Adaptive deprivation scales in a multi-national context: the EU child deprivation indicator

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Deprivation scales

- Fifty years of development from Townsend (1979) on

- Non-monetary poverty measure based on set of indicative items – goods or activities

- Items selected by public opinion plus barrage of statistical tests (Guio et al 2012, 2018)

- Items are used to measure a latent trait (deprivation) – Item Response Theory

EU adoption

- **2009** – 9-item *material depvn* scale for whole population (annual)

- **2010** – *severe material depvn* (lack 4+), part of AROPE *Europe 2020* targets

- **2017** –13-item *material and social depvn* scale for whole population (annual)

- **2018** – 17-item *child-specific depvn* scale (3-yearly)

- **2021** – *severe material and social depvn* (lack 6+), part of new target

- **2021** – sub-target for children

EU Child Deprivation Scale – 17 items

Child

1. Some new (not second-hand) **clothes**
2. Two pairs of properly fitting **shoes**
3. Fresh **fruit** and vegetables daily
4. **Meat**, chicken, fish or equivalent daily
5. **Books** at home suitable for the children's age
6. **Outdoor** leisure equipment
7. **Indoor** games
8. Regular leisure **activities**
9. **Celebration** on special occasions
10. **Invitation** of friends to play and eat
11. Participation in **school trips** and events
12. **Holiday**

Household

13. Not in **arrears** with bills, etc.
14. Home adequately **warm**
15. Access to **car** for private use
16. Replace worn-out **furniture**
17. Access to **internet**

Deprivation - lack item due to affordability (not choice)

Deprivation score – count of deprivations

Deprived – lack 3+ items

Adaptive testing

- Adaptive testing
  - Use latent trait model to order test/scale items (difficulty/severity)
  - Tailor items asked to individual ability – maximises information
  - Still rate each individual on the same underlying (latent) trait
    - In effect, assume we know the answer to unasked questions

- Advantages – time saving
  - Efficiency - cost savings and/or space for more useful questions
  - Reduce respondent burden and irritation
  - Include scales more frequently and/or in more surveys

- Disadvantages – potential information loss or error

- Adaptive deprivation scale
  - Start with most-commonly lacked items (lowest severity)
  - Stop questions when **very unlikely** respondent will lack any remaining items (and assume they don't)
  - Wide range of possible algorithms – number of questions asked at each stage and rules on when to stop

- Applied to UK's child deprivation scale (21 items) in Bailey (2020)
  - Time saving – 48%
  - Deprived cases missed – 0.3%
    - Non-deprived cases all correctly identified by definition
  - Deprivation rate <0.1% lower than on full scale
  - Correlation of adaptive and full scales – 0.99
  - Even at level of individual items, missingness is minimal

- 1: How well does the adaptive deprivation approach work in the multi-national context of the EU's child deprivation scale?

- 2: Given the EU-SILC also has a whole-population deprivation scale, can we use this to make collection of child deprivation even more efficient?

Data and model

- Ad hoc module on child deprivation in 2014 EU-SILC
  - EU-27 countries
  - Analysis for **households** with children, **unweighted data**
    - Drop cases with missing data on any child items
    - Take whole popln scale items from adult respondent

- Two-parameter latent trait models – all 31 countries:

$$Y_{ij} = a_i \theta_j - b_i$$

Y_{ij} = Logit that item i is endorsed by person j
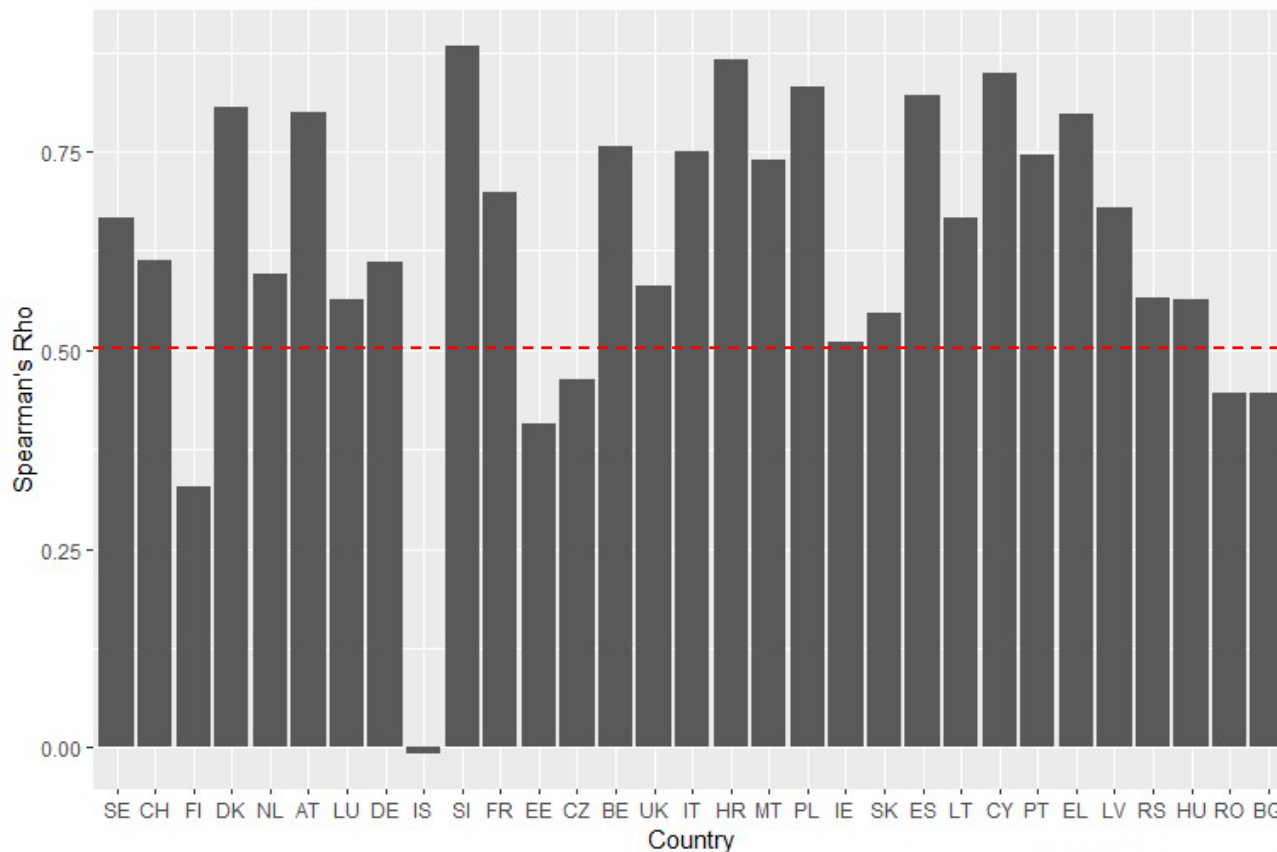
θ_j = **Trait** level of person j

b_i = **Difficulty** of item i (a.k.a. item *threshold*)

a_i = **Discrimination** of item i (a.k.a. item *slope*, or *loading*)

Item order within countries vs EU order

Spearman rank correlation of item difficulty within country vs EU-wide
Countries ordered by deprivation

EU-SILC 2014, unweighted.

- Item order from separate LTM for each country vs order from single LTM for all 31 countries

- Rank correlation > 0.5 in 25 of 31
  - Iceland an exception

- More clear agreement on 'first four' items

Adaptive deprivation algorithms – "i+j"

- Order items by severity, start with least severe

- Ask first i questions and stop if lack none*
  - % time saved = $(17 - i)/17$

- If not, ask next j questions and stop if lack one*
  - % time saved = $(17 - i - j)/17$

- If not, ask remaining questions
  - Time saved = 0

* Different stopping rules explored but this performs best

Evaluation of adaptive scales – criteria

- Information loss evaluated using different criteria, depending on main intended uses
  - % of deprived cases 'missed'
  - Deprivation rates on adaptive vs full scales
  - Correlations of adaptive vs full deprivation score
  - Average number of items lacked by deprived children on adaptive vs full scales
  - Proportions lacking individual items on adaptive vs full scales
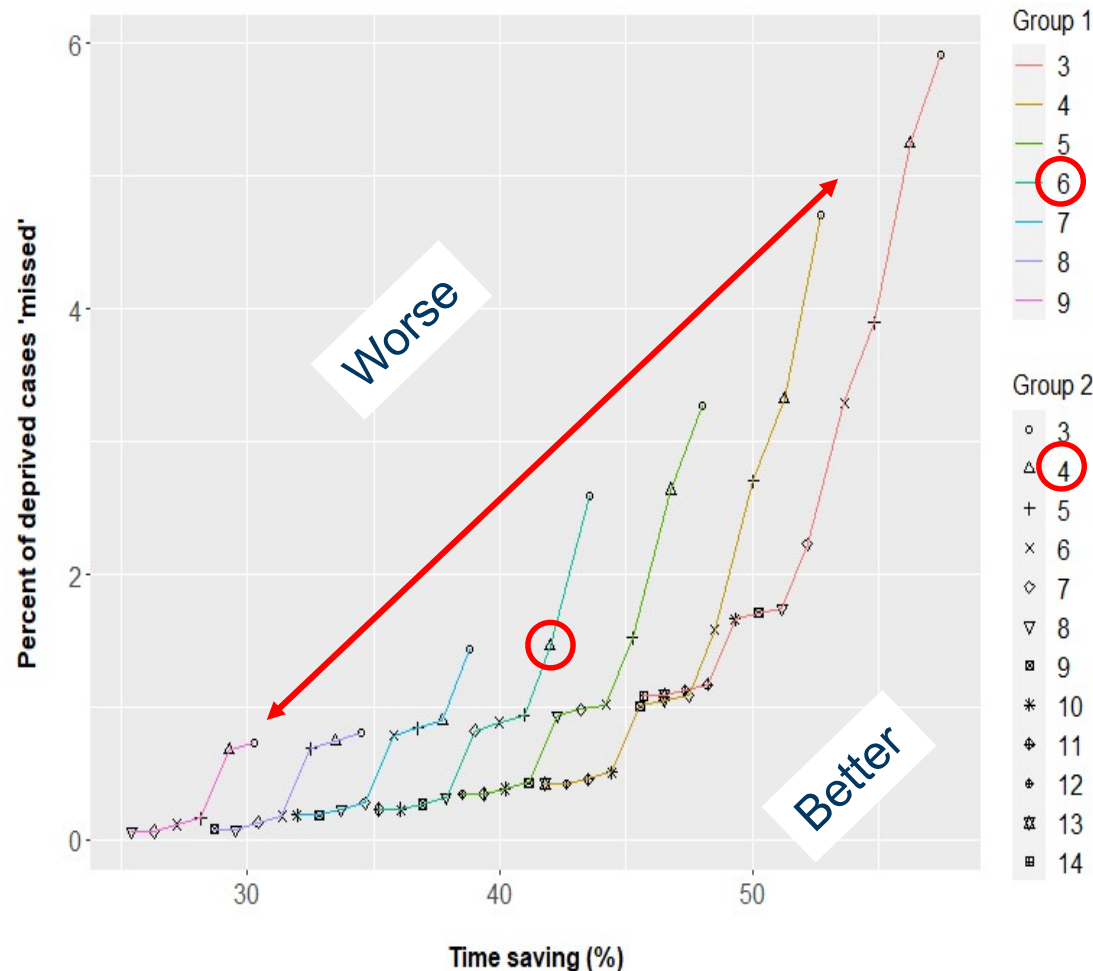
- "6+4" algorithm
  - Time saving 42%
  - Deprived cases missed 1.4%

- In general, more time saving means more information loss

- Some better than others but not single 'best' solution

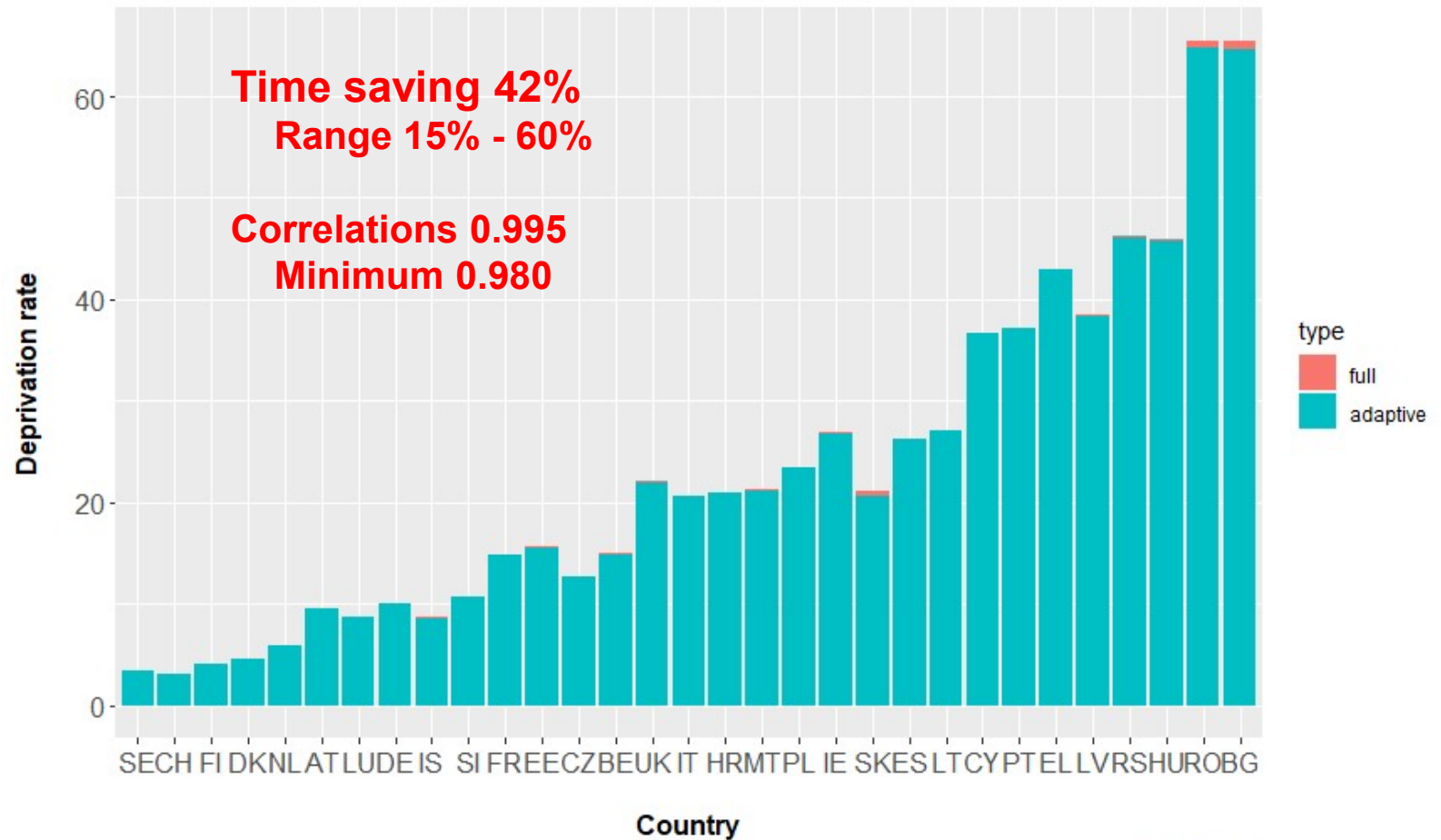## Step 1: All 54 algorithms
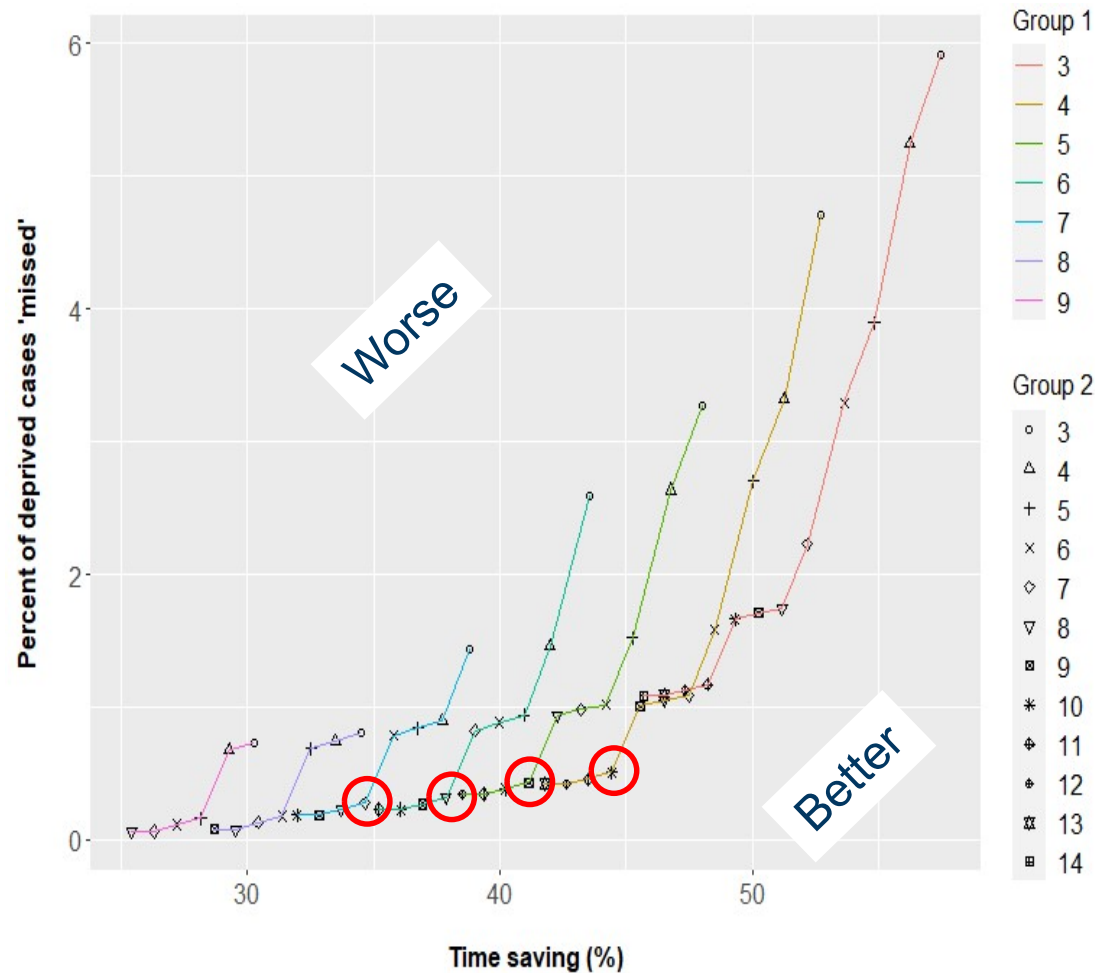
- Preferred options
  - "4+10"
  - "5+9"
 - "6+8"
  - "7+7"

- Deprived cases missed 0.3-0.5%
- Time saving 35-44%

Deprivation rates on adaptive vs full scales "5+9" option

Child deprivation rates on adaptive and full scales ('5+9' option)

Time saving 42%
Range 15% - 60%

Correlations 0.995
Minimum 0.980

EU-SILC 2014

% of cases where lacked item missed by simple adaptive scales ('5+9' option)
Countries ordered by deprvn, items ordered by difficulty; y axis truncated
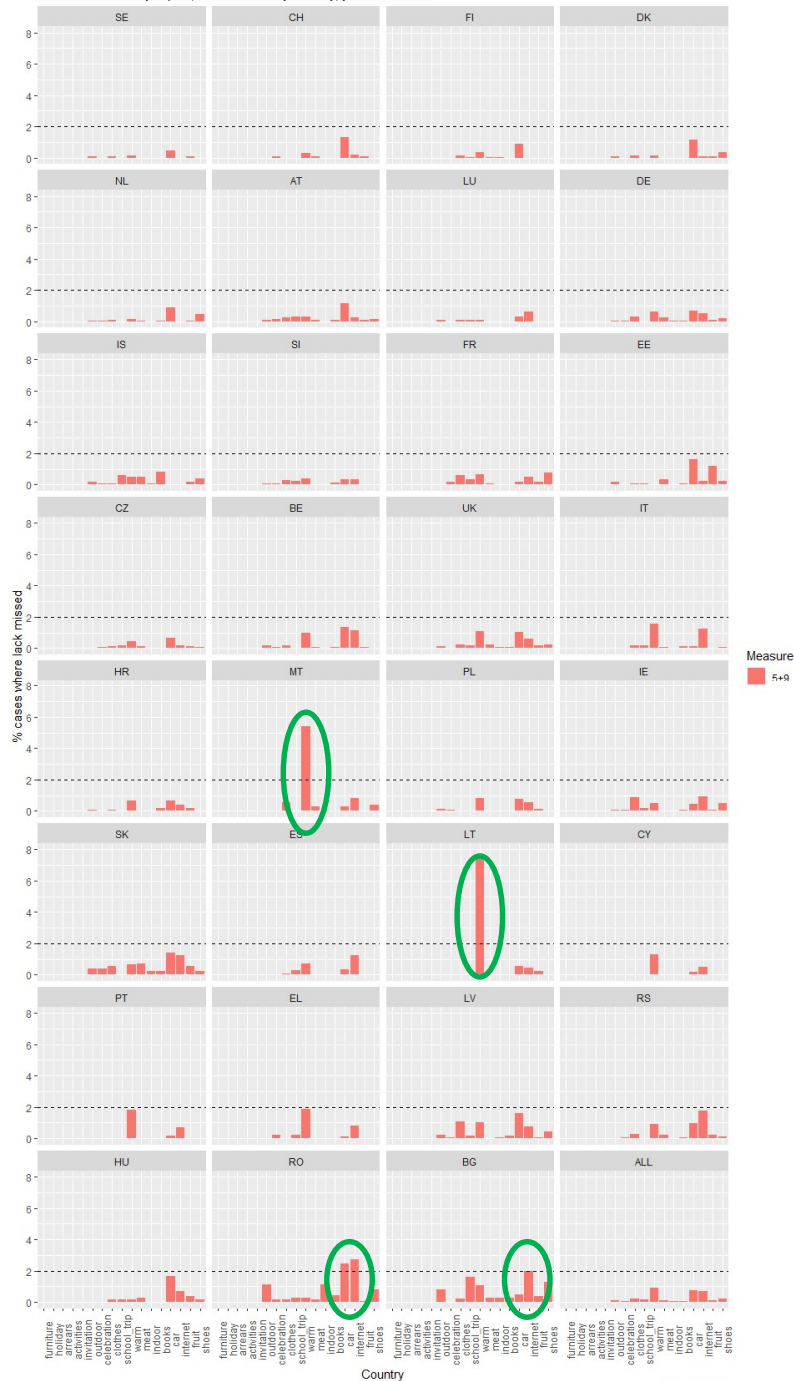
Item-level missingness – "5+9" option

- % cases where lack of an item missed
  - 17 items in all 31 countries (N=527)

- 27 countries - % missed less than 2% on all 17 items

- 4 others
  - BG – one item missed 2%
  - RO – two items missed 3%

  - MT – one item missed 5%
 - LT – one item missed 7%

Conclusions – 1

- Adaptive approach performs very well even in the highly varied context of the 31 EU-SILC countries
  - "5+9" algorithm: time saving 42%
  - Deprivation rate 21.75% c.w. 21.84% on full scale
  - Minimal item missingness
  - Policy choice about which algorithm is most appropriate

Questions

- 1: How well does the adaptive deprivation approach work in the multi-national context of the EU's child deprivation scale?

- 2: Given the EU-SILC also has a whole-population deprivation scale, can we use this to make collection of child deprivation even more efficient?

  - ➢ *Narrower task*: If we just want to measure child deprivation rate (lacking 3+ items), how much time would that take?
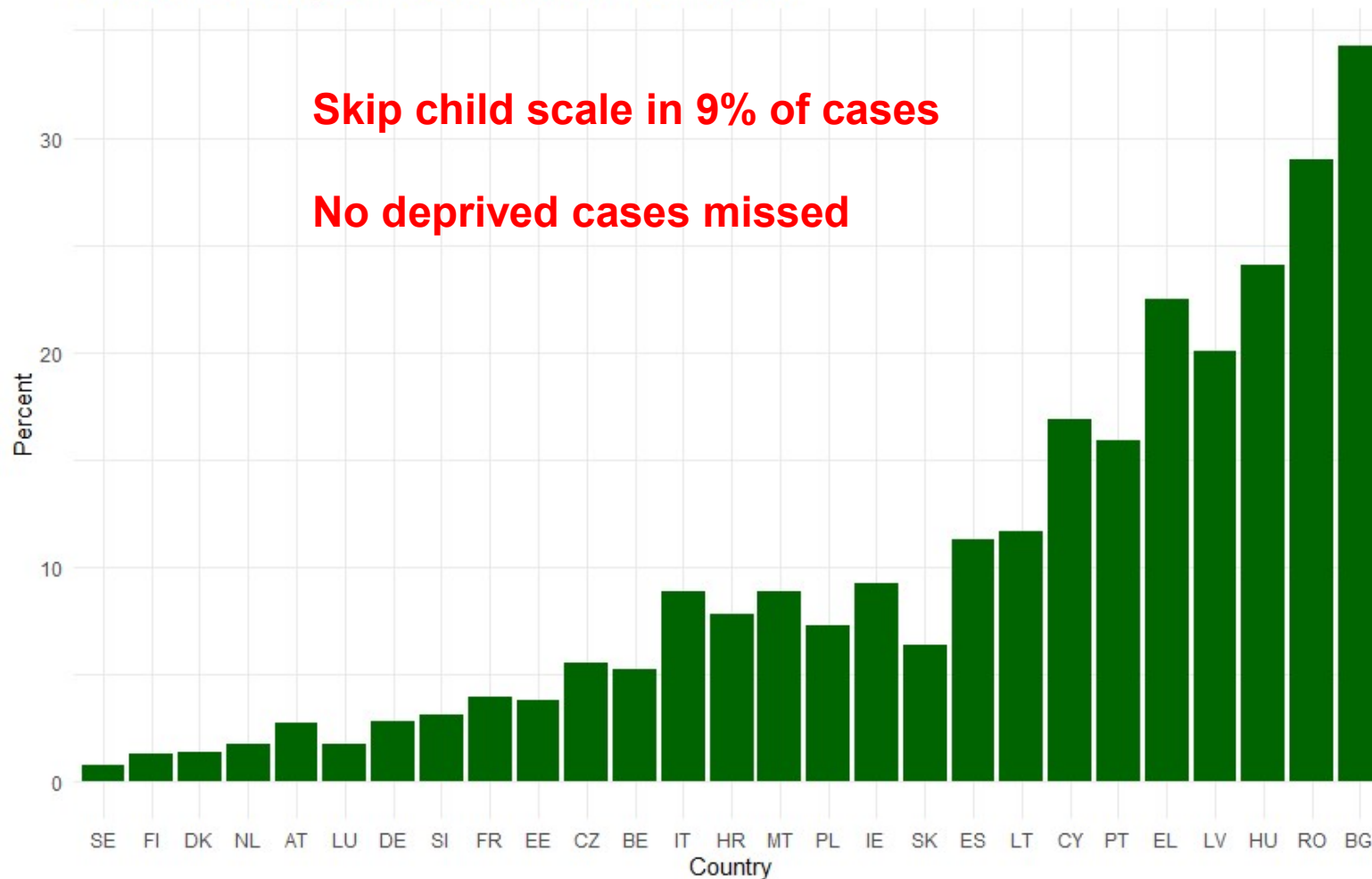 - ➢ Focus on EU-27
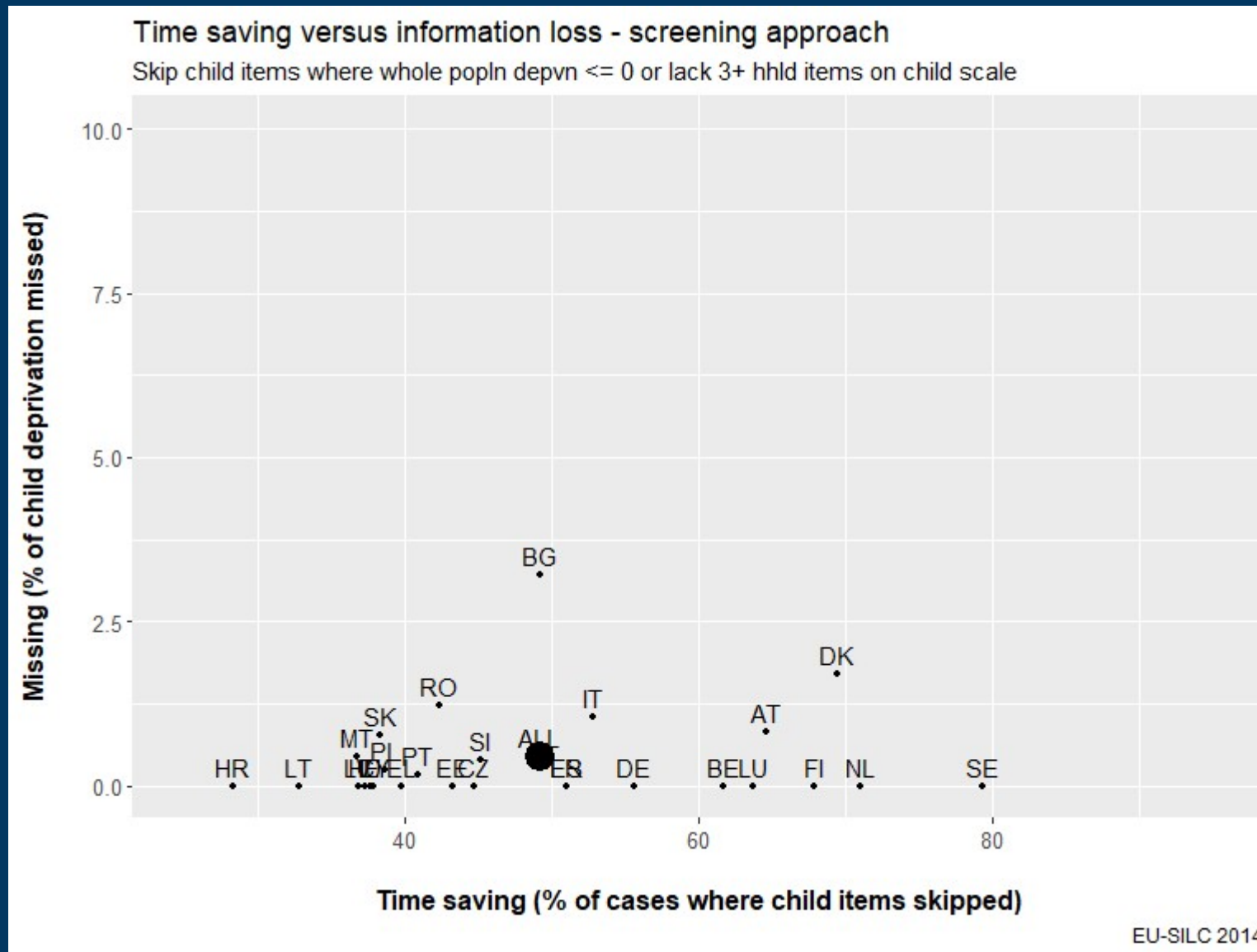
Depvn on whole popln scale vs child items
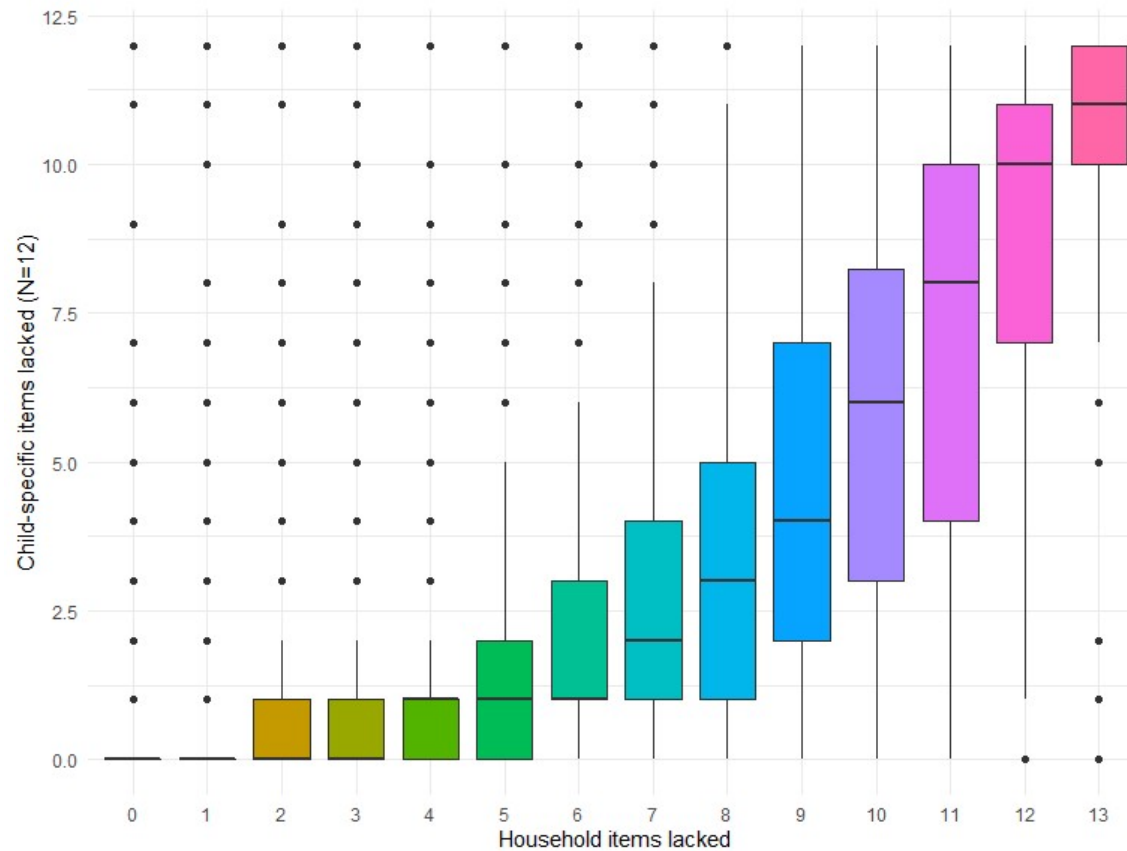
- Whole population scale annual contains a lot of information about child deprivation

1. Screen out where child deprived on household items

Households lacking 3+ household items from child scale

Skip child scale in 9% of cases

No deprived cases missed

2. Screen out where lack 0/1/2 items on whole popln scale

Time saved 40% – depvd cases missed 0.4%

Time saved 14% – depvd cases missed 0.8%

Time saved 10% – depvd cases missed 2.3%

Items lacked on child scale
- 0
- 1
- 2
- 3
- 4
- 5
- 6+

Number of households

Items lacked on whole population scale

Screening: skip if whole popln depvn == 0 or lack 3+ hhld items

Time saving versus information loss - screening approach

Skip child items where whole popln depvn <= 0 or lack 3+ hhld items on child scale

EU-SILC 2014

Screening: skip if whole popln depvn <=1 or lack 3+ hhld items

Time saving versus information loss - screening approach

Skip child items where whole popln depvn <= 1 or lack 3+ hhld items on child scale

EU-SILC 2014

Screening: skip if whole popln depvn <=2 or lack 3+ hhld items

Time saving versus information loss - screening approach
Skip child items where whole popln depvn <= 2 or lack 3+ hhld items on child scale

EU-SILC 2014

Screening: skip if whole popln depvn <= 0/1 or lack 3+ hhld items
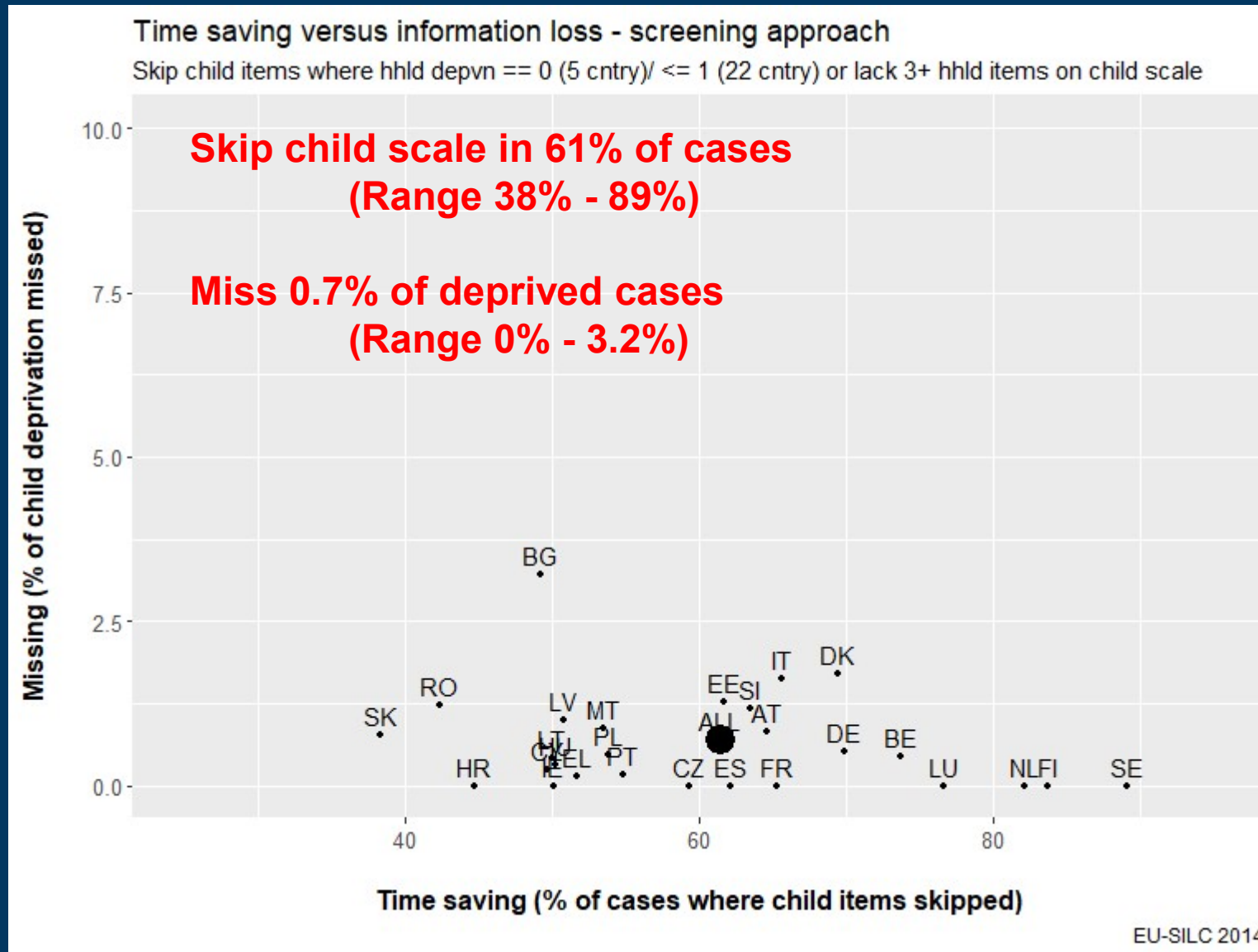
Time saving versus information loss - screening approach

Skip child items where hhld depvn == 0 (5 cntry)/ <= 1 (22 cntry) or lack 3+ hhld items on child scale

Skip child scale in 61% of cases
(Range 38% - 89%)
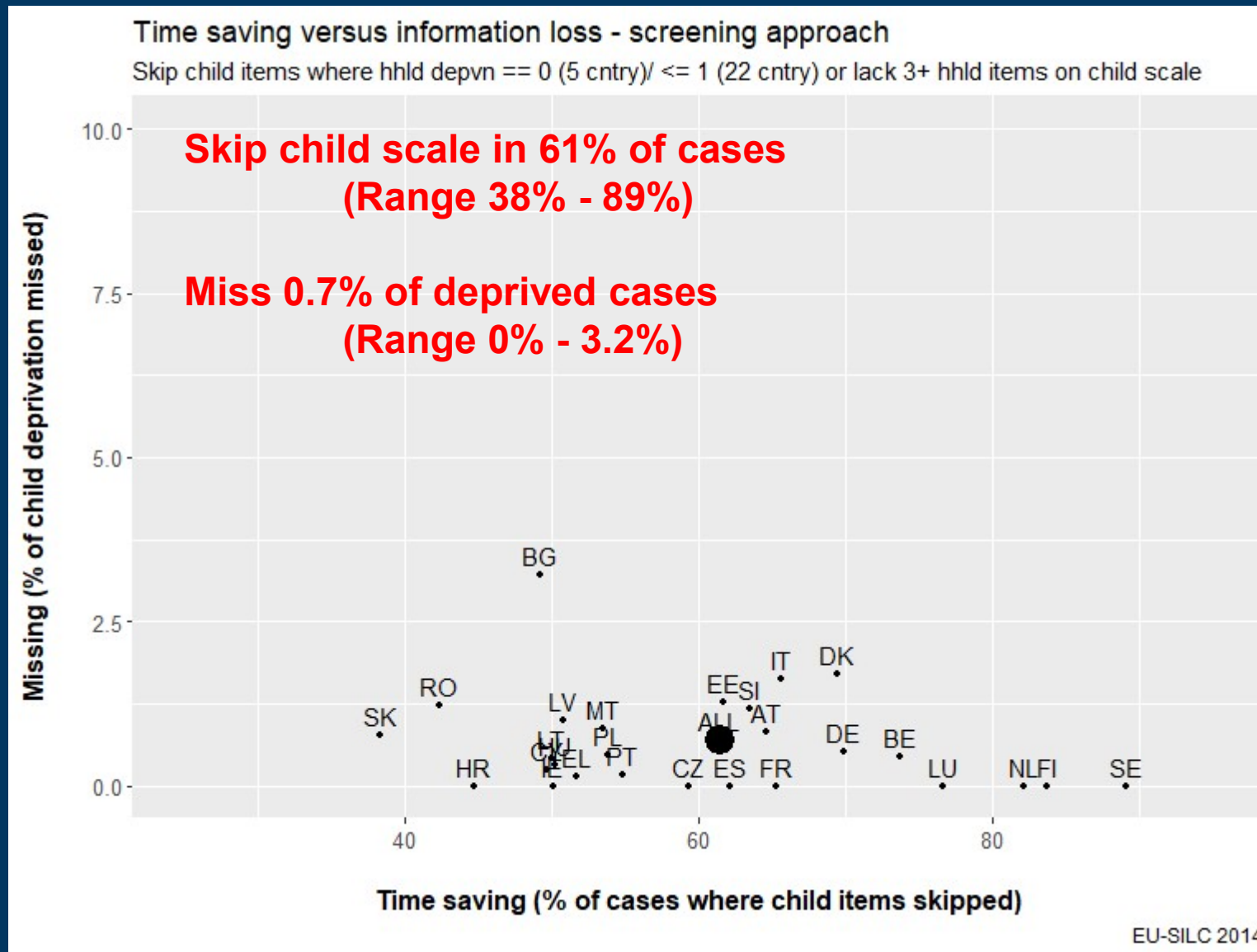
Miss 0.7% of deprived cases
(Range 0% - 3.2%)

EU-SILC 2014

Screening alone – time saving 61%

Child deprivation rates on screening and full scales

Skip child items where hhld depvn == 0 (6 cntry)/<= 1 (25 cntry)
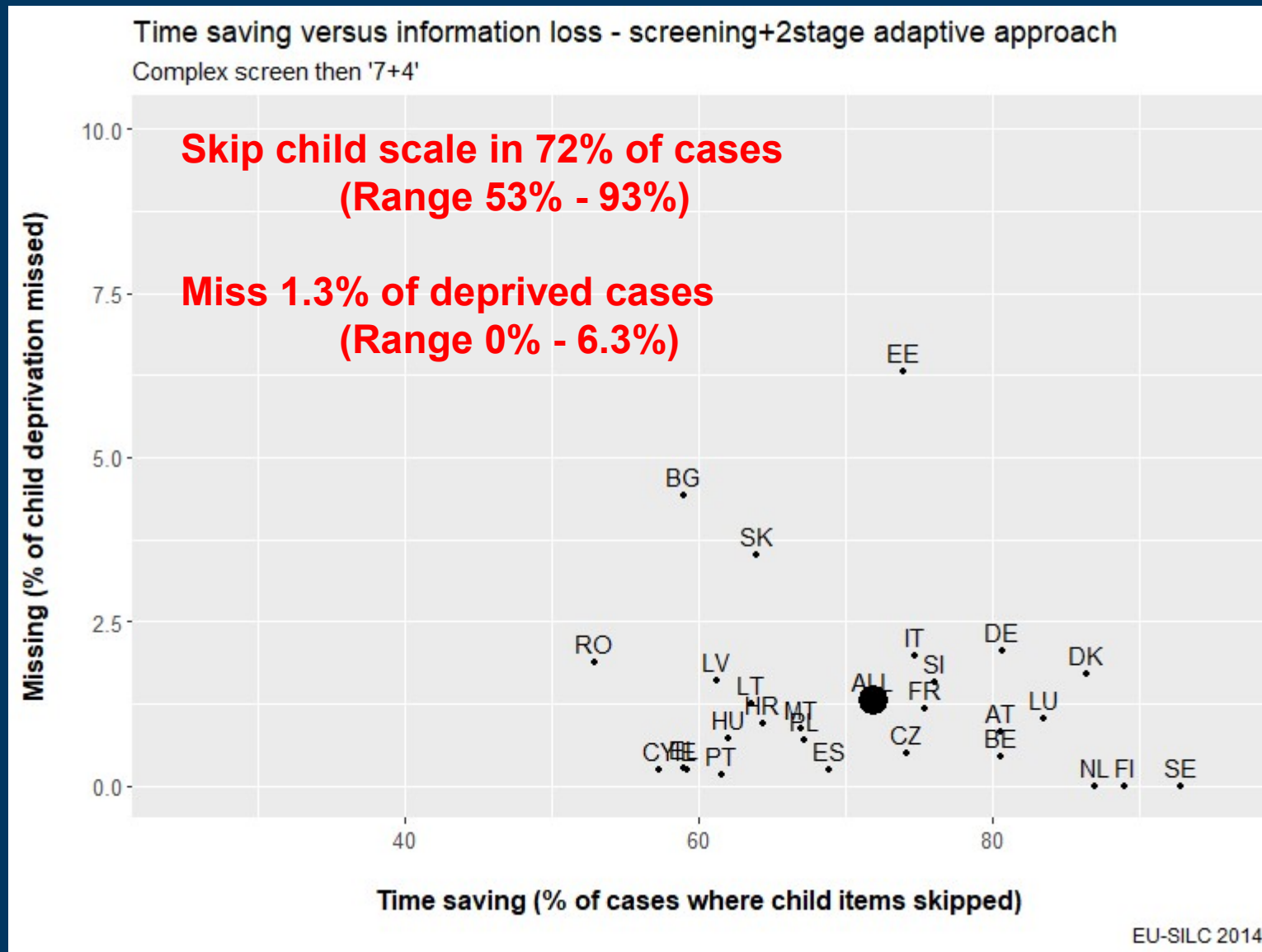
EU-SILC 2014

Screening

Time saving versus information loss - screening approach

Skip child items where hhld depvn == 0 (5 cntry)/ <= 1 (22 cntry) or lack 3+ hhld items on child scale

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EU-SILC 2014
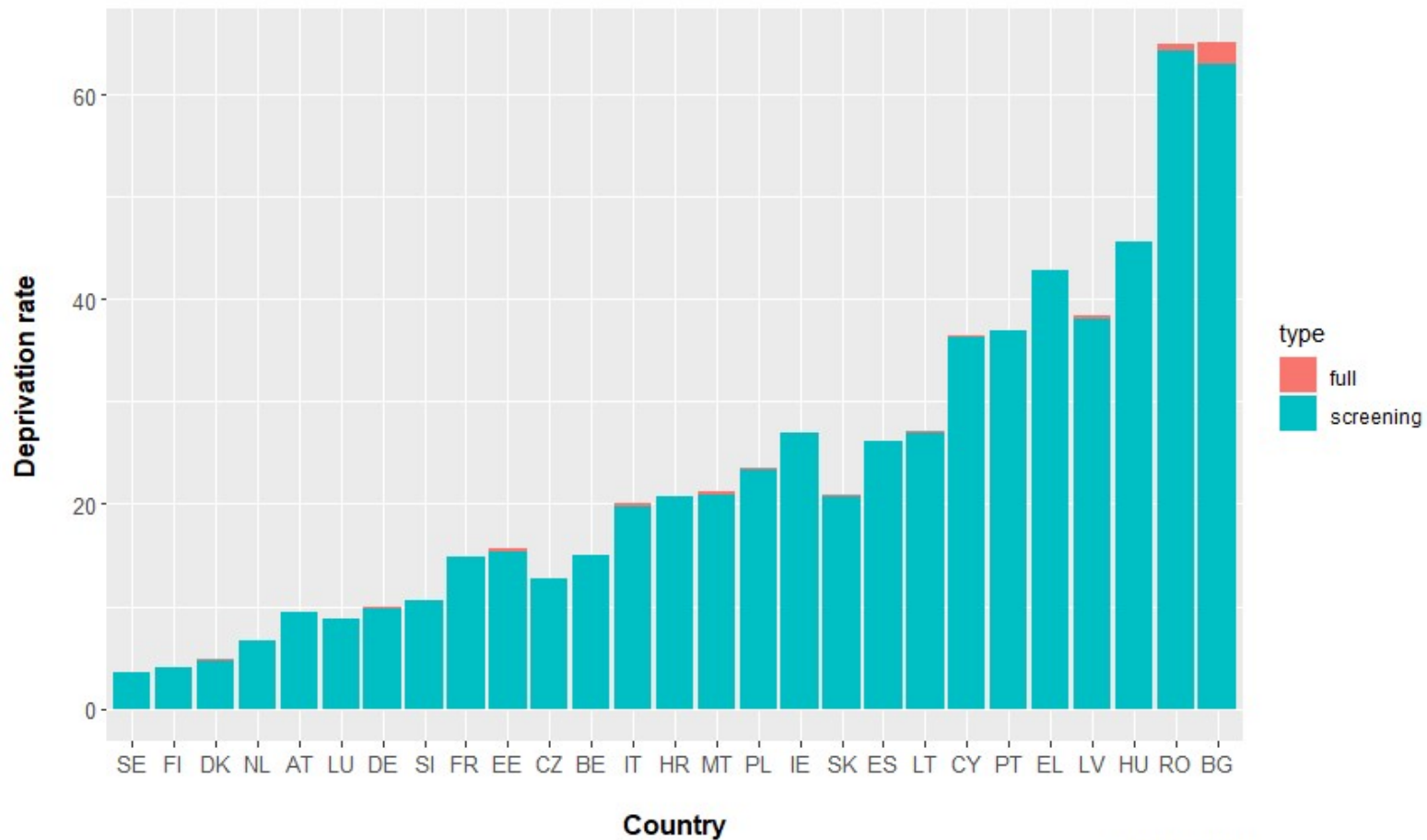
Screening + 1-stage adaptive

Time saving versus information loss - screening+adaptive approach

Screen hhld depvn <=2 (RO/BG 0) or 3+ hhld items on child scale; adaptive - first six child qns

**Skip child scale in 70% of cases
(Range 51% - 92%)**

**Miss 0.7% of deprived cases
(Range 0% - 3.4%)**

EU-SILC 2014

Screening + 2-stage adaptive

Time saving versus information loss - screening+2stage adaptive approach
Complex screen then '7+4'

Skip child scale in 72% of cases
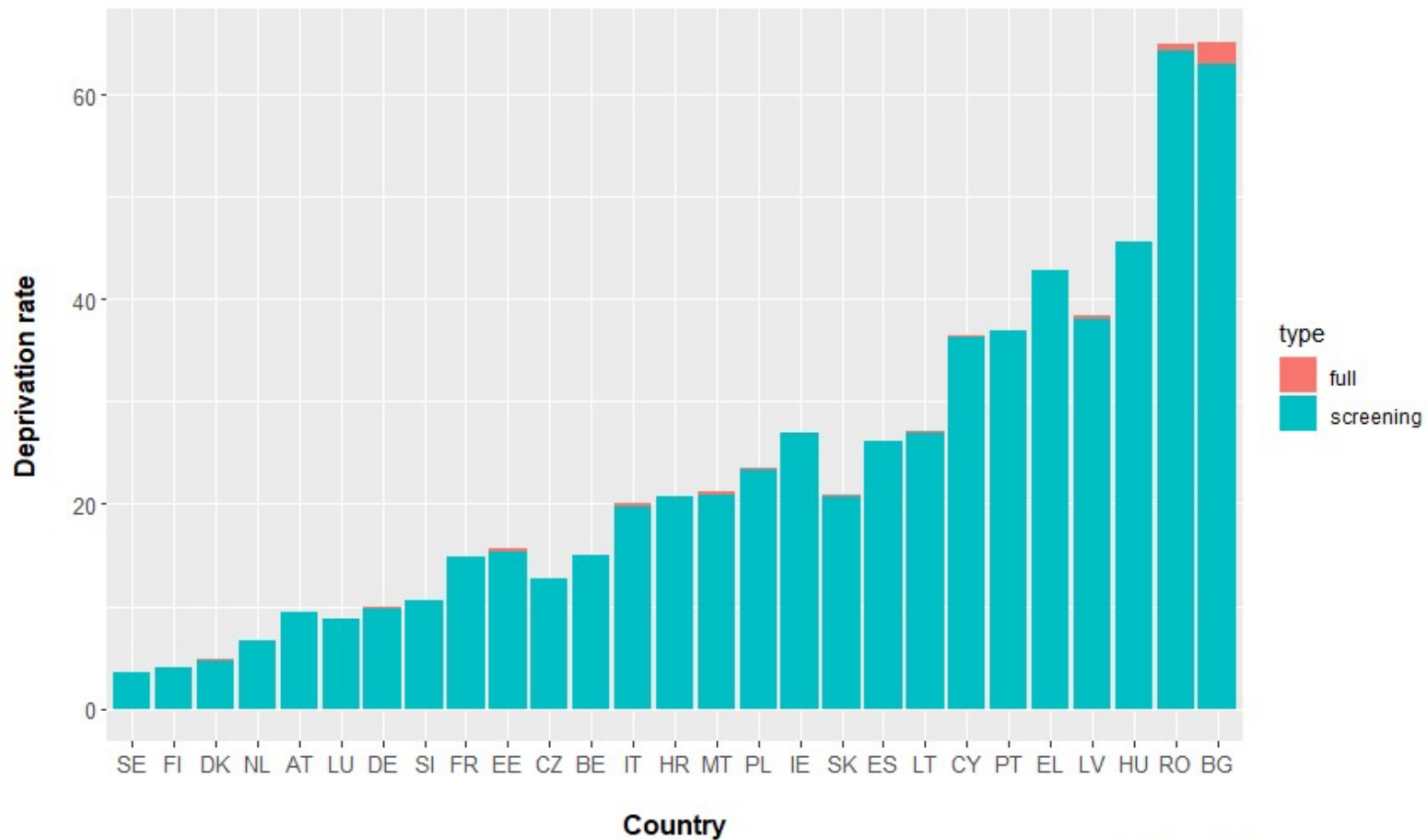**(Range 53% - 93%)**

Miss 1.3% of deprived cases
(Range 0% - 6.3%)

EU-SILC 2014

Screening alone – time saving 61%

Child deprivation rates on screening and full scales

Skip child items where hhld depvn == 0 (6 cntry)/<= 1 (25 cntry)

EU-SILC 2014

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Screening + 2-stage adaptive – time saving 72%

Child deprivation rates - 'screening+2stage adaptive' and full scales
Complex screen then '7+4'

type
■ full
■ screen_adapt

EU-SILC 2014
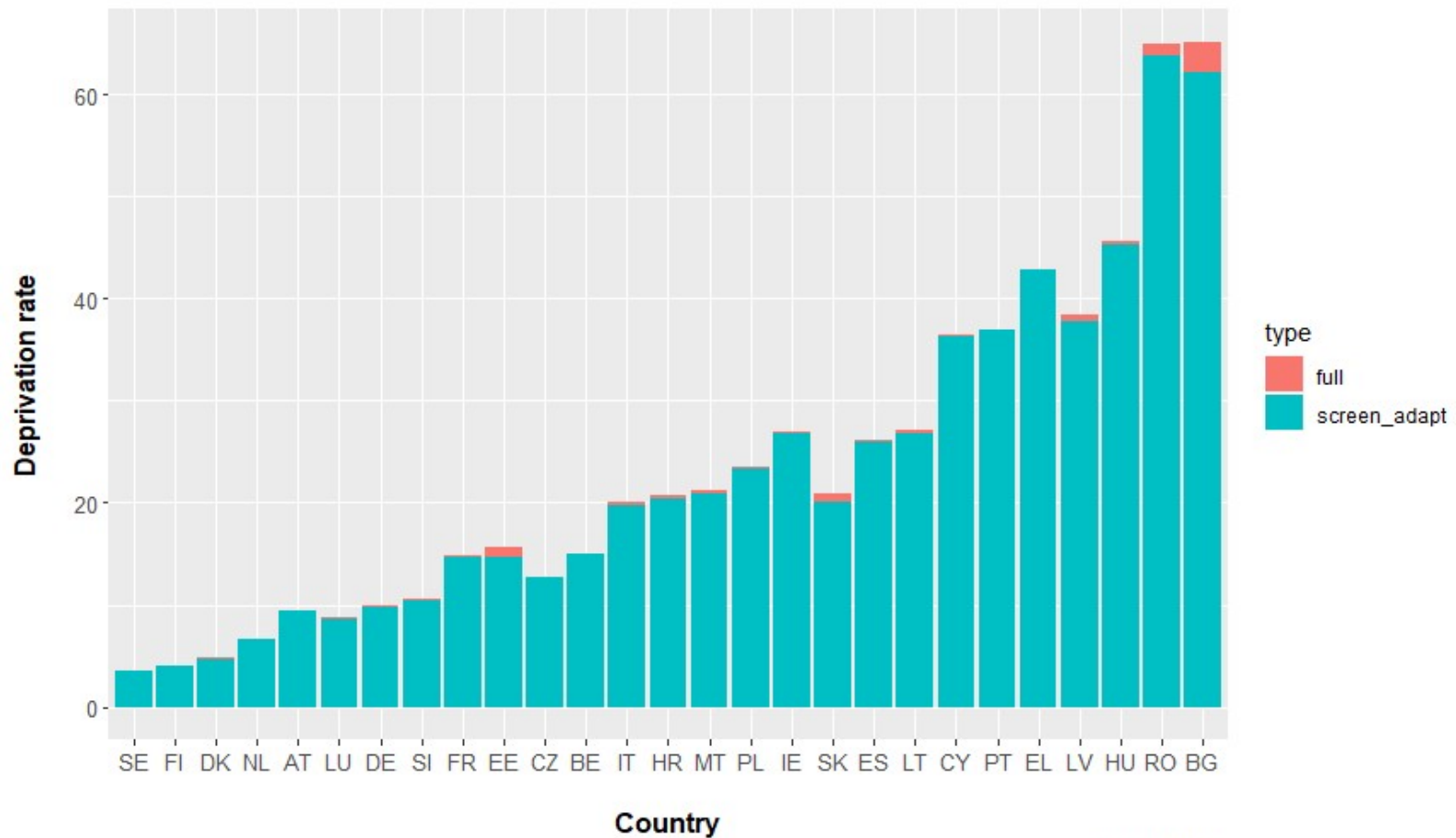
Conclusions – 1 + 2

- Adaptive approach performs very well even in the highly varied context of the 31 EU-SILC countries
  - "5+9" algorithm: time saving 42%
  - Misses 0.4% of deprived cases
  - Deprivation rate 21.75% c.w. 21.84% on full scale
  - Minimal item missingness
  - Policy choice about which algorithm is most appropriate

- Simplifying aim to **measuring deprivation rate only**
  - Screening on whole popln scale saves 61%
  - Deprivation rate 22.04% c.w. 22.20% for full scale

  - Screening + 2-stage adaptive approach saves 72%
  - Deprivation rate 21.92% c.w. 22.20% for full scale

University of Glasgow

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- None of above responsible for analysis or interpretation

References

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