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Economic Development, Household Consumer Expenditure Inequalities in Rwanda: A Decomposition Analysis

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Abstract:
The Objectives of this study are to analyse recent changes in Rwanda economic development and inequality levels analysis after the genocide. We decompose household consumer expenditure inequalities by region, and sector (Urban-Rural) for the year 2000-2001 and 2005/2006 based on National Sample Survey data. A Gini decomposition between and within regions and sectors is used. Contrary to other studies in decomposition of income inequality, we found that the level of expenditure inequality is high in rural area than in urban area. For example Turkey (Silber 2004); Ethiopia (Adugna; 2006), measuring income inequality in Turkey and Ethiopia, they have found that the level of inequality is higher in urban area than in rural area.

JEL Classification: C1, D31, I32.

Keywords: *Income Inequality, Poverty, Decomposition, Rwanda*

1. Background of the study

1.1 A brief review of literature on Inequality decomposition

There have been many studies of inequalities in the literature using the technical of decomposition by population sub-groups. In 1967 Bhattacharya and Mahalanobis had decomposed the Gini-coefficient and its standard deviation for the year 1957-58 based on the household consumer expenditure survey data of India and found that one-quarter of the total inequality was being explained by between-state inequality and the remaining three-quarters was explained by with-state inequality. Similar studies have been done by others. Mehran (1974), Mangahas (1975) and Pyatt (1976) have decomposed the Gini-coefficient for cities in Iran, regions in Philippine and regions (Urban/Rural) in Sri Lanka, respectively. Glewee (1986) and Fields and Schultz (1980) have used decomposition analysis for studying inequality in Sri Lanka and Colombia, respectively. All of these studies have agreed more or less on the lack of importance of regional effects income disparities. Das and Parikh (1982) have decomposed the Gini-coefficient for both the U.K economy and the U.S.A economy. Their grouping was not on the basis of region or sector, but on the basis of the size of the family. However, they found the decomposition results were very sensitive to the particular measure of inequality used whereas Mukherjee and Shorroks (1982) found a broadly consistent pattern across a number of indices used for studying the trends in U.K inequality.

We have also some studies in effects of intraregional disparities on regional decomposition and panel-data for example in China Reuter and Ulrich (2004) analyzed the development and effects of intra-provincial regional disparities between 1989 and 2001.

A decomposition analysis shown that intra-provincial disparities contribute significantly to total regional inequalities.

The present paper, focusing on expenditure inequality and on differences between regions in Rwanda, is not another study to check the validity of model's thesis. Its much less ambitious goal is to take a look at the most recent data than have been published on the distribution of expenditures in Rwanda. In particular it tries to estimate the contribution of urban and rural areas to the overall level of inequality in Rwanda and attempts to understand the determinants of difference which exists between expenditure inequality in urban and rural areas in a period of just 6 years between 2000 and 2006.

1.2 The decomposition of the Gini Index by Expenditure Source

Let X_{ji} denote the value of expenditure source i for individual j and let X_i and X_j be respectively defined as

$$X_i = \sum_{j=1}^{n} X_{ji} \quad (1)$$

$$X_i = \sum_{i=1}^{I} X_{ji} \quad (2)$$

Where i represent the total number of expenditure sources and n the number of individuals. Let S_{ji}, S_i and S_j be defined as

$S_{ji} = X_{ji} / X$ (3)

Si = Xi /X (4)

Sj = Xj /X (5)

Where X represents the total expenditure of population (all sources combined). S_i represents therefore the weight of expenditure source i in total expenditure X while S_j denotes the share of individual j in total expenditure. Following Silber's (1989) analysis of the decomposition of income/expenditure inequality, it is possible to define the Gini Index I_G of overall income/expenditure as:

$$I_G = [e'][G][S] \quad (6)$$

Where e' is a 1 by n row vector of population shares, each equal to 1/n, S is the n by 1 column vector of the income/expenditure shares S_j and G is a n by n square matrix whose typical element g_{hk} is equal to 0 if h = k, to -1 if h < k and to +1 if h > k. Notice that in (5) the income/expenditure shares Sj are ranked by decreasing value of the total income/expenditure (all sources combined) of the various individuals. Since the share S_j of individual j may also be written as

$$S_j = \sum_{i=1}^{1} S_{ji} \quad (7)$$

Expression (6) may also be written as

$$I_G = e'G\left[S_{j1} + s_{j2} + s_{j3} + ... + S_{ji} + ...S_{j1}\right] \quad (8)$$

Note that in (8) the term S_{ji} on the R.H.S. of the G-matrix represent, in fact, column vectors whose typical element is equal to S_{ji}. In other words, (8) may be written as

$$I_G = [e'][G]\left\{\sum_{i=1}^{1}\left[S_{ji}\right]\right\} \quad (9)$$

Where S_{ji} is an n by 1 column vector containing the n shares S_{ji} (=X_{ji} /X) of the income/expenditure source i.

Let now V_{ji} represent the share of (X_{ji}/X_i) of individual j in income/expenditure source i. Expression (9) may be written as:

$$I_G = [e'][G]\left\{\sum_{i=1}^{1} S_i\left[V_{ji}\right]\right\} \quad (10)$$

$$I_G = \sum_i S_i \{[e'] G[V_{ji}]\} = \sum_i S_i H_i = \sum_i C_i \qquad (11)$$

Where H_i is called the Pseudo-Gini, C_i is the contribution of income/expenditure source i to overall inequality and V_{ji} represents the n by 1 vector of the shares V_{ji}. Remember that in the vector $[V_{ji}]$ the shares V_{ji} are ranked not by decreasing value of the shares (X_{ji}/X_i) but by decreasing values of the share $S_j=(X_j/X)$. The shares V_{ji} my therefore not be monotonically decreasing and this explains why the product $Hi = [e'] G[V_{ji}]$ is called Pseudo-Gini of income/expenditure source i. let $[V_{ji}]$ represent the vector of the shares (X_{ji}/X_i) when the latter are ranked by decreasing values. The product $[e'] G[y_{ji}]$ represents then Gini Index of Inequality of income/expenditure source i among the values individuals. Following Silber (1993) and Fluckiger and Silber (1995) and using (10), the index of overall income/expenditure inequality is written as:

$$I_G = \sum_{I=1}^{1} S_i [[e'] G[Y_{ji}]] + \sum_{i=1}^{1} S_i [[e'] G[V_{ji} - y_{ji}]] \qquad (12)$$

The first term of the R.H.S of (11) is the weighted sum of the values of Gini index for the various income/expenditure sources, the weight (S_i) being equal to the share of income/expenditure source $_i$ in the total income/expenditure in the population. The second term on the R.H.S of (12) is a permutation component which is equal to the weighted sum of the difference between the values of the Pseudo-Gini and the actual Gini index for the various income/expenditure sources. This permutation component is therefore a consequence of the fact that the ranking of different individuals may vary from one income/expenditure to the other.

1.3 The Gini decomposition by Subgroups

Bhattacharya and Mahalanobis (1967) first provided the Gini decomposition by subpopulations. Then, Rao (1969), Mookherjee and Shorroks (1982), Silber (1989), Lerman and Yitzhaki (1991), Dagum (1997a, 1997b) and other authors contributed to the extension and qualification of the Gini decomposition by Subgroups.

Let us introduce Dagum's (1977a, 1997b) methodology. Given a population Q, with n income/expenditure units $x_{Q,i}$ (i = 1,….n) of mean μ, divided in k subgroups Q_j (j = 1, ….k), where Q_j has n_j expenditure units (i, r= 1). The Gini index computed on Q is:

$$G = \sum_{i=1}^{n} \sum_{r=1}^{n} \left| x_Q, i^- x_Q, r \right| / 2\mu n^2 \qquad (13)$$

There are n^2 binary expenditure differences that can be gathered in order to bring out the share of with-group and the gross between-group inequalities:

$$G = \underbrace{\frac{\sum_{j=1}^{k} \left(\sum_{i=1}^{nj} \sum_{r=1}^{nj} \left| x_j, i^- x_j, r \right| \right)}{2\mu n^2}}_{G_w} + \underbrace{\frac{2 \sum_{j=2}^{k} \sum_{h=1}^{j-1} \left(\sum_{i=1}^{nj} \sum_{r=1}^{nh} \left| x_j, i^- x_h, r \right| \right)}{2\mu n^2}}_{G_{gb}}, \qquad (14)$$

Where $x_{j,i}$ corresponds to the i-th individual's expenditure of the j-th group. This method gives: (i) the contribution of the inequalities within the subgroup G_w that allows one to know if the expenditure inequalities are generated by expenditure gaps within the subpopulations; (ii) and the gross contribution of the inequalities between the subpopulation G_{gb} that enables to gauge expenditure gaps between the pairs of the subpopulations.

Referring to Dagum's (1977a, 1997b) Gini decomposition in three elements, we can take benefit from more complete configuration of the decomposition. In particular, his method provides additional

information on the gross between-group component. He distinguishes the net contribution of the inequalities between subpopulation G_{nb}, issued from the non-overlap part between the distributions. This decomposition is built on many indices. The Gini index within the subpopulation Q_j (G_{jj}) and the Gini index between the subpopulation Q_j and Q_h (G_{jh}, Dagum (1987) are:

$$G_{jj} = \frac{\sum_{i=1}^{nj}\sum_{r=1}^{nj}\left|x_j, i^{-} x_{j,r}\right|}{2n_j{}^2\,\mu_j}, \qquad G_{jh} = \frac{\sum_{i=1}^{nj}\sum_{r=1}^{nh}\left|x_j, i^{-} x_{j,r}\right|}{n_j n h_j\left(\mu_j + \mu_h\right)}, \quad (j=1,\ldots k \text{ and } h=1,\ldots,k). \qquad (15)$$

Lemma 1: **Dagum (1997a)**. The gross economic affluence between Q_j and Q_h is:

$$d_{jh} = \int_0^{\infty} dF_J(y) \int_0^{y} (y-x) dF_h(x) \quad \forall \ \ \mu_j > \mu_h \qquad (16)$$

where $F_j(x)$ and $F_h(y)$ are, respectively, the cumulative distributions of Qj and Qh. It is the weighted average of the binary expenditure differences such as $x_{j,i} > x_{h,r}$ and $\mu_j > \mu_h$.

Lemma 2: Dagum (1997a). The first order of transvariation,

$$p_{jh} = \int_0^{\infty} dF_h(y) \int_0^{\infty} (y-x) dF_j(x) \quad \forall\,,\ \mu_j > \mu_h \qquad (18)$$

is the weighted average of the binary expenditure differences such as $x_{j,i} > x_{h,r}$ and $\mu_j > \mu_h$.

According to (16) and (17) we can introduce the relative economic affluence (Dagum 1980). It is a normalized index that indicates the "distance" between P_j and P_h:

$$D_{jh} = \left(d_{jh} - p_{jh}\right) \Big/ \Delta_{jh} = d_{jh} - p_{jh} \Big/ d_{jh} + p_{jh}\,. \qquad (17)$$

Calculating $G_{jh} \times D_{jh}$, we proceed to the net measure of the between-group Gini. It symbolizes the inequalities derived from then non-overlap of the distribution j and h. The expression G_{jh} $(1\text{-}D_{jh})$ is the transvariation between Pj and Ph, which is the part of the inequality issued from the overlap of the distribution j and h.

$$Pj = \frac{n_j}{n},\ Sj = \frac{n_j\ \mu_j}{n\ \mu}. \qquad (19)$$

According to (3), (6) and (7) we can define the first component of the Gini decomposition. It is the net contribution of the between-group inequalities to the overall Gini measured on P:

$$G_{gb} = \sum_{j=2}^{k}\sum_{h=2}^{j-1} G_{jh}\ (1-D_{jh})(p_j\ s_h + p_h\ s_j). \qquad (20)$$

The second component is the contribution of the within-group inequalities to G:

$$G_t = \sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}\ (1-D_{jh})(p_j\ s_h + p_h\ s_j). \qquad (21)$$

The third element is the contribution of the with-group inequalities to G:

$$G_w = \sum_{j=1}^{k} G_{jj}\ p_j\ s_j. \qquad (22)$$

Theorem: Dagum (1997a) given (8), (9) and (10) the fundamental equation of the Gini decomposition in three components is:

$$G = G_w + G_{gb} + G_t. \quad (23)$$

1.1.4 The Gini Multi Decomposition

According to the Gini decomposition by expenditure components, the standard Gini index computed on the j-th subpopulation is decomposed as follows;

$$Gjj = \sum_{m=1}^{q} S^m{}_j \left(\frac{\sum_{1=1}^{n}\sum_{r=1}^{n}\left(x^m j,i + x^m j,r - 2x^{*m}{}_{j,ir}\right)}{2\mu jnj^2} \right) = \sum_{m=1}^{q} S^m{}_j \quad (24)$$

Where $S^m{}_j$ is the contribution of the m-th source to Gjj. Consequently, the source disaggregation of the within-group inequality G_w is expected as:

$$Gw = \sum_{j=1}^{k} G_j{}_j p_j s_j \quad (25)$$

$$= \sum_{m=1}^{q}\sum_{j=1}^{k} S^m j_p j_s{}_j. \quad (26)$$

The second step of the multi-decomposition consists on the separation of the between group terms. This page is based on the factor decomposition of the Relative Economic Affluence D_{jh} and its counterpart: P_{jh}=1-D_{jh}. The ratio p_{jh} is included in the close interval [0,1]. As it gauges the percentage of binary expenditure differences issued from the overlap between two distributions, it is a ration of overlap.

Proposition 1. The relative Economic Affluence Djh and the Ration of Overlap Pjh are decomposable by factor components:

$$D_{jh} = \sum_{m=1}^{q} D^m{}_{jh}, \text{d}$$

$$1 - D_{jh} = P_{jh} = \sum_{m=1}^{q} p^m{}_{jh}. \quad (27)$$

According to (20) and (28) it is possible to yield the weight of the net between-group inequalities and the intensity of transvariation between the subpopulation Qj and Qh of the m-th source:

$W^m{}_{nb},j_h = D^m{}_{jh}\,(p_j\, s_h + p_h\, s_j)$ (28)

$W^m{}_t,j_h = p^m{}_{jh}(p_j\, s_h + p_h\, sj)$. (29)

Therefore, considering equations (21), (22), (23), (28) and (29) the net between-group contribution, the intensity of transvariation between the subgroups and the gross contribution between the groups to the overall extended Gini ration, respectively are:

$$Gnb = \sum_{m=1}^{q}\sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh} w^m{}_{nb,jh}, \quad (30)$$

$$Gt = \sum_{m=1}^{q}\sum_{j=2}\sum_{h=1} G_{jh} w^m t,_{jh} \quad (31)$$

$$G_{gb} = \sum_{m=1}^{q}\sum_{j=2}^{k}\sum_{h=1}^{j-1}(w^{m}{}_{nb,jh} + w^{m}{}_{t,jh}). \quad (32)$$

Proposition 2. The Gini multi-decomposition in two elements is the decomposition by source of expenditure of the subgroup Gini decomposition in two components:

$$G = G_w + G_{gb} = \sum_{j=1}^{k}\sum_{m=1}^{q} S^{m}{}_{j}\, p_j s_j + \sum_{m=1}^{q}\sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh}(w^{m}{}_{nb,jh} + w^{m}{}_{t,jh}) \quad (33)$$

And it is equal to the following perfect multi-decomposition,

$$G = \sum_{m=1}^{q} \times \frac{\sum_{j=1}^{k}\left(\sum_{i=1}^{nj}\sum_{r=1}^{nj}\left(x^{m}{}_{j,i} + x^{m}{}_{j,r} - 2x^{*}{}_{j}^{m}{}_{,ir}\right)\right)}{2\mu n^{2}} + \sum_{m=1}^{q} \times \frac{2\sum_{j=2}^{k}\sum_{h=1}^{j-1}\left(\sum_{i=1}^{nj}\sum_{r=1}^{nh}\left(x^{m}{}_{j,i} + x^{m}{}_{h,r} - 2x^{*m}{}_{jh,ir}\right)\right)}{2\mu n^{2}} \quad (34)$$

Proposition 2 shows that the Gini decomposition leads to a natural multi-decomposition. This approach allows one to isolate the pairs "source/within-group" and "source/gross between-group" that tend to increase the global inequality. Indeed, the first part of this double decomposition represents the with-in group contributions of the k subpopulations to the overall inequality that are decomposed in q sources. The second part of the multi-decomposition characterizes the gross between-group contributions to the global inequality separated in q vector components. The second formulation (34) points out the linearity of the natural multi-decomposition that enables to compute all the contributions. However, the first equivalent equation indicates that it is not necessary to separate the between-group Gini index (G_{jh}) by expenditure sources.

Proposition 3. The Gini multi-decomposition in three components allows one to decompose perfectly the global amount of inequalities both by subgroup and by expenditure sources with the distinction of the net between-group inequality and the intensity of transvariation:

$$= \sum_{j=1}^{k}\sum_{m=1}^{q} S^{m}{}_{j}\, p_j s_j + \sum_{m=1}^{q}\sum_{j=2}^{k}\sum_{h=1}^{j-1} G_{jh} w^{m}{}_{nb,jh} + \sum_{m=1}^{q}\sum_{j=1}^{k}\sum_{h=1}^{j-1} G_{jh} w^{m} w_{t}^{\ m}{}_{,jh} \quad (35)$$

Proposition 3 demonstrate that the within-group inequalities, the net between-group inequalities and the intensity of transvariation introduced by Dagum (1997a) are broken down into q contributions corresponding to the q sources of expenditure. This decomposition is perfect in the sense that the three elements are totally decomposed.

Proposition 2 and 3 show that the Gini coefficient is issued from intersection of the two decomposition domains: factor components and subgroup decomposable measures of inequality. Consequently, a property of multi-decomposability can be expressed such as:

$$I(x) = \sum_{m} C^{m}{}_{W} + \sum_{m} C^{m}{}_{B} \quad (MD)$$

The term $C^{m}{}_{W}$ is the contribution to the overall amount of inequality of m-th source of the within-group element. The term $C^{m}{}_{B}$ represents the contribution to I(x) of the m-th source of the inequalities between the subgroups. The expression (MD) specifies an extension of the formulation of Shorroks' Consistent Decomposition (1982):

$$I(x) = \sum_{m}^{q} C^{m}, \quad (CD)$$

Where C^{m} is the contribution of the m-th source to the overall inequality.

1.5 Data for Inequality Decomposition

The data for inequality decomposition has been taken from "Enquête Integrale sur les Condition de Vie des Ménages 2000-2001 (EICV1), 2005/2006 (EICV2) done by National Institute of Statistics of Rwanda. The sampling frame for the EICV2 was based on the 2002 Rwanda census frame, while the sampling frame for the EICV1 based on the data and cartographic materials from the 1991 Rwanda Census of population and Housing. There were significant changes in the areas considered urban between the two censuses, but these geographic changes are taken into account in the comparatives analysis between the EICV1 and EICV2. A stratified two-stage sample design was used for both EICV1 and EICV2. The primary sampling units (PSUs) were the enumerator areas or zone de dénombrement (ZDs) defined for the census. The sample of ZDs in each stratum was selected with probability proportional to size, where the measure of size was based on the number of households from the census frame. A new listing of households was conducted in each ZD and a sample of households was selected at the second sampling stage. The units of analysis are the households and the individual members of the households. One of the objectives of EICV1 and EICV2 was to provide reliable estimates of household consumption and other characteristics at the level of the 12 old provinces, as well as at the national level, City of Kigali, other urban and rural. Later the country was divided into five new provinces; given the larger size of the new provinces, the corresponding estimates will have better precision than those at the old provincial level.

Each survey contains a rich body of information about many aspects of households living standards, including households and individual demographics, education, health, employment, migration, household business, expenditures, incomes, and credit and savings.

1.2 Decomposition Results and Interpretation

1.2.1 Gini Index and Pseudo-Gini Index by Expenditure sector

As a fist result the following tables (table 2.1 and 2.2) shows the development of total inequality for the specific sample on the all regions and in the city of Kigali by Gini Index, pseudo-Gini, contribution to overall Gini Index (in the brackets). In all sectors (all regions), we observe an Index of Gini equal to 0.674 in 2000-01, 0.649 in 2005-06, so a variation of -0.025 Gini points. At sector level, inequality is higher in Health, Education and Utilities with respectively 0.933, 0.904 and 0.927 in all regions, while in city of Kigali we have a higher Index in Health (0.879), Education (0.879) and Utilities (0.656). Expenditure on food and non food presents an equal distributed index of Gini in both tables. In the City of Kigali the Gini Index of food-expenditure is equal distributed as the coefficient of Gini is 0.429 with a contribution to overall Gini equal to 0.216. The tables gives also an indication concerning the degree of inequality of the distribution of the various expenditures sources for the different population categories, in the same tables we have the indication how important is the contribution of each expenditure sector to overall inequality, for a given category. The data in each row have been computed on the basis of equation (11).

In a second time we compare different regions and different sectors, we can observe that in the City of Kigali in 2000-01, we observe the small variations on shares of contribution for each sector versus 2005-06 situation, as shown in table 2.1, we have in 2000-01 for education sector 0.021 and in 2005-06 we have 0.037, with a variation between them equal to 0.013. In the sector of health the variation is -0.046. In food sector, the variation between 2000-01 and 2005-06, is equal to -0.038, and at overall Gini index, the variation is -0.033. Here we can observe the improvement of Government on Inequality reduction policies. If we consider Kigali City as an urban area, we can observe that the Gini Index is higher in some rural areas (other regions) than in Kigali city, but in general the higher level of expenditure inequality is located in Kigali city. In the tables from to 2.3 to 2.6 we have results for other regions. At Gini Index, we have in the Eastern Province for example, an overall Gini of 0.591 in 2000-01 and 0.512 in 2005-06. The Gini index in this area is lower than in the City of Kigali, because

is a region of a fertile agricultural land, producing crops from rice to strawberries, beans to coffee, vegetables to vanilla. So in this area, the level of poverty is low that in other rural areas. As is shown in the tables 2.3.

Table 2.1 Gini Index and Pseudo Gini by expenditure sectors and Population Sub Group: EICV 1(2000 01)& EICV2 (2005 06)
(In brackets, we have the absolute contribution of each sector to overall Gini Index)

	2000-01(all regions)		2005-06(All regions)		Variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.904(0.026)	0.751	0.897(0.038)	0.751	-0.007
Health	0.933(0.010)	0.647	0.939(0.005)	0.575	0.006
Rent	0.654(0.084)	0.566	0.644(0.074)	0.550	-0.010
Utilities	0.927(0.015)	0.863	0.918(0.020)	0.836	-0.009
Durable goods	0.961(0.040)	0.930	0.959(0.045)	0.930	-0.002
Non food expenditure	0.787(0.283)	0.762	0.732(0.308)	0.711	-0.055
Food expenditure	0.616(0.216)	0.584	0.574(0.193)	0.534	-0.042
Overall	**0.674**		**0.649**		**-0.025**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

Table2.2 Gini Index and Pseudo-Gini by expenditure sector and Population Sub-Group: EICV 1(2000-01)& EICV2 (2005-06)

	2000-01(Kigali City)		2005-06 (Kigali City)		Variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.820(0.021)	0.600	0.807(0.037)	0.668	0.013
Health	0.879(0.007)	0.448	0.925(0.004)	0.503	-0.046
Rent	0.544(0.070)	0.460	0.580(0.048)	0.500	-0.036
Utilities	0.656(0.013)	0.501	0.681(0.013)	0.566	-0.025
Durable goods	0.912(0.051)	0.871	0.919(0.065)	0.883	-0.007
Non food expenditure	0.653(0.250)	0.630	0.629(0.269)	0.614	0.025
Food expenditure	0.429(0.124)	0.394	0.467(0.134)	0.438	-0.038
Overall	**0.537**		**0.570**		**-0.033**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

Concerning other rural regions, the level of inequality is quite similar and with a small variation across sectors and overall. We have a particular case in Northern province in 2005-06. This province has a big variation between 2000-01 and 2005-06. In 2000-01 the overall level of Inequality was equal to 0.575 and in 2005-06 is drop 0.500. This big variation (-13%), is a result of tourism improvement in this zone during last years. But in this area of high mountains and over hanged by chain of volcanoes, we have also the fertile agricultural land. The agriculture is the main economic activity but mostly attracts the population is the marketing mainly of food products and manufactured products. Western and Southern provinces have the higher level of Gini Index in 2000-01 (0.593). In those provinces the land is not fertile as in eastern and northern provinces. Historically are the provinces where the level of poverty is higher in the country. In the southern province the primary sector is predominantly agriculture 95% of GDP relies on subsistence farming for their survival. In 2000-01 two provinces has an index of Gini higher in comparison of other provinces, 0.593 and a small change in 2005-06, in Southern the Index become 0.515 and 0.564 in Western provinces. In term of variation the Southern province has computed a big change with -0.078 of variation between 2000 to 2006. However, in all regions of Rwanda, the level of expenditure inequality was decreased.

Table 2.3 Gini Index and Pseudo-Gini by expenditure sectors and Population Sub-Group in 2000-01 and 2005-06
(in brackets, we have absolute contribution of each sector contribution to overall Gini Index)

	2000-01 (Eastern Province)		2005-06 (Eastern Province)		variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.874(0.028)	0.663	0.870(0.030)	0.648	-0.004
Health	0.931(0.013)	0.650	0.916(0.003)	0.384	-0.015
Rent	0.455(0.039)	0.271	0.482(0.021)	0.318	0.027
Utilities	0.963(0.004)	0.731	0.906(0.007)	0.679	-0.057
Durable goods	0.902(0.019)	0.777	0.866(0.016)	0.749	-0.036
Non food expenditure	0.657(0.225)	0.606	0.621(0.285)	0.591	-0.036
Food expenditure	0.552(0.191)	0.486	0.478(0.151)	0.412	-0.074
Overall	**0.519**		**0.512**		**-0.007**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

Table 2.4 Gini Index and Pseudo-Gini by expenditure sectors and Population Sub-Group in 2000-01 and 2005-06

	2000-01(Northern Province)		2005-06 (Northern Province)		Variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.906(0.029)	0.762	0.883(0.027)	0.653	-0.023
Health	0.920(0.006)	0.415	0.934(0.005)	0.500	0.014
Rent	0.561(0.056)	0.400	0.467(0.027)	0.293	-0.094
Utilities	0.965(0.008)	0.856	0.500(0.004)	0.679	-0.465
Durable goods	0.966(0.032)	0.928	0.926(0.016)	0.847	-0.040
Non food expenditure	0.721(0.198)	0.673	0.621(0.225)	0.575	-0.100
Food expenditure	0.564(0.245)	0.524	0.502(0.196)	0.446	-0,062
Overall	**0.575**		**0.500**		**-0.075**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

Table 2.3 Gini Index and Pseudo-Gini by expenditure sectors and Population Sub-Group in 2000-01 and 2005-06
(in brackets, we have absolute contribution of each sector contribution to overall Gini Index)

	2000-01 (Eastern Province)		2005-06 (Eastern Province)		variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.874(0.028)	0.663	0.870(0.030)	0.648	-0.004
Health	0.931(0.013)	0.650	0.916(0.003)	0.384	-0.015
Rent	0.455(0.039)	0.271	0.482(0.021)	0.318	0.027
Utilities	0.963(0.004)	0.731	0.906(0.007)	0.679	-0.057
Durable goods	0.902(0.019)	0.777	0.866(0.016)	0.749	-0.036
Non food expenditure	0.657(0.225)	0.606	0.621(0.285)	0.591	-0.036
Food expenditure	0.552(0.191)	0.486	0.478(0.151)	0.412	-0.074
Overall	**0.519**		**0.512**		**-0.007**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

Table 2.4 Gini Index and Pseudo-Gini by expenditure sectors and Population Sub-Group in 2000-01 and 2005-06

	2000-01(Northern Province)		2005-06 (Northern Province)		Variation
Sectors	**Gini Index**	**Pseudo Gini**	**Gini Index**	**Pseudo Gini**	**Δ2006-01**
Education	0.906(0.029)	0.762	0.883(0.027)	0.653	-0.023
Health	0.920(0.006)	0.415	0.934(0.005)	0.500	0.014
Rent	0.561(0.056)	0.400	0.467(0.027)	0.293	-0.094
Utilities	0.965(0.008)	0.856	0.500(0.004)	0.679	-0.465
Durable goods	0.966(0.032)	0.928	0.926(0.016)	0.847	-0.040
Non food expenditure	0.721(0.198)	0.673	0.621(0.225)	0.575	-0.100
Food expenditure	0.564(0.245)	0.524	0.502(0.196)	0.446	-0,062
Overall	**0.575**		**0.500**		**-0.075**

Source: Author Calculation from EICV1(2000-01) and EICV2 (2005-06).

1.2.2 The Gini Decomposition by Subgroups

Following earlier studies (see, Bhattacharya and Mahalanobis, 1967, Rao 1969, Fei, Ranis and Kuo 1979, Kakwami 1980, Lerman an Yitzhaki 1984), Silber (1989), Mussard, (2003), has proven, using the approach based on the G-matrix which was described above, that the Gini index may be decomposed into three elements: the contribution of the inequalities within the subgroups to the overall inequality (G_w), the net contribution of the between-group inequalities to the overall Gini ration (G_{nb}) and the contribution of the transvariation intensity between the subpopulations to the overall inequality (G_t).

The results of this decomposition are presented on tables 2.7 and 2.8. Beginning with tables description, we have n_j as the size of subgroup, μ_j as the average of expenditure in millions Rwanda Franc, p_j and s_j as the percentage of individuals belonging to P_j and the expenditure share of the subpopulation j. As we can observe in the following table for the year 2000-01, the average of expenditure is high in the city of Kigali with a Gini index between the subgroup (G_{jj}) equal to 0.5370; 0.5189 of Gini Index between the subgroup in Eastern province, 0.5750 in Northern province, 0.5932 in Western province and 0.5925 in Southern province. The high level of expenditure in the city of Kigali is due to the consumption on electricity and lent. In 2005-06 (table 2.8) we have a decrease of G_{jj}, in Southern province (0.5125) and an increase in city of Kigali (0.5704).

Contrary to other study in decomposition of income like in inequality, Turkey (Silber 2004); Ethiopia (Adugna; 2006), the level of expenditure is high in rural area than in urban area. Measuring income inequality in Turkey and Ethiopia, those studies have found that the level of inequality is higher in urban area than in rural area. But the relative importance of the three components which were just mentioned above, is not the same.

Using the technique of Dagum's Gini decomposition[1], we compute the three elements for 2000-01 and 2005-06.

$\mathbf{G}_{(2000\text{-}01)} = G_w + G_{nb} + G_t = 0.101 + 0.377 + 0.195 = 0.673$

$\mathbf{G}_{(2005\text{-}06)} = G_w + G_{nb} + G_t = 0.101 + 0.380 + 0.167 = 0.648$

The within-group component represents almost 15.09% in 2000-01 and in 2005-06, The between group component is 55.94% in 2000-01 and 2005-06 is 0.58.64%. The binary expenditure differences between the groups are characterized by an important intensity of transvariation 28.95% in 2000-01, and 25.81% in 2005-06.

Table 2.7. The Gini Decomposition and the Gini Multi-decomposition across regions (2000-01)

	2000-01				
Regions	**Kigali Prov**	**East Prov**	**North Prov**	**West Prov**	**South Prov**
n_j	885	1360	1021	1602	1558
μ_j(RwF/Year	11581164,5	178939,2	181991,6	2076683,4	197206,08
p_j	0.1379	0.2118	0.1576	0,25	0.2427
s_j	0.4897	0.1163	0.0880	0.1593	0.1468
G_{jj}	0.5370	0.5189	0.5750	0.5932	0.5925

Source: Author Calculation from EICV1(2000-01)

[1] For the computation of Dagum's Gini decomposition and the comparison with the entropy measures see Mussard, Seyte and Terazza (2003)

Table 2.8. The Gini Decomposition and the Gini Multi-decomposition across regions (2005-06)

	2000-06				
Regions	**Kigali Prov**	**East Prov**	**North Pro**	**West Prov**	**South Prov**
n_i	1025	1454	1058	1652	1704
μ_i(RwF/Year	2011089,44	422924,58	289690,67	392960,39	321151,14
p_j	0.1487	0.2109	0.1576	0.2397	0.2472
sj	0.4932	0.1471	0.088	0.1593	0.1309
G_{jj}	0.5704	0.5125	0.5750	0.5925	0.5147

Source: Author Calculation from EICV1(2000-01)

1.2.3 Conclusion and Policy Implication

This study analyzes the expenditure multi-decomposition of Gini indices inequality in different regions and sector in Rwanda. In this study we use data from National Institute of Statistics of Rwanda (EICV1 and EICV2) for the years 2000/1 and 2005/06. The distribution of expenditures is measured using the new approach to the Gini decomposition by Expenditure Sources and the Gini Decomposition by Subpopulation. The data confirm that the level of inequality between and within regions and sector is high. We observe the higher level of expenditure inequalities in sectors as health, education, utilities and use value of durable goods. Differently in good expenditure we have a reasonable level of inequalities between regions. This result depend on the fact in Rwanda of the agricultural activities are largely for own- consumption, so the households use the income for to buy other utilities as to pay money for children education and health. Those high levels of inequalities are the results of rapid growth of population resulting from an increase in fertility combined with a decline in infant mortality. Another cause of expenditures inequalities may be the problem of land inequality (not shown in this work but documented in several economic reports on Rwanda Economic Development). Natural population growth, together with increased number of returnees from neighboring countries, has inevitably placed land administration and land use management reform processes. So in Rwanda the high level of expenditure inequality is due to this big problem of land inequality. For example, two percent of cultivating households do not own any land, so they rent, sharecrop or borrow land. A round of half of cultivating households (representing 3.6 million people in 2000/01 and 4.5 million in 2005/6) cultivate less than half a hectare. More than 60 percent of households cultivate less than 0.7 ha of land and more than a quarter cultivate less than a 0.2 ha. Standard of living is strongly related to the size of landholding, with those holding the least land generally being the poorest.

There are several direct policy implications. The appropriate land redistribution actions as a land reform that ensures efficient and effective administration rights and obligations of land users, the introduction of legal and institutional mechanisms for land use management and dispute resolution, all can provide scope to improve the welfare of the poor and vulnerable groups.

In agriculture the main programs as shown above can include the intensification of sustainable production systems in crop cultivation and animal husbandry; building the technical and organizational capacity of farmers (e.g. in Coffee sector), promoting commodity chains and agribusiness and strengthening the intuitional framework of sector at central and local government.

To reduce inequality in health sector the government of Rwanda can planning to maximize preventive health measures and build the capacity to have high quality and accessibility health care services for the entire population in order to reduce infant malnutrition and children mortality. This includes strengthening intuitional capacity, increasing the quantity and quality of human resources, ensuring

that health care is accessible to the all population and increasing geographical accessibility. As shown above, high inequality also depend on high population growth, slowing down population requires innovative measures including the strengthening of reproductive health services and family planning and ensuring free access to information, education and contraceptive services.

1.2.4 Future research

Only this study only covered the data of 2001/2002 and 2005/2006, Rwanda achieved a lot after this period, the next research will have to cover from 2010/2011 and 2015/2016.

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