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A comparison of multidimensional deprivation characteristics between natives and immigrants in Luxembourg

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Novembre 2008

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Keywords: Decomposition, Immigrants, Luxembourg, Multidimensional Poverty, Fuzzy Set Theory

JEL Classification: D31, D63, I32

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1. INTRODUCTION

Several of the methods used in analyzing poverty share two limitations: (*i*) they are unidimensional, i.e. they consider a single dimension, generally income, occasionally expenditures, as the only variable supposed to capture the intensity of poverty; (*ii*) on the basis of the poverty line they dichotomise the population into two groups, the *poor* and the *non-poor.*

Poverty is however a complex phenomenon that cannot be reduced to a unique monetary dimension. There is thus a need for a multidimensional approach taking into account various non-monetary indicators of living conditions [i.e. Kolm (1977), Atkinson and Bourguignon (1982), Maasoumi (1986) and Tsui (1995)].[4]

By contrast, little attention has been devoted to the second limitation of the traditional approach, i.e. its rigid poor/non-poor dichotomy, even if now a days more approaches consider the poverty gap into their analysis. Yet it is undisputable that such a clear division causes a loss of information and removes the nuances that exist between the two extremes of substantial welfare on the one hand and distinct material hardship on the other [Betti *et al.* (2005)]. In other words, poverty should be considered as a matter of *degree* rather than an attribute that is simply present or absent among individuals in the population.

An early attempt to incorporate this concept at the methodological level was made by Cerioli and Zani (1990) who drew their inspiration from the *Fuzzy Sets Theory* initiated by Zadeh (1965). The authors developed the first multidimensional method based on fuzzy set theory, which allows deriving a poverty index that includes different dimensions (attributes) of poverty. Is an efficient and rigorous method which allos to operationalize a multivariate analysis of poverty, including social exclusion and Sen's capability approaches [Dagum and Costa, (2004)]. This method was further discussed by Dagum *et al.* (1991), Cheli *et al.* (1994), Chiappero-Martinetti (1994, 2000), Cheli and Lemmi (1995) Vero and Werquin (1997), Cheli and Betti (1999), Lelli (2001), Qizilbash (2003), Eurostat (2003), Betti, Cheli and Cambini (2004) and Dagum and Costa (2004), Lemmi and Betti (2006).

The aim of this paper is to apply a multidimensional poverty measure based on the fuzzy set approach to a Luxembourgish socioeconomic panel in order to illustrate a number of decomposition properties of these indices. More precisely, the application is focused on the comparisons between natives and immigrants (in particular Portuguese immigrants) to shed new light on the assimilation of immigrants beyond classic income or earnings-based comparisons. In other, the decomposition techniques will allow us identifying the main characteristics of deprivation of these sub-populations. Knowing if these sub-groups are confronted to the same difficulties is necessary for the design and implementation of relevant socioeconomic policies aiming at reducing the deprivations levels.

This paper is organized as follows: *Section 2* presents de basic notions of the multidimensional approach using fuzzy set theory and the decompositions properties. In *Section 3* the multidimensional approach and the decompositions are applied to the analysis

[4] Several authors have proposed and/or analysed different multidimensional poverty measures, see Van Praag (1978), Atkinson (1987, 1992, 2003), Jenkins and Lambert (1993), UNDP (1997, 1998), Carvalho and White (1997), Zheng (1999), Bourguignon and Chakravarty (1999, 2003), Deutsch and Silber (2005).

and measurement of poverty in Luxembourg in 2006. Finally, *Section 4* is devoted to the concluding remarks.

2. MULTIDIMENSIONAL MEASUREMENT OF POVERTY

2.1. A multidimensional approach of poverty using fuzzy set theory

This section relies on a previous paper of Dagum and Costa (2004) and briefly summarizes the basic concepts related to the multidimensional analysis of poverty in the framework of the fuzzy set theory.

Let $A = \{a_1,..., a_i ,…, a_n\}$ be a sample of households drawn from the population of interest, where n is the cardinality of the set A, and $X = \{X_1,…, X_j ,…, X_m\}$ are the vectors of attributes. B is a fuzzy sub-set of households in A such that any household $a_i \in B$ presents some degree of poverty in at least one of the m attributes selected to study multidimensional poverty.

The degree of membership of the i-th household ($i = 1,…, n$) to the fuzzy sub-set B with respect to the j-th attribute is defined as the (normalized) quantity of the j-th attribute ($j = 1,…, m$) possessed by the i-th household. Formally:

$$x_{ij} := \mu_B\left(X_j\left(a_i\right)\right),\ 0 \le x_{ij} \le 1. \tag{1}$$

In particular:

- $x_{ij} = 1$, if the i-th household is fully deprived in the j-th attribute;
- $x_{ij} = 0$, if the i-th household possesses the j-th attribute;
- $0 < x_{ij} < 1$, if the i-th household possesses the j-th attribute with an intensity belonging to the open interval (0,1).

The degree of membership of the i-th household to the fuzzy sub-set B is defined as a weighted average of x_{ij}:

$$\mu_B\left(a_i\right) = \sum_{j=1}^{m} x_{ij} w_j \Big/ \sum_{j=1}^{m} w_j\ . \tag{2}$$

$\mu_B\left(a_i\right)$ is the multidimensional poverty index of the i-th household. It is a weighted function of the m attributes, where w_j is the weight attached to the j-th attribute. Following this definition, one obtains:

$$0 \le \mu_B\left(a_i\right) \le 1. \tag{3}$$

In particular:

- $\mu_B(a_i) = 0$, if a_i is completely non-poor in the m attributes;
- $\mu_B(a_i) = 1$, if a_i is totally poor in the m attributes;
- $0 < \mu_B(a_i) < 1$, if a_i is partially or totally deprived in some attributes but not fully deprived in all of them.

The weights w_j assigned to the j-th attribute, and used in this paper, was proposed by Betti and Verma (1999). It takes into account the intensity of deprivation of X_j, and limits the influence of those indicators that are highly correlated. They defined the weight of any attribute as follows:

$$w_j = w_j^a * w_j^b \tag{4}$$

where w_j^a only depends on the distribution of the j-th attribute, whereas w_j^b depends on the correlation between X_j and the others attributes.

In particular, w_j^a is determined by the coefficient of variation of the attribute:

$$w_j^a = \left[\sum_{i=1}^{n} \left(x_{ij} - \bar{x}_j \right)^2 \Big/ n \right]^{1/2} \Bigg/ \left(\sum_{i=1}^{n} x_{ij} \Big/ n \right). \tag{4'}$$

For example, if one attribute is having safe drinkable water provided by a public utility service and the other is having a car no more than five year old, certainly fewer households will be deprived of the former and they will feel more intensively this deprivation.

The weights w_j^b are computed as follows:

$$w_j^b = \left[\frac{1}{1 + \sum_{j'=1}^{m} \rho_{j,j'} \Big/ \rho_{j,j'} < \rho_H} \right] * \left[\frac{1}{\sum_{j'=1}^{m} \rho_{j,j'} \Big/ \rho_{j,j'} \geq \rho_H} \right], \tag{4''}$$

where $\rho_{j,j'}$ is the correlation between the two indicators. In the first factor of the equation, the sum is taken over all the indicators whose correlation with the j-th dimension is less that a certain value ρ_H (determined by dividing the ordered set of correlation values at the point of the largest gap). The sum in the second term always includes the case $j'=j$, since the correlation coefficient is 1.

The fuzzy poverty index of the A set is a weighted average of $\mu_B(a_i)$:

$$\mu_B = \sum_{i=1}^{n} \mu_B(a_i) g(a_i) \Big/ \sum_{i=1}^{n} g(a_i). \tag{5}$$

In the case of a census, A contains all the households of a population, hence, each a_i has the constant weight of 1, i=1,...,n. If A is a representative sample of a population, being it a stratified sample, which includes representative subsamples of some socioeconomic attributes of the household head, to each a_i corresponds a weight $g(a_i)$ equal to the number of households the sample observation a_i represents.

The theory of fuzzy sets allows one also to derive an unidimensional poverty index for each one of the m attributes:

$$\mu_B(X_j) = \sum_{i=1}^{n} x_{ij} g(a_i) \Big/ \sum_{i=1}^{n} g(a_i). \tag{6}$$

$\mu_B(X_j)$ measures the degree of deprivation of the j-th attribute for the entire population of n households.

We can also rewrite the fuzzy poverty index as a weighted function of the unidimensional poverty indexes:

$$\mu_B = \sum_{j=1}^{m} \mu_B(X_j) w_j \Big/ \sum_{j=1}^{m} w_j \,. \tag{7}$$

The analysis of the results obtained in (6), for all $j = 1,\ldots m$, enables policy makers to identify monetary and non monetary aspects of poverty.

2.2. Decompositions of the multidimensional fuzzy poverty index

Three kinds of decomposition are satisfied by the multidimensional fuzzy poverty index [see Mussard and Pi Alperin (2007), and Pi Alperin (2007)]: (*i*) the group and sub-group decompositions; (*ii*) the attribute decompositions; and finally, (*iii*) the multidimensional decomposition.

2.2.1. Group and sub-group decompositions

As Mussard and Pi Alperin (2007) show, a richer way to evaluate the structure of poverty is to provide a decomposition by sub-population groups. Let us divide the total economic surface into s groups, S_k, of size n_k ($k = 1,\ldots, s$). The intensity of poverty of the i-th household of S_k is given by:

$$\mu_B(a_i^k) = \sum_{j=1}^{m} x_{ij}^k \, w_j \Big/ \sum_{j=1}^{m} w_j \,, \tag{8}$$

where x_{ij}^k is the degree of membership related to the fuzzy sub-set B of the i-th household of S_k ($i = 1,\ldots, n_k$) with respect to the j-th attribute ($j = 1,\ldots, m$). Then, the fuzzy poverty index associated with group S_k is[5]:

$$\mu_B^k = \sum_{i=1}^{n_k} \mu_B\left(a_i^k\right) g\left(a_i^k\right) \Big/ \sum_{i=1}^{n_k} g\left(a_i^k\right). \tag{9}$$

Following (9), the overall fuzzy poverty index can be computed as a weighted average of the poverty level within each group:

$$\mu_B = \sum_{k=1}^{s} \sum_{i=1}^{n_k} \mu_B\left(a_i^k\right) g\left(a_i^k\right) \Big/ \sum_{i=1}^{n} g\left(a_i\right). \tag{10}$$

Hence, it is possible to measure the contribution of the k-th group to the global index of poverty:

$$C_{\mu_B}^k = \sum_{i=1}^{n_k} \mu_B\left(a_i^k\right) g\left(a_i^k\right) \Big/ \sum_{i=1}^{n} g\left(a_i\right). \tag{11}$$

Such a decomposition allows policy makers to focus on the poorest groups (region, educational group, etc.) when aiming at reducing overall poverty.

Now, let us divide each one of the s groups, S_k, ($k = 1,\ldots, s$), into p sub-groups S_{bk} ($b = 1,\ldots, p$) of size n_{bk}. The intensity of poverty of the i-th household of sub-group S_{bk} is:

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5 $g\left(a_i^k\right) \Big/ \sum_{i=1}^{n_k} g\left(a_i^k\right)$ is the relative frequency represented by the sample observation a_i^k of S_k.

$$\mu_B\left(a_i^{bk}\right) = \sum_{j=1}^{m} x_{ij}^{bk}\, w_j \Big/ \sum_{j=1}^{m} w_j\,, \tag{12}$$

where x_{ij}^{kb} is the degree of membership related to the fuzzy sub-set B of the i-th household of S_{bk} (i = 1,…, n_{bk}) with respect to the j-th attribute (j = 1,…, m). Thus, we can measure the state of poverty within each sub-group[6]:

$$\mu_B^{bk} = \sum_{i=1}^{n_{bk}} \mu_B\left(a_i^{bk}\right) g\left(a_i^{bk}\right) \Big/ \sum_{i=1}^{n_{bk}} g\left(a_i^{bk}\right). \tag{13}$$

It is also possible to calculate the contribution of the b-th sub-group to the k-th group's multidimensional poverty index:

$$C_{\mu_B^k}^{bk} = \sum_{i=1}^{n_{bk}} \mu_B\left(a_i^{bk}\right) g\left(a_i^{bk}\right) \Big/ \sum_{i=1}^{n_k} g\left(a_i^{k}\right). \tag{14}$$

Hence, the overall fuzzy poverty index can be defined as a weighted average of the poverty intensity that exists within the groups of the second partition:

$$\mu_B = \sum_{b=1}^{p} \sum_{k=1}^{s} \sum_{i=1}^{n_{bk}} \mu_B\left(a_i^{bk}\right) g\left(a_i^{bk}\right) \Big/ \sum_{i=1}^{n} g\left(a_i\right). \tag{15}$$

Consequently, the contribution to the global poverty index of the b-th sub-group of the k-th group is:

$$C_{\mu_B}^{bk} = \sum_{i=1}^{n_{bk}} \mu_B\left(a_i^{bk}\right) g\left(a_i^{bk}\right) \Big/ \sum_{i=1}^{n} g\left(a_i\right). \tag{16}$$

This multi-level decomposition allows computing precisely the sub-group determinants (gender, educational group, age group, region, etc.) that contribute to amplify the global poverty.

α-cut concept

An interesting sub-group decomposition could arise from the application of the α-cut concept in the theory of fuzzy sets. It allows the determination of nested subsets of poor households classified by decreasing intensity of deprivation.

Given the set A of households and a fuzzy set $B \subset A$, an α-cut is the fuzzy set B_α such that,

$$B_\alpha = \left\{a_i^\alpha \in A \,/\, \mu_B\left(a_i\right) \geq \alpha, \quad \alpha \in \left(0,1\right]\right\}$$

where $\left(0,1\right]$ is an open-closed interval and $\mu_B(a_i)$ is the multidimensional poverty index of the i-th household. Since $\alpha > 0$, an α-cut is formed by the members of A that belong to the fuzzy set B, such that, $a_i \in B$ and the i-th households poverty index $\mu_B\left(a_i\right) \geq \alpha > 0$.

[6] $g\left(a_i^{bk}\right) \Big/ \sum_{i1=}^{n_{bk}} g\left(a_i^{bk}\right)$ is the relative frequency represented by the sample observation a_i^{bk} of S_{bk}.

Let $F(\alpha)$ stands for the cumulative distribution function by decreasing sizes of the households poverty ratios $\mu_B(a_i)$, $i = 1,\ldots,n$, then $F(\alpha)=P(\mu_B(a_i)\geq\alpha)$. For $F(\alpha)$=0,05, we have:

$$\alpha = F^{-1}(0{,}05) = \max_{\{i\}}\{\mu_B(a_i), s.t., F(\mu_B(a_i)) \geq 0{,}05\}$$

hence, the fuzzy set B_α for $F(\alpha)$=0,05 contains the 5% poorest households, i.e., the 5% greatest values of $\mu_B(a_i)$.

2.2.2. *Decomposition by attribute: Dagum and Costa (2004)*

Dagum and Costa (2004) introduced the decomposition by attribute showing that it is possible to gauge the contribution of the j-th attribute to the overall amount of poverty:

$$C^j_{\mu_B} = \mu_B(X_j)w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{17}$$

According to (17), it is possible to calculate the contribution of the j-th attribute to the k-th group, and the contribution of the j-th attribute to the b-th sub-group.

The unidimensional poverty index of the j-th attribute for the k-th group is expressed as:

$$\mu_B(X^k_j) = \sum_{i=1}^{n_k} x^k_{ij} g(a^k_i) \Big/ \sum_{i=1}^{n_k} g(a^k_i). \tag{18}$$

Using (18) it is possible to estimate the contribution of the j-th attribute to the k-th group:

$$C^j_{\mu^k_B} = \mu_B(X^k_j)w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{19}$$

Secondly, the unidimensional poverty index of the j-th attribute in S_{bk} can be defined as follow:

$$\mu_B(X^{bk}_j) = \sum_{i=1}^{n_{bk}} x^{bk}_{ij}\, g(a^{bk}_i) \Big/ \sum_{i=1}^{n_{bk}} g(a^{bk}_i). \tag{20}$$

This gives the contribution of the j-th attribute to the b-th sub-group poverty index:

$$C^j_{\mu^{bk}_B} = \mu_B(X^{bk}_j)w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{21}$$

In contrast to the group and sub-group decompositions, the attribute decomposition allows decision makers to obtain more information about different characteristics of poverty. It yields therefore more precision in designing an appropriate structural socio-economic policy aimed at alleviating poverty.

2.2.3. *Multidimensional decomposition*

Chakravarty, Mukherjee and Ranade (1998) introduced a class of poverty indexes simultaneously decomposable by attribute and by sub-population. Mussard and Pi Alperin

(2007) have demonstrated that the multidimensional fuzzy index of poverty satisfies this property.

Following (18), we define the fuzzy poverty index as a weighted function of the unidimensional poverty indexes by attribute for all groups:

$$\mu_B = \sum_{k=1}^{s} \sum_{j=1}^{m} \mu_B\left(X_j^k\right) w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{22}$$

Thus, it is possible to gauge the contribution of the j-th attribute of the k-th group to the global index of poverty:

$$C_{\mu_B}^{jk} = \mu_B\left(X_j^k\right) w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{23}$$

This combined decomposition gives the contribution to overall poverty of all the couples "attribute/group" If two partitions of groups are taken into account, and if we consider the unidimensional poverty index of the j-th attribute in S_{bk} (20), the multidimensional poverty index for the entire economic surface is:

$$\mu_B = \sum_{k=1}^{s} \sum_{b=1}^{p} \sum_{j=1}^{m} \mu_B\left(X_j^{bk}\right) w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{24}$$

Therefore, we measure the contribution of the pairs "sub-group/attribute" to μ_B:

$$C_{\mu_B}^{jbk} = \mu_B\left(X_j^{bk}\right) w_j \Big/ \sum_{j=1}^{m} w_j \ . \tag{25}$$

3. APPLICATION IMMIGRANTS vs NATIVES IN LUXEMBOURG

Since the beginning of the industrialization by 1870, Luxembourg knew a strong population growth. In 1900, Luxembourg counted 200.000 persons. In 2006, the population amounts to 459.500 inhabitants, representing an increase of more than 100 % in a century. This increase is essentially due to a constant immigration flow since the end of the *XIX*th century explained by the industrialization and the discovery of iron ore deposits in the South of the country. For the last thirty years, the immigration increased considerably, due to the development of the financial centre.

During the *XX*th century, immigrants contributed to Luxembourg's economic and social development. In 2006, approximately 181.962 foreigners lived in Luxembourg (39,6% of the country's total population). Most of the foreigners are white, European, and Catholic; among them, immigrants from Portugal constitute the majority, accounting for 37,29% of the total foreigner population (Kollwelter, 2007).

Our analysis deals with the multi-decomposition of the multidimensional fuzzy poverty index. This method is applied to study the different characteristics of deprivation between natives and immigrants living in Luxembourg. The database used in this study is the Panel Socio-Economique *Liewen zu Lëtzebuerg* (PSELL-3) which includes information about living conditions and labour market characteristics in Luxembourg. This survey has been performed every year since 2003 and is representative of the population of households and individuals residing in Luxembourg. The application covers 3.557 households in 2006.

The socio-economic attributes selected to study the state of poverty

Based on the information available in the PSELL-3 dataset, we select the socioeconomic attributes whose lack of, or partial (insufficient) possession of any of those attributes, contributes to the state of a household poverty. The selected attributes can be divided in four dimensions as follow:

- Basic non-monetary deprivation:
  - Capacity to face unexpected expenses (X_1);
  - Keeping home (household's principal accommodation) adequately warm (X_2);
  - Paying for a week annual holiday away from home (X_3);
  - Eating meat or fish every second day, if the households wanted to (X_4);
  - Inability to meet scheduled payment such as mortgage payments, utility bills or hire purchase instalments (X_5);
- Secondary non-monetary deprivation:
  - Do you have a computer? (X_6);
  - Do you have a dishwasher? (X_7);
  - Do you have a car or van for private use? (X_8);
- Housing: facilities and deterioration:
  - Household size and dimension (in square meters) of the household residence (X_9);
  - Do you have a leaky roof? (X_{10});
  - Do you have damp walls, windows or floors? (X_{11});
  - Do you have rot in walls, windows or floors? (X_{12});
  - Do you have non-hermetic windows and doors? (X_{13});
  - Do you have double glazing windows? (X_{14});
  - Do you have an outdoor space? (X_{15});
- Household disposable equivalent income (X_{16}).

Appendix A.1 presents the degree of membership and description of the socio-economic attributes. In the following sections, we expose the principal characteristics of poverty of immigrants and natives from Luxembourg..

The standard decomposition

We apply Dagum and Costa's (2004) attribute decomposition. The multidimensional poverty index (*MPI*) for Luxembourg in 2006 is μ_B = 0,0421, that means that 4,21% of Luxembourg's households have some degree of structurally poor, that is the lack of those attributes that contribute to reproduce poverty from generation to generation.

We have estimated the unidimensional poverty indexes by attribute (*UPI*) to identify the main characteristics of the poor households. Among these 16 attributes the incapacity to face unexpected expenses (X_1) emerge as the most generating attribute of poverty, followed by three housing poverty characteristics: the dimension household characteristic (X_9), the absence of double glazing windows (X_{14}) and of an outdoor space (X_{15}) (see *Table 1*).

Table 1. *UPI by attribute for the entire country, and relative contributions to* μ_B

	Attributes	UPI	Relative Contributions to μ_B
Basic non-monetary deprivation	**Capacity fo face unexpected expenses**	**0,1713**	7,63
	Keeping home adequately warm	0,0150	2,69
	Paying for a week annual holiday	0,0963	5,82
	Eating meat or fish every two days	0,0178	4,31
	Inability to meet scheduled payement	0,0048	1,04
Secondary non-monetary deprivation	**Have a computer**	0,0278	4,04
	Have a dishwasher	0,0033	1,90
	Have a private car or van	0,0127	2,81
Housing	**Dimension of the household residence**	**0,1472**	6,68
	Have a leaky roof	0,0496	**8,03**
	Have damp walls, windows or floors	0,1087	7,14
	Have rot in walls, windows or floors	0,0709	5,60
	Having non-hermetic windows and doors	0,1195	**12,33**
	Do not have double glazing windows	**0,1431**	**15,00**
	Do not have an outdoor space	**0,1428**	**9,86**
Income	**Household equivalent income**	0,0968	5,10
Total			100 %

Source: PSELL3, CEPS/INSTEAD

It is also possible to measure the contribution of each attribute to the global poverty. Indeed, the contributions are also useful since they provide suitable statistical information to decision makers and it appears obvious to reduce poverty for the majority of the population which is in need. Four main aspects of deprivation exhibit the highest contributions to μ_B: the absence of double glazing windows (X_{14}), the presence of non-hermetic windows and doors (X_{13}), the absence of an outdoor space (X_{15}) and the leaky roof (X_{10}). Then, the four most explicative dimensions of deprivation for the entire population below to the dimension "housing characteristics". Then, the monetary component of multidimensional deprivation is not the most explicative attribute.

Even if these results provide us enough information to identify the features of poverty, the decomposition analysis offers complementary ways to explain precisely the global poverty phenomenon.

The multidimensional decomposition[7]

As we mentioned, Luxembourg is characterized by a high proportion of immigrants. We first analyze the group decomposition by the nationality of the head of household living in Luxembourg. Four categories are studied: Luxemburger, immigrants from Portugal, immigrants from others countries of the European Union before the recent enlargement (EU15) and immigrants from non EU15 countries. *Table 2* underlines two statistical

[7] The sample size of each one of the groups and sub-groups of population studied in this section are present in Appendix A.2.

information: the multidimensional poverty indexes for each one of the groups after decompositions; and their relative contribution to the *MPI*.

Table 2. ***MPI by nationality decomposition, and their relative contributions to μ_B***

Nationality	μ_B^k	Relative contributions to μ_B
Other EU15	0,0472	23,29
Luxemburger	0,0324	**49,68**
Non EU15	**0,0996**	5,11
Portuguese	0,074	21,92

Source: PSELL3, CEPS/INSTEAD

This decomposition shows that immigrants from non EU15 countries are the poorest with 9,96% of households presenting somme degree of structural poverty. Nevertheless, the analysis of the group contributions shows that 49,68% of the intensity of poverty is explained by Luxemburg's households. This result is due to the fact that the relative contribution involves the number of representative households in each group. This information is very important because even if the non EU15 is the poorest group, the eradication of poverty of this sub-population would only reduce 5,11% (relative contribution level) of Luxembourg's poverty level.

Table 3a and *3b* present the unidimensional poverty indexes by attribute and by nationality, their relative contribution to the global poverty for each group (μ_B^k), and their relative contribution to the global poverty to the entire population (μ_B). Then we distinguish different characteristics, and intensity, of poverty in each group. Thus, having double glazing windows (X_{14}) is the most explicative variable in Luxembourg and other EU15 groups explaining 17,5% and 14,04% of total deprivation in these groups, respectively. On the other hand, the deprivation level of non EU15 and Portugal groups are explained by the attribute have an outdoor space (X_{15}) which explains 12,74% and 12,60%, respectively.

Table 3a. ***UPI by attribute and by nationality and their relative contributions to μ_B^k and μ_B***

Nationality	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
	0,2009	0,0174	0,0949	0,0225	0,0048	0,0195	0,004	0,0187
Other EU15	[8,00]*	[2,79]	[5,13]	[4,86]	[0,93]	[2,53]	[2,10]	[3,71]
	[1,49]**	[0,52]	[0,96]	[0,90]	[0,17]	[0,47]	[0,39]	[0,69]
	0,1118	0,0115	0,0732	0,0152	0,0029	0,0166	0,0017	0,0075
Luxemburger	[6,47]	[2,67]	[5,75]	[4,75]	[0,80]	[3,12]	[1,29]	[2,16]
	[0,83]	[0,34]	[0,74]	[0,61]	[0,10]	[0,40]	[0,17]	[0,28]
	0,5072	0,0406	0,2396	0,0622	0,0132	0,1008	0,0203	0,101
Non EU15	[9,56]	[3,09]	[6,13]	[6,36]	[1,21]	[6,20]	[4,99]	[9,49]
	[3,76]	[1,21]	[2,41]	[2,50]	[0,48]	[2,44]	[1,96]	**[3,73]**
	0,3709	0,0249	0,193	0,0162	0,0133	0,0871	0,0071	0,014
Portuguese	[9,41]	[2,54]	[6,64]	[2,23]	[1,63]	[7,20]	[2,35]	[1,77]
	[2,75]	[0,74]	[1,94]	[0,65]	[0,48]	[2,11]	[0,69]	[0,52]

Source: PSELL3, CEPS/INSTEAD

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

Table 3b. ***UPI by attribute and by nationality and their relative contributions to*** μ_B^k ***and*** μ_B

Nationality	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
	0,1671	0,0448	0,1533	0,0978	0,1196	0,1498	0,1874	0,0879
Other EU15	[6,78]*	[6,47]	[9,00]	[6,90]	[11,03]	**[14,04]**	[11,59]	[4,14]
	[1,26]**	[1,21]	[1,68]	[1,29]	[2,05]	[2,62]	[2,16]	[0,77]
	0,0866	0,0477	0,0888	0,0535	0,116	0,1285	0,0845	0,0604
Luxemburger	[5,11]	[10,02]	[7,58]	[5,48]	[15,55]	**[17,50]**	[7,59]	[4,14]
	[0,65]	[1,28]	[0,97]	[0,70]	[1,99]	[2,24]	[0,97]	[0,53]
	0,4407	0,0364	0,1224	0,0906	0,1261	0,218	0,4349	0,3434
Non EU15	[8,47]	[2,49]	[3,40]	[3,03]	[5,51]	[9,68]	**[12,74]**	[7,66]
	[3,33]	[0,98]	[1,34]	[1,19]	[2,17]	**[3,81]**	**[5,01]**	[3,01]
	0,3765	0,07	0,1349	0,1128	0,136	0,1942	0,3196	0,257
Portuguese	[9,73]	[6,45]	[5,05]	[5,07]	[8,00]	[11,60]	**[12,60]**	[7,71]
	[2,84]	[1,88]	[1,48]	[1,48]	[2,34]	**[3,39]**	**[3,68]**	[2,25]

Source: PSELL3, CEPS/INSTEAD

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

The relative contributions to the multidimensional poverty index by attribute and by nationality, provides the couples "attribute/group" that have the most important contribution to the multidimensional poverty index. Even if the marginal decompositions (group or attribute decompositions) indicate that double glazing windows (X_{14}) and Luxemburger nationality yield the highest contributions (15% and 49,68%, respectively), the combination "double glazing windows/Luxemburger" do not necessary produces the most important contribution. Il contributes with a 2,24% to the overall poverty, whereas 5,01% of the *MPI* is explained by the "outdoor space (X_{15})/non EU15" combination. This example shows that the marginal decompositions techniques are independent. Other couples that explain the deprivation level of Luxembourg are: "double glazing windows (X_{14})/non EU15" (3,81%), "capacity to face unexpected expenses (X_1)/non EU15" (3,76%), "car or van (X_8)/non EU15" (3,73%), "outdoor space (X_{15})/Portuguese".

The multi-level decompositions

Table 4. ***MPI by nationality and gender decomposition, and their relative contributions to*** μ_B

Nationality	Sexe	μ_B^{kb}	Relative contributions to μ_B
Others EU15	**Women**	0,0568	9,59
	Men	0,0421	13,7
Luxemburger	**Women**	0,0386	**23,13**
	Men	0,0285	**26,55**
Non EU15	**Women**	**0,1028**	2,05
	Men	**0,0976**	3,06
Portuguese	**Women**	0,0658	4,77
	Men	0,0766	**17,16**

Source: PSELL3, CEPS/INSTEAD

We first investigate different multi-level decompositions. The first partition was by nationality..Several secondary partitions of the population based on the head of household characteristics are proposed: (*i*) gender, (*ii*) age (less that 25 years old, between 25 and 49 years old, between 50 and 64 years old, and more than 65 years old), and (*iii*) civil status (divorced, never married, married, separated and widower). *Tables 4*, *5* and *6* show the multidimensional poverty index after multi-level decomposition and their relative contributions to global deprivation.

Table 5. ***MPI by nationality and age decomposition, and their relative contributions to μ_B***

Nationality	Age	μ_B^{kb}	Relative contributions to μ_B
Others EU15	**[16-24]**	0,0746	0,6
	[25-49]	0,0548	13,99
	[50-64]	0,0363	5,54
	>64	0,0405	3,16
Luxemburger	**[16-24]**	0,064	0,8
	[25-49]	0,0311	**20,27**
	[50-64]	0,0318	13
	>64	0,0341	**15,61**
Non EU15	**[16-24]**	0,3209	0,11
	[25-49]	**0,1025**	3,77
	[50-64]	**0,0939**	1,21
	>64	0,0107	0,01
Portuguese	**[16-24]**	0,0799	0,96
	[25-49]	0,0768	**16,53**
	[50-64]	0,052	2,89
	>64	**0,1152**	1,54

Source: PSELL3, CEPS/INSTEAD

Table 6. ***MPI by nationality and civil status decomposition, and their relative contributions to μ_B***

Nationality	Civil Status	μ_B^{kb}	Relative contributions to μ_B
Others EU15	**Divorced**	0,0779	4,41
	Never married	0,062	6,59
	Married	0,0357	10,03
	Separated	0,0358	0,46
	Widower	0,0486	1,81
Luxemburger	**Divorced**	0,0542	8,16
	Never married	0,0547	**13,99**
	Married	0,0216	**18,88**
	Separated	0,0297	0,48
	Widower	0,0346	8,16
Non EU15	**Divorced**	0,0696	0,22
	Never married	**0,1058**	0,97
	Married	0,0957	3,3
	Separated	**0,1952**	0,51
	Widower	0,0566	0,1
Portuguese	**Divorced**	0,0684	1,19
	Never married	0,0799	3,05
	Married	0,0705	**15,85**
	Separated	**0,1327**	1,55
	Widower	0,0657	0,28

Source: PSELL3, CEPS/INSTEAD

The multidimensional poverty indexes for each sub-population, presented in *Table 4*, *5* and *6*, show that the female and male immigrants from non EU15 countries are more affected by poverty than the other sub-groups (10,28% and 9,76% respectively). Those Portuguese older than 64 years old (11,52%), non EU15's heads of households aged between 25 and 49 years old (10,25%) or between 50 and 64 years old (9,39%) have the highest poverty indexes. Immigrants from non EU15 countries separated (19,52%) or never married (13,27%) and immigrants from Portugal separated (10,58%) are more affected by the intensity of poverty than other civil status.

The unidimensional poverty indexes for each multi-level decomposition and their relative contributions to μ_B^{kb} and μ_B are presented in *Tables 1a,b, 2a,b* and *3a,b,c,d* in Appendix A.3. The principal couples with the most important contributions to the multidimensional poverty index are "outdoor space (X_{15})/women from non EU15 countries" (2,84%), "car or van (X_8)/men from non EU15 countries" (2,36%), "dishwasher (X_7)/[16-24] non EU15 countries" (16,43%), "eating meet or fish (X_4)/separated from non EU15 countries" (4,95%) and "computer (X_6)/separated from non EU15 countries" (3,47%) .

The α-cut multi-level decomposition

The last multi-level decomposition used the α-cut property of fuzzy set theory. We have calculated the multidimensional poverty index for each household included in the database. Then, the state of poverty of the households was ordered by decreasing values. So, the first partition decompose the population by nationality, and the second partition decompose the population into four sub-groups according to the intensity of poverty of each household: those belonging to the poorest 10% of the Luxembourg population; those households which are between the 10% and 25% poorest; those households which are between the 25% and 50% poorest and finally, those belonging to the 50% richest households in the country.

If we consider the poorest 10% of the population, we can notice that 38,28% came from Portugal and 26,41% from Luxembourg, and 71,51% have between 50 and 64 years old. In the following, only the results for the heads of households from Luxembourg and Portugal are presented. Nevertheless, the results for the other nationalities are presented in Appendix A.4.

Table 7: ***MPI by sub-group of population and their relative contribution to MPI***

Nationality	Percentile	μ_B^{kb}	Relative contributions to μ_B
Luxemburger	**10%**	0,2384	**14,81**
	10-25%	0,1033	**13,55**
	25-50%	0,0497	**17,15**
	50-100%	0,0042	4,17
Portuguese	**10%**	0,2247	**10,25**
	10-25%	0,1036	6,65
	25-50%	0,0501	4,04
	50-100%	0,0092	0,98

Source: PSELL3, CEPS/INSTEAD

Table 7 presents the multidimensional poverty index for each sub-group of population and their relative contribution level to the global *MPI*. Given that the second partition considers percentiles of population, what is interesting in this decomposition is to study the contributions levels of each attribute to explain the poverty level of each sub-group (see *Table 8a,b*). The intensity of poverty of the poorest 10% from Luxembourg is explained as follows: 13,17% come from keeping home adequately warm (X_2), 12,86% from the impossibility to have double glazing windows (X_{14}), 12,63% from the inability to meet scheduled payment (X_5). For the subgroup of the 10% to 25% poorest the contributions are as follows: the impossibility to have a computer (X_6: 16,08%), the impossibility to keeping home adequately warm (X_2: 14,98%) and the inability to meet scheduled payment (X_5: 13,50%). For the group of the 25% to 50% poorest the contributions are: the inability to meet scheduled payment (X_5: 23,48%), the impossibility to have a computer (X_6: 22,82%) and the impossibility to have a dishwasher (X_7: 14,01%). Finally for the 50% richest households the contributions to the intensity of deprivation are: 33,65% by the impossibility to have a computer (X_6), 20,70% by the incapacity to face unexpected expenses (X_1) and 17,31% by having damp walls, windows or grounds (X_{11}).

Table 8: ***UPI by attribute and by sub-group of population***

Nationality	Percentile	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Luxemb.	**10%**	0,3205	0,4605	0,6287	0,501	0,6922	0,4366	0,379	0,144
		[2,57]*	[**13,17**]	[7,31]	[6,99]	[**12,63**]	[8,10]	[4,64]	[3,70]
		[0,39]**	[1,98]	[1,10]	[1,05]	[1,90]	[1,22]	[0,70]	[0,56]
	10-25%	0,1893	0,2269	0,291	0,1548	0,3205	0,3757	0,1785	0,0489
		[3,51]	[**14,98**]	[7,81]	[4,99]	[**13,50**]	[**16,08**]	[5,04]	[2,90]
		[0,23]	[0,98]	[0,51]	[0,32]	[0,88]	[1,05]	[0,33]	[0,19]
	25-50%	0,1239	0,0424	0,1137	0,0881	0,2681	0,2564	0,2385	0,0289
		[4,77]	[5,81]	[6,34]	[5,90]	[**23,48**]	[**22,82**]	[**14,01**]	[3,56]
		[0,15]	[0,18]	[0,20]	[0,18]	[0,74]	[0,72]	[0,44]	[0,11]
	50-100%	0,0454	0	0,0196	0	0	0,032	0	0
		[**20,70**]	[0,00]	[12,90]	[0,00]	[0,00]	[**33,65**]	[0,00]	[0,00]
		[0,05]	[0,00]	[0,03]	[0,00]	[0,00]	[0,09]	[0,00]	[0,00]
Portuguese	**10%**	0,5374	0,3787	0,4688	0,3609	0,4619	0,4839	0,541	0,3546
		[4,58]	[**11,49**]	[5,78]	[5,34]	[8,94]	[**9,52**]	[7,03]	[**9,66**]
		[0,65]	[1,63]	[0,82]	[0,76]	[1,27]	[1,35]	[1,00]	[1,37]
	10-25%	0,5213	0,0538	0,209	0,234	0,2567	0,3506	0,4857	0,0717
		[9,63]	[3,54]	[5,59]	[7,51]	[10,78]	[**14,96**]	[**13,67**]	[4,24]
		[0,63]	[0,23]	[0,37]	[0,49]	[0,70]	[0,98]	[0,89]	[0,28]
	25-50%	0,3649	0	0,0454	0,0238	0,0341	0,1506	0,4817	0,0621
		[**13,92**]	[0,00]	[2,51]	[1,58]	[2,96]	[13,28]	[**28,03**]	[7,58]
		[0,44]	[0,00]	[0,08]	[0,05]	[0,09]	[0,42]	[0,89]	[0,24]
	50-100%	0,2281	0	0,0141	0	0	0,0076	0	0
		[**47,25**]	[0,00]	[4,23]	[0,00]	[0,00]	[3,65]	[0,00]	[0,00]
		[0,28]	[0,00]	[0,02]	[0,00]	[0,00]	[0,02]	[0,00]	[0,00]

Source: PSELL3, CEPS/INSTEAD

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

Concerning the intensity of poverty of the poorest 10% of Portugal's immigrants living in Luxembourg is explained as follows: 11,49% come from keeping home adequately warm (X_2), 9,66% from the impossibility to have a car or van for private use (X_8), 9,52% from the inability to have a computer (X_6). For the subgroup of the 10% to 25% poorest the contributions are as follows: the impossibility to have a computer (X_6: 14,96%), the impossibility to have a dishwasher (X_7: 13,67%) and having damp walls, windows or floors (X_{11}: 12,09%). For the group of the 25% to 50% poorest the contributions are: the inability to have a dishwasher (X_7: 28,03%), the household equivalent income (X_{16}: 14,33%) and the incapacity to face unexpected expenses (X_1: 13,92%). Finally, the intensity of poverty for the 50% richest households is explained at 47,25%, 28,76 and 16,12% by the incapacity to face unexpected expenses (X_1), the possession of damp walls, windows or grounds (X_{11}) and the household equivalent income (X_{16}), respectively.

Table 8: ***UPI by attribute and by sub-group of population***

Nationality	Percentile	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Luxemb.	10%	0,0421	0,177	0,54	0,1167	0,4586	0,3012	0,0447	0,2346
		[4,33]*	[6,95]	[4,25]	[3,71]	[4,90]	[**12,86**]	[1,70]	[2,19]
		[0,65]**	[1,05]	[0,64]	[0,56]	[0,74]	[1,93]	[0,26]	[0,33]
	10-25%	0	0,0037	0,4331	0,0784	0,3609	0,0342	0,0103	0,1882
		[0,00]	[0,33]	[7,88]	[5,74]	[8,90]	[3,37]	[0,91]	[4,05]
		[0,00]	[0,02]	[0,51]	[0,37]	[0,58]	[0,22]	[0,06]	[0,26]
	25-50%	0	0	0,1228	0	0,0974	0	0,0008	0,0789
		[0,00]	[0,00]	[4,64]	[0,00]	[4,99]	[0,00]	[0,14]	[3,53]
		[0,00]	[0,00]	[0,15]	[0,00]	[0,16]	[0,00]	[0,00]	[0,11]
	50-100%	0	0	0,0387	0	0,0026	0	0	0,0262
		[0,00]	[0,00]	[**17,31**]	[0,00]	[1,59]	[0,00]	[0,00]	[13,86]
		[0,00]	[0,00]	[0,05]	[0,00]	[0,00]	[0,00]	[0,00]	[0,04]
Portuguese	10%	0,0461	0,0909	0,6094	0,1509	0,5905	0,086	0,0739	0,513
		[5,03]	[3,79]	[5,09]	[5,09]	[6,70]	[3,89]	[2,99]	[5,07]
		[0,71]	[0,54]	[0,72]	[0,72]	[0,95]	[0,55]	[0,42]	[0,72]
	10-25%	0	0	0,6669	0,0075	0,3597	0,0136	0,0085	0,3046
		[0,00]	[0,00]	[**12,09**]	[0,55]	[8,84]	[1,34]	[0,75]	[6,53]
		[0,00]	[0,00]	[0,79]	[0,04]	[0,58]	[0,09]	[0,05]	[0,43]
	25-50%	0	0	0,3013	0	0,0886	0	0,0001	0,3236
		[0,00]	[0,00]	[11,29]	[0,00]	[4,50]	[0,00]	[0,02]	[**14,33**]
		[0,00]	[0,00]	[0,36]	[0,00]	[0,14]	[0,00]	[0,00]	[0,45]
	50-100%	0	0	0,1414	0	0	0	0	0,0671
		[0,00]	[0,00]	[**28,76**]	[0,00]	[0,00]	[0,00]	[0,00]	[**16,12**]
		[0,00]	[0,00]	[0,17]	[0,00]	[0,00]	[0,00]	[0,00]	[0,09]

Source: PSELL3, CEPS/INSTEAD

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

This multidimensional decomposition shows that the principal dimension that generates structural poverty among the nationality groups, and for all α-cut decompositions, is not necessarily the monetary one. For the two poorest sub-groups of populations, the household equivalent income is not one of the major contributions to the intensity of poverty of the various sub-populations. Another important result is that the principal's characteristics of the poorest 10% of the natives from Luxembourg are not the same of those characterising the poorest 10% of immigrants from Portugal. Thus, decision makers must take into account the characteristics of poverty of these groups of population before proposing socio-economic policies aiming at reducing poverty.

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Appendix A.1 The membership functions

Basic non-monetary deprivation

Table A.1.1. *Capacity to face unexpected expenses*

Characteristics	Degree of membership
Yes	0
No	1

Table A.1.2. *Eating meat or fish every second day, if the households wanted to*

Characteristics	Degree of membership
Yes	0
No	1

Table A.1.3. *Paying for a week annual holiday away from home*

Characteristics	Degree of membership
Yes	0
No	1

Table A.1.4. *Keeping home (household's principal accommodation) adequately warm*

Characteristics	Degree of membership
Yes	1
No	0

Table A.1.5. *Inability to meet scheduled payment such as mortgage payments, utility bills or hire purchase instalments*

<table>
<tr><th colspan="6">Characteristics</th><th>Degree of membership</th></tr>
<tr><td rowspan="8">Scheduled payment</td><td rowspan="4">Yes</td><td rowspan="4">Mortgage payments</td><td rowspan="2">Yes</td><td rowspan="2">Hire purchase</td><td>Yes</td><td>1</td></tr>
<tr><td>No</td><td>0,75</td></tr>
<tr><td rowspan="2">No</td><td rowspan="2">Hire purchase</td><td>Yes</td><td>0,75</td></tr>
<tr><td>No</td><td>0,25</td></tr>
<tr><td rowspan="4">No</td><td rowspan="4">Mortgage payments</td><td rowspan="2">Yes</td><td rowspan="2">Hire purchase</td><td>Yes</td><td>0,75</td></tr>
<tr><td>No</td><td>0,25</td></tr>
<tr><td rowspan="2">No</td><td rowspan="2">Hire purchase</td><td>Yes</td><td>0,25</td></tr>
<tr><td>No</td><td>0</td></tr>
</table>

Secondary non-monetary deprivation

Table A.1.6. *Do you have a computer?*

Characteristics		Degree of membership
Have		0
Do not have	**Due to choice**	0
	Can not afford it	1

Table A.1.7. *Do you have a dishwasher?*

Characteristics		Degree of membership
Have		0
Do not have	**Due to choice**	0
	Can not afford it	1

Table A.1.8. ***Do you have a car or van for private use?***

Characteristics		Degree of membership
Have		0
Do not have	**Due to choice**	0
	Can not afford it	1

Housing: facilities and deterioration

This domain is related to the absence of housing facilities (so basic that one can presume all households would wish to have them), and serious problems with accommodation.

Table A.1.11. ***Household size and dimension (in m²) of the household residence***

Household size	Square meters	Degree of membership
1	**< 50**	1
1	**50 - 65**	0,50
1	**65 – 80**	0,25
1	**>80**	0
2	**< 60**	1
2	**60 – 75**	0,50
2	**75 – 90**	0,25
2	**> 90**	0
3	**< 70**	1
3	**70 – 85**	0,50
3	**85 - 100**	0,25
3	**> 100**	0
4	**< 80**	1
4	**80 – 95**	0,50
4	**95 – 110**	0,25
4	**> 110**	0
≥5	**< 100**	1
≥5	**100 – 120**	0,50
≥5	**120 – 140**	0,25
≥5	**>140**	0

Source: Dagum and Costa (2004)

Table A.1.12. ***Do you have a leaky roof?***

Characteristics	Degree of membership
Yes	1
No	0

Table A.1.13. ***Do you have damp walls, windows or grounds?***

Characteristics	Degree of membership
Yes	1
No	0

Table A.1.14. ***Do you have rot in walls, windows and grounds?***

Characteristics	Degree of membership
Yes	1
No	0

Table A.1.15. ***Do you have non-hermetic windows and doors?***

Characteristics	Degree of membership
Yes	1
No	0

Table A.1.16. ***Do you have double glazing windows?***

Characteristics		Degree of membership
No		1
Yes	**Some of them**	0,5
	All of them	0

Table A.1.17. ***Do you have an outdoor space?***

Characteristics	Degree of membership
Yes	0
No	1

Household disposable equivalent income

Table A.1.18. ***Household equivalent income***[8]

Income level (y_i^e)	Degree of membership
If $y_i^e \leq y_{0,05}^e$	1
If $y_{0,05}^e < y_i^e \leq y_{0,25}^e$	$(y_{0,25}^e - y_i^e) / (y_{0,25}^e - y_{0,05}^e)$
If $y_i^e > y_{0,25}^e$	0

[8] Where $y_{0,05}^e$ and $y_{0,25}^e$ are the equivalent income for the 5th and 25th percentile, respectively.

Appendix A.2 The sample size of the studied sub-groups of population (in number of households)

It is important to notice that we consider as a representative sample, a sample size bigger than 30 households. The conclusions presented for the sample sizes < 30 households, are not necessary representative of the corresponding sous-populations.

Table A.2.1 ***The number of studied households by nationality***

Nationality	Sample size
Other EU15	984
Luxemburger	1906
Non EU15	142
Portuguese	525

Table A.2.2 ***The number of studied head of the households by nationality and by gender***

Nationality	Gender	Sample Size
Other EU15	**Men**	673
	Women	311
Luxemburger	**Men**	1207
	Women	699
Non EU15	**Men**	93
	Women	49
Portuguese	**Men**	387
	Women	138

Table A.2.1 ***The number of studied households by nationality and by age***

Nationality	Age	Sample Size
Other EU15	**[16-24]**	12
	[25-49]	611
	[50-64]	272
	>64	89
Luxemburger	**[16-24]**	27
	[25-49]	749
	[50-64]	612
	>64	518
Non EU15	**[16-24]**	2
	[25-49]	111
	[50-64]	26
	>64	3
Portuguese	**[16-24]**	29
	[25-49]	422
	[50-64]	66
	>64	8

Table A.2.1 ***The number of studied households by nationality and by civil status***

Nationality	Civil Status	Sample Size
Other EU15	**Divorced**	129
	Never married	239
	Married	547
	Separated	28
	Widower	41
Luxemburger	**Divorced**	211
	Never married	313
	Married	1094
	Separated	28
	Widower	260
Non EU15	**Divorced**	5
	Never married	21
	Married	108
	Separated	4
	Widower	4
Potuguese	**Divorced**	45
	Never married	78
	Married	375
	Separated	15
	Widower	12

Appendix A.3 The UPI for the multilevel decomposition

Table A.3.1a. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***and*** μ_B

Nationality	Sexe	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Other UE	**Women**	0,2204	0,0106	0,1261	0,0344	0,0032	0,0429	0,0021	0,0447
		[7,29]*	[1,42]	[5,65]	[6,17]	[0,51]	[4,63]	[0,92]	[7,37]
		[0,81]**	[0,16]	[0,63]	[0,69]	[0,06]	[0,52]	[0,10]	[0,82]
	Men	0,1907	0,0209	0,0788	0,0163	0,0057	0,0073	0,005	0,0052
		[8,50]	[3,76]	[4,76]	[3,94]	[1,23]	[1,06]	[2,93]	[1,15]
		[0,70]	[0,31]	[0,39]	[0,33]	[0,10]	[0,09]	[0,24]	[0,10]
Luxemb.	**Women**	0,1586	0,0106	0,0916	0,0146	0,0016	0,0249	0	0,0146
		[7,72]	[2,07]	[6,05]	[3,85]	[0,38]	[3,95]	[0,00]	[3,54]
		[0,59]	[0,16]	[0,46]	[0,29]	[0,03]	[0,30]	[0,00]	[0,27]
	Men	0,0818	0,012	0,0614	0,0155	0,0037	0,0112	0,0028	0,0029
		[5,39]	[3,20]	[5,49]	[5,54]	[1,17]	[2,40]	[2,41]	[0,96]
		[0,30]	[0,18]	[0,31]	[0,31]	[0,07]	[0,13]	[0,14]	[0,05]
Non EU15	**Women**	0,5436	0,0308	0,2827	0,0937	0,0198	0,1853	0,0147	0,0579
		[9,93]	[2,27]	[7,01]	[9,28]	[1,75]	[11,04]	[3,50]	[5,27]
		[2,01]	[0,46]	[1,42]	[1,87]	[0,35]	**[2,23]**	[0,71]	[1,06]
	Men	0,4841	0,0468	0,2123	0,0422	0,0091	0,0471	0,0238	0,1284
		[9,32]	[3,63]	[5,54]	[4,40]	[0,85]	[2,96]	[5,99]	[12,32]
		[1,79]	[0,70]	[1,06]	[0,84]	[0,16]	[0,57]	[1,15]	**[2,36]**
Portuguese	**Women**	0,3414	0, 0425	0, 1709	0,0346	0,0075	0,0711	0,0023	0,0136
		[9,74]	[4,88]	[6,61]	[5,35]	[1,03]	[6,61]	[0,86]	[1,94]
		[1,26]	[0,63]	[0,86]	[0,69]	[0,13]	[0,85]	[0,11]	[0,25]
	Men	0,3804	0,0192	0,2001	0,0102	0,0151	0,0922	0,0087	0,0141
		[9,32]	[1,89]	[6,65]	[1,36]	[1,80]	[7,37]	[2,77]	[1,73]
		[1,40]	[0,29]	[1,00]	[0,20]	[0,27]	[1,11]	[0,42]	[0,26]

[.]*: relative contribution to μ_B^{kb} .

[.]**: relative contribution to μ_B.

Table A.3.1b. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Sexe	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Other EU15	**Women**	0,1648	0,055	0,2026	0,1143	0,1388	0,1682	0,1868	0,1028
		[5,55]*	[6,60]	[9,88]	[6,69]	[10,63]	[13,08]	[9,59]	[4,02]
		[0,62]**	[0,74]	[1,10]	[0,75]	[1,19]	[1,46]	[1,07]	[0,45]
	Men	0,1683	0,0394	0,1276	0,0893	0,1095	0,1403	0,1876	0,0801
		[7,64]	[6,38]	[8,39]	[7,05]	[11,31]	[14,71]	[12,99]	[4,22]
		[0,63]	[0,53]	[0,69]	[0,58]	[0,94]	[1,22]	[1,08]	[0,35]
Luxemb.	**Women**	0,1159	0,0544	0,1028	0,0642	0,1104	0,1604	0,115	0,081
		[5,75]	[9,61]	[7,38]	[5,53]	[12,44]	[18,38]	[8,69]	[4,66]
		[0,44]	[0,73]	[0,56]	[0,42]	[0,94]	[1,39]	[0,66]	[0,35]
	Men	0,0678	0,0434	0,0797	0,0466	0,1196	0,1079	0,0649	0,0472
		[4,55]	[10,38]	[7,75]	[5,44]	[18,26]	[16,74]	[6,64]	[3,68]
		[0,25]	[0,58]	[0,43]	[0,30]	[1,02]	[0,94]	[0,37]	[0,21]
Non EU15	**Women**	0,45	0,0191	0,1884	0,1254	0,0489	0,1685	0,4957	0,3601
		[8,38]	[1,26]	[5,08]	[4,06]	[2,07]	[7,25]	[14,07]	[7,78]
		[1,69]	[0,26]	[1,03]	[0,82]	[0,42]	[1,46]	**[2,84]**	[1,57]
	Men	0,4348	0,0474	0,0804	0,0684	0,1752	0,2495	0,3963	0,3328
		[8,53]	[3,31]	[2,28]	[2,33]	[7,81]	[11,30]	[11,85]	[7,57]
		[1,64]	[0,64]	[0,44]	[0,45]	[1,50]	**[2,17]**	**[2,27]**	[1,45]
Portuguese	**Women**	0,3476	0,0366	0,1066	0,0525	0,1168	0,1449	0,3735	0,2348
		[10,11]	[3,79]	[4,49]	[2,65]	[7,72]	[9,73]	[16,56]	[7,92]
		[1,31]	[0,49]	[0,58]	[0,34]	[1,00]	[1,26]	**[2,14]**	[1,02]
	Men	0,3858	0,0808	0,144	0,1322	0,1423	0,2101	0,3022	0,2642
		[9,63]	[7,19]	[5,21]	[5,74]	[8,07]	[12,12]	[11,50]	[7,65]
		[1,45]	[1,08]	[0,78]	[0,86]	[1,22]	[1,83]	[1,73]	[1,15]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Table A.3.2a. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Age	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Other EU15	**[16-24]**	0,2836 [7,14]* [0,44]**	0,0982 [9,97] [0,61]	0,0385 [1,31] [0,08]	0 [0,00] [0,00]	0,0149 [1,82] [0,11]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,0385 [4,82] [0,30]
	[25-49]	0,2214 [7,59] [0,34]	0,0241 [3,33] [0,15]	0,1071 [4,98] [0,22]	0,0289 [5,36] [0,24]	0,0064 [1,07] [0,05]	0,0223 [2,49] [0,11]	0,0078 [3,50] [0,16]	0,0251 [4,28] [0,19]
	[50-64]	0,1612 [8,33] [0,25]	0,0068 [1,41] [0,04]	0,0886 [6,22] [0,19]	0,0245 [6,88] [0,20]	0,0036 [0,91] [0,03]	0,0186 [3,14] [0,09]	0 [0,00] [0,00]	0,0026 [0,67] [0,02]
	>64	0,2028 [9,40] [0,31]	0,008 [1,49] [0,05]	0,0733 [4,60] [0,15]	0 [0,00] [0,00]	0,0009 [0,20] [0,01]	0,0139 [2,10] [0,07]	0 [0,00] [0,00]	0,0273 [6,30] [0,21]
Luxemb.	**[16-24]**	0,6426 [18,87] [0,99]	0,0132 [1,56] [0,08]	0,2459 [9,80] [0,51]	0,0427 [6,80] [0,36]	0,0071 [1,01] [0,05]	0,0426 [4,08] [0,21]	0 [0,00] [0,00]	0,0289 [4,24] [0,22]
	[25-49]	0,1389 [8,40] [0,21]	0,0113 [2,76] [0,07]	0,0878 [7,20] [0,18]	0,0123 [4,03] [0,10]	0,0053 [1,55] [0,04]	0,0134 [2,64] [0,07]	0 [0,00] [0,00]	0,0073 [2,20] [0,06]
	[50-64]	0,0752 [4,44] [0,12]	0,0101 [2,40] [0,06]	0,0727 [5,82] [0,15]	0,0286 [9,16] [0,24]	0,0017 [0,49] [0,01]	0,0127 [2,44] [0,06]	0,0064 [4,93] [0,13]	0,0074 [2,17] [0,06]
	>64	0,0914 [5,03] [0,14]	0,0128 [2,84] [0,08]	0,0481 [3,59] [0,10]	0,0065 [1,93] [0,05]	0,0003 [0,09] [0,00]	0,0238 [4,27] [0,12]	0 [0,00] [0,00]	0,0073 [2,00] [0,06]
Non EU15	**[16-24]**	1 [5,85] [1,54]	0 [0,00] [0,00]	0,8174 [6,49] [1,71]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,1826 [3,48] [0,92]	0,8174 [62,42] **[16,43]**	0 [0,00] [0,00]
	[25-49]	0,5576 [10,21] [0,86]	0,0426 [3,14] [0,26]	0,1917 [4,76] [0,40]	0,0797 [7,91] [0,67]	0,0152 [1,35] [0,11]	0, 1173 [7,00] [0,59]	0,0203 [4,86] [0,41]	0,0772 [7,04] [0,59]
	[50-64]	0,4 [8,00] [0,62]	0,0401 [3,23] [0,25]	0,3846 [10,44] [0,80]	0,0201 [2,18] [0,17]	0,0093 [0,91] [0,07]	0,0615 [4,01] [0,31]	0 [0,00] [0,00]	0,1821 [18,16] [1,40]
	>64	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]
Portuguese	**[16-24]**	0,3479 [8,18] [0,54]	0 [0,00] [0,00]	0,105 [3,35] [0,22]	0 [0,00] [0,00]	0 [0,00] [0,00]	0, 1122 [8,61] [0,56]	0 [0,00] [0,00]	0,0068 [0,80] [0,05]
	[25-49]	0,3872 [9,47] [0,60]	0,0337 [3,32] [0,21]	0,206 [6,83] [0,43]	0,0218 [2,88] [0,18]	0,016 [1,90] [0,12]	0,0976 [7,78] [0,49]	0,004 [1,28] [0,08]	0,0106 [1,29] [0,08]
	[50-64]	0,2794 [10,10] [0,43]	0,0021 [0,31] [0,01]	0,0656 [3,22] [0,14]	0,002 [0,40] [0,02]	0,0088 [1,54] [0,07]	0,0619 [7,29] [0,31]	0,0223 [10,51] [0,45]	0,0322 [5,80] [0,25]
	>64	0,509 [8,30] [0,78]	0 [0,00] [0,00]	0,594 [13,13] [1,24]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Table A.3.2b. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Age	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Other EU15	**[16-24]**	0,3062 [7,85]* [0,48]**	0,1654 [15,11] [0,92]	0,1166 [4,33] [0,26]	0,1166 [5,20] [0,32]	0,1466 [8,54] [0,52]	0,0917 [5,43] [0,33]	0,2983 [11,66] [0,71]	0,5652 [16,82] [1,03]
	[25-49]	0,2292 [8,00] [0,36]	0,0527 [6,56] [0,29]	0,1922 [9,72] [0,44]	0,1178 [7,15] [0,32]	0,1293 [10,26] [0,46]	0,109 [8,79] [0,40]	0,2469 [13,15] [0,59]	0,0931 [3,77] [0,17]
	[50-64]	0,1042 [5,49] [0,16]	0,035 [6,58] [0,20]	0,1287 [9,82] [0,29]	0,0695 [6,37] [0,19]	0,1037 [12,43] [0,37]	0,1673 [20,37] [0,61]	0,0935 [7,52] [0,22]	0,0635 [3,88] [0,12]
	>64	0,0727 [3,43] [0,11]	0,0252 [4,23] [0,14]	0,0775 [5,30] [0,18]	0,0858 [7,04] [0,23]	0,116 [12,44] [0,41]	0,2552 [27,82] [0,93]	0,1644 [11,83] [0,39]	0,0694 [3,80] [0,13]
Luxemb.	**[16-24]**	0,3668 [10,97] [0,58]	0,0349 [3,72] [0,20]	0,0346 [1,50] [0,08]	0,0289 [1,50] [0,08]	0,0876 [5,96] [0,31]	0,1032 [7,13] [0,37]	0,406 [18,52] [0,97]	0,1251 [4,34] [0,23]
	[25-49]	0,0956 [5,89] [0,15]	0,0545 [11,95] [0,30]	0,1012 [9,03] [0,23]	0,0583 [6,24] [0,16]	0,105 [14,71] [0,37]	0,0719 [10,23] [0,26]	0,0936 [8,79] [0,22]	0,0613 [4,38] [0,11]
	[50-64]	0,0679 [4,09] [0,11]	0,0297 [6,37] [0,17]	0,0777 [6,77] [0,18]	0,0531 [5,55] [0,14]	0,1219 [16,68] [0,43]	0,1295 [18,00] [0,47]	0,0726 [6,66] [0,17]	0,0576 [4,02] [0,10]
	>64	0,0829 [4,65] [0,13]	0,0544 [10,86] [0,30]	0,0823 [6,68] [0,19]	0,0476 [4,64] [0,13]	0,1272 [16,21] [0,45]	0,2089 [27,06] [0,76]	0,0733 [6,26] [0,18]	0,0599 [3,90] [0,11]
Non EU15	**[16-24]**	1 [5,96] [1,57]	0 [0,00] [0,00]	0,1826 [1,58] [0,41]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,8174 [7,43] [1,96]	0,9798 [6,78] [1,78]
	[25-49]	0,4848 [9,05] [0,76]	0,0327 [2,18] [0,18]	0,1164 [3,15] [0,26]	0,1149 [3,73] [0,31]	0,1182 [5,01] [0,42]	0,2051 [8,84] [0,74]	0,4487 [12,76] [1,07]	0,4158 [9,00] [0,76]
	[50-64]	0,333 [6,79] [0,52]	0,0516 [3,74] [0,29]	0,15 [4,43] [0,34]	0,0325 [1,15] [0,09]	0,1649 [7,64] [0,59]	0,2631 [12,39] [0,95]	0,4282 [13,31] [1,02]	0,1527 [3,61] [0,28]
	>64	0,0995 [17,79] [0,16]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,199 [82,21] [0,72]	0 [0,00] [0,00]	0 [0,00] [0,00]
Portuguese	**[16-24]**	0,5529 [13,25] [0,87]	0,1518 [12,96] [0,85]	0,2847 [9,88] [0,65]	0,1299 [5,41] [0,35]	0,1089 [5,93] [0,39]	0,1021 [5,65] [0,37]	0,5053 [18,46] [1,21]	0,2701 [7,51] [0,49]
	[25-49]	0,3959 [9,86] [0,62]	0,068 [6,03] [0,38]	0,1467 [5,29] [0,33]	0,1136 [4,92] [0,31]	0,1365 [7,73] [0,49]	0,1898 [10,92] [0,69]	0,3227 [12,26] [0,77]	0,285 [8,24] [0,52]
	[50-64]	0,3001 [11,05] [0,47]	0,0224 [2,94] [0,13]	0,0686 [3,66] [0,16]	0,0579 [3,71] [0,16]	0,0978 [8,19] [0,35]	0,1526 [12,98] [0,55]	0,2357 [13,23] [0,56]	0,1189 [5,08] [0,22]
	>64	0,222 [3,69] [0,35]	0,2274 [13,46] [1,27]	0,085 [2,04] [0,19]	0,3125 [9,02] [0,85]	0,3125 [11,80] [1,11]	0,5213 [20,00] [1,89]	0,4516 [11,43] [1,08]	0,3697 [7,13] [0,67]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Table A.3.3a. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Civil Status	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Other EU15	**Divorced**	0,323 [7,79]* [0,43]**	0,0149 [1,45] [0,08]	0,2479 [8,11] [0,45]	0,0984 [12,86] [0,72]	0,0026 [0,30] [0,02]	0,1117 [8,78] [0,49]	0,0043 [1,37] [0,08]	0,0819 [9,85] [0,55]
	Never M	0,2214 [6,71] [0,30]	0,0305 [3,73] [0,17]	0,1011 [4,16] [0,18]	0,0139 [2,28] [0,10]	0,0095 [1,39] [0,06]	0,0183 [1,81] [0,08]	0,0159 [6,31] [0,28]	0,0123 [1,87] [0,08]
	Married	0,1531 [8,05] [0,21]	0,0145 [3,08] [0,08]	0,0696 [4,97] [0,13]	0,0138 [3,92] [0,10]	0,0041 [1,04] [0,03]	0,0046 [0,79] [0,02]	0,0002 [0,14] [0,00]	0,0051 [1,35] [0,03]
	Separated	0,339 [17,77] [0,46]	0,0298 [6,29] [0,16]	0,0451 [3,21] [0,08]	0,0159 [4,51] [0,12]	0,0069 [1,76] [0,05]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]
	Widower	0,2699 [10,42] [0,36]	0,0012 [0,18] [0,01]	0,0531 [2,78] [0,10]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,0013 [0,16] [0,01]	0 [0,00] [0,00]	0,0496 [9,54] [0,33]
Luxemb.	**Divorced**	0,1942 [6,74] [0,26]	0,0194 [2,71] [0,11]	0,186 [8,75] [0,34]	0,0203 [3,81] [0,15]	0,0043 [0,72] [0,03]	0,0286 [3,23] [0,13]	0,0173 [7,85] [0,30]	0,0019 [0,33] [0,01]
	Never M	0,2031 [6,98] [0,27]	0,0166 [2,31] [0,09]	0,1453 [6,77] [0,27]	0,0422 [7,86] [0,31]	0,0044 [0,72] [0,03]	0,0291 [3,26] [0,13]	0 [0,00] [0,00]	0,032 [5,48] [0,21]
	Married	0,0676 [5,86] [0,09]	0,0079 [2,77] [0,04]	0,0366 [4,31] [0,07]	0,0076 [3,59] [0,06]	0,0029 [1,20] [0,02]	0,0125 [3,55] [0,06]	0 [0,00] [0,00]	0,001 [0,43] [0,01]
	Separated	0,4295 [27,17] [0,58]	0 [0,00] [0,00]	0,1615 [13,86] [0,29]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,0388 [8,00] [0,17]	0 [0,00] [0,00]	0,0067 [2,13] [0,05]
	Widower	0,102 [5,53] [0,14]	0,0146 [3,19] [0,08]	0,0523 [3,85] [0,10]	0,0113 [3,33] [0,08]	0,0006 [0,15] [0,00]	0,0086 [1,52] [0,04]	0 [0,00] [0,00]	0,0086 [2,32] [0,06]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Table A.3.3b. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Civil Status	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
		0,2386	0,0714	0,2466	0,0634	0,1861	0,1472	0,1016	0,1175
	Divorced	[5,86]*	[6,25]	[8,77]	[2,71]	[10,39]	[8,35]	[3,81]	[3,35]
		[0,33]**	[0,35]	[0,49]	[0,15]	[0,58]	[0,47]	[0,21]	[0,19]
		0,3258	0,0427	0,1629	0,1419	0,1477	0,174	0,345	0,0852
	Never M	[10,06]	[4,70]	[7,28]	[7,62]	[10,37]	[12,41]	[16,24]	[3,05]
		[0,45]	[0,21]	[0,32]	[0,34]	[0,46]	[0,55]	[0,72]	[0,14]
		0,1111	0,0452	0,1425	0,0834	0,0942	0,1272	0,137	0,0772
Other EU15	**Married**	[5,96]	[8,64]	[11,07]	[7,77]	[11,48]	[15,76]	[11,20]	[4,80]
		[0,15]	[0,22]	[0,28]	[0,20]	[0,29]	[0,40]	[0,29]	[0,12]
		0,0749	0,0006	0,0867	0,0867	0,0509	0,0353	0,3909	0,0838
	Separated	[4,00]	[0,11]	[6,71]	[8,05]	[6,18]	[4,36]	[31,84]	[5,19]
		[0,10]	[0,00]	[0,17]	[0,21]	[0,16]	[0,11]	[0,82]	[0,13]
		0,0594	0,0218	0,0874	0,137	0,1533	0,294	0,1781	0,1327
	Widower	[2,34]	[3,06]	[4,98]	[9,37]	[13,71]	[26,72]	[10,68]	[6,06]
		[0,08]	[0,11]	[0,17]	[0,33]	[0,48]	[0,93]	[0,37]	[0,21]
		0,1539	0,046	0,1063	0,0828	0,1664	0,2095	0,154	0,1305
	Divorced	[5,44]	[5,79]	[5,44]	[5,08]	[13,36]	[17,10]	[8,30]	[5,35]
		[0,21]	[0,22]	[0,21]	[0,20]	[0,52]	[0,66]	[0,32]	[0,21]
		0,1912	0,0669	0,0939	0,0568	0,1631	0,1677	0,2198	0,1262
	Never M	[6,69]	[8,34]	[4,76]	[3,45]	[12,97]	[13,56]	[11,73]	[5,13]
		[0,26]	[0,33]	[0,19]	[0,14]	[0,51]	[0,53]	[0,46]	[0,20]
		0,0445	0,0393	0,0802	0,0484	0,0944	0,0827	0,0344	0,0366
Luxemb.	**Married**	[3,93]	[12,40]	[10,26]	[7,44]	[18,97]	[16,89]	[4,63]	[3,76]
		[0,06]	[0,19]	[0,16]	[0,12]	[0,29]	[0,26]	[0,07]	[0,06]
		0,2009	0,0252	0,0489	0,0206	0,0333	0,024	0,0651	0,1121
	Separated	[12,95]	[5,78]	[4,56]	[2,31]	[4,88]	[3,57]	[6,40]	[8,39]
		[0,28]	[0,12]	[0,10]	[0,05]	[0,10]	[0,08]	[0,14]	[0,18]
		0,0783	0,0603	0,1066	0,0521	0,1186	0,2108	0,0799	0,0287
	Widower	[4,33]	[11,88]	[8,53]	[5,00]	[14,89]	[26,91]	[6,73]	[1,84]
		[0,11]	[0,29]	[0,21]	[0,12]	[0,37]	[0,67]	[0,17]	[0,05]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B.

Table A.3.3c. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Civil Status	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Non EU15	**Divorced**	0,1984 [5,36]* [0,27]**	0,1247 [13,57] [0,68]	0,3231 [11,83] [0,59]	0 [0,00] [0,00]	0,0312 [4,08] [0,20]	0,1006 [8,85] [0,44]	0 [0,00] [0,00]	0 [0,00] [0,00]
	Never M	0,5844 [10,37] [0,79]	0,0096 [0,69] [0,05]	0,1918 [4,62] [0,35]	0,0838 [8,06] [0,61]	0 [0,00] [0,00]	0,0167 [0,97] [0,07]	0,0318 [7,37] [0,56]	0,0351 [3,10] [0,24]
	Married	0,5132 [10,07] [0,69]	0,0463 [3,66] [0,25]	0,237 [6,31] [0,43]	0,0186 [1,98] [0,14]	0,0168 [1,60] [0,11]	0,0762 [4,87] [0,33]	0,0217 [5,56] [0,38]	0,1325 [12,96] [0,89]
	Separated	0,8884 [8,54] [1,20]	0 [0,00] [0,00]	0,0681 [0,89] [0,12]	0,6784 [35,36] **[4,95]**	0 [0,00] [0,00]	0,7901 [24,78] **[3,47]**	0 [0,00] [0,00]	0,1116 [5,35] [0,75]
	Widower	0 [0,00] [0,00]	0 [0,00] [0,00]	0,6307 [28,37] **[1,15]**	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]
Portuguese	**Divorced**	0,1995 [5,48] [0,27]	0,0374 [4,14] [0,20]	0,1256 [4,68] [0,23]	0,0108 [1,60] [0,08]	0,0264 [3,51] [0,17]	0,0784 [7,02] [0,34]	0,0312 [11,19] [0,55]	0,0546 [7,48] [0,37]
	Never M	0,3284 [7,72] [0,44]	0,0933 [8,84] [0,51]	0,183 [5,83] [0,33]	0,042 [5,35] [0,31]	0,0417 [4,74] [0,27]	0,0728 [5,58] [0,32]	0,0084 [2,59] [0,15]	0,0272 [3,19] [0,18]
	Married	0,3969 [10,57] [0,53]	0,013 [1,40] [0,07]	0,1867 [6,74] [0,34]	0,013 [1,87] [0,09]	0,0082 [1,05] [0,05]	0,0933 [8,10] [0,41]	0,0055 [1,92] [0,10]	0,0088 [1,16] [0,06]
	Separated	0,2854 [4,04] [0,38]	0,0196 [1,12] [0,11]	0,4504 [8,65] [0,82]	0,0081 [0,62] [0,06]	0,0041 [0,28] [0,03]	0,0081 [0,37] [0,04]	0 [0,00] [0,00]	0,0113 [0,80] [0,08]
	Widower	0,3112 [8,90] [0,42]	0 [0,00] [0,00]	0,1807 [7,01] [0,33]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,1356 [12,64] [0,60]	0 [0,00] [0,00]	0,0134 [1,92] [0,09]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Table A.3.3d. ***UPI by attribute and by nationality and sexe and their relative contributions to*** μ_B^{kb} ***et*** μ_B

Nationality	Civil Status	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Non EU15	**Divorced**	0,2644 [7,28]* [0,36]**	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,0978 [6,12] [0,30]	0,0978 [6,22] [0,31]	0,3231 [13,55] [0,68]	0,725 [23,15] [1,15]
	Never M	0,6506 [11,76] [0,89]	0,016 [1,03] [0,08]	0,0983 [2,57] [0,20]	0,0912 [2,87] [0,22]	0,0991 [4,07] [0,31]	0,2917 [12,19] [0,92]	0,8027 [22,13] **[1,68]**	0,3915 [8,21] [0,62]
	Married	0,417 [8,34] [0,57]	0,05 [3,56] [0,24]	0,1148 [3,32] [0,23]	0,1027 [3,57] [0,24]	0,1523 [6,92] [0,47]	0,211 [9,74] [0,67]	0,3709 [11,30] [0,78]	0,2687 [6,23] [0,43]
	Separated	0,4231 [4,15] [0,58]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0 [0,00] [0,00]	0,2535 [5,74] [0,80]	0,3216 [4,80] [0,67]	0,9128 [10,38] **[1,45]**
	Widower	0,1642 [5,55] [0,23]	0 [0,00] [0,00]	0,7786 [38,10] **[1,55]**	0,1479 [8,69] [0,35]	0 [0,00] [0,00]	0,1397 [10,91] [0,44]	0,1479 [7,62] [0,31]	0,0195 [0,76] [0,03]
Portugais	**Divorced**	0,4286 [11,99] [0,59]	0,0175 [1,74] [0,09]	0,0642 [2,60] [0,13]	0,0639 [3,11] [0,15]	0,1492 [9,49] [0,47]	0,2093 [13,53] [0,66]	0,11 [4,69] [0,23]	0,2381 [7,73] [0,38]
	Never M	0,4874 [11,67] [0,67]	0,0329 [2,81] [0,16]	0,1592 [5,52] [0,32]	0,1014 [4,22] [0,24]	0,1435 [7,81] [0,45]	0,1579 [8,73] [0,50]	0,295 [10,77] [0,62]	0,1668 [4,63] [0,27]
	Married	0,3408 [9,25] [0,47]	0,0697 [6,74] [0,34]	0,1252 [4,92] [0,25]	0,1226 [5,78] [0,29]	0,1307 [8,06] [0,41]	0,1851 [11,60] [0,59]	0,3135 [12,97] [0,66]	0,2499 [7,87] [0,40]
	Separated	0,72 [10,38] [0,99]	0,3 [15,41] [1,47]	0,3365 [7,03] [0,67]	0,0123 [0,31] [0,03]	0,1895 [6,21] [0,59]	0,4851 [16,16] [1,54]	0,8065 [17,73] [1,69]	0,6515 [10,90] [1,04]
	Widower	0,1103 [3,21] [0,15]	0 [0,00] [0,00]	0,1629 [6,87] [0,32]	0,1695 [8,58] [0,40]	0,1495 [9,90] [0,47]	0,1382 [9,30] [0,44]	0,3804 [16,90] [0,80]	0,4367 [14,77] [0,70]

[.]*: relative contribution to μ_B^{kb}

[.]**: relative contribution to μ_B

Appendix A.4. The α-cut multi-level decomposition

Table A.4.1: ***MPI by sub-group of population and their relative contribution to MPI***

Nationality	Percentile	μ_B^{kb}	Relative contributions to μ_B
Others EU15	**10%**	0,2219	9,13
	10-25%	0,104	6,44
	25-50%	0,0468	6,01
	50-100%	0,0065	1,71
Non EU15	**10%**	0,242	2,78
	10-25%	0,1131	1,41
	25-50%	0,0532	0,73
	50-100%	0,0138	0,19

Table A.4.2a: ***UPI by attribute and by sub-group of population***

Nationality	Percentile	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
Other EU15	**10%**	0,5545	0,2761	0,3776	0,3764	0,4851	0,396	0,5071	0,1099
		[4,78]*	[**8,48**]	[4,71]	[5,64]	[**9,51**]	[7,89]	[6,67]	[3,03]
		[0,67]**	[1,19]	[0,66]	[0,79]	[1,33]	[1,11]	[0,93]	[0,42]
	10-25%	0,2636	0,129	0,3673	0,2902	0,398	0,433	0,3266	0,0606
		[4,85]	[8,46]	[**9,79**]	[9,29]	[**16,65**]	[**18,41**]	[9,17]	[3,57]
		[0,32]	[0,56]	[0,64]	[0,61]	[1,09]	[1,21]	[0,60]	[0,23]
	25-50%	0,1716	0,0214	0,1607	0,1156	0,1124	0,2111	0,3997	0,0103
		[7,02]	[3,12]	[**9,52**]	[8,22]	[10,45]	[**19,94**]	[**24,92**]	[1,35]
		[0,21]	[0,09]	[0,28]	[0,24]	[0,31]	[0,59]	[0,74]	[0,04]
	50-100%	0,0814	0	0,0639	0	0	0,0143	0,0004	0
		[**23,87**]	[0,00]	[**27,14**]	[0,00]	[0,00]	[9,70]	[0,18]	[0,00]
		[0,10]	[0,00]	[0,11]	[0,00]	[0,00]	[0,04]	[0,00]	[0,00]
Non EU15	**10%**	0,596	0,0907	0,1559	0,1039	0,1639	0,3755	0,6605	0,4293
		[4,71]	[2,56]	[1,78]	[1,43]	[2,95]	[6,86]	[7,96]	[10,86]
		[0,72]	[0,39]	[0,27]	[0,22]	[0,45]	[1,05]	[1,22]	[1,66]
	10-25%	0,6165	0,0629	0,2643	0,2768	0,2265	0,3859	0,6104	0,0191
		[10,43]	[3,79]	[6,48]	[8,14]	[8,71]	[15,09]	[15,75]	[1,03]
		[0,74]	[0,27]	[0,46]	[0,58]	[0,62]	[1,08]	[1,12]	[0,07]
	25-50%	0,4256	0,0029	0,0866	0	0,1283	0,0716	0,5175	0
		[15,31]	[0,37]	[4,51]	[0,00]	[10,49]	[5,95]	[28,38]	[0,00]
		[0,51]	[0,01]	[0,15]	[0,00]	[0,35]	[0,20]	[0,95]	[0,00]
	50-100%	0,1636	0	0	0	0	0,079	0	0
		[22,74]	[0,00]	[0,00]	[0,00]	[0,00]	[25,35]	[0,00]	[0,00]
		[0,20]	[0,00]	[0,00]	[0,00]	[0,00]	[0,22]	[0,00]	[0,00]

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

Table A.4.2b: ***UPI by attribute and by sub-group of population***

Nationality	Percentile	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
Other EU15	**10%**	0,0485	0,1764	0,731	0,2011	0,5944	0,246	0,0476	0,3364
		[5,36]*	[7,44]	[6,19]	[6,86]	[6,82]	[**11,28**]	[1,95]	[3,37]
		[0,75]**	[1,04]	[0,87]	[0,96]	[0,96]	[1,58]	[0,27]	[0,47]
	10-25%	0	0,0319	0,3835	0,0052	0,1565	0,016	0,0069	0,1699
		[0,00]	[2,87]	[6,93]	[0,38]	[3,84]	[1,57]	[0,60]	[3,63]
		[0,00]	[0,19]	[0,45]	[0,02]	[0,25]	[0,10]	[0,04]	[0,24]
	25-50%	0	0	0,2056	0	0,0744	0	0	0,0667
		[0,00]	[0,00]	[8,25]	[0,00]	[4,05]	[0,00]	[0,00]	[3,17]
		[0,00]	[0,00]	[0,24]	[0,00]	[0,12]	[0,00]	[0,00]	[0,09]
	50-100%	0	0	0,0722	0	0,0121	0	0	0,0399
		[0,00]	[0,00]	[**20,80**]	[0,00]	[4,73]	[0,00]	[0,00]	[13,58]
		[0,00]	[0,00]	[0,09]	[0,00]	[0,02]	[0,00]	[0,00]	[0,06]
Non EU15	**10%**	0,0905	0,3758	0,849	0,1773	0,629	0,2629	0,0493	0,5999
		[9,17]	[14,54]	[6,59]	[5,55]	[6,62]	[11,06]	[1,85]	[5,51]
		[1,40]	[2,22]	[1,01]	[0,85]	[1,01]	[1,69]	[0,28]	[0,84]
	10-25%	0	0,069	0,6159	0,0036	0,2293	0,0137	0,0026	0,3965
		[0,00]	[5,71]	[10,23]	[0,24]	[5,17]	[1,23]	[0,21]	[7,79]
		[0,00]	[0,41]	[0,73]	[0,02]	[0,37]	[0,09]	[0,02]	[0,56]
	25-50%	0	0	0,4307	0	0,1604	0	0,0058	0,2659
		[0,00]	[0,00]	[15,21]	[0,00]	[7,68	[0,00]	[0,99]	[11,10]
		[0,00]	[0,00]	[0,51]	[0,00]	[0,26]	[0,00]	[0,03]	[0,37]
	50-100%	0	0	0,1959	0	0	0	0	0,1561
		[0,00]	[0,00]	[26,73]	[0,00]	[0,00]	[0,00]	[0,00]	[25,18]
		[0,00]	[0,00]	[0,23]	[0,00]	[0,00]	[0,00]	[0,00]	[0,22]

[.]*: relative contribution to μ_B^k

[.]**: relative contribution to μ_B.

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