Can a Neighbour Region Influence Poverty?

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Outline

Introduction

Motivation

- 2030 UN Agenda for Sustainable Development
  - ➜ "... *eradicate poverty, in all its forms and dimensions...*"
- European union's Europe 2020 strategy headline targets
  - ➜ reduction of at-risk-of-poverty-rate
  - ➜ reduction of at-persistent-risk-of-poverty-rate
- DG Regional Policy of the European Commission
  - ➜ Monitoring the headline targets at regional level (NUTS2)

Fuzzy Poverty

Fuzzy approach to poverty

- ✗ Simple dichotomy $i \in \{0, 1\}$
- ✓ individual i is given a certain *propensity* to poverty covering the whole range $[0, 1]$
  - ➜ Crucial choice of membership functions

Fuzzy Poverty

Cross-sectional fuzzy membership function. See Betti et al. (2015)

$$\mu_{iK} = \left(\frac{\sum_{\gamma=i+1}^{n} \omega_\gamma | X_\gamma > X_i}{\sum_{\gamma=2}^{n} \omega_\gamma | X_\gamma > X_1} \right)^{\alpha_K - 1} \left(\frac{\sum_{\gamma=i+1}^{n} \omega_\gamma | X_\gamma > X_i}{\sum_{\gamma=2}^{n} \omega_\gamma | X_\gamma > X_1} \right)$$

$K = 1, 2$ - Fuzzy Monetary (**FM**) and Fuzzy Supplementary (**FS**)

Longitudinal measures of fuzzy and multidimensional poverty

1. Anytime $\mu_{\text{any}} = \max\{\mu_1, \mu_2, \mu_3, \mu_4\}$
2. Continuous $\mu_{\text{cont}} = \min\{\mu_1, \mu_2, \mu_3, \mu_4\}$
3. Fuzzy at-persistent-risk-of-poverty. See Verma et al. (2017)

Data Set and Methodology

EU Statistics on Income and Living Conditions (EU-SILC) survey

- rotational panel
  - four years follow-up
- designed to be representative at national level
- but the need is to obtain estimates at NUTS2 level (see Motivation)
  - ➜ Low sample size
  - ➜ Direct estimators suffer from large variances

Need of small area estimation (**SAE**) techniques

Data Set and Methodology

Model based small area estimation

1. Classic Fay and Herriot (1979) model

$$\hat{\theta}_i = \mathbf{x}_i'\boldsymbol{\beta} + z_i v_i + e_i$$

2. Extension allowing for spatially correlated random effects. See Pratesi and Salvati (2008)

$$\hat{\boldsymbol{\theta}} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}(\mathbf{I} - \rho\mathbf{W})^{-1}\mathbf{u} + \mathbf{e}$$

Input

1. Auxiliary information for each small area
2. Direct sample estimates for each measure
3. Standard error estimates. See Betti et al. (2018) and Verma and Betti (2011) for a proposal of JRR procedure.

Data Set and Methodology

Application

- data for Spain
  - ✓ 13,109 households (2011)
  - ✓ 34,756 individuals (2011)
- public data
- non public data
  - ✓ code for regions at NUTS2
  - ✓ sampling strata
  - ✓ primary sampling units

Data Analysis - Results

Table 1: FM continuous poverty rate. The average reduction in standard errors is about 20% for the Fay and Herriot model over the direct estimator and about 24% for the Spatial EBLUP

Region	Direct (%)	SE	Fay-Herriot	SE	Spatial EBLUP	SE
Galicia	7,91	1,14	8,28	1,06	8,10	1,05
Asturias	5,11	1,03	5,57	0,97	5,70	0,94
Cantabria	7,01	1,46	6,72	1,28	6,49	1,21
Pais Vasco	4,43	1,17	4,03	1,10	3,65	1,06
Navarra	2,13	0,76	2,44	0,74	2,63	0,63
Rioja	11,24	3,09	8,61	1,88	7,44	1,58
Aragon	4,77	1,02	4,98	0,96	4,86	0,93
Madrid	5,59	0,87	5,04	0,85	5,17	0,88
Castilla y Leon	8,50	2,07	8,25	1,60	9,04	1,29
Castilla - La Mancha	13,63	1,96	12,55	1,58	13,31	1,37
Extremadura	19,49	1,95	17,04	1,65	17,07	1,55
Cataluna	6,18	0,92	6,44	0,88	6,24	0,87
Comunitat Valenciana	7,86	1,17	8,15	1,08	8,16	1,04
Balears	6,04	1,87	7,57	1,51	6,98	1,59
Andalucia	13,80	1,58	13,10	1,38	13,82	1,33
Murcia	11,08	2,96	11,21	1,91	11,79	1,64
Ceuta	14,43	7,55	13,95	2,40	11,83	2,26
Melilla	5,76	6,01	9,23	2,13	7,68	2,07
Canarias	9,19	2,03	9,99	1,60	9,02	1,67

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Data Analysis - Results

Table 2: i) Anytime poverty rate - ii) Continuous poverty rate - iii) Fuzzy-at-persistent-risk-of-poverty-rate

Measure	Gain (%)	
	Fay-Herriot	Spatial-EBLUP
FM_{iii}	18.22	25.81
FS_{iii}	15.98	13.42
FM_{i}	18.46	24.49
FS_{i}	16.64	16.21
FM_{ii}	19.57	23.02
FS_{ii}	15.72	14.11

Conclusions

To **conclude**

1. Propose direct estimates of poverty based on fuzzy set theory
   - ➜ New measure at-persistent-risk-of-poverty-rate
2. JRR procedure for estimating standard errors of such estimates
3. SAE techniques to have estimates with lower MSEs
   - ✓ Lower MSEs of 20-30% on average
   - ✓ Peaks of 70% for areas of small sample size
   - allowing for neighbouring regions yields more efficient estimates for monetary measures
   - for multidimensional and non-monetary measures it provides little benefit

Questions?

Thank you for your attention

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