

# Multidimensional Poverty Measurement in Europe: accounting for individual preferences

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# Introduction and Motivation

- It has long been argued that poverty is multidimensional (Atkinson and Bourguignon, 1982; Sen, 1985).
- Several studies have proposed multidimensional poverty measures covering different aspects of human deprivation: Alkire and Foster (2011); Bossert, Chakravarty and D'Ambrosio (2012), etc.
- These measures have been used to evaluate multidimensional deprivation both in developed and developing countries for dimensions of deprivation (material deprivation, education, health status, etc.)

# Introduction and Motivation

- Existing measures does not take into account:
  - ▶ degree of substitution between dimensions;
  - ▶ inequality in the distribution of deprivations;
  - ▶ population preferences in terms of weighting of different dimensions/subdimensions
- This work aims to address these shortcomings by adopting a specific functional form while calculating the deprivation and deriving subjective weights representing population preferences using Alkire-Foster method.
- The contribution of each poverty dimension to overall deprivation will be evaluated with Shapley value approach.
- The method is applied to 11 EU countries using 2013 cross-sectional EU-SILC data.

# Methodology: Identification of multidimensionally poor

- The methodology employs a counting approach.
- The identification of poor is based on the dual poverty cut-off method. First, an individual's deprivation is evaluated for each subdimension based on threshold value.
  - ▶ Dimension - a sphere of human deprivation; for instance, material deprivation.
  - ▶ Dimensions can include one or several subdimensions; for instance, material deprivation includes possession of durable goods and nutrition indicator.
- Second, if the number of subdimensions in which an individual is poor exceeds a threshold number, an individual is considered poor and included in the calculation of overall MPI.

## Methodology: First poverty cut-off

- Let  $X_i=(x_{i1}...x_{im})$  be the achievement vector of individual  $i$ ,  $i = 1, 2, \dots, n$  in subdimensions  $j = 1, 2, \dots, m$ . and  $Z = (z_1...z_m)$  is vector of poverty lines for each dimension  $j$ .
- An individual  $i$  is poor in subdimension  $j$  if  $x_{ij} < z_j$  and non-poor otherwise.
- Accordingly, if we define  $a_{ij}$  as follows:

$$a_{ij} = \begin{cases} 1 & \text{if } x_{ij} < z_j \\ 0 & \text{otherwise} \end{cases} \quad (1)$$

# Deprivation Matrix and Second Poverty cut-off

- Deprivation matrix is defined as below:

$$\begin{pmatrix} a_{11} & \dots & a_{1m} \\ a_{21} & \dots & a_{2m} \\ \dots & \dots & \dots \\ a_{n1} & \dots & a_{nm} \end{pmatrix}$$

- Based on the deprivation matrix, we will count the number of 1's for each individual and identify poor.
- Those with the number of subdimensions in which they are poor is less than the threshold are excluded.

# Individual deprivation function: CES specification

- Individual deprivation is evaluated with the following function:

$$p_i(X, Z) = \sum_{j=1}^m \left( w_j (a_{ij})^\beta \right)^{\frac{1}{\beta}} \quad (2)$$

$\beta \geq 1$  is the substitutability parameter among subdimensions;  $w_j$  is the weight assigned to each dimension,  $\sum_{j=1}^m w_j = 1$ . Larger the  $\beta$ , lower the degree of substitution.

- Given the ordinal evaluation of subdimensions, the latter are averaged within each dimension and individual function becomes:

$$p_i(X, Z) = \sum_{l=1}^L \left( w_j \left( \frac{\sum_j a_{ij}}{r} \right)^\beta \right)^{\frac{1}{\beta}} \quad (3)$$

$l$  is the number of dimensions.



# Aggregate deprivation function: a double CES specification

- Aggregate deprivation function is also constructed using CES specification:

$$MPI(X, Z) = \frac{1}{n} \sum_{i=1}^n (p_i(X, Z)^\alpha)^{\frac{1}{\alpha}} = \frac{1}{n} \sum_{i=1}^n \left( \sum_{l=1}^L \left( w_j \left( \frac{\sum_j a_{ij}}{r} \right)^\beta \right)^{\frac{\alpha}{\beta}} \right)^{\frac{1}{\alpha}} \quad (4)$$

- $\alpha \geq 1$  is the parameter of inequality aversion. Higher the  $\alpha$ , higher the aversion.
- $\alpha = 1$  and  $\beta = 1$  correspond to global MPI.

# Decomposition method: Shapley value

- First proposed by Shorrocks (2013), the method is used in the decomposition of inequality and poverty indices.
- The procedure is as follows:
  - ▶ The value of total deprivation is calculated with and without a given element (in our case, dimension) taking into account different orders of exclusion;
  - ▶ The difference between the values of total deprivation with and without a certain element is found and averaged.
  - ▶ The contribution of each element (average difference) is calculated as the share of total deprivation.
- Already applied by Chakravarty, Deutsch and Silber, (2008) and Nicholas et al. (2019) among others.

## Selected dimensions and subdimensions

An individual will be considered multidimensionally poor if she is deprived in at least 33% of dimensions - that is, in more than 4 dimensions.

<b>Dimension</b>	<b>Subdimension</b>
Education	Not completed a secondary education
Health	Subjective health status below fair Suffering from chronic illness Presence of unmet medical needs
Material deprivation	Leaking roof, damp walls/floor or rot in window Not being able to keep the dwelling warm No access to bath/shower and indoor flushing toilet inside the dwelling No colour TV, washing machine, access to a car and telephone Living in an overcrowded household Not affording meal with chicken/meat (or protein equivalent) every two days
Environment	Suffering from noise from neighbours or from the street Suffering from pollution Suffering from crime and violence

## Choosing weights: normative weights

<b>Dimension</b>	<b>Weight</b>	<b>Subdimension</b>
Education	1/4	Not completed a secondary education
Health	1/4	Subjective health status below fair Suffering from chronic illness Presence of unmet medical needs
Material deprivation	1/4	Leaking roof, damp walls/floor or rot in window Not being able to keep the dwelling warm No access to bath/shower and indoor flushing toilet inside the dwelling No colour TV, washing machine, computer and telephone Living in an overcrowded household Not affording meal with chicken/meat (or protein equivalent) every two days
Environment	1/4	Suffering from noise from neighbours or from the street Suffering from pollution Suffering from crime and violence

# Choosing weights: Subjective weights

- Subjective weights are estimated from satisfaction data via ordered logit (Schokkaert, 2007):

$$S_i = \alpha_{i0} + \alpha_I * Dimension_{ij} + \gamma_I * Dimension_I * X_i + \epsilon_i \quad (5)$$

$S_i \in [0, 10]$  is the overall life satisfaction measure;

$Dimension_I * X_i$  are interaction terms of each domain with sociodemographic characteristics;

$\alpha_{i0}$  includes individual-specific mood variable to "clean out" satisfaction data from temporary elements (Schokkaert and Xavier, 2013).

- The coefficients of dimensions will be normalized to 1 and the share of each domain will be used as its weight.
- Interaction terms helps to take into account observed heterogeneity.

# Data and Sample

- Source: 2013 cross-sectional EU-SILC dataset. The year is specifically chosen as satisfaction data is only available for this year.
- Sample: Individuals older than 18 years old to correctly assess the deprivation in education.
- 11 EU countries is chosen with missing satisfaction data not exceeding 20% of the sample.

# Data and Sample

Country	Sample size (older than 18)	Sample with non-missing satisfaction data (older than 18)
Austria	10441	9423
Belgium	10952	9412
Bulgaria	10130	8468
Cyprus	10309	9509
Germany	19936	17036
Greece	14356	14215
Hungary	19475	16226
Romania	14829	14478
Slovakia	11833	11225
Spain	23116	22305
Switzerland	11615	11582

# Life satisfaction regression results

- Deprivations in education and environment have comparatively low impact on life satisfaction while health and material deprivations has larger impact.
- Some heterogeneity is observed among groups:
  - ▶ Employed who are deprived in education report lower LS than others in in some countries.
  - ▶ Living with a partner mitigates the impact of health deprivation on LS. Being male and living in densely populated areas aggravates the negative impact of health deprivation on LS.
  - ▶ Those living with a partner and deprived materially report lower LS than other groups.



# Subjective weights

Country	Education	Health	Material deprivation	Environment
Austria	0.079	0.466	0.404	0.045
Belgium	0.057	0.369	0.528	0.046
Bulgaria	0.091	0.353	0.512	0.043
Cyprus	0.092	0.290	0.592	0.026
Germany	0.063	0.307	0.565	0.066
Greece	0.135	0.359	0.1473	0.033
Hungary	0.095	0.376	0.496	0.034
Romania	0.081	0.402	0.461	0.057
Slovak Republic	0.080	0.360	0.519	0.041
Spain	0.111	0.325	0.564	0.0003
Switzerland	0.018	0.350	0.521	0.111

# Headcount ratios per dimension

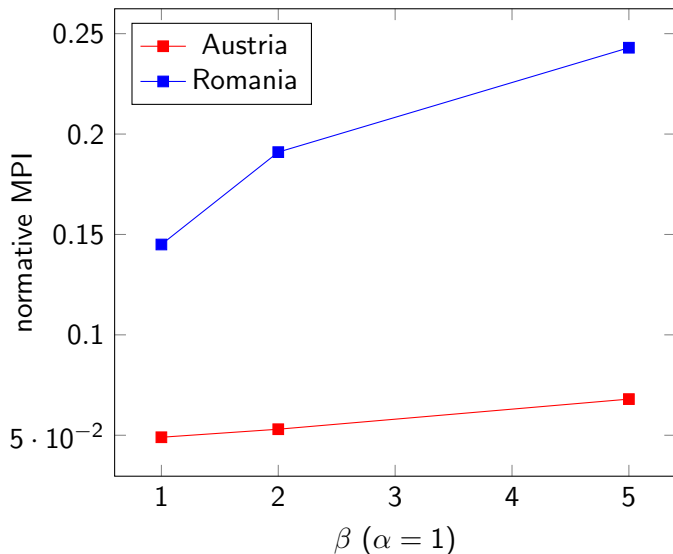
- Education: largest poverty rate is observed in this dimension
  - ▶ 36% in Greece and 46% in Spain.
  - ▶ lowest rate in Slovak Republic (12%).
- Health:
  - ▶ lowest rates in the presence of unmet medical needs - 0.6 - 10.4% (largest rate in Romania).
  - ▶ highest rate of respondents suffer from chronic illnesses - rates are relatively higher for Austria, Cyprus, Hungary and Switzerland.
- Material deprivation: lower-income countries suffer more from material deprivation
  - ▶ irregular protein intake - 22-50%
  - ▶ living in a overcrowded household - 26-48%
- Environment: relatively low poverty rates in all subdimensions (18-26%).

## Normative vs. subjective MPI

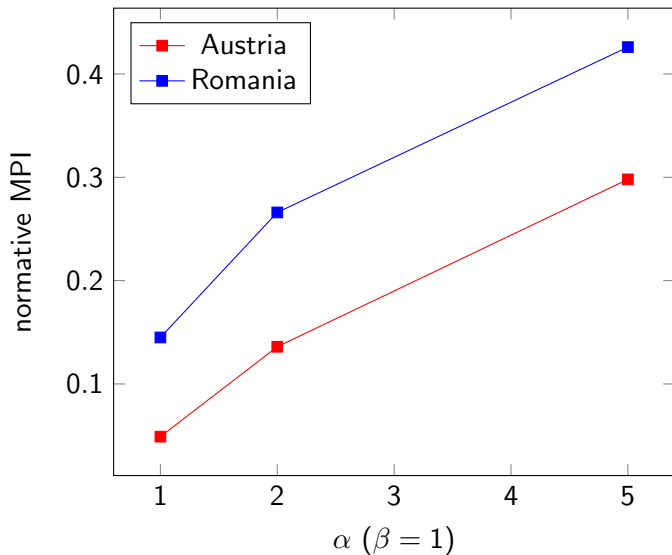
Country	Normative MPI	Subjective MPI	Normative A	Subjective A	Headcount ratio
Austria	0.049	0.035	0.416	0.356	9.9%
Belgium	0.051	0.038	0.451	0.334	11.4%
Bulgaria	0.147	0.150	0.428	0.336	34.3%
Cyprus	0.080	0.064	0.428	0.343	18.7%
Germany	0.043	0.032	0.407	0.304	10.5%
Greece	0.106	0.091	0.434	0.372	24.4%
Hungary	0.105	0.104	0.427	0.426	24.5%
Romania	0.145	0.138	0.437	0.417	33.1%
Slovak Republic	0.051	0.045	0.398	0.349	12.8%
Spain	0.048	0.034	0.433	0.328	10.4%
Switzerland	0.022	0.015	0.433	0.309	5%

- Subjective MPI and A is systematically lower than normative MPI and A (except Bulgaria).
- Switzerland is found to be the least deprived and Romania and Bulgaria the most deprived.

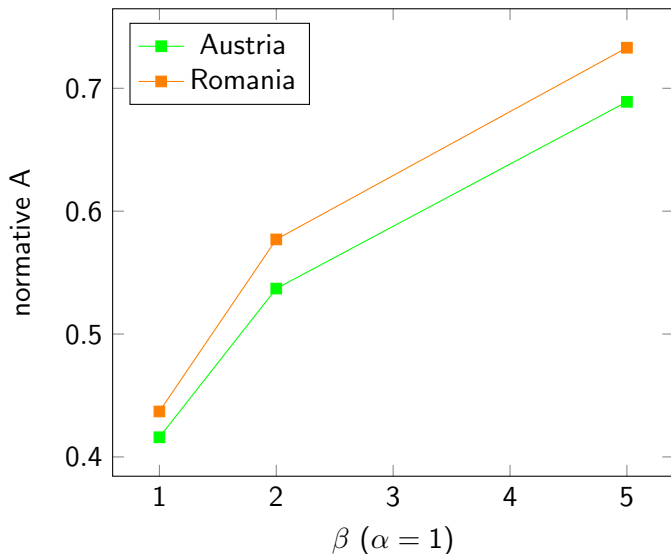
## Multidimensional poverty: lower substitutability between dimensions



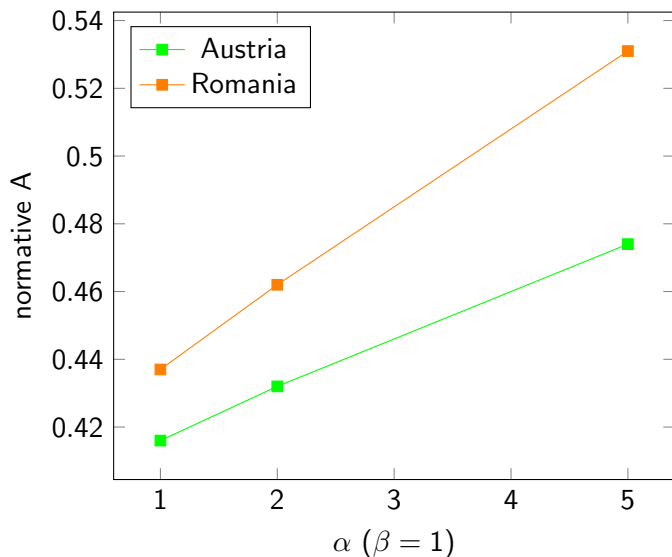
# Multidimensional poverty: higher aversion to inequality



## Poverty intensity index A: lower substitutability between dimensions

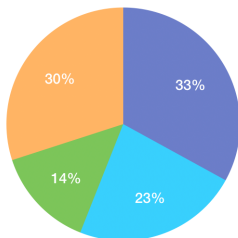


## Poverty intensity index A: higher aversion to inequality

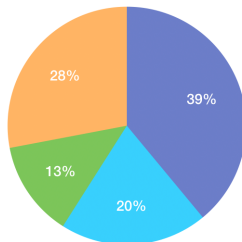


# Shapley decomposition: Normative MPI

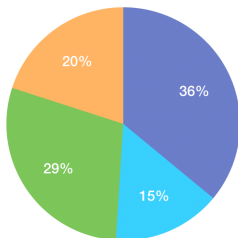
Austria ( $\alpha=1$ ;  $\beta=1$ )



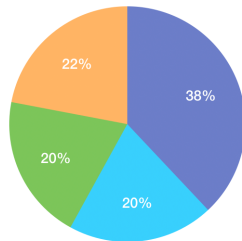
Austria ( $\alpha=5$ ;  $\beta=5$ )



Romania ( $\alpha=1$ ;  $\beta=1$ )



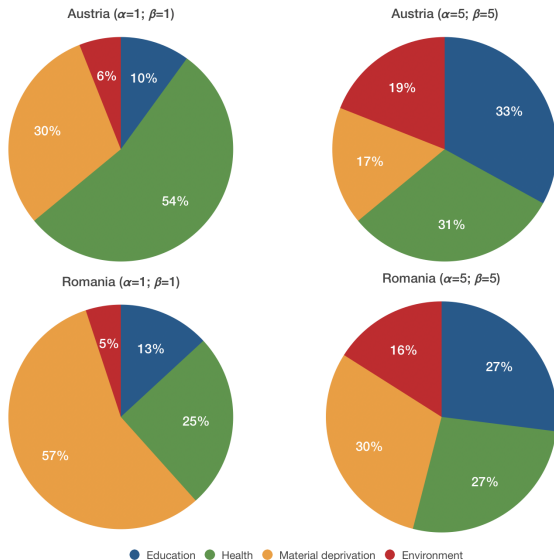
Romania ( $\alpha=5$ ;  $\beta=5$ )



● Education ● Health ● Material deprivation ● Environment



# Shapley decomposition: Subjective MPI



# Conclusion

- This work aimed to assess the sensitivity of MPI to
  - ▶ different degrees of substitution between deprivation dimensions;
  - ▶ different levels of aversion to inequality
  - ▶ taking population preferences into account (subjective weights).
- MPI levels vary across EU countries with MPIs measured with subjective weights being systematically lower than normative MPIs.
- Decreasing the degree of substitution and increasing aversion to inequality increases MPI and intensity index (A) dramatically.
- The distribution of deprivations among the poor does not vary significantly across the countries in the sample. The poorest of high-income countries are as poor as those of lower-income countries in the sample.

# Conclusion

Shapley decomposition results showed:

- In case of normative MPI:
  - ▶ slightly higher share of education and material deprivation in lower-income countries;
  - ▶ high share of education and environment deprivation in total deprivation in high-income countries.
- In case of subjective MPI:
  - ▶ higher share of health deprivation in total deprivation in high-income countries;
  - ▶ higher share of material deprivation in total deprivation in low-income countries.

# Thank you!