Session Number: Poster Session 2
Time: Thursday, August 26, PM

Measuring and accounting for the 'deprivation gap' of Portuguese immigrants in Luxembourg

María Noel Pi Alperin, Philippe Van Kerm, and Vincent Hildebrand

For additional information please contact:

Name: Philippe Van Kerm
Affiliation: CEPS/INSTEAD and ISER, University of Essex

Email Address: philippe.vankerm@ceps.lu

This paper is posted on the following website: http://www.iariw.org

Measuring and accounting for the 'deprivation gap' of Portuguese immigrants in Luxembourg[*]

María Noel Pi Alperin

CEPS/INSTEAD and
LAMETA, Université Montpellier I
Email: MariaNoel.PiAlperin@ceps.lu

Philippe Van Kerm

CEPS/INSTEAD
and ISER, University of Essex
Email: philippe.vankerm@ceps.lu

Vincent Hildebrand

Glendon College, York University
and CEPS/INSTEAD
Email: vincent@econ.yorku.ca

July 2010 - **Preliminary version**

Abstract

Portuguese immigrants constitute the largest foreign community in Luxembourg. As many foreigners elsewhere in industrialized countries, this community is consistently reported to record lower economic achievements than nationals (or than immigrants from neighbouring countries) as measured by earnings and employment, by income, or even by indicators of satisfaction of financial conditions. This paper takes a new look at the relative well-being of Portuguese immigrants in Luxembourg by looking at non -monetary, or direct indicators of deprivation based on the so-called fuzzy set approach to multidimensional poverty measurement (Cerioli and Zani, 1990, Lemmi and Betti, 2006). The paper not only documents deprivation differentials between immigrants and natives, but also models the association between deprivation indicators and income and population characteristics (with respect to household demographics, human capital or employment) in order to shed light on the sources of differentials in our direct measure of deprivation. In particular, we measure how much income differentials explain differences in direct outcomes. The objective of the paper is to point out explanations for this gap by constructing counterfactual distributions of deprivation indicators using variations on reweighting techniques popularized by DiNardo, Fortin, and Lemieux (1996).

1 Introduction

Portuguese immigrants form the largest foreign community in Luxembourg. As many foreigners elsewhere in industrialized countries, this community is consistently reported to record lower economic achievements than nationals (or, in the case of Luxembourg, than immigrants from neighboring countries) as measured by earnings and employment (Langers, 2006), by income (Hartmann-Hirsch, 2007), or even by indicators of satisfaction with financial conditions (Van Kerm and Villeret, 2007). This paper takes a new look at the relative well-being of Portuguese immigrants in Luxembourg by looking at non-monetary, or 'direct' indicators of deprivation. It has been shown that non-monetary indicators and income are not perfect correlates. So there is interest in trying to explain which is the real relation between these two deprivation components.

Our direct measure of deprivation is based on the approach known as the 'fuzzy set approach' to multidimensional poverty measurement (Cerioli and Zani, 1990, Lemmi and Betti, 2006).[1] This multidimensional method allows measuring a deprivation index (for each household and for the entire population) including different dimensions of poverty and evaluating the different degrees of deprivation of each attribute.

The paper not only documents differentials between immigrants and natives, but also models the association between deprivation indicators and income and population characteristics (with respect to household demographics, human capital or employment) in order to shed light on the sources of differentials in our direct measure of deprivation. In particular, we measure how much income differentials explain differences in direct outcomes.

To set the scene, Figure 1 describes the cumulative distribution functions of our direct indicators of deprivation for Portuguese immigrants and natives. Details on how these indicators are constructed are only given *supra*, but the unfavourable position of Portuguese immigrants is already directly clear from the configuration of these curves. The objective of the paper is to point to explanations for this gap. Is it because incomes of Portuguese immigrants are lower? Can we track these lower incomes in human capital and employment differentials? What is the role for household demographics? Or is there really further differentials in direct deprivation indicators going beyond income differentials? Answers to these questions are provided by constructing counterfactual distributions of deprivation indicators using variations on reweighting techniques popularized by DiNardo, Fortin, and Lemieux (1996).

---

[1]This is but one of a number of alternative approaches to the measurement of multidimensional poverty (See Deutsch and Silber (2005)).
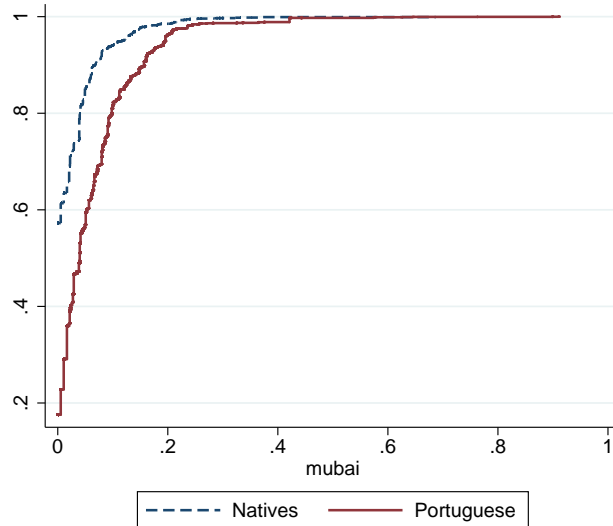
Fig. 1. The cumulative distribution functions of deprivation

This paper is organized as follows: *Section 2* presents the basic notions of the approaches used for the construction of our direct measures of deprivation; *Section 3* develops the technique for decomposing deprivation differentials between Portuguese immigrants and natives living in Luxembourg using the reweighting methodologies proposed by DiNardo, Fortin, and Lemieux (1996); *Section 4* describes the PSELL-3 database used in this paper and the principals attributes selected to study non-monetary deprivation; results are presented in *Section 5*. Finally, *Section 6* is devoted to the concluding remarks.

2   Direct measures of deprivation

Direct measures of deprivation summarize multiple directly observable indicators of living conditions (such as the possession of particular goods, housing conditions, the absence of particular financial difficulties, etc.).

The technique adopted in this paper to aggregate the multiple dimensions is based on the 'fuzzy set approach'. This approach allows computing aggragated indicators taking into account the different intensity levels of deprivation of each individual in each dimension. This technique also allows computing multidimensional indicators for each studied unit.[2]

Let the number of deprivation units, say households, in a population be N, $(i = 1, ..., N)$, and the number of selected attributes to study multidimensional depri-

---

[2]See for instance Cerioli and Zani (1990) who developed the first multidimensional method based on fuzzy set theory.

vation be M, ($j = 1, ..., M$). Then, we can define B as the sub-set of households such that any i presents some degree of deprivation in at least one of the M attributes.

Let x_{ij} be the quatity of the jth attribute possessed by the ith household. In particular:

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

Then, it is possible to aggregate the multiple attributes as a weighted average of x_{ij}:

$$\phi_i = \frac{\sum_{j=1}^{M} x_{ij} w_j}{\sum_{j=1}^{M} w_j} \tag{1}$$

where w_j is the weight attached to the jth attribute and ϕ_i is the multidimensional deprivation index of the ith household. In other words, ϕ_i represents the degree of membership of the ith household to B. In particular:

- $\phi_i = 1$ if i is totally poor in the M attributes;
- $\phi_i = 0$ if i is completely non-poor in the M attributes;
- $0 < \phi_i < 1$ if i is partially or totally deprived in some attributes but not fully deprived in all of them.

The weight w_j attached to the jth attribute used in this paper is a variation of the weight proposed by **?**. It takes into account the intensity of deprivation of j, and it limits the influence of those indicators that are highly correlated. **?** defined the weight of any attribute as follows:

$$w_j = w_j^a * w_j^b \tag{2}$$

where w_j^a only depends on the distribution of the jth attribute, whereas w_j^b depends on the correlation between j and the others dimensions.

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

$$w_j^a = \left[\frac{\sum_{i=1}^{N} (x_{ij} - \bar{x}_j)^2}{N} \right]^{1/2} \cdot \left[\frac{\sum_{i=1}^{N} x_{ij}}{N} \right]^{-1} \tag{3}$$

The weights w_j^b are computed as follows:

$$w_j^b = \left[1 + \sum_{j'=1}^{m} \rho_{j,j'} | \rho_{j,j'} < \rho_H \right]^{-1} \cdot \left[\sum_{j'=1}^{m} \rho_{j,j'} | \rho_{j,j'} \geq \rho_H \right]^{-1} \tag{4}$$

where, in our case, $\rho_{j,j'}$ is the polychoric correlation [3]. In the first factor of the

---

[3]The polychoric correlation was proposed by Pearson and Pearson (1922). This correlation is more appropriated when using proxies of household deprivation variables with a small number of clear response categories between the two indicators (Kolenikov and Angeles, 2009)

equation, the sum is taken over all the indicators whose correlation with the jth attribute is less than 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.

3   Decomposing deprivation differentials

This section relies on a previos paper of Cobb-Clark and Hildebrand (2006). We begin by defining I to be a dummy variable indicating group membership, which for convenience we shall refer to as nationality status. Further, ϕ_B is the deprivation level and z is a vector of deprivation determinants. Each observation in our data is then drawn from some joint density function, f, over (ϕ_B, z, I). The marginal distribution of deprivation for group l can be expressed as follows:

$$
\begin{aligned}
f^l(\phi_B) \equiv f(\phi_B | I = l) &= \int_z f(\phi_B, z | I = l) dz \\
&= \int_z f(\phi_B | z, I = l) f_z(z | I = l) dz
\end{aligned}
$$

where l equals 1 for Portuguese immigrants and 0 for natives from Luxembourg. This equation expresses the marginal deprivation distribution for group l as the product of two conditional distributions (see Greene, 1997 and DiNardo et al., 1996).

In order to consider the source of disparities in our direct deprivation measures of the two groups, we will partition the vector of households deprivation determinants (z) into four components: (*i*) income (y); (*ii*) employment (e); (*iii*) human capital (c); and (*iv*) household demographic composition (d). These factors were selected because they are potential explanations for Portuguese immigrants' relatively hight level of deprivation. Thus, $z = (y, e, c, d)$. Given this partitioning and the same logic as behind previous equation, we can write the deprivation distribution of group l as follows:

$$
\begin{aligned}
f^l(\phi_B) \equiv f(\phi_B | I = l) &= \int_y \int_e \int_c \int_d f(\phi_B, y, e, c, d | I = l) dy\, de\, dc\, dd \\
&= \int_y \int_e \int_c \int_d f(\phi_B | y, e, c, d, I = l) f_{y|ecd}(y | e, c, d, I = l) \\
&\quad f_{e|cd}(e | c, d, I = l) f_{c|d}(c | d, I = l) f_d(d | I = l) dy\, de\, dc\, dd
\end{aligned}
$$

Equation 5 involves five conditional densities. The first term, that is f, is the conditional deprivation distribution given our deprivation determinants (z) and group membership (I), while the second term ($f_{y|e,c,d}$) is the conditional income distribution given employment, capital, demographic composition and group membership. Similarly, ($f_{e|c,d}$) and ($f_{c|d}$) are the conditional employment and human capital distributions respectively. Finally, f_d captures the distribution of demographic

composition conditional on group membership. When the conditional expectation is linear in its relevant arguments, these conditional densities are closely related to regression functions (Butcher and DiNardo, 2002) allows us to consider relationships which closely parallel income, employment and human capital regressions and are of inherent interest to us. Consequently, we will only consider decompositions based on deprivation distributions as given by Equation 5.

Expressing the deprivation distributions as we have in Equation 11 leads quite naturally to a series of interesting counterfactual deprivation distributions. In particular, we can define the deprivation distribution (f^d) that would prevail if natives retained their own conditional distributions of deprivation, human capital, employment and income, but had the same conditional distribution of demographic composition (f_d) as the Portuguese immigrants. Specifically,

$$
\begin{aligned}
f^{dcey}(\phi_B) &= \int_y \int_e \int_c \int_d f(\phi_B|y,e,c,d,I=0) f_{y|ecd}(y|e,c,d,I=0) \\
&\quad f_{e|cd}(e|c,d,I=0) f_{c|d}(c|d,I=0) f_d(d|I=1) dy\,de\,dc\,dd
\end{aligned}
$$

Equation 5 answers the following question: what would the natives deprivation distribution look like if they faced their own conditional deprivation distribution, income, employment and human capital characteristics but otherwise had the same conditional distribution of demographic characteristics as the Portuguese immigrants? This can be compared to another deprivation distribution (f^{dc}) that would result if natives retained their own conditional distributions of deprivation employment and income, but had the same conditional human capital and demographic distributions as the comparison group. Similarly, f^{dce} and f^{dcey} are the counterfactuals deprivation distributions that result when natives retained their own conditional distributions of deprivation and income, their own conditional deprivation distribution respectively.

Using these counterfactual distributions, we can decompose the deprivation gap between natives and Portuguese immigrants in the following way:

$$
f^0 - f^1 = [f^0 - f^d] + [f^d - f^{dc}] + [f^{dc} - f^{dce}] + [f^{dce} - f^{dcey}] + [f^{dcey} - f^1] \quad (5)
$$

where the first right-hand-side term captures the effect of disparities in conditional demographic distributions on the deprivation gap (d), the second term reflects the effect of differences in human capital levels (c), while the third and fourth terms capture the effects of employment levels (e) and the income levels (y) respectively. Finally, the fifth term represents the unexpleind component (u). In order to implement the decomposition given in Equation 5 it is necessary to have estimates of counterfactuals distributions (f^d) through (f^{dcey}). DiNardo, Fortin, and Lemieux (1996) provide a method for obtaining these and other couterfactual distributions

by reweighting, in our case, the deprivation distribution of the natives from Luxembourg. Specifically, our first counterfactual deprivation distribution can be constructed as follows:

$$f^{dcey}(\phi_B) = \int_y \int_e \int_c \int_d f(\phi_B|y,e,c,d,I=0)f_{y|ecd}(y|e,c,d,I=0)$$
$$f_{e|cd}(e|c,d,I=0)f_{c|d}(c|d,I=0)\psi_d f_d(d|I=0)dydedcdd$$

where

$$\psi_d = \frac{f_d(d|I=1)}{f_d(d|I=0)} \qquad (6)$$

In effect, the deprivation distribution of the comparison group is simply reweighted by the ratio of conditional income distributions of the two groups. Following Di-Nardo, Fortin, and Lemieux (1996), we can write the reweighting factor required to produce the counterfactual deprivation distribution (f^{dcey}) as:

$$\psi_d = \frac{P(I=1|d)P(I=0)}{P(I=0|d)P(I=1)} \qquad (7)$$

Counterfactual distributions f^{dc}, f^{dce} and f^{dcey} are constructed similarly.

An estimate of reweighting function $\psi_d(d)$ can be obtained by estimating the conditional probability $P(I=1|d)$. A standard model for estimating this conditional probability is the probit model:

$$P(I=1|d) = P(\epsilon > -\beta_i' H(d)) = 1 - \Phi(-\beta_i' H(d)) \qquad (8)$$

where $\Phi(.)$ is the cumulative normal distribution and $H(d)$ is a vector of covariates that is a function of d.

4   Data

The database used in this study comes from the survey Panel Socio-Economique *Liewen zu Lëtzebuerg* (PSELL-3) which is the Luxemburgish part of the new EU program on *Community Statistics on Income and Living Conditions* (EU-SILC). This survey is realized with individuals and households living in the *Grand-Duché* in order to learn about their condition of existence. It serves for constructing and for testing social and economic indicators and for estimating the impact of the economic and social policies on the conditions of existence of the population. It includes information about life conditions as income, education, health, labor market characteristics, transport, and savings in Luxembourg.

This survey has been performed every year since 2003 and it is representative of the population living in private households in Luxembourg. The application covers 5720 households in 2006.

Our estimation sample includes 1837 Portuguese immigrants and 3883 natives from Luxembourg households. We only consider those households where the reference person has between 16 and 64 years old. Individuals of more than 64 years old were eliminated from our sample because they are not a representative group of the Portuguese immigrants population (see Table 1).

Table 1. Descriptive statistics by nationality

	Luxemburgish	Portuguese
Gender		
- Men	67,05%	74,68%
- Woman	32,95%	25,32%
Age		
- <16	17,59%	33,23%
- 16-24	10,80%	12,20%
- 25-49	32,93%	47,32%
- 50-64	22,76%	6,28%
- >64	15,93%	0,97%
Household demographic composition		
- Couples without any children	36,75%	16,71%
- Isolated person	6,88%	3,27%
- Households with one or two children	45,61%	65,32%
- Households with three or more children	10,76%	14,70%
Employment		
- The non-working population	15,94%	5,93%
- One active person in the household	40,56%	38,87%
- More than one active person in the household	43,50%	55,20%
Education level of reference person		
- Between 25 and 49 years old and without any formation	15,01%	69,68%
- Between 40 and 64 years old and without any formation	13,47%	9,91%
- Between 25 and 49 years old with secondary school	25,14%	12,57%
- Between 40 and 64 years old with secondary school	18,18%	0,33%
- Less than 25 years old with post-secondary school	1,18%	4,14%
- Between 25 and 49 years old with post-secondary school	16,35%	2,99%
- Between 40 and 64 years old with post-secondary school	10,66%	0,38%

Source: PSELL-3, 2006.

Table 1 reports some descriptive statistics for Portuguese immigrants and natives from Luxembourg. Then, it is possible to notice that there are more immigrants without any formation (79,59%) than natives (28,48%). Table 1 also reveals that the labor offer of the Portuguese immigrants is more important than the natives one, with 94,07% and 84,06% of the households with at least one active person, respectively. Finally, there are also important differences in household demographic composition between these two groups of population. Hence, more than 80% of the immigrants households have at least one child in the household against 56,37% of the natives ones.

4.1 The selected dimensions to study non-monetary deprivation

In addition to the level of monetary income, the standard of living of households, or persons, can be studied looking at the non-monetary deprivation dimensions such as housing conditions, possession of durable goods, the general financial situation, and others.

The two principal criteria that guided the selection of the non-monetary dimensions, in this paper, are not only based on a group of items adopted in various European publications, but also by the information provided by the PSELL-3 data for year 2006. Then, total non-monetary deprivation can be described by a host of indicators related to the enforced lack of a combination of items depicting material living conditions: basic non-monetary deprivation, secondary non-monetary deprivation and housing facilities and deterioration.

The basic non-monetary deprivation concerns the lack of ability to afford most basic requirements as:

- the capacity to face unexpected expenses;
- eating meat or fish every second day (if the households wanted to);
- paying for a weeks annual holiday away from home;
- keeping home (household's principal accommodation) adequately warm;
- the inability to meet scheduled payment such as mortgage payments, accommodation or hire purchase installments.

The secondary non-monetary deprivation includes enforced lack of widely desired possessions (enforced means that the lack of possession is due to a lack of financial resources):

- to have a computer;
- to have a dishwasher;
- to have a car or van for private use.

Finally, housing 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:

- the household size and dimension (in square meters) of the household residence;
- having a leaky roof;
- having damp walls, windows or grounds;
- having rot in walls, windows or grounds;
- having non-hermetic windows and doors;
- do not have double glazing windows;

- having an outdoor space.[4]

4.2 Selected variables for decomposing deprivation differentials

As it was explained in previous section, in order to study the source of disparities in our direct deprivation measures of Portuguese immigrants and natives in Luxembourg, we had partitioned the vector of households deprivation determinants (z) into four potential explanations for Portuguese immigrants' relatively low level of deprivation: income (y); employment (e); human capital (c); and household demographic composition (d).

The income determinant is constructed as the ratio: disposable income/the number of units of consumption[5].

The employment determinant is constructed as:
- the non-working population;[6]
- one active person in the household;[7]
- more than one active person in the household.[8]

The education level of reference person determinant is constructed as:
- head of household aged with less than 25 years old;[9]
- head of household aged between 25 and 49 years old;[10]
- head of household aged between 49 and 64 years old.[11]

The household demographic composition determinant consider:

---

[4]Appendix 1 presents the degree of membership and description of the selected attributes.

[5]The number of units of consumption are defined as: (number of persons with 13 years old or less*0,3)+(((number of persons with 14 years old or more)-1))*0,5)+1.

[6]Regrouping: particular cases, neither pensioners nor active persons; isolated pensioner; one pensioner with other non active persons; two pensioners with other non active persons.

[7]Regrouping: isolated active person; monoactive person with other persons but without pensioner(s); monoactive person with other persons but with pensioner(s).

[8]Regrouping: household of two persons or more, all active persons; household with three persons or more and at least two active persons but without pensioner(s); household with three persons or more and at least two active persons and at least one pensioner.

[9]Regrouping: individuals without any formation, nor primary or secondary school; individuals with secondary school, and individuals with post-secondary school.

[10]Regrouping: individuals without any formation, nor primary or secondary school; individuals with secondary school, and individuals with post-secondary school.

[11]Regrouping: individuals without any formation, nor primary or secondary school; individuals with secondary school, and individuals with post-secondary school.

- couples without children;
- isolated person;
- households with one or two children;
- households with three or more children.

5 Accounting for the 'deprivation gap' between natives and Portuguese immigrants

The distribution of individual deprivation indicators, namely ϕ_i, is typically peaked at 0 (individuals experiencing deprivation in none of the attributes observed) and is therefore not usefully represented by its probability distribution function. The cumulative distribution functions is a more informative chart (see Figure 1) for both describing and comparing the deprivation distribution of the Portuguese immigrants and the natives of Luxembourg.

A more revealing picture of deprivation and its distribution is giving by the Inverse Generalized Lorenz Curves (IGLC)[12] of individual deprivation indicators (Jenkins and Lambert (1997)). These curves are based on distributions of deprivation gaps, and are so named because of their ability to simultaneously portray the incidence, the intensity and the inequality dimensions of aggregated measures of poverty. More precisely, the *incidence* aspect of poverty is summarized by the lenght of the IGLC curve's non horizontal section. The proportion of the population deprived is the level at wich the curve becomes horizontal. The *intensity* dimension of poverty is summarized by the height of the IGLC curve: the vertical intercept at the cumulative population proportion equal to 1 is the aggregated deprivation gap averaged across all deprivated household units. Finally, the *inequality* dimension of deprivation is summarized by the degree of concavity of the non-horizontal section of the IGLC curve (see for example Figure 2).

In order to decompose the deprivation differentials presented in Figures 1 and 2, we used a semi-parametric decomposition approach proposed by DiNardo et al. (1996) which allows constructing a series of conterafactuals deprivation distributions. The difference between the actual deprivation distribution of various groups and these counterfactual deprivation distributions form the basis of the decompositions underlying our empirical results.

We begin with a comparison of natives and Portuguese immigrants. Figure 2 shows the IGLC of cumulated normalized individual deprivation measures. It is clear that the Portuguese distribution IGLC dominates the native's one. Specifically, more than 80% of Portuguese are affected by different levels of deprivation

---

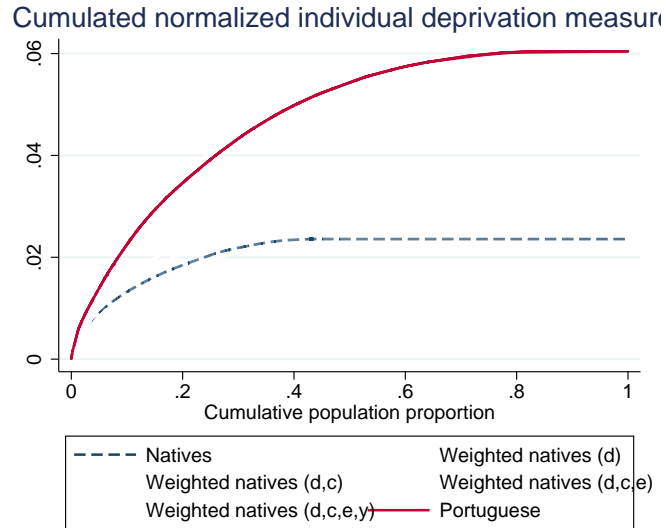[12]Also labeled the "Three I's of Poverty" (TIP) curve.

Fig. 2. The deprivation differentials between natives and immigrants

with an average deprivation value of 0,0604, whereas 42% of natives have some degree of deprivation with an average deprivation level of 0,0236.
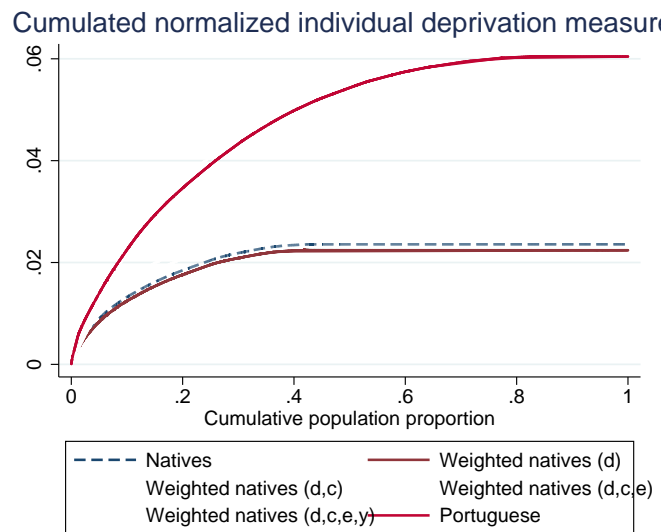

Fig. 3. The f^d counterfactual deprivation distribution

In order to explain this deprivation gap we perform a counterfactual analysis. Then, how the natives IGLC will look like if natives had the same demographic characteristics as Portuguese immigrants while keeping their own deprivation function, human capital, employment and income functions?

As it is possible to see in Figure 3 there is almost no difference between the counterfactual and the native's IGLC. We can not say that the difference between natives and Portuguese is explained by demographic characteristics of households.

Let see a second counterfactual deprivation distribution where natives had the same demographic and human capital characteristics as Portuguese immigrants. From the comparison of this new counterfactual IGLC with the previous one, we can notice an augmentation of the incidence (from 42% to 51%) and of the intensity (from 0,02 to 0,03) of deprivation for the native population (see Figure 4).
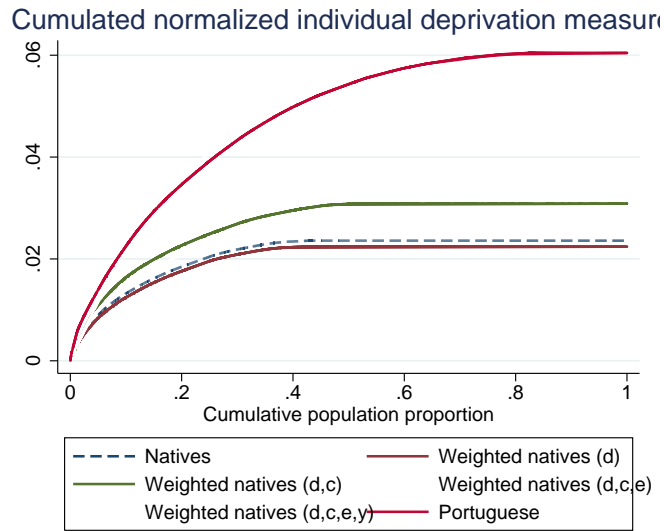

Fig. 4. The f^d and f^{dc} counterfactual deprivation distributions

But if in addition to demographic and human capital, natives have the employment characteristics of Portuguese immigrants, the IGLC counterfactual curve decrease with respect to previous counterfactual deprivation distribution. One possible explanation is that there are more active persons in immigrants households but the average annual income of natives from Luxembourg is more important than the average annual income of Portuguese immigrants (35647,08 euros and 20167,07 euros, respectively). Then, more active persons with higher income levels will produce a better situation than previously (see Figure 5).
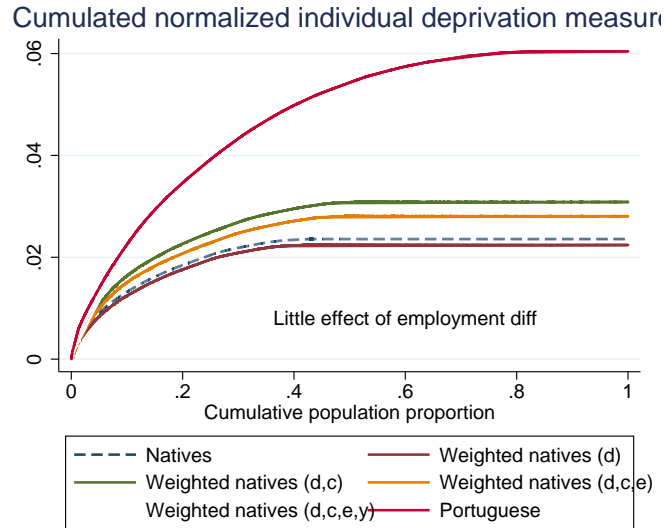
12

Fig. 5. The f^d, f^{dc}, and f^{dce} counterfactual deprivation distributions

Finally, the counterfactual analysis also indicates that if natives had faced the income, human capital, employment and demographic characteristics of Portuguese then, their deprivation distribution closely resembled that of Portuguese immigrants.
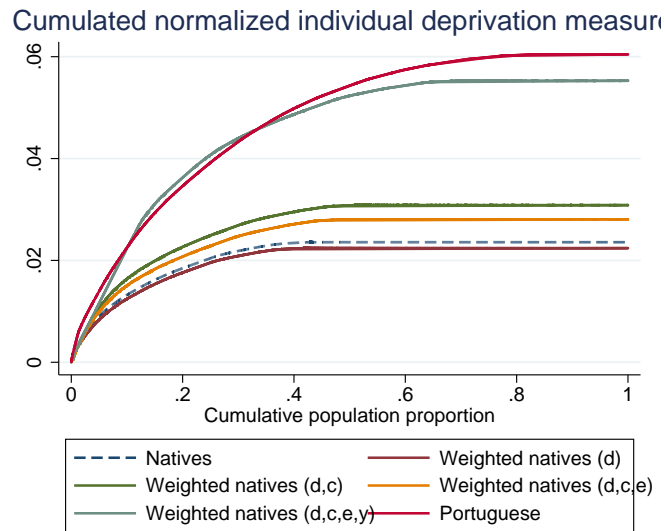

Fig. 6. The f^d, f^{dc}, f^{dce} and f^{dcey} counterfactual deprivation distributions

The amount of the difference between natives and Portuguese aggregated deprivation gap average is explained by the selected model, as follows:

Table 2. Difference between natives and Portuguese immigrants aggregated deprivation gap average

Demographic c.	Human capital	Employment	Income	Unexplained	Total difference
-3,18%	22,91%	-7,55%	73,78%	14,03%	100%

The counterfactual analysis suggests that the increasing deprivation gap between natives and Portuguese immigrants is principally linked to changes in the income structure, explaining more than 73% of the total gap and, in a less important manner, to changes in education (22,91%). In fact, Portuguese have lower incomes and education levels than natives. The proposed method leaves only 14% of the total difference unexplained.

References

BUTCHER, K. F., AND J. DINARDO (2002): "The Immigrant and Native-Born Wage Distributions: Evidence from United States Censuses," *Industrial and Labor Relations Review*, 56(1), 97–121.

CERIOLI, A., AND S. ZANI (1990): "A fuzzy approach to the measurement of poverty," in *Income and wealth distribution, inequality and poverty*, ed. by C. Dagum, and M. Zenga, pp. 272–84. Springer Verlag, Berlin.

COBB-CLARK, D., AND V. HILDEBRAND (2006): "The Wealth of Mexican Americans," *Journal of Human Resources*, 41(4), 841–868.

DEUTSCH, J., AND J. SILBER (2005): "Measuring Poverty: An Empirical Comparison of Various Approaches," *Review of Income and Wealth*, 51(1), 145–74.

DINARDO, J., N. M. FORTIN, AND T. LEMIEUX (1996): "Labor Market Institutions and the Distribution of Wages, 1973-1992: A Semiparametric Approach," *Econometrica*, 64(5), 1001–1044.

HARTMANN-HIRSCH, C. (2007): "Les étrangers et le marché de l'emploi: politiques migratoires et immigrations," Cahier PSELL 157, CEPS/INSTEAD, Differdange, Luxembourg.

JENKINS, S. P., AND P. J. LAMBERT (1997): "Three 'I's of Poverty Curves, With An Analysis of UK Poverty Trends," *Oxford Economic Papers*, 49(?), 317–327.

KOLENIKOV, S., AND G. ANGELES (2009): "Socioeconomic Status Measurement With Discrete Proxy Variables: Is Principal Component Analysis a reliable Answer?," *Review of Income and Wealth*, 55(1), 128–165.

LANGERS, J. (2006): "Nationaux et étrangers résident au Luxembourg: Analyse statistique de quelques différences socio-démographiques," Economie et Statistique 2, Statec.

LEMMI, A., AND G. BETTI (2006): *Fuzzy set approach to the multidimensional poverty measurement*. Springer, New York.

PEARSON, K., AND E. S. PEARSON (1922): "On polychoric coefficients of correlation," *Biometrika*, 14(?), 127–156.

VAN KERM, P., AND A. VILLERET (2007): "Difficile de joindre les deux bouts? La satisfaction des ménages luxembourgeois quant à leur situation financière," Vivre au Luxembourg 36, CEPS/INSTEAD, Differdange, Luxembourg.

6 Appendix: The membership functions of selected attributes

6.1 Basic non-monetary deprivation

Table 3. Capacity to face unexpected expenses

Characteristics	Degree of membership
Yes	0
No	1

Table 4. Eating meat or fish every second day, if the households wanted to

Characteristics	Degree of membership
Yes	0
No	1

Table 5. Paying for a week annual holiday away from home

Characteristics	Degree of membership
Yes	0
No	1

Table 6. Keeping home (household's principal accommodation) adequately warm

Characteristics	Degree of membership
Yes	0
No	1

Table 7. Inability to meet scheduled payment

Arrears on mortgage on rent payments	yes	arrears on utility bills	yes	1
Arrears on mortgage on rent payments	yes	arrears on utility bills	no	0,75
Arrears on mortgage on rent payments	no	arrears on utility bills	yes	0,75
Arrears on mortgage on rent payments	no	arrears on utility bills	no	0

6.2   Secondary non-monetary deprivation

Table 8. Do you have a computer?

Characteristics	Degree of membership
Yes	0
No	1

Table 9. Do you have a washing machine?

Characteristics	Degree of membership
Yes	0
No	1

Table 10. Do you have a car?

Characteristics	Degree of membership
Yes	0
No	1

6.3 Housing: facilities and deterioration

Table 11. Household size and dimension (in square meters) 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

Table 12. Do you have a leaky roof?

Characteristics	Degree of membership
Yes	1
No	0

Table 13. Do you have damp walls, windows or grounds?

Characteristics	Degree of membership
Yes	1
No	0

Table 14. Do you have rot in walls, windows or grounds?

Characteristics	Degree of membership
Yes	1
No	0

Table 15. Do you have non-hermetic windows and doors?

Characteristics	Degree of membership
Yes	1
No	0

Table 16. Do you have an outdoor space?

Characteristics	Degree of membership
Yes	0
No	1