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## Determinants of households' food diversity demand in Uganda

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### ***Abstract***

*Given that a diversified food contributes to the individuals' health reinforcement, this analysis has tried to identify the households' food diversity demand determinants in Uganda by using a latent class model. Its implementation reveals several important results. Beyond the traditional determinant (income), on the one hand, one can note that the characteristics of the household influence the food diversity demand with a variable intensity according to the class considered. On the other hand, it appears that the structure of the household is a significant factor determining the food diversity demand. Besides, there is also an area of residence impact on food diversity demand. Consequently, the consideration of this heterogeneity of the population in the formulation of nutritional policies is necessary in order to make those more efficient by targeting households, empowering women, facilitating access to markets or encouraging a diversified agricultural production.*

Keywords: Consumer demand; Food diversity; Determinants of variety; Uganda

JEL: D1, Q11



## Introduction

The food question is particularly alarming in Uganda. If the average calorific consumption per person and day has improved, passing from 1494 kcal in 1992 to 1971 kcal in 2005, it remains still lower than the level of 2300 kcal per day recommended by the World Health Organization. Given the strong growth of the population, the number of people in food insecurity situation increased by 12 million in 1992 to 17.7 million in 2007. The problem of a low weight at the birth seems endemic then in the country (more than 16000 newborns with a weight lower than 2.5 kg died in 2009) and anemia affects 49% of the women<sup>1</sup>. However the nutrition is a determinant of individuals' health status (Fogel, 2004; Krebs-Smith et al., 1987). The Ugandan government has recognized the importance of the nutrition for health by setting up a program of fight against malnutrition (Uganda National Action Plan, 2011-2016), defining a certain number of objectives such as the improvement of the access and the use of the services relating to the maternal and infantile nutrition, the promotion of food diversity consumption, the protection of the households from the shocks and other vulnerabilities that can affect their nutritional status<sup>2</sup>, etc.

Widely explored in the literature, this link nutrition-health can however be apprehended from several point of view. At a first level of analysis, it returns to the problematic of under nutrition and the questions of the food intake insufficiency or the difficulty of access to foods (Deolalikar, 1988; Strauss and Thomas, 1998; Huffman and Orazem, 2007; Behrman and Rosenzweig, 2004; Ruel and Hoddinott, 2008). On a second level of analysis, it can also return to the problematic of malnutrition by rather focusing on the qualitative dimension of the food. Fan and Brzeska (2011) underline thus that, in spite of the significant efforts which were accomplished in terms of quantitative satisfaction of the world food demand, many areas of developing countries continue to undergo a problem of malnutrition. Then, from this point of view, the question of the food intake diversity takes a particular place. A large number of studies show, indeed, that it can be associated to an increase of the nutritive elements and considered as a proxy of dietetic quality and thus of health (see for example Ruel, 2003).

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<sup>1</sup> If no intervention is devised, one estimates that 15000 mothers will die of anemia from 2006 to 2015. (Uganda Ministry of Health and al., 2012).

<sup>2</sup> For example, recurring episodes of droughts (1998, 1999, 2002 and 2005) or of floods (1997, 2007).

In this context, considering that in Uganda the food problems are more about malnutrition than of undernutrition, it is in this last dimension of the link nutrition-health that we chose to register ourselves here, by focusing more particularly on the question of food diversity in this country<sup>3</sup>. At first, it is to use this criterion of diversity to distinguish various groups from Ugandan households according to their food behavior. In the second time, it seeks also to find out for each group of households, the various socio-economic factors which determine this diversity. The objective is, finally, to be able to identify the levers of economic policies allowing to incite households to consume a greater food diversity and thus to reach a better health status.

The approach developed is exclusively empirical and mobilizes the data of UNHS survey 2005/2006. It bases moreover on the subjacent assumption that the households' food demand diversity depends primarily on unobserved characteristics related to their preferences (Tonsor et al., 2009; Ouma et al., 2007)<sup>4</sup>. To apprehend this unobserved heterogeneity of the households, we chose to use an econometric model with latent classes allowing distributing the Ugandan consumers on a finite number of segments according to the nature of their utility function.

This paper is organized in the following way. After a review of the empirical literature on the determinants of the demand for food diversity, we clarify the bases and principles of the econometric model with latent classes. The results are then presented in the following section and the last section is devoted to the conclusion.

## **1. Determinants of food diversity demand in the literature**

The empirical literature dealing with the relative questions of the food diversity demand finds its origin in the consumer traditional microeconomic theory. The assumption of convexity of preferences indeed implies an inherent preference for diversity (the consumption of a combination of goods is preferable of that of an equivalent quantity of each good). But, if the differences

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<sup>3</sup> Little attention seems to have been accorded to this question of food diversity in the developing countries. The majority of the analysis were carried out in developed countries: in Germany (Thiele and Weiss, 2003), in Canada (Drescher and Goddard, 2011), in the United States (Jackson 1984; Stewart and Harris, 2005), Bulgaria (Moon et al., 2002), etc But, a positive relation between food diversity and the nutritional adequacy however seem to be able to be also established in the developing countries. Torheim et al. (2004) reveal for example a positive correlation between food diversity and the nutritive adequacy in Mali.

<sup>4</sup> Drescher and Goddard (2011) tried to approach these problems in the case of the food diversity while resorting to the techniques of quantiles regressions.

observed in the consumers demands are explained by the fact that the consumers do not have the same preferences or opportunities, the dependence of these preferences to the social situation of the individual however is not really taken into account in the theory. However, other determinants of the decisions of the consumer, like the tradition, the habits or publicity probably have impacts on the demand in general and the diversity demand in particular (Moritz, 1993; Kooreman and Wunderink, 1997).

Some works tried to extend the traditional microeconomic theory of the consumer to this analysis of diversity. Taking again the traditional assumption of preference for diversity, Jackson (1984) develops in particular a hierarchical model of consumer demand based on the concept of pyramid of the needs of Maslow and stressing in particular on the income role. Within this framework, the increase in income motivates the successive satisfaction of the physiological needs, security, membership, regard and achievement of oneself. This model is then most frequently used as reference framework in the empirical studies (Drescher, 2008). The paramount role of the income is thus unanimously recognized here (Theil and Finke, 1983; Moon et al., 2002; Stewart and Harris, 2005; Lee, 1987; Lee and Brown, 1989) even if, at the macroeconomic level, there does not seem to have a consensus. For Fan and Brzeska (2011) and Pauw and Thurlow (2011), the economic growth was often perceived as the principal determinant of the nutritional situation of a country through the increase in the income and the food expenditure. However, it has not generated an improvement of the nutritional state in numerous developing countries. In this case, to consider the income as the only essential factor of the improvement of the nutritional situation of the households appears a little restrictive.

In this context, some empirical studies of the food diversity demand explore the effective influence of other sociodemographic characteristics of the households and thus often reveal particularisms related to the specific context of the studies. Without claiming with exhaustiveness, it is possible to expose here some of them. The female gender has for example a determining effect. In general positive (Lee, 1987; Wardle et al., 2004; Westenhoefer, 2005; Shamsul et al., 2012) it can however sometimes appear negative according to certain cultural identities, as show it, for example, Rashid et al. (2006) in Bangladesh. The age seems also influential by a nonlinear relation to the food diversity demand (Lee and brown, 1989; Thiele and Weiss, 2003; Moon et al., 2002; Stewart and Harris, 2005; Shamsul et al., 2012). More precisely, this diversity decreases with the years while

the fact of being young influences it positively. Again, this relation always does not hold, as show it for example Stewart and Harris (2005) for certain food groups like vegetables. The level of education, which approximates the level of dietetic information of the consumer and his capacity to assimilate them, also seems to act positively on the diversity demand (Variyam et al., 1998). This effect appears higher then among women than among the men (Lee, 1987; Rashid and al., 2006). The size of the household, as for it, acts positively (Lee, 1987 positively; Moon and al., 2002; Thiele and Weiss, 2003; Rashid and al., 2006), just like acts the nature of employment (Thiele and Weiss, 2003; Stewart and Harris, 2005), the race (Jekanowski and Binley, 2000) or the area of residence (Lee, 1987; Moon et al., 2002; Thiele and Weiss, 2003). Thiele and Weiss (2003) find for example that the households living in the big cities have a greater demand for diversity.

In most of these empirical studies, a subjacent assumption is made on the homogeneity of the preferences of the households (and thus on the nature of their demand for food diversity). However this assumption can seem restrictive because the nature of these preferences is determined by a set of characteristics which act on their diversity demand but are unobserved in the survey data (Tonsor et al., 2009; Ouma et al., 2007). In our analysis of the determinants of food diversity in Uganda, thus we chose to depart ourselves from the previous literature by taking into account this unobserved heterogeneity.

## **2. Methodology**

The analysis of the determinants of food diversity poses two methodological challenges. The first is due to the choice of a type of modeling making it possible to take into account the heterogeneity of the households in terms of food consumption related to the presence of unobserved factors. The second relates to the choice of a relevant statistical indicator to express the households' food diversity demand.

### *2.1. Modeling choice*

To apprehend the unobserved heterogeneity of the Ugandan households, we chose to develop an econometric model with latent classes. Largely discussed in the literature and applied in multiple fields, this kind of modeling indeed seems to be the most suitable strategy (i.e. McLachlan and Peel, 2000). Its subjacent logic is to consider that the households having the same unobserved

characteristics belong to the same group (or latent class) with a specific utility function (and thus a specific function of diversity demand). Two types of latent classes models could be a priori potentially considered (Cameron and Trivedi, 2005): models with continuous latent classes which regard the distribution of unobserved individual heterogeneity as a continuous random variable and models with finite latent classes which consider it like a discrete random variable. It is this second type of model that has been finally privileged here. It indeed enables us to capture the effect of the specific characteristics in each class, which seems paramount, thereafter, to facilitate the design of differentiated food policies.

## 2.2. *A food diversity indicator choice*

Three types of indicators are frequently met in the literature to express the households' food diversity.

The first relates to the number of the types of food purchased (see for example Jackson (1984) or Lee (1987)). The second is the Berry index (Thiele and Weiss, 2003) defined by:  $BI_i = 1 - H_i = 1 - \sum_{j=1}^n S_{i,j}^2$  where  $H_i$  is the Herfindahl index for the household  $i$  and  $S_{i,j}$  is the share of the product  $j$  in the food total expenditure of the household  $i$ . The third is the (relative) Entropy index (Lee and Brown, 1989), which weights more the small consumptions and, consequently, is particularly sensitive to the difference in the number of the minority food products in the consumption basket. It is defined by:  $EL_i = \frac{1}{\log(n)} \sum_{j=1}^n S_{i,j} \log(\frac{1}{S_{i,j}})$  where  $S_{i,j}$  is the share of the product  $j$  in the food total expenditure of the household  $i$ .

That are these two last indicators that we choose to retain a priori. Indeed, although easy to interpret, the number of the food purchased types presents the disadvantage of not taking into account the information on the distribution of the food quantities purchased. Otherwise, the Berry index and Entropy index are closely linked (Thiele and Weiss, 2003). This strong link between the two indexes shows finally that there does not exist a discriminating selection criterion of the one or the other.

Furthermore, as  $0 \leq EL_i \leq 1$  and  $0 \leq BI_i \leq 1$ , it is important to have estimators which ensure that the predicted values by the models are comprised in the same interval. The most widespread

transformation to solve this problem is then the logit transformation (Greene, 1997 cited by Thiele and Weiss, 2003) where the Entropy and Berry indexes become respectively:

$$TEI_i = \ln\left[\frac{EI_i}{1-EI_i}\right]$$

and  $TBI_i = \ln\left[\frac{BI_i}{1-BI_i}\right]$ .

Otherwise, it is important to notice that the households' autoconsumption has been taken into account. In fact, it is assumed that consumption and production decisions are completely separable and market prices are the true opportunity costs of consumption out of home production. Thus, the quantity of home produce can be revalued at market prices.

### 2.3. Econometric model

#### 2.3.1. Specification

The model developed has finite latent classes in the extent that it provides a representation of unobserved heterogeneity in a number  $C$  of classes. The density function of the model is expressed by:

$$(1) \quad f(y_i|x_i; \theta_1, \theta_2, \dots, \theta_c; \pi_1, \pi_2 \dots \pi_c) = \sum_{j=1}^C \pi_j f_j(y_i|x_i; \theta_j)$$

Where  $y_i$  the indicator of diversity is selected representing the dependent variable and  $x_i$  the vector of socio-economic variables characterizing the household  $i$ .  $\theta_j$  with  $j = 1, \dots, C$  represents the set of parameters of interests of the various classes;  $\pi_j$  satisfying  $0 < \pi_j < 1$  and  $\sum_{j=1}^C \pi_j = 1$ , indicates the prior probabilities that a given household belongs to the class  $j$ ;  $f_j(y|x, \theta_j)$  is the density function of the class  $j$  which is supposed, in general, to follow a normal, gamma, Poisson or binomial negative distribution.

The estimate of the parameters  $\theta_j$  is obtained by using the estimator of maximum likelihood, which, for a given population of  $N$  Individuals, yields to the following program of optimization:

$$(2) \quad \text{Max}_{\pi, \theta} \ln L = \sum_{i=1}^N (\log(\sum_{j=1}^C \pi_j f_j(y_i|x_i, \theta_j)))$$



The probability that a household  $i$  belongs to a class  $c$  is provided by the a posteriori distribution; once the parameters  $\theta_j$  estimated, these probabilities  $p_{ic}$  can be calculated by using the Bayes rule:

$$(3) \quad p_{ic} = \frac{\hat{\pi}_c f_c(y_i | x_i, \hat{\theta}_c)}{f(y_i | x_i; \hat{\theta}_1, \hat{\theta}_2, \dots, \hat{\theta}_c; \hat{\pi}_1, \hat{\pi}_2 \dots \hat{\pi}_c)}$$

### 2.3.2. Optimal number of classes to retain and model validation

In line with this type of model, the number of classes is not known a priori. To determine this it is therefore necessary to use an information criterion. The optimal number of classes is then the one that comes from the model minimizing the information criterion whose value ( $C_s$ ) is expressed by:

$$(4) \quad C_s = -2l_s + dn_s$$

Where  $l_s$  is the log-likelihood of the maximum likelihood estimation and  $n_s$  the number of free parameters for the estimated model. For  $d = 2$  or  $\log(N)$  we have respectively the Akaike information criterion (AIC) and Bayesian information criterion (BIC). For each of these criteria, a smaller value indicates a more parsimonious model.

The choice of the type of information criterion, BIC or AIC, is decisive. The literature shows that however there is no criterion universally better, and that this choice depends on the purpose of the analysis and understanding of data (Lebarbier and Mary-Huard, 2004). Each of them seems to be used equally well regardless of the problem, however, one can remark that choosing between one or the other of these criteria is like choosing between a predictive model and an explanatory model (Reschenhoffer, 1996). When it comes to explicitly describe the structure of the studied population by finding the components number of the mixture which is then interpreted to characterize many distinct subpopulations Mclachlan and Peel (2000) agree that BIC gives better results than AIC. This later is logically disqualified because it is not consistent<sup>5</sup>.

## 3. Findings

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<sup>5</sup> Let's note also that in the case of mixture model, others more performant criteria than BIC have been proposed for the selection of the number of mixture components (Biernacki et al., 2000).

### *3.1. Statistical validation of the model*

#### **3.1.1. Berry or Entropy index to indicate the diversity?**

The first step of the implementation of the model is to select the most relevant diversity indicator in the context of Uganda. To this end, we have sought to reveal the level of connection between the Entropy index and that of Berry as shown in Figure n°1. In accordance to what is reported in the literature, both indices appear highly correlated. In this context, our choice of indicator has finally settled on the Entropy one.

(Insert Figure n°1)

#### **3.1.2. Number of Classes retained**

The second step of the implementation of the model is to determine the number of latent classes in Ugandan households. The AIC and BIC information criteria were calculated for different number of classes. The number retained is that which minimizes the information criterion and provides a higher Entropy index between classes (calculated from the posterior probabilities). As that appears in Table n°1, the AIC has not identified a model that meets the second aspect. However, the BIC criterion shows that a 2-class model is the most appropriate.

(Insert Table n°1)

So, finally, the Ugandan consumers' population can be distributed into two classes. The probability of belonging to the first class (respectively the second) is 81% (respectively 19%). These two classes are distinct as displayed in figure n°2 which shows a small support in common for the two densities.

(Insert Figure n°2)

Although this heterogeneity is, by assumption, unobservable, the descriptive analysis of the households' characteristics of each class reveals some significant differences or similarities between the two classes.

One notes at first a difference in age of the households' heads between the classes. The age of the households' heads of the first class is on average 46 years while it is 41 years for the second one households' heads. In terms of marital status, the proportion of polygamous is relatively higher in

the first class (8%) that in the second one (6%). However, one observes the same rate of widowhood in the two classes which is approximately 4%. In the same line, the proportion of the women household head seems identical in the two classes given the fact that approximately 75% of the households are headed by men in each group.

The difference between the two classes is clear in case of the educational level criterion. Indeed, overall of the households of the second class have the best educational level. The mean of the average number of years of education by household is 5 years in the second class while it is 3 years in the first one. It also appears that the heads of the second class households seem to be the most educated. For example, the rate of households' heads having completed the primary cycle in the second class is approximately the double of that of the first class.

Compared to the households structure not less important differences are to be noted. Thus, it comes out that the first class households (with 8 members) are on average broader than the households of the second class (with 6 members). The latter presents moreover the smallest proportion of children from 0 to 5 years in the households. However, the households of the first class have on average a proportion of women higher than those of the second class (52% against 44%). Finally, another disparity between the classes is related to the area of residence and the financial status of the household. The percentage of the rural households is higher in the first class than in the second one while the households of the second class present on average a per capita expenditure higher than those of the first class.

### *3.2. Econometric findings*

Table n°2 displays the results of the model with two latent classes. In parallel, a model with only one class is also estimated in order to compare these results with the previous empirical literature which has not taken into account this unobserved heterogeneity between the individuals.

(Insert Table n°2)

#### **3.2.1. Influence of factors related to the household head**

##### **3.2.1.1. Gender effect**

The gender of the household head influences positively the diversity demand in the first and the second class significantly at 10% and 5% respectively. More precisely, the fact that the household is headed by a man improves the food diversity compared to the fact that the household is headed by a woman. In contrast, it should be stressed that the effect of the gender is more intense in the

second class than in the first<sup>6</sup> one. This result reflects more the difficulty of access to food of the households headed by women in Uganda than the reconsideration of the role assigned traditionally to women compared to the nutrition of the household. The food insecurity analysis of FAO (2012) using these same data of the UNHS 2005/2006 revealed that the food insecurity rate for the households headed by Ugandan women was 41% compared to 37% for the households headed by men; what indicates that the households headed by the women are more in food insecurity than those directed by the men. Thus, a policy with regard to the households headed by the women would consist in supporting their access to food.

#### 3.2.1.2. Age effect

In accordance to the literature, the age of head affects negatively food diversity demand in the household. This variable is significant at 1% in the first class. In other words, older households appear having a low nutritional status. This result is also consistent with the descriptive analysis of classes which revealed that the first class contains households with low food diversity and the highest average age. Therefore, any policy aiming to incite households to consume a variety of foods based on the criterion of household heads age must prioritize households in the first class.

#### 3.2.1.3. Marital status effect

The effect relating to the marital status is based here on five statuses: polygamous, monogamous, divorced, widowed and unmarried. It appears that the influence of being unmarried is positive in the first class and significant at 10% while it is negative in the second one and significant at 5%. However, the influence of being polygamous, widowed or divorced is not significantly different from that of being monogamous on the diversity demand. Thus, the unmarried of the second class must be the potential targets of the nutritional policies.

#### 3.2.1.4. Education effect

In accordance with the previous findings, the household head education appears to be an effective determinant of the diversity demand. Indeed, in the first class, having completed at least primary school enhances positively the food diversity demand. This result is similar to those of the work of Lee (1987) and Rashid et al. (2006). In contrast, in the second class, those are the university and primary education which appear to act positively at 1% and 5% respectively. It should be noted also that the sensitivity to the educational level is not the same in the two classes as indicated by

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<sup>6</sup>The comparison of the extents of the coefficients was made on the basis of marginal effect not reported here.

the value of the coefficients. Then this result emphasizes the role of education in the ability of households to consume a variety of foods or to implement the recommendations for good nutrition and efforts in terms of nutritional policies should target households whose heads have no formal education.

### 3.2.2. Influence of factors related to household and area of residence

#### 3.2.2.1. Income effect

In accordance with the literature we find, in the Ugandan context, the positive influence of the economic status of the household. The variable income per capita is indeed significant at 1% and 10% for the first and the second class respectively. So the income seems to be a determining factor of the households food diversity demand in Uganda. This result is of crucial importance because it reveals that monetary poverty is one of the main causes of the consumption of low food diversity. However, it should be noticed that the influence of the economic status is approximately three times higher in the first class than in the second. In other words, the households of the two classes do not have the same sensitivity to consumption of a variety of food following the variation of the income. This result can be partly explained by the fact that the households of the two classes do not have the same initial financial resources as indicated by the description of the classes. Thus, in case of the implementation of cash transfer policy, the households having initially a low level of income must be the target to privilege.

#### 3.2.2.2. Household structure effect

At first, one can note that the women weight in the household as their share is a positive factor of the food diversity demand. This variable is statistically positive and significant at 5% for the first class and 1% for the second. However, the influence of the women seems to be limited in reality by the lack of own income. Indeed, 42% of the women who work in Uganda are not remunerated. This rate is only 16% for the men (EPRC, 2009). This result also shows the importance of the reduction of the inequalities between the men and the women in terms of decision power. It also appears that the influence of the women share is higher in the second class than in the first one. That is explained by the fact that the women of the second class are probably better educated and thus have more decision power or have a best knowledge the importance of the nutrition. The food diversity demand increases with the size of the household as announced in the literature. Lastly, the presence of the young and teenagers in a household also seem to influence positively and significantly the diversity demand in the first class. Otherwise, only the members share of group

6-10 years determines this diversity in the second class (at 10%). The effect of the young member goes then in decreasing because the least old seem more influencing this food diversity demand.

#### 3.2.2.3. Area of residence effect

The nature of the households' area of residence determines also their level of various foods' consumption. Even if this effect is observed only in the first class, it appears that living in rural area impacts negatively on food diversity. Previously, Werema (2007) also showed that in Uganda the urban households are more interested in the choice of quality products such as milk, fish, alcohol and fizzy drinks than their counterparts of rural areas. This result can be explained by the fact that the rural households are in major part subsistence farmers and having difficulties of access to markets. So it is advisable to facilitate this access for them so that they can sell their production and get other products. Moreover, the improvement of their nutritional situation can also pass by the production of a diversified food at each household farm level. Lastly, one also observes a significant difference in terms of food diversity consumption at the regional level in particular between the households residing in east of country and those residing in the Center.

### **Conclusion**

This article has focused on the second essential component of the health of the Ugandan households, the nutrition, through one of its qualitative dimensions: food diversity. First, it is appeared that there exists an unobserved heterogeneity between the Ugandan households according to the nature of their food demand. Thus, two latent classes could be identified within the population. Secondly, in this context, the influence of the characteristics of the household head, the household itself or its area of residence on the food diversity demand could be identified. Thus, the gender (female), the age or the lack of education of the household head act negatively on the food diversity demand with an effect variable according to the class considered. The level of income, the share of the women in the household or that of the young individuals act for their part positively with, again, different widths between the classes. Lastly, it appeared that living in rural area impacts negatively on food diversity demand. Globally, these results testify the need for formulating nutritional policies differentiated in Uganda in order to render these policies more efficient. Indeed, devising a nutritional policy common to all the households is likely not to lead to the expected results because of the population heterogeneity. For this purpose, for each class, the actions could consist to targeting the households presenting the factors which influence their food diversity demand negatively. For example, the sensitization campaigns should target the

households whose heads do not have any formal education and who are in majority in the first class. In the same way, cash transfers policies or the creation of opportunities so that the households have an improved income seem important. Moreover, gender dimension should be integrated into the design of the food policies by supporting the access to food for the households headed by the women and by increasing the decision power of the women compared to the management of their resources within the households. Lastly, the government could, for example, create a framework allowing the households to purchase food with a more wide choice especially in the rural areas where the households of the first class concentrate mainly.

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## Tables

Table n°1 - Calculations of information criteria and the entropy index for different number of class

	Latent classes number			
	1	2	3	4
Information criteria				
AIC	9926,799	8791,188	8624,340	8465,237
BIC	10084,570	9126,450	9130,519	9142,335
Entropie index	00,000	00,572	00,440	00,562

Source: Author's calculations from UNHS data 2005-2006

Table n°2 - Estimation results the model with one and two latent classes

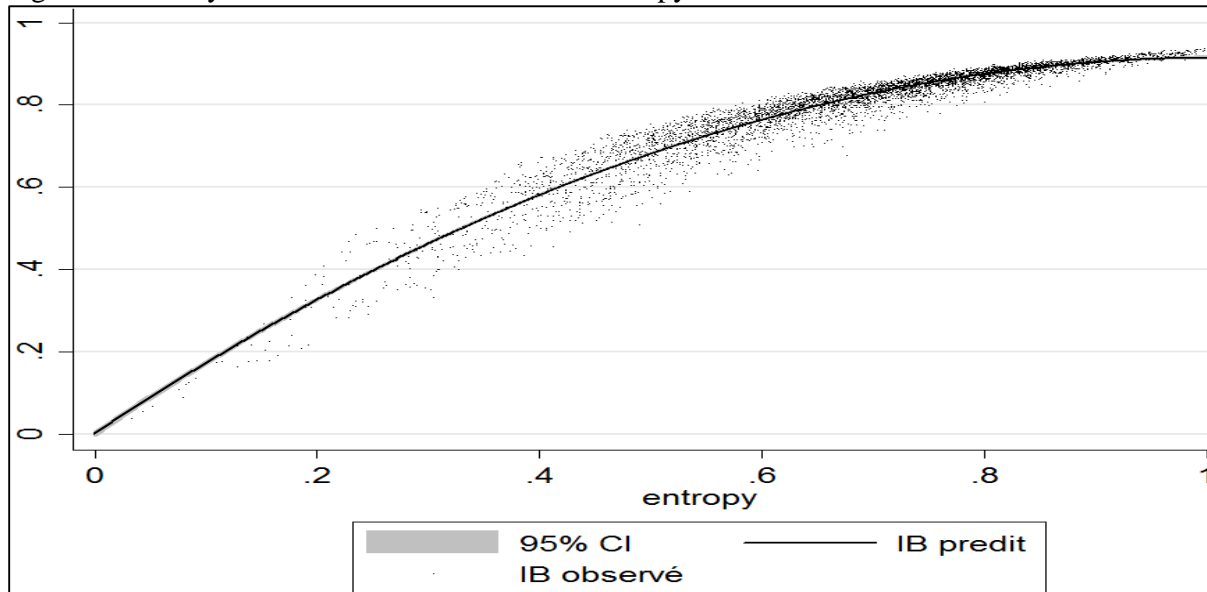
Variables	Pooled	Class 1	Class 2
<i>Household head characteristics</i>			
Gender	0,0883 (0,0250)***	0,0366 (0,0216)*	0,2070 (0,0933)**
Age	-0,0026 (0,0007)***	-0,0029 (0,0005)***	-0,0009 (0,0024)
Marital status			
Polygamous	0,0254 (0,0320)	-0,0102 (0,0279)	0,1240 (0,1380)
Divorced	-0,0675 (0,0507)	-0,0222 (0,0345)	-0,2320 (0,1910)
Widow	0,0078 (0,0420)	-0,0201 (0,0369)	0,0685 (0,1490)
Unmarried	-0,0076 (0,0227)	0,0052 (0,0179)*	-0,0303 (0,0859)**
Education level			
Primary	0,1340 (0,0225)***	0,1080 (0,0195)***	0,1600 (0,0782)**
Secondary junior	0,2010 (0,0332)***	0,1810 (0,0262)***	0,2050 (0,1260)
Secondary senior	0,1840 (0,0489)***	0,1700 (0,0380)***	0,2280 (0,1620)
University	0,2650 (0,0605)***	0,1170 (0,0637)*	0,8250 (0,2090)***
<i>Households characteristics</i>			
Income per capita (log)	0,2720 (0,0191)***	0,3300 (0,0146)***	0,1050 (0,0605)*
Size	0,0228 (0,0036)***	0,0201 (0,0031)***	0,0233 (0,0104)**
Average years of education	0,0231 (0,0058)***	0,0202 (0,0044)***	0,0242 (0,0225)
Women share	0,2670 (0,0491)***	0,0747 (0,0380)**	0,7840 (0,1640)***
Age group			
0-5 years	0,2700 (0,1030)***	0,2280 (0,0865)***	0,1330 (0,4180)
6-10 years	0,2490 (0,0687)***	0,1840 (0,0592)***	0,4080 (0,2320)*
11-15 years	0,1870 (0,0664)***	0,1590 (0,0568)***	0,2260 (0,2070)
16-20 years	0,0389 (0,0541)	0,0083 (0,0458)	0,1870 (0,1640)
Farmer group	-0,0325 (0,0350)	-0,0108 (0,0286)	-0,0696 (0,1320)
<i>Area of résidence</i>			
Rural(urban)	-0,0431 (0,0137)***	-0,0319 (0,0111)***	-0,0420 (0,0572)
East(centre)	0,0423 (0,0260)	0,0776 (0,0196)***	-0,0861 (0,1070)
North(centre)	0,0077 (0,0281)	-0,0018 (0,0232)	0,1340 (0,1070)
West(centre)	-0,0220 (0,0252)	-0,0264 (0,0207)	0,0601 (0,0975)
Constant(centre)	-1,5930 (0,2220)***	-1,8640 (0,1820)***	-1,0900 (0,6760)
/arct(rho)		1,4310 (0,1610)***	
/lnsigma		-0,9120 (0,0291)***	-0,2860 (0,0395)***
$\pi_i$		0,807	0,193
Observations	7400	7400	

Robust Standard-Error in parentheses, \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Source: Author's calculations from the UNHS data 2005-2006

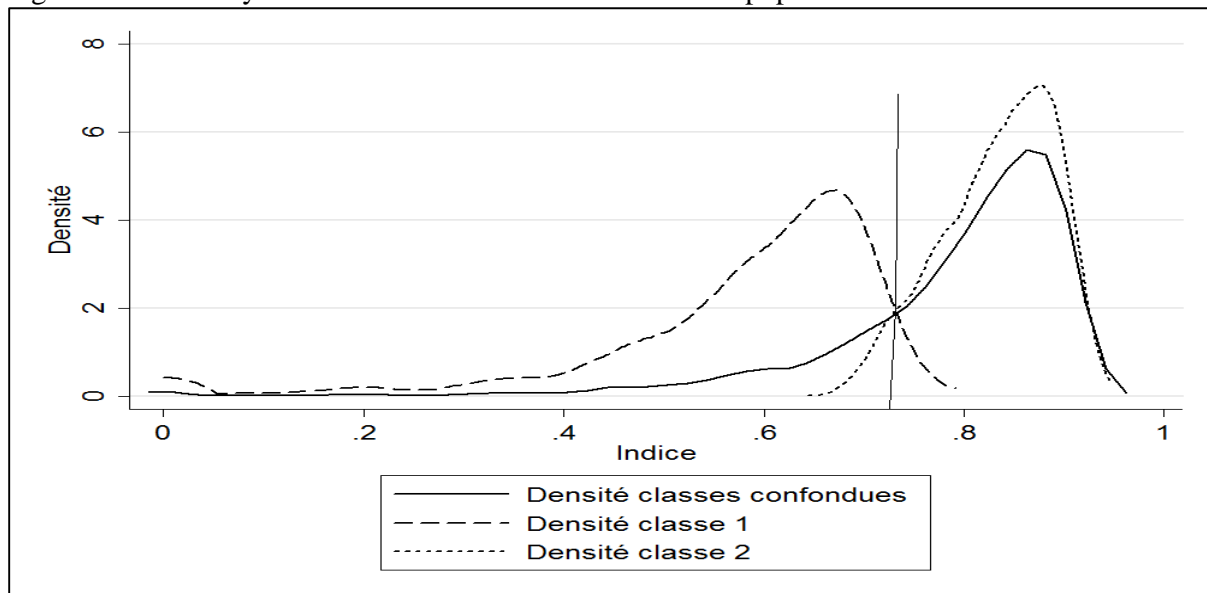
## Figures

Figure n°1: Berry index in function of index of Entropy



Source: Author from the UNSH 2005-2006

Figure n°2 - Density curves for each class and for the entire population.



Source: Author's calculations from UNHS data 2005-2006