Is Income Equality also Better for Your Cognitive Health? A Multilevel Analysis on Trajectories of Cognitive Function at Older Ages

Anja Leist and Louis Chauvel

University of Luxembourg. PEARL Institute for Research on Socio-Economic Inequality (IRSEI), Luxembourg

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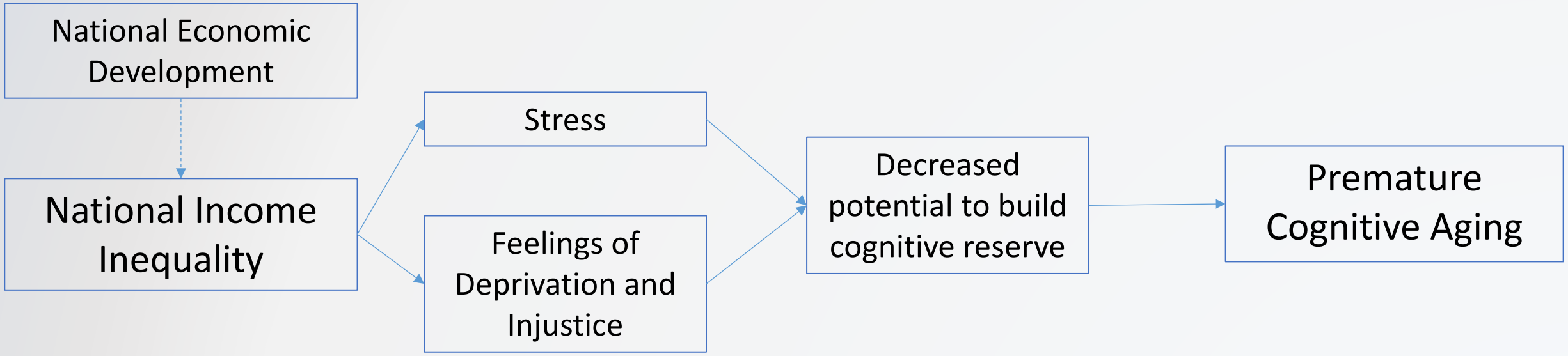
UNIVERSITY OF LUXEMBOURG
Integrative Research Unit on Social and Individual Development (INSIDE)

Is Income Equality Good for Cognitive Health?

- Starting point: Income equality and physical health/mortality
- Health is dependent on socioeconomic position and responds to income equality on a contextual level (Wilkinson & Pickett 2008; 2010; Babones 2008; Elgar 2010)
- Health gradients are paradoxically steeper in more egalitarian countries (Beckfield & Olafsdottir 2013; Chauvel & Leist in press)
- Assumed mechanism: income inequality puts individuals under stress and frustration which leads to impaired health

Paths from Income Inequality to Cognitive Decline



Similarly to health, income inequality could lead to impairments in cognitive health/ premature cognitive aging via stress or frustration.

Important in order to identify population segments at risk of cognitive decline.

And Some Explorations…

… on the Associations between Educational Attainment and Cognitive Function at Older Ages

Another way of looking at inequality is to estimate the extent to which health or cognitive health is associated with social hierarchy – how well is environment (welfare state…) compensating for past inequalities in education?

Our argument: Less supporting/enabling environments lead to stronger education-cognition gradients (leaving less educated worse off), more enabling environments compensate and lead to flatter education-cognition gradients.

Research Questions

Research Question 1:
Is income inequality associated with aging-related cognitive decline? Controlling for socio-demographic factors and health.

Research Question 2:

How is cognitive function associated with educational attainment net of the educational distribution per country?

Research Question 3:

Do education-cognition gradients vary with income inequality?

Data

- SHARE waves 1. 2. 4. 5
- Cognitive function: average summary z-score of fluency, immediate and delayed recall (2nd, 3rd, 4th testing standardized with 1st test mean and sd)
- Education: ISCED information recoded in three categories
- Gender, marital status/living with partner
- Self-rated health
- Level of economic development (GDP) and level of income inequality (Gini) from UNU-WIDER World Income Inequality Database

Strategy of Data Analysis

- Mixed multilevel modelling: measurements within individuals within countries with varying slope of age (`xtmixed`)
- Interactions of Gini with age to investigate the role of income equality on aging-related cognitive decline
- Postestimate BLUPS (`reffects/reses`): random intercept residuals (=average cognitive function) and slope of logit rank of education (=education-cognition gradient) per country

Three-Level Random-Slope Model Specification

$$y_i = \alpha_{j[i]} + \beta_{j[i]} x_i + \gamma_{k[i]} + \delta_{k[i]} z_i + V_i\, u \; + \; \varepsilon_i$$

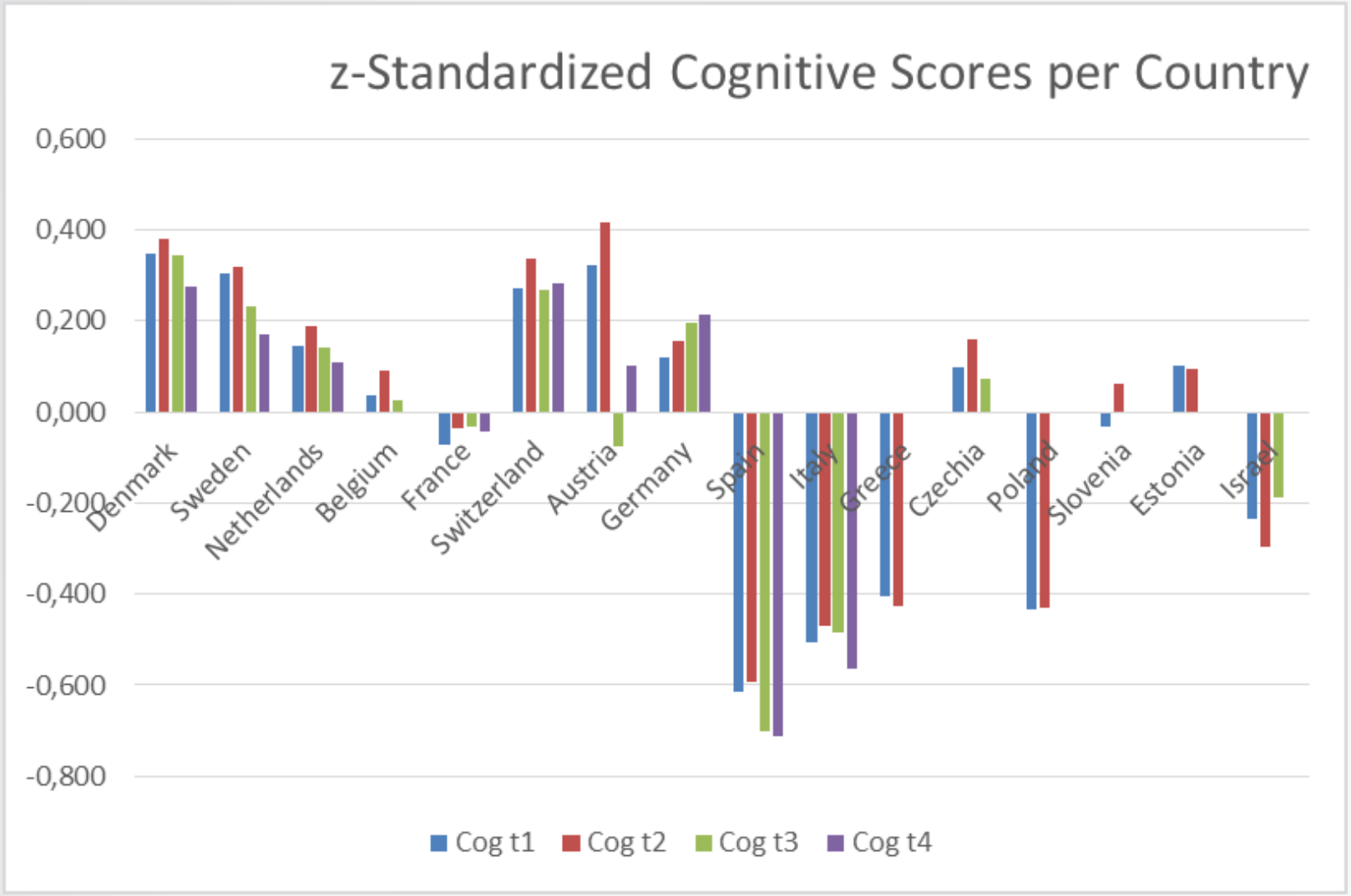
$$\begin{pmatrix} \alpha_j \\ \beta_j \end{pmatrix} \sim \mathrm{N} \begin{pmatrix} \mu_\alpha \\ \mu_\beta \end{pmatrix}, \Sigma \Big), \; \begin{pmatrix} \gamma_k \\ \delta_k \end{pmatrix} \sim \mathrm{N} \begin{pmatrix} \mu_\gamma \\ \mu_\delta \end{pmatrix}, \Lambda \Big)$$

- y_i - Cognitive Function
- $\alpha_{j[i]}$ - Country-Level Intercept
- $\beta_{j[i]}$ - Random Country-Level Slope of Age
- $\gamma_{k[i]}$ - Individual-Level Intercept
- $\delta_{k[i]}$ – Random Individual-Level Slope of Age
- ζ – Fixed Effects of: Age (Model 1)
  + Gender. education (Model 2)
  + Centered Country-Level GDP and Income Inequality (Model 3)
  + Interactions Age*Gini (Model 4)
- ε_i - Error
- $\alpha_j, \beta_j, \gamma_k, \delta_k$ are normally distributed with mean μ and covariance matrix Σ/Λ

Note. $j[i]$ - maps individuals to countries. Notation according to Gelman & Hill (2007) Data analysis using regression and multilevel/hierarchical analysis. NY: Cambridge University Press (p. 261 ff.).

Stata notation: mixed ctot agedec50 i.edu3 gender mstat sphus_2 c.cgdp c.cgini cginiagedec50 || country: agedec50 || mergeid: agedec50. cov(unstruc) iter(15)

Descriptive Results



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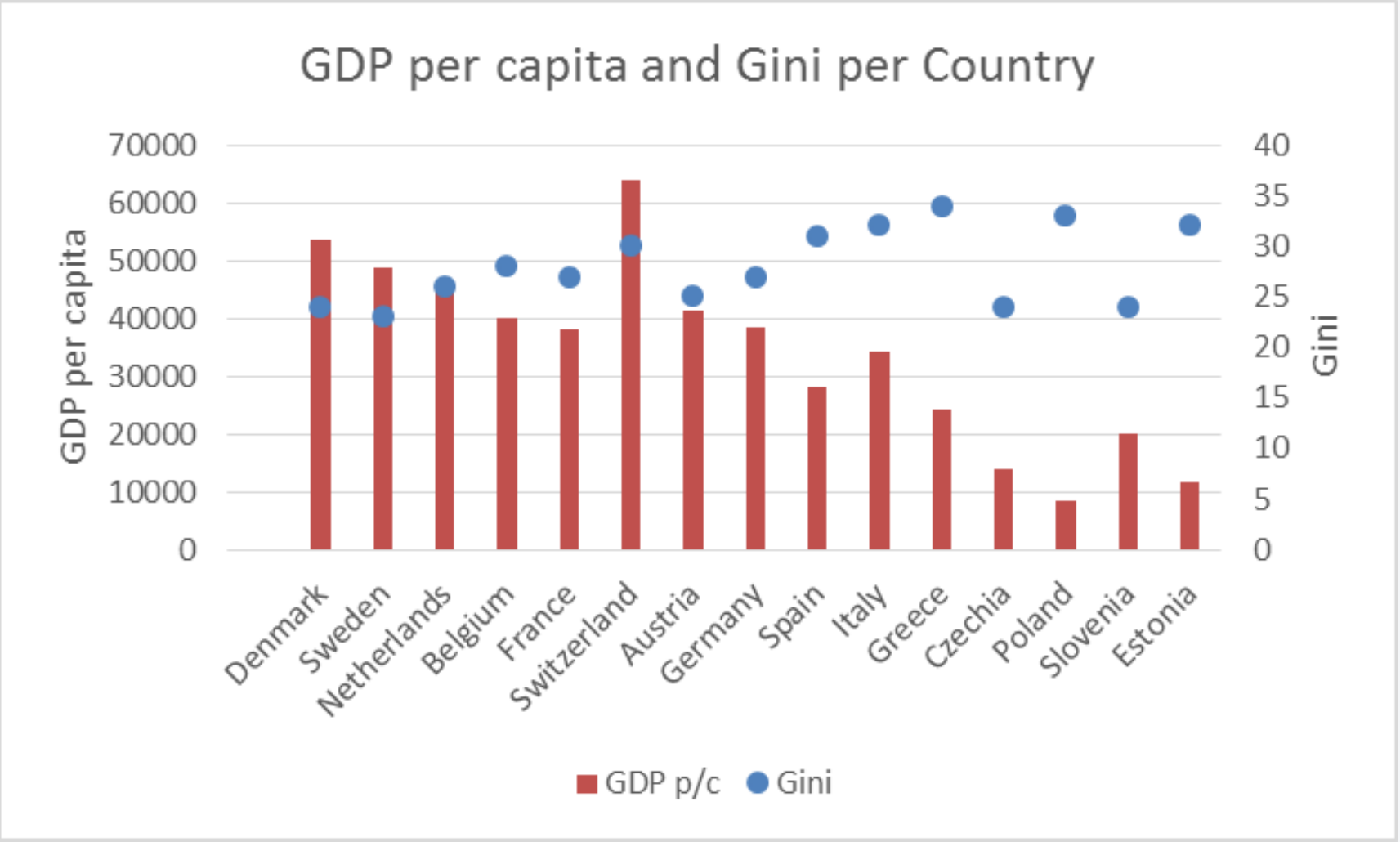

Results

Avg. c. score	Model 1	Model 2	Model 3	Model 4
Age	-0.276	-0.225	-0.225	-0.225
Education (ref. primary)				
Upper secondary		0.362	0.362	0.362
Tertiary		0.644	0.644	0.644
Gender		0.166	0.167	0.167
Living with partner		0.080	0.080	0.080
Bad health		-0.217	-0.217	-0.217
Centered GDP p/c			0.002	0.002
Centered Gini			-0.040	-0.040
Gini * age				0.003
_cons	0.390	-0.204	-0.191	-0.191
lns1_1_1	-3.352	-3.430	-3.430	-3.510
lns1_1_2	-1.179	-1.367	-1.775	-1.777
lns2_1_1	-1.509	-1.647	-1.647	-1.647
lns2_1_2	-0.550	-0.687	-0.687	-0.687
atr2_1_1_2	-0.454	-0.447	-0.447	-0.447
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Results with Single Cognitive Indicators

Model 4	**zImm**	**zDel**	**zFlu**
Age	-0.255	-0.244	-0.223
Education (ref. primary)			
Upper secondary	0.384	0.363	0.330
Tertiary	0.647	0.640	0.629
Gender	0.218	0.238	0.036
Living with partner	0.091	0.065	0.084
Bad health	-0.219	-0.209	-0.216
Centered GDP p/c	0.003	0.000	-0.002
Centered Gini	-0.025	-0.026	-0.068
Gini * age	0.001	0.004	0.004

Results for Countries with >2 Waves*

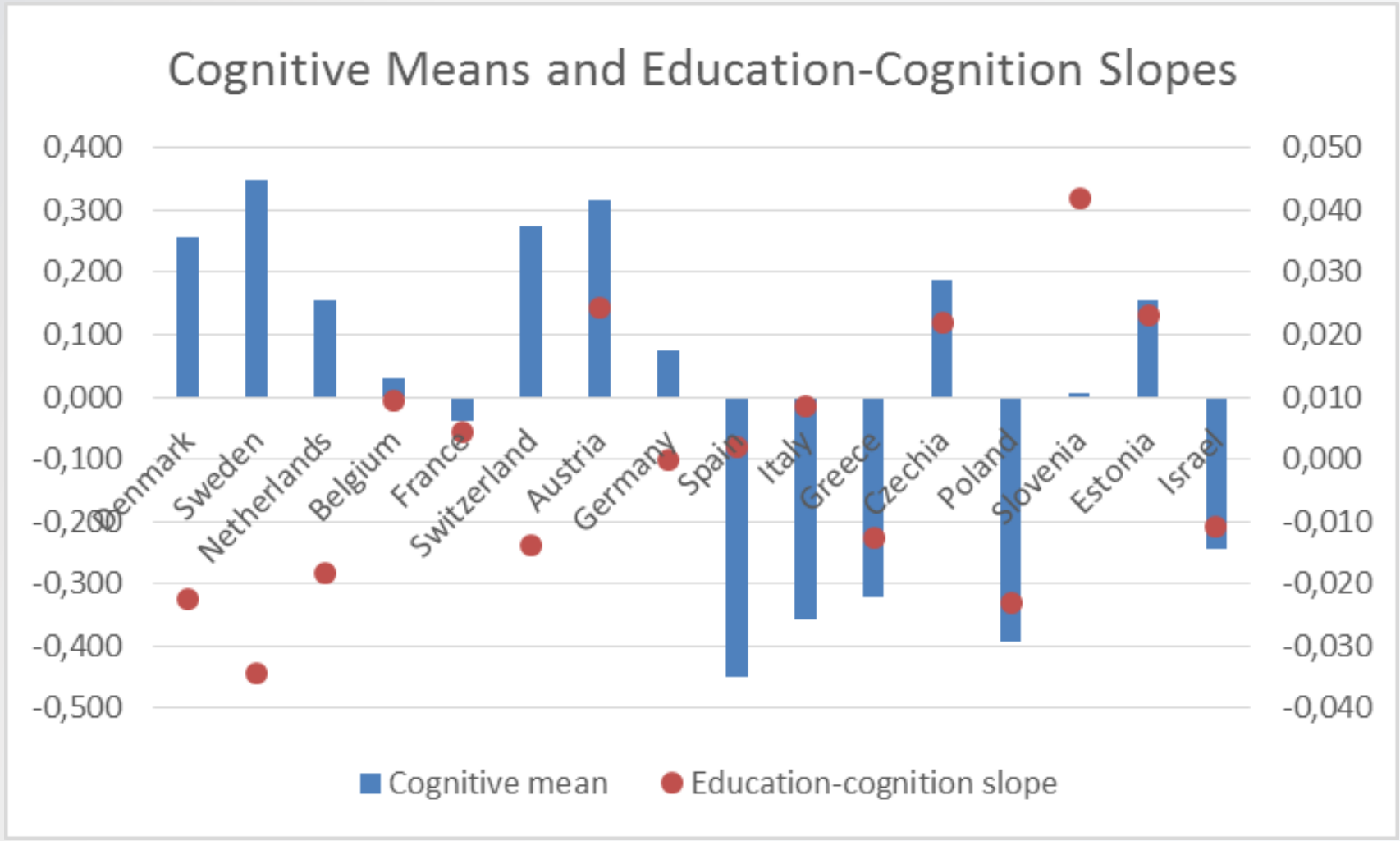
	Avg C score	zImm	zDel	zFlu
Age	-0.218	-0.248	-0.229	-0.227
Education (ref. primary)				
Upper secondary	0.362	0.382	0.358	0.335
Tertiary	0.635	0.635	0.625	0.629
Gender	0.173	0.224	0.252	0.032
Living with partner	0.082	0.093	0.066	0.088
Bad health	-0.229	-0.232	-0.220	-0.225
Centered GDP p/c	0.005	0.005	0.000	0.000
Centered Gini	-0.038	-0.028	-0.028	-0.056
Gini * age	0.001	-0.001	0.003	0.001

* Austria. Germany. Sweden. Netherlands. Spain. Italy. France. Denmark. Switzerland. Belgium. Israel. Czechia (12 countries with >2 cognitive measurements)

Just for fun… The education-cognition gradients per country

- Explore the cross-sectional association of education and cognition net of educational distribution
- Logitrank transformation (Chauvel. 2015) of education as random slope in xtmixed model cross-sectionally: xtmixed ctot1 agedec501 c.logitrankeducation || country: logitrankeducation, cov(unstruc) iter(15)
- BLUP with Stata 'reffects' command estimates the steepness of the education-cognition gradient NET of the underlying educational distribution
- Steeper education-cognition gradients suggest a stronger link between education and cognitive resources (≈ less supportive/enabling environments for low-educated), flatter gradients suggest cognitive resources to be more independent of education (more equality in terms of building/maintaining cognitive reserve). Calculated net of age.*

*see Chauvel & Leist, in press at IJEqH for similar comparative analyses on income-health gradients

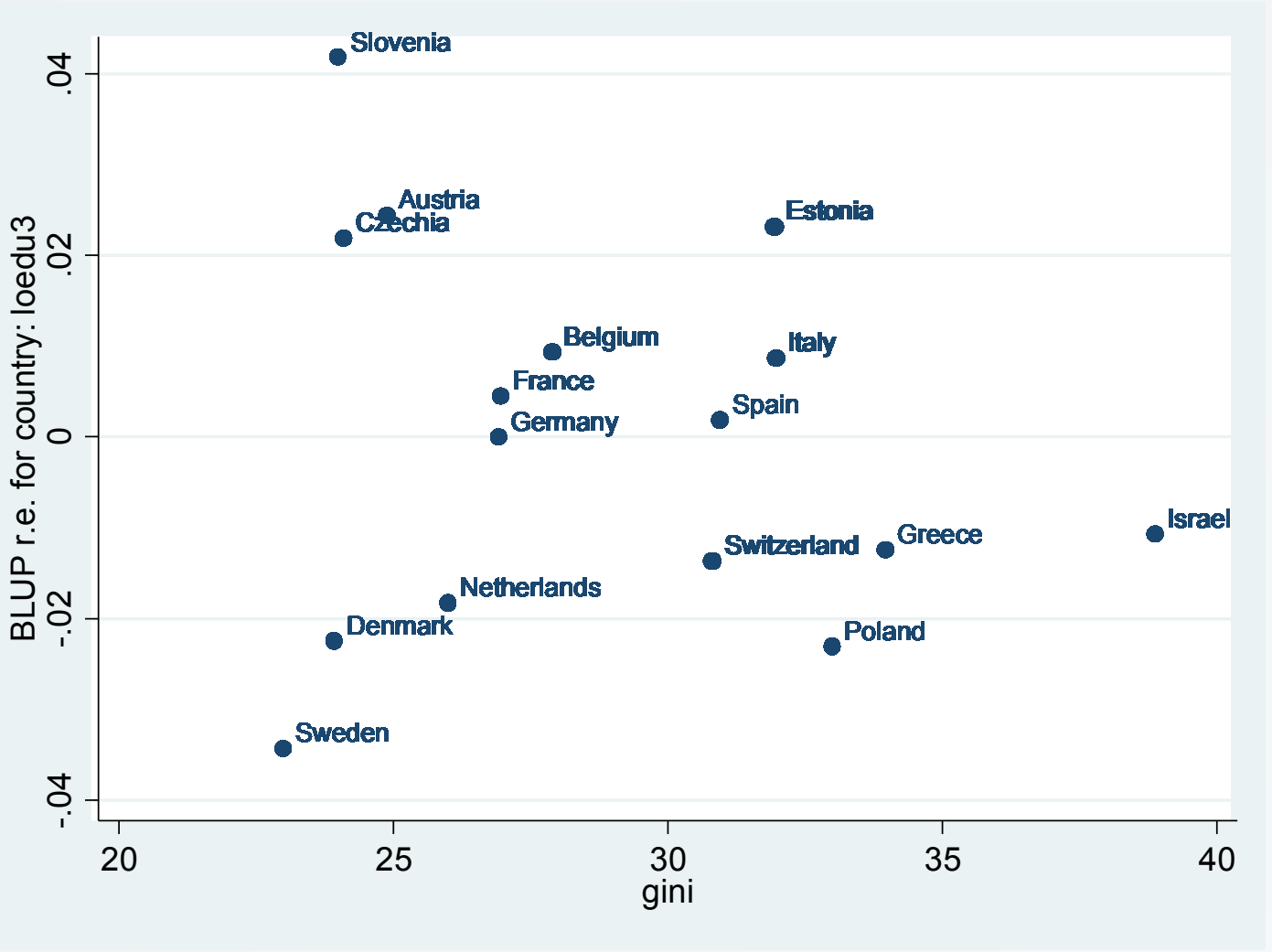


*Postestimated with BLUPs

Education-cognition gradients and income inequality

BLUPs assess steepness of the education-cognition gradient.

Marginal association between gradients and income inequality.



Discussion

- Income inequality is associated with level of cognitive function, but we do not find evidence for associations of income inequality with aging-related cognitive decline – inequality does not lead to premature cognitive aging
- Results hold for single cognitive indicators and for countries with three or four measurements of cognitive function
- Cognitive function typically first increases over time (learning and practice effect) then decreases with age
- Explorations on the education-cognition gradient – different assessment of inequalities at older ages
- Still missing: Including information on childhood conditions and current socioeconomic position (occupation, income, wealth)

Thanks!

anja.leist@uni.lu

louis.chauvel@uni.lu

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