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Decline in Fertility between 1980 and 2010 in the African Countries Mostly Affected by HIV/AIDS: Analysis of Individual and Group Effects

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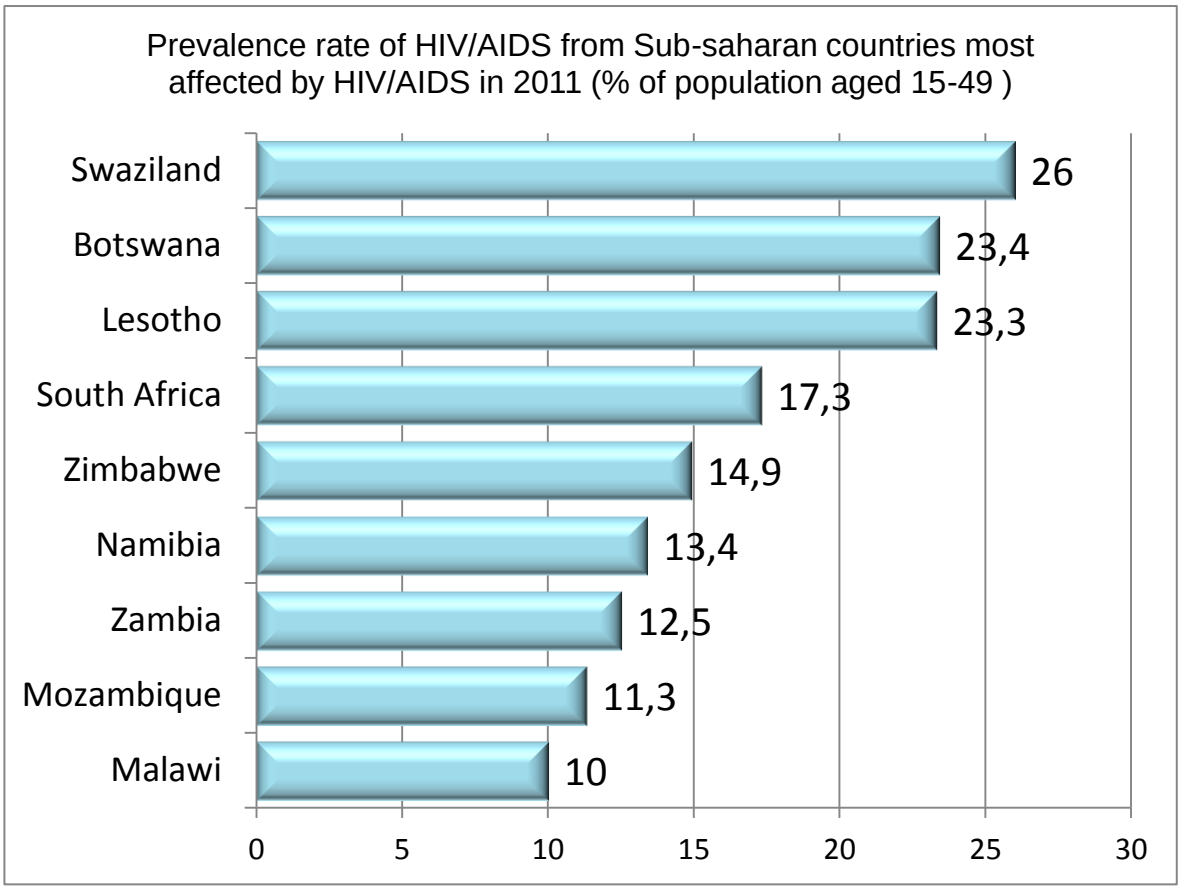
Summary

The decline in fertility has long been illustrated in demography and economics studies by many authors, including Karl Schwarz (1968); Cantrelle P. & Ferry B.(1979); Knodel J.(1983); Bongaarts J.(1978, 1983-84 & 2005); JC Caldwell et al.(1989); Evina A.(1999); Desgrees et al. (2001); Lori S. Ashford (2006); K. Bietsch et al.(2013); etc. These authors identified the various factors that contribute significantly to the decline in fertility. Policies of birth control also contributed to the decline in fertility in the world. But all these studies and policies have not highlighted the decline in fertility due to ***"individual" and "group" effects***, when population is affected by infectious diseases such as HIV/AIDS, STIs, TB, etc...). This approach of decline in fertility is certainly not new, but it is based on two assumptions which suggest that leaders of population planning have obligations and important decisions in the fight of infectious diseases. The decline in fertility is mainly related to five factors**: contraception, mortality, poverty, educational level, and urbanization.** Women's behaviors and characteristics determine their HIV/AIDS infection. We speak of ***"the individual effect of fertility decline"***. Moreover, vulnerability to HIV/AIDS determines the level of female mortality. The decrease of women and child in the population due to mortality, the decline in the number of wealthy and educated women, the increase of poor and no educated women is assigned to the ***"group effect of fertility decline"***.

Introduction

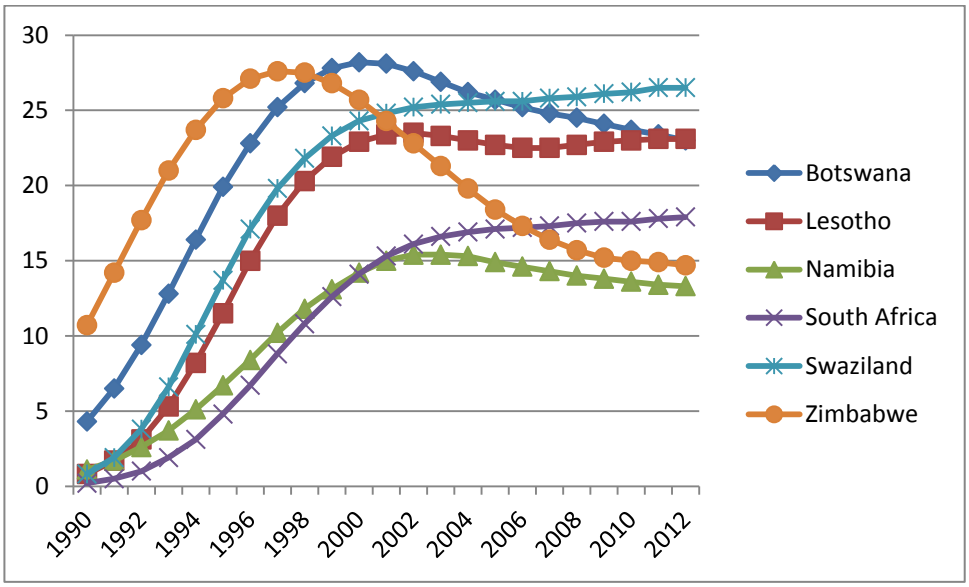
The prevalence rate of HIV/AIDS in African countries mostly affected varies between 10% and 26% of population aged 15-49 years old (World Bank, 2011). Six of them showed a significant decrease in fertility over 50% in 20 years (1980-2010), after maintaining fertility at a high level from 1950 to 1980, while the average ratio of the under-five mortality decreased from 222‰ to 79‰ between 1950 and 2010. But the downward trend of the under-five mortality of children was slowed between 1995 and 2005, while fertility has continued to decline at the same rate. The different trends in HIV/AIDS prevalence, Adult mortality, child mortality and Fertility from those countries are illustrated by the four Graphs below.

Graph1: Prevalence of HIV/AIDS from sub-Saharan African countries most affected in 2011.



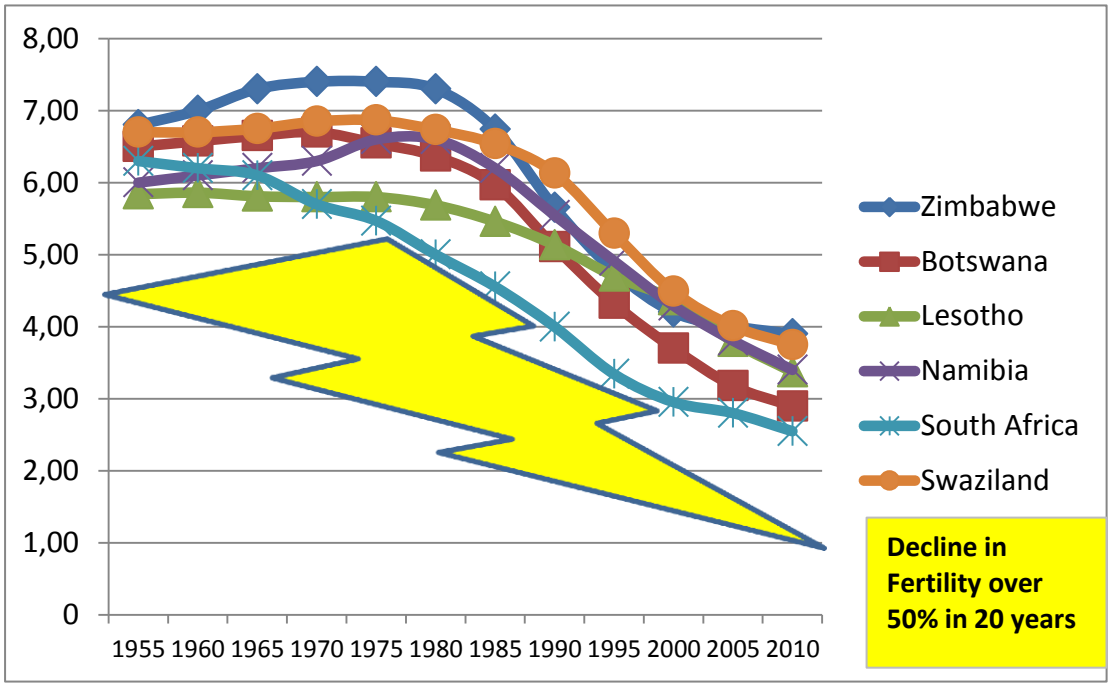
Source: Analysis of data from the World Bank in 2011 (WDI Table).

Graph2: Trends in Aids/HIV prevalence from the most affected countries which have experienced a decline in fertility over 50% between 1980 and 2010



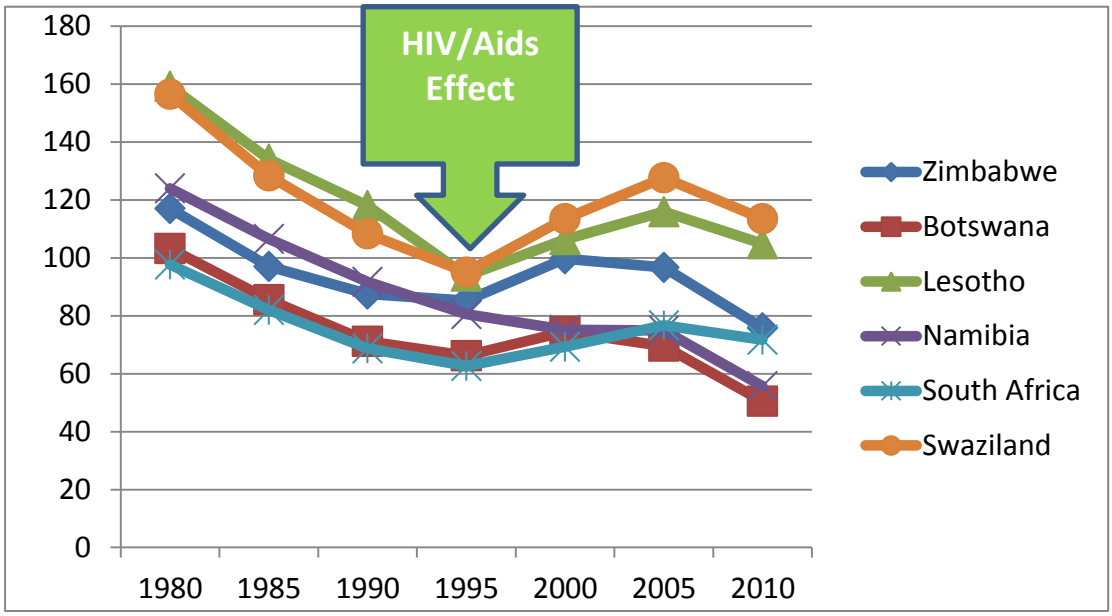
Source: Analysis of data from UNAIDS Report on the Global AIDS Epidemic – 2013 (HIV estimates with uncertainty bounds 1990-2012)

Graph3: Trends in Fertility from the most affected countries by HIV/AIDS which have experienced a decline in fertility over 50% between 1980 and 2010.



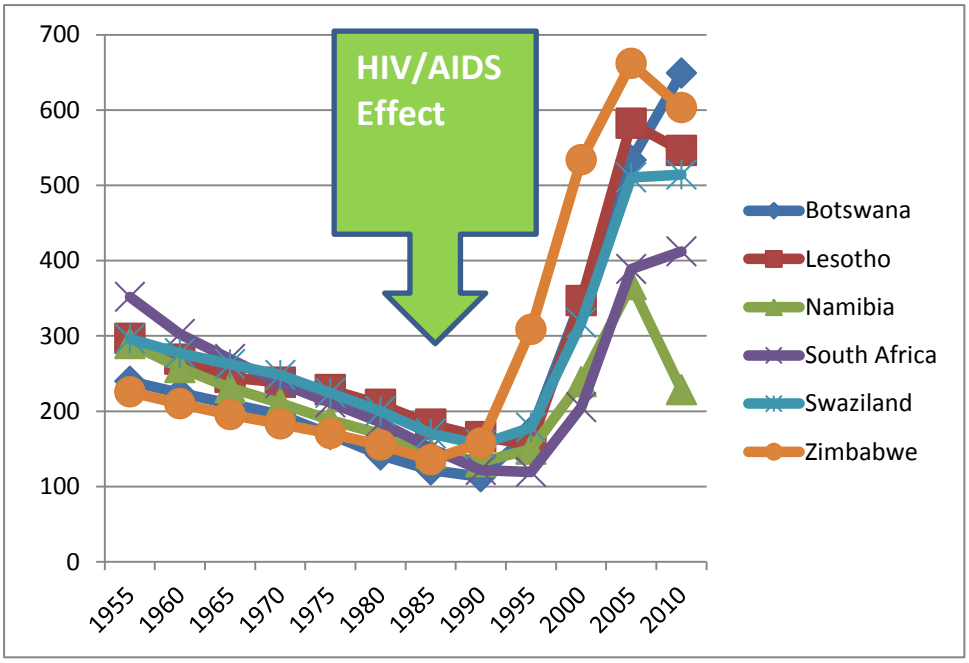
Source: Analysis of data from the United Nations (United Nations Department of Economic Nations and Social Affairs, Population Division (2011).World Population Prospects: The 2010 Revision, CD- ROM Edition).

Graph4: Trends in under-five mortality of children from the most affected countries by HIV/AIDS which have experienced a decline in fertility over 50% between 1980-2010.



Source: Analysis of data from the United Nations (United Nations Department of Economic Nations and Social Affairs, Population Division (2011). World Population Prospects: The 2010 Revision, CD- ROM Edition).

Graph4: Trends in women adult mortality from the most affected countries by HIV/AIDS which have experienced a decline in fertility over 50% between 1980-2010.



Source: Analysis of data from the United Nations (United Nations Department of Economic Nations and Social Affairs, Population Division (2011). World Population Prospects: The 2010 Revision, CD- ROM Edition).

The above graphs show that the adult mortality of women was influenced in its decline by the impact of HIV/AIDS between 1955 and 2010. After a decline from 300 to 150 women per 1000 inhabitants between 1955 and 1990, the average ratio of female mortality of those countries has increased sharply in 10 years, from 150 to 650 women per 1000 inhabitants on average between 1990 and 2010.

According to those historical trends, which factors do really explain this decline in fertility over 50 % in 20 years in those countries? A decline in fertility, is it due to the behavior of groups of women aged between 15-49 years old, or due to their composition? We will firstly develop a few literature reviews in order to understand the various factors that contribute significantly in fertility decline, and secondly, we will use a Multidimensional Analysis (decomposition and Multiple Factor Analysis Methods), in order to highlight the ***"individual and group effects in fertility decline" due to the infectious diseases***.

I. Decline in Fertility : A review of the Literature[1]

The "causal" relationship between fertility and development has been for decades, based on the theory of fertility transition or simply based on the theory of demographic transition, attempt to explain the demographic development of the developed countries. This theory of fertility called "classic" was quickly generalized to developing countries (Noumbissi, 1991).

In the classical model[2], the oldest, the relevant factors of fertility decline are mortality, urbanization, literacy, rural density and crop yields (Notestein, 1945, Davis, 1945). These factors are quite variables commonly accepted to define precisely a process of socio-economic modernization and industrialization. There is a first revision, named Princeton Review, because it was developed after the work of F.W Notestein, by professors (AJ Coale and E. Hoover) from this American University. This model incorporates: (i) culture and religion, (ii) communication, in the associate factors of the classical model. The introduction of those factors, which are not of an economic nature, marks the introduction of a cultural dimension in a relation scheme exclusively dedicated to demographic and socio-economic variables. However, these factors are likely to evolve over a period of economic growth, by participating in a global process of modernization. In this sense, this model does not replace a

[1] This literature synthesis is derived largely in the work of Amadou Noumbissi entitled "Fertility and Development: From a few theories."

[2] P.VIMARD (2001): Demographic and family Transition: From modernization theories to the models of crisis. Centre St Charles, case 10, 13331 Marseille Cedex 3 ; ORSTOM.

cultural determinism in socio-economic determinism, but it indicates an interaction of both types of variables. This model also incorporates the age structure of the population and the supply of labor related to it, as well as population policies that relate only to developing countries.

Finally, there is a second revision of the classical model , giving rise to the model said equitable development , developed by R. Repetto (1978) and validated by the analysis of the transition process in Hungary between 1880 and 1970 (Cook and Repetto, 1982). This model adds the factors of two previous series a third set of factors: index of real wages, land distribution, average income of individuals without land, development expenditure of property value. This model is also in the perspective of an economic effect on the population but much more emphasis on the structure of economic development and the distribution of wealth among different segments of the population on the degree of growth. His interest is in showing that the redistribution of wealth may be the instrument which could bring down the fertility rate to focus on the relevance of a policy of balanced distribution of income, goods and knowledge for developing countries development and conversely the negative impact that can have strong socio-economic inequalities on a generalized decline in fertility. Similarly, equivalent to average income, socio-economic inequalities are a factor of mortality and one of the causes of delay in the decline of mortality.

Recently, many authors have multiplied, including Karl Schwarz (1968); Cantrelle P. & Ferry B.(1979); Knodel J.(1983); Bongaarts J.(1978, 1983-84 & 2005); JC Caldwell et al.(1989); Evina A.(1999); Desgrees et al. (2001); Lori S. Ashford (2006); K. Bietsch et al.(2013); etc. These authors isolated the determinants of fertility, and the various factors that contribute significantly to the decline in fertility. But all these authors have not highlighted the decline in fertility due to individual and group effects when population is affected by infectious diseases such as HIV/AIDS, STIs, TB, etc....). This approach to fertility decline is certainly not new, but it can highlight two interesting effects, which contribute significantly to the decline in fertility in countries heavily affected by infectious diseases.

II. Sociological approaches of individual and Group Effects

The word "group dynamics" appeared for the first time in an article by Kurt Lewin (1944) was devoted to relations between theory and practice in social psychology. By 1939, Lewin saw the need to address the problem groups in designing the group as a single unit and

setting it not on the basis of the similarity of members, but on the basis of their dynamic interdependence.

According to Turner (1981), the group exists only if at least two individuals define themselves as part of this group and a third individual recognizes this existence. However, the group is not a collection of individuals in the same place or share common values . Large differences opposed, for example, groups of athletes endure the political groups, ethnic groups, collector groups, gender, fans club or club of all kinds. In all cases the individual will acquire the values and its own codes (or groups) of belonging. In this respect, the Group recognizes a set of direct and privileged relationship. In addition, other aspects involved in the group concept as size, status, role and standards.

Most theories on individual and group[3] effects were written by sociologists. We present below a summary of those who contribute most to the explanation of social performance.

1. **The Scapegoat or frustration theory of Dollard, Miller, Mowrer and Sears (*1939*)**

It represents the ratio frustration/aggression that all frustration leads to aggressive reactions. These aggressive reactions are directed to the person or persons responsible for the frustration. When frustrations accumulate and that aggression cannot be returned to the person responsible for the frustration, then a scapegoat may be designated and may become the target of prejudice, abuse or discrimination.

2. **The black sheep theory of Marques, Yzerbyt and Leyens (*1988*)**

It helps account for how individuals perceive and evaluate a target person who behaves or manner consistent (normative) or contrary (deviant) their expectations. That person belongs to the same target group (ingroup) or another group (outgroup). The black sheep effect refers to a group behavior.

[3] For more details, please refer to: (i) Psychologie sociale S. Delouvée, éditions Dunod (2010). (ii) Turner, J.C. Social categorization and social discrimination in the minimal group paradigm. In H. Tajfel (ed.), Differentiation between social groups: Studies in the social psychology of intergroup relations. European Monographs in social psychology, n°. 14. London: Academic Press, 1978**.** (iii) Michael A. Hogg, Turner. J.C, et al., 1986: Social categorization, intergroup behavior and Self-Esteem: Two experiments; In Revista de Psicologia Social, 1986, I. 23-38. (iv) Cl. Faucheux : La dynamique de groupe In: L'année psychologique. 1957 vol. 57, n°2. pp. 425-440.

3. The theory of real conflicts of Sherif (*1966*)

It demonstrates that it is competition for the acquisition and control of natural resources and (or) economic would be at the origin of intergroup conflict. In the case of competitive relationships between groups, generating characteristics of conflict behaviors are attributed to the other group. In the case of cooperative relations intergroup competition would be the basis of stereotypes, prejudice and discrimination.

4. The social identity theory of Tajfel

It is complementary to the theory of real conflict. According to this theory, social categorization allows the individual to define themselves as members of particular groups (self-categorization) and leads to a need to maintain or achieve a positive social identity. This theory allows the study of intergroup conflict by postulating that the only categorization into two distinct groups causes a phenomenon of discrimination against the other group (outgroup) only in order to differentiate themselves and get a collective identity to its own membership group (ingroup).

5. The social dominance theory proposed by Sidanius and Pratto (*1999*)

It states that in any organized society, we find the idea of a hierarchy of social groups. This social hierarchy based on belonging to different groups is the cause of intergroup conflict and all forms of social oppression. The dominant groups would develop ideologies to legitimize inequality and maintain their status.

6. The relative deprivation theory of Berkowitz (*1972*), Crosby (*1976*), Guimond and Tougas (*1994*)

It is defined as the dissatisfaction resulting from comparisons perceived negatively. According to this theory, individuals tend to respond to unfair comparisons, where they feel they have the right to possess the same attributes as those to whom they compare. Relative deprivation is a feeling of dissatisfaction that appears in situations of social comparison and predisposes individuals to revolt.

7. The justificative system theory of Jost and Banaji (*1994*).

The central idea of this theory is that the social system is maintained and perpetuated through social stereotypes. Stereotypes appear as a way to influence the dominant groups in the dominated groups, they aim to maintain the status quo between the groups, resentments inequality.

8. The cognitive dissonance theory of Léon Festinger (*1957*)

It helps to understand some of the processes of change of an individual within a group, for example. Festinger believes that when cognition (knowledge, opinion or belief about oneself or something else) is in contradiction with the appearance of cognition (in contradiction with that absorbed by an individual) appears inconsistency inducing a state of tension so called dissonance.

However, the redistribution of wealth may be the instrument which could bring down the fertility rate to focus on the relevance of a policy of balanced distribution of income, goods and knowledge for developing countries development and conversely the negative impact that can have strong socio-economic inequalities on a generalized decline in fertility. Similarly, equivalent to average income, socio-economic inequalities are a factor of mortality and one of the causes of delay in the decline of mortality. Social categorization allows the individual to define their self-categorization, through their behavioral. Categorization into many distinct groups causes a phenomenon of discrimination against the other group (outgroup). Belonging to different groups is the cause of intergroup conflict and all forms of social oppression.

After this literature reviews, that helped us to highlight the most important factors that contribute in the fertility decline, and knowing how to categorize the "individual and group effects", we will continue with a Multidimensional Analysis (Decomposition and Multiple Factor Analysis Methods), in order to understand the social changes in fertility decline due to the ***"individual and group effects" when a country is mostly affected by infectious diseases***. Thus, we will begin by the methodology used.

III. Methodology

The first scientific approach to the concept of group was highlighted by Carnot (1824), which defined the second law of thermodynamics in physics ("Carnot's principle"), studying the disorder of a system. This principle establishes the irreversibility of physical phenomena, especially during the heat exchange. It has since been the subject of many generalizations and successive formulations Clapeyron (1834), Clausius (1850), Kelvin, Boltzmann in 1873 and Max Planck throughout the nineteenth century[4].

[4] 1) Alfred Brian Pippard, *Elements of Classical Thermodynamics - For Advanced Students of Physics*, Cambridge University Press (1957) 173 pp. Reissue: April 2004), ISBN 0-521-09101-2. Second level degree.

The second law of thermodynamics introduces the state function called entropy S, usually equated with the notion of disorder that can only grow in a real transformation. Thus, " Any transformation of a thermodynamic system is done with the overall increase in entropy, including the entropy of the system and the external environment: We say that there is entropy creation." In 1967, Theil introduced a new measure of income inequality derived by analogy with the second law of thermodynamics (entropy law), which measures the disorder of a thermodynamic system, offering the opportunity to assess the contribution of intergroup and intragroup inequality to total inequality. Entropy is the information expected in a distribution which is associated with a probability. Theil performs a transposition replacing the idea of probability by the income shares of each sub- population derived from the "decomposition" of the total income of the parent population (S. Mussard, S.Seyte and M. Terraza 2002). Thus, in 1971, Nicholas Georgescu-Roegen, Romanian economist (1906-1994), father of ecological economics has contributed to the introduction of physics in the economy, linking economic and physical sciences (thermodynamics), paving the way for the thermodynamic economy. His major work is The Entropy Law and the Economic Process appeared in 1971.

More recently, the Decomposition have been developed by numerous authors, including Ronald Oaxaca (1973); Alan S. Blinder (1973); Sinning, M. Hahn, and T K Bauer (2006, 2007 & 2009); Eloundou and Giroux (2010) and Daniel Powers et al. (2011).

Eloundou and Giroux (2010) had focus on social changes and inequalities amongst subpopulations. We will rely on this method, and the Multiple Correspondence Factor Analysis (MCA), to highlight the individual effects of the decline in fertility due to infectious diseases (HIV / AIDS, STIs, TB group, etc. ...). Data from Demographic and Health Surveys (DHS), those of the UN (United Nations Department of Economic and Social Affairs Nations, Population Division (2011) World Population Prospects: The 2010 Revision, CD-ROM Edition), and those of UNAIDS (Global AIDS Epidemic, 2013 - HIV Estimates with uncertainty bounds 1990-2012) will be used for analysis.

2) Robert Locqueneux, Prehistory & History of Classical Thermodynamics (A History of the heat), books History & Philosophy of Science 45, French Society for the History of Science & Techniques (December 1996) pp. 333. ISSN: 0221-3664. Test theories of heat in the eighteenth and nineteenth centuries. First level university degree.

Decomposition Method

In our case, we must replace the variables used by Eloundou and Giroux (2010) in the case of mortality among children by the variables of fertility. Then, we have to replace:

- the group of children by the group of women;
- the national mortality among children by the Total Fertility Rate among women, and;
- the average mortality level among children in each group by the average fertility level among women in each group.

Then, we can apply this decomposition method in the case of Fertility Decline in the African countries most affected by Hiv/Aids.

Given information on the proportion of Women in various SES groups at a given time (w_{jt}) and on the average Fertility level among Women in each group at that time (y_{it}), the Total Fertility Rate among Women is:

$$Y_t = \sum w_{jt} * y_{jt}$$

Its change over time is:

$$\Delta Y = \sum \overline{y}_{j*} \Delta w_j + \sum \overline{w}_{j*} \Delta y_j \quad [1]$$

Composition Effect (A) + Behavioral Effect (B)

Where barred variables are averages over two time points:

$$e.g.\ \overline{y}_j = (y_{j\,(t+1)} + y_{j(t)})/2$$

Decomposition [1] expresses the total variation due to composition change and that due to "behavior" among the different socio-economic classes. It then becomes possible to extend this formulation by expressing the performance of a given group (j) as a function of one or several other predictors. In a single-variable, linear model for instance:

$$Y_j = \alpha + \beta x_j + \mu_j \quad [2]$$

Where the intercept α represents the baseline Fertility, β is the increase in Fertility associated with the unit increase in the variable X (here SES), μj the error terms, which could also be interpreted as the relative over performance / under performance of the group, or the residual effect of other factors not considered in the analysis. In this case, a change in the value of y_j between two periods is obtained as such:

$$\Delta y_j = \Delta\alpha + x_j \Delta\beta + \Delta\mu_j \quad [3]$$

By inserting [3] into [1], we obtain:

$$\Delta Y = [\sum \bar{y}_j * \Delta w_j] + [\sum \bar{w}_j * \Delta\alpha] + [\sum w_j * x\Delta\beta] + [\sum w_j * \Delta\mu_j] \quad [4]$$

$$= \quad A \quad + \quad B_1 \quad + \quad B_2 \quad + \quad B_3$$

Composition effect + **Behavioral effect**

This decomposition, which is more refined, splits the behavioral effect into the three subcomponents already discussed before, including the effects of change in baseline Fertility (B1), the SES gradient (B2) and the residual effect of other variables (B3). The composition effect can be likewise disaggregated. Thus the proportion of women in poor households (wj) is based on the number of poor households (nj) and on fertility of poor households (fj) which is the fertility of the poor with respect to national average:

$$W_j = n_j * f_j \qquad [5]$$

The change in the proportion of women from each of the socio-economic groups would depend on the change in (1) the proportion of households belonging to the different social categories and (2) the relative fertility of each household as follows:

$$\Delta w_j = \bar{f}\,\Delta n_j + \bar{n}\,\Delta f_j \qquad [6]$$

We thus could insert [6] into [1] to obtain:

$$\Delta Y = [\sum \bar{y}_j * \bar{f}\Delta n_j] + [\sum \bar{y}_j * \bar{n}\,\Delta f_j] + [\sum \bar{w}_j * \Delta y_j] \quad [7]$$

A1 + **A2** + **B**

Composition Effect + **Behavioral Effect**

In this equation, A1 represents the change in the proportion of poor households within the population, while A2 represents the change in relative fertility of different socio-economic categories. One could then insert [7] into [4], yielding a much longer formulation not presented here because of its length. This approach has a few limitations. It basic strengths are its simplicity, flexibility, easy of interpretation, and compatibility with other methods (Eloundou and Giroux, 2010). It is simple both in its explication and application; it can flexibly incorporate other elaboration, and it is easy to interpret and discuss with policy audiences. Its major weakness, however, is that it only offers a partial solution, offering just a beginning of explanation. To overcome this limit, we will use the Multiple Correspondence Factor Analysis (MCA) to classify women according to the profiles of fertility.

IV. FINDINGS

1. Decline in Fertility: Individual and Group Effects (Decomposition Parameters)

The table below present the main findings obtained after performed our analysis.

Table1: Decomposition results in fertility decline

COUNTRIES	PERIOD	CHANGE (F_b-F_a)	BASIC DECOMPOSITION		ADVANCED DECOMPOSITION				
					COMPOSITION		BEHAVIORAL		
			% Composition	% Behavioral	% Pauperization	% Fertility	% Basic	% Vulnerability	% Error
LESOTHO	2009/2004	1,2	949,15%	-849,15%	1991,1%	-156,9%	2903%	-4552%	800%
NAMIBIA	2000/1992	-144,4	16,54%	83,46%	34,6%	-21,3%	94%	-9%	-2%
	2007/2000	-49,5	-34,73%	134,73%	-63,5%	37,3%	202,12%	-66,95%	-0,44%
ZIMBABWE	1999/1994	-19,7	-47,26%	147,26%	-94,3%	76,1%	396,54%	-251%	1,69%
	2006/1999	-27,4	43,05%	56,95%	79,1%	-77,7%	-145,95%	204,27%	-1,37%
	2011/2006	27,9	-4,44%	104,44%	-8,2%	-17,2%	7,16%	100,50%	-3,23%

FITTING PARAMETERS

COUNTRIES	YEAR	FITTING PARAMETERS		
		ALPHA	BETA	R^2
LESOTHO	2004	5,28	-0,75	96%
	2009	5,62	-0,96	96%
NAMIBIA	1992	7,48	-0,9	90%
	2000	6,12	-0,84	97%
	2007	5,12	-0,69	96%
ZIMBABWE	1994	5,94	-0,77	95%
	1999	5,16	-0,53	84%
	2006	5,56	-0,8	99%
	2011	5,58	-0,67	94%

F_b-F_a: Change (increase or decrease) in the average fertility of women.

1) The case of Lesotho

Between 2004 and 2009, the results show that 949.15% of the fertility decline is related to the composition or group effect (the number of poor women has increased from 16.3% to 20%, while the rich women decreased from 25.6% to 22.2%). The average fertility has increased by 1 point but only the effect of fertility is largely down (-157%) between the two years. The remainder of the change (-849.15%) is bound to a behavior effect. We also note a significant impoverishment in the composition of women (1991%).

2) Namibia Experience

Between 1994 and 1999, the results show that 16.54% of the fertility decline is related to the composition or group effect. The average fertility fell to (-144) points but only the effect of fertility is in decline (-21.3%) between the two years. The remainder of the change (83.46%) is bound to a behavior effect. We also note a significant impoverishment in the

composition of women (34%) and fertility based on 94%. Between 2000 and 2007, the average fertility is still down (-49.5%). This decrease is always related to the effect of behavior (134.73%).

3) Zimbabwe Situation

Between 1992 and 2006, we saw a decline in average fertility from -20 to -27 points. This decrease is much related to an effect of behavior (147.26% between 1992 and 1999 and 57% between 1999 and 2006). But during the last period (2006 to 2011), the results obtained show that -4.44% of the fertility decline is related to the effect of composition and 104.44% are related to the behavior effect. The average fertility has increased during the last period (28 points), with a significant vulnerability effect of 100%.

Thus, we see that the decline in fertility is related to two effects: the individual effect and the group effect. To determine the different factors that explain this change, we have classified women according to socio-economic variables from the factor Multiple Correspondence Analysis (MCA). We selected as variables, level of education, standard of living, place of residence and the use of contraception, as these variables are included in all studies on the determinants of fertility. The table below sums up the situation.

2. Classification of Women according to Social and Demographic Characteristics (the Multiple Correspondence Factor Analysis)

The Multiple Factor analysis methods[5] include search subspaces of small dimensions that best fit the scatter of individuals and the scatterplot of variables. The proximities measured in these subspaces should best reflect the actual proximity. The representation space obtained is called factorial space. The methods differ depending on the nature of the analyzed variables, which can be continuous variables, categorical variables or categories in the case of contingency tables. The lines can be individuals or groups.

Three criteria allowed us to retain five (05) factorial axes: (i) the method of Cattle (method or the elbow), which helps to retain the number of axes that lie after breaking information, (ii) Kaiser method, which holds the number of axes according to the value of the last considered axis, which must be greater than the average of the eigenvalues (iii) the method of the cumulative percentage of inertia (which holds the number of axes as the last considered line reveals at least 60% of the inertia of the cloud point. Based on these three

[5] For more information, please refer to the user's work Lebart, Morineau and Piron (1995).

criteria, we finally selected two factorial axes (axis 1 and axis2) among the five because they reflected the maximum information (OWOUNDI, 2013).

Table 2: women classification profiles with age between 15-49 years old

Countries	Years	WOMEN PROFILES WITH AGE BETWEEN 15-49 YEARS OLD		
		Social and Demographic characteristics	Lower Fertility	Highest Fertility
LESOTHO	2004	Highest Education Level	Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Never used	Used of any method
	2009	Highest Education Level	High and Secondary	Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never used
NAMIBIA	1992	Highest Education Level	Primary	Secondary
		Wealth Index	Middle income	Richest
		Place of Residence	Rural	Urban
		Used of Contraception	Never used	Used any method
	2000	Highest Education Level	High and Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never Used
	2007	Highest Education Level	High and Secondary	No education and Primary
		Wealth Index	Richer and Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never Used
ZIMBABWE	1994	Highest Education Level	Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never Used
	1999	Highest Education Level	Secondary	No education and Primary
		Wealth Index	Richest	Middle, Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never Used
	2005	Highest Education Level	High and Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Never Used	Used any method
	2011	Highest Education Level	High and Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Never Used	Used any method

So we get a classical result corresponding to two profiles of women:

- On one hand , we have rich women with secondary or higher education level, using contraception, who live in urban areas and have low fertility ;
- On the other hand, we have poor women living in rural areas, with no education or a primary education level, which do not use contraception and have a high fertility.

This result shows that the decline in fertility is linked to the variables identified above, namely, the standard of living, level of education, contraception, and urbanization. But aside from these two profiles, we also obtained three different profiles that have attracted our attention:

1. ***High fertility among poor women with no education or with primary education level , using contraception;***
2. ***Low fertility among rich women with high level or secondary education, but not using contraception;***
3. ***High fertility among the rich women with secondary level of education, using contraception***

To understand this, we have conducted a second decomposition analysis, to understand social changes in the use of contraceptive methods. The results are recorded in the table below:

3. Social Change in the use of Contraceptive Methods (Decomposition Parameters)

Table 3: Decomposition results in the use of contraceptive methods

COUNTRIES	PERIOD	CHANGE (C_b-C_a)	BASIC DECOMPOSITION		ADVANCED DECOMPOSITION				
					COMPOSITION		BEHAVIORAL		
			% Composition	% Behavioral	% Pauperization	% Fertility	% Basic	% Vulnerability	% Error
LESOTHO	2009/2004	864,1	-12,26%	112,26%	-24,5%	-2,6%	147%	-35%	0%
NAMIBIA	2000/1992	1765,5	15%	85%	31,6%	-52,3%	109%	-24%	0%
	2007/2000	1031	-21,88%	121,88%	-49,1%	13,7%	116,83%	2,79%	2,27%
ZIMBABWE	1999/1994	456,8	-11,89%	111,89%	-26%	12,7%	109,07%	4%	-1,23%
	2006/1999	808,6	12,03%	87,97	26%	-14,8%	74,46%	12,83%	-1,32%
	2011/2006	-196,2	-4,40%	104,40%	-8,2%	-9,1%	27,8%	331,13%	5,68%

FITTING PARAMETERS

COUNTRIES	YEAR	FITTING PARAMETERS		
		ALPHA	BETA	R^2
LESOTHO	2004	17,66	8,86	97%
	2009	30,34	7,46	97%
NAMIBIA	1992	1,86	11,6	83%
	2000	21,14	9,67	91%
	2007	33,18	9,8	94%
ZIMBABWE	1994	37,28	5,17	91%
	1999	42,26	5,26	74%
	2006	48,44	5,76	93%
	2011	53	2,75	94%

C_b-C_a: Change (increase or decrease) in the number of women who use contraceptive methods

The results mainly show that for all three countries, the use of contraception is more related to the individual effect (112, 26% in Lesotho between 2004 and 2009, 122% for Namibia between 2007 and 2000, and 112% for Zimbabwe between 1994 and 1999). We also note a significant increase in the number of women using contraception during the study periods. We note, for example, (+864) women in Lesotho between 2004 and 2009, (+1766) for Namibia between 1992 and 2000, and (+808.6) for Zimbabwe between 1999 and 2006. Only Zimbabwe is experiencing a decline in the number of women using contraception during the last period (-196) women between 2006 and 2011).

To understand social change linked to the individual and group effects within the sub-groups of women in the use of contraception, we have made the following calculations:

4. SOCIAL CHANGE IN SOCIAL AND DEMOGRAPHIC CHARACTERISTICS[6]

Table 4: Changes in social and demographic characteristics

COUNTRIES	PERIOD	CHANGE (C_b-C_a)	CHANGE IN SOCIAL AND DEMOGRAPHIC CHARACTERISTICS								
			WEALTH INDEX					HIGHEST EDUCATIONAL LEVEL			
			Poorer	Poorest	Middle	Richer	Richest	No Education	Primary	Secondary	High
LESOTHO	2009/2004	864,1	585	26	191	261	-199	-90	-725	1236	443
NAMIBIA	2000/1992	1765,5	308	369	298	397	395	-4	-665	2310	124
	2007/2000	1031	38	156	401	395	41	-7	150	761	127
ZIMBABWE	1999/1994	456,8	411	-70	150	47	-81	569	916	-881	-147
	2006/1999	808,6	83	151	115	167	292	-15	122	673	30
	2011/2006	-196,2	-62	22	22	-115	-62	116	238	-451	-99

- ***High fertility among poor women with no education or with primary education level , using contraception***

In Lesotho, for example, the use of contraception has increased holistically between 2004 and 2009 (+864 women). Poor women hold the record of this increase (+611 women). Among these poor women, contraceptive use has declined among women with no education or with primary education (-576 women). Thus, we can remember that: irregular uses of contraception or traditional contraceptive methods, poverty, education level, etc., are the main significantly factors that explain this result.

[6] These results do not come from the decomposition method. They were obtained on the basis of the author's own calculations, as the difference of the indicator values (Highest educational level and Wealth index) between the initial and final years. The results were reported in the number of women using contraception (Cb-Ca), and the number of women among sub-populations.

- ***Low Fertility among women with a high level or secondary education, but not using contraception***

In Lesotho, for example, the use of contraception by women with secondary level of education had increased (+284 women). Among these women, the use of contraception by richest women had decreased significantly (-199 women) between 2004 and 2009.

In Zimbabwe, for example, the use of contraception has decreased between 2005 and 2011 (-196 women). Among these women, the use of contraception by the rich women greatly diminished (-177 women).

To this end, these results may be due to several causes: absence of sex intercourse (prolonged abstinence) of women due to HIV/AIDS status, infertility, poverty, etc.

- ***High fertility among women with a high level or secondary education , using contraception***

In Namibia for example, the use of contraception has increased holistically between 1992 and 2000 (+1766 women). Among these women, there is an increase in the number of women with a secondary education (+1037 women) from which we have (+792) rich women.

The main factors that explain this result are the irregular use of contraception or traditional contraceptive methods, poverty, etc.

To understand social change due to HIV/AIDS effect, we have conducted the third decomposition between sub-groups of women.

5. SOCIAL CHANGE IN HIV/AIDS PREVALENCE AMONG WOMEN: INDIVIDUAL AND GROUP EFFECTS (DOMPOSITION PARAMETERS)

It should be noted that the data on HIV/AIDS are not available for all countries that have experienced a significant decline in fertility at least 50 %, and which have completed at least two DHS. Only the DHS of Lesotho and Zimbabwe provide data on HIV/AIDS. The results obtained by the method of decomposition are reported in the table below:

Table 5: Social change in HIV/AIDS prevalence of women

COUNTRIES	PERIOD	CHANGE (H_b-H_a)	BASIC DECOMPOSITION		ADVANCED DECOMPOSITION				
					COMPOSITION		BEHAVIORAL		
			% Composition	% Behavioral	% Pauperization	% Fertility	% Basic	% Vulnerability	% Error
LESOTHO	2009/2004	-47,5	43,39%	56,61%	91,3%	26%	-703%	745%	14%
ZIMBABWE	2011/2006	11,8	58,29%	41,71%	116%	-11,5%	-1016%	1115%	-56,8%

FITTING PARAMETERS

COUNTRIES	YEAR	FITTING PARAMETERS		
		ALPHA	BETA	R^2
LESOTHO	2004	14,98	2,49	82%
	2009	18,32	0,83	46%
ZIMBABWE	2006	16,62	1,68	63%
	2011	15,42	2,29	91%

H_b-H_a: Change (increase and decrease) of HIV/AIDS prevalence of infected women VIH/SIDA.

The main results show that the increase in the prevalence of HIV/AIDS in Lesotho and Zimbabwe is due partly to the "individual effect" or behavioral effect (56.61 % for Lesotho, and 41.71 % for Zimbabwe), and secondly the "Group effect" or composition effect (43.39 % for and Lesotho, and 58.29 % for Zimbabwe). The number of women infected with HIV/AIDS varies from one country to another. In Lesotho, an Infected women has been move in a reduction. We have about (-47 women between 2004 and 2009), likely due to mortality. In Zimbabwe, (+12) women over were infected between 2006 and 2011. We also note a significant effect of poverty (91.3% in Lesotho and 116 % in Zimbabwe). This results in a high vulnerability of women to HIV/AIDS (745 % and 1115 % in Lesotho to Zimbabwe).

In addition, we performed the classification of women according to socio-economic variables, using the Factor Multiple Correspondence Analysis (MCA). We selected as variables, level of education, standard of living, place of residence and the use of contraception, as these variables are included in all studies on the determinants of the prevalence of HIV/AIDS. The table below sums up the situation:

6. Classification of women according to Social and demographic characteristics (The Multiple Correspondence Factor Analysis)

Table 6: classification of women by HIV/AIDS prevalence

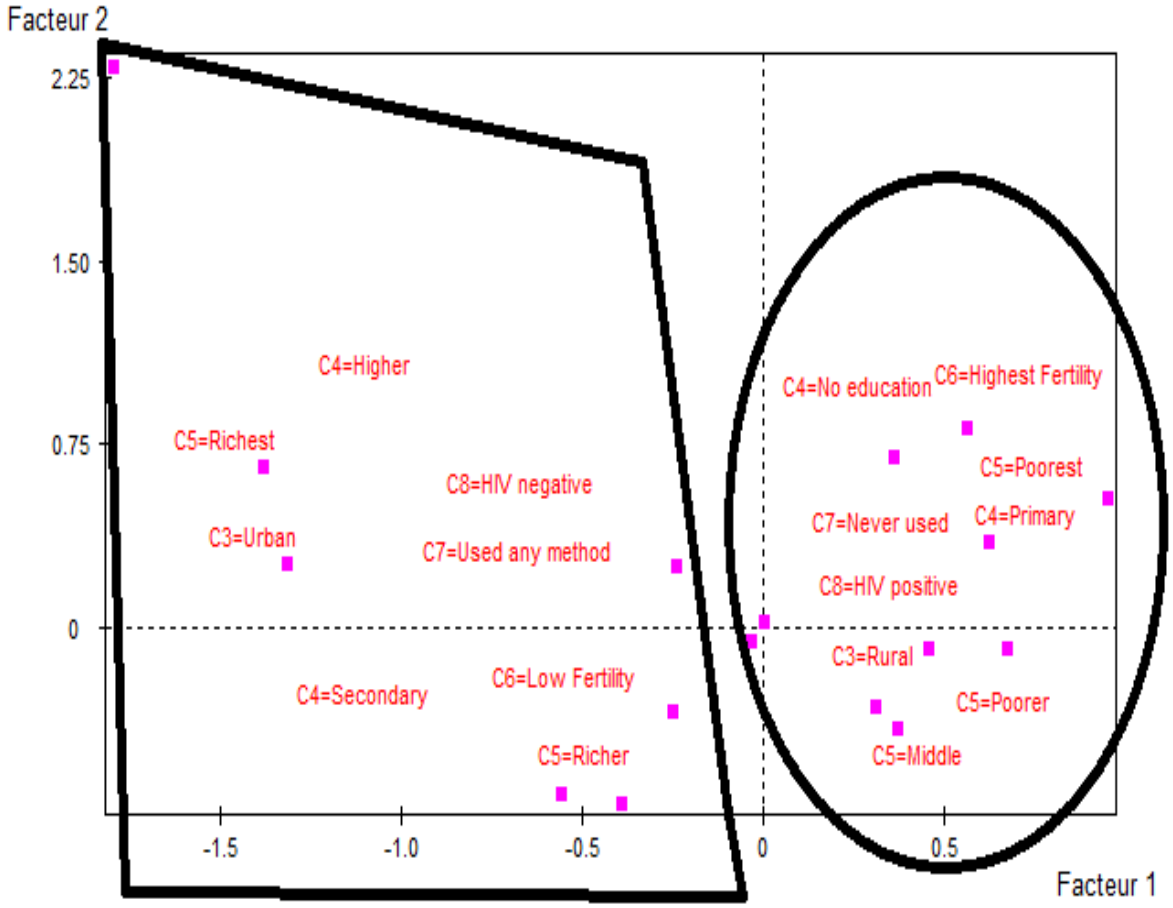
Countries	Years	WOMEN PROFILES WITH AGE BETWEEN 15-49 YEARS OLD		
		Social and Demographic characteristics	HIV Negative	HIV Positive
LESOTHO	2009	Highest Education Level	High and Secondary	Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Used any method	Never used
		Fertility Rate	Lower Fertility	Highest Fertility
ZIMBABWE	2005	Highest Education Level	High and Secondary	No education and Primary
		Wealth Index	Richest	Poorer and Poorest
		Place of Residence	Urban	Rural
		Used of Contraception	Never Used	Used any method
		Fertility Rate	Lower Fertility	Highest Fertility

We finally get two profiles of women:

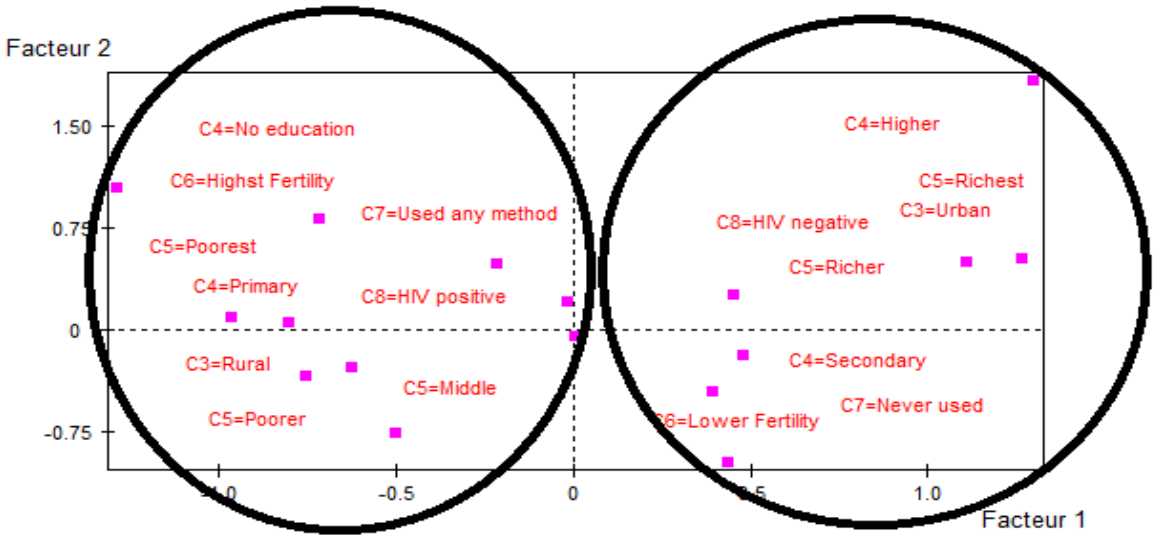
1) On one hand, women with HIV/AIDS, very poor, with primary education, who live in the rural areas and which experiencing a high level of fertility. Among them, some have never used contraceptive methods (in Lesotho) , while others have used contraceptive methods (case of Zimbabwe);
2) On the other hand, we have a profile of uninfected women to HIV/AIDS, which are rich or very rich, living in the urban areas, having a secondary or higher educational level. Their fertility level is low. In addition, some have never used contraceptive methods (case of Zimbabwe), while others have used contraceptive methods (in Lesotho);

These two profiles lead us to reconsider the results we obtained in the analysis of decomposition. To this end, we observe that the education levels, poverty, urbanization, use of contraception, are variables or factors that determine HIV/AIDS prevalence. Thus, women's behavior and characteristics determine their HIV/AIDS infection. We speak of “individual effect”. Moreover, vulnerability to HIV/AIDS determines the level of female mortality. The decrease of women in the population due to mortality, decline in the number of wealthy women, secondary or higher educated women, increase of poor and uneducated women determine the social changes in the group of women. These social changes can be attributed to the "group effect”, subject to the assumption of a closed migration. The two Graphs below show the above profiles for Lesotho (2009) and Zimbabwe (2005).

Graphic 5: Profiles of Women according to social and Economic characteristics for Lesotho in 2009



Graphic 6: Profiles of Women according to social and Economic characteristics for Zimbabwe in 2005



Thus, the decline in fertility in the countries heavily affected by infectious diseases is mainly related to five factors: the use of contraception, mortality, poverty, education level, and urbanization, subject to the assumption of a closed migration.

With focus to contraception, we have seen that through the increase in the number of women using contraception from one year to the other, when fertility is in downward movement (+12 % between 2004 and 2009 in Lesotho; +43% between 1992 and 2000 in Namibia; For Zimbabwe, we have +8% between 1994 and 1999, and +13 % between 1999 and 2006).

Regarding the level of education and urbanization, we have highlighted that women with secondary or higher education, who live in urban areas, have experienced low fertility relative to those with primary education or uneducated, living in rural areas.

In terms of poverty, we have seen the decline of 2 % in the number of women using contraception (-196 women in Zimbabwe between 2006 and 2011). Among these women, we have (-177) rich women and (-19) poor women.

Finally, with regard to mortality, the number of women infected with HIV/AIDS varies from one country to another. In Lesotho, an Infected women has been move in a reduction about (-47 women between 2004 and 2009), likely due to mortality. In Zimbabwe, (+12) women over were infected with HIV/AIDS between 2006 and 2011.

Thus, whenever a population is affected by infectious diseases (HIV / AIDS, STIs, TB, etc…), fertility may be reduced under the influence of two effects:

1) The behavioral or individual effect, due to the change in contraception use, educational level, standard of living, infertility, etc.) ;
2) The Group effect, due to the decrease of women in the population due to mortality, the decrease in the number of children in the population due to mortality, the prolonged abstinence resulting to the status of HIV/AIDS prevalence, the decline in the number of wealthy women, secondary or higher educated women, the increase of poor and uneducated women, subject to the assumption of a closed migration.

In the first case, we speak of the ***"Individual effect of fertility decline",*** and in the second case, we will call it the ***"Group effect of fertility decline".***

NB: In the context of population policies (policies of birth control), a country may decide to limit the number of births to achieve its development goals (China, South Korea, etc. ...). In this case, fertility is much more influenced by the use of contraception, late marriage, few and little closer births, recommended by Government policies of those counties.

Limits:

The main limitation to this study is the lack of data for 9 countries with high HIV/AIDS, only three have at least two demographic and health surveys. But the method of decomposition requires at least two studies during the reference period. Furthermore, only two countries had data on HIV/AIDS (Lesotho and Zimbabwe). Then we have based all our analysis for the social change in HIV/AIDS prevalence within those two countries.

7. CONCLUSION

Finally, we observe that **educational level, poverty, urbanization and contraception,** are the main factors that determine HIV/AIDS infection, and therefore the decline in fertility. Women's behaviors and characteristics determine their HIV/AIDS infection and fertility decline. We speak of ***"the individual effect of fertility decline"***. Moreover, vulnerability to HIV/AIDS determines **the level of female mortality**. The decrease of women and children in the population due to mortality, the decline in the number of wealthy women, secondary or higher educated women, the increase of poor and no educated women is assigned to the "group effect", subject to the assumption of a closed migration. We will name this effect, ***"the Group effect of fertility decline"***.

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