$, yields

\begin{equation}
L_2' (H^2) = L_1' (H^2) - \gamma [1 - L_1' (H^2)].
\end{equation}

For the Lorenz curve $L_1(p)$, $H$ is the proportion of individuals with income less than or equal to $z$ such that $L_1' (H^*) = z / \mu_2$. By substituting $H^2$ for $H$ in this equation, then $z$ must change to a new level $z^*$. In that case:

\begin{equation}
L_1' (H^2) = \frac{z^*}{\mu_2}.
\end{equation}

Substituting (18) and (20) in (19) gives (Kakwani, 1993):

\begin{equation}
z^* = \frac{z + \gamma \mu_2}{(1 + \gamma)}.
\end{equation}

Thus (8) can be rewritten as:

\begin{equation}
\Delta P = \left[ P(F_1^*; z) - P(F_1; z) \right] + \left[ P(F_1^*; z^*) - P(F_1^*; z) \right] + \text{Residual}
\end{equation}

Alternatively in the case of starting from final distribution (8) can be expressed as:

\begin{equation}
\Delta P = \left[ P(F_2; z) - P(F_2^*; z) \right] + \left[ P(F_2^*; z) - P(F_2^*; z^*) \right] + \text{Residual}
\end{equation}

where

\begin{equation}
z^{**} = \frac{z + \gamma \mu_1}{(1 + \gamma)}
\end{equation}
The residual in (22) and (23) only vanishes if the Lorenz curve remains unchanged over the decomposition period. In that case, all poverty changes are due to the growth component. Therefore, whenever there is no redistribution (change of inequality), there is no residual. One would conclude that the residual that appears in (22) and (23) is also a part of the redistribution component that failed to be explained by the special form of the Lorenz curve presented in (17) because of the fact that inequality in a distribution can change in infinite ways. However, these residuals are too nebulous and equations (22) and (23) can be rejected.

The argument so far convinces us that the decomposition of poverty into two components (‘pure growth’ and ‘redistribution’) provides an analytical framework which does not require the residual term. This has been expressed in (16), which is an average of $F_1$ as reference points and then using $F_2$ as the reference point. We may therefore conclude that (16) is a simple decomposition formula that can be considered as a desirable tool for applied purposes.

3.2 An elasticity-based presentation of the approach

This section aims to explain the decomposition process in an alternative way, using an elasticity approach. This further clarifies the method and would also help to obtain approximation of the components based on the slope of the distribution function around the poverty line.

The reduction in poverty depends on where the poor are in relation to the poverty line. If they are concentrated just below the line, the increase in their income will have a bigger effect on poverty than if they are spread more evenly below the line. Hence the slope of distribution function at the poverty line is an important determinant of the incidence of poverty (headcount ratio). In other words, if the density of households around the poverty line is generally high, we can expect poverty will be highly elastic with respect to the poverty line. If the slope is less steep it implies that few people are located immediately below the poverty line. In this case the same increase in income moves only a few of the poor above the poverty line and the reduction in the incidence of poverty (headcount ratio) will be much smaller (World Bank, 1990).
Using the slope of distribution function as a determining component of poverty changes and holding the distribution function constant, we can simply show the change in headcount ratio as:

\[(25) \quad dH = F'(z)dz\]

and the elasticity of headcount ratio with respect to poverty line can be stated as:

\[(26) \quad \eta_H = \frac{dH}{dz} \frac{z}{H}.\]

Expression (12) allows us to concentrate on the initial distribution function in order to see the impact of changes in mean income on poverty. Hence, from (25) and (26) it is possible to define the headcount ratio changes through growth as shown in the following:

\[(27) \quad \Delta H^G = (z - \frac{z}{\lambda}) F'_1(z)\]

\[= \frac{\lambda - 1}{\lambda} \eta_{H^1} H(F'_1; z)\]

\[= \frac{\mu_2 - \mu_1}{\mu_2} \eta_{H^1} H(F'_1; z)\]

where \(\eta_{H^1}\) is the elasticity of the headcount ratio, \(F'_1(z)\), with respect to the poverty line and \(\lambda\) defined as before. Alternatively, starting from \(F_2\) and deducting the “pure growth” effect, we have:

\[(28) \quad \Delta H^G = (\lambda - 1) F'_2(z)z\]

\[= (\lambda - 1) \eta_{H^2} H(F'_2; z)\]

\[= \frac{\mu_2 - \mu_1}{\mu_1} \eta_{H^2} H(F'_2; z)\]
where $\eta_{\mu^2}$ is the elasticity of the headcount ratio, $F_2(z)$, with respect to the poverty line.

Headcount ratio is insensitive to the “intensity of poverty”, that is the distribution of poverty below the poverty line. But, our approach can be extended to members of $P_\alpha$ which includes the headcount ratio. Similar to (27) and by normalizing the “poverty deficit curve” with poverty line ($z$), and the “poverty severity curve” by $z^2/2$ we can express the contribution of changes in $P_\alpha$ caused by ‘pure growth’ effect as:

$$\Delta P_\alpha^G = \frac{\mu_2 - \mu_1}{2} \left[ \frac{1}{\mu_2} \eta_{P_{\alpha,1}} P_{\alpha}(F;z) + \frac{1}{\mu_1} \eta_{P_{\alpha,2}} P_{\alpha}(F;z) \right]$$

where $\eta_{P_\alpha}$ is the elasticity of $P_\alpha$ with respect to the poverty line. Notice that (29) is an average of the two decompositions, first using the initial year as the reference and next using final year as the reference.

4. An Empirical Application to Iran

The methodology developed in this paper is applied to consumption expenditure data obtained from the Iranian household survey, conducted by Statistical Centre of Iran (SCI). We draw on micro-data sets of SCI Budget Household Survey (SCIBHS) for the years 2000 and 2004. The SCIBHS is a nationally and regionally representative household survey carried out by SCI through the sample observations. The sampling unit is an household. Information for the SCIBHS was collected by personal interview over a 24 hour period for rural, and a 48 hour period for urban areas, for food items, and month by month for non-food items throughout the year. The sampling methodology can be described as multi-stage random sampling with geographical stratification and clustering. The sample size for our analysis is as follows: the 2000 sample contains 26,941 households—54% rural households and 46% urban

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5 The “Poverty Deficit Curve” (PDC), defined as the area under CDF up to some poverty line $z$:

$$D(F; z) = \int_0^z F(x) \, dx = z P_1(F; z)$$

The “Poverty Severity Curve” is the area underneath the PDC up to some poverty line $z$:

$$S(F; z) = \int_0^z D(x) \, dx = \frac{1}{2} z^2 P_2(F; z), \text{ (see Ravallion,2004 and Deaton,1997).}$$
households. The 2004 sample covered 24,534 households—53% rural households and 47% urban. We focus on the distribution of adjusted household expenditure.

In adjusting the data to the 2000 price levels we used a modified version of Iran’s consumer price index (CPI) for rural and urban areas separately. The ordinary CPI is far from ideal for our purpose because it is particularly problematic in the case of the dual-price systems in transitional economies implementing adjustment policies. Following a policy in which *coupon* prices are gradually phased out (as has partially occurred in Iran since 2000), using ordinary CPI would not to be recommended because it fails to properly reflect the inflation which poor households experience. We have re-weighted the CPI so as to better reflect the consumption pattern of the poorer households. The differences in needs are considered by defining different poverty lines for different household types. For more detail see Mahmoudi (2008).

Before turning to explain decomposition of change in poverty it is worth noting the general direction of its fundamentals, i.e. inequality and growth changes between 2000 and 2004. Income inequality is somewhat high compared to ‘averaged Gini coefficient’ of ‘High Income Countries’, ‘Eastern Europe’ and ‘South Asia’ (Deininger and Squire, 1996). There was a decrease in income inequality in the whole country during the Islamic Republic’s third five-year plan (2000-2004). Other, more tail sensitive measures of inequality confirm this view; see Maasoumi and Salehi (2008).

Figure 2, provides an overall picture of the dominant dynamics in expenditures over this period of time.
The distribution in 2004 first order dominates the one in 2000. This renders moot the question of sensitivity of the empirical findings to the choice of a particular poverty line. To highlight the factors that contributed most to the decrease of urban and rural poverty over time, we decompose poverty change between 2000 and 2004 into growth and inequality components. The results are presented in Tables 1, 2 using the decomposition formula in equation (16), for the urban and rural areas of Iran respectively. If the growth component is the largest part of the change in poverty then this indicates that growth has played a more important role than redistribution in achieving the change in poverty and vice versa.

Table 1 illustrates that in urban areas the contribution of growth is larger than that of the redistribution component. The most striking finding is that the redistribution component is negative for all poverty measures! This means that the change in distribution, which occurred in urban areas between 2000 and 2004, was able to somewhat mitigate the adverse effect of the fall in mean incomes on the rise in poverty. This also means that the observed increase in poverty over the period is entirely due to the negative growth in expenditure. Moreover, the absolute value of the redistribution component becomes larger relative to the total change as one moves
from $P_0$ to $P_2$, which means that the poverty reduction attributable to redistribution benefited the poorest the most. Equally striking is the finding that all poverty measures show a decline in rural areas. Both an increase in mean consumption and redistributonal shifts contributed to the decrease in poverty in rural areas (Table 2).

To this end, it is also instructive to mention that the poverty indices (especially $P_1$) are useful to estimate the size of the resources needed to eradicate poverty. If it were possible to perfectly target resources to the poor, then, in 2004 a total amount of 11470 milliard Rials ($p_1 \times \text{the poverty line} \times \text{population}$) would have been needed to bring the expenditure of all poor households up to the level of poverty line.\(^6\) This represents about 2.5 percent of real GDP in that year.

Table 1 *Decomposition of change in poverty into growth and redistribution components in urban areas of Iran, 2000, 2004,*a

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<tbody>
<tr>
<td>$P_0$</td>
<td>27.1518.81</td>
<td>-3.8</td>
<td>-8.34</td>
<td>-5.83</td>
<td>-2.51</td>
</tr>
<tr>
<td>$P_1$</td>
<td>8.285.39</td>
<td>-0.9</td>
<td>-2.89</td>
<td>-1.98</td>
<td>-0.91</td>
</tr>
<tr>
<td>$P_2$</td>
<td>3.682.33</td>
<td>-3.7</td>
<td>-1.35</td>
<td>0.93</td>
<td>-0.42</td>
</tr>
</tbody>
</table>

\(a\) The calculated values of $P_0$ have been multiplied by 100.

\(b\) 1000s of Rials. ($1 > 9000$ Rials).

\(^6\) $p_1 \times \text{the poverty line} \times \text{population}$ represents the amount of resources required to eradicate poverty. The total income of the poor before transfer is equal to $P_0 \mu Z \quad \text{where} \quad \mu Z = \int_0^{\infty} x f(x) dx$.

After transfer, this is equal to $P_0 z$. The total amount of transfer therefore equal to: $P_0 z - P_0 \mu Z = zP_1$.

This represents the lowest cost at which poverty could be eliminated, a sum which would be of interest to planners and international aid agencies. If it should happen that the resources could not be found internally or via international sources, then the figure would be an indication of the extent of the ‘redistributive’ effort that would be required within the country (see, for example, Kanbur, 1987 and Essama-Nssah, 1997).
c: \( t = (P_a^{94} - P_a^{89}) / \text{standard error of } (P_a^{94} - P_a^{89}) \). The standard error of the \( P_a \) measure can be calculated by estimating asymptotic variance of poverty measure (\( \pi = t / p = \sum_{j=1}^{N} w_j h_j \pi_j / \sum_{j=1}^{N} w_j h_j \)) that is;

\[
AV(\pi) = 1 / p^2 \left[ \text{Var}(t) + \pi^2 \text{Var}(p) - 2 \pi \text{cov}(t, p) \right]
\]

where \( w_j \) is sampling weight, \( h_j \) is household size and for the case of the \( P_a \) measure

\[
\pi_j = \pi_a(y_j) = I(y_j < z)[1 - y_j / z]^a
\]


Table 2 Decomposition of change in poverty into growth and redistribution components in rural areas of Iran, 2000, 2004:

<table>
<thead>
<tr>
<th>Period</th>
<th>Period</th>
<th>t-statistic</th>
<th>Total Change</th>
<th>Growth Effect</th>
<th>Redistribution Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>( P_0 )</td>
<td>35.9427.96</td>
<td>-6.4</td>
<td>-7.98</td>
<td>-5.95</td>
<td>-2.03</td>
</tr>
<tr>
<td>( P_1 )</td>
<td>12.208.43</td>
<td>-5.8</td>
<td>-3.77</td>
<td>-2.23</td>
<td>-1.54</td>
</tr>
<tr>
<td>( P_2 )</td>
<td>5.223.77</td>
<td>-6.2</td>
<td>-2.15</td>
<td>-1.13</td>
<td>-1.02</td>
</tr>
</tbody>
</table>

a, b, c: The same as Table 1
Source: authors’ calculations from SCIHBS, 2000, 2004

5. Conclusions

The analytical approaches proposed here and that of Datt-Ravallion are clearly related because of the link between the Lorenz curve and the distribution function. However the differences between the two approaches are in the decomposition equations. The present method has the merit of exact decomposition without residuals and the simplicity and robustness of empirical implementation. We decompose the aggregate value of poverty changes which are estimated directly from conventional poverty indices rather than from specific parametric functional forms of Lorenz curves, as in Datt-Ravallion’s. This affords much needed robustness, and avoids mis-specification issues. Our approach is applicable to all decomposable poverty measures.
The empirical application to Iran suggests an inverse relationship between poverty and growth, i.e. growth helps to reduce poverty and vice versa. There is also a direct relationship between poverty and inequality. Both redistribution and growth effects therefore contributed to the change in poverty in rural and urban area of Iran. The results for Iran suggest inequality cannot be neglected for growth, if one decided to eliminate poverty as a principal factor of stable development. It would thus seem a good idea to rely on policies which consider both growth and redistribution simultaneously. In other words, as the World Bank (1990) argues, priority should be given to those growth-based policies that create opportunities for the poor to increase their income. Therefore the pattern of growth plays an important role in determining the effect of growth on poverty.

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