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Poverty and Economic Growth

With Application to Côte d'Ivoire

Nanak Kakwani

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The Living Standards Measurement Study

The Living Standards Measurement Study (LSMS) was established by the World Bank in 1980 to explore ways of improving the type and quality of household data collected by statistical offices in developing countries. Its goal is to foster increased use of household data as a basis for policy decisionmaking. Specifically, the LSMS is working to develop new methods to monitor progress in raising levels of living, to identify the consequences for households of past and proposed government policies, and to improve communications between survey statisticians, analysts, and policymakers.

The LSMS Working Paper series was started to disseminate intermediate products from the LSMS. Publications in the series include critical surveys covering different aspects of the LSMS data collection program and reports on improved methodologies for using Living Standards Survey (LSS) data. More recent publications recommend specific survey, questionnaire, and data processing designs, and demonstrate the breadth of policy analysis that can be carried out using LSS data.

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ABSTRACT

The 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. This decomposition provides a link between macro-economic adjustment policies and poverty which is discussed in the context of the adjustment experience of Côte d'Ivoire. The issue of targeting a poverty alleviation budget is shown to be related to the poverty decomposition proposed in the paper. The methodology proposed is applied to the data taken from the 1985 Living Standards Survey in Côte d'Ivoire.

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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 facts - the average level of income and the extent of inequality in income distribution. The increase in average income reduces poverty though 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 (Chenery, et al, 1974). But 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, not sufficient progress has been made in the eradication of poverty.

1/ There can be situations when increase in inequality may have no impact on poverty. But such situations are highly unlikely.

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.

This paper also addresses the issue of poverty within subgroups 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 in income inequality of a subgroup is considered. This question is of crucial importance because many government poverty reduction programs are focused on certain population subgroups.

Because of the economic crisis in the 1980s, many developing countries have now adopted structural adjustment policies initiated by the World Bank. These policies have implications for the living standards of the people, particularly those who are poor. The effects of such policies on poverty are not adequately quantified.[2/] The poverty elasticities derived in in this paper provide a link between macro-economic adjustment policies and the poverty. This link has been discussed in the context of the adjustment experience of Côte d'Ivoire.

2/ The exception is that of Kanbur's (1987, 1988) work which provides methodology to analyze the impact of structural policies on poverty. In this paper, his methodology has been extended and results generalized for several poverty measures not considered by him.

Because the poverty alleviation budget is always limited, it is important to know the most efficient way of directing expenditures towards various population subgroups. Obviously, the most efficient policy will be to target expenditures to the most poor in each group.[3/] But such a policy is difficult to implement because the poor are not easily identifiable and the cost of targeting may be high. Kanbur (1987, 1988), Ravallion and Chao (1988) and more recently Glewwe (1989) have suggested procedures for allocating a limited budget for poverty relief without having full information on individual incomes. Because of the importance attached to this problem, we provide a further analysis and propose a targeting indicator which provides a simple way of allocating a poverty budget among different population groups. This indicator is similar to that used by Kanbur (1988) but has been derived by an alternative procedure using poverty decomposition presented in the paper.

The methodology developed in this paper is applied to the data taken from the 1985 Living Standards Survey in the Côte d'Ivoire. A description of the survey and sampling methodology is given in Ainsworth and Muñoz (1986).

3/ Note this result will not be true if poverty is measured by the head-count ratio which is a crude measure of poverty (Sen 1976).

2. DECOMPOSITION OF POVERTY MEASURES

The Lorenz curve is widely used to analyze inequality in the size distribution of income. It is defined as the relationship between the cumulative proportion of income units and the cumulative proportion of income received when units are arranged in ascending order of their income.

The Lorenz curve is represented by a function L(p), which is interpreted as the fraction of total income received by the bottom p x 100 percent of the population. If all individuals receive exactly the same income, L(p) = p which is called the egalitarian line. The deviation of the Lorenz curve from the egalitarian line provides a measure of inequality. The nearer the Lorenz curve is to the egalitarian line, the more equal the distribution of income will be. The Lorenz curve is independent of the size of the mean income. Any shift in the Lorenz curve will change the inequality. Suppose the Lorenz function has k parameters $m_1, m_2, \ldots m_k$, then shifts in the Lorenz curve will occur as a result of changes in these parameters. Thus,

$$dL(p) = \sum_{i=1}^{k} \frac{\partial L(p)}{\partial m_i} dm_i$$

which shows how a shift in the Lorenz curve is related to changes in its parameters. Suppose θ is a poverty index which will be a function of three facts: (1) the poverty line income z - the threshold income, below which one is considered to be poor, (2) the size of the mean income of the society, μ; and, (3) income inequality. Inequality can be measured by a single inequality index (many of which are available in the literature), but more generally it should be represented by the parameters of the Lorenz curve. We assume that the poverty line z is fixed, then we can write

$$d\theta = \frac{\partial\theta}{\partial\mu} d\mu + \sum_{i=1}^{k} \frac{\partial\theta}{\partial m_i} dm_i \qquad (2.1)$$

This allows us to decompose the change in poverty into two components: (1) the impact of growth on poverty when the distribution of income does not change, and (2) the effect of income redistribution when the total income of the society remains unchanged. If the first component in (2.1) is known, the second may be obtained as a residual.

To compute numerically the growth and distribution components of poverty, it will be necessary to have individual incomes or expenditure data for two periods. For most developing countries, such data are available for one time period only. This paper provides methodology to compute these components individually on the basis of one time period data. Once these components are calculated, (2.1) can also be used to forecast poverty for specified values of economic growth and changes in income inequality.

It may appear that the decomposition in (2.1) measures only the effect of aggregate economic growth on poverty. Because the economy is made up of several widely different sectors, it will be of considerable interest to analyze the effect of economic growth on total poverty within the sectors. The methodology to analyze how the total poverty is affected by changes in inter and intra sectoral income distributions is provided in Section 5.

One important limitation of the above analysis is, it assumes various growth rates and inequality changes within various sectors (or at aggregate level) to be exogenously known. The fact is that these changes are the outcomes of several economic and political forces in the economy. The key question is: What will be the impact of these various forces on total poverty? The analysis presented in this paper needs to be extended to answer these causal questions.

3. GROWTH COMPONENT OF POVERTY

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, we write (Kakwani, 1980):

$$L'(H) = z/\mu \tag{3.1}$$

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 (3.1) with respect to μ to obtain

$$\frac{\partial H}{\partial \mu} = - \frac{z}{\mu^2 L''(H)} \tag{3.2}$$

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

$$L''(H) = \frac{1}{\mu f(z)} \tag{3.3}$$

where f(z) is the probability density function of income x at x = z. Substituting (3.3) into (3.2) gives the elasticity of head-count ratio for the mean income:

$$\eta_H = \frac{\partial H}{\partial \mu} \frac{\mu}{H} = - \frac{zf(z)}{H} < 0 \tag{3.4}$$

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):

$$S = HI \tag{3.5}$$

where

$$I = \frac{(z-\mu^*)}{z} \tag{3.6}$$

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

$$\frac{\partial\mu^*}{\partial\mu} = \frac{\mu^*}{\mu} + \frac{(z-\mu^*)}{\mu}\,\eta_H \tag{3.7}$$

using (3.3) and (3.4); the first term in the righthand side of (3.7) 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 (3.7). Because 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 righthand side of (3.7).

Utilizing (3.7) into (3.6) gives the elasticity of the aggregate income gap I with respect to μ as

$$\eta_I = \frac{\partial I}{\partial \mu}\frac{\mu}{I} = -\eta_H - \frac{\mu^*}{(z-\mu^*)} \tag{3.8}$$

which can be positive or negative, suggesting that I cannot be considered to be a suitable poverty index because it does not always decrease when the mean income of the society increases.

From (3.5), it is easy to see that

$$\eta_S = \eta_H + \eta_I$$

which in conjunction with (3.8) gives

$$\eta_S = - \frac{\mu^*}{(z-\mu^*)} < 0 \tag{3.9}$$

showing 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

$$S^* = H[z - \mu^* (1-g)] \tag{3.10}$$

where g is the Gini index of income among the poor.[4/]

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:

$$\frac{\partial g}{\partial \mu} = \frac{1}{\mu\mu^*} [(1-g)\ z - (1+g)\ \mu^*]\ \eta_H \tag{3.11}$$

where η_H is given in (3.4); g will decrease with μ if and only if $g < \frac{z-\mu^*}{z+\mu^*}$. If there is a high inequality of income among the poor, the economic growth may increase it even further.

Using (3.4), (3.7) and (3.11) in conjunction with (3.10) gives the elasticity of Sen's index with μ as

$$\eta_{S*} = -\frac{\mu^* H(1-g)}{zS^*} + \frac{[z-\mu^*(1+g)]H}{S^* z}\ \eta_H \tag{3.12}$$

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

4/ The Gini index is the most widely used index for measuring income inequality.

Let us now consider a class of additively separable poverty measures

$$\theta = \int_0^z P(z,x)f(x)dx \tag{3.13}$$

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

and $P(z,x)$ is a homogeneous function of degree zero in z and x. Using (3.1) into (3.13) gives

$$\theta = \int_0^H P\big(L'(H),\ L'(p)\big)\ dp \tag{3.14}$$

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

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

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

$$\frac{\partial \theta}{\partial \mu} = -\ \frac{\mu L''(H)}{z}\ \frac{\partial H}{\partial \mu} \int_0^z \frac{\partial P}{\partial x}\ x\ f(x)dx \tag{3.15}$$

Utilizing (3.2), (3.4) into (3.15) gives the elasticity of θ with respect to μ as

$$\eta_{\theta} = \frac{1}{\theta} \int_0^z x \frac{\partial P}{\partial x} f(x)dx \qquad (3.16)$$

which is always negative in view of $\frac{\partial P}{\partial x} < 0$.

Equation (3.16) 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:

$$P_{\alpha} = \int_0^z \left(\frac{z-x}{z}\right)^{\alpha} f(x)dx \qquad (3.17)$$

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 (3.16), we obtain the elasticity of P_{α} with respect to μ as

$$\eta_{P_{\alpha}} = \frac{\partial P_{\alpha}}{\partial \mu} \frac{\mu}{P_{\alpha}} = - \frac{\alpha \, [P_{\alpha-1} - P_{\alpha}]}{P_{\alpha}} \qquad (3.18)$$

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 3.5), therefore substituting $\alpha = 1.0$ in (3.18) must give the elasticity of S with respect to μ as given in (3.9). 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). Because this measure is also a particular member of θmeasures, (3.16) 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 (3.16):

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

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

The elasticities of various poverty measures (for mean income) derived above provide the magnitude of the first component in (2.1). 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.[5/] Consequently, the total poverty will increase or decrease depending on which of these two facts 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:

$$L^*(p) = L(p) - \lambda\, [p - L(p)] \qquad (4.1)$$

which implies that when $\lambda > 0$, the Lorenz curve shifts downwards resulting in higher 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 $\lambda = .01$, it means that the Gini index has increased 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 (3.1) we must have

$$L'^*(H^*) = \frac{z}{\mu} \qquad (4.2)$$

where $L^*(p)$ is given in (4.1). Differentiating (4.1) with respect to p, yields

$$L'^*(H^*) = L'(H^*) - \lambda[1 - L'(H^*)] \qquad (4.3)$$

5/ Countries such as Taiwan, Hong Kong, South Korea and Singapore have achieved high economic growth without accentuation of income inequality.

For the Lorenz curve L(p), H is the proportion of individuals with income less than or equal to z. When H changes to H*, z must also change to a new level z*:

$$L'(H^*) = \frac{z^*}{\mu} \tag{4.4}$$

Substituting (4.2) and (4.4) into (4.3) gives

$$z^* = \frac{z + \lambda\mu}{(1+\lambda)} \tag{4.5}$$

where $H^* = F(z^*)$ and $H = F(z)$. Thus, $100 \times \frac{[F(z^*) - F(z)]}{F(z)}$ will be the percentage change in the head-count ratio when the Gini index has changed by $\lambda \times 100$ percent. Therefore, the elasticity of the head-count poverty ratio for the Gini index G will be given by

$$\varepsilon_H = \lim_{\lambda \to 0} \frac{F(z^*) - F(z)}{\lambda\, F(z)} \tag{4.6}$$

where z* is given in (4.4). Applying the mean value theorem on F(z) we obtain

$$F(z^*) = F(z) + (z-z^*)\, f[z+ \delta\, (z-z^*)]$$

where $0<\delta<1$ and f(x) is the first derivative of F(x) for x. Substituting this equation in (4.6) yields

$$\varepsilon_H = - \frac{(\mu-z)}{z}\, \eta_H \tag{4.7}$$

where η_H is derived in (3.4). Note that $\varepsilon_\theta > 0$ only if $\mu > z$ which implies that the higher income inequality leads to greater poverty only if the poverty line income is less than the mean income of the distribution.

Let us now consider the θ class of poverty measures defined in (3.13). When the Lorenz curve of the x distribution shifts in accordance with (4.1), the poverty measures in (3.13) change to

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

where z^* is given (4.5). Therefore, the elasticity of this entire class of poverty measures for the Gini index will be given by

$$\varepsilon_\theta = \lim_{\lambda\to 0} \frac{\theta(\lambda)-\theta}{\theta\lambda}$$

which on differentiation under integral sign yields

$$\varepsilon_\theta = \frac{1}{\theta}\int_0^z \frac{\partial P}{\partial x}\ (x-\mu)\ f(x)dx \tag{4.8}$$

This equation can be further simplified by using (3.16)

$$\varepsilon_\theta = \eta_\theta - \frac{\mu}{\theta}\int_o^z \frac{\partial P}{\partial x}\ f(x)dx \tag{4.9}$$

where η_θ is the elasticity of the poverty measures θ for the mean income μ (when the income inequality has remained the same). The first term in (4.8) 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 (4.8)).

Equation (4.9) gives the general expression for deriving the elasticity of θ for the Gini index. We may now consider the poverty measures. For Foster, Greer and Thorbecke's poverty measures:

$$P(z,x) = \left(\frac{z-x}{z}\right)^{\alpha}$$

which on substituting in (4.9) gives

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

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

$$P(z,x) = \log z - \log x$$

which yields

$$\varepsilon_w = \eta_w + \frac{\mu H}{w\bar{H}}$$

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

$$P(z,x) = \frac{1}{\alpha}\left[1 - \left(\frac{x}{z}\right)^{\alpha}\right]$$

which on substituting in (4.9) gives

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

The expressions for elasticities of the various poverty measures for μ denoted by η_θ have been derived in the Section 3. Therefore, the above formulae provide procedures for computing poverty measure elasticities for the Gini index.

Because 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:

$$\text{MPRS} = \frac{\partial \mu}{\partial G} \frac{G}{\mu} = - \frac{\varepsilon_\theta}{\eta_\theta} \tag{4.10}$$

which can be computed for each poverty measure.

5. SECTORAL GROWTH AND POVERTY

This section considers the question of how total poverty is affected by a change in average income and in income inequality of a population subgroup.

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

$$\theta = \sum_{i=1}^{m} f_i \theta_i \tag{5.1}$$

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. Kakwani (1989) has demonstrated that the entire class of additively separable poverty measures given in (3.13) are additively decomposable. All the poverty measures discussed in Section 3 (with the exception of Sen's measure) are additively separable. These additively decomposable measures will be used to answer the question raised in this section.

Differentiating (5.1) for the mean income of the ith subgroup we obtain:

$$\eta^*_{\theta_i} = \frac{\theta_i f_i}{\theta} \eta_{\theta_i} \tag{5.2}$$

where $\eta_{\theta_i} = \frac{\partial \theta_i}{\partial \mu_i} \frac{\mu_i}{\theta_i}$ is the elasticity of ith subgroup poverty for the mean income of the ith subgroup and $\eta^*_{\theta_i} = \frac{\partial \theta}{\partial \mu_i} \frac{\mu_i}{\theta}$ is the elasticity of the total poverty for the ith subgroup mean income. Thus, equation (5.2) provides a technique for computing the effect of changes in the ith subgroup mean income on the total poverty. This equation is useful to know how total poverty is affected by the economic growth in various regions or sectors of the economy. It can be shown that

$$\eta_\theta = \sum_{i=1}^{m} \frac{\theta_i f_i}{\theta} \eta_{\theta_i} = \sum_{i=1}^{m} \eta^*_{\theta_i} \tag{5.3}$$

η_θ being the elasticity of the total poverty for 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. Differentiating (5.1) for G_i, the Gini index of the ith subgroup we obtain

$$\varepsilon^*_{\theta_i} = \frac{\theta_i f_i}{\theta} \varepsilon_{\theta_i} \tag{5.4}$$

where $\varepsilon_{\theta_i} = \frac{\partial \theta_i}{\partial G_i} \frac{G_i}{\theta_i}$ and $\varepsilon^*_{\theta_i} = \frac{\partial \theta}{\partial G_i} \frac{G_i}{\theta}$. $\varepsilon^*_{\theta_i}$ measures the effect of change in the Gini index of the ith group of the population on the total poverty. Put differently, and given that other things are fixed, this indicates by what proportion the total poverty in the population will change if the Gini index in the ith sector or group changes by one percent. $\varepsilon^*_{\theta_i}$ can be computed for any group and any poverty measure using the formulae given in Section 4. The proportional change in poverty in the ith group or the sector can always be written as

$$\frac{d\theta_i}{\theta_i} = \eta_{\theta_i} \frac{d\mu_i}{\mu_i} + \varepsilon_{\theta_i} \frac{dG_i}{G_i}, \tag{5.5}$$

which on substituting in (5.1) yields

$$\frac{d\theta}{\theta} = \sum_{i=1}^{n} \eta^*_{\theta_i} \frac{d\mu_i}{\mu_i} + \sum_{i=1}^{m} \varepsilon^*_{\theta_i} \frac{dG_i}{G_i} \tag{5.6}$$

where (5.2) and (5.4) are used and $\frac{d\mu_i}{\mu_i}$ is the growth rate in the ith sector. If we know the growth rates in various sectors, the first term in the righthand side of (5.6) 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. Because 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 righthand side of (5.6) as

$$\sum_{i=1}^{n} \eta^*_{\theta_i} \frac{d\mu_i}{\mu_i} = \eta_\theta \frac{d\mu}{\mu} - \sum_{i=1}^{m} \eta^*_{\theta_i} \left[\frac{d\mu}{\mu} - \frac{d\mu_i}{\mu_i} \right] \tag{5.7}$$

where (5.3) is used. The first term in the righthand side of (5.7) is the pure growth effect on poverty and the second term 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. Because of 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. The quantitative measurement of the effect of adjustment policies on poverty is an extremely difficult task. However, equations (5.6) and (5.7) provide some link between the two.

What we need is the growth rate in various sectors during the adjustment periods. This growth rate can be estimated in the short-run from the national accounts without conducting a new household survey. From the growth rate we can estimate the proportional change in aggregate poverty from (5.6) on the assumption that different population groups or sectors are fairly homogeneous 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 (5.7) may be used to see the effect of such policies on total poverty. Thus, the methodology developed in the paper allows us to provide linkages between adjustment policies and poverty.

6. TARGETING THE POOR

Suppose a government program is directed toward increasing the mean income of the ith group in such a way that every individual in the group gets exactly the same income. For instance, the government may provide a fixed amount of subsidized food to everyone, in which case every individual in the group receives the same amount of benefit. Such a policy will not only increase the mean income of the group but it will also reduce income inequality within that group. We want to know how such a policy will affect the total poverty in the population.

Obviously, the most efficient policy will be to target subsidies only to the poor. But such a policy is difficult to implement: the poor are not easily identifiable and the cost of targeting may be quite high. Alternatively, the government may direct its policies to a particular group such as landless labourers, families with children, or even the most depressed regions. The question is, which particular target group should be the focus of attention for a maximum reduction in the total poverty?

The issue has already been considered earlier by Kanbur (1987, 1988), Besley and Kanbur (1988), Ravallion and Kalvin Chao (1988) and more recently by Glewwe (1989). The following analysis shows that the issue of targeting a poverty alleviation budget is related to the poverty decomposition presented in this paper.

Let us suppose that the income of every individual in the ith group is increased by an amount δ. The new equation of the Lorenz curve for the ith group therefore will be

$$L_i^*(p) = L_i(p) + \frac{\delta}{(\mu_i+\delta)} [p - L_i(p)]$$

where μ_i is the mean income of the ith group. This equation implies that the Gini index of the ith group is reduced by $\frac{\delta}{(\mu_i+\delta)}$ percent and the mean income increased by δ. Equation (5.5) may then be used to calculate the percentage change in the poverty index θ_i for the ith group. Therefore

$$\frac{d\theta_i}{\theta_i} = \eta_{\theta_i} \frac{\delta}{\mu_i} - \varepsilon_{\theta_i} \frac{\delta}{(\mu_i+\delta)} \tag{6.1}$$

Equation (5.1) and (6.1) together yield

$$\frac{d\theta}{\theta} = \frac{f_i\theta_i\delta}{\theta} \left[\frac{\eta_{\theta_i}}{\mu_i} - \frac{\varepsilon_{\theta_i}}{(\mu_i+\delta)} \right] \tag{6.2}$$

which gives the proportionate change in total poverty when the incomes of each individual in the ith group (only) are increased by δ. Thus, this equation provides a method to know which particular group in the population should be targeted for a maximum reduction in the total poverty. Because the poverty budget is always limited, the reduction in poverty must be compared with the cost of targeting. In our model the cost of targeting the ith group is equal to the product of population proportion f_i and δ and therefore, equation (6.2) must be divided by f_i δ. If we are operating with a marginal increase in the poverty budget, we can let δ approach zero. Thus, we introduce a targeting indicator

$$k_i = \lim_{\delta \to 0} - \frac{1}{\delta f_i} \frac{d\theta}{\theta}$$

$$= - \frac{\theta_i}{\theta\mu_i} \left[\eta_{\theta_i} - \varepsilon_{\theta_i}\right] \tag{6.3}$$

which provides a quantitative basis for allocating additional poverty budget among different population groups. We may think of k_i as the marginal benefit for a proportional reduction in the total poverty when one dollar is spent for poverty alleviation in the ith group. If the marginal benefit for group i exceeds that for group j, then it would be beneficial to switch poverty budget from sector j to sector i. Thus, if $k_i > k_j$, there will be a greater reduction in proportional poverty in group i from spending one dollar than in group j. Thus, statistics k_i guide us in the allocation of poverty budget in the various sectors.

The targeting indicator for the whole population is given by the expression

$$k = -\frac{1}{\mu}\left[\eta_\theta - \varepsilon_\theta\right] \tag{6.4}$$

which is interpreted as the proportional reduction in poverty when one dollar is spent for poverty alleviation in the whole population (not targeted at all). Thus, a normal targeting indicator is proposed as

$$k_i^* = \frac{k_i}{k} \tag{6.5}$$

which takes a minimum value of zero if targeting the ith group results in zero poverty reduction: a situation which arises when the ith group contains no poor people and k^*_i takes the maximum value when all the poor are contained in the ith group. If k^*_i is unity, targeting the ith group will not be superior or inferior to no targeting at all. The ith group will be regarded as a good target if the value of k^*_i is greater than unity.

Note that k^*_i is directly proportional to the poverty level and inversely proportional to the mean income of the ith group. Also, it depends on the sensitivity of the poverty index to changes in the mean income and income inequality.[6] The most important feature of the proposed targeting indicator is that it is easy to compute, involving no non-linear estimation. How sensitive this indicator is on the choice of a poverty measure is an empirical question and will be addressed in the next section using the Côte d'Ivoire data.

6/ Kanbur (1988) has proposed a similar targeting indicator for Foster, Greer and Thorbecke (1984) poverty measures. He demonstrated that if the objective is to minimize P_α at the national level, the appropriate targeting indicator for the ith group is $P_{i, \alpha-1}$. It can be shown that k^*_i for P_α measure is proportional to $P_{i, \alpha-1}$ indicating the similarity of our indicator with that of Kanbur. The indicator k^*_i is clearly more general and has intuitively natural interpretation.

7. METHODOLOGY APPLICATION: TO COTE 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 and the Direction de la Statistique, Ministère de l'Economie et des Finances of the Republic of Côte d'Ivoire in 1985.

To analyze poverty, we need to measure the economic welfare of each individual in the society. Although income is widely used to measure economic welfare, it has many serious drawbacks.[7/]

In this paper we have used per capita adjusted consumption as a measure of household economic welfare. This measure, constructed by Glewwe (1987), takes into account the imputed value of owner-occupied dwelling, the regional price variation and depreciated value of consumer durables.[8/] 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: 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.

7/ For a detailed discussion of this issue, see Kakwani (1986).

8/ It is not clear whether we should include the imputed value of owner-occupied dwelling and depreciated value of consumer durables in the construction of the individual welfare measure because these items are not readily disposable in the market by the owners. However, in our view, these items should be included because they provide utility to the owners even if they cannot be easily disposed of. If a household owns a dwelling, it amounts to greater consumption possibilities of that household because of the saving in rent.

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). Despite weaknesses, the welfare value was considered to be the best choice.

Once we have decided upon a suitable index of economic welfare of individuals, the next step is to find a threshold welfare level below which an individual is considered to be poor. In this paper we have considered two poverty lines: one with adjusted per capita consumption of 91394 CFAF and another of 162613 CFAF per year. The two poverty lines identify roughly the poorest 10 percent and the poorest 30 percent of the total Ivorian population. When measured in adjusted per capita terms, consumption for the poorest 10 percent of Ivorians is less than 20 percent consumption for the average Ivorian; the poorest 30 percent consumes about one third of the national average. The poverty line of 91394 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 Appendix.

The numerical values of various poverty measures and their elasticities for 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 for 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 correctly without analyzing data from a sample of several countries. However, we can attempt to give a speculative answer by observing the shape of the density function in Figure 1 the Appendix. The figure shows that people are most densely clustered around the lower poverty line consumption level of 91394 CFAF per year. In fact this consumption level happens to be the mode of the distribution. We 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

TABLE 1: Elasticities of Poverty Measures for 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 for mean income	Elasticity for Gini index	MPRS	Value of Poverty Measure	Elasticity for mean income	Elasticity for 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 measures								
α = 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 measures								
β = 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

* All poverty measures have been multiplied by 100.

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 162610 CFAF per year. Because the density of people around the poverty line is very high, we can expect that poverty will be highly elastic.

The elastic nature of poverty is an important conclusion for policy. If this conclusion is valid, a greater emphasis should be placed on the growth oriented policies which at least maintain the income share of the poor. But 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 tradeoff 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. The numerical results suggest 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. In Kuznets' (1955) hypothesis of inverted U-shaped pattern of income inequality, 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 even prevent 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 always 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. But 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. But 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.[9]

9/ See Addison and Demery (1985), 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 a sound statistical evidence for this observation, their suggestive direction may not be wrong.

8. REGIONAL GROWTH RATES AND ADJUSTMENT EXPERIENCE: COTE D'IVOIRE

The Côte d'Ivoire may be divided into five regions: Abidjan, Other Urban, West Forest, East Forest, and Savannah. The first two regions are the urban areas and the remaining three are the rural areas. About 60 percent of the Ivorians live in rural areas. We will investigate how the growth in different regions affects the total poverty in the country. We have therefore constructed Table 2 which provides elasticities of total poverty (in the country) for changes in mean income and income inequality in the regions. The table also provides the values of poverty indices for each region.

The empirical results show that poverty varies widely among the regions. For instance, only 5.25 percent of the population in Abidjan is poor whereas in Savannah the figure is as high as 61.62 percent. All the poverty measures indicate that poverty in Savannah is distressingly high whereas in Abidjan it is extremely low (if not negligible).

The impact of economic growth on the total poverty in the regions also varies widely. This is indicated by the values of elasticities. For instance, one percent economic growth in Abidjan with no change in inequality will reduce the total poverty in the country (measured by poverty gap ratio) by 0.08 percent whereas the same growth rate in Savannah will reduce the total poverty by 0.75 percent. Thus, the income growth in Savannah is almost ten times more efficient than that in Abidjan if the aim is to reduce total poverty. This observation emphasizes the importance of regional economic policies which have widely differing effects on total poverty in the country.

The above analysis provides a link between structural adjustment policies and changes in poverty. An important component of structural

TABLE 2: Elasticities Measuring Effects of Economic Growth and Changes in Inequality Within Regions on Total Poverty in Côte d'Ivoire, 1985

Poverty Line = 162.61 (000's of CFAF per year)

Poverty Measures	Abidjan			Other Urban			West Forest			East Forest			Savannah		
	Value of Poverty Measure	η_θ^*	ε_θ^*	Value of Poverty Measure	η_θ^*	ε_θ^*	Value of Poverty Measure	η_θ^*	ε_θ^*	Value of Poverty Measure	η_θ^*	ε_θ^*	Value of Poverty Measure	η_θ^*	ε_θ^*
Head-count Ratio	5.25	-0.06	0.17	11.94	-0.33	0.46	18.40	-0.34	0.28	39.13	-0.46	0.23	61.62	-0.35	0.03
Poverty gap Ratio	1.26	-0.08	0.32	2.68	-0.22	0.47	5.30	-0.21	0.33	12.52	-0.70	0.85	24.38	-0.75	0.59
Watts Measure	1.58	-0.07	0.30	3.41	-0.20	0.47	7.21	-0.21	0.39	17.25	-0.73	1.12	36.01	-0.88	1.01
Foster et measures															
α = 2.0	0.44	-0.07	0.34	0.96	-0.17	0.47	2.34	-0.20	0.45	5.56	-0.78	1.33	12.68	-1.00	1.25
= 3.0	0.19	-0.06	0.33	0.42	-0.15	0.47	1.21	-0.21	0.59	2.91	-0.81	1.75	7.41	-1.22	1.94
Clark et measures															
β = 0.25	1.49	-0.08	0.34	3.19	-0.21	0.48	6.63	-0.21	0.37	15.79	-0.72	1.03	32.32	-0.84	0.87
= 0.50	1.41	-0.08	0.33	3.00	-0.21	0.46	6.13	-0.21	0.36	14.54	-0.72	0.96	29.23	-0.81	0.76
= 0.75	1.33	-0.08	0.32	2.83	-0.22	0.48	5.68	-0.21	0.34	13.46	-0.71	0.90	26.62	-0.78	0.67

* All poverty measures have been multiplied by 100.

Elasticity of total poverty (at national level) with respect to the mean income of the ith region.

Elasticity of total poverty with respect to the Gini index of the ith region.

adjustment policies in the Côte d'Ivoire was the attempt to restore incentives in agricultural production by raising producer prices in line with world prices. As a result, the rural-urban trade terms rose from 88.5 in 1982 to 100 in 1984 (Addison and Demery 1986). In the Report of the Poverty Task Force on Poverty Alleviation (World Bank 1988), between 1980 and 1984 per capita disposable income declined by an estimated 10.8 percent per year in the urban sector, compared with a slight reduction of 1.2 percent per year in the rural sector. How do these growth rates affect the total poverty? To provide an answer, we assume that the two urban regions, that is, Abidjan and Other Urban, had the same negative 10.8 percent per capita growth rate and the remaining three rural regions had the same growth rate of -1.2 percent.

Using the estimated elasticities in Table 2, we computed the annual percentage changes in poverty for various poverty measures. The numerical results are presented in column 1 of Table 3. 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 3 shows that poverty has increased between 1980 to 1984 at an annual rate varying from 4.96 to 5.28 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 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. Thus, a policy of changing the trade terms in favour of agriculture reduced total poverty.

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

TABLE 3: Percentage of Change in Poverty: Côte d'Ivoire, 1980-84

Poverty Measures	Based on Regional Disaggregation		Based on Disaggregation by Occupation	
	Percentage change in poverty	Percentage change in poverty due to change in trade terms	Percentage change in poverty	Percentage change in poverty due to change in trade terms
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 measures				
α = 2.0	4.97	-10.35	5.93	-9.70
= 3.0	4.96	-12.01	6.54	-10.80
Clark et measures				
α = 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

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 rates 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 3. 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 3 may have been exaggerated.

9. THE IMPACT OF STRUCTURAL ADJUSTMENT POLICIES ON POVERTY IN COTE D'IVOIRE, 1986-90

The Côte d'Ivoire is one of the successful examples of the World Bank's structural adjustment policies. The process of adjustment is expected to be completed during the 1986-90 period with a moderate growth rate of GDP led by the expansion of exports. In the World Bank document: "The Ivory Coast in Transition: From Structural Adjustment to Self-Sustained Growth" 1986, GDP is projected to grow by 3.0 percent per year between 1986 and 1990. Between 1986 and 1990 this growth performance should be led by the industrial sector, at 5.1 percent per year and by a recovery in agricultural value added at 2.3 percent per year. The service sector is expected to grow at an annual rate of 3.7 during the same period. The question here is: if these growth rates are realized, how will the 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 4. The table also presents the total poverty elasticities for changes in mean income and income inequality within each sector. The results indicate that the total poverty is very sensitive to growth in income and changes in inequality within the agricultural sector. This suggests that adjustment policies should be directed to 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 the total poverty would increase at an annual rate of 3.63 percent during the adjustment period 1986 to 1990. The effect of changes between group inequality was equivalent to an increase in poverty by 1.95 percent. Thus, the poor will probably bear the substantial cost of adjustment policies during the transition phase. Will the poor benefit when the country takes off on a self-sustained growth path after the adjustment period? We do not know the answer to this question.

TABLE 4: 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)

Source: The Ivory Coast in Transition: From Structural Adjustment to Self-Sustained Growth: World Bank, March 14, 1986.

10. TARGET GROUP IDENTIFICATION IN COTE D'IVOIRE

The targeting indicator k^*_i developed in Section 6 is used here to identify the target groups in Côte d'Ivoire. We begin with the regional analysis. The values of targeting indicators are presented in Table 5 for various poverty measures. The same budget allocation for Savannah will reduce the total poverty by 2.51 percent and for Abidjan, the reduction in poverty will be only 0.15 percent (when poverty is measured by Watt's measure). But if exactly the same budget was allocated to the whole population (on additive basis), the total poverty reduces by 1 percent. Then it is clear, any region for which k^*_i is less than unity will not be considered for targeting. Except for the head-count ratio, all other poverty measures indicate Savannah is the most desirable region to spend the poverty budget if our aim is to reduce poverty by the maximum amount. The head-count ratio, however, suggests that the West Forest is the most appropriate region for targeting. This is a surprising result because Savannah is the region which has the highest poverty and the lowest mean income. The reason for this unusual observation is that in Savannah a large proportion of population is clustered around the consumption level which is considerably lower than the poverty line. The effect of redistribution of income will therefore have little effect on the poverty measure which is insensitive to the distribution of income among the poor. This observation demonstrates the weakness of head-count ratio as a tool for analyzing poverty.

TABLE 5: Targeting Indicator for Regions of Côte d'Ivoire, 1985
Poverty Line = 162.61 (000's of CFAF)

Poverty Measures	Abidjan	Other Urban	West Forest	East Forest	Savannah	All Regions
Head-count Ratio	0.21	0.95	1.45	1.20	1.21	1.00
Poverty gap Ratio	0.19	0.43	0.67	1.41	2.23	1.00
Watts measure	0.15	0.34	0.59	1.35	2.51	1.00
Foster et Measures						
α = 2.0	0.14	0.29	0.57	1.34	2.61	1.00
= 3.0	0.10	0.22	0.53	1.26	2.87	1.00
Clark et Measures						
α = 0.25	0.16	0.36	0.61	1.36	2.43	1.00
= 0.50	0.17	0.39	0.63	1.38	2.35	1.00
= 0.75	0.18	0.41	0.65	1.40	2.28	1.00

Table 6 presents the value of targeting indicators for households disaggregated by various socio-economic and demographic household characteristics. From this table the following household groups will be considered good targets for poverty alleviation:

1. Households living in Savannah.
2. No education of household head.
3. Northern Mande and Voltaic ethnicity of households.
4. Agricultural occupation.
5. Self-employed household head.
6. Household heads aged 65 and over.

The question arises if we can further improve upon targeting by combining two or more of the above household groupings. The answer is provided in Table 7 which gives the value of targeting indicators for several combinations of the above groups.

TABLE 6: Targeting Indicator for Various Socio-economic and Demographic Groups Based on Watt's Poverty Measure: Côte d'Ivoire, 1985

Socio-economic and Demographic Groups	Value of Targeting Indicator
Sex of Household Head	
Male	1.02
Female	0.61
Nationality of Household Head	
Ivorian	1.04
Others	0.74
Household Size	
Small (<5)	0.62
Medium (5-6)	0.81
Large (>7)	1.07
Age of Household Head	
< 26	0.65
26-35	0.58
36-45	0.56
46-65	1.16
> 65	1.86
Education of Household Head	
Elementary School	0.61
Junior High School	0.09
Senior High School	0.00
University	0.00
None	1.32
Ethnicity of Household Head	
AKAN	0.98
KROU	0.53
N. Mande	1.31
S. Mande	0.51
Voltaic	2.35
Other	0.70
Occupation of Household Head	
None	0.84
Agriculture	1.46
Sales/Service	0.26
Industry/Crafts	0.44
White Collar/Management	0.09
Other	0.57
Employer of Household Head	
None	0.83
Government	0.08
Parastatal	0.00
Private	0.19
Self-employed	1.33

TABLE 7: Targeting Groups Based on Watt's Poverty Measure: Côte d'Ivoire, 1985

Groups	Value of Watt's Poverty Measure	Value of Targeting Indicator
1. Voltaic Ethnicity and Savannah Region	57.39	3.74
2. Voltaic or North Mande and Savannah	51.41	3.38
3. Voltaic and Savannah and age of head > 65 years	105.96	6.72
4. Voltaic, Savannah and age of head > 45 years	71.83	4.53
5. Voltaic and Savannah, and age of head > 45 years and occupation agriculture	76.49	4.77
6. Voltaic and Savannah and age > 65, agriculture	128.91	8.04
7. Voltaic and Savannah or East Forest, age > 65 and agriculture	128.91	8.04
Total Population	13.22	1.00

We found that by performing calculations on all possible combinations, the maximum efficiency of targeting could be increased to 8.04. The households which have this efficiency are those living in Savannah, of Voltaic ethnicity, with agricultural occupation, and with age of head greater than 65. The value of the poverty index for this combination is 128.91 compared with the value of 13.22 for the whole country. The achievement of this much efficiency (the poverty reduction of more than 8 percent compared with the 1 percent under no targeting), is indeed remarkable and will be almost equal to the perfect targeting.

Therefore, in this paper we have identified a target group to which most of the poor belong. Even a small poverty budget targeted toward this group will have a substantial impact on the total poverty in the country. But this analysis is based on the assumption that all gains from a budget appear in the group where it is directed. The possible incentive effect which may change the pre-transfer income distribution within and between groups has been assumed to be negligible. An extension of the present analysis should introduce such considerations, which are commonplace, in the optimal tax literature. Also, the people may move from one group to another to enhance their gains from transfers. The targeting rules have to be revised regularly to minimize such possibilities.

11. 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 provides a link between structural adjustment policies and poverty, which has been discussed in the context of the adjustment experience of Côte d'Ivoire. The paper also discusses the issue of targeting a poverty alleviation budget and proposes a simple targeting indicator. Some main conclusions which emerge are as follows:

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. But if inequality deteriorates during the course of a country's economic growth, the poverty may even increase with economic growth, because the 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 is the relative sensitivity of poverty 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. The impact of economic growth on poverty was found to vary considerably across the regions. The economic growth in Savannah was almost ten times more efficient than in Abidjan if the purpose is to reduce total poverty. This observation emphasizes the importance of regional economic policies which have widely differing effects on total poverty in the country.

4. During the initial phase of the structural adjustment program, the 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.

5. Using the poverty elasticities and projected per capita growth rates, it was estimated that the total poverty in Côte d'Ivoire will increase at an annual rate of 3.63 percent during the final phase of the adjustment period, 1986 to 1990. Thus, the poor would bear the substantial cost of adjustment.

6. By performing appropriate calculations we demonstrated that with the same poverty budget, targeting can reduce the total poverty by more than 8 percent compared with that of 1 percent when there is no targeting. The households identified for targeting are those living in Savannah, of Voltaic ethnicity, with agricultural occupation, and with age of the head greater than 65.

In conclusion we point out that because the poor in Côte d'Ivoire have already paid for the substantial cost of adjustment, when the country is on a self-sustained growth path, the government should give top priority to the poverty alleviation programs. This paper has identified the groups of households which should be targeted to achieve a large reduction in poverty with a limited budget. Finally, a useful extension of this study and one that we hope to carry out, will be to apply our analysis to the countries which did not undergo structural adjustment.

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):

$$L(p) = p - a\, p^{\alpha}\, (1 - p)^{\beta} \qquad \text{(A.1)}$$

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

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

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

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

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

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.

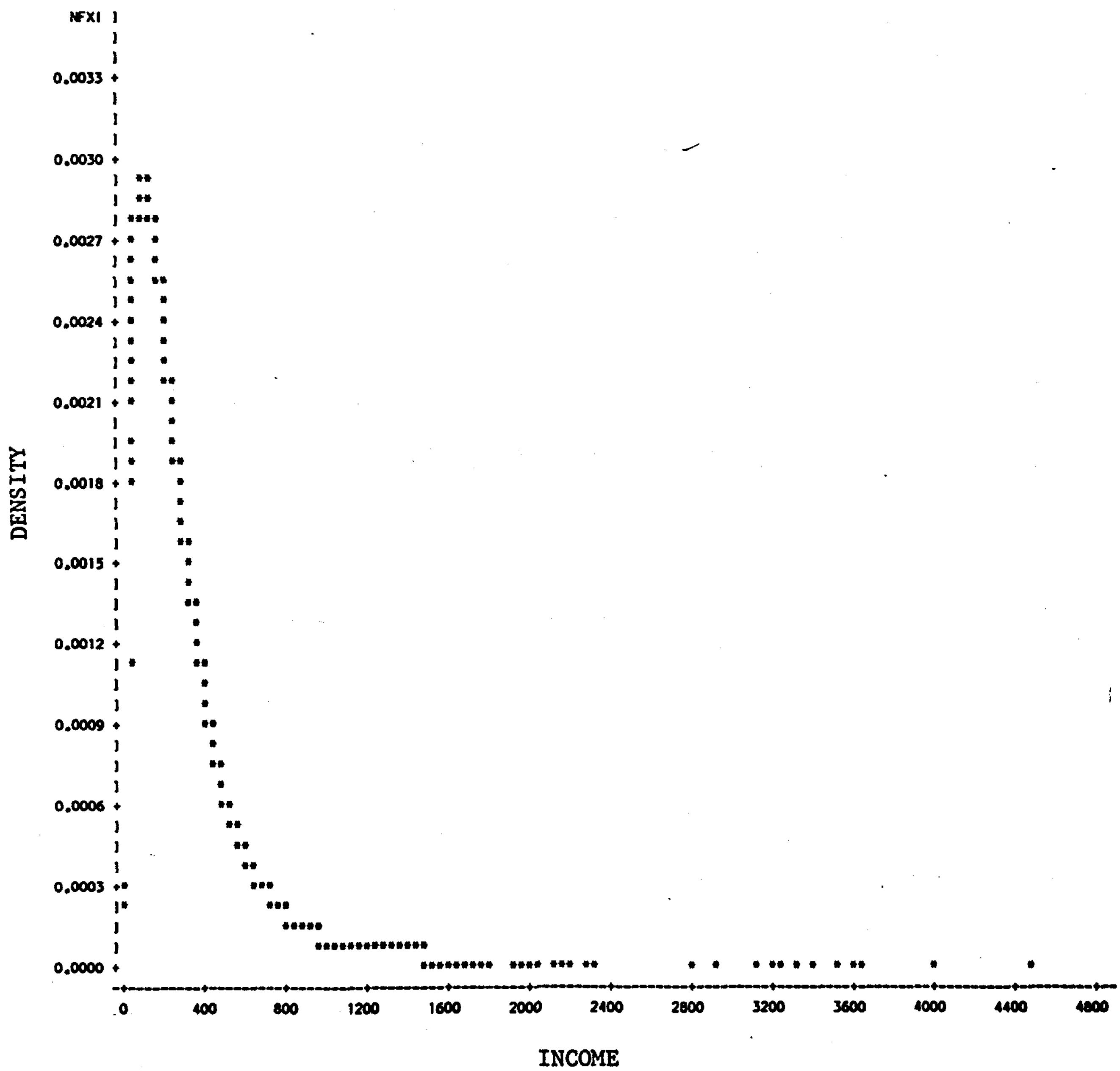
The Lorenz function parameters a, α and β were estimated by regressing log $[p - L(p)]$ on log p and log (1-p). Therefore, for the Côte d'Ivoire household expenditure data, the following regression estimates were obtained:

$$\log\left[p - L(p)\right] = \underset{(.0039)}{-.1798} + \underset{(.0021)}{.9967}\log p + \underset{(.0017)}{.5355}\log(1-p)$$

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 .9929 which is an extremely high value given the fact that we used 1569 observations in our estimation. Comparison of the actual with the estimated values of the Lorenz function L(p), found this curve provided an extremely good fit over the entire income range. The values of f(x) for x = 91.39 and x = 162.61 were estimated to be .0029 and .0026, respectively.

Figure 1 presents a graph of the estimated density function. 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. This suggests that a large proportion of the Côte d'Ivoire population is clustered around a very low level of adjusted per capita consumption.

FIGURE 1: Density Function of Per Capita Adjustment Consumption Distribution in Côte d'Ivoire, 1985



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