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## **Using integrated fuzzy and relative method to measure multidimensional poverty (NUTS2)**

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on Advanced Statistics for the Equitable and Sustainable Development  
– ASESD**

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Poverty and social exclusion indicators are an essential **monitoring tool**, most useful when comparable across countries.

Implementing informed policies often requires statistics **disaggregated to lower levels** than those whom meet national needs (for instance at NUT2 or lower levels).

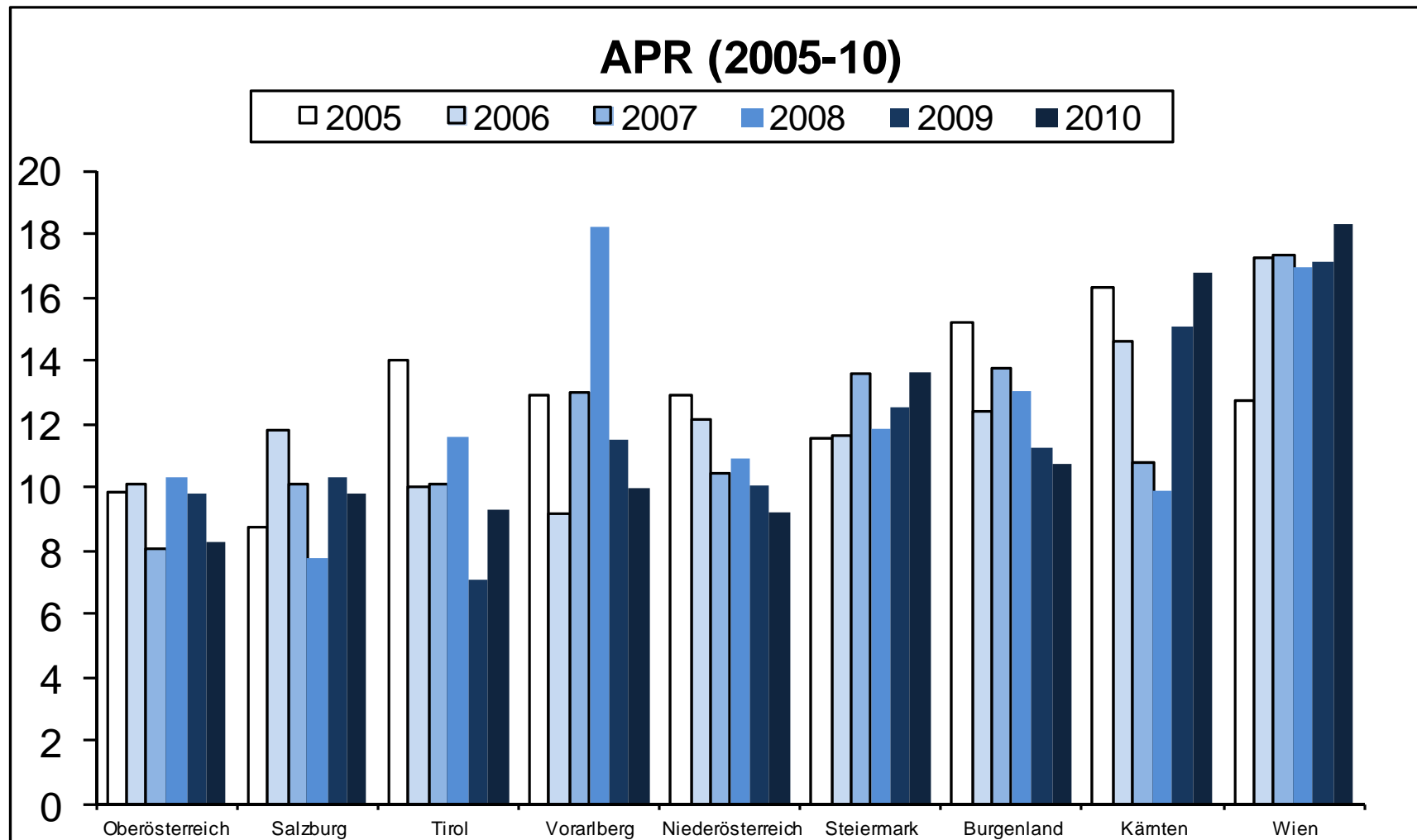
National estimates are particularly insufficient for monitoring poverty and social exclusion, as these fields require **complex statistics** that take into account the distribution.

The correct statistics are necessarily based on intensive and relatively **small-scale surveys** of households and individuals.

To introduce the problem with an empirical and real case we take in to account (with authorisation) some slides presented by **Matthias Till** of Statistics Austria at the OECD Conference in Paris, last November 27th, 2012, titled:

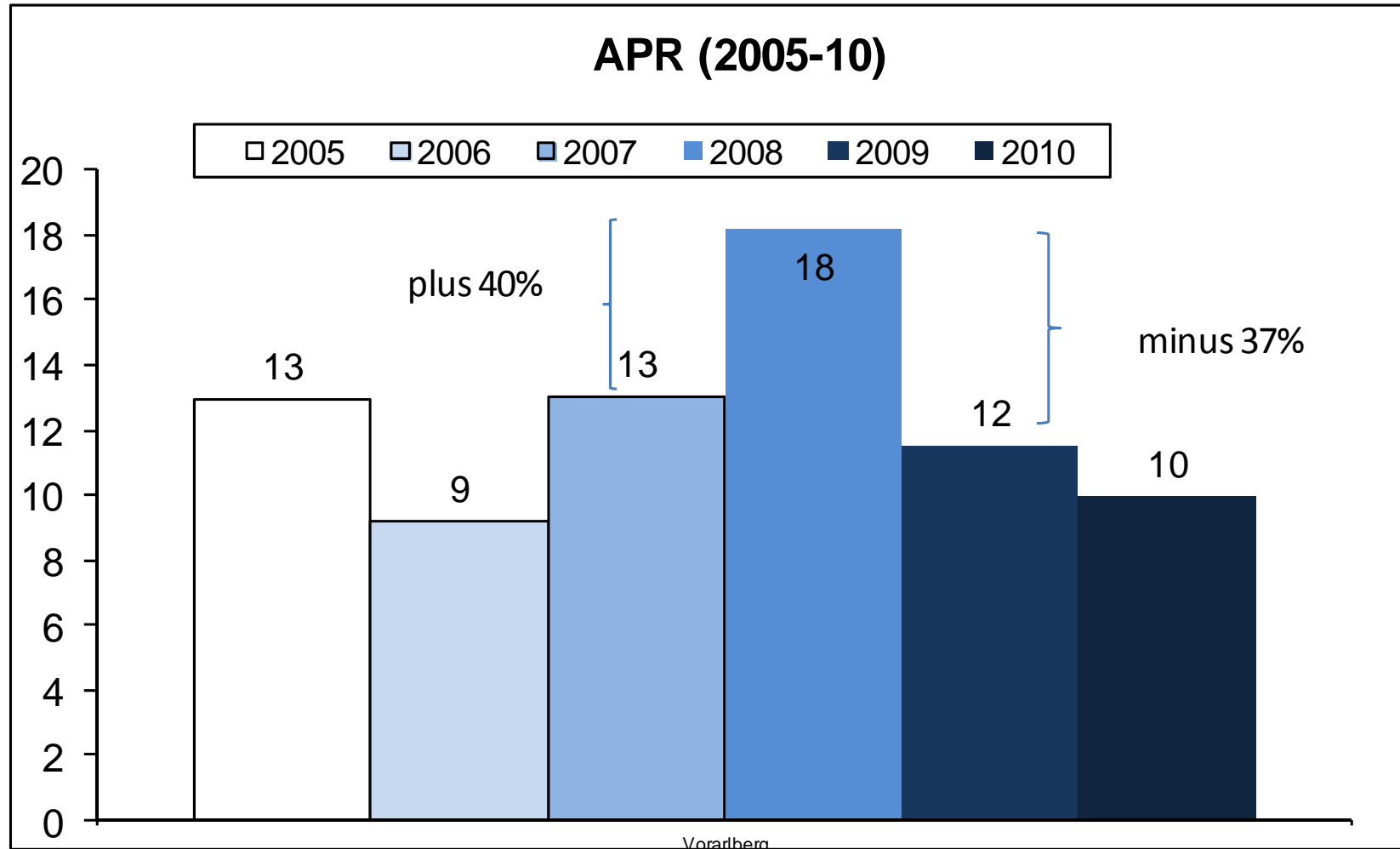
**Precision gains for NUTS2 poverty estimates: preliminary findings from an Austrian exercise**

## Our problem: Erratic patterns over time



Statistics Austria Eu-SILC

## AT34: a special case



Statistics Austria Eu-SILC

## Our problem: precision proportionate to region size

NUTS 2	n=	CI
<b>AT11</b>	<b>247</b>	4,7
<b>AT34</b>	<b>307</b>	3,6
<b>AT32</b>	<b>440</b>	3,0
<b>AT21</b>	<b>475</b>	4,3
<b>AT33</b>	<b>584</b>	2,6
AT22	1.014	2,4
AT13	1.219	2,4
AT31	1.233	2,2
AT12	1.287	1,8
Total	6.806	0,8

EU-SILC 2007, number of households, 95% confidence interval for Poverty Rate

Survey data can be used in different ways to compute Regional Indicators:

1. Direct estimation from survey data
2. Constructing alternative indicators
3. Cumulation over data
- 4. Small area estimation (SAE)**



Further insight into the relative income situations of individuals, particularly at the lower end of the income distribution by incorporating a measure of the actual levels of incomes received

Non-monetary deprivation means forced non-access to various facilities/possessions: hence it is inherently a matter of degree

Some *quantitative approach* is essential

# Membership functions

- Reconsider the definition of the membership function
  - based on monetary variables

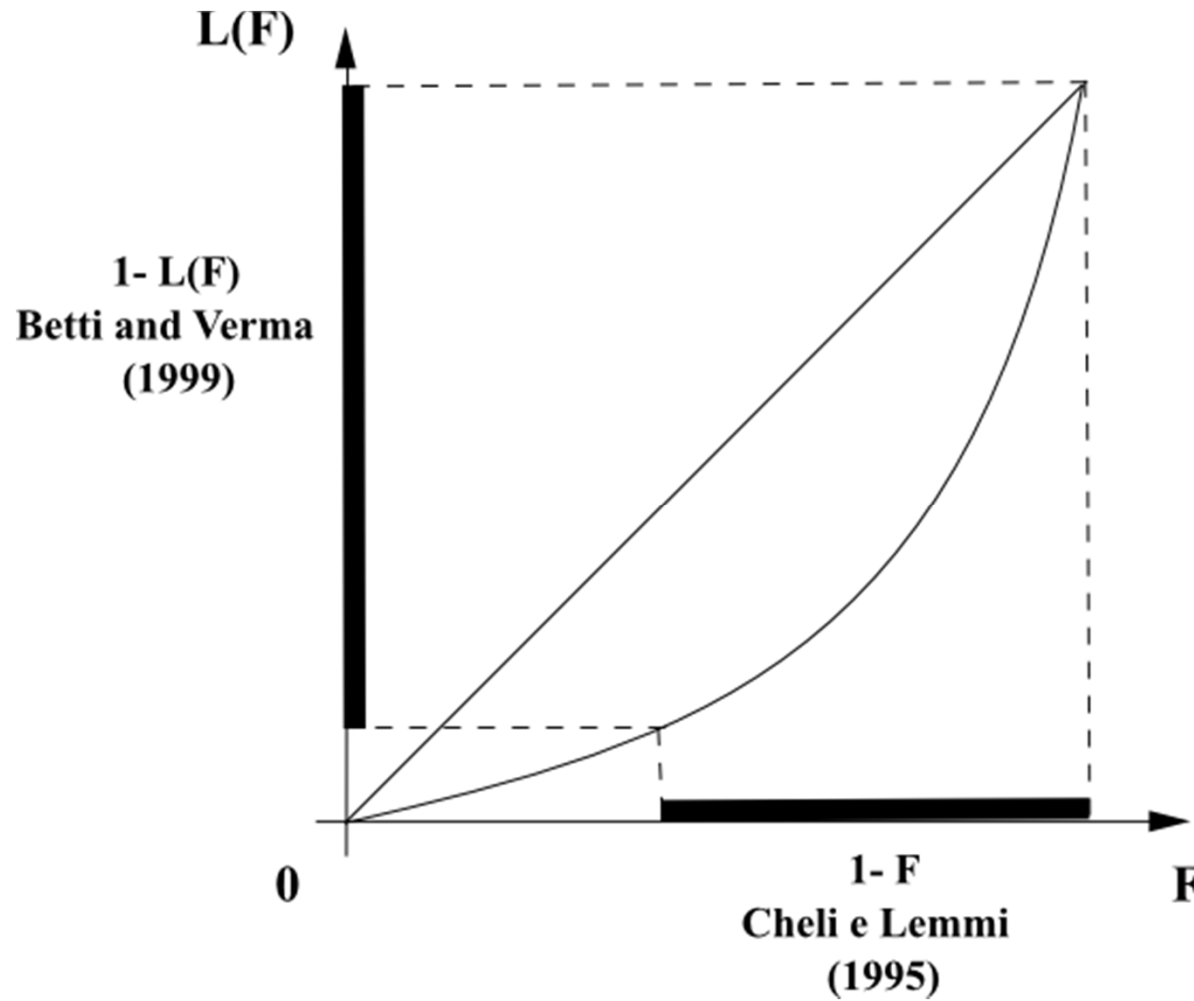
• **Cheli and Lemmi (1995)**

$$\mu_i = (1 - F)^{\alpha} = \left( \frac{\sum_{l=i}^n w_l}{\sum_{l=1}^n w_l} \right)^{\alpha}$$

• **Betti and Verma (1999)**

$$\mu_i = FM_i = \left( 1 - L_{(M),i} \right)^{\alpha} = \left( \frac{\sum_{l=i+1}^n w_l y_l}{\sum_{l=1}^n w_l y_l} \right)^{\alpha}$$

- Corresponding to the following projections:



# Definition of the membership function

•Betti, Cheli Lemmi and Verma (2005, 2006)

$$\mu_i = FM_i = (1-F)^{\alpha-1} \cdot [1-L(F)] = \left( \frac{\sum_{\gamma} w_{\gamma} | y_{\gamma} > y_i}{\sum_{\gamma} w_{\gamma} | y_{\gamma} > y_1} \right)^{\alpha-1} \cdot \left( \frac{\sum_{\gamma} w_{\gamma} y_{\gamma} | y_{\gamma} > y_i}{\sum_{\gamma} w_{\gamma} y_{\gamma} | y_{\gamma} > y_1} \right)$$

•The definition of the membership function is based on the monetary variable, where the alpha parameter is chosen such that the mean is equal to the Head Count Ratio.

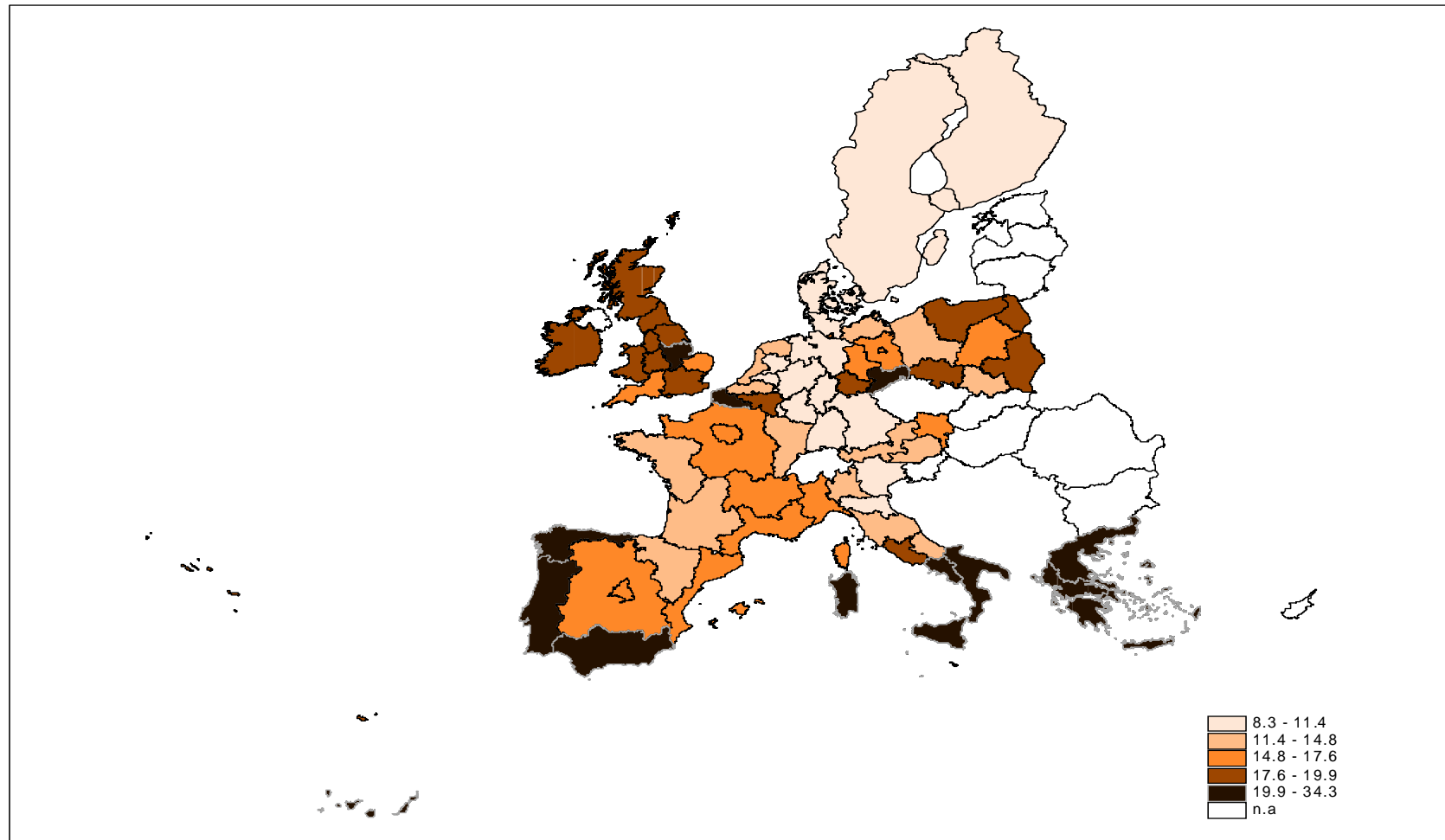
- **Proposal for new multidimensional and fuzzy Fuzzy Supplementary Indicator**
- To quantify and put together diverse indicators several steps are necessary:
  - Identification of items;
  - Transformation of the items into the  $[0, 1]$  interval;
  - Exploratory and confirmatory factor analysis;
  - Calculation of weights within each dimension (each group);
  - Calculation of scores for each dimension;
  - Calculation of an overall score and the parameter;
  - Construction of the fuzzy deprivation measure in each dimension (and overall).

# The indicators of poverty

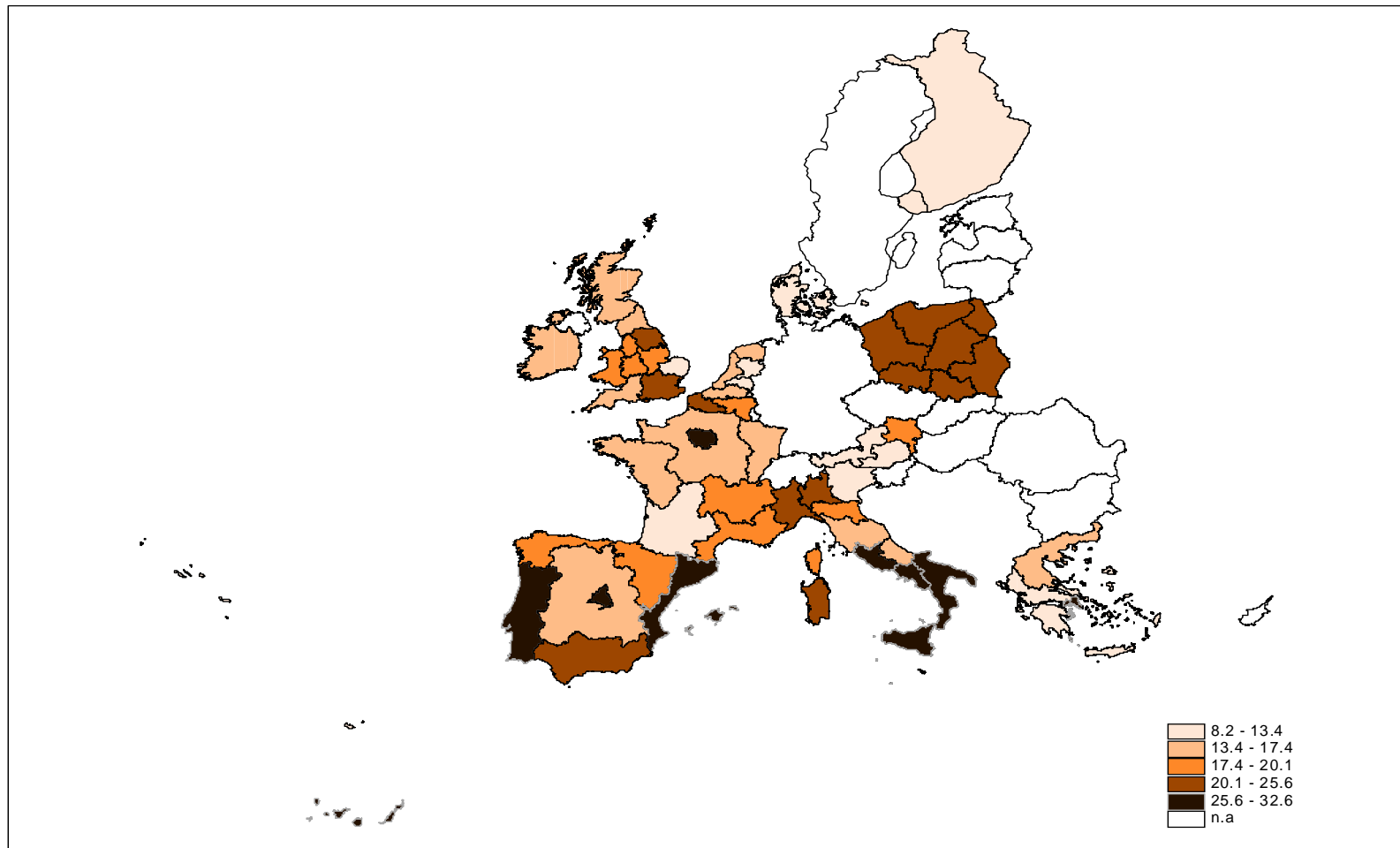
6 dimensions are identified:

1. Basic life-style – these concern the lack of ability to afford most basic requirements: *Keeping the home (household's principal accommodation) adequately warm; Paying for a week's annual holiday away from home; Eating meat chicken or fish every second day, if the household wanted to; Ability to make ends meet.*
2. Financial situation – these concern the lack of ability to pay in time due to financial difficulties: *Inability to cope with unexpected expenses; Arrears on mortgage or rent payments; Arrears on utility bills; Arrears on hire purchase instalments.*
3. Housing amenities – these concern the absence of basic housing facilities (so basic that one can presume all households would wish to have them): *A bath or shower; An indoor flushing toilet; Leaking roof and lamp; Rooms to dark.*
4. Environmental problems – these concern problems with the neighbourhood and the environment: *Pollution; Crime, violence, vandalism; Noise.*
5. Consumer durables - these concern enforced lack of widely desired possessions ("enforced" means that the lack of possession is because of lack of resources): *A car or van; A colour TV; A pc; A washing machine; A telephone.*
6. Health related – these concern problems with personal health: *General health; Chronic illness; Mobility restriction.*

## Overall Non-monetary deprivation rates, NUTS1 regions

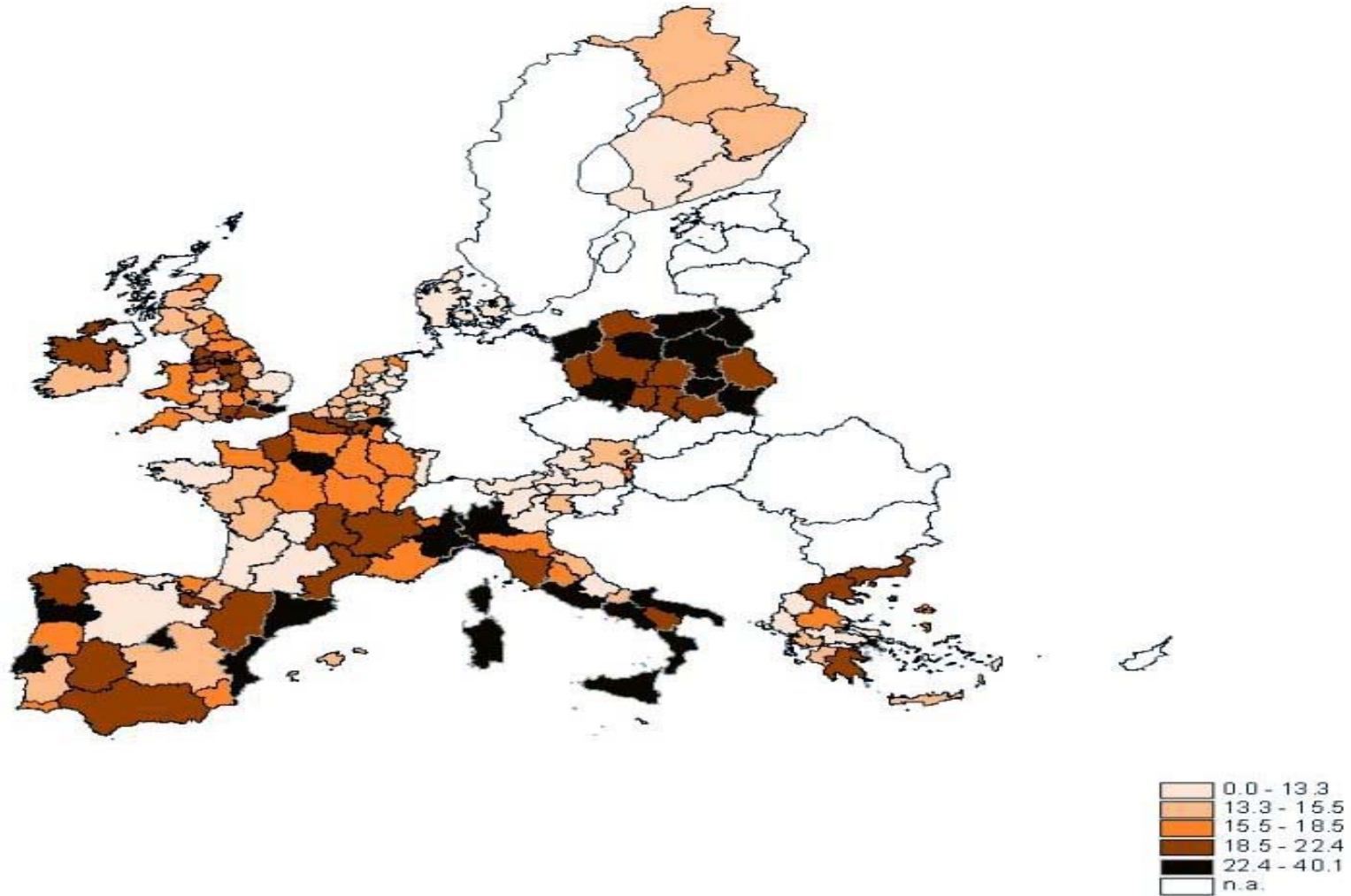


## Environmental Problems, NUTS1 regions





## Environmental Problems, NUTS2 regions



- **Problems and limitations**
- EU-SILC data do not often report information on NUTS2 level, only on NUTS1 (target variable DB040). This precludes researchers to estimate poverty at such level.
- Moreover, full information on sampling design (stratification, clustering, implicit stratification, and so on...) is partially or even not reported. This precludes the estimation of variance of 'direct estimates', which are the needed input of typical SAE methods, such as EBLUP.

## References

- Betti G., Gagliardi F., Lemmi A., Verma V. (2012), Sub-national indicators of poverty and deprivation in Europe: methodology and applications, *Cambridge Journal of Regions, Economy and Society*, 5(1), pp. 149-162.
- Betti G., Lemmi A. (2013, eds.), *Poverty and Social Exclusion: New Methods of Analysis*. London and New York: Routledge. →
- European Commission (2005), *Regional Indicators to reflect social exclusion and poverty*. Report prepared for Employment and Social Affairs DG - with contribution of Gianni Betti, Achille Lemmi, Anna Mulas, Michela Natilli, Laura Neri, Nicola Salvati, and Vijay Verma.

