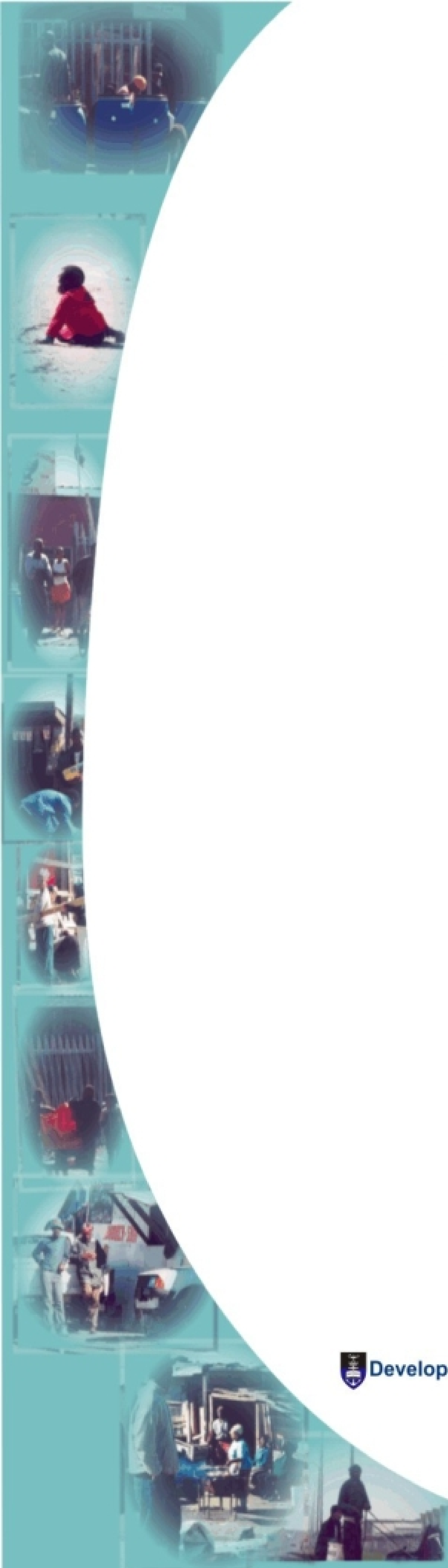

Growth and Redistribution Effects of Poverty Changes in Cameroon: A Shapley Decomposition Analysis

Francis Menjo Baye

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Francis Menjo Baye
Faculty of Economics and Management
University of Yaoundé II
P.O. Box 1365 Yaoundé
Republic of Cameroon
bayemenjo@yahoo.com

Abstract

This paper (1) develops an exact decomposition framework based on the Shapley Value in cooperative game theory, and (2) investigates the growth and redistribution effects of changes in poverty using Cameroon's household surveys. By all the P_α class of measures, poverty increased significantly between 1984 and 1996. The growth components over-accounted for the increase, while shifts in national, rural and semi-urban distributions marginally mitigated the worse effects on the population. A decline in mean incomes as well as adverse distributional shifts contributed to a significant increase in urban poverty during the same period. Our findings corroborate the general result in the literature that growth effects tend to dominate the effects of changes in the distribution of income. These results illustrate the potential contribution of distributionally neutral growth in household incomes to poverty alleviation in Cameroon. The temptation is resisted, however, not to deny that redistribution also has an important role to play, yet there must be severe limits to what can be achieved by growth neutral redistribution. Growth in household incomes appears more likely to be essential for long-term poverty reduction, and will be much effective if poverty alleviation programmes are targeted disproportionately in favour of rural and semi-urban areas.

Keywords: Poverty changes, Shapley Decomposition, Household surveys, Cameroon.

1. Introduction

Many developing countries are now addressing concerns for the poor in addition to pursuing growth objectives as enshrined in their Poverty Reduction Strategy Papers (PRSPs). This development approach anchors on the broadening of the initial objectives of structural adjustment to take on board social considerations, as governments and donors now share the same opinion that adjustment efforts cannot be sustainable if the needs of the poor are ignored.1

After a period of sustained growth, which Cameroon experienced up to the middle of 1980s – accomplishing an annual average growth of 7 per cent over a ten year period, the situation deteriorated from 1986 onwards and the country suffered a severe economic and social crisis. The crisis was blamed on poor macro-economic performance, occasioned, at least in part, by a slum in world market prices of it export commodities from 1986 that exposed the structural deficiencies of the country, and by the overvaluation of the CFA franc against the dollar – a currency in which most of Cameroon's exports are quoted. The short-term effects of the ensuing policies designed to achieve macro-economic stability are thought to have caused a deterioration in the welfare of Cameroonians, especially those at the lower half of the distribution of living standards. The harshness of the crisis led to the abandonment of the long-term planned development system pursued since the early 1960s, and the adoption of the IMF/World Bank medium-term structural adjustment programmes (SAP) from 1988.[2] The crisis also led to considerable shortfalls in public finances, making it difficult for the government to pursue with vigour its development strategy. Even some of the achievements in terms of infrastructure deteriorated for lack of maintenance. Many of the rural infrastructures, notably development projects, put in place by the state collapsed, thereby aggravating the poverty of the people that benefited from those services.

Economic indicators continued to deteriorate and the steady decline in incomes led to a 40 per cent fall in per capita consumption between 1985/86 and 1992/93. The external debt stock rose from less than one-third to more than three-quarters of GDP between 1984/85 and 1992/93. Investment declined from 27 per cent to less than 11 per cent of GDP over the same period (Government of Cameroon, 2003).

Cameroonian authorities tried to cope with the economic crises by reducing public expenditures, including a 60 per cent cut in civil service wages in 1993, and cuts in producer prices of traditional exports in 1991. These measures did not, however, stimulate growth. The authorities also tried to cope by more borrowing to finance

[1] See Cornia *et al*. (1987) and Woodward (1992) for a discussion of this view as well as the conventional view frequently associated with the World Bank and the IMF.
[2] For a succinct presentation of the development planning policies executed through five-year Development Plans in Cameroon, see Baye and Fambon (2001).

budgetary shortfalls in the system. Unfortunately, debt servicing grew rapidly and started crowding out investments (Mbanga and Sikod, 2002). The provision of public services declined markedly, due to lack of investment and poor performance of state owned enterprises. Government reduced basic health and education funding and this led to a major decline in health delivery systems and school enrolment (Khan and Noumba, 2001). Restructuring of state and semi-state enterprises, a freeze in increments and recruitment in the public service and staff redundancies caused a surge in unemployment, which affected mostly women and young people. The marketing of traditional export commodities was liberalized in 1992-1994, thus exposing farmers to the volatility of world market prices. These moves were judged by the political entrepreneurs, subjected to the conditionalities of the donor community, to be too slow to effect the much needed adjustment and hence recourse was made to expenditure-switching measures.

The adverse international environment as reflected in the slum in world market prices of commodity exports in the late 1980s and early 1990s, and its implications for government revenue, production, consumption and relative prices, culminated to compel the Franc Zone Countries to yield to the 50 per cent devaluation of the CFA franc in January 1994. Being a centre-piece of adjustment, the devaluation was intended to re-allocate resources away from non-tradable to tradable commodities with a view to propping up the global competitiveness of the economy. Subsequent to the 1994 devaluation of the CFA franc, Cameroon achieved macro-economic stability. Yet rural incomes were slow to improve because much of the acreage under coffee and cocoa had been abandoned, in addition to the typically low short-run elasticities of supply of these commodities. Moreover, salary cuts, devaluation of the CFA franc with its short-run inflationary effects, and the retrenchment of public sector workers, eroded the real purchasing power of most Cameroonians.

Some effort has been made in the past in constructing poverty lines and profiles for Cameroon (see for example, Lynch, 1991; Njinkeu *et al*., 1997; Government of Cameroon, 1996); World Bank, 1995 and Fambon *et al.*, 2000a, 2000b). Knowledge on how poverty changes by socio-economic characteristics such as level of education, employment status and region of the country is unfortunately absent, with the exception of the Institute of Statistics (2002) and Baye (2004). To the best of our knowledge, the exact decomposition of changes in poverty into growth and redistribution components is still poorly understood by both analysts and decision makers in Cameroon. The methodology we propose performs exact decomposition of changes in aggregate measured poverty. The procedure hinges on the Shapley Value, which is a well-known solution concept in the theory cooperative games. Our contributions are therefore both analytical and empirical in nature.

To better inform public debate in the aftermath or during policy changes that affect living standards, it is necessary to measure the evolution of poverty and income distribution, notably the decomposition of observed changes, with a view to assessing the importance of factors explaining them. In the dynamic decomposition proposed by Datt and Ravallion (1992), for instance, the factors contributing to changes in the P_α class of poverty measures are variations in growth and redistribution. But growth and redistribution in this standard decomposition do not form a partition since a residual element is usually included to ensure the identity of the decomposition. This residual constitutes a “black box”, which is definitely of interest to both analysts and policy-makers if opened and its contents attributed accordingly to meaningful components.

The main objective of this paper is to investigate the characteristics of poverty in the period 1984-1996, how it has changed and the factors explaining the changes. The specific objectives are: (1) to develop a general conceptual framework for assigning contributions based on the Shapley decomposition rule in cooperative game theory, (2) to investigate the growth and redistribution effects of changes in aggregate poverty, and (3) to derive policy implications on the basis of the analysis. The study is in five main sections. Section 2 presents a framework for decomposition analysis that is motivated by the Shapley Value. Section 3 presents a methodology based on the Shapley Value and confronts it with the standard approach. Section 4 presents the data and other information necessary for implementing the methodology. Section 5 presents the results and Section 6 outlines the concluding remarks.

2. Conceptual Framework for Decomposition Analysis based on the Shapley Value

Shorrocks (1999) proposes a general framework in decomposition analysis, whether static or dynamic, and whether concerning poverty or inequality in the distribution of living standards, which eliminates the “black box” that remains unexplained in many conventional decomposition techniques. As a starting point, if I is an aggregate indicator of a welfare measure, which could be an overall level or a change, and X_k, k = 1, 2, …, m a set of factors contributing to the value I, then it can be expressed as:

$$I = f(X_1, X_2, \ldots, X_m) \qquad (1)$$

where f(.) is an appropriate aggregation function. The goal of all decomposition techniques is to attribute contributions, ϕ_k, to each of the factors, X_k, so that, ideally the value of I should equal the sum of the m contributions.

Standard decomposition techniques typically suffer from a number of shortcomings (*see* Shorrocks, 1999; Kabore, 2002). Two of the major ones are to view the standard decomposition procedures:

(1) As only applicable to certain poverty and inequality indices. When used with other indices, these decomposition techniques sometimes introduce hazy notions, such as “residual or “interaction”, to ensure the identity of the decomposition.

(2) As lacking a shared theoretical framework. Each individual application is viewed as a different problem requiring a different solution. Yet the various applications share certain features and objectives that can be formulated into a common structure.

In this background, Shorrocks (1999) proposes a unified theoretical framework driven by the Shapley Value analysis, which is a technique for measuring the relative importance of a set of contributing factors. The output generally shows which factors are important and which are not as important. The Shapley Value is a solution concept in cooperative game theory introduced by Lloyd Shapley in 1953. The attempt to massage the Shapley Value into a generalized framework for attributing entitlements was pioneered by Owen (1977).

2.1. Characterisation of the Shapley Value

An important issue in distributive analysis would be how to assign weights to the factors that contribute to an observed level or change in a measure of living standards. For instance, a change in the incidence of poverty between two dates may be attributable to factors such as growth, redistribution or both growth and redistribution, and analysts are interested in quantifying the relative degree of importance of these factors. There are different methods to perform the attribution, all of which must have to deal with the fact that the contribution of a factor depends on the presence of the other factors. This issue is similar to problems that arise in cooperative game theory, and recent literature in distributive analysis is proposing an attribution according to the Shapley Value (see Shorrocks, 1999; Kabore, 2002; Rongve, 1995; Chantreuil and Trannoy, 1999). We will first appeal to cooperative game theory before interpreting the solution set in distributive analysis.

A typical question to address is: what might each player reasonably expect to receive (or pay) as his or her share of the reward (or cost) in a cooperative game? The solution concept widely used in the theory of cooperative games to answer such questions is the Shapley Value (see Owen, 1977, Moulin 1988). The Shapley Value provides a recommendation for the division of the joint profits or costs of the grand coalition, which satisfies some reasonable properties. For instance, let K = {1, 2, …, m} be a finite set of players. Non-empty sub-sets of K are called coalitions. To accomplish the division process, the players may form coalitions and the strength of each coalition is expressed as a characteristic function v. For any coalition or sub-set $S \subseteq K$, v(S) measures the share of the surplus or loss that the coalition, S, is capable of appropriating without resorting to agreements with players belonging to other coalitions.

For each player k, $k \notin S$, Shapley (1953) proposes a value based on the player's marginal contribution – defined as the weighted mean of the marginal contributions $v(S \cup \{k\}) - v(S)$ of player *k* in all coalitions $S \subseteq K - \{k\}$. That is, player *k* is attributed the extra amount that he brings to the existing coalition of players. To identify this value, we imagine that the m players are randomly ranked in some order, or join the game in a random order, defined by σ:

$$\sigma = \{\sigma_1, \sigma_{2, \ldots,} \sigma_{k-1}, \sigma_{k,} \sigma_{k+1} \ldots, \sigma_m\}, \qquad (2)$$

and then successively eliminated in that order. The elimination of players reduces the share accruing to the group of those not yet eliminated. When the coalition, S, is composed of s elements, we can only find the value they will obtain, v(S), when the first s elements of σ are exactly the elements of S. The weight of the coalition, S, will be measured by the probability that the first s elements of σ are all elements of S. This probability is found by dividing the number of ordered arrangements of which the first s elements are all in S by the total number of possible ordered arrangements. The numerator can be obtained by imagining that the first s players are orderly arranged in a sequence and the remaining m-s-1 players are also orderly arranged in another sequence.

The number of possible ordered arrangements is the number of permutations of m players taken m at a time, which is m!. By the same reasoning, since the first s players yield s! number of permutations, the remaining m-s-1 players would yield (m-s-1)! number of permutations. The number of ordered arrangements in which the first s players are all elements of S is thus given by s!(m-s-1)!.

The weight (or probability) that the first s elements of σ are all elements of S is thus defined by s!(m-s-1)!/m!, where s is the size of the coalition S. This weight also measures the probability that the player before player *k* will be in S. The Shapley Value of player *k*, denoted by $f_k^S(K,v)$, is thus the weighted mean of his marginal contributions v(S∪{*k*}) - v(S) over the set of coalitions S ⊆ K- {*k*} given by:

$$f_k^S(K,v) = \sum_{s=0}^{m-1} \sum_{\substack{S \subseteq K-\{k\} \\ |S|=s}} \frac{s!(m-s-1)!}{m!} [v(S \cup \{k\}) - v(S)] \qquad (3)$$

where by convention, 0! = 1 and v(∅) = 0.[3]

To apply the Shapley Value in distributive analysis, instead of considering m players as in cooperative game theory, we now consider m factors that contribute to the explanation of an observed phenomenon. The Shapley Value given in Equation 3 satisfies all three of Shapley's axioms, two of which are of interest to us here. They state that:

(1) The expression $f_k^S(K,v)$ should be symmetric (or anonymous) in the sense that the contributions assigned to any given factor should not depend on the way in which the factors are labelled or listed. In other words, $f_k^S(K,v)$ should be independent of the factor's label, 1, 2, …, m; and

(2) The decomposition should be exact and additive, so that, for $\forall_k \in K$ and $\forall_{k+1} \in K$, $f_k^S(K,v) \cap f_{k+1}^S(K,v) = \varnothing$ and $\sum_{k=1}^{m} f_k^S(K,v) = v(K)$. That is, the intuitively appealing contributing factors should form a partition, so that there is no need for vague concepts such as residual or interaction terms to secure the identity of the decomposition.[4] Since by the additivity axiom the set of factors completely determine the aggregate indicator, I, in Equation 1, it is convenient to assume that v(∅) = 0, in the sense that I is zero when all the factors are removed.

[3] The Shapley Value can also be interpreted as the expected marginal contribution made by the player (or factor) to the value of a coalition, where the distribution of coalitions is such that any ordering of the players (or factors) is equally likely.

[4] For a proof of these Shapley's axioms in the context of distributive analysis, see Shorrocks (1999. p. 5-6)

3. Decomposition of Poverty Changes into Growth and Redistribution effects

The adoption of the Enhanced Growth and Poverty Reduction (EGPR) strategies proposed by the donor community in sub-Saharan Africa in the 1990s is indicative of the belief that economic growth helps to alleviate poverty. In the context of absolute poverty measurement, growth is expected to augment the incomes of, at least, some of the poor, hence leading to a fall in measured poverty using any conventional poverty index. This tendency can, however, be reinforced or even reversed if economic growth is accompanied by redistribution, which is pro-poor or pro-rich, respectively. Even for a given rate of economic growth, a neutral or pro-poor redistribution pattern is preferable in terms of its impact on poverty. In what follows, an attempt is made to separate the effects of growth and redistribution on changes in measured poverty between two dates – using the Shapley approach, which yielded an exact decomposition and then the standard approach due to Datt-Ravallion (1992).

3.1. The Shapley Approach

Given a fixed poverty line Z, the poverty level at time t may be expressed as a function $P(\mu_t, L_t)$ of mean income μ_t and the Lorenz curve L_t. Following Shorrocks (1999), the growth factor in the change in poverty between period t and t+n is denoted by $G = \frac{m_{t+n}}{m_t} - 1$ and the redistribution factor by $D = L_{t+n} – L_t$. The exercise becomes one of identifying the contributions of growth, G, and redistribution, D, in the decomposition of changes in any poverty measure that is additively decomposable. As is habitual in most applications, we adopt the P_α class of poverty measures (Foster, Greer and Thorbecke, 1984). The aggregate change in the P_α class of measures is given as

$$\Delta P_\alpha = P(\mu_{t+n}, L_{t+n}) – P(\mu_t, L_t) = P(\mu_t(1+G), L_t + D) – P(\mu_t, L_t) = v(G, D). \qquad (4)$$

This is an expression of the change in poverty, ΔP_α, which we need to decompose into the growth (G) and redistribution (D) components. Since there are just two factors here, the possible elimination sequences (permutations) are m! = 2! = 2, given by {G, D} and {D, G}. The marginal contribution of growth, G, to ΔP_α and the associated weight is given in panel (a) of Table 1 and the marginal contribution of redistribution, D, and the associated weight is given in panel (b).

Table 1: Application of Equation 3 for growth and redistribution components

		S	s	$\frac{s!(m-s-1)!}{m!}$	v(S∪{k})-v(S) (marginal contributions)
Panel (a)					
Nº of elements in S before G	0	∅	0	0.5	v(∅∪{G})-v(∅) = v(G)-0
	1	{D}	1	0.5	v(D∪{G})-v(D) = v(G,D)-v(D)
Panel (b)					
Nº of elements in S before D	0	∅	0	0.5	v(∅∪{D})-v(∅) = v(D)-0
	1	{G}	1	0.5	v(G∪{D})-v(G) = v(G,D)-v(G)

The Shapley Values of the growth and redistribution components can be interpreted from Table 1 as follows:

$$f_G^S(2,v) = 0.5[v(G,D) - v(D) + v(G)] \quad (5)$$

$$f_D^S(2,v) = 0.5[v(G,D) - v(G) + v(D)] \quad (6)$$

When growth is absent, G takes the value 0 and the change in poverty due only to redistribution becomes

$$v(D) = P(\mu_t, L_{t+n}) - P(\mu_t, L_t) \quad (7)$$

The indication here is that the change in poverty is due only to a shift in the Lorenz Curve from L_t to L_{t+n}, holding mean income constant. By the same token, assuming away the redistribution factor by setting D=0 gives

$$v(G) = P(\mu_{t+n}, L_t) - P(\mu_t, L_t) \quad (8)$$

This shows that the change in poverty is due to a change in mean income from μ_t to μ_{t+n}, with the Lorenz Curve fixed at L_t. In other words, this is a situation of a distributionally neutral growth. The full expressions of Shapley contributions for the growth and redistribution effects are given by Equations 9 and 10, making use of Equations 4 to 8, as

$$f_G^S(2,v) = 0.5[P(\mu_{t+n}, L_{t+n})–P(\mu_t, L_t)–\{P(\mu_t, L_{t+n})–P(\mu_t, L_t)\}+\{P(\mu_{t+n}, L_t)–P(\mu_t, L_t)\}]$$

$$= 0.5[P(\mu_{t+n}, L_{t+n}) – P(\mu_t, L_{t+n}) + P(\mu_{t+n}, L_t) – P(\mu_t, L_t)] \quad (9)$$

$$f_D^S(2,v) = 0.5[P(\mu_{t+n}, L_{t+n})–P(\mu_t, L_t)–\{P(\mu_{t+n}, L_t)–P(\mu_t, L_t)\}+\{P(\mu_t, L_{t+n})–P(\mu_t, L_t)\}$$

$$= 0.5[P(\mu_{t+n}, L_{t+n}) – P(\mu_{t+n}, L_t) + P(\mu_t, L_{t+n}) – P(\mu_t, L_t)] \quad (10)$$

It can easily be seen that overall change in poverty is the sum of the growth and redistribution components given by the Shapley contributions.

$$\Delta P_\alpha = \phi_G(2, v) + \phi_D(2, v) \quad (11)$$

This is an exact decomposition, it does not depend on the choice of the base year and the factors are treated symmetrically in contrast with the standard one suggested by Datt and Ravallion (1992).

3.2. The Standard Datt-Ravallion (1992) Approach

The standard dynamic decomposition of measured poverty between two dates, t and t + n, which allows one to rigorously quantify the relative importance of growth versus redistribution, is proposed by Datt and Ravallion (1992). This decomposition procedure has been widely applied or reviewed (see, Datt and Gunewardena, 1997; Canagarajan et al., 1997; McKay, 1997) and modified for the effect of a change in the poverty line by Ali (1997) and Shorrocks and Kolenikov (2001). As this is not an exact decomposition, there is always a residual component that captures the interaction between growth and redistribution.

Essentially, the Datt-Ravallion methodology decomposes a given change in aggregate poverty between two dates, t and t+n, into a growth component denoted by G(t, t+n, r), a redistribution component D(t, t+n, r) and a residual R(t, t+n, r), where r is a reference period (which may be t or t+n). The growth component, W(.), gives the change in the mean income while holding the Lorenz Curve constant at the reference level L_r. The redistribution component, D(.), gives the change in poverty due to a change in the Lorenz Curve while keeping the mean income at the reference level μ_r. The residual, R(.), measures the interaction between growth and redistribution.

Assuming a fixed absolute poverty line, a poverty measure that is additive and time-consistent may be defined as $P_{\alpha,t} = P(Z/\mu_t, L_t)$, where μ is mean expenditure (or income) and L is a vector fully defining the Lorenz Curve. The change in poverty can be decomposed as in Equation 12.

$$P_{\alpha,t+n} - P_{\alpha,t} = G(t, t+n; r) + D(t, t+n; r) + R(t, t+n; r) \quad (12)$$

where

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

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

$$R(t, t+n; r) = G(t, t+n; t+n) - G(t, t+n; t) = D(t, t+n; t+n) - D(t, t+n; t) \quad \text{for } r=t$$

The residual term is interpreted as the difference between the growth (redistribution) components evaluated at the terminal and initial Lorenz Curves (mean incomes), respectively. Such a residual term is absent in the Shapley decomposition. The problem of which period one should consider as reference is also eliminated by the Shapley decomposition.

4. Data, Poverty Measures, and Poverty Lines

4.1 Presentation of Household Data

The analysis of poverty in this text is based on two household surveys – the 1984 budgetary and consumption survey (BCS) (Government of Cameroon, 1984), September 1983 – September 1984, and the 1996 Cameroon Households Consumption Survey (CHCS) (Government of Cameroon, 1996), February – April 1996, carried out by the government’s Statistics Office. These snapshots represent points before and during SAP in which household surveys are available.

These surveys vary in duration – one year for the first survey and three months for the second - and in sample size – 5474 households for the first and 1731 for the second. They are similar in (1) the partitioning of the various regions - in the sense that the 1984 survey could easily be regrouped to mimic the structure of the 1996 survey - and

(2) the sampling techniques used. During the 1984 survey, price data were systematically collected from the nearest markets, which were used to value the products consumed by households. In the case of the 1996 survey, price data were only available for the urban areas, and hence some adjustments were made to obtain unit prices for the rural areas.[5]

The 1984 food and total expenditures were scaled up, employing the food and total consumer price indices, respectively, to express them in terms of 1996 prices to enable us use the poverty lines computed from the 1996 survey for the two periods.[6] For all practical purposes, these surveys are considered suitable for the present study. The welfare indicator used is expenditures per adult equivalent. Since the composition of households by age was captured by the surveys, we followed previous studies in Cameroon to attribute adult equivalent scales of 1 to all adults (15 years old and above) and 0.5 to children (less than 15 years old).

4.2 Poverty Measures

The poverty indices used belong to the P_α class of poverty measures, specifically P_0, P_1 and P_2, which represent the headcount, the poverty-gap and the squared poverty-gap indices, respectively (using the terminology of Foster, Greer and Thorbecke, 1984). The headcount index measures the incidence of poverty, the poverty-gap index measures the depth of poverty and the squared poverty-gap index measures the severity of poverty.[7]

4.3 Poverty Lines

The procedure we follow in deriving the poverty lines to separate the poor from the non-poor is a blend of the FEI and CBN methods, which consists of two-stages (see Fambon *et al*, 2000b; and Baye, 2004): (1) calculating a food poverty line by the FEI method, and evaluating the corresponding non-food expenditures required to scale-up the food poverty line to determine the overall poverty lines using a hybrid of the CBN approach.[8] In particular, to obtain the food poverty line use is made of "non-parametric" regressions of food expenditures on calorie-intake per adult equivalent, which follow the logic of parametric regressions proposed by Greer and Thorbecke (1986), and for non-food expenditures "non-parametric" regressions of total expenditures on food

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[5] More detailed description of the content of 1996 data, their sampling properties and other features can be found in Fambon *et al.* (2000a).

[6] Ideally, we would have used the same methodology to compute poverty lines using the 1984 data, but the food items in these data are not disaggregated to enable the calculation of calorie-intake per adult equivalent that is crucial in the methodology. Fischer indices could have been the first best alternative approach to use in scaling up the 1984 food and total expenditures, but Fischer indices also require data on disaggregated quantities, which are unavailable. We therefore consider our choice of the food and aggregate consumer price indices as a second best approach.

[7] For the implications and shortcomings of these measures, see Baye (1998).

[8] For a more comprehensive presentation of this approach, with illustrations see Baye (2004).

expenditures, which follow the logic of parametric regressions proposed by Ravallion (1992), Ravallion and Bidani (1994), and Ravallion (1998).

The first stage consists of estimating the cost of a basket of food items required to meet some minimum level of calorie intake, estimated for Cameroon by FAO at 2400 kcal per adult per day. This value is projected from the X-axis to intersect the "non-parametric" regression line of food expenditures on calorie-intake and the cost read on the Y-axis as the food poverty line.[9] The food poverty line (Z_F) was estimated at 255.95 CFA francs per day per adult equivalent for 1996. The "non-parametric" regressions were performed using DAD4.3-R: software for Distributive Analysis developed by researchers in Université Laval.[10]

The second stage involves estimating the *total* expenditures of those whose food expenditures equal the *food* poverty line. In practice, however, to obtain the aggregate poverty line, an amount equal to the food poverty line can be projected from the X-axis to intersect the estimated regression line of total expenditures on food expenditures. The corresponding point on the Y-axis defines the aggregate poverty line. An aggregate poverty line (Z_U) of 533.87 CFA francs per day per adult equivalent was adopted.

5. The Empirical Results

Both national and zonal poverty levels, their changes and contributions to the changes are presented in Tables 2 to 5. The standard decomposition results due to Datt-Ravaillion are reported in the first panel and those due to Shapley are reported in the second panel of Table 3 for food poverty and Table 5 for overall poverty. The first panel of Tables 3 and 5 show that the standard results have residual effects that tend to eclipse the redistributional effects. Our discussion on the growth and redistribution components is based on the second panel of Tables 3 and 5 that present the exact decomposition results due to Shapley. The decomposition exercise indicates the relative importance of the change in the level of mean household income/expenditure and the change in its distribution in explaining the observed changes in poverty.

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[9] The advantages of a "non-parametric" regression over a parametric one are that: (1) they do not impose *a priori* functional forms, and (2) the procedure applies a local weighting process that attributes smaller weights as the absolute gaps between individual calorie intakes and the predetermined minimum increase. The results obtained by this method are less affected by the presence of "outliers" in the data and thus do not suffer significantly from specification bias that originates from a "wrong" functional form.

[10] See for example, Duclos, Araar, and Fortin (2003).

Table 2: Zonal Food Poverty indices in 1984 and 1996

(Z_F = 255.95)

Zone	1984				1996			
	Pop. Share	P_0	P_1	P_2	Pop. Share	P_0	P_1	P_2
Urban	0.1119	0.0284	0.0046	0.0014	0.2945	0.4578	0.1603	0.0760
	(0.0062)	(0.0071)	(0.0013)	(0.0005)	(0.0268)	(0.0279)	(0.0134)	(0.0079)
Semi-Urban	0.1824	0.2680	0.0906	0.0419	0.0518	0.5859	0.2534	0.1342
	(0.0280)	(0.0343)	(0.0157)	(0.0089)	(0.0238)	(0.1613)	(0.0790)	(0.0470)
Rural	0.7056	0.4206	0.1355	0.0598	0.6537	0.8129	0.3691	0.2022
	(0.0289)	(0.0246)	(0.0108)	(0.0058)	(0.0429)	(0.0340)	(0.0261)	(0.0187)
Cameroon	1.0 (0.00)	0.3488 (0.0194)	0.1126 (0.0084)	0.0500 (0.0044)	1.0 (0.00)	0.6965 (0.0291)	0.3016 (0.0198)	0.1615 (0.0134)

Source: Calculated from BCS 1984 and CHCS 1996 Survey Data.

All the national food poverty indices (incidence, depth and severity) show a highly significant increase during the period 1984-1996. The head-count index, for instance, rose by 35 percentage points from 35 % in 1984 to 70 % in 1996, while the depth and severity of national food poverty rose by 19 and 11 percentage points, respectively (Tables 2 and 3). These food poverty changes were found to be significantly different from zero at the 1 % level. By components, distributionally neutral growth accounted for more than 35 points, and the distributional shifts moderated the outcome to register just a 35 percentage points' increase in the incidence of food poverty. A similar tendency is observed with the changes in the depth and severity of poverty. The indication here is that the increase in national food poverty between 1984 and 1996 was overwhelmingly accounted for by a large decline in mean incomes and the redistribution effects only marginally mitigated worse effects of poverty on the population. A similar tendency is captured in both the rural and semi-urban areas.

In the rural areas, for instance, the incidence, depth and severity of food poverty increased by 41.2, 25.2 and 15.7 percentage points, respectively (Table 3). But for the attenuating effects of the distributional shifts, poverty would have hit the rural dwellers even harder. This is so because the distributionally neutral decline in mean incomes accounted for the increases in the incidence, depth and severity of rural poverty of 41.8, 27.2 and 17.3 percentage points, respectively, which surpassed the changes in rural poverty (Table 3). In the semi-urban areas, the increase in the headcount, poverty gap and squared poverty gap indices of 30.4, 15.4 and 8.6 percentage points were more than accounted for by the distributionally neutral growth effects. The redistribution effects had a positive effect on poverty alleviation, reflecting reducing inequality in semi-urban areas, but it was much too small to counter the impact on poverty of the sharp decline in mean incomes.

A different picture is, however, painted in the urban centres where the significant increase in the headcount, poverty gap and squared poverty gap indices were reinforced by both distributionally neutral growth and distributional shifts. The main mechanism of the observed adverse redistributional components of poverty changes over the period under consideration seem to have been the relative downturn in formal sector employment following the retrenchments in the early 1990s of public and semi-public sector workers and the consequent overcrowding in the urban informal sector. This suggests that the economic crisis and expenditure reducing measures caused income distribution to be skewed towards the richest households in urban centres. The indication of these observations is that the structure of income distribution in urban centres is such as to exacerbate the negative impact on the welfare of the poor. The implication of the findings is that growth would have a significantly positive impact on poverty alleviation and policies that redistribute in favour of the rural and semi-urban areas could marginally enhance the positive effects of growth on poverty reduction.

Table 3: Growth and Redistributional Effects of Changes in Food Poverty
(Z_F = 255.95)

	Standard Approach due to Datt et Ravallion (reference period t_1)				Shapley Approach		
Zones and P_{α}'s	Growth Component	Redistribution Component	Residual	Total Change	Growth Component	Redistribution Component	Total Change
Urban							
P_0	0.3690	0.0288	0.0338	0.4316	0.3859	0.0457	0.4316**
	(0.0445)	(0.0130)	--	(0.0247)	(0.0152)	(0.0152)	(0.0247)
P_1	0.1166	0.0085	0.0288	0.1539	0.1310	0.0229	0.1539**
	(0.0160)	(0.0076)	--	(0.0103)	(0.0127)	(0.0127)	(0.0103)
P_2	0.0505	0.0042	0.0193	0.0741	0.0602	0.0139	0.0741**
	(0.0083)	(0.0029)	--	(0.0059)	(0.0061)	(0.0061)	(0.0059)
Semi-urban							
P_0	0.3727	-0.0841	0.0152	0.3038	0.3803	-0.0765	0.3038**
	(0.0828)	(0.0448)	--	(0.1295)	(0.0280)	(0.0280)	(0.1295)
P_1	0.2001	-0.0332	0.0128	0.1541	0.1937	-0.0396	0.1541*
	(0.0356)	(0.0275)	--	(0.0671)	(0.0545)	(0.0545)	(0.0671)
P_2	0.1248	-0.0186	0.0203	0.0860	0.1147	-0.0287	0.0860*
	(0.0273)	(0.0165)	--	(0.0405)	(0.0348)	(0.0348)	(0.0405)
Rural							
P_0	0.4060	-0.0172	0.0234	0.4122	0.4177	-0.0055	0.4122**
	(0.0348)	(0.0295)	--	(0.0371)	(0.0168)	(0.0168)	(0.0371)
P_1	0.2678	-0.0237	0.0083	0.2523	0.2719	-0.0196	0.2523**
	(0.0211)	(0.0284)	--	(0.0257)	(0.0326)	(0.0326)	(0.0257)
P_2	0.1752	-0.0149	0.0035	0.1567	0.1734	-0.0167	0.1567**
	(0.0189)	(0.0139)	--	(0.0184)	(0.0207)	(0.0207)	(0.0184)
Cameroon							
P_0	0.3465	-0.0129	0.0141	0.3477	0.3535	-0.0058	0.3477**
	(0.0306)	(0.0277)	--	(0.0350)	(0.0131)	(0.0131)	(0.0350)
P_1	0.2026	-0.0199	0.0063	0.1890	0.2057	-0.0167	0.1890**
	(0.0170)	(0.0212)	--	(0.0215)	(0.0246)	(0.0246)	(0.0215)
P_2	0.1271	-0.0123	0.0032	0.1115	0.1255	-0.0140	0.1115**
	(0.0135)	(0.0103)	--	(0.0141)	(0.0147)	(0.0147)	(0.0141)

Source: Calculated from BCS 1984 and CHCS 1996 Survey Data.
Note: Figures in parentheses represent standard errors. Stratification and clustering in the surveys were taken into consideration when setting the sample designs. ** and * indicate significance at the 1% and 5% levels, respectively.

The incidence of overall poverty in rural areas is higher than that of urban areas over the period under review. Rural areas contributed relatively about 86 % of national aggregate poverty in 1984 and about 80 % in 1996 (Table 4). This drop in the rural contribution to national poverty is attributable to the decline in the population share of rural areas from about 71 % in 1984 to 65 % in 1996 associated with net migration from rural to urban areas. Yet, a comparison of relative contributions and population shares in both periods indicates that the rural areas are disproportionately suffering from aggregate poverty. Table 4 also shows the contraction of the semi-urban population from 18 % to 5 % over the same period. This apparent depopulation of the semi-urban areas may be attributed to the reclassification of villages, as well as to net migration to the main cities between 1984 and 1996 (Baye, 2004).

The incidence of overall national poverty increased from 39 to 68 % between 1984 and 1996. The change in national incidence of poverty of 29 percentage points is significantly different from zero at the 1 % level (Table 5). The depth and severity of aggregate poverty increased significantly by 14 and 8 percentage points, respectively.

Table 4: Zonal Overall Poverty indices in 1984 and 1996

(Z_U = 533.87)

Zone	1984				1996			
	Pop. Share	P_0	P_1	P_2	Pop. Share	P_0	P_1	P_2
Urban	0.1119	0.0150	0.0024	0.0007	0.2945	0.3675	0.1163	0.0509
	(0.0062)	(0.0048)	(0.0010)	(0.0004)	(0.0268)	(0.0314)	(0.0126)	(0.0066)
Semi-Urban	0.1824	0.2961	0.0998	0.0466	0.0518	0.6032	0.2096	0.0946
	(0.0280)	(0.0281)	(0.0126)	(0.0068)	(0.0238)	(0.1152)	(0.0520)	(0.0270)
Rural	0.7056	0.4764	0.1578	0.0711	0.6537	0.8265	0.3426	0.1748
	(0.0289)	(0.0238)	(0.0115)	(0.0064)	(0.0429)	(0.0357)	(0.0246)	(0.0166)
Cameroon	1.0 (0.00)	0.3918 (0.0190)	0.1298 (0.0087)	0.0588 (0.0048)	1.0 (0.00)	0.6798 (0.0313)	0.2691 (0.0188)	0.1342 (0.0119)

Source: Calculated from BCS 1984 and CHCS 1996 Survey Data.

As with the decomposition of the determinants of food poverty changes, the growth components overwhelmingly dominate the redistribution components both at the national and zonal levels (Table 5). With the exception of the head-count index at the national level, the other measures at the national level and all measures at the rural and semi-rural areas indicated opposing effects between growth and redistribution in explaining the poverty outcomes. For all the poverty measures, while the growth components over-accounted for the increase in poverty between 1984 and 1996, shifts in rural and semi-urban distributions mitigated worse effects of the crisis and reforms that caused poverty to rise. By all poverty measures, shifts in urban distribution, on the other hand, reinforced poverty in that sector. Indeed, both a decline in mean income and adverse distributional shifts contributed to the significant increase in urban poverty during the period under study.

Table 5: Growth and Redistributional Effects of Changes in Overall Poverty

(Z_U = 533.87)

	Standard Approach due to Datt et Ravallion (reference period t_1)				Shapley Approach		
Zones and P_a's	Growth Component	Redistribution Component	Residual	Total Change	Growth Component	Redistribution Component	Total Change
Urban							
P_0	0.2663	0.0350	0.0512	0.3525	0.2920	0.0606	0.3525**
	(0.0420)	(0.0143)	--	(0.0318)	(0.0145)	(0.0145)	(0.0318)
P_1	0.0693	0.0109	0.0337	0.1139	0.0862	0.0277	0.1139**
	(0.0120)	(0.0056)	--	(0.0126)	(0.0110)	(0.0110)	(0.0126)
P_2	0.0255	0.0039	0.0209	0.0503	0.0359	0.0143	0.0503**
	(0.0053)	(0.0026)	--	(0.0066)	(0.0052)	(0.0052)	(0.0066)
Semi-urban							
P_0	0.2819	-0.0741	0.0993	0.3071	0.3316	-0.0245	0.3071**
	(0.1136)	(0.0679)	--	(0.1186)	(0.0325)	(0.0325)	(0.1186)
P_1	0.1396	-0.0410	0.0112	0.1098	0.1452	-0.0354	0.1098*
	(0.0373)	(0.0409)	--	(0.0535)	(0.0578)	(0.0578)	(0.0535)
P_2	0.0822	-0.0253	0.0089	0.0480	0.0778	-0.0297	0.0480
	(0.0248)	(0.0204)	--	(0.0279)	(0.0310)	(0.0310)	(0.0279)
Rural							
P_0	0.3242	-0.0405	0.0665	0.3502	0.3574	-0.0072	0.3502**
	(0.0370)	(0.0329)	--	(0.0430)	(0.0220)	(0.0220)	(0.0430)
P_1	0.2108	-0.0401	0.0142	0.1848	0.2178	-0.0330	0.1848**
	(0.0217)	(0.0273)	--	(0.0272)	(0.0339)	(0.0339)	(0.0272)
P_2	0.1352	-0.0258	0.0058	0.1037	0.1323	-0.0287	0.1037**
	(0.0179)	(0.0133)	--	(0.0178)	(0.0208)	(0.0208)	(0.0178)
Cameroon							
P_0	0.2611	-0.0170	0.0439	0.2880	0.2830	0.0050	0.2880**
	(0.0321)	(0.0278)	--	(0.0366)	(0.0133)	(0.0133)	(0.0366)
P_1	0.1491	-0.0214	0.0116	0.1393	0.1549	-0.0156	0.1393**
	(0.0163)	(0.0187)	--	(0.0207)	(0.0228)	(0.0228)	(0.0207)
P_2	0.0913	-0.0155	0.0004	0.0754	0.0911	-0.0157	0.0754**
	(0.0120)	(0.0100)	--	(0.0129)	(0.0138)	(0.0138)	(0.0129)

Source: Calculated from BCS 1984 and CHCS 1996 Survey Data.
Note: Figures in parentheses represent standard errors. Stratification and clustering in the surveys were taken into consideration when setting the sample designs. ** and * indicate significance at the 1% and 5% levels, respectively.

A central observation emanating from the paper is that the significant increase in poverty between 1984 and 1996 was due more to the reduction in average incomes than to the rise in inequality. Such results illustrate the potential contribution of distributionally neutral growth in household incomes to poverty alleviation. As remarked by McKay (1997), this is not to deny that redistribution also has a role to play, but there must be severe limits to what can be achieved by redistribution in the absence of growth. This is reflected in the growth neutral marginal redistributional effects. In this context, growth in household incomes is likely to be essential for long-term poverty reduction. This will, however, be much less effective if growth tends out to be highly skewed towards the richest households. Growth in incomes is, therefore, needed and it should be distributionally sensitive.

6. Concluding Remarks

This paper attempted to investigate the characteristics of poverty in the period 1984-1996, how poverty evolved over this period and the factors explaining its various changes. Specifically, it (1) developed an exact decomposition method that anchors on the Shapley Value analysis, and (2) investigated the growth and redistribution effects of changes in both food and aggregate poverty. The procedure adopted tended out to be a unified conceptual framework that is amendable to most kinds of decompositions in distributive analysis and free of hazy concepts like residual or interaction terms. The paper discussed the effects of growth and redistribution on changes in measured poverty between 1984 and 1996 using the Shapley approach.

The decomposition of food and aggregate poverty changes indicated that the growth components overwhelmingly dominated the redistribution components both at the national and zonal levels. Most measures at the national level and all measures at the rural and semi-rural areas indicated opposing effects between growth and redistribution in explaining the poverty outcomes. For all the poverty measures, while the growth components over accounted for the increase in poverty between 1984 and 1996, shifts in rural and semi-urban distributions mitigated worse effects of the crisis and reforms that caused poverty to rise. Shifts in urban distribution, on the other hand, reinforced poverty in that sector. Indeed, both a decline in mean incomes and adverse distributional shifts contributed to the significant increase in urban poverty during the period under review. In general, knowledge of how much of observed changes in poverty are due to changes in the redistribution as distinguished from growth in average incomes is critical for public policy and debate. These issues are particularly useful in the context of poverty reduction under resource constraints warranting the use of informed targeting schemes.

The implication of these findings is that growth would have a significantly positive impact on poverty alleviation and policies that redistribute in favour of the rural and semi-urban areas could marginally enhance the positive effects of growth on poverty alleviation. Such outcomes would curb massive migration into the main cities of the country and perhaps reduce the skewness in income distribution in the urban centres.

The decomposition analysis of poverty changes in this paper corroborated the general result in the literature that growth effects tend to dominate the effects of changes in the distribution of income (*see* Datt, and Ravallion, 1992; McKay, 1997). The results illustrated the potential contribution of distributionally neutral growth in household incomes to poverty alleviation in Cameroon. The temptation is resisted, however, not to deny that redistribution also has an important role to play, but there must be severe limits to what can be achieved by redistribution in the absence of growth. This is reflected in the marginal redistributional effects registered in the paper. Under all practical considerations, growth in household incomes appears more likely to be essential for long-term poverty reduction, which will, however, be much less effective if growth tends out to be highly skewed towards the richest deciles. The bottom line is an advocacy for growth-based policies that create opportunities for the poor to increase their incomes.

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