



Munich Personal RePEc Archive

A subgroup decomposition of inequality of poverty in Cameroon

BEJA BILOA ESSIMI Jean Aristide and CNC CHAMENI
NEMBUA Célestin and MWC MIAMO WENDJI Clovis

University of Yaoundé II, Faculty of Economics and Management,
University of Yaoundé II, Faculty of Economics and Management,
University of Dschang, Faculty of Economics and Management.

2012

Online at <http://mpra.ub.uni-muenchen.de/38141/>
MPRA Paper No. 38141, posted 16. April 2012 16:24 UTC

A subgroup decomposition of Inequality of Poverty in Cameroon

Auteurs

BILOA ESSIMI Jean Aristide
University of Yaoundé II, Faculty of Economics and Management
Tel: (237) 96 49 33 76
e-mail: essaristid@yahoo.com

CHAMENI NEMBUA Célestin
University of Yaoundé II, Faculty of Economics and Management,
BP 604 Yaoundé
Tel : (237) 220.66.32 (D) (237) 7795.19.27 (M) Fax (237) 222.18.73
e-mail: chameni@yahoo.com

MIAMO WENDJI Clovis
University of Yaoundé II, Faculty of Economics and Management.
University of Dschang, Faculty of Economics and Management.
BP 12808 Yaoundé
Tel: (237) 99 32 97 06
e-mail: c_miamo_w@yahoo.fr

Abstract

This paper studies multi-dimensional aspects of deprivation associated to the living conditions and inequality status in Cameroon. The study employs the fuzzy-set framework to analyze deprivation and inequalities through Dagum sub group decomposition. Results in deprivation analysis and inequalities related reveal some new insights about the poverty situation in the country, which contrasts with the results available from traditional poverty analysis. We observe respectively, high deprivation degrees for household 'essential' items such as health, education and housing and a small Gini index for inequalities of deprivation. Decomposition by group reveals that within groups inequalities are as important as the between groups.

Keywords: Fuzzy-sets, Poverty, Inequality, Sub-group-Decomposition, Cameroon

Classification JEL : C02, D01, I32, R20

1. Introduction

For more than a decade, inequality and poverty have attracted a lot of attention among analysts (Bourguignon and Morrison, 2002) and a generally viewed in most countries as a serious development problem (Milanovic, 2000). However, most of these studies suffer from

limitations associated to uni-dimensional analysis¹, where they referred to income or consumption as the single proxy of poverty (Filipone et al., 2001). This simplification of the analysis, associated to well being issues like inequality and poverty by the traditional need to dichotomise the population into the poor and the non poor through the means of the so called poverty line (Cheli 1995) needs to be further enhanced. The simplification wipes out the complexity and multidimensionality² of these phenomena. Consequently the policy recommendations from such traditional income based analysis are inefficient. These limitations of uni-dimensional poverty measures are also compounded by other technical difficulties of income measurement, especially in developing countries where information on income are not available³.

Limitations associated to poverty measures based on a single monetary indicator of resources (Atkinson and Bourguignon, 1982; Maasoumi, 1998), underscore the strong need for a multidimensional approach to poverty analysis. It is believed that the inclusion of other dimensions in normative poverty analysis would help to reveal complexities and ambiguities in the distribution of well-being that income based poverty analysis cannot capture (Robeyns, 2003). This can also facilitate analysis of deprivation outcomes. This make possible to differentiate economic well-being (i.e. increased material prosperity) from *human* well-being (Baliamoune, 2003) along the lines of Sen's notion of *functionings* and *capability*⁴

In Cameroon the problem of poverty remains a preoccupation for the government. Many studies in the country denote a stagnation of monetary poverty levels during the period of 2001-2007 around 39.9 percent. Concerning inequalities, over the period 1996-2001, the square of the coefficient of variation and the Theil index indicates an increase of income inequalities from 1.2259 to 1.5230 for the first, and from 0.4579 to 0.4936 for the last second, denoting the presence of strong deprivations in the country (Fambon, 2006; Bayes, 2003; Chameni, 2005, 2008). Given these facts, it is possible to think that there is a problem of inequality of households to poverty in Cameroon.

The aim of this paper therefore is to assess the actual living conditions in Cameroon by analyzing inequality of poverty in Cameroon. This study therefore employs the fuzzy-set theoretic framework (Zadeh, 1965; Cheli et Lemmi, 1995; Chiappero, 2000). After

¹ In the view of Satterthwaite (2001) uni-dimensional poverty measures, at best, can lead to only a partial understanding of poverty, and often to focused to ineffective poverty reduction programs.

² The multidimensional approach captures many aspects of deprivation, including lack of access to the services essential for health and literacy, as well as a lack of political voice and legal protection.

³ As noted by Sahn and Stifel (1999), the vast majority of African countries, for instance, suffer from paucity of data.

⁴ Functioning refer to various doings and beings of a person, the achievements of an individual determined by the particular way in which he is able to "let the available goods function". Capability, on the other hand, portrays one's freedom to choose what kind of life to live and, therefore the actual autonomy in pursuing and achieving those doings and beings one deems valuable (Lelli, 2001).

constructing a composite index of deprivation, the analysis of well-being will be done by applying the bidecomposition approach to sub-group and sources developed by (Dagum and Costa, 2005; Mussard and Pi Alperin, 2005). Inequality associated to deprivation will be observed with Dagum (1997)⁵ sub-groups decomposition using micro data from the 2007 Cameroon household consumption survey.

The rest of the paper is organized as follows: After a brief review of the literature in the next section, we follow up with an overview of the poverty situation in Cameroon. The subsequent section presents the methodology for estimating the poverty indices for the various dimensions, to be followed by presentation of the results. A final section presents a summary of the results and concluding remarks.

2. Capabilities approach and inequalities of deprivation

The capability approach and extensions which have been made constitutes an adequate framework for the analysis of multidimensional poverty. This is because it fills the gaps in monetary and basic needs approaches. Capability approach gives a central place to human existence and apprehends the individual well-being through the items desired by the population. According to Sen's capability reflects the freedom of individuals to choose the operating mode "functioning" to which he aspires in achieving their life choices.

The main facet of this approach is that it focuses on the features that people are actually able to achieve. The capability can be understood as a set of vectors of functioning that an individual is free to choose to conduct a certain type of life. These vectors represent the freedom to choose between possible lifestyles (Sen, 1992). The operations that are referred to, in general, concern the different basic needs required for development (include's among others those relating to nutrition, education or full participation in society). In light of the previous definition, Bojer (2004) distinguishes four types of capabilities: economic, social, human and environmental capability.

As part of our analysis, we limit ourselves to economic and human aspects of capability, as these dimensions are those encountered most often in the analysis of poverty. The economic capability is represented by the functions relating to employment, income, and some elements of comfort. The human capability includes freedom of access to institutions, education, health services, housing, etc. Inequalities on the other hand represent a fundamental social issue. Indeed, the economic and social inequities have always existed in

⁵ This decomposition is appropriate for this type of analysis, insofar as it makes it possible to arise the disparities between the natural groups which form the company (area, sex...).

all known societies. Even in the most egalitarian societies, age and sex - criteria which in itself beyond the possibilities of individual influence - provide an opportunity to observe differences (identity, activities, clean spaces) but also the forms of inequality, in the economic and social areas.

The definition of inequality often refers to three traditional forms: monetary inequality, inequality associated to living conditions and potential inequality. Monetary inequality traces the income/consumption expenditure differences between households, individuals and social groups. The inequality of living conditions arise from differences in opportunities for access to community services to satisfy basic needs such as food, health, housing, education and employment. Inequality of opportunity refer to the difference in the means available: equipment and financial assets, health infrastructure and education, as well as their proximity to housing, availability of time ("time capital" commonly used in gender inequalities), membership in social networks (social capital), etc. (Dubois, 2000).

The inequality of deprivation outcomes does not necessarily mean poverty; it tends to facilitate comparisons with respect to the dispersion or concentration of deprivation outcomes because it captures the disparities among the poor. A low level of inequality attributed to the index capturing deprivations associated with a high overall poverty rates, generally leads to the fact that a large proportion of the population is affected by poverty.

3. Fuzzy Multidimensional measures

The analysis on poverty has basically ranged its methodological choices from descriptive statistics to multivariate methods of factor analysis (Sahn and Stifel, 1999; Lelli, 2001). But if we side with Cheli (1995) in that poverty is not a discrete attribute characterised in terms of presence or absence, but rather a vague (*fuzzy*) predicate that manifests itself in different shades and degrees, then a methodological framework that uses fuzzy-sets theory to analyze poverty may seem appropriate. Fuzzy sets theory has gained popularity in recent times because it does not dichotomize the population into poor and non-poor through an arbitrary poverty line like the traditional methods. In this way it is also able to circumscribe targeting errors associated with the drastic differentiation between the poor and the non-poor, particularly between those in similar circumstances but who just happen to lie on opposite sides of a poverty line (Makdissi and Wodon, 2004). Hence many analysts including Shorrocks and Subramanian (1994) and Schaich and Munich (1996) have applied it to analyse multidimensional poverty (Chiappero Martinetti, 1994, 2000).

The fuzzy set theory is one of the two recommended approaches in the construction of a welfare index into capabilities (Lelli, 2001)⁶. For the fuzzy approach precursors, the dichotomous (poor/ non poor) vision is an excessive over simplification: because poverty is not limited only to the state of deprivation or non-deprivation in one dimension of welfare, it concerns situations where the grade or level varies from an individual to another. The fuzzy approach permits us taking in account the continuity in the individual poverty situations. It is at this point that should be situated the importance of implementation this approach, with comparison in terms of poverty-inequalities as goals.

3.1 Construction of fuzzy indicator

The construction of the fuzzy measurements is achieved through four essential steps⁷. Let $X = (X_1, X_2, X_3, \dots, X_j, \dots, X_m)$ be a set of m attributes of economic, demographic, social, politic order. Let $A = \{a_1, a_2, \dots, a_i, \dots, a_n\}$ be a population of n households.

The first step is relative to the identification of the poor's population. The main point is to define the criterion which defines a household as poor. Two criteria can be distinguished: on one hand, a household is said to be poor if it is deprive of at least one attribute. On the other hand every household whose achievements are not up to acceptable levels are considered as poor (Dagum et Costa, 2005).

The second step put an accent on the advantage of the fuzzy theory which in a gradual manner takes into consideration the poverty situations. Thus, for a given attribute j, the ratio of membership to a set of poors B, takes values from 0 to 1. The general form of the membership function is given as follows:

$$\theta_B(X_j(a_i)) = \begin{cases} 1 & \\ x_{ij} & 0 < x_{ij} < 1 \\ 0 & \end{cases}$$

Where $\theta_B(X_j(a_i))$ represents the outcome of the considered household,,1 and 0 represent the extreme situations, with 1 indicating that the household does not possess the attribute (therefore considered as extremely poor); and 0 the household possessesthe attribute.

The third step considers the poverty ratio of a household as the weighted sum of membership ratios; relatively to the m attributes of this household.

$$\theta_B(a_i) = \frac{\sum_{j=1}^m Z_j X_{ij}}{\sum_{j=1}^m Z_j} \quad (1)$$

⁶The blurry approach and the factorial approach are recommended in the construction of an indicator.

⁷ Costa(2002)

With Z_j : the weight or ponderation.

The ponderation selection depends on the social context and beliefs of the researcher. We maintain the ponderation proposed by Cérioli et zani (1990) which considered an equal weight to logarithms of the population's weight of poor individuals, in terms of the considered attribute.

The fourth step is concerned with the measurement of the total poverty by aggregating the individual levels. Total poverty is defined as the weighted average of unidimensional poverties:

$$P = \frac{\sum_{i=1}^n \theta_B(a_i)H(a_i)}{\sum_{i=1}^n H(a_i)} \quad (2)$$

These fuzzy poverty indicators have been subject to sub group decomposition (Mussard et Pi Alperin, 2005) and by attribute (Dagum et Costa, 2005). These decompositions allow us to obtain the different socio economic subgroup and their attributes, contributions to global poverty. These decompositions will be used in the framework of our applications.

3.2 Fuzzy poverty gaps

Numerous studies concerning inequalities have been realized, among which we have the Sen (1976) approach. This approach is the first to capture inequality in poor distribution on the base of the Gini index for the poverty gaps ratio. The main limit to this measurement is that it does not offer precise information on determinants of inequalities associated to different forms of deprivations. This justifies the use of multidimensional analysis. Referring to the precedent results on the poverty analysis, we will hereby perform an evaluation of multidimensional poverty-gaps by geographic and socioeconomic characteristics.

Thus, we consider the Gini index which captures multidimensional poverty-gaps through the application of the following formula:

$$G = \frac{\sum_{i=1}^n \sum_{r=1}^n |\theta_B(a_i) - \theta_B(a_r)|}{2\overline{\theta}_B n^2}$$

Where $\theta_B(a_i)$: poverty of household i;

$\theta_B(a_r)$: Poverty of the r^{th} household;

$\overline{\theta}_B$: Arithmetic poverty average of households

To capture poverty differences within and between the groups, it is necessary to decompose the population into K subgroups (k, k=1... K).

Dagum's 1997 poverty Gini index decomposition gives:

$$G = \frac{\sum_{k=1}^K \sum_{i=1}^n \sum_{r=1}^n |\theta_B(a_i^k) - \theta_B(a_r^k)|}{2\theta_B n^2} + \frac{2 \sum_{k=2}^K \sum_{h=1}^{K-1} \sum_{i=1}^n \sum_{r=1}^n |\theta_B(a_i^k) - \theta_B(a_r^h)|}{2\theta_B n^2}$$

$$G = G_w + G_{gb}$$

With G_w , the within groups inequalities contribution to overall inequality, G_{gb} the gross between groups inequalities contribution. It is appropriate to point out that the gross inequality is the sum of the net between-group poverty inequality component and the inequality associated to the transvariation component. $\theta_B(a_r^h)$ is poverty index of the r^{th} household of the S_k sub-groups.

If the within group inequality of poverty extends toward 0 or equals 0, it therefore assumes an absence of poverty gaps (differences) within the subgroups. Thus, households within the various groups all have an identical poverty level. This absence of distance leads the global poverty inequality to be equal to the between group component. Likewise, if the net between group inequalities is equal to 0 or extends toward 0, then observed poverty gaps within the population come from the groups⁸.

4. Empirical evaluation in Cameroon

4.1 Data Survey

In the follow up and evaluation framework of the implementation of the Poverty Reduction Strategies, as much as the measurement of accomplished progress toward the achievement of the millennium goals, the government, through the National Institute of Statistics, has realized in 2007 the third Cameroon household consumption survey (ECAM III). The ECAM III goal consisted in updating the 2001 poverty profile, appreciating the progress realized in terms of poverty reduction, achievement of millennium goals, and supplying with information the PRSD's revisions.

4.2 The choice of attributes on well-being

The selection of the attributes used in this study lies on two basic criteria namely; the characteristics of the multidimensionality poverty and the available information from the ECAM III data base. We identify human capability (among which we find attributes of health, of accommodation, accommodation environment, education and accessibility to infrastructures) and the economic capability (among which we find total expenditure attributes per unit of consumption, employment, telecommunications and land patrimony).

Tableau 1 : Attributes and deprivations Levels

⁸ As far as the numeric application is concerned, the data processing program elaborated by C. Dagum will be used, see Dagum, Mussard, Seyte, and Terraza (2002).

The expressions (1), (2) and (3) give a multidimensional poverty index (MPI) around 0.4631. The attributes housing and education which contribute more to the MPI (table 1) explain this situation. We used sub-groups decomposition of the MPI following the geographical and socioeconomic characteristics of the household head, for a better multidimensional analysis of poverty. According to the area of residence, tables 2 indicate a higher level of poverty in rural zone; this one also contributes more to total poverty. We observe in this area a lack of human capabilities as indicated by education and housing (table 2).

Tableau 2 : Region /Attributes Contribution Overall Poverty

The extent to gender explanation shows that households headed by men are relatively poorer than households headed by women .Households head men contribute more to the poverty rate, health and education attributes explains that (Table 2).

4.3 Gini index of fuzzy poverty: Dagum decomposition

Using the distribution of poverty obtained following the fuzzy analysis of poverty, the Gini index of poverty is 0.188736, denoting low disparities (gap) between the poor and rich in Cameroon. This Gini index associated to the poverty rate is 0.4631, meaning that in the country most of the population is concerned with poverty.

Following the region of head, we observe more poverty differences in the South region. The poverty disparities following the area of residence show that in the rural zone most of population is concern with poverty, because the Gini index is 0.159800 and it has a high contribution level to poverty (0.33).

The estimate of fundamental equation of the Gini index gives the following decomposition:

$$G = G_W + G_{nb} + G_t = 0.087059 + 0.063280 + 0.038396.$$

The decomposition indicates that, within-group inequalities represent 46.13% of overall inequality and between-group inequality 53.87%. Inequality is much the fact of the stratification of households between groups. In each group, the dispersion of deprivation seems as pronounced. However, this dispersion is less than that observed between groups. This decomposition also indicates strong poverty differences in urban environment, the presence of a great number of people in the informal sector explain that. This sector doesn't give much secure, guaranteed and access to credit bank is so difficult.

The gender decomposition shows that inequality among the male group is higher. We also note that within-group inequalities represent 58.71% of overall inequality: 0.110813, the

between-group inequalities represent 41.29% they are subdivided in two 15.63% for the net between-group inequalities and 25.66% for the transvariation inequalities:

$$G_{gb} = G_{nb} + G_t ; G_{gb} = 0.029491 + 0.048432 = 0.077923$$

Finally, we observed much more poverty differences inside the two groups (female and male).

5. Conclusion

The objective of this paper was to assess the inequalities of poverty in Cameroon, we used the capabilities approach and a Sub-group decomposition, and we construct a multidimensional poverty indicator (MPI). Poverty and inequality decomposition execute from socio-demographic characteristics of households head, generally reveals some new insights about the poverty situation in the country, which contrasts with the results available from traditional poverty analysis. The results used to estimate membership functions, depicting the deprivation levels for the various categories of deprivation, show a composite deprivation degree of 0.4631 for the whole country, which is different than the one obtained from the head count index of 0.39524. Considering the various deprivation characteristics, the results show high deprivation degrees for essential household items such as instruction (0.0942), housing (0.0809) and employment (0.0677). This suggests that the Cameroonian lifestyle is geared toward fulfilling basic necessities of life.

Decomposition results by area of residence shows that deprivation is more present in the rural zone. According to the gender, we observed that household headed by men very exposed to deprivations than those by women. The inequalities of poverty analysis indicate a relatively low level of deprivations disparities (0.188736), which lets predict homogeneity of the deprivations in the country. However, after decomposition, in general we note that between-group inequalities contribute more to overall inequality. The inequalities of deprivations are relatively soft, which means that in the country, all the households would be similar to poverty.

Appropriate policy recommendation would probably involve a multi-faceted approach, which, in addition to improving the income earning power, upgrades the capabilities (i.e. employment, health and education) of the poor. Therefore policymakers should emphasize access to education, health and employment, because the ownership of these assets can help households to reduce the variability and avoid the inter-generational transmission of inequalities. Nevertheless we must point out that the fuzzy-set analysis needs further refinements, among others, with regard to the choice of variables and the number of variables

to be included in the estimation of the membership functions. On the other hand, if those elements are solved, inequality analysis of deprivation in the fuzzy-set approach could be seen as a strong alternative to the unidimensional FGT severity and depth measures of deprivation in a multidimensional analysis.

Bibliography

Atkinson, AB & Bourguignon, F, 1982. The comparison of Multi-Dimensioned Distributions of Economic status. *Review of Economic studies*, XLIX, 183-201.

Baliamoune, M, 2003. On the measurement of human well-being: Fuzzy set theory and Sen's capability approach. Presented at the wider conference on inequality, poverty and human well-being. Helsinki, Finland.

Bayes, MF, 2003. Alternative methods for setting poverty lines; measuring poverty in Cameroon. *Pakistan Economic and Social Review*. Volume XLIII, N^o 1 (2005), pp. 17-42.

Bojer, H, 2004. the capability approach to economic inequality, Congress of the Society for Study of Economic Inequality. Berlin, 17 p.

Bourguignon, F & Morrisson, C, 2002. Inequality Among World Citizens: 1820-1992, *The American Economic Review*.

Ceroli, A & Zani S, 1990. A Fuzzy Approach to the Measurement of poverty. In Dagum C. and Zenga M.(eds) *Income and Wealth Distribution, Inequality and Poverty*, Springer verlag, Berlin ,272-84

Chameni, NC, 2005. A three components subgroup decomposition of the Hirschman-Herfindahl index and household's income inequalities in Cameroon. *Applied Economics Letters*, 12, 941-47.

Chameni, NC, 2008. The "natural" bidimensional decomposition of inequality indices: evaluating factors contribution to households welfare inequality in Cameroon, 1996-2001. *Applied Economics Letters*, 15: 12, 963-970.

Cheli, B, 1995. Totally Fuzzy and Relative Measures of Poverty in Dynamic Context. *Metron*, Vol. 53, Nrs. 3-4: 183-205.

Cheli, B & Lemmi, A, 1995. « A 'Totally' Fuzzy and Relative Approach to the Multidimensional Analysis of Poverty. *Economic Notes*, Vol. 24: 115-134.

Chiappero-Martinetti, E, 2000. A multidimensional assessment of well-being based on Sen's functionings approach. *Rivista internazionale di scienze sociali*, n^o2.

Costa, M, 2002. A Multidimensional approach to the measurement of poverty. *IRISS Working Paper Series*, N^o2002-05.

Dagum, C, 1997. A New Approach to the Decomposition of the Gini Income Inequality Ratio. *Empirical Economics* 22, 515-31.

- Dagum, C & Costa, M, 2005. Analysis and Measurement of Poverty, Univariate and Multivariate Approaches and their Policy Implications. A case of Study: Italy. In Dagum C. and Ferrari G. (eds.); Household Behaviour, Equivalence Scales, *Welfare and Poverty*, Springer Verlag, Germany, 221-71.
- Dagum, C, Mussard, S, Seyte, F & Terraza M, 2002. Programme pour la décomposition de l'indice de GINI. De C. DAGUM, disponible sur <http://www.lameta.univ-montpl.fr/online/gini.html>.
- DSCN (Direction de la Statistique et de la Comptabilité Nationale), 1996. Enquête Camerounaise auprès des Ménages : éléments méthodologiques. Document de travail, MINEFI, Cameroon.
- DSCN (Direction de la Statistique et de la Comptabilité Nationale), 2002. *Conditions de vie des ménages et profil de la pauvreté au Cameroun en 2001: les premiers résultats de ECAM II*, Rapport préliminaire Yaoundé mai 2002.
- INS (Institut National de la Statistique), 2007. Rapport ECAM 3, MINEPAD, Cameroon.
- Dubois, JL, 2000. Comment les politiques de lutte contre la pauvreté prennent-elles en compte les inégalités sexuées ? Genre, population et développement, *les pays du Sud*, (Th. Locoh, ed.), Dossiers et recherches de l'INED n°85, Paris, pp. 35-51.
- Fambon, S, 2006. Poverty Profiles for Cameroon. AERC discussion paper, Poverty, Income Distribution and Labour Markets in Sub-Saharan Africa Dissemination Conference 12-13 October, 2006, Addis Ababa, Ethiopia.
- Filippone, A, Cheli B & D'Agostino A, 2001. Addressing The Interpretation and The Agregation Problems in Totally Fuzzy and Relative Poverty Measures. ISER Working Papers 2001-22, University of Essex.
- Lelli, S, 2001. Factor Analysis vs. Fuzzy Sets Theory: Assessing the Influence of Different Techniques on Sen's Functioning Approach. Discussion Paper Series DPS 01.21, November 2001, Center for Economic Studies, Catholic University of Louvain.
- Maasoumi, E, 1998. On Mobility. In Ullah, A., D. E. A. Giles (Eds), Handbook of Applied Economic Statistics, Marcel Dekker, New York.
- Makdissi, P & Wodon, Q, 2004. Fuzzy Targeting Indices and Orderings, Bulletin of Economic Research, Vol. 56, No. 1, 41-51.
- Milanovic, B, 2000. A new polarization measure and some applications. Development Research World Bank First draft.
- Mussard, S & Pi Alperin, MN, 2008. Inequality in multidimensional poverty: evidence from Argentina. Applied Economics Letters, 15, 759-65
- Robeyns, I, 2002. In defense of Armatya Sen. Post-autistic Economic Review, Issue 17.

- Sahn, D & Stiffel, D, 2000. Poverty Comparisons over Time and across Countries in Africa. *World Development*, Vol. 28, pp. 2123-2155.
- Satterthwaite, D, 2001. Rural And Urban Poverty: Understanding The Differences. In: *Economic Perspectives, An Electronic Journal of the U.S. Department of State*, Vol. 6, No. 3,; (<http://usinfo.state.gov/journals/ites/0901/ijee/satterthwaite.htm> (5.12.2003)).
- Schaich, E & Munnich R, 1996. Der Fuzzy-Set-Ansatz in der Armutsmessung. In: *Jahrbucher fur Nationalokonomie and Statistik*, Vol. 215: 444–69.
- SEN, A, 1976. Poverty: an ordinal approach to measurement. *Econometrica*, vol 44.
- Sen, A, 1981. *Poverty and famines: an essay on entitlements and deprivation*. Clarendon Press, Oxford, Royaume-Uni.
- Sen, A, 1983. Poor, relatively speaking. *Oxford Economic Papers*, n°35, pp 153-169.
- Sen, A, 1985. *Commodities and capabilities*. Elsevier, Amsterdam.
- Sen, A, 1992. *Inequality re-examined*. Oxford : Clarendon Press, trad. de Paul Chemla, *Repenser l'inégalité*, Paris : Seuil, 2000, 281 p.
- Shorrocks, A F & Subramanian S, 1994. *Fuzzy Poverty Indices*. mimeo, University of Essex.
- Zadeh, LA, 1965. Fuzzy sets. *Information and Control*, Vol. 8: 338–53.

Appendices

Table 3 Fonctions ou Degré d'appartenance