

## **MULTIDIMENSIONAL POVERTY ACROSS EUROPE**

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### **1. Introduction**

Recently the analysis of poverty has evolved towards a multidimensional perspective, considering not only the economic dimension, i.e. income or consumption, but also other attributes regarded as determinant for an acceptable living standard.

The idea of enlarging the dimensions analysed is supported by several approaches: the basic-needs approach for instance regards poverty as lack of basic needs, also Sen's capability approach sees poverty as inability of possession of a wide range of characteristics related to the living standard, while the social exclusion perspective argues that poverty can be considered as an exclusion of individuals from standard way of living and basic social activities. All those approaches criticize the uni-dimensional analysis because limiting and argue that focusing the attention on poverty only as lowness of income depicts an incomplete picture of the phenomenon, sometimes with misleading conclusions (Madden, 2008).

With the aim of a more richer description of poverty in Europe, among elderly people, our paper adopts a multidimensional approach, considering as measure of well-being not only income but also health. Moreover the focus on elderly people is driven mainly by the fact that this part of the population has become relevant due to the substaisted aging process that Europe has occured in the last decades. We are interested therefore in comparing poverty across Europe, in terms of income and health, for a more and more preeminent part of the population.

The development of multi-dimensional poverty is intrinsically motivated not only by the recognition that deprivation may occur in more than one dimension but also by the fact that the correlation between different dimensions of deprivation may not be perfect. If the aim is to identify poors and the correlation would be perfect in fact, the choice of the dimension upon which to measure the incidence of poverty is unimportant, since all dimensions will identify the same individuals as poor but if the degree of correlation between dimensions decreases, the case of a multi-dimensional approach becomes more persuasive (Madden, 2008). Using the Receiver Operating Characteristics curve (ROC) approach, we will examine the

correlation between income and health, to understand if a multidimensional approach is really useful to describe better the phenomenon and, if this is the case, we will compute some indexes of multidimensional poverty.

The paper is structured as follows: we first review briefly the multidimensional poverty approaches that we find in literature and some empirical findings about the relationship between income and health in Europe for elderly people, then we describe the data used for the analysis, the Survey of Health, Ageing and Retirement in Europe (SHARE) and methods, finally we conclude with the empirical results.

## 2. Literature review

Multidimensional analysis has been broadly used to compare poverty across Europe, also various reports have extended officially the analysis of monetary poverty by considering the interaction with non-monetary aspects (Eurostat, 2000 and 2002) and especially recently the importance of a multidimensional approach has been highlighted by the Commission on the Measurement of Economic Performance and Social Progress (CMEPSP) that encourages the production of statistical indicators to measure social progress.

Given the intrinsic problem of summarizing information about several attributes, part of the literature on multidimensional poverty has focused on developing new measures, while other authors have tried to translate empirically the proposed indicators. Theoretically the multidimensional poverty can be found in the *fuzzy set theory*, that classifies poors according to grades of membership, in the *information theory approach*, whose basic concepts are useful to derive a multivariate generalization of the generalized entropy index and in the *axiomatic approach*, see D'Ambrosio et al. (2009) for a more detailed review of the relevant theoretical literature on multidimensional poverty. Among all the listed approaches, we will focus on the last mentioned, i.e. multidimensional poverty indexes derived axiomatically, where the basic idea is defining measures with a certain number of desirable properties.

All the approaches of multidimensional poverty are based on the idea that there is an imperfect correlation between dimensions, which causes a partial view of the social progress if relying only on a uni-dimensional measure: considering only income will ignore individuals who are not income poor, even though they may be poor in health. In this context therefore is also important to understand the relationship between dimensions and control for a real advantage in moving from a uni-dimensional to a multi-dimensional measure, advantage that increases the more

imperfect is the correlation between dimensions, at least from the point of view of identifying the poor.

Many studies have analysed the relationship between income and health, concluding that health conditions, especially for elderly people, are largely determined by socio-economic factors<sup>1</sup>. Especially it has been found that those individuals with lower socio-economic status have a higher probability to contract illnesses, a lower life expectancy and are also more subjected to disabilities. Also for the first wave of SHARE the empirical results seem to suggest the same high correlation between income and self-reported health, which is an established predictor of morbidity and mortality (Bussini and Lanari, 2010).

All these findings would suggest a low attractiveness of a multidimensional analysis of poverty, since low income people are more likely poor in health, but, as we would like to determine explicitly if the multidimensional perspective is justified, we will examine the correlation between income and health using the Receiver Operating Characteristic curve (ROC) as in Madden (2008), providing a summary of the degree to which poverty in one dimension (health) acts as an indicator for poverty in the other dimension (income).

### 3. Data and methods

The data used for the analysis are those collected for SHARE in the year 2004 and 2006. The database, that is multidisciplinary, cross-national and panel, contains individual information on health and socio-economic status for more than 45000 individuals aged 50 or over.

Since we would like to compare poverty across Europe but also between the two waves, we selected only those countries that were present both in the first and second year of the survey; therefore the analysis is carried on for Austria, Germany, Sweden, Netherland, Spain, Italy, France, Denmark, Greece, Switzerland and Belgium.

As measure of health status we use the variable *self-reported health status* which is categorical, ranging from 1 (Excellent) to 5 (Poor) and, as measure of income, we use the disposable household income<sup>2</sup>, equivalised using the squared

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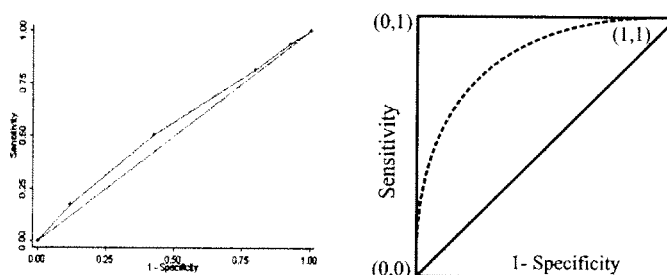
<sup>1</sup> Mackenbach et al., 2008, Socio-economic inequalities in health in 22 European Countries, The New England Journal of medicine, 358, pp. 2468-81.

<sup>2</sup> The disposable income is not present in the first wave of the survey, the only information available is the gross income of the household, therefore, to compute the disposable income, we use the average tax and social security contribution rates estimates at various multiples (67%, 100%, 133% and 167%) of the average annual gross wage earnings,

root of the household size.

In order to understand the correlation between health and income, we used the ROC curve, method originally used in the field of engineering or disease diagnosis, that measure the extent to which a given signal can detect an underlying condition. In our case we consider as underlying condition income poverty, therefore we define two categories, *poor* if the equivalised disposable household income is lower than the traditional relative poverty threshold (half of the median value for each year and each country) and *non-poor* otherwise. Given the two groups, we try to understand in what extent the health poverty line produces the *same* partition.

**Figure 1** – An example of ROC curve (Italy, wave 2).



Those individuals that are poor according to both dimensions are called *true positive* (TP), those who are classified as non-poor by both health and income are called *true negative* (TN). If the health poverty threshold identifies as poor someone who is not according to income, he or she will be a *false positive* (FP), while *false negative* (FN) is someone poor in income but non-poor in health. The ROC curve exploits this classification to plot, on the vertical axis, the sensitivity or TP rate,  $TP/(TP+FN)$ , against 1- the specificity or TN rate,  $TN/(FP+TN)$ , on the horizontal axis, for all possible values of the health poverty threshold. The more correlated are the two dimensions, the higher will be the sensitivity and the specificity, in graphical terms (figure 1) the more one dimension acts as a signal of the other, the nearer will be the curve to the point (0,1). If the ROC curve lies on the  $45^\circ$  line, the probability of finding true positive is exactly equal to the probability of finding false positive, meaning that health is not informative as

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*Segue nota a pagina precedente:* considering also the combined central and sub-central government income tax and security contribution. This method recalls what proposed by Hallberg (2006) who analyzed the cross-national differences in income poverty among European countries using the first wave of SHARE.

signal for income poverty, while if the curve is below the 45° line, this means that health acts as a contra-indicator for income poverty.

The area under the ROC curve can be a measure of the extent to which two dimensions of poverty are correlated in the sense of identifying the poor, we report therefore in table 1 the estimates of the areas in both waves (ROC1 and ROC2).

As suggested by Madden (2008), we transformed the ordinal measure of self-reported health into a cardinal one using an ordered probit model for each country and wave using as independent variables age, gender, education, marital status, information about chronic diseases or disabilities and income, then we take the linear prediction of this ordered probit and re-scale it so that it takes a value from 0 to 1 to maintain the relative approach to poverty.

After having analysed the correlation between health and income, we compute the multidimensional indexes of poverty, using the bidimensional union and intersection headcount ratios and the Bourguignon and Chakravarty's index (1), that can be viewed as a CES (Constant Elasticity of Substitution) weighted average of the Foster-Greer-Thorbecke poverty index.

$$P_{\alpha}^{\theta}(X;z) = 1/n \sum_{i=1}^n \{ \{ [\max(1-x_{i1}/z_1, 0)]^{\theta} + b^{\theta/\alpha} [\max(1-x_{i2}/z_2, 0)]^{\theta} \}^{\alpha/\theta} \} \quad (1)$$

More precisely the union headcount ratio identifies those who are poor in any one of the two dimensions considered, while the intersection headcount ratio is more restrictive and requires to be poor both in health and income. The multidimensional index of Bourguignon and Chakravarty takes into consideration also the effect of the substitutability between attributes, by satisfying the non-decreasing poverty under correlation increasing switch (NDCIS) or the converse property NICIS. The NDCIS demands that, if the two attributes are substitutes (complements), poverty should not decrease (increase) under a correlation increasing switch, i.e. an increase in the correlation between the attributes. The poverty thresholds are given by  $z_1$  and  $z_2$  and  $b$  is the relative weight given to poverty dimension 2, the parameter  $\alpha$  reflects instead the relative weight attached to extreme poverty, while  $\theta$  determines the elasticity of substitution between the shortfalls of the different attributes. The Bourguignon–Chakravarty index satisfies NDCIS or NICIS depending upon the relative values of  $\alpha$  and  $\theta$ , with NDCIS holding when  $\alpha > \theta$ .

#### 4. Empirical results

Starting from the correlation between health and income poverty, we can notice in table 1 that Denmark and Sweden record the highest values of correlation, while Spain the lowest in both years. Moreover, the area under the ROC curves ranges in the first year of the survey from 0.505 to 0.639, while in the second wave from 0.506 to 0.650, meaning that health conditions are not a perfect signal of income poverty and justifying therefore the multidimensional approach to describe poverty in Europe.

In table 1 we also summarize the head count ratios of income and health poverty: Switzerland seems to be the country where there is the largest portion of poor in income in both years, while Sweden records in the two waves low income poverty rates. Focusing on health instead those countries with the highest poverty in health are Netherlands, Greece and Switzerland.

**Table 1** – ROC areas and head count ratios for income and health, wave 1 and 2.

	<i>Obs1</i>	<i>Obs2</i>	<b>ROC1</b>	<b>ROC2</b>	<b>Income1</b>	<b>Income2</b>	<b>Health1</b>	<b>Health2</b>
<b>AT</b>	1853	1341	0.530	0.550	0.171	0.138	0.037	0.018
<b>DE</b>	2929	2568	0.602	0.555	0.159	0.178	0.030	0.024
<b>SE</b>	2930	2745	0.637	0.621	0.100	0.155	0.054	0.019
<b>NL</b>	2857	2661	0.543	0.586	0.164	0.159	0.077	0.098
<b>ES</b>	2329	2228	0.505	0.506	0.154	0.180	0.024	0.021
<b>IT</b>	2500	2983	0.577	0.544	0.187	0.161	0.038	0.044
<b>FR</b>	2931	2967	0.609	0.604	0.160	0.178	0.028	0.053
<b>DK</b>	1655	2616	0.639	0.650	0.176	0.170	0.033	0.094
<b>GR</b>	2840	3243	0.569	0.509	0.145	0.206	0.091	0.107
<b>CH</b>	944	1462	0.597	0.517	0.239	0.208	0.087	0.083
<b>BE</b>	3689	3169	0.523	0.526	0.140	0.140	0.066	0.054

If we summarize poverty in the two dimensions using the union approach, we find that Netherlands and Switzerland are the two countries with the highest value of multidimensional poverty in 2004, the same index remains high even if slightly lower for Switzerland in 2006 and decreases for Austria, Italy and Belgium. The ranking changes if we consider the intersection approach: while in 2004 Switzerland has the highest value, in 2006 is Denmark that records the largest proportion of poor, Spain and Austria instead have the lowest value in both waves.

Looking at the Bourguignon and Chakravarty indexes, we can notice that if we give equal weights to income and health, Switzerland and Italy are the countries with the highest poverty in 2004, while if the relative importance of health

increases also Netherland and Greece have high poverty rates. In 2006 Switzerland, Greece and Spain record a high value for the multidimensional poverty index with equal weights for income and health, while if we triple the relative weight of health, also Netherland is among those countries with the highest poverty rates.

**Table 2** – *Bi-dimensional headcount ratios (union and intersection) and Bourguignon and Chakravarty indexes of multidimensional poverty, wave 1 and 2.*

	Union		Intersection		BC ( $\alpha=1, \theta=1, b=1$ )		BC ( $\alpha=1, \theta=1, b=3$ )	
	w1	w2	w1	w2	w1	w2	w1	w2
AT	0.201	0.152	0.007	0.004	0.074	0.042	0.082	0.043
DE	0.177	0.192	0.013	0.010	0.056	0.077	0.060	0.080
SE	0.127	0.165	0.027	0.009	0.031	0.043	0.039	0.045
NL	0.224	0.221	0.016	0.035	0.076	0.081	0.121	0.122
ES	0.172	0.197	0.006	0.004	0.068	0.096	0.075	0.101
IT	0.209	0.192	0.016	0.012	0.085	0.091	0.092	0.105
FR	0.176	0.202	0.012	0.028	0.054	0.076	0.058	0.084
DK	0.197	0.221	0.012	0.043	0.050	0.061	0.068	0.085
GR	0.209	0.283	0.028	0.030	0.075	0.145	0.099	0.172
CH	0.279	0.264	0.048	0.027	0.113	0.102	0.148	0.136
BE	0.191	0.180	0.016	0.014	0.069	0.067	0.095	0.090

Our empirical results show that, in Europe among elderly people, the degree of correlation between the two poverty dimensions considered, income and health, is low, meaning that there is an advantage moving from the uni-dimensional to multi-dimensional poverty in order to give a more complete view of the phenomenon.

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### SUMMARY

Income poverty is commonly encountered in developing and developed countries alike, but in the latter case the incidence rate is lower. Beyond income, the health dimension is recalling the attention of a wide number of studies about poverty. A disjoint analysis of the two components could potentially lead to misleading results, especially in developed countries (Madden, 2008). In this framework Sen's Capability Approach emerged as the leading alternative to standard economic analysis of poverty and human development generally, arguing that poverty is not just low level of consumption or income, but it is a broader concept related to the inability of reaching an acceptable standard in several dimensions, e.g. health. This paper presents poverty according to the multidimensional approach.

The correlation between these two dimensions of poverty is examined using the Receiver Operating Characteristics curve (ROC). We are interested in comparing the dynamic of multidimensional poverty across European countries for elderly people, therefore we use data from the Survey of Health, Ageing and Retirement in Europe (SHARE) for the years 2004-2006.

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