

Indirect estimation of poverty at a local level in Poland

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Outline

1. Introduction
2. Small area estimation
3. Selected results
4. Conclusions

Aim of the research

Estimation of poverty indicators
at LAU 1 level in Poland

Poverty indicators — headcount ratio and poverty gap

The general formula for poverty indicators depending on the parameter α :

Headcount ratio (F_0) for $\alpha = 0$

Poverty gap (F_1) for $\alpha = 1$

$$F_\alpha = \frac{1}{N} \sum_{j=1}^N \left(\frac{z - E_j}{z} \right)^\alpha I(E_j < z), \quad \alpha \geq 0, \quad (1)$$

where:

N — population size,

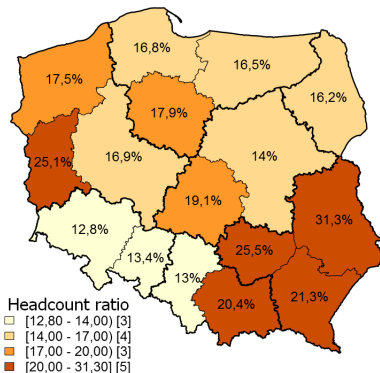
z — poverty threshold,

E_j — income of j -th unit,

$I(E_j < z) = 1$, if $E_j < z$ and $I(E_j < z) = 0$ in opposite case.

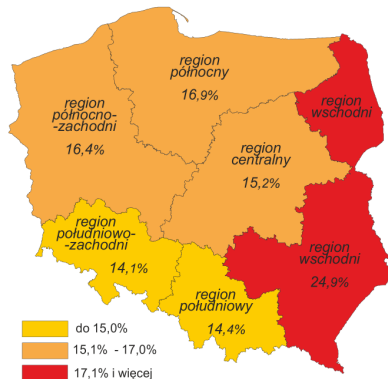
Currently published information about poverty

Figure 1: Headcount ratio by provinces in 2011 year



Source: EU-SILC.

Figure 2: Headcount ratio by regions in 2012 year



Unit level model

Nested error linear regression model:

$$Y_{dj} = x_{dj}^T \beta + u_d + e_{dj}, \quad j = 1, \dots, N_d, \quad d = 1, \dots, D, \quad (2)$$

where:

Y_{dj} — transformed income of j -th unit in d -th area,

x_{dj}^T — auxiliary variables for j -th unit in d -th area,

β — regression coefficients,

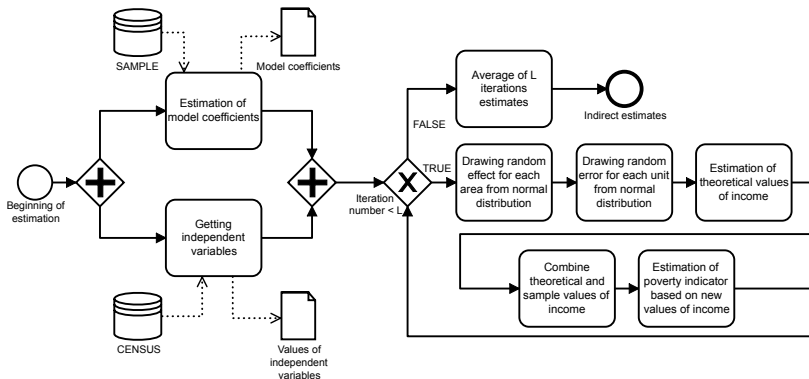
u_d — random effect with $u_d \stackrel{iid}{\sim} N(0, \sigma_u^2)$,

e_{dj} — random error with $e_{dj} \stackrel{ind}{\sim} N(0, \sigma_e^2)$.

[Molina and Rao 2010]

Empirical best estimator

Figure 3: Poverty indicators estimation using Monte Carlo simulations



Own elaboration based on [Molina and Rao 2010].

Precision assessment criterion

- Relative root mean square error:

$$RRMSE(\hat{F}_{\alpha d}) = \frac{RMSE(\hat{F}_{\alpha d})}{\hat{F}_{\alpha d}}, \quad (3)$$

where:

$RMSE(\hat{y})$ — root of mean square error of estimate,

\hat{y} — poverty indicator estimate. Bootstrap — 500

replications.

Background of research

Estimated variables

- headcount ratio
- poverty gap

Domains

- 379 LAU 1

Data

- **EU-SILC 2011** — as a source of dependent and independent variables
- **National Census of Population and Housing 2011** — as a source of auxiliary variables

Headcount ratio by LAU 1

Spatial diversity of **headcount ratio** by LAU 1 in 2011 year — direct and indirect approach

Figure 4: Direct estimation

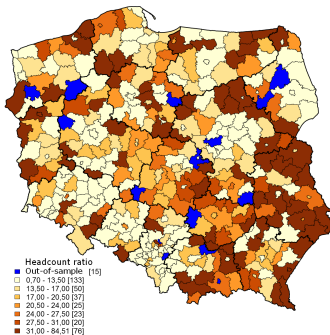
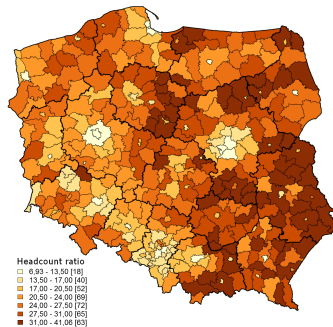


Figure 5: Indirect estimation

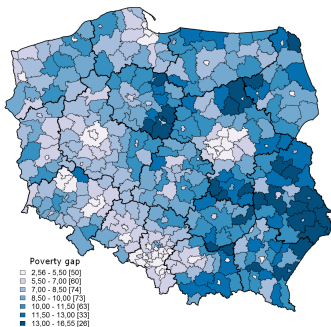


Source: own elaboration based on LDB, 2011 census and EU-SILC 2011.

Poverty gap and headcount ratio by LAU 1

Spatial diversity of poverty gap and headcount ratio by LAU 1 in 2011 year — indirect approach

Figure 6: Poverty gap



Source: own elaboration based on LDB, 2011 census and EU-SILC 2011.

Poverty gap and headcount ratio by LAU 1

Spatial diversity of poverty gap and headcount ratio by LAU 1 in 2011 year — indirect approach

Figure 6: Poverty gap

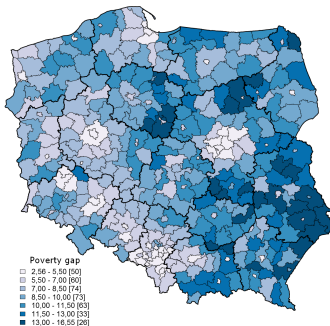
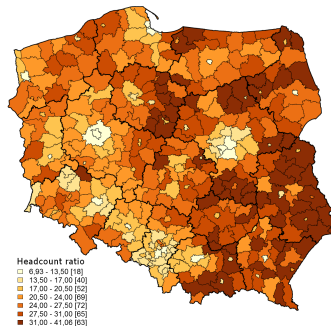


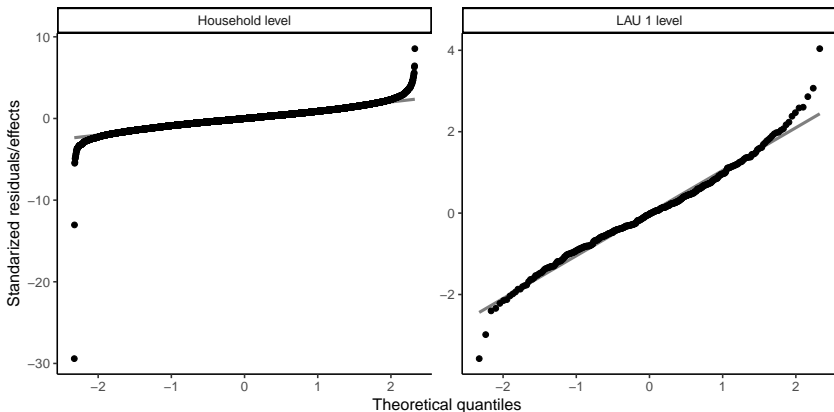
Figure 7: Headcount ratio



Source: own elaboration based on LDB, 2011 census and EU-SILC 2011.

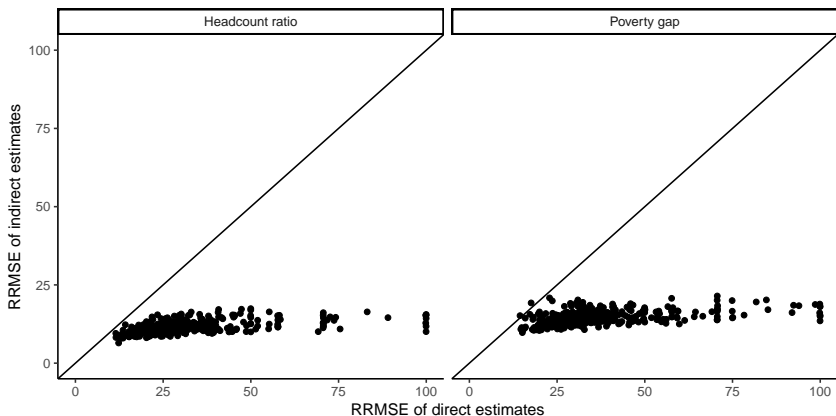
Model assumptions checking

Figure 8: Distribution of random errors at household level and random effects at LAU 1 level



Precision of headcount ratio and poverty gap estimates

Figure 9: Comparison of RRMSE of estimates by LAU 1 in 2011 year



Source: own elaboration based on LDB, 2011 census and EU-SILC 2011.

Conclusions

- Obtained results significantly expand available information about poverty of poverty gap in territorial sections.
- The unit level model made possible to obtain precise results at the LAU 1 level.
- The use of indirect estimation allows to estimate poverty indicators for LAU 1 that were not present in the sample.
- Poverty in Poland is characterized by a strong spatial diversity.

Thank you for your attention