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Monetary inequality among households in Togo

An illustration based on the decomposition of the Gini coefficient using the Shapley value approach

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Abstract: This paper aims at measuring and analysing for the first time inequality in the distribution of expenditures among households in Togo according to the characteristics of household heads. The study is based on the most recent survey (QUIBB 2006) and the monetary well-being indicator used is total real annual expenditure per adult equivalent. With regard to the decomposition of the Gini index through Shapley's approach, within-group inequality is greater than between-group inequality. These findings witness that in Togo, policy actions to reduce inequalities should first target the within-group expenditure disparities without neglecting the between-strata effects.

Keywords: decomposition, Gini coefficient, inequality, Shapley's value, Togo
JEL classification: D63, I31

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1 Introduction

Togo is one of the least developed countries. According to the United Nations Development Programme (UNDP) report 2011, with a gross national income per capita estimated at US$798 (PPP constant 2005) and a Human Development Index of 0.435, Togo is ranked 162nd of 183 countries in the world. After the political crisis of the 1990s, which had serious economic consequences, Togo began to record an increase in its real growth rate in 2006 and this reached 3.4 per cent in 2010 (ADF and AfDB 2011). This performance is linked, among others, to efforts in terms of investment, control of inflation and debt reduction. This positive growth, however, is insufficient to have had a serious impact on the issues of poverty and inequality.

In recent years, many empirical studies, such as Piketty (1994), Kanbur and Lustig (1999), Bourguignon and Morrison (2002), Milanovic (2002), Charpentier and Mussard (2011), and Chantreuil and Trannoy (2013), have addressed inequality issues. This research indicates a considerable interest in the measurement of inequality and its decomposition.

Decomposition analysis may be divided into two categories. The first category is concerned with the decomposition of the well-being indicator (income or expenditure) of individuals or households into different components, which are the socioeconomic sources of inequality. It allows us to look at the contributions of these components to overall inequality and helps in the design of effective socioeconomic policies to reduce poverty and inequality.

The second category of decomposition consists of dividing the sample into discrete categories (rural or urban residents, gender of individual, and so on) and calculating the level of inequality in the distribution of income or expenditure in each sub-sample, and between the means of sub-samples. Thus, total inequality is the sum of within- and between-group inequalities (Bourguignon 1979; Cowell 1980; Shorrocks 1980, 1984).

Some of the research carried out regarding monetary inequalities has revealed interesting results. Fambon (2010), studying inequality in the distribution of household expenditure in Cameroon through the Shapley value, showed evidence that, between 1984 and 1996, inequality defined by the Gini index decreases with the age of household head and the within-group effect is more predominant in total inequality. As for Araar (2006), he demonstrated, using the Gini index, that in 2001 the distribution of Cameroonian household expenditures decreased when moving from urban to rural areas. Using Shapley's value, he noted that the within-group inequality is larger and represents approximately 69.25 per cent of total inequality.

The purpose of this paper is the measurement and analysis of inequality in the distribution of household expenditure in Togo, relying on the second category of decomposition and using the Gini index and its components as derived from the Shapley value decomposition approach. The latter allows us to identify the link between the characteristics of household heads and inequality. This work is interesting because no study has yet been done on inequalities depending on the characteristics of household heads in Togo. The only existing research concerns non-monetary inequality and was carried out by Lawson Body et al. (2007). These authors, using data from the Demographic Health Survey (DHS-Togo 88 and DHSS-Togo 98), decomposed the Gini coefficient by source of non-monetary welfare. It appears from this paper that, over the two years, housing, conveniences in the house, and means of communication contribute most to inequality of households' non-monetary wealth.

To fill this void, and based on the most recent data from the Unified Questionnaire for Basic Well-being Indicators (QUIBB 2006) survey which have not yet been used for this case, we will try to understand what relationship may exist between the characteristics of household heads and the distribution of expenditure, and then propose some socioeconomic policies. We intend through this study to enrich the literature on inequalities in Togo and in Africa.

In the following sections, after an overview of the socioeconomic context and the methodological framework, we will then outline the empirical results. This is followed by a conclusion and recommendations.

2 The socioeconomic context of Togo

Table 1 shows changes in certain socioeconomic indicators for the country from 2000 to 2010.

Table 1: Socioeconomic indicators of Togo 2000-2010

Indicators	2000	2005	2006	2007	2008	2009	2010
Real GDP growth (%)	-1.2	1.2	3.9	2.1	2.4	3.2	3.4
Real GDP growth / capita (%)	-4.3	-1.2	1.3	-0.4	-0.1	0.7	1.0
Gross total investment (% GDP)	15.9	16.9	17.4	14.6	17.7	18.7	19.9
Including public	3.7	3.4	4.1	2.0	3.6	4.4	4.3
Including private	12.2	13.6	13.3	12.6	14.1	14.3	15.6
Inflation rate (%)	1.9	6.8	2.3	1.0	8.7	2.9	5.3
Total external debt (% GDP)	9.7	77.1	84.8	83.8	56.3	55.0	12.6
Deficit (-) / Surplus overall (+) (% GDP)	-4. 7	-2.9	-4.2	0.4	-0.2	-5.5	-5.8

Source: ADF and AfDB (2011).

The growth rate in real terms was 2.4 per cent in 2008 and rose to 3.4 per cent in 2010. The determinants of this performance include: (i) the increase, since 2007, in public and private domestic investment; (ii) low inflation in recent years, although an exceptional increase was observed in 2008 as a result of the food crisis; (iii) the debt relief that Togo benefited from, given the good performance in terms of macroeconomic management, including the successful implementation of programmes agreed with the International Monetary Fund (IMF). The country reached the completion point of the Heavily Indebted Poor Countries Initiative in December 2010 and has also benefited from debt forgiveness under the Multilateral Debt Relief Initiative. Thus, the ratio of total external debt to gross domestic product (GDP), which was 84.8 per cent in 2006 and 83.8 per cent in 2007, stood at 12.6 per cent in 2010; (iv) a sustainable budget deficit of slightly over 5 per cent of GDP. The highest negative balances recorded in 2009 and 2010, respectively - 5.5 per cent and -5.8 per cent of GDP, were the result of the government economic recovery policy devised to tackle the international economic and financial crisis.

This context has generated positive real GDP growth but this is still too low to solve the problems of poverty and inequality. Indeed, the impact of this result on the population is almost insignificant since the growth of real GDP per capita was negative in 2007 (-0.4 per cent) and 2008 (-0.1 per cent), while there was a weak positive trend in 2009 (0.7 per cent) and 2010 (1 per cent). Thus, according to the UNDP report (2011), poverty now affects 61.7 per cent of the Togolese people and the country is ranked 162nd of 183 countries in terms of human development.

3 Methodological framework

3.1 Well-being indicator

Our baseline indicator of well-being is total real annual expenditures for the following reasons: First, expenditure flows are more regular and more easily identifiable than income (Friedman 1957). Second, households more easily remember their spending than their income from informal sector activities. Moreover, the expenditure indicator takes into account people said to be without income. Once the measure of welfare is specified, we determine total real annual expenditures per adult equivalent. This requires the implementation of an equivalent scale which takes into account the lesser cost of children and economies of scale. The former is important because there is a difference between the consumption of children and adults, as their needs are not the same, while economies of scale are significant because overcrowded households have the benefit of such economies on joint purchasing or joint use of property.

According to Cutler and Katz (1992), the equivalence scale may be expressed by the following equation:

$$n_e = (n_a + \gamma n_c)^{\theta} \tag{1}$$

with n_e the number of persons in adult equivalents, n_a the number of adults and n_c the number of children aged less than 18 years. γ means the relative cost of a child compared to an adult and θ the equivalence elasticity. We implement the Oxford equivalence scale because it is the most popular. The Oxford equivalence scale represents the size of family in adult equivalents and it is expressed as follows:

$$m_{Oxford} = (1A + 0.7AA + 0.5E_{0-14})^{\theta} \text{ with } \theta = 1 \tag{2}$$

In this equation, A is the first adult in the household, AA other household members aged over 14 years and E_{0-14} the number of children aged between 0 and 14. These individuals have respectively the coefficients 1, 0.7, and 0.5. θ, the factor of economy of scale, is equal to 1. The distribution of household expenditures per adult equivalent is obtained by dividing the annual total real expenditures by the equivalent scale m_{Oxford} . Thus we have determined the level of expenditure of a household to have the same standard of living as that of a representative.

3.2 The measurement of inequalities

The Gini index and the Lorenz curve

Several inequality measures can be found in the literature, notably in Jenkins (1995) and Sen (1997). However, the Gini index is the most interesting inequality index because it is easier to interpret in terms of a Lorenz curve. The Gini coefficient is defined as being equal to one minus twice the area under the Lorenz curve (Kakwani 1980). However, the simplest and most popular formalization is based on the covariance between the well-being indicator of an individual or household and the rank which it occupies in the distribution of this indicator. According to Duclos and Araar (2006), the class of Gini indices is expressed as follows:

$$I(\rho) = \frac{-\operatorname{cov}[Q(p), \rho(1-p)^{(\rho-1)}]}{\mu} \tag{3}$$

where ρ is the parameter of aversion to inequality. The more the value of ρ increases, the more emphasis is put on the lower tail of the income distribution, and hence on the position of the poorest individuals in a population. $Q(p)$ is the living standard of the individual according to his rank p; and p is ranked from 0 (poorest individuals) to 1 (richest individuals). μ is the mean of the distribution of living standards. If $\rho = 2$, the standard Gini index is calculated as follows:

$$I(\rho = 2) = \frac{2\,\mathrm{cov}(Q(p), p)}{\mu} \tag{4}$$

The Gini index varies from 0 (total equality) to 1 (total inequality).

The Lorenz curve is the most popular graphical tool used to make inequality comparisons in terms of living standards. The reason for the use of Lorenz curves in order to compare inequality between several distributions is that they give more robust results than the Gini index. The Lorenz curve relates cumulative population to income (or expenditure). For a proportion p of the population, Duclos and Araar (2006) express the Lorenz curve $L(p)$ as follows:

$$L(p) = \frac{1}{\mu}\int_0^p Q(q)\,dq \tag{5}$$

p is the rank of household or individual going from 0 (the poorest) to 1 (the richest). $Q(p)$, the individual or household standard of living according to its rank and μ the mean of the living standard distribution. $L(p)$ is the cumulative proportion of living standards held by a cumulative proportion of households or individuals p, knowing that they are ranked in ascending order according to their own standards of living. The more the Lorenz curve diverges from the 45 degree line (first bisector), the greater the inequality in the distribution of wealth. The distribution is perfectly equal if the Lorenz curve is represented by the 45 degree line.

Debates on the decomposition of the Gini index into sub-groups

Reflection on the decomposition of inequality measures into sub-groups, discussed by Theil (1967), was translated into axioms and developed by Shorrocks (1980, 1984, 1988). Indeed, Shorrocks (1980) echoed the idea of Theil (1967) that it is possible to use the second law of entropy, which measures the disorder of a thermodynamic system, to measure inequality: the more entropy there is, the more inequalities there are. This law allows him to focus on the notion of decomposability into sub-groups. As for the Gini index, it also respects the property of decomposability, but only when there is an absence of overlap between the distributions of income in population groups. That is why the entropy measure is often preferred to that of Gini, because entropy has properties of monotony and additive decomposition.

Nevertheless, the issue of the evolution of total inequality is logically more complex than the condition of monotony suggests. Thus, a problem arises if the monotony condition is abandoned. One can show, for instance, that total inequality decreases even though inequality within each group increases. This is particularly the case if between-group inequality outweighs within-group inequality.

To overcome the difficulties that economists face when proposing a compromise between economic logic, based on the calculation of the contribution of a factor to total inequality, and mathematical logic to justify a measure, Auvray and Trannoy (1992) advocate the use of the Shapley value, an idea echoed by Shorrocks (2013).

Shapley's value favours secondary measures, that is, contribution indices, which are applied to all measures of inequality. It allows mathematical properties to be reconciled with some economic analysis assumptions, such as the negative contribution of a factor.

According to research conducted by Jenkins (1995) on entropy, however, the sets associated with decomposable measures into sub-groups and factors are disjoint. Thus, the generalized or multi-dimensional entropy measure (Shorrocks 1980) does not allow the property of multi-decomposability to be achieved, as there may be redundant terms (such as multiplicative terms between two sources of income) or non-decomposable terms (such as the logarithm of a sum), making it difficult to measure a particular source contribution to the level of within-group and between-group inequalities.

Generalizability offered by the Shapley value can temper this result by applying Shapley's algorithm separately to each within-group and between-group component of inequality while respecting the rule of consistency. But these multi-decompositions involve sub-populations whose characteristics obey normal distributions with the same variance and which are statistically independent.

Tsui's (1999) version of multi-dimensional generalized entropy allows an accurate multi-decomposability, but also fails to provide further solutions to problems related to the structure of between-group inequality.

Decomposition of the Gini index by household groups according to Shapley's approach

By considering the extended formula of the Shapley value (see equation A4 in Appendix A),[1] and assuming that household groups represent factors that contribute to the Gini coefficient, the component of group g according to the Shapley approach is equal to what follows:

$$E_g^S = \frac{1}{n!}\sum_{i=1}^{n!} MV(\sigma^i, g) \tag{6}$$

Where σ^i represents the i_{th} possible order of groups and $MV(\sigma^i, g)$ shows the impact of eliminating group g for the order σ^i on the contribution of the set of groups S. A crucial step for this type of decomposition is to determine accurately the impact of eliminating factors (groups, in this case) on the characteristic function v, which is the Gini coefficient. The clarification of this idea is outlined in Appendix B (Araar 2006).

This decomposition is carried out in two steps (Duclos and Araar 2006). In the first step, total inequality is broken down into total between-group and total within-group contributions. The second step consists of expressing the total within-group contribution as a sum of the within-group contributions of each group.

The two Shapley factors in the first step are between-group (C_{inter}) and within-group (C_{intra}) inequalities. Hence, the total inequality is expressed as follows:

[1] See the full the demonstration of the Shapley value in Appendix A (Araar 2006).

Overall inequality (I) = $C_{\text{inter}} + C_{\text{intra}}$ (7)

The rules for computing the contribution of each of the two factors are:

- To eliminate within-group inequality and calculate between-group inequality $(I(\mu_{1,...,}\mu_G))$ we will use a vector of income in which each household has its group's average income given by μ_g;
- To eliminate between-group inequality and calculate within-group inequality $(I(y_i(\mu/\mu_g)))$, we will use a vector of income in which each household has its income multiplied by μ/μ_g. So the mean income of each group is equal to μ;
- To highlight the between-group and within-group inequalities simultaneously, we will simply use a vector of incomes where each household has the average of incomes.

The order followed to eliminate factors is arbitrary. To remove this arbitrariness, Araar (2006) follows Shapley's approach, which consists in eliminating either of the two factors. By taking into account this method, the decomposition gives us:

$$C_{\text{inter}} = 0.5[I - I(y_i(\mu/\mu_g)) + I(\mu_{1,...,}\mu_G)] \tag{8}$$

$$C_{\text{intra}} = 0.5[I - I(\mu_{1,...,}\mu_G) + I(y_i(\mu/\mu_g))] \tag{9}$$

Starting from this decomposition, one can proceed to the second stage of decomposition, consisting of breaking down within-group inequality into specific group components. Regarding equation (9), which defines the contribution of within-group inequality, this contribution is based on three inequality indices.

In order to avoid arbitrariness in the sequence of eliminations of the marginal contribution of groups to total within-group inequality, the Shapley approach is used for the three terms. We assume that there are only two groups, A and B. The decomposition gives:

$$C_{\text{intra}} = 0.5[\underbrace{I}_{terme1} - \underbrace{I(\mu_A, \mu_B)}_{terme2} + \underbrace{I(y_i^A(\mu/\mu_A), y_i^B(\mu/\mu_B))}_{terme3}] \tag{10}$$

Within-group inequality is eliminated when the income of each household is equal to the average income of its group. In this way, we apply the same rule to the three terms as follows:

$$CA = \sum_{i=1}^{3} 0.25 C_{A:terme\,(i)} \tag{11}$$

$$\begin{aligned}
C_{A:terme(1)} &= [I - I(\mu_{A,} y_B) + I(y_{A,} \mu_B) - I(\mu_{A,} \mu_B)] \\
C_{A:terme(2)} &= [I(\mu_{A,} \mu_B) - I(\mu_{A,} \mu_B) + I(\mu_{A,} \mu_B) - I(\mu_{A,} \mu_B)] = 0 \\
C_{A:terme(3)} &= [I(y_i^A(\mu/\mu_A), y_i^B(\mu/\mu_B)) - I(\mu, y_i^B(\mu/\mu_B)) + (I(y_i^A(\mu/\mu_A), \mu) - I(\mu, \mu)]
\end{aligned} \tag{12}$$

Let CA_g be the absolute contribution of each group g to the Gini inequality index. This value gives the magnitude, in absolute value, of the contribution of group g. The coefficient of relative contribution is defined as follows:

$$CR_g = \frac{C_g}{I} \tag{13}$$

Finally, note that the Gini index and its decomposition are computed by DAD software developed by Duclos et al. (1999).

3.3 Data

The data are from the most recent survey (QUIBB 2006) on the issue of poverty in Togo. The collation of QUIBB was carried out by the General Directorate of Statistics and National Accounts in cooperation with the World Bank, UNDP, the United Nations Population Fund and the United Nations Children's Fund. These international institutions funded the survey, which took place from 4 July to 11 August 2006. It is an areolar survey stratified into two stages. At the first stage, 300 zones of counting (ZC) were drawn with proportionate probabilities to the size of ZC. The second stage included 7500 households from the ZC (25 households per ZC) with 2600 and 4900 in urban and rural areas, respectively. If a household refuses to respond or is absent, it is automatically replaced by another according to well-defined criteria. Thus, among the 10.3 per cent of households replaced, 0.9 per cent refused to answer and 9.4 per cent were not found during the survey period. The first results of QUIBB (2006) revealed a problem concerning the quality of cartographic work, and doubts about the household listing in particular. An investigation was then carried out from 9 to 12 November 2006 in order to redress the weights of households and achieve better estimates of the survey results.

4 Empirical results of the Gini index and its decomposition based on the Shapley value

The Gini coefficient (see Tables 3, 5, and 7) indicates that the overall inequality in the distribution of expenditures among Togolese households is equal to 38.75 per cent, but disparities exist according to the areas, and the gender and age of household heads.

4.1 Decomposition by area

According to the results in Table 2, the average annual real expenditure per adult equivalent in urban areas is more than twice that in rural areas. Thus urban households have a better standard of living than those in rural areas.

Table 2: Mean annual household real expenditure by area

Characteristics of household head	Mean expenditure of households in CFA	Number of households	Share of households
Areas			
Urban	407,614.6	2,599	0.3466
Rural	174,387.0	4,899	0.6534

Source: Author's own calculation based on data from QUIBB (2006).

Observing the Gini inequality in Table 3, we note that the distribution of expenditures is more uneven in urban areas (34.01 per cent) than in rural areas (29.25 per cent). These results are not surprising, since generally the variation of income in urban areas is higher than the national average, which affects expenditure. The fact that rural areas are less uneven than urban areas reflects how widespread a low standard of living is in rural areas. This situation evidences the extent of rural poverty. The comparison of Lorenz curves (Figure 1) based on the distribution of total expenditure per adult equivalent for urban and rural areas supports the results of the Gini coefficient. Indeed, the urban curve is more remote from the first bisector.

With regard to the Shapley approach (Araar 2006), in Table 3 we can see that the within-area inequality component of total expenditure representing 63.27 per cent is greater than the between-area component (36.73 per cent). The contribution to within-area total inequality is amounts to 36.98 per cent for rural area and 26.28 per cent for urban areas.

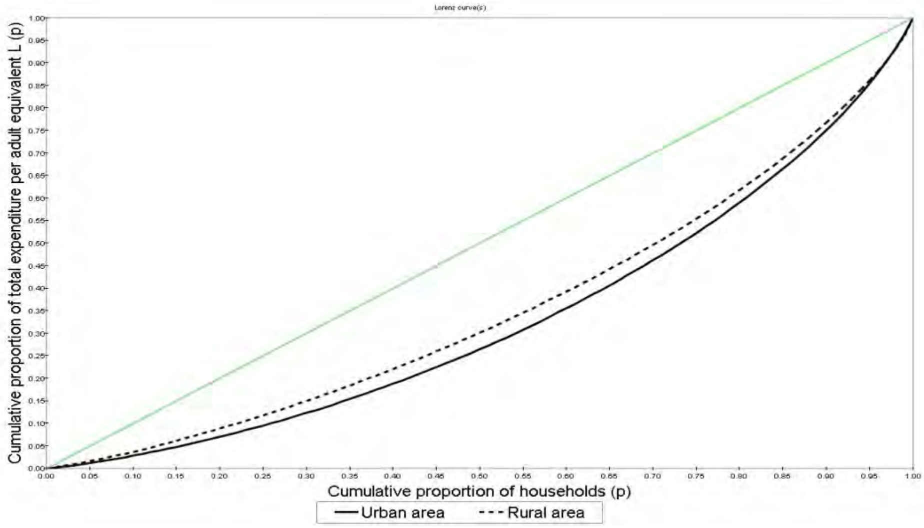
Table 3: Inequality decomposition by area

Characteristics of household head	Gini index	Decomposition of within-group component (Shapley)	
		Absolute contribution	Relative contribution
Areas			
Urban	0.3401	0.1019	0.2628
Rural	0.2925	0.1433	0.3698
Decomposition of Gini into between- and within-groups (Shapley)			
Between-groups	-	0.1424	0.3673
Within-groups	-	0.2452	0.6327
Overall	0.3875	0.3875	1

Source: Author's calculation using data from QUIBB (2006).

Policies likely to achieve a significant reduction in total expenditure inequalities in Togo should centre first on the within-areas disparities, with a special emphasis on rural areas. However, inequalities between the areas should not totally be neglected.

Figure 1: The Lorenz curves for per capita expenditures, urban–rural



Source: Author's calculation and graphic with DAD 4.5 using data from QUIBB (2006).

4.2 Decomposition by gender of household head

Regarding Table 4, on average female-headed families have a higher standard of living than male-headed families. This finding is in part due to the higher participation of Togolese women in informal sector activities. The income from these activities, although modest, helps to raise the standard of living of households compared to families managed by males. It should also be noted that when Togolese women manage a family, they are engaged exclusively in the restricted family unit (themselves with their children). Unlike men, many of whom are polygamous with a large family already and who also carry the burden of supporting the needs of close and distant cousins, consequently causing the impoverishment of households.

Table 4: Mean annual household real expenditure by gender

Characteristics of household head	Mean expenditure of households in CFA	Number of households	Share of households
Gender			
Male	240,163.2	5,935	0.7915
Female	312,440.0	1,563	0.2085

Source: Author's calculation using data from QUIBB (2006).

The design of gender-sensitive policies requires the breakdown of inequality according to the gender of the household head. Referring to Table 5, we see that inequality in the distribution of consumption expenditures among households headed by men is almost equal to expenditure inequality in families managed by women – 38.61 per cent and 37.17 per cent, respectively. If both indices are substantially equal, there is still a slight superiority of monetary inequality in male-headed households.

Decomposition results of Gini using Shapley's value approach shows the overwhelming contribution of within-gender groups inequalities (93.40 per cent) to the explanation of total inequalities. A decomposition of the within-gender component indicates that households managed by men contribute more to within-gender inequalities (75.54 per cent), whereas, this contribution amounts to 17.95 per cent when women are the household heads.

Table 5: Inequality decomposition by gender of household head

Characteristics of household head	Gini index	Decomposition of within-group component (Shapley)	
		Absolute contribution	Relative contribution
Gender			
Male	0.3861	0.2924	0.7545
Female	0.3717	0.0696	0.1795
Decomposition of Gini into between- and within-groups (Shapley)			
	-	0.0256	0.0660
Between-groups	-	0.3620	0.9340
Within-groups			
Overall	0.3875	0.3875	1

Source: Author's calculation based on data from QUIBB (2006).

Policies that aim to reduce total expenditure inequalities should focus more on within-strata disparities, while paying particular attention to households headed by men. However, between-strata inequalities should not be shelved.

4.3 Decomposition by age of household head

The average real annual household expenditure decreases when the age of the household head increases (Table 6). Indeed, poverty increases in families as the age of the household head increases. Indeed, the young household heads, aged between 15 and 30, do not have much in the way of a family burden. In the 31-50 age group, many household heads are active and carry the burden of the family, leading to a reduction of expenditure per adult equivalent. As for the over-50 age group, the average expenditure of these households is the lowest. In effect, the majority of household heads includes elderly retired people. The latter have lost their labour power in part or totally and have therefore joined the ranks of the poor.

Table 6: Mean annual household real expenditure by age of household

Characteristics of household head	Mean expenditure of households in CFA	Number of households	Share of households
Age group			
15-30	340,510.4	1,438	0.1925
31-50	249.923.7	3,735	0.4977
51-99	211,007.8	2,325	0.3098

Source: Author's calculation from QUIBB (2006).

According to Table 7, there is also a decreasing relationship between the distribution of wealth and the age of household head. The Gini index (34.75 per cent) is lowest in the 51-99 age group because, as mentioned above, most of household heads in that age group fall into poverty.

Considering the Shapley value principle (Table 7), total within-age-group inequality (87.22 per cent) is much greater than between-age-group inequality (12.78 per cent). Moreover, the 31-50 age group is the main contributor to total inequality within-age-group (45.90 per cent), followed successively by the over 50 (23.12 per cent) and the 15-30 (18.20 per cent) age groups. In order to effectively reduce monetary inequality, policy makers should target first the within-age disparities, with a particular emphasis on households with heads aged between 31 and 50, because this group of individuals is the most active and especially carry family responsibilities. Then safety nets can be implemented to help seniors. However, between-group inequality must not be neglected.

Table 7: Inequality decomposition by age of household head

Characteristics of household head	Gini index	Decomposition of within-group component (Shapley)	
		Absolute contribution	Relative contribution
Age group			
15-30	0.4010	0.0705	0.1820
31-50	0.3823	0.1779	0.4590
51-99	0.3475	0.0896	0.2312
Decomposition of Gini into between- and within-groups (Shapley):			
Between-groups	-	0.0495	0.1278
Within-groups	-	0.3380	0.8722
Overall	0.3875	0.3875	1

Source: Author's calculation from QUIBB (2006).

5 Conclusion and implications of socioeconomic policies

As already mentioned, the purpose of this study is the measurement and analysis of inequality in the distribution of household expenditure in Togo, and its decomposition into within- and between-group components through Shapley's approach. The data used come from the QUIBB 2006 surveys, which provide the monetary variable (real annual expenditures of households) that we have transformed into expenditure per adult equivalent by using the Oxford equivalence scale.

The Gini results indicate that the level of inequality in the country in 2006 is 38.75 per cent. Considering the decomposition of inequality according to Shapley's approach, total within-group inequality is greater than the between-group effect. The breakdown of the within-group component shows that households living in rural areas contribute more to within-group inequality. The same observation is made when household heads are men, aged between 31 and 50. Thus, strategies to reduce inequalities should be a priority in the within-group component, while putting a strong emphasis on the strata that contribute most to inequality. However, the between-group effect should not be underestimated.

It is recommended that state and non-governmental organizations' policies should focus on rural areas by strengthening micro-finance programmes, for example. Rural areas are predominantly agricultural in Togo and micro-finance can help farm households to develop extensive agriculture, part of which will be destined for the market. This could help to lift households out of subsistence agriculture and consequently of poverty. With a view to making their business profitable, rural household heads should also be trained in modern agricultural techniques and business management. To this end, education is necessary.

Moreover, awareness campaigns aiming to change attitudes must be directed at male household heads, since many of them are polygamists with large families, which leads to the impoverishment of households. Considering that the 31-50 age class is the most active and carries the family burden (including close and distant cousins); the struggle against disparities of wealth must focus on unemployment. Another measure is to set up safety nets to help the elderly and retired people. This means creating social security for this population. All of these poverty reduction measures depend on a serious economic growth policy and the willingness of policy makers to improve the social welfare of populations

The data from QUIBB (2006) do not necessarily reflect the situation of subsequent years. Indeed, the exogenous shocks, notably the increase in food prices by 8.4 per cent on average in 2008 (IMF 2010), and the floods of 2007 and 2008 probably increased poverty and inequality. Moreover, according to the African Development Bank (AfDB et al. 2012), the growth rate of real GDP in 2012 is 4.2 per cent and the inflation rate stood at 2.6 per cent. We do not currently know the combined impact of this inflation control and the growth rate on households' standard of living. So even though this paper provides an additional contribution to the issue of inequality, the extrapolation of the findings to subsequent years in order to formulate policies for socioeconomic development must be done with great caution.

Appendices

Appendix A: The Shapley value

The Shapley value is a solution concept used mostly in cooperative games (Shorrocks 2013). Consider a set N and n players who have a surplus to divide among themselves. To do so, the players may form coalitions leading to sub-sets S and N. Let us assume that v is the function that determines the coalition force, that is, which surplus will be divided without resorting to an agreement with the outside players (the $n-s-1$ players who do not belong to the coalition S). The problem to resolve is: how can the surplus be shared between the n players? According to the Shapley approach (1953, cited in Araar 2006), the value or the expected gain (E_k) of player k is expressed as follows:

$$E_k = \sum_{\substack{s \subset S \\ s \in \{0, n-1\}}} \frac{s!(n-s-1)!}{n!} MV(S,k) \qquad \text{(A.1)}$$

$$MV(S,k) = (v(S \cup \{k\} - v(S))$$

The term $MV(S,k)$ is the marginal value generated by player k after his adhesion to the coalition S. What will then be the marginal contribution expected from player k according to the different possible coalition that can be formed and to which the player may adhere? First, the size of coalition S is limited so that $S \in \{0,1,\ldots n-1\}$. Supposed that the n players are randomly ordered following a rank such that:

$$\sigma = \left\{ \underbrace{\rho^1, \rho^2, \ldots, \rho^{i-1}}_{s}, \rho^i, \underbrace{\rho^{i+1}, \ldots, \rho^n}_{n-s-1} \right\} \qquad \text{(A.2)}$$

For each of the permutations possible of the n players (that is, $n!$), the number of times that the same first s players are located in the sub-set or coalition S is given by the number of possible permutations of the s players in coalition S, that is $s!$. For each permutation in the coalition S, we can find $(n-s-1)!$ permutations for the players that complement the coalition S. The expected marginal value generated by player k after his adhesion to a coalition S is given by the Shapley value (equation A.1). For every position of the factor k, there are several possibilities of forming coalition S from the $n-1$ players (that is, n players without the player k). This number of possibilities is equal to the combinations C_{n-1}^{s}.

How many marginal values would we have to determine the expected marginal contribution of a given factor or player k? Since the rank of players in the coalition S does not affect the contribution of the player k once he has adhered to the coalition, the number of calculations required for the marginal values is:

$$\sum_{s=0}^{n-1} C_{n-1}^{s} = 2^{n-1} \qquad \text{(A.3)}$$

If we do not take into account this simplification, we can write the extended formula of the Shapley value as follows:

$$E_k = \frac{1}{n!}\sum_{i=1}^{n!} MV(\sigma^i, k) \tag{A.4}$$

where, for each order σ of the $n!$ orders, the players k have only one position that determines the coalition to which he can adhere. The term $MV(\sigma^i, k)$ equals the marginal value of adding the player k to its coalition. The properties of the decomposition of this approach are:

- Symmetry, which ensures that the contribution of each factor is independent of its order of appearance on the list of the factors or the sequence;
- Additivity of components.

Equality (A.3) is obtained from Newton's binomial theorem which is:

$$(a+b)^n = \sum_{s=0}^{n} C_n^s a^{n-1} b^n \quad \forall (a,b) \in R, n \in N$$

Raising $(a+b)$ to the power n is equivalent to multiplying n identical binomials $(a+b)$. The result is a sum where each element is the product of n factors of type a or b. Thus, the terms are of the form $a^{n-p}b^p$. Each of these terms is obtained a number of times equal to C_n^p, which is the number of times we can choose p elements among n. When $a = b = 1$, we will have:

$$(1+n)^n = \sum_{s=0}^{n} C_n^s = 2^n$$

We can thus conclude that:

$$\sum_{s=0}^{n-1} C_{n-1}^s = 2^{n-1}$$

Appendix B: Clarification of the impact of eliminating factors (groups) on the Gini coefficient (Araar 2006)

The analysis is made by using average incomes. We need to look at the decomposition of this average, noted by μ, in components A and B, which are two groups forming the population of households. The analytical decomposition of the average is written as follows:

$$E_A = \phi_A \mu_A \tag{B.1}$$

$$E_B = \phi_B \mu_B$$

Where ϕ_g is the proportion of the population of group g. If we assume that the elimination of one factor (a group) represents the case where we do not consider those households that compose the group, the decomposition according to Shapley's approach is:

$$E_A^S = 0,5[\mu - \mu_B + \mu_A] \quad \text{(B.2)}$$

$$E_B^S = 0,5[\mu - \mu_A + \mu_B]$$

The necessary condition for reconciling both approaches, such as $E_F = E_F^S \ (F = \{A, B\})$, is as follows:

$$\frac{\mu_A}{\mu_B} = \frac{\phi_A}{\phi_B} \quad \text{(B.3)}$$

Hence, when specification of the impact of elimination factors on the characteristic function is done incorrectly, this can lead to unfounded decomposition results. Now, for the example above, if we suppose that the elimination of the group g requires simply the subtraction of $\phi_g \mu_g$, the analytical and Shapley approaches are reconciled.

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