EVALUATING DEPRIVATION IN ITALY USING A MULTIDIMENSIONAL COUNTING APPROACH

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1. Introduction

In the last decades, there is a unanimous consensus that deprivation is a multidimensional concept that cannot be adequately captured by considering only unidimensional measures related to income. However, a difficulty arises. Whereas most of the multidimensional indices proposed deal well only with quantitative data, the majority of the data available to measure deprivations are either ordinal or categorical. In 2010, the European Council adopted 9 common indicators to measure the material deprivation (EU-MD) for all the 27 EU Member States. The EU MD rate is currently defined as the proportion of people living in households who cannot afford at least 3 items. The main drawback of the MD indicators currently used is its small number of items. Since 2010, the importance of MD indicators has grown significantly and several initiatives have been implemented to modify and amply such dataset. An alternative to the traditional indices is the counting approach introduced by Atkinson (2003), who observed that empirical studies of deprivation do not use a social welfare function approach, but rather focus on counting the number of dimensions in which people suffer deprivation. The counting approach is an appropriate procedure that deals well with ordinal and categorical variables. A number of counting deprivation measures has been derived. Many times choosing different measures leads to contradictory results. The dominance criteria introduced by Lasso de la Vega (2010) guarantee reaching robust conclusions in a counting framework.

This paper applies the cited methodology and dominance criteria to Italy in the period 2005-2009 using data collected in the Survey on Income and Living Conditions (EUSILC). Following Ravallion's (1996) recommendations, we

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1 Although all authors contributed extensively and in closely collaboration to the work presented in this paper, the Introduction may be attributed to Lasso de la Vega and Chelli, the Methodology to Lasso de la Vega and Ciommi, Section 3 as well as the Data Analysis to Ciommi; Results and Conclusions to all the authors.

2 Coping with unexpected expenses; one week of annual holidays away from home; avoiding arrears; a meal with meat, chicken, fish or vegetarian equivalent every second day; keeping the home adequately warm; a washing machine; a colour TV; a telephone; a personal car.
supplement monetary indicators by including non-monetary ones (such as housing, health, personal resource, access to several basic needs).

2. Methodology

We consider a population of \( n \) individuals (or households) endowed with \( k \geq 1 \) (fixed) attributes considered as relevant in terms of deprivation (i.e. access to certain goods and services, housing conditions, ability to satisfy several basic needs, and so on). Let \( X = [x_{ij}] \subset \mathbb{R}_+^{nk} \) be the multidimensional distribution of a society where \( x_{ij} \) represents the quantity of the attribute \( j \) observed for individual \( i \). The \( j \)-th column of this matrix represents the distribution of the attribute \( j \) across all the individuals in the population. The \( i \)-th row, denoted by \( x_i \in \mathbb{R}_+^k \), represents the \( k \)-vector of non-negative attributes\(^3\) for individual \( i \). The analysis of poverty and the construction of a poverty measure, as Sen (1976) observed, involves two steps: the identification of the poor and the aggregation of their individual poverty levels into an aggregate measure. In the unidimensional approach (essentially based on income or consumption) the identification step fixes a minimum level of income (poverty line) necessary to have access to basic needs. Therefore, individuals (or households) are identified as poor if their income falls short the poverty line. In the multidimensional approach, the identification approach requires to fix a multidimensional poverty line that is a threshold level for each dimension. We denote by \( z \in \mathbb{R}_+^k \) the \( k \)-vector of non-negative attributes, such that each \( z_j \) represents the minimum level of subsistence for attribute \( j \). Following Brandolini and D’Alessio (1998), Bourguignon and Chakravarty (2003), Alkire and Forster (2011) among others, we define an identification function \( q(x_j, z_j) : \mathbb{R}_+^k \times \mathbb{R}_+^k \to \{0,1\}^k \) which maps from the \( i \)-th individual’s achievement vector and a non-negative \( k \)-th dimensional vector cut-off \( z \) to a \( k \)-th dimensional vector which entries are 1 or 0 if the individual is, respectively, deprived or not in these dimensions. Formally: for all \( i \in \{1, \ldots, n\} \)

\[
q(x_{ij}, z_j) = \begin{cases} 
0 & \text{if } x_{ij} \geq z_j \\
1 & \text{if } x_{ij} < z_j 
\end{cases} \quad \text{for } j = \{1, \ldots, k\}
\]

This process transforms the original matrix \( X \) in a new matrix \( C = [c_{ij}] \subset \{0,1\}^{nk} \), we call deprivation matrix. Looking at the rows of such matrix it is possible to identify the dimensions in which each individual is deprived. However, this is not sufficient to identify who is poor since a 2\(^{nd}\) step it is required.

\(^3\) We assume that any individual attribute should be non-negative, although our results remain valid if negative value are considered.
Let \( w = (w_1, ..., w_k) \) denote a vector of weights or deprivation values that indicates the relative importance of the different attributes. Following Brandolini and D’Alessio (1998), a synthetic index of deprivation at individual level can be written as: 

\[
\sum_{j=1}^{k} w_j (e_{ij})^\beta / \beta \]

where \( \beta \) represents the degree of substitution across the different dimension (deprivation). In what follows, for simplicity, we assume that all the dimensions are equally weighted, \( \sum_{j=1}^{k} w_j = k \) and \( \beta=1 \). Consequently, \( s_i = \sum_{j=1}^{k} w_j c_{ij} \in \{0,1, ..., k\} \) denotes the number of (weighted) dimensions in which person \( i \) is deprived. We call \( s_i \) the vector of deprivation counts. Finally we rearrange the individuals in a decreasing order (from the most deprived), that is \( \tilde{s}_i \leq \tilde{s}_{i+1} \) for \( i = 1, ..., n - 1 \).

But, who are the poor? There are two extremely approaches: the union and the intersection approach. The first one has been theoretically formulated by and Bourguignon and Chakravarty (2003), among others. Following this approach, a person is defined as poor if he is deprived in at least one dimension, \( 
\). (It may happen that the dimension in which the individual is deprived is weighted with a weigh less than 1). The union approach often predicts high numbers. The second extreme approach, the intersection, has been developed by Atkinson (2003). Following this approach, a person is identified as poor if he is deprived in all the dimensions, i.e., \( s_i = k \). The mail problem with this second approach is that, if \( k \) is very large, only few people are identified as poor. Rather than selecting the union or the intersection approach, Alkire and Foster (2011) introduce a so-called intermediate approach, defining a person as poor if he is deprived in at least \( d \) dimensions, where \( d \) is between 1 and \( k \). They call such procedure the dual cutoﬀs procedure since it involves a second identiﬁcation step using a new dichotomic function \( \delta(s_i; d) \) such that, if dimensions are not weighted, it is defined as:

\[
\delta(s_i; d) = \begin{cases} 
0 & \text{if } s_i \geq d \\
1 & \text{if } s_i < d 
\end{cases}
\]

for \( i = 1, ..., n \). This second identiﬁcation criterion allows us to deﬁne the set of the multidimensionally poor people such as \( q_d \) denotes the number of poor person according to \( d \). As suggested by Sen (1976) the Aggregation step consists in summarizing overall information in a single number by deﬁning a function (index) satisfying several properties.

\[ ^4 \] However, similar conclusions may be derived if different fixed weights are attached to the different dimensions.

\[ ^5 \] Obviously, in case of equal weights, if \( d = 1 \) the identiﬁcation criterion corresponds to the union approach, whereas for \( d = k \), the identiﬁcation criterion corresponds to the intersection approach.

\[ ^6 \] It is possible to apply such procedure to a sub-matrix obtained by merging some columns of the original matrix. This is hopeful if some attributes can be considered as variables belonging to the same dimension.

\[ ^7 \] Following Alkire and Foster (2011) and Bourguignon and Chakravarty (2003) we aggregate first across all dimensions for the same person (household) and then across people.
The Deprivation Curves are obtained by plotting, for any vector of deprivation counts, the identification cut-off, ranked in decreasing order against the multidimensional headcount ratio $H_m (m \leq d)$ that is the percentage of household in the society having a poverty scores higher than or equal to $m$. The obtained curve is the so-called First dimension deprivation curve (henceforth FD). Lasso de la Vega (2010) proves that if the FD curve associated to a country is everywhere to the left and above another FD curve associated to a another country or to the same but in a different period, then the second one has lower deprivation than the first one for any multidimensional deprivation measure satisfying Focus, Monotonicity, Symmetry and Replication invariance and for any identification cut-off. In contrast, if they intersect we need to restrict the set of measure or reduce the range for the cut-offs. The first possibility implies to construct the so-called Second dimension deprivation curve (SD), for any vector of deprivation, by plotting $H_m$ against the adjusted headcount ratio $M_m$ that is the ratio of the average number of deprivation among those in poverty to the maxima deprivation of the overall population. Also in this case Lasso de la Vega (2010) shows that for two vector $s$ and $s'$, if $SD(s')$ is everywhere above $SD(s)$ then $s$ has lower deprivation than $s'$ for any multidimensional deprivation measure satisfying all the previous properties plus Distribution Sensitivity.\(^8\)

3. Dimensions and Data

Our analysis refers on all households in the EU-SILC Italian survey. Data employed ranges from 2005 to 2009. In the analysis, we make use of 20 variables merged in 7 dimensions, as described in the following Table 1.

The last column of Table 1 shows the chosen cut-off for each variable. We decide on such variables taking in account those selected from Eurostat (2012) as well as empirical literature on multidimensional well-being (see Bossert et al. (2007), among other) As stressed in the theoretical section, we have to choose the number of variables to fall to be consider deprived in the respective dimension (double cut-off). For “financial control”, “House”, Safety perception”, “Fun” and “Personal durable” we choose 1, whereas for “House durable” and “Food”, we opt for 2.

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\(^8\) See Lasso de la Vega (2010) for a rigorous definition of FD and SD curves and above-mentioned properties.
<table>
<thead>
<tr>
<th>Dimension</th>
<th>Variables</th>
<th>Values</th>
<th>Cut-off</th>
</tr>
</thead>
<tbody>
<tr>
<td>Financial control</td>
<td>a) Capacity to face unexpected financial expenses</td>
<td>1) Yes - 2) No</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>b) Ability to make ends meet</td>
<td>From 1) with great difficulty; to 6) very easily</td>
<td>1-2</td>
</tr>
<tr>
<td>House</td>
<td>a) Number of rooms available to the household</td>
<td>1-6 (number)</td>
<td>1-2</td>
</tr>
<tr>
<td></td>
<td>b) Leaking roof, damp walls/floors/foundation, or rot in window frames or floor</td>
<td>1) Yes - 2) No</td>
<td>1</td>
</tr>
<tr>
<td>House Durables</td>
<td>a) Do you have a color TV?</td>
<td>1) yes; 2) no - cannot afford; 3) no - other reason</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>b) Do you have a DVD reader?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Do you have internet connection?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>d) Do you have satellite dish?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>e) Do you have camera-video?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>f) Do you have washing machine?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>g) Do you have fridge?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>h) Do you have phone at home?</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety perception</td>
<td>a) Noise from neighbours or from the street</td>
<td>1) Yes - 2) No</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>b) Pollution, grime or other environmental problems</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Crime violence or vandalism in the area</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fun</td>
<td>a) Capacity to afford paying for one week annual holiday away from home</td>
<td>1) Yes - 2) No</td>
<td>2</td>
</tr>
<tr>
<td>Personal durables</td>
<td>a) Do you have a mobile phone?</td>
<td>1) yes; 2) no - cannot afford; 3) no - other reason</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>b) Do you have a computer?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>c) Do you have a car</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td>a) Capacity to afford a meal with meat, chicken, fish (or vegetarian equivalent) every second day</td>
<td>1) Yes - 2) No</td>
<td>2</td>
</tr>
</tbody>
</table>

4. Analysis, results and conclusions

Applying the above-mentioned methodology, we carried out a first explorative analysis calculating the percentage of people deprived in each of the 7 dimensions from 2005 to 2009. As shown in Figure 1, each dimension has a different path. For each year, Italy presents the high share of deprived household in Financial Control (about 45% of people are deprived in such dimension) whereas the dimension in which people suffer less deprivation is House Durable. In both cases, deprivation is decreasing and this is true also for House and Personal durable dimension. Figure 2 shows more in details the trend of the two variables constituting the first dimension.

In order to find if deprivation is increasing or not in the five-year period under analysis, we plot FD curves for each year (Figure 3, on the right). Since curves are very close, we draw ten distinct pairs of FD curves finding that in two cases the
curves do not intersect: 2007 vs 2009 and 2008 vs 2009. In both cases, the FD curve associated to 2009 is below the other one. Consequently, there is less deprivation in 2009 than in 2007 and 2008. But 2007 and 2008 curves intersect (at lower level of deprivation) so it is not possible to rank these three years in an unambiguously way. Therefore, we calculate SD curves. Also in this case, curves are very close and, furthermore, they intersect as shown in Figure 4 (left). Dominance arises since the SD curve for 2007 is above SD curve for 2006 (Figure 4 – right). However, as stressed in section 2, even if FD and SD curve intersect it is also possible to obtain robust conclusion simply restricting the set of identification cut-off.

**Figure 1 – Percentage of deprived people**

![Percentage of deprived people in all the 7 Dimensions](image1)

**Figure 2 – Percentage of deprived people in Financial control**

![Percentage of deprived people in Financial Control](image2)

Based on these preliminary results, a number of possible further studies using the same methodological set up are apparent. Firstly, since the dataset is collected for all Member States of the EU, it seems quite interesting to extend Italian results...
to these Countries. Second, we think that to move from household to individual as unit of analysis would allow us to extend the analysis to subgroup (by gender, age or geographical location). Inference analysis can be also carried out.

**Figure 3 – FD curves**

Figure 3 shows the FD curves for 2008 and 2009, comparing the years with different lines.

**Figure 4 – SD curves**

Figure 4 displays the SD curves for 2006 and 2007, with different lines indicating the years.

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References


SUMMARY

Evaluating deprivation in Italy using a multidimensional counting approach

The aim of the study is to analyze multidimensional deprivation in Italy at household level in the period 2005-2009 using EUSILC data. As alternative to the traditional indices, we propose the counting approach that fits well with ordinal and categorical variables. Dominance conditions are introduced to guarantee reaching robust conclusions in a counting framework.

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