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POVERTY AND ECONOMIC GROWTH WITH APPLICATION TO CÔTE D'IVOIRE

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This paper explores the relation between economic growth and poverty, and develops the methodology to measure separately the impact of changes in average income and income inequality on poverty. The paper also provides a link between the growth rates in various sectors of the economy and the total poverty. The methodology proposed is applied to the data taken from the Côte d'Ivoire Living Standards Survey conducted in 1985.

1. INTRODUCTION

Poverty has been in existence for many centuries and continues to exist in a large number of developing countries although the world economy has expanded at an unprecedented rate during the 1960s and 1970s. Therefore, the concern has been expressed by many economists that the benefits of growth have not reached the world's poor. The growth processes underway in most developing countries, it has been suggested, are such that incomes of the poor groups increase more slowly than the average (Ahluwalia, Carter and Chenery, 1979).

The degree of poverty depends upon two factors—the average level of income and the extent of inequality in income distribution. The increase in average income reduces poverty and the increase in inequality increases it.[1] A general impression among economists seems to be that poverty has remained at a higher level largely due to the worsening income inequality (Ahluwalia, 1974). However, there exists no conclusive evidence to suggest that the inequality has actually worsened significantly over time in a large number of developing countries (Fields, 1988).

The fact is that the relation between changes in poverty and economic growth has not been explored thoroughly. Countries with a high concentration of poor have also possibly experienced lower economic growth rates. Consequently, sufficient progress has not been made in the eradication of poverty.

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[1]There can be situations when an increase in inequality may have no impact on poverty, but such situations are highly unlikely.

[2]Ravallion and Huppi (1991) have attempted to measure separately the impact of changes in mean income and income inequality on poverty by means of a regression model explaining poverty in terms of mean income and Gini index. First, this procedure is not very accurate and second, it requires an enormous amount of data. The methodology developed in the present paper provides an alternative way of separating the effects of mean income growth and changes in inequality on poverty.

To understand the impact of economic growth on poverty, it is important to measure separately the impact of changes in average income and income inequality on poverty. Thus, this paper is concerned with the decomposition of a change in poverty into two components—one relating to a change in average income and the other to income inequality. The magnitudes of the two components will provide the relative sensitivity of poverty levels for changes in average income and in income inequality.[2]

This paper also addresses the issue of poverty within sub-groups of population defined along ethnic, geographical, demographic or other lines. The question of how total poverty is affected by a change in average income and income inequality of a sub-group is considered. This question is of crucial importance because many government poverty reduction programs are focused on certain population sub-groups.

The methodology developed in this paper is applied to the data taken from the 1985 Living Standards Survey in Côte d'Ivoire.

2. Impact of Economic Growth and Income Redistribution on Poverty

Suppose θ is a poverty index which is a function of three factors: (1) the poverty line, z: (2) mean per capita income, μ; and (3) inequality of income. Inequality can be measured by a single inequality index (many of which are available in the literature), but more generally it is represented by a Lorenz curve. Any shift in the Lorenz curve will change the inequality. Suppose a Lorenz curve is characterized by k parameters $m_1, m_2, \ldots, m_k$, then shifts in the Lorenz curve will occur as a result of changes in the parameters. If we assume that the poverty line z is fixed, then we can write

$$d\theta = \frac{\partial \theta}{\partial \mu} d\mu + \sum_{i=1}^{k} \frac{\partial \theta}{\partial m_i} dm_i, \tag{1}$$

which decomposes the change in poverty into: (1) the impact of growth when the distribution of income does not change, and (2) the effect of income redistribution when the total income of the society remains unchanged. The first component in the right-hand side of (1) may be called "pure growth effect" and the second component as "inequality effect."

If economic growth is positive (negative), the first component in (1) will always be negative (positive). However, economic growth may be accompanied by a redistribution of income. If the redistribution of income favours the poor (rich), the second component in (1) will be negative (positive).

Generally, economists consider that "trickle-down" occurs when there is a reduction in poverty, howsoever small, for any positive growth in per capita income. According to this definition, the inequality component can be positive as long as its adverse effect on poverty is smaller than the pure growth effect. It will be more useful to say that "trickle down" occurs when the poor are receiving benefits at least equal to the growth rate in that case the inequality component will be non-positive. Thus, the magnitude of the inequality component provides a useful measure of the degree of "trickle down" (Kakwani and Subbarao, 1992).

3. Pure Growth Effect

Suppose income x of an individual is a random variable with distribution function $F(x)$. Let z denote the poverty line, then $F(z)$ is the proportion of individuals (or families) below the poverty line. $F(z)$ is the most popular poverty measure and is called the head-count ratio.

To see how this measure is affected by a change in the mean income of the society (pure growth effect), we write (Kakwani, 1980):

$$L'(H) = z/\mu, \tag{2}$$

where $L'(p)$ is the first derivative of the Lorenz function with respect to p and $H = F(z)$ is the head-count ratio.

Assuming that the Lorenz curve does not shift, we can differentiate (2) with respect to μ to obtain

$$\frac{\partial H}{\partial \mu} = -\frac{z}{\mu^2 L''(H)}, \tag{3}$$

where $L''(p)$ is the second derivative of $L(p)$ with respect to p. Again from Kakwani (1980), we can write

$$L''(H) = \frac{1}{\mu f(z)}, \tag{4}$$

where $f(z)$ is the probability density function of income x at $x = z$. Substituting (4) into (3) gives the elasticity of head-count ratio with respect to the mean income:

$$\eta_H = \frac{\partial H}{\partial \mu}\frac{\mu}{H} = -\frac{zf(z)}{H} < 0, \tag{5}$$

which is the percentage of poor who cross the poverty line as a result of 1 percent growth in the mean income. This result is derived on the assumption that the relative income distribution measured by $L(p)$ does not change.

Another poverty measure which has attracted attention in the literature is the poverty gap ratio which is defined as (Sen, 1976):

$$S = HI, \tag{6}$$

where

$$I = \frac{(z - \mu^*)}{z}, \tag{7}$$

is the aggregate income gap, μ^* being the mean income of the poor.

Before we derive the elasticity of S with respect to μ, it will be interesting to see how the mean income of the poor changes when the mean income of the whole population increases. To do so, let us write

$$L(H) = \frac{H\mu^*}{\mu},$$

which follows immediately from the definition of the Lorenz curve. Differentiating

this equation with respect to μ gives

$$\frac{\partial \mu^*}{\partial \mu} = \frac{\mu^*}{\mu} + \frac{(z-\mu^*)}{\mu}\eta_H, \tag{8}$$

using (4) and (5); the first term in the right-hand side of (8) is positive and the second term is negative. Thus, we cannot say unambiguously that the mean income of the poor will always increase. If, however, none of the poor crossed the poverty line, the mean income of the poor would always increase. This effect is captured by the first term in the right-hand side of (8). Since the poor who cross the poverty line are the richest poor, their loss will have a negative effect on the mean income of the poor. This effect is captured by the second term in the right-hand side of (8).

Utilizing (8) and (3) into (6) gives the elasticity of the poverty gap ratio S with respect to μ as

$$\eta_S = -\frac{\mu^*}{(z-\mu^*)} < 0, \tag{9}$$

which shows that the poverty gap ratio will always decrease with increase in the mean income of the society.

The most widely used poverty index is that of Sen (1976) which takes into account not only the number of poor and their aggregate income gap but also the inequality of income among the poor. This measure is

$$S^* = H[z-\mu^*(1-g)]/z, \tag{10}$$

where g is the Gini index of income among the poor.

To derive the elasticity of S^* with respect to μ, we need to know how the Gini index of income among the poor is affected by a change in μ. The value of g will change because people cross the poverty line as a result of changes in μ. After doing some complicated algebraic manipulations we arrived at the following derivative:

$$\frac{\partial g}{\partial \mu} = \frac{1}{\mu\mu^*}[(1-g)z-(1+g)\mu^*]\eta_H \tag{11}$$

where η_H is given in (5); g will decrease with μ if and only if $g < (z-\mu^*)/(z+\mu^*)$. If there is a high inequality of income among the poor, the economic growth may increase it even further.

Using (5), (8) and (11) in conjunction with (10) gives the elasticity of Sen's index with μ as

$$\eta_{S^*} = -\frac{\mu^* H(1-g)}{zS^*} + \frac{[z-\mu^*(1+g)]H}{S^* z}\eta_H, \tag{12}$$

which can be proved to be always negative. Therefore, Sen's index will always decrease when the mean income of the society increases (without changing income inequality).

Let us now consider a class of additively separable poverty measures

$$\theta = \int_0^z P(z, x)f(x)\,dx, \tag{13}$$

where

$$\frac{\partial P}{\partial x}<0; \qquad \frac{\partial^2 P}{\partial x^2}\geq 0; \qquad P(z, z)=0,$$

and $P(z, x)$ is a homogenous function of degree zero in z and x. Using (2) into (13) gives

$$\theta=\int_0^H P[L'(H), L'(p)]\, dp, \tag{14}$$

which holds because $P(z, x)$ is homogenous of degree zero in z and x. Differentiating θ with respect to μ (assuming that the Lorenz curve $L(p)$ does not change) gives

$$\frac{\partial \theta}{\theta \mu}=L''(H)\frac{\partial H}{\partial \mu}\int_0^z \frac{\partial P}{\partial z}f(x)\, dx,$$

which on using homogeneity property of $P(z, x)$, that is,

$$\frac{\partial P}{\partial z}z+\frac{\partial P}{\partial x}x=0,$$

yields

$$\frac{\partial \theta}{\partial \mu}=-\frac{\mu L''(H)}{z}\frac{\partial H}{\partial \mu}\int_0^z \frac{\partial P}{\partial x}xf(x)\, dx. \tag{15}$$

Using (3) and (5) into (15) gives the elasticity of θ with respect to μ as

$$\eta_\theta=\frac{1}{\theta}\int_0^z x\frac{\partial P}{\partial x}f(x)\, dx, \tag{16}$$

which is always negative in view of $\partial P/\partial x<0$.

Equation (16) gives the general expression for deriving the elasticity of the entire class of additively separable poverty measures θ with respect to μ. We may now consider the particular poverty measures.

Foster, Greer and Thorbecke (1984) proposed a class of poverty measures:

$$P_\alpha=\int_0^z \left(\frac{z-x}{z}\right)^\alpha f(x)\, dx, \tag{17}$$

where α is the parameter of inequality aversion; the higher the value of α, the greater the weight given to the poorest poor. P_α is a particular case of θ measures and, therefore, using (16), we obtain the elasticity of P_α with respect to μ as

$$\eta_{P_\alpha}=\frac{\partial P_\alpha}{\partial \mu}\frac{\mu}{P_\alpha}=-\frac{\alpha[P_{\alpha-1}-P_\alpha]}{P_\alpha} \tag{18}$$

for $\alpha\neq 0$, which will always be negative because P_α is a monotonically decreasing function of α. Note that for $\alpha=1$, $P_\alpha=S$ (given in 6), therefore substituting $\alpha=1{\cdot}0$ in (18) must give the elasticity of S with respect to μ as given in (9). This can easily be verified.

In 1968, Watts proposed a poverty measure:

$$W = \int_0^z (\log z - \log x) f(x)\, dx,$$

which, although extremely simple, possesses all the important attributes (Kakwani, 1989). Since this measure is also a particular member of θ measures, (16) immediately provides its elasticity:

$$\eta_W = -\frac{H}{W} < 0.$$

Finally, we consider Clark, Hemming and Ulph's (1981) poverty measure:

$$C_\alpha = \frac{1}{\alpha} \int_0^z \left[1 - \left(\frac{x}{z}\right)^\alpha\right] f(x)\, dx,$$

the elasticities of which for μ can again be obtained from (16):

$$\eta_{C_\alpha} = -(H - \alpha C_\alpha)/C_\alpha,$$

which is always negative in view of H being greater than αC_α.

The elasticities of various poverty measures derived above provide the magnitude of the first component in (1). The estimation of the second component is discussed in the next section.

4. Inequality Component of Poverty

The economic growth increases the mean income of a population but at the same time it may also worsen its income inequality. Consequently, the total poverty will increase or decrease depending on which of these two factors is dominant.

The measurement of the effect of inequality on poverty is a difficult task because inequality in distribution can change in infinite ways. To get an idea of the size of this effect we make a simple assumption that the entire Lorenz curve shifts according to the following formula:

$$L^*(p) = L(p) - \lambda[p - L(p)], \tag{19}$$

which implies that when $\lambda > 0$ ($\lambda < 0$), the Lorenz curve shifts downwards (upwards) resulting in higher (lower) inequality. It can be easily shown that λ is equal to the proportional change in the Gini index (a well-known measure of inequality). If $\lambda = 0{\cdot}01$ (-0.01), it means that the Gini index has increased (decreased) by 1 percent.

If, as a result of change in inequality (with no change in the mean income), the head-count measure of poverty changes from H to H^*, using (2) we must have

$$L'^*(H^*) = \frac{z}{\mu}, \tag{20}$$

which on differentiating with respect to p at $p = H^*$, yields

$$L'^*(H^*) = L'(H^*) - \lambda[1 - L'(H^*)]. \tag{21}$$

For the Lorenz curve $L(p)$, H is the proportion of individuals with income less than or equal to z such that $L'(H) = z/\mu$. Suppose we substitute H^* for H in this equation, then z must change to a new level z^* such that

$$L'(H^*) = \frac{z^*}{\mu} \tag{22}$$

holds. Substituting (20) and (22) into (21) gives

$$z^* = \frac{z + \lambda\mu}{(1+\lambda)}, \tag{23}$$

where $H^* = F(z^*)$ and $H = F(z)$. Thus, a shift in the Lorenz curve (as defined in 19) is equivalent to a change in poverty line from z to z^* when using the original income distribution.

Let us now consider the θ class of poverty measures defined in (13). When the Lorenz curve of the x distribution shifts in accordance with (19), the poverty measures in (13) change to

$$\theta(\lambda) = \int_0^{z^*} P[z, (1+\lambda)x - \lambda\mu] f(x)\, dx,$$

where z^* is given (23). Therefore, the elasticity of this entire class of poverty measures for the Gini index will be given by

$$\varepsilon_\theta = \operatorname*{limit}_{\lambda \to 0} \frac{\theta(\lambda) - \theta}{\theta\lambda},$$

which on differentiation under integral sign yields

$$\varepsilon_\theta = \frac{1}{\theta} \int_0^z \frac{\partial P}{\partial x} (x - \mu) f(x)\, dx. \tag{24}$$

This equation can be further simplified by using (16)

$$\varepsilon_\theta = \eta_\theta - \frac{\mu}{\theta} \int_0^z \frac{\partial P}{\partial x} f(x)\, dx. \tag{25}$$

The first term in (25) is negative and the second term is positive. Then to satisfy the requirement that higher inequality would lead to greater poverty, the size of the second term must always be larger than that of the first term. This requirement will always be satisfied if the poverty line income is less than the mean income [which follows immediately from (24)].

We may now consider the poverty measures. For Foster, Greer and Thorbecke's poverty measures:

$$\varepsilon_{P_\alpha} = \eta_{P_\alpha} + \frac{\alpha\mu P_{\alpha-1}}{zP_\alpha}$$

for $\alpha \neq 0$. Similarly for Watts' poverty measure:

$$\varepsilon_W = \eta_W + \frac{\mu H}{w\bar{H}},$$

$\bar{H}$ being the harmonic mean of the income distribution of the poor only. Finally, Clark, Hemming and Ulph's poverty measures give

$$\varepsilon_{C_\alpha} = \eta_{C_\alpha} + \frac{\mu}{zC_\alpha}[H - (\alpha - 1)C_{\alpha-1}].$$

The expressions provide procedures for computing the elasticities of poverty measures with respect to Gini index.

Since the mean income and income inequality each affect poverty, an important question arises: what is the trade-off between mean income and income inequality? Put differently, we may ask, if the Gini index of the income distribution increases by one percent, what would be the percentage increase in the mean income for the poverty not to increase at all? The question can now be answered if we decompose the proportionate change in poverty as

$$\frac{d\theta}{\theta} = \eta_\theta \frac{d\mu}{\mu} + \varepsilon_\theta \frac{dG}{G}.$$

The first term relates to the effect of mean income on poverty and the second term measures the effect of change in the Gini index. Equating the proportional change in poverty to zero, we obtain the marginal proportional rate of substitution (MPRS) between mean income and income inequality:

$$\text{MPRS} = \frac{\partial \mu}{\partial G}\frac{G}{\mu} = -\frac{\varepsilon_\theta}{\eta_\theta}, \tag{26}$$

which can be computed for each poverty measure.

5. Sectoral Growth and Poverty

Suppose the entire population is divided into m sectors or groups along ethnic, geographic, demographic or other lines. A poverty measure θ is then said to be additively decomposable if

$$\theta = \sum_{i=1}^{m} f_i \theta_i, \tag{27}$$

where θ_i is the poverty measure of the ith subgroup and f_i the proportion of individuals in the ith subgroup such that $\sum_{i=1}^{m} f_i = 1$ or, in other words, all the subgroups are mutually exclusive. The entire class of additively separable poverty measures given in (13) are additively decomposable.

Differentiating (27) with respect to the mean income of the ith sub-group we obtain:

$$\eta^*_{\theta_i} = \frac{\theta_i f_i}{\theta}\eta_{\theta_i}, \tag{28}$$

where $\eta_{\theta_i} = \partial\theta_i/\partial\mu_i(\mu_i/\theta_i)$ is the elasticity of ith subgroup poverty with respect to the mean income of the ith subgroup and $\eta^*_{\theta_i} = \partial\theta/\partial\mu_i(\mu_i/\theta)$ is the elasticity of the total poverty with respect to the ith subgroup mean income. This elasticity is useful in knowing how total poverty is affected by the economic growth in

various regions or sectors of the economy. It can be shown that

$$\eta_\theta = \sum_{i=1}^{m} \frac{\theta_i f_i}{\theta} \eta_{\theta_i} = \sum_{i=1}^{m} \eta^*_{\theta_i}, \tag{29}$$

η_θ being the elasticity of the total poverty with respect to the mean income of the entire economy. The equation shows how the effects of sectoral growth rates on poverty add up to the total effect on poverty.

Suppose the growth process also has an effect on income inequality within various sectors. Then proportional change in poverty in the ith group can be written as

$$\frac{d\theta_i}{\theta_i} = \eta_{\theta_i} \frac{d\mu_i}{\mu_i} + \varepsilon_{\theta_i} \frac{dG_i}{G_i}, \tag{30}$$

where $\varepsilon_{\theta_i} = \partial\theta_i / \partial G_i (G_i / \theta_i)$, which on substituting in (27) yields

$$\frac{d\theta}{\theta} = \sum_{i=1}^{n} \eta^*_{\theta_i} \frac{d\mu_i}{\mu_i} + \sum_{i=1}^{m} \varepsilon^*_{\theta_i} \frac{dG_i}{G_i}, \tag{31}$$

where $\varepsilon^*_{\theta_i} = \partial\theta / \partial G_i (G_i / \theta)$ is the effect of change in the Gini index in the ith group on the total poverty.

If we know the growth rates in various sectors, the first term in the right-hand side of (31) can be used to measure the proportionate change in the total poverty, if it can be assumed that the inequality within various sectors or groups has not changed. How realistic is the assumption of constant inequality within sectors? The answer depends on the nature of the groups or sectors. If the individuals belonging to the sectors are fairly homogeneous, the effect of this assumption will be negligible. Since the sectoral growth rates can differ, the income inequality in the population may change because of between group inequality. This effect can be significant and has been taken into account, which can be seen by writing the first term in the right-hand side of (31) as

$$\sum_{i=1}^{n} \eta^*_{\theta_i} \frac{d\mu_i}{\mu_i} = \eta_\theta \frac{d\mu}{\mu} - \sum_{i=1}^{m} \eta^*_{\theta_i} \left[\frac{d\mu}{\mu} - \frac{d\mu_i}{\mu_i} \right], \tag{32}$$

where (29) is used. The first term in the right-hand side of (32) is the pure growth effect on poverty and the second measures the effect of change in the between sector inequality caused as a result of different growth rates in various sectors. If every sector has the same growth rate, the second term will be zero.

The policy relevance of the disaggregation may now be mentioned. Due to the 1980s economic crisis, several developing countries have now adopted structural adjustment policies initiated by the World Bank. These policies have implications for living standards, particularly for the poor. It is, therefore, of interest to know how these policies have affected poverty in these countries.[3]

What we need is the growth rates in various sectors during the adjustment periods. These growth rates can be estimated in the short-run from the national

[3]The link between structural adjustment policies and changes in poverty has also been discussed by Kanbur (1987, 1988). In the present paper we have extended this methodology to include several poverty measures (including the head-count ratio) not considered by him. Kanbur also did not consider the between sector inequality effect on the total poverty.

accounts without conducting a new household survey. From the growth rate we can estimate the proportional change in aggregate poverty from (31) on the assumption that different population groups or sectors are fairly homogeneous and therefore changes in inequality within them will have a negligible effect. If, for instance, an adjustment policy is designed to change trade terms in favour of certain sectors or to shift resources from one sector to another, these effects will be reflected in the between sector inequality. Then the second term in (32) may be used to see the effect of such policies on total poverty.

6. Application to Côte D'Ivoire

The methodology developed in this paper is applied to the data obtained from the Côte d'Ivoire Living Standards Survey, conducted by the World Bank's Living Standards Unit.[4]

To analyze poverty, we need to measure the economic welfare of each household in the society. In this paper we have used per capita consumption as a measure of household economic welfare.[5] This measure, constructed by Glewwe (1987), takes into account the imputed value of owner-occupied dwelling and depreciated value of consumer durables. To take into account the differing needs of various household members, Glewwe divided the total household consumption by the number of equivalent adults. In his formulation of equivalent adults, children were given smaller weight than adults: children less than 7 years old were given a weight of 0.2, between the ages of 7 and 13 a weight of 0.3 and between the ages of 13 and 17 a weight of 0.5.[6]

An additional difficulty in comparing expenditures across different households is that prices may vary over different regions of the country and over differential agricultural seasons. Since almost all expenditures are based on purchases within the past year (entire year), seasonal price variations should not significantly affect comparability across households. However, the prices may vary substantially across regions. Therefore, a household welfare measure must take into account the regional price variations. This adjustment was made to the welfare measure using the spatial price indices constructed for each region by Glewwe (1987).

[4]The survey is a random sample in 1,600 households interviewed from mid-February, 1985 to mid-February, 1986. A thorough discussion of the survey is given in Ainsworth and Muõs (1986).

[5]There are a number of quite different conceptual approaches to the measurement of well-being at the individual level. We have adopted the welfarist approach which typically emphasizes aggregate expenditure on all goods and services consumed valued at appropriate market prices, and including consumption from own production. Deaton (1980) argues that this approach is "well-founded in economic theory." For further discussion in the context of poverty measurement see Ravallion (1992) and Slesnick (1990).

[6]This procedure of handling the equivalence scale may seem totally *ad hoc*, but there is no definitive way out of this problem. Several procedures have been suggested in the literature to estimate the equivalent adult scales from the household expenditure survey data (see for instance, Kakwani, 1977). However, the basic problem with these procedures is that there exist infinitely many utility functions which may be consistent with the observed data. Thus, there is always an element of arbitrariness in the estimation of equivalence scale [Pollak and Wales (1979), Deaton and Muellbauer (1986) and Fisher (1987)]. The scale we have adopted has been widely used by the World Bank, and is consistent with those estimated for Sri Lanka and Indonesia by Deaton and Muellbauer (1986).

Once the index of household welfare is constructed, the next step involves the determination of the welfare of individuals belonging to households. In this paper individual welfare was derived by assigning each individual in a household a welfare value equal to the consumption per equivalent adult for that household. The validity of this approach is discussed in Kakwani (1986). The poverty estimates presented here, therefore, relate to the poverty among individuals (not households).

We have considered two poverty lines: one with adjusted per capita consumption of 91,394 CFAF and another of 162,613 CFAF per year. The two poverty lines identify roughly the poorest 10 percent and the poorest 30 percent of the total Ivorian population. The poverty line of 91,394 CFAF measures the ultra-poverty situation, a threshold below which physical personal maintenance is unstable (Lipton 1988).

To compute the elasticities of the head-count ratio and the Sen index, we need an estimate of the density function $f(x)$ at $x = z$, the poverty line income. The procedure for estimating this function is outlined in the Appendex.

The numerical values of various poverty measures and their elasticities with respect to the mean income and the Gini index are presented in Table 1. Some conclusions from this table are summarized below. First, the absolute magnitude of poverty elasticity with respect to the mean income is greater than unity for all poverty measures. Therefore poverty is highly sensitive to economic growth. Thus, poverty should decrease faster than the rate of income growth provided the growth process does not lead to an increase in income inequality. The absolute value of elasticity is higher for the poverty measures which are sensitive to income transfers among the very poor. For instance, in Foster, Greer and Thorbecke's poverty measures, α is a measure of degree of inequality aversion—the larger the value of α, the greater weight is attached to the poorest poor. The elasticity increases monotonically with α, which means that economic growth accompanied by no change in inequality will benefit ultra poor more than moderately poor. This is also evident when we compare elasticity magnitude for two different poverty lines—the lower poverty line which identifies the ultra poor gives higher values of the absolute elasticities.

The elastic nature of poverty is indicated by all the poverty measures considered in the paper. The question then arises whether this observation is valid for all countries. The answer to this question cannot be given definitely without analyzing data from a sample of several countries. However, we can attempt to give a speculative answer by observing the estimated density function (see the Appendix), which indicates that people are most densely clustered around the lower poverty line consumption level of 91,394 CFAF per year. In fact this consumption level happens to be the mode of the distribution. We, therefore, conjecture that the elasticity of poverty has to do with the density of people around the poverty line. The larger the difference of the poverty line from the mode, the smaller the absolute magnitude of the poverty elasticity will be. This conjecture is in agreement with our observation that poverty becomes considerably less elastic when the poverty line is increased to 162,610 CFAF per year. Since the density of people around the poverty line is generally high, we can expect that poverty will be highly elastic.

TABLE 1

ELASTICITIES OF POVERTY MEASURES WITH RESPECT TO MEAN INCOME AND GINI INDEX AND MARGINAL PROPORTIONATE RATE OF SUBSTITUTION: CÔTE D'IVOIRE, 1985

	Poverty line = 91.39				Poverty line = 162.61			
Poverty Measures	Value of Poverty Measure	Elasticity with Respect to Mean Income	Elasticity with Respect to Gini Index	MPRS	Value of Poverty Measure	Elasticity with Respect to Mean Income	Elasticity with Respsct to Gini Index	MPRS
Head-count measure	9.36	−2.87	7.86	2.74	27.76	−1.54	1.70	1.10
Poverty gap ratio	2.42	−2.86	11.58	4.05	9.34	−1.97	4.28	2.17
Sen's index	3.37	−3.02	—	—	12.68	−1.92	—	—
Watt's measure	3.22	−2.91	13.36	4.59	13.22	−2.10	5.67	2.70
Foster *et al.* measures								
$\alpha = 2.0$	0.98	−2.92	15.48	5.30	4.42	−2.22	6.66	2.99
$= 3.0$	0.49	−3.06	19.62	6.40	2.43	−2.46	9.02	3.67
Clark *et al.* measures								
$\beta = 0.25$	2.98	−2.89	12.81	4.43	12.01	−2.06	5.23	2.54
$= 0.50$	2.77	−2.88	12.34	4.28	10.98	−2.03	4.85	2.39
$= 0.75$	2.58	−2.87	11.93	4.16	10.10	−2.00	4.54	2.27

Note: All poverty measures have been multiplied by 100.

The elastic nature of poverty is an important conclusion for policy. It implies that a greater emphasis should be placed on the growth oriented policies which at least maintain the income share of the poor. However, if the income inequality deteriorates during the course of a country's economic growth, the poverty may even increase because the poverty measures are considerably more elastic for changes in inequality. This is apparent from the numerical results on the elasticity of poverty for the Gini index.

The marginal proportionate rate of substitution (MPRS) measures the trade-off between growth and inequality. For instance, for ultra poor, the value is 4.59, when we measure poverty by Watt's measure. The implication is, we need an income growth rate of 4.59 percent to compensate for an increase of 1 percent in the Gini index. The value of the MPRS is considerably smaller for the moderately poor, implying that the smaller the poverty threshold, the greater is the relative sensitivity of poverty for changes in income inequality than for changes in the mean income. This sensitivity is also a monotonically increasing function of the inequality aversion parameter α. Thus, the choice of a poverty measure is also crucial to the discussion of the relationship in poverty, inequality and economic growth.

The high values of the MPRS suggest that it is of crucial importance to know if there is a systematic tendency for inequality to increase with economic growth. The Kuznets' (1955) hypothesis of inverted U-shaped pattern of income inequality implies that the inequality first increases and then decreases in the course of a country's economic growth. If this hypothesis is accepted, the inequality in most developing countries would be increasing. To compensate for the increase in inequality, these countries will need a very high economic growth to prevent even an increase in poverty. Once a country has crossed the Kuznets' turning point (when the inequality starts decreasing), even a low but steady growth will substantially reduce poverty.

Recently, Fields (1988) has observed inequality changes over time in many countries. He arrived at the conclusion: there is no tendency for inequality to increase systematically with economic growth or to decrease either—inequality increases as often as it decreases. From these observations we cannot conclude that economic growth will aways lead to a reduction in poverty. In more than 50 percent of the countries observed by Fields, economic growth was accompanied by either decrease in inequality or no change. Our analysis, which is highly suggestive, shows that poverty must have decreased substantially in these countries because of the elastic nature of poverty measures. However, in the remaining 50 percent of the countries which showed an increase in inequality, it is not possible to deduce the direction of change in poverty.

The above analysis also suggests that in the event of negative growth, the increase in poverty will be quite substantial. Since 1980 the world has plunged into the deepest and the most sustained recession since the 1930s. Per capita incomes have declined substantially in many developing countries, particularly in Africa and Latin America. It is very unlikely that during the recessionary periods, inequality will decline because when real incomes are falling, the poor and the vulnerable sections of society bear the greatest burden. Even if inequality has not changed, the sharp and widespread decline in per capita income would

have increased poverty to a distressingly high level. Several studies suggest this happened.[7]

7. Link Between Adjustment Policies and Poverty

An important component of adjustment policies in Côte d'Ivoire was the attempt to restore incentives in agricultural production by raising producer prices in line with world prices. As a result, between 1980 and 1984, per capita disposable income declined by a massive 10.8 percent per year in the urban sector, compared with a slight reduction of 1.2 per cent per year in the rural sector (World Bank, 1988). How could these growth rate have affected the total poverty? To provide an answer, we computed the poverty elasticities with respect to the mean income separately for the rural and urban regions of Côte d'Ivoire. These elasticities along with the observed growth rates of the rural and urban sectors were used to compute the annual percentage changes in poverty for various poverty measures. The numerical results are presented in column 1 of Table 2. Column 2 in the table gives the percentage change in poverty as a result of changes in the between group inequality. (A change which may be attributed to a change in trade terms between the rural and urban sectors.)

Table 2 shows that poverty has increased between 1980 to 1984 at an annual rate varying from 4.96 to 5.59 percent (depending on which poverty measure is used). The increase is partly attributed to the overall contraction of the economy during the initial phase of the structural adjustment program. The contraction

TABLE 2

Percentage Change in Poverty: Côte d'Ivoire, 1980-84

	Based on Regional Disaggregation		Based on Disaggregation by Occupation	
Poverty Measures	Percentage Change in Poverty	Percentage Change in Poverty Due to Change in Terms of Trade	Percentage Change in Poverty	Percentage Change in Poverty Due to Change in Terms of Trade
Head-count Ratio	5.59	−5.05	5.01	−5.85
Poverty gap Ratio	5.23	−8.39	5.51	−8.38
Watt's measure	5.10	−9.39	5.79	−9.02
Foster *et al.* measures				
$\alpha = 2.0$	4.97	−10.35	5.93	−9.70
$= 3.0$	4.96	−12.01	6.54	−10.80
Clark *et al.* measures				
$\alpha = 0.25$	5.26	−8.95	5.74	−8.78
$= 0.50$	5.22	−8.79	5.70	−8.61
$= 0.75$	5.28	−8.52	5.57	−8.53

[7]See Addision and Demery (1985, 1986), ECLAC (1986), Edgren and Muqtada (1986), World Bank (1986), Aboagye and Gozo (1987), Tokman and Wurgaft (1987) and UNICEF (1987). Although these studies do not provide sound statistical evidence for this observation, their suggestive direction may not be wrong.

was accompanied by a substantial reduction in the gap between urban and rural incomes in Côte d'Ivoire which contributed to a substantial reduction in poverty. The size of the reductions is indicated by the figures in column 2. If the government had not pursued the policy of improving agricultural producer prices, the increase in poverty would have been about 14 percent per annum.

In the above analyses we made an unlikely assumption that all households in rural areas were entirely dependent on agricultural income. Surely there will be some households whose income source will be from the non-agricultural sector despite their location in rural areas? To improve upon this limitation, we disaggregated households by the occupation of household head. A household whose head's occupation was agriculture was classified as belonging to the rural sector and the remaining households were classified in the urban sector. Applying the growth rate of −1.2 percent for rural and −10.8 percent for urban, we computed the percentage change in total poverty for various poverty measures. The numerical results are presented in column 3 of Table 2. Column 4 gives the effect on total poverty caused by the change in trade terms in favour of the rural sector. The results are similar to those based on regional disaggregation of households.

This analysis is, of course, based on the assumption that inequality within sectors has remained constant. There exists some evidence that inequality within the urban sector has been reduced during the adjustment period (World Bank, 1986). If this is so, the magnitude of poverty increases in Table 2 may have been exaggerated.

Next, we illustrate how the growth rates in various sectors may be used to forecast changes in poverty.

A World Bank document (1986) projected that the total GDP in the Ivory Coast would grow at a rate of 3 percent per year between 1986 and 1990. This growth performance would be led by the industrial sector which would grow at a rate of 5.1 percent followed by the agricultural sector with a growth rate of 2.3 percent. The service sector was to grow at an annual rate of 3.7 percent during the same period. The question we attempt to answer is: if these growth rates were to be realized, how would total poverty be affected?

We classified the households by the occupation of the household head into four different sectors: Agriculture, Sales/Service, Industry and others. The population was assumed to grow at a rate of 3.8 percent per annum from which the projected per capita growth rates in income were computed for each sector. The figures are presented in column 2 of Table 3. The table also presents the total poverty elasticities for changes in mean income and income inequality within each sector. The results indicate that total poverty is very sensitive to growth in income and changes in inequality within the agricultural sector. This suggests that a greater emphasis should be placed on increasing the growth in the agricultural sector either by means of higher investment or by changing trade terms in favour of the agricultural sector, or a combination of the two.

Using the poverty elasticities and projected per capita growth rates we computed that total poverty would increase at an annual rate of 3.63 percent during the 1986–90 peiod. The effect of changes in between sector inequality was equivalent to an increase in poverty by 1.95 percent. Thus, the poor would have borne the substantial cost of adjustment policies during the transition phase.

TABLE 3

PROJECTED REAL CAPITA GROWTH RATES IN POVERTY (WATT'S MEASURE) AND THE ELASTICITY BY SECTORS OF CÔTE D'IVOIRE

	Mean Consumption Per capita	Projected* per capita real growth rates 1986-90	Watt's Poverty Measure	Elasticity with Respect to Mean Income	Elasticity with Respect to Gini index
Agriculture	231.94	−1.70	19.51	−1.76	2.68
Sales/Service	436.75	−0.10	2.98	−0.09	0.32
Industry	640.78	1.30	1.72	−0.08	0.34
Others	355.74	−4.33	11.58	−0.17	0.54
Total	341.85	−0.80	13.22	−2.10	5.67

*Average annual increase (at constant 1984 prices).

9. SUMMARY AND CONCLUSIONS

We have investigated the relation between economic growth and poverty. The paper develops methodology to measure separately the impact of changes in average income and income inequality on poverty. The analysis also provides a link between the growth rates in various sectors of the economy and the total poverty.

1. Poverty was found to be highly sensitive to economic growth and should decrease faster than the economic growth rate provided the growth process does not lead to an increase in income inequality. However, if inequality deteriorates during the course of a country's economic growth, poverty may even increase with economic growth, because poverty measures were found to be considerably more elastic for changes in inequality.

2. The numerical results for Côte d'Ivoire suggested that the smaller the poverty threshold, the greater the relative sensitivity of poverty is for changes in income inequality than for changes in the mean income. Thus, the ultra poor are considerably more affected by the changes in income inequality than by changes in mean income.

3. During the initial phase of the structural adjustment program, poverty in Côte d'Ivoire was estimated to have increased by an annual rate of about 5 percent. If the government had not pursued the policies of improving agricultural producer prices, the increase in poverty would have been about 14 percent per annum. Thus, changing the trade terms in favour of agriculture was a policy which reduced poverty.

4. Using the poverty elasticities and projected per capita growth rates, it was estimated that total poverty in Côte d'Ivoire would have increased at an annual rate of 3.63 percent during the 1986-90 period. The effect of changes in between sector inequality was computed to be equivalent to an increase in poverty by 1.95 percent.

APPENDIX

To compute the elasticities of the head-count ratio and the Sen index, we need an estimate of the density function $f(x)$ when $x = z$. This estimate can be

obtained by fitting an equation of the Lorenz curve (Kakwani 1981):

$$L(p) = p - ap^{\alpha}(1-p)^{\beta}, \tag{A.1}$$

where a, α and β are the parameters and are assumed to be greater than zero. Note that $L(p) = 0$ for both $p = 0$ and $p = 1.0$. The sufficient condition for $L(p)$ to be convex to the p axis is $0 < \alpha \leq 1$ and $0 < \beta \leq 1$. This new functional form of the Lorenz curve was introduced by Kakwani (1981) for the estimation of a class of welfare measures. The idea of estimating a density function by means of the Lorenz curve is new and is introduced here.

Differentiating (A.1) with respect to p twice yields

$$L'(p) = 1 - ap^{\alpha}(1-p)^{\beta}\left[\frac{\alpha}{p} - \frac{\beta}{1-p}\right], \tag{A.2}$$

$$L''(p) = ap^{\alpha}(1-p)^{\beta}\left[\frac{\alpha(1-\alpha)}{p^2} - \frac{2\alpha\beta}{p(1-p)} + \frac{\beta(1-\beta)}{(1-p)^2}\right]. \tag{A.3}$$

Using equation (3.5) of Kakwani (1980), we obtain

$$f(x) = \frac{1}{\mu L''(p)}, \tag{A.4}$$

which can be estimated for each value of p if we know μ and the parameters of the Lorenz function a, α and β. The values of p for a given x are easily obtained from the income data of the individual households.

The Lorenz function parameters a, α and β were estimated by regressing $\log[p - L(p)]$ on $\log p$ and $\log(1-p)$. Therefore, for the Côte d'Ivoire household expenditure data, the following regression estimates were obtained:

$$\log[p - L(p)] = \underset{(0.0039)}{-0.1798} + \underset{(0.0021)}{0.9967}\log(p) + \underset{(0.0017)}{0.5355}\log(1-p),$$

where the figures in the brackets are the standard errors of the coefficient estimates. The value of coefficient of determination, R^2, was calculated to be 0.9929 which is an extremely high value given the fact that we used 1,569 observations in our estimation. Comparison of the actual with the estimated values of the Lorenz function $L(p)$, suggested that this curve provided an extremely good fit over the entire income range. The values of $f(x)$ for $x = 91.39$ and $x = 162.51$ were estimated to be 0.0029 and 0.0026, respectively.

The estimated density function suggested that the distribution of per capita adjusted consumption in Côte d'Ivoire is highly skewed and has a single mode which is very close to the lower poverty line income identifying the ultra poor. It means that a large proportion of the Côte d'Ivoire population is clustered around a very low level of adjusted per capita consumption.

References

Aboagye, A. and Gozo, K., Sub-Saharan Africa, in *World Recession and Global Independence: Effects on Employment, Poverty and Policy Formation in Developing Countries*, International Labour Organisation, Geneva, 1987.

Addison, T. and Demery, L., Macro-economic Stabilization, Income Distribution and Poverty, Working Paper No. 15, Overseas Development Institute, London, 1985.
———, Poverty Alleviation Under Structural Adjustment, Overseas Development Institute, London, 1986.
Ahluwalia, M. S., Carter, N., and Chenery, H., Growth and Poverty in Developing Countries, in Chenery, H. (ed.), *Structural Chance and Development Policy*, Oxford University Press, New York, 1979.
Ahluwalia, M. S., Income Inequality: Some Dimensions of the Problem, in Chenery, H. *et al.* (eds.), *Redistribution with Growth*, Oxford University Press, New York, 1974.
———, Inequality, Poverty and Development, *Journal of Development Economics*, 3, 307-342, 1976.
Ainsworth, M. and Muñoz, J., The Côte d'Ivoire Living Standards Survey: Design and Implementation, Living Standards Measurement Study Working Paper No. 26, The World Bank, Washington, D.C., 1986.
Clark, S. R., Hemming, R., and Ulph, D., On Indices for Poverty Measurement, *Economic Journal*, 1981.
Deaton, A., The Measurement of Welfare Theory and Practical Guidelines, Living Standards Measurement Study Working Paper No. 7, World Bank, Washington, D.C., 1980.
Deaton, A. and Muellbauer, J., *Economics and Consumer Behavior*, Cambridge University Press, Cambridge, 1980.
ECLAC (Economic Commission for Latin America and the Caribbean), *The Economic Crisis: Policies for Adjustment, Stabilization and Growth*, 1986.
Edgren, G. and Muqtada, M., Adjustment under Decelerating Growth: The Asian experience, in *Stabilization, Adjustment and Poverty*, International Employment Policies Working Paper No. 1, International Labour Organisation, 1986.
Fields, G., Changes in Poverty and Inequality in the Developing Countries, Cornell University, Ithaca, NY, 1988.
Fisher, F. M., Household Equivalent Scales and Interpersonal Comparisons, *Review of Economic Studies*, 54, 519-524, 1987.
Foster, J. E., Greer, J., and Thorbecke, E., A Class of Decomposable Poverty Measures, *Econometrica*, 52, 761-776, 1984.
Glewwe, P., The Distribution of Welfare in the Republic of Cote d'Ivoire in 1985, Living Standards Measurement Survey Working Paper No. 29, The World Bank, Washington, D.C., 1987.
Kakwani, N., On the Estimation of Consumer Unit Scale, *Review of Economics and Statistics*, 59, 507-510, 1977.
——— *Income Inequality and Poverty: Methods of Estimation and Policy Applications*, Oxford University Press, New York, 1980.
———, On a Class of Poverty Measures, *Econometrica*, 48, 437-446, 1980.
———, Welfare Measures: An International Comparison, *Journal of Development Economics*, 8, 21-45, 1981.
———, Issues in Measuring Poverty, *Advances in Econometrics*, 3, 253-282, 1984.
———, *Analyzing Redistribution Policies: A Study Using Australian Data*, Cambridge University Press, New York, 1986.
Kakwani, N. and Subbarao, K., Rural Poverty in India: 1973-87, forthcoming in Michael Lipton and Jacques van der Gaag (eds), *Including the Poor*, 1992.
Kanbur, R., Poverty: Measurement, Alleviation and the Impact of Macroeconomic Adjustment, International Monetary Fund Staff Papers, 34 (1), 60-85.
———, Structural Adjustment, Macroeconomic Adjustment and Poverty: A Methodology for Analysis, *World Development*, 15 (12), 1515-1526, 1987.
———, Poverty and the Social Dimensions of Adjustment in Côte d-Ivoire, The World Bank, (mimeo), 1988.
Kuznets, S., Economic Growth and Income Inequality, *American Economic Review*, 45, 1-28, 1955.
Lipton, M., Poverty: Concepts, Thresholds and Equity Conflicts, International Food Policy Research Institute, Washington, D.C., 1988.
Pollak, R. A. and Wales, T. J., Welfare Comparisons and Equivalence Scales, *American Economic Review*, 69, 216-221, 1979.
Ravallion, M., Poverty Comparisons: A Guide to Concepts and Methods, Living Standards Measurement Study Working Paper No. 88, World Bank, Washington, D.C., 1992.
Ravallion, M. and Huppi, M., Measuring Changes in Poverty: A Methodological Case Study of Indonesia During an Adjustment Period, *World Bank Economic Review*, 5, 57-84, 1991.
Sen, A., Poverty: An Ordinal Approach to Measurement, *Econometrica*, 44 (2), 219-231, 1976.
Slesnick, D. T., Consumption and Poverty, Processed, Kennedy School of Government, Harvard University, 1990.

Tokman, V. and Wurgaft, J., The Recession and Workers in Latin America in *World Recession and Global Independence: Effects on Employment, Poverty and Policy Formation in Developing Countries*, International Labour Organisation, Geneva, 1987.
Watts, H. W., An Economic Definition of Poverty, in Moynihan, D. P. (ed.), *On Understanding Poverty*, Basic Books, New York, pp. 316–329, 1968.
World Bank, Poverty in Latin America: The Impact of Depression, Washington, D.C., 1986.