

An examination of the identification problem arising from unit nonresponse in ILSA studies

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Diego Cortes, Jeff Dominitz, Maximiliano Romero,
Sabine Meinck

A FAMILIAR EXAMPLE

A familiar example

Target inference: *Was it very painful, somehow painful, or not painful?*

Evidence: The picture

Missing information: The context in which he lost the tooth



A familiar example

$$truth = f \left(\underbrace{observable, unobservable}_{information} \right)$$



$$conclusion = f \left(\underbrace{evidence}_{observable}, \underbrace{assumption}_{unobservable} \right)$$

A familiar example

Credibility

Certitude

5

1. Make no assumptions
2. Assume that my son cries when something is very painful
3. Assume the tooth fall naturally, it was loose for weeks, and the root was fully dissolved.

GENERATING KNOWLEDGE WITH IEA STUDIES

A fundamental objective of an IEA study

Generate knowledge about the distribution of student outcomes or characteristics in a given population

PIRLS

TIMSS

ICILS

ICCS

Generating knowledge



| ID | Name | Type | WFO | Organization | Label | Index | Measuring | Columns | Angle | Minimum | Max |
|----|--------|-----------|-----|--------------|---------------|-------|-----------|---------|-------|---------|------|
| 1 | COXCOX | Numerical | 4 | 0 | School ID | None | None | 0 | Right | 0 | None |
| 2 | COXSE | Numerical | 5 | 0 | Student ID | None | None | 0 | Right | 0 | None |
| 3 | COXSTR | Numerical | 6 | 0 | Country ID | None | None | 0 | Right | 0 | None |
| 4 | COXSTR | String | 1 | 0 | Country ID | None | None | 0 | Right | 0 | None |
| 5 | COXSTR | Numerical | 2 | 0 | About you/How | None | None | 0 | Right | 0 | None |
| 6 | COXSTR | Numerical | 1 | 0 | About you/How | None | None | 0 | Right | 0 | None |
| 7 | COXSTR | Numerical | 1 | 0 | About you/How | None | None | 0 | Right | 0 | None |
| 8 | COXSTR | Numerical | 2 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 9 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 10 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 11 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 12 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 13 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 14 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 15 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 16 | COXSTR | Numerical | 2 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 17 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 18 | COXSTR | Numerical | 2 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 19 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 20 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 21 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 22 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 23 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 24 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |
| 25 | COXSTR | Numerical | 1 | 0 | Your name and | None | None | 0 | Right | 0 | None |



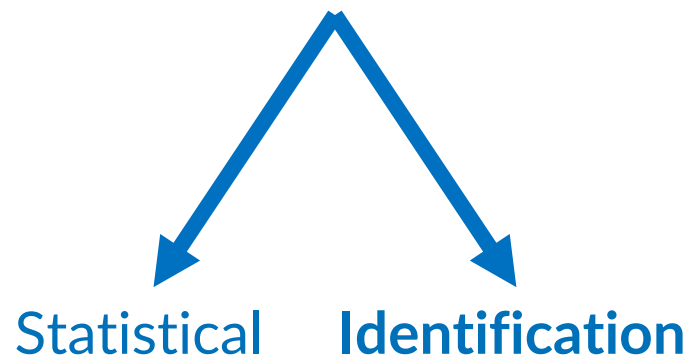
Table 3.4: Country domains for CI, average CI score, ICT development index score and average ICT score

| Country | Average CI score (0-100) | CI development distribution | Average ICT score | ICT development index (0-100) |
|----------------------|--------------------------|-----------------------------|-------------------|-------------------------------|
| Dominican | 34.9 | | 355 (2.0) | 1171 (4) |
| Korea Rep. of | 54.7 (3.1) | | 1185 (7) | |
| France | 54.0 | | 121 (2.0) | 239 (2.0) |
| Germany | 53.5 | | 213 (2.0) | 219 (2.0) |
| Hong Kong | 53.0 (2.0) | | 123 (2.0) | 143 (2.0) |
| Finland | 51.0 | | 400 (7.0) | 616 (4.0) |
| Latvia | 45.0 | | 462 (2.0) | 647 (3.0) |
| China | 41.0 (3.7) | | 417 (2.0) | 417 (2.0) |
| United Arab Emirates | 31.0 | | 420 (2.0) | 247 (2.0) |
| Malaysia | 30.0 | | 700 (2.0) | 679 (2.0) |
| OECD average | 44.4 | | 430 (3.0) | |



Notes: CI score is the average CI score and country index data are from 2017 (Survey P12 2016). ICT score is the average ICT score and country index data are from 2017 (Survey P12 2016).
 * Data is not available for the following countries: Armenia, Azerbaijan, Cambodia, Georgia, Guatemala, Honduras, Indonesia, Jordan, Kazakhstan, Kyrgyzstan, Lebanon, Lithuania, Luxembourg, Mexico, Myanmar, Nepal, Nicaragua, Oman, Pakistan, Panama, Paraguay, Peru, Philippines, Qatar, Romania, Saudi Arabia, Singapore, Sri Lanka, Taiwan, Thailand, Timor-Leste, Turkey, Uzbekistan, Viet Nam, and Yemen.
 † Data is not available for the following countries: Albania, Bulgaria, Czechia, Denmark, Estonia, Hungary, Iceland, Ireland, Israel, Italy, Japan, Korea Rep. of, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Slovakia, Slovenia, Spain, Sweden, Switzerland, and United Kingdom.

Estimation components

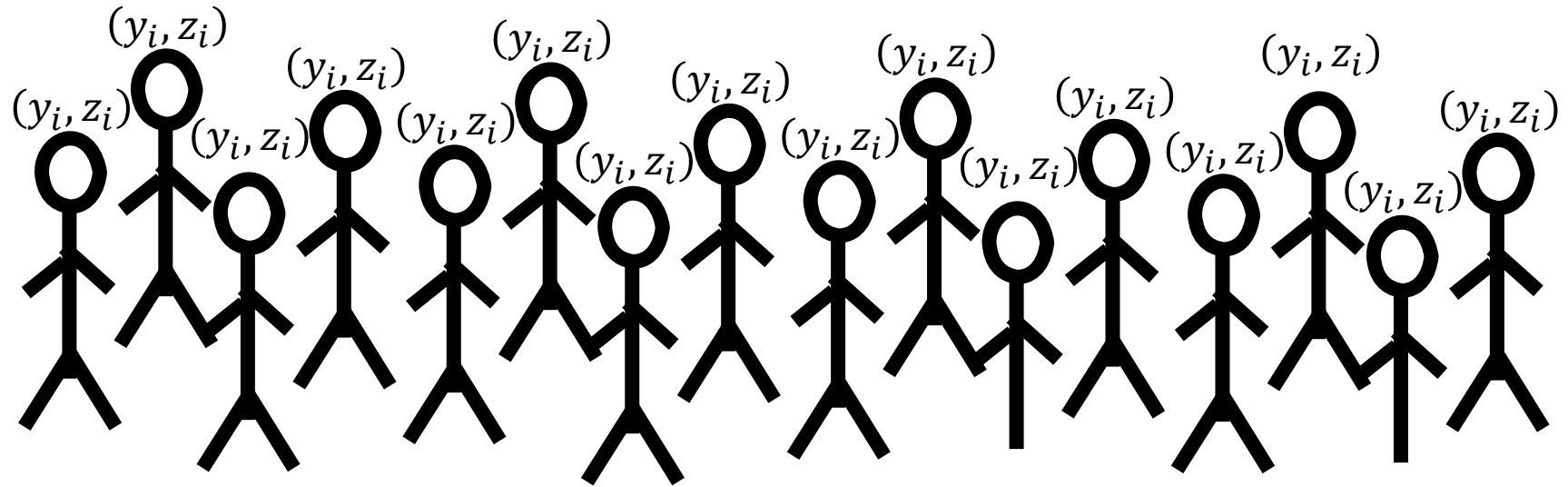


THE IDENTIFICATION PROBLEM

Unit nonresponse in IEA surveys

Some insights

The basic structure

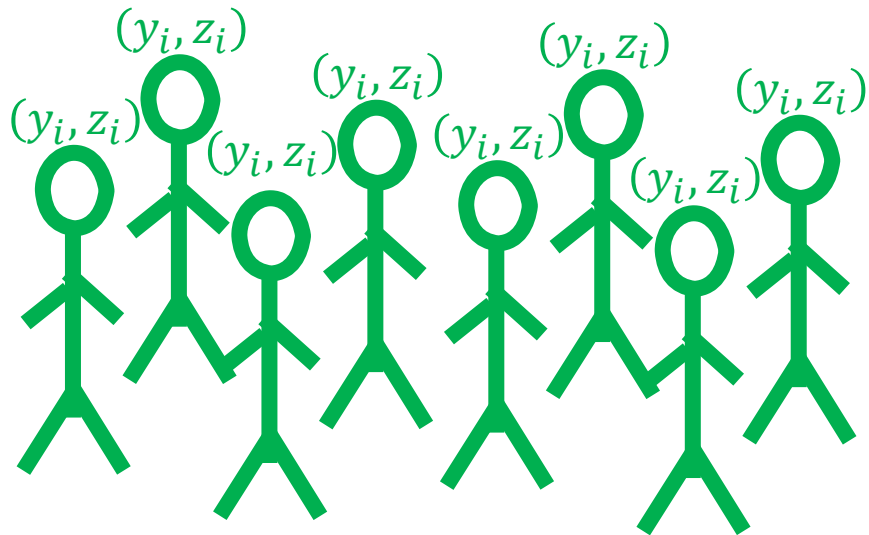


Each member of the population is characterized by:

- y_i Student i 's CIL
- z_i Student i 's indicator reflection participation if sampled

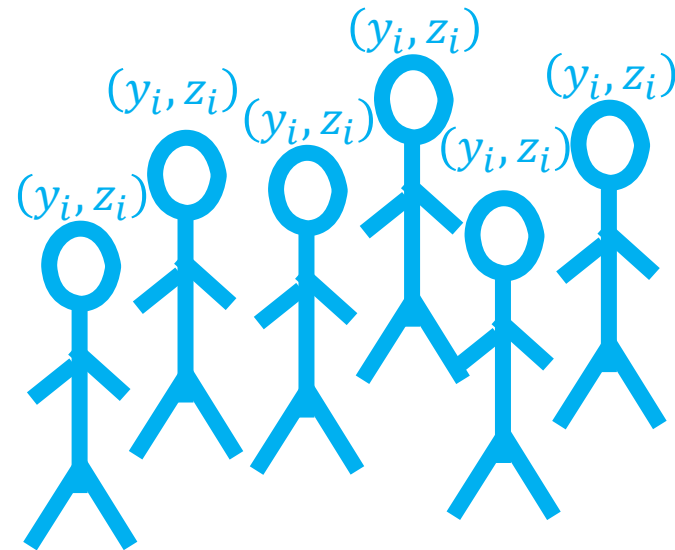
Respondents if sampled

$$(Z_i = 1)$$



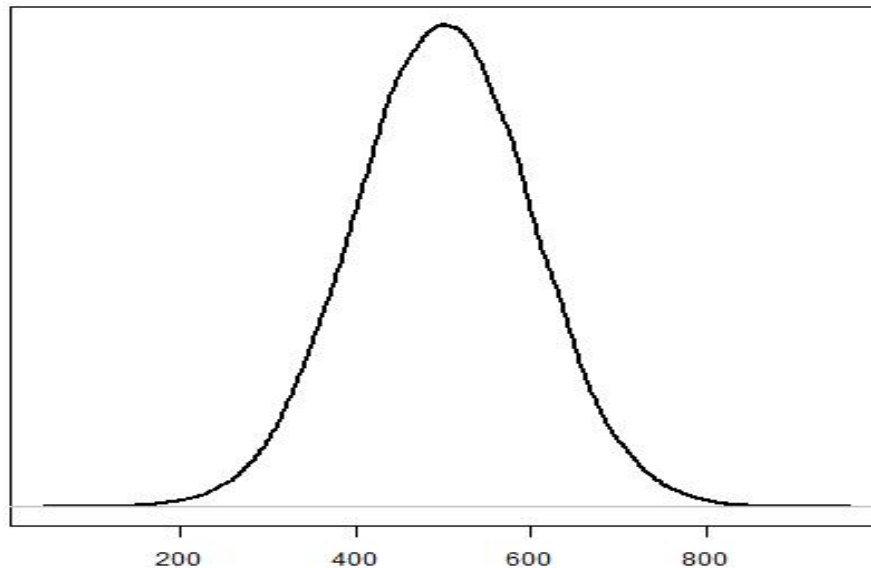
Nonrespondents if sampled

$$(Z_i = 0)$$



Objective

To make conclusions about the mean of the CIL distribution in each population participating in ICILS 2018

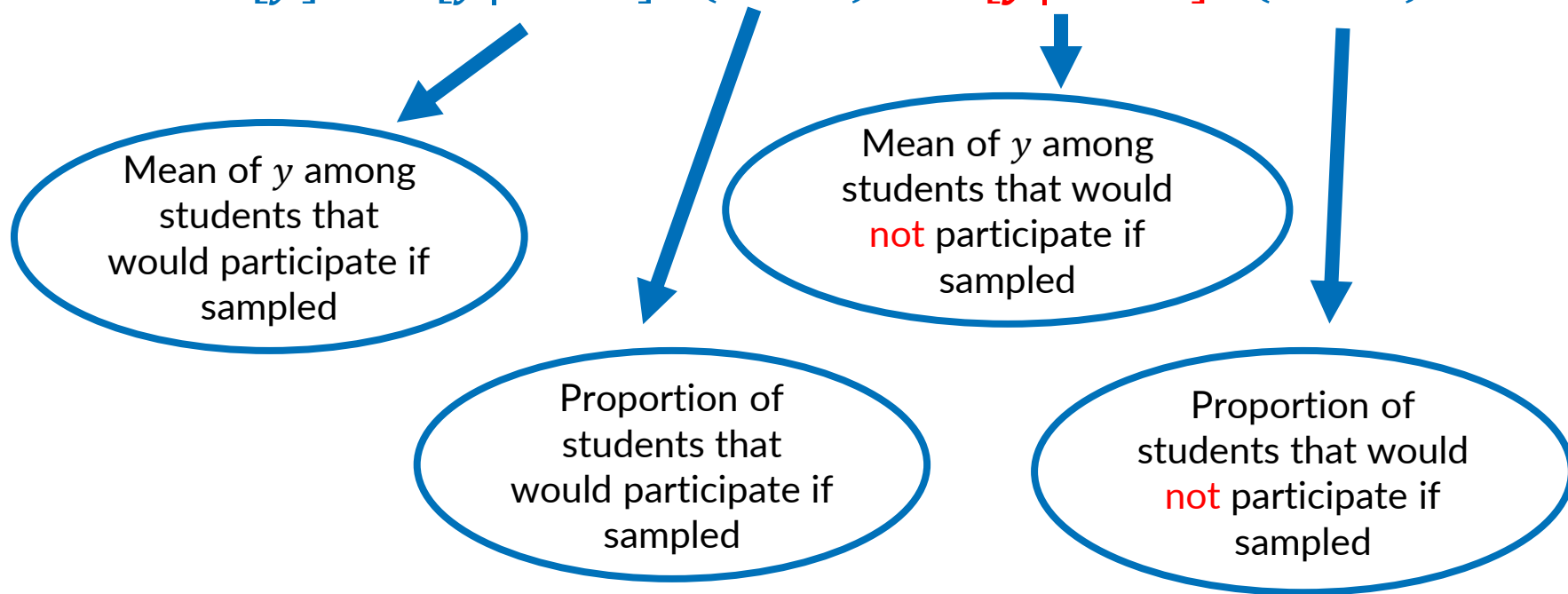


Identification question

What can be learned about the mean if all members of the population were to be sampled?

Law of Iterated Expectations

$$E[y] = E[y|z = 1]P(z = 1) + E[y|z = 0]P(z = 0)$$





Our conclusion really depends on our
choice for $E[y|z = 0]$

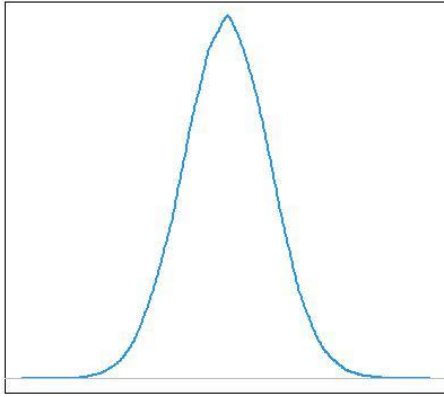
Credibility

Certitude

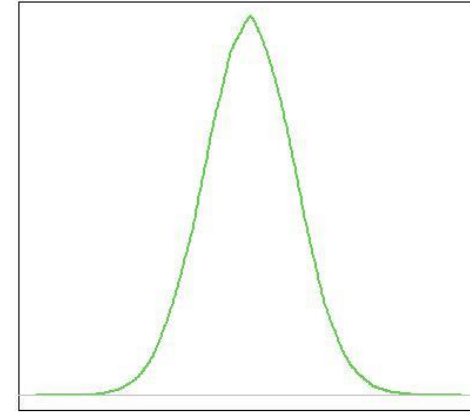
Two extreme examples

- Get full certitude at the expense of credibility
- Get full credibility at the expense of certitude

Get full certitude at the expense of credibility



$$E[y|z = 0] = E[y|z = 1]$$

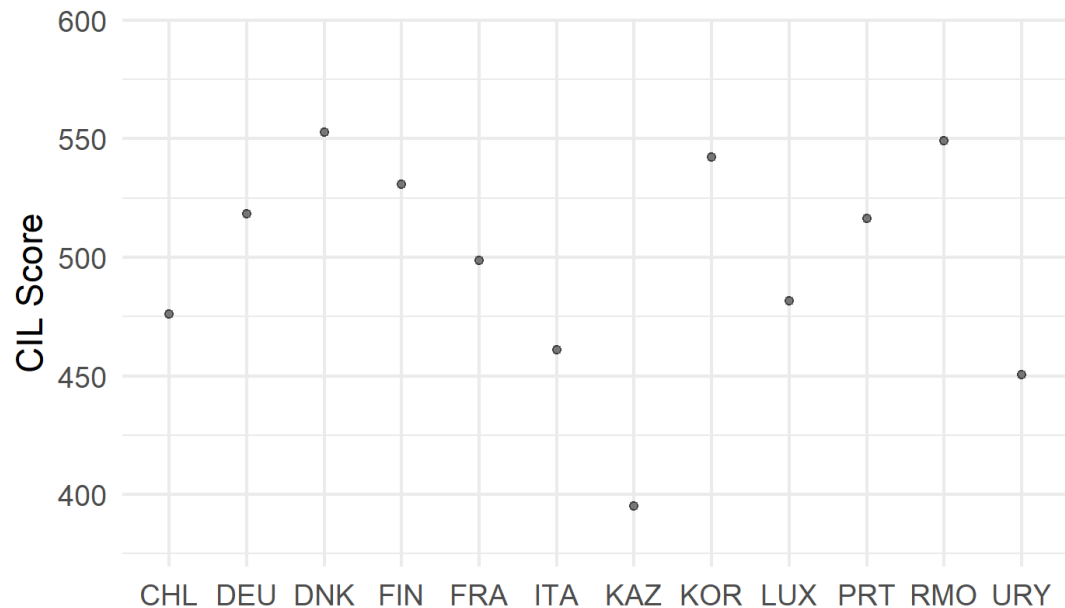


Nonrespondents if sampled

Respondents if sampled

$$E[y] = E[y|z = 1]$$

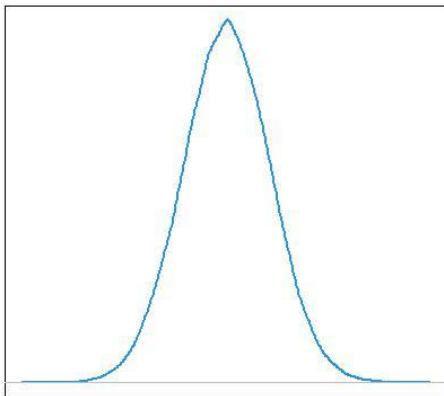
Get full certitude at the expense of credibility



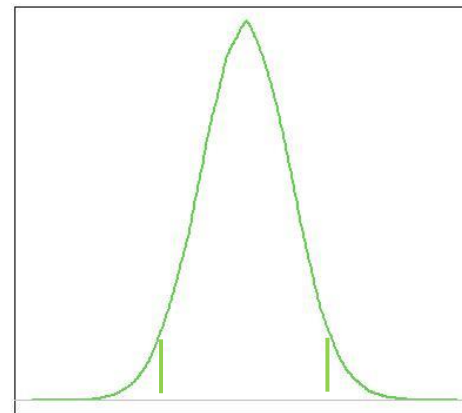
Assumption:

$$E[y|z = 0] = E[y|z = 1]$$

Get full credibility at the expense of certitude



$$E[y|z = 0] \in [Q_5(y), Q_{95}(y)]$$

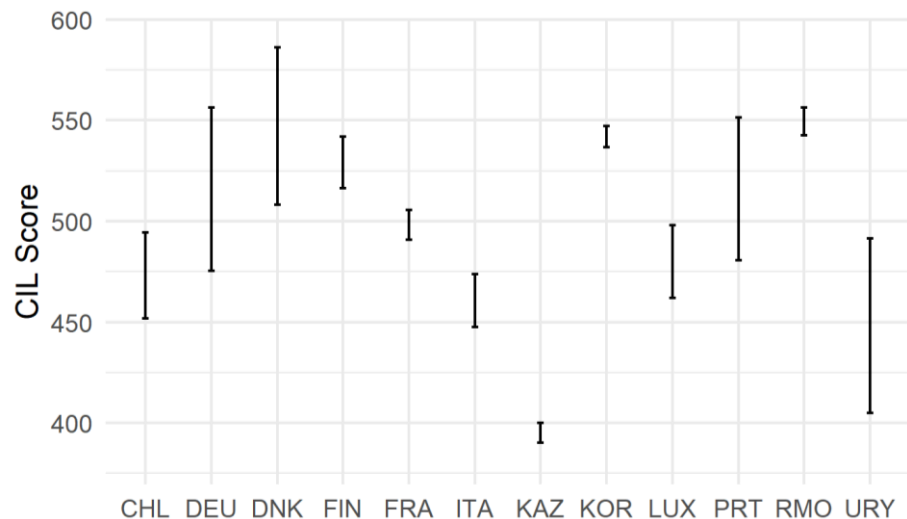


Nonrespondents if sampled

Respondents if sampled

$$E[y] = \left[\begin{array}{l} E[y|z = 1]P(z = 1) + Q_5(y)P(z = 0), \\ E[y|z = 1]P(z = 1) + Q_{95}(y)P(z = 0) \end{array} \right]$$

Get full credibility at the expense of certitude



Assumption:

$$Q_5(y) \leq E[y|z = 0] \leq Q_{95}(y)$$

Two extreme examples

Between these two extreme examples there is a continuum of options for $E[y|z = 0]$. Our nonresponse model lies within this continuum

Take aways from the exercise

1. If $P(z = 0) > 0$ then we **must** make a **choice** about $E[y|z = 0]$
2. Our choice impacts where we stand in the balance between **certitude** and **credibility**
3. If $P(z = 0) > 0$, our **conclusion** about our parameter of interest is a **weighted average** of **evidence** and **assumptions**

Wrap up

- Estimation framework: Partial identification
 - Establishing the boundaries of what the data reveals
- Vocal about identification problems in ILSA context
 - Assumptions matter
- Unit nonresponse

Thank you 😊

Diego.cortes@iea-hamburg.de