Parental Investments and Socio-Economic Gradients in Learning across European Countries

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Fighting poverty: Measurement and policy challenges, (LIS)2ER

December 12, 2024

Motivation & Research Question

Inequalities are transmitted from parents to children

⇒ This varies across countries (e.g., Corak, 2013), and even across regions within a country (e.g., Chetty et al, 2014)

Why do we observe such differences in inequality transmission?

1. Inequality widens early with **parents** (e.g., Carneiro & Heckman, 2003)
   ⇒ Focusing on income and years of schooling conceals a part of the picture
2. Strong **public investments** can mitigate differences
   ⇒ Affordable daycare and high-quality public schools are notable features of Nordic countries

Research question:

⇒ How has the intergenerational transmission of learning evolved over the last 20 years in European countries? What are the drivers of these changes?

This paper

Descriptive paper using the Programme for International Student Assessment (**PISA**) data over 8 cohorts from 2000 to 2022

- Measure transmission of inequality by focusing on learning

  $\Rightarrow$ Regress rank of test score on mother's educational attainment

- **Attention to comparability** of the estimates across countries and time

Findings:

1. The **socioeconomic (SES) gradients in test scores have failed to close** over the last 20 years,
2. **Nordic** countries have **similar SES gradients as elsewhere in Europe**, despite their high levels of social mobility and low income inequality,
3. These gradients in learning occur despite generous welfare states **because of SES gradients in parental investment**.

Overview

Measuring the intergenerational transmission of learning

Geography and dynamics

Cross-country correlates

Panel estimates

Concluding remarks

PISA data

The PISA test is **administered every 3 years** by the OECD to test skills in *reading, mathematics and science* of students at the **age of 15**:

- Individual-level data from **8 waves of the PISA test, starting in 2000**
- PISA data include a **Student, Parent and School questionnaire**

PISA tests are **explicitly designed to allow comparisons across countries**,

$\Rightarrow$ making intergenerational transmission of learning *estimates comparable* across European countries and over time

Intergenerational transmission of learning

For each country c and cohort t, we estimate:

$$Rank(Y_{itc}^k) = \alpha_{tc}^k + \beta_{tc}^k HS_{itc}^P + \epsilon_{itc}^k$$

- $Rank(Y_{itc}^k)$: **test score rank** for student i in test k at t in country c PISA data
  The rank of the test score k is computed at the European level Within country rank
- HS_{itc}^p: dummy equal to 1 if i's mother **has at least completed upper secondary education** and 0 otherwise Data validation Trends in mothers' education

1. β_{tc}^k: measures the **SES in learning** for each cohort t and country c
   $\Rightarrow$ Higher values correspond to higher persistence/larger SES gradient
2. α_{tc}^k: measures **upward mobility** for each cohort t and country c
   $\Rightarrow$ Higher values correspond to more mobility

Alternative measures of intergenerational transmission

Main measure is **robust to**:

1. Other dimensions of child's success:
   - Reading and science
   - Occupational and educational aspirations
   - Being on time at school and self-efficacy
2. Other definitions of socio-economic status:
   - Completed higher education
   - Father's education
   - Socio-economic and cultural status (ESCS) - $Rank(Y^k_{itc}) = \mu^k_{tc} + \rho^k_{tc} Rank(ESCS^P_{itc}) + \epsilon^k_{itc}$
3. Changes in composition Mothers' education Migrants

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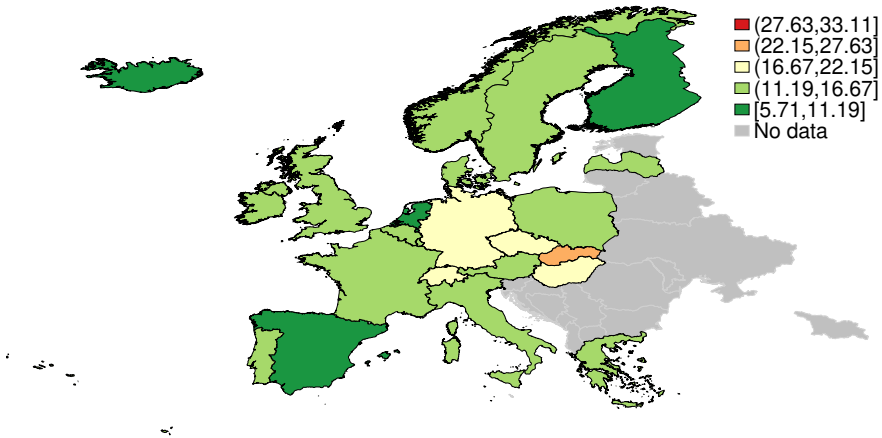
Geography of SES gradients in learning (math)

2003

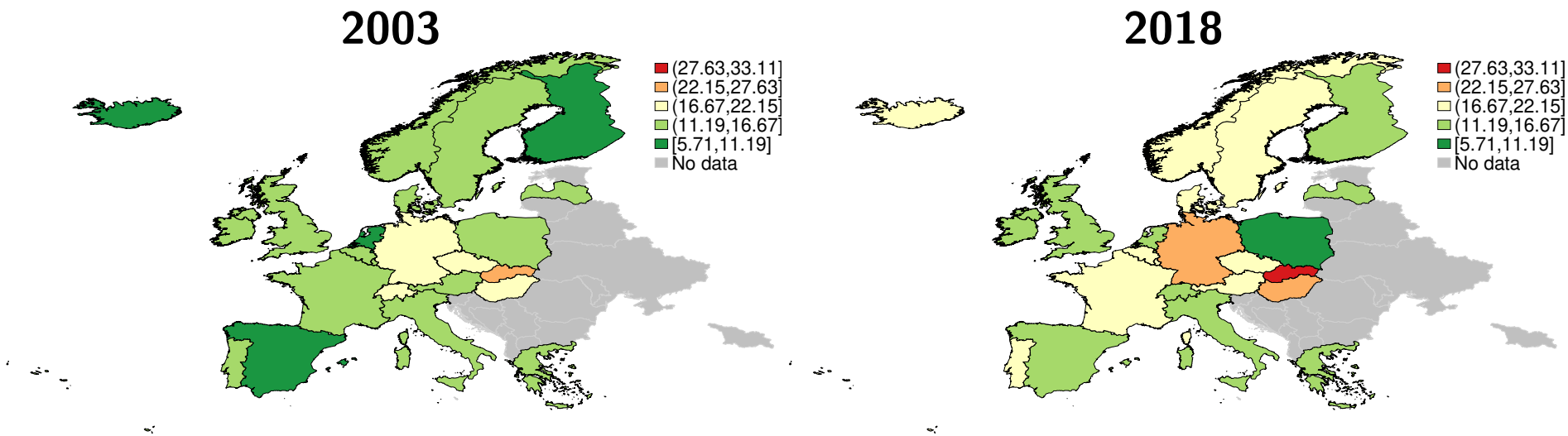


2018

Green areas represent countries with lower SES gradients in test scores (low β_{tc}^{math})

Upward mobility heatmap | SES gradients in reading heatmap | Trends in SES gradients in math | Trends in upward mobility (math) | Trends in SES gradients in reading | Trends in SES gradients in learning (only native)

Geography of SES gradients in learning (math)



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Upward mobility heatmap | SES gradients in reading heatmap | Trends in SES gradients in math | Trends in upward mobility (math) | Trends in SES gradients in reading | Trends in SES gradients in learning (only native)

Trends in SES gradients in learning (math)

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Cross-country correlates

What drives differences across countries, and changes over time, in SES gradients in learning?

- This is an **important but difficult question** to answer

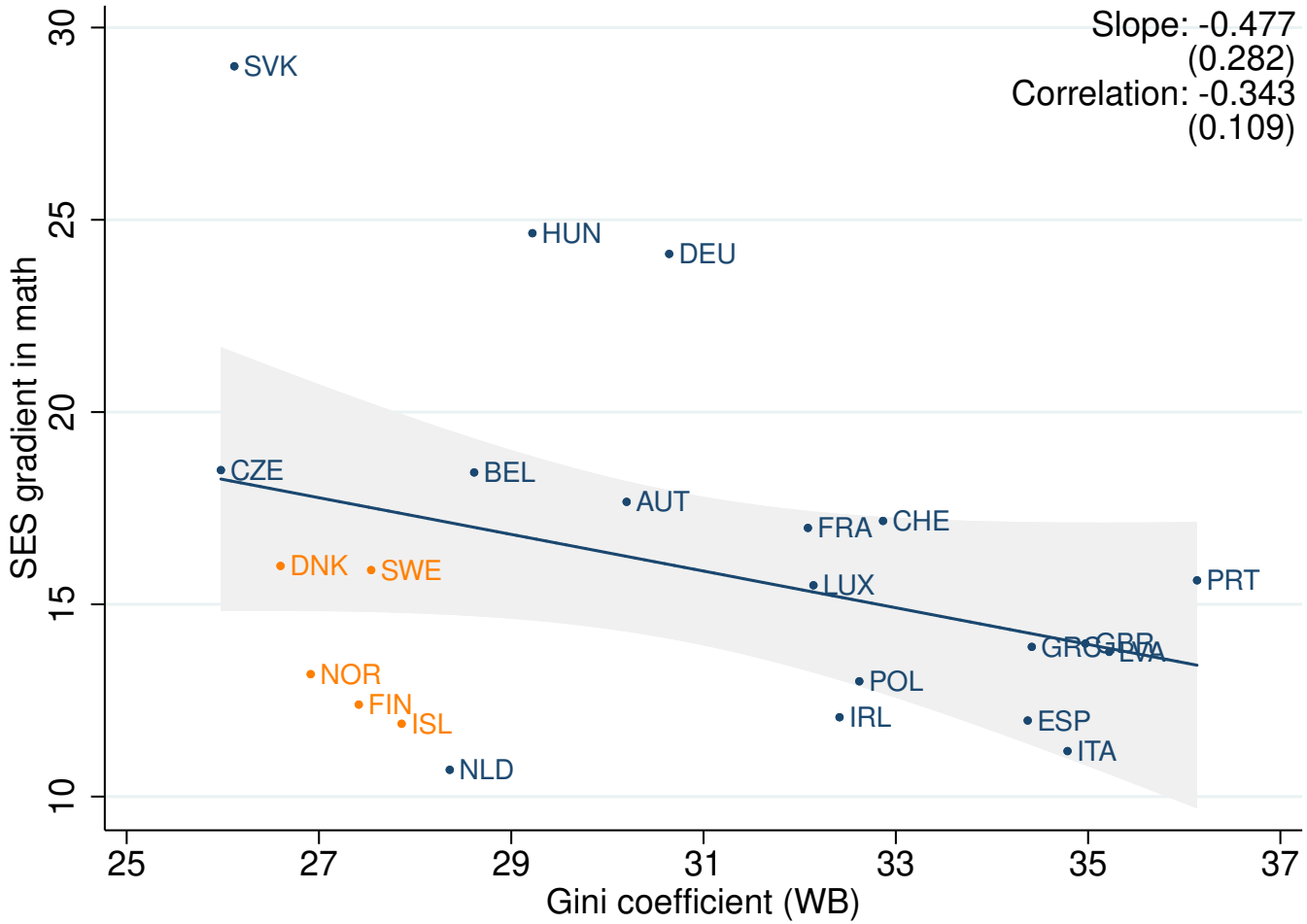
$\Rightarrow$ Difficult to establish that they are causal, even if we identify important correlates of cross-country variation in SES gradients in learning

Cross-country correlates

1. We begin by asking if there is a relationship between SES gradients in learning and inter and intra-generational inequality.

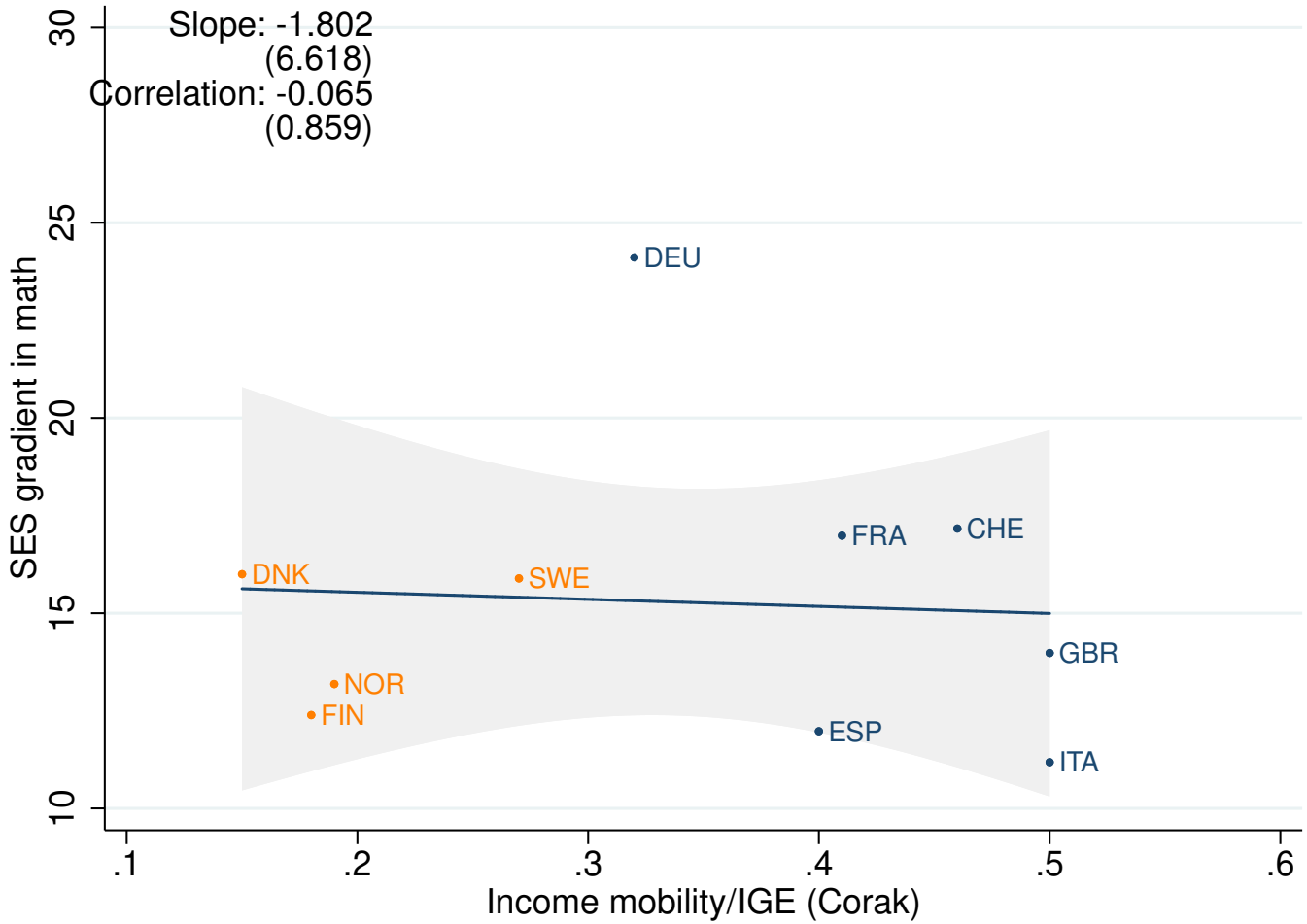
Gatsby curve (association between inequality and SES gradients in learning)

Corak (2013)'s Gatsby Curve



Robust to different datasets about learning (LLECE, TIMSS) and different measures of within-group inequality

SES gradients in learning and intergenerational elasticity of income (IGE)



Robust to using inequality of opportunity measure with larger sample of countries

figure

Cross-country correlates

1. We begin by asking if there is a relationship between SES gradients in learning and inter and intra-generational inequality.

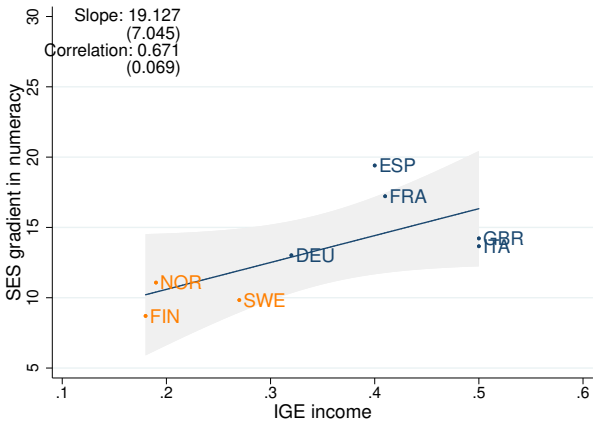
2. Surprising results lead us to undertake further analysis:
   i. use **PIAAC** - Programme for International Assessment of Adult Competencies
   ii. comparable measures of numeracy skills across countries in adults
   iii. divide the PIAAC sample into different cohorts (or age groups)
   iv. estimate SES gradients in test scores for each cohort **from 1960 to 1990**
   v. correlate SES gradients in test scores and intergenerational transmission of income (IGE) for each cohort

Studying older cohorts with Survey of Adult Skills (PIAAC)

Born before 1957

Cohort 1957-1966

Cohort 1967-1976

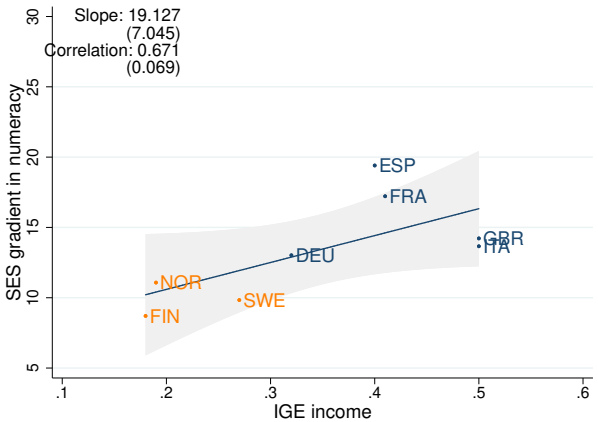


Cohort 1977-1986

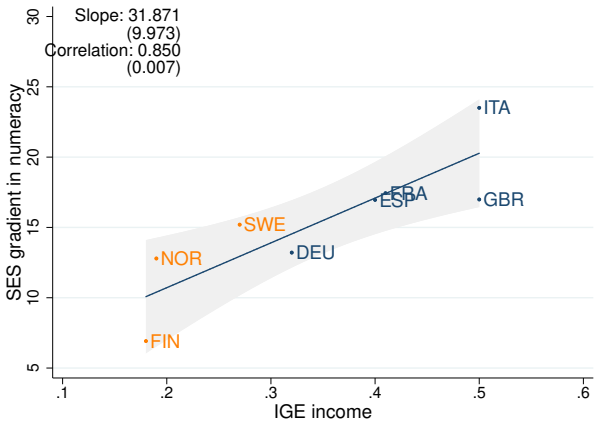
Born 1987 or later

Studying older cohorts with Survey of Adult Skills (PIAAC)

Born before 1957



Cohort 1957-1966



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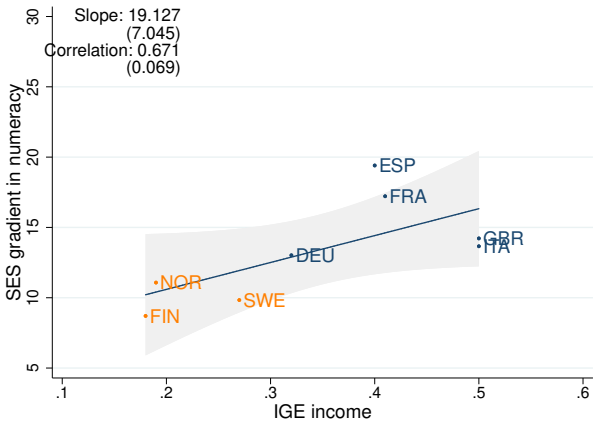

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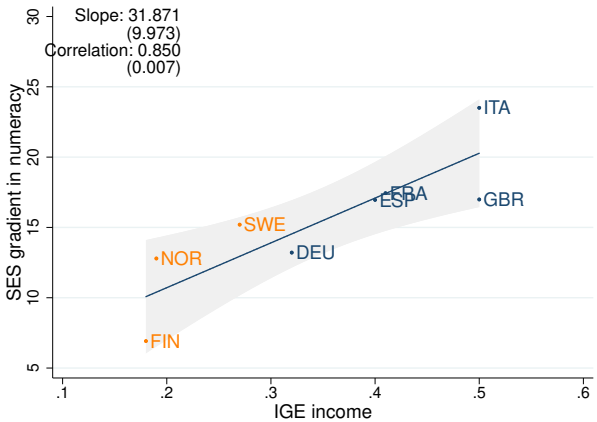

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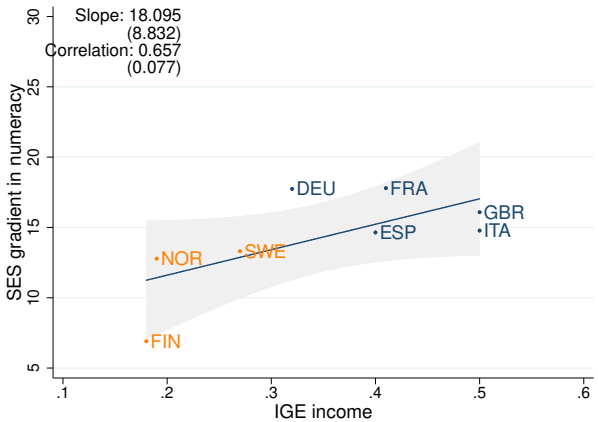

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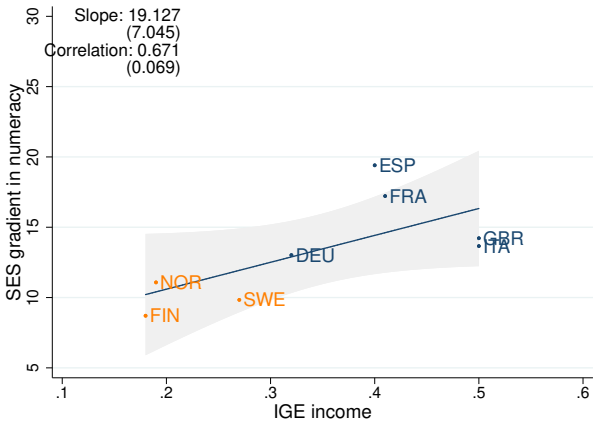

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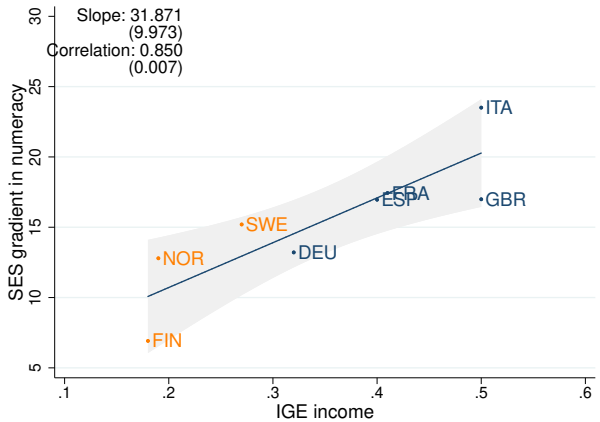
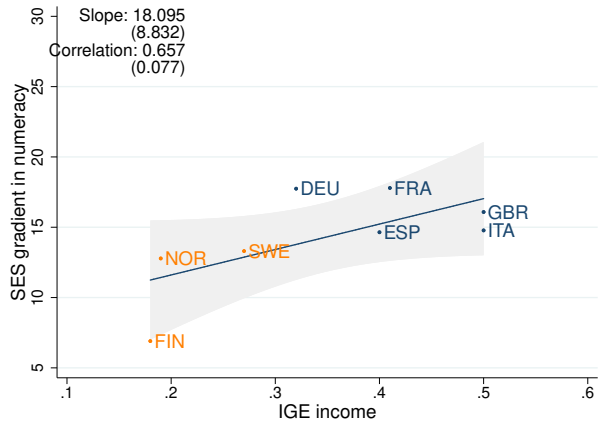


Cohort 1967-1976



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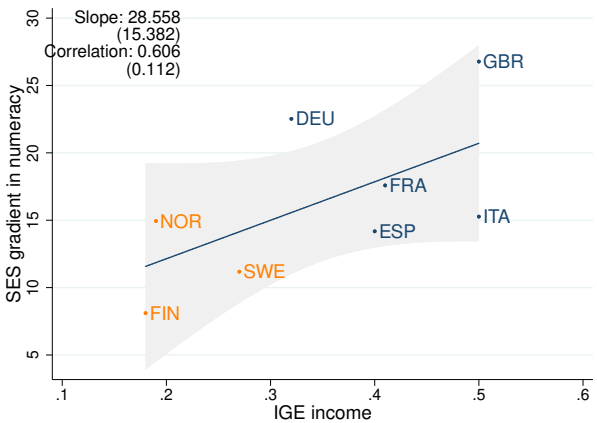

Born 1987 or later

Studying older cohorts with Survey of Adult Skills (PIAAC)

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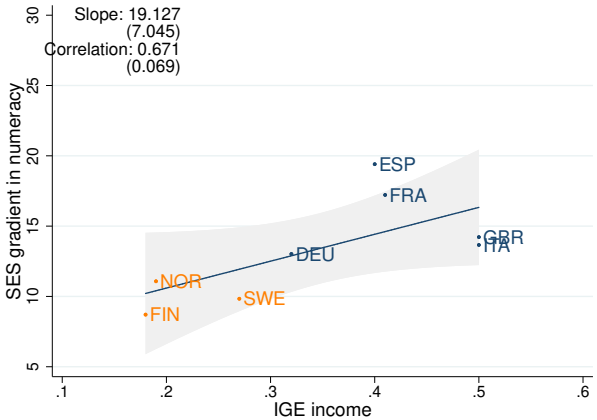

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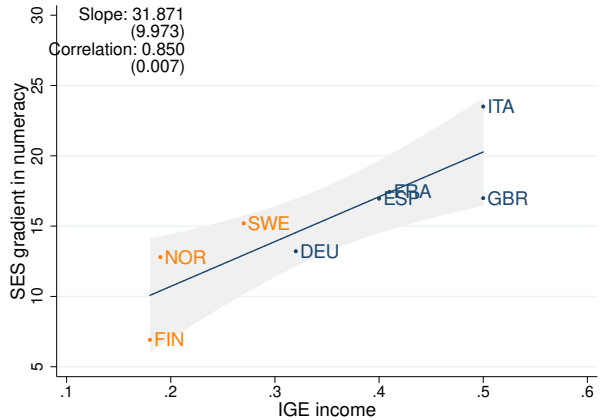

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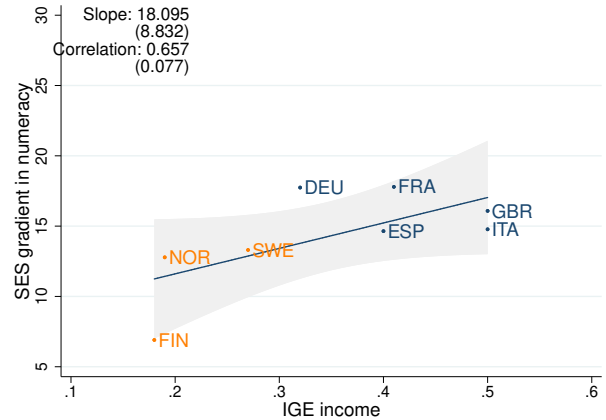

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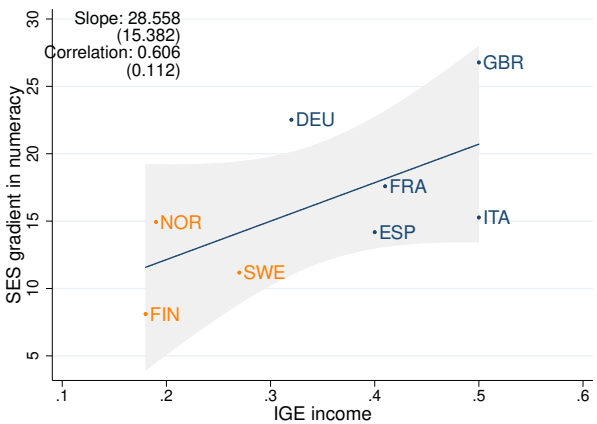

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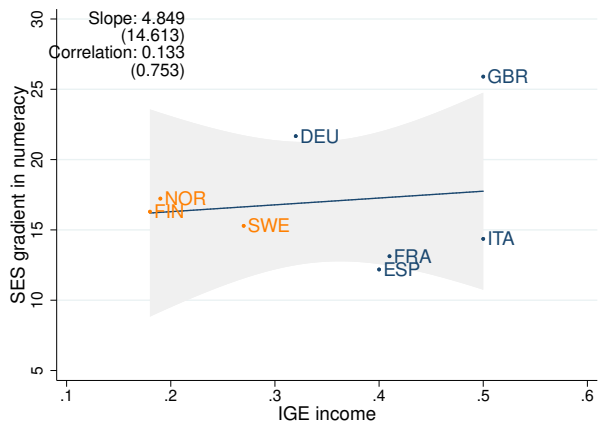

High correlation between SES gradients in the same PISA and PIAAC cohort figure

Cross-sectional correlates of SES gradients in learning

1. *Socio-economic variables*:
   - returns to secondary school (OECD)
   - country GDP (WB)
2. *Institutional variables*
   - progressivity of the tax system, proxied by the difference between the top and lowest tax rates on personal income (WB)
   - spending in public education (WB)
3. *Education system variables*
   - age in which academic tracking starts (Eurydice)
   - school level segregation, which we measure from the PISA data as the R-squared from regressing the ESCS index on school fixed effects.
4. A final variable captures parental investments in children, in particular, the *SES gradients in parental investments* more detail

Correlates of SES gradients in learning

	SES gradients in math							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP per capita	-1.901							
	(1.432)							
Returns to secondary school		0.285*						
		(0.137)						
Difference top & lowest tax rates on personal income			-0.051					
			(0.072)					
Government expenditure on education (% of GDP)				-0.498				
				(0.569)				
School tracking age					-0.987***			
					(0.319)			
School segregation						38.118***		
						(10.741)		
SES gradient in parental investment							0.841***	
							(0.128)	
Observations	24	22	23	23	23	23	24	
R^2	0.090	0.193	0.034	0.020	0.369	0.352	0.570	

Note. Table shows the estimates from SES gradients in math (averaged over all PISA years) and country-level variables (averaged over all PISA years). We consider different sets of variables. Some are socio-economic variables: the returns to secondary school from the OECD, country GDP. Some are institutional variables, such as the progressivity of the tax system, proxied by the difference between top and lowest tax rates on personal income, and spending in public education. Some are related to the education system, such as the age in which academic tracking starts, from Eurydice and school level segregation, which we measure from the PISA data as the R-squared from regressing the ESCS index on school fixed effects. Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Robustness to outliers | Robustness to other definitios | Robustness to compositional changes | Other traits

Correlates of SES gradients in learning

	SES gradients in math							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP per capita	-1.901							-1.528
	(1.432)							(1.379)
Returns to secondary school		0.285*						0.012
		(0.137)						(0.102)
Difference top & lowest tax rates on personal income			-0.051					0.048
			(0.072)					(0.053)
Government expenditure on education (% of GDP)				-0.498				0.979
				(0.569)				(0.563)
School tracking age					-0.987***			-1.074**
					(0.319)			(0.456)
School segregation						38.118***		1.775
						(10.741)		(15.890)
SES gradient in parental investment							0.841***	0.532**
							(0.128)	(0.202)
Observations	24	22	23	23	23	23	24	20
R^2	0.090	0.193	0.034	0.020	0.369	0.352	0.570	0.741

Note. Table shows the estimates from SES gradients in math (averaged over all PISA years) and country-level variables (averaged over all PISA years). We consider different sets of variables. Some are socio-economic variables: the returns to secondary school from the OECD, country GDP. Some are institutional variables, such as the progressivity of the tax system, proxied by the difference between top and lowest tax rates on personal income, and spending in public education. Some are related to the education system, such as the age in which academic tracking starts, from Eurydice and school level segregation, which we measure from the PISA data as the R-squared from regressing the ESCS index on school fixed effects. Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

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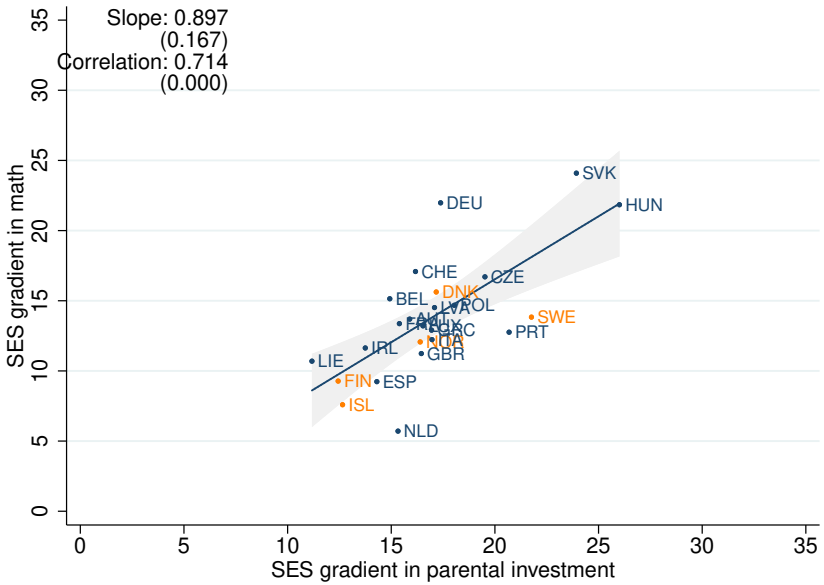
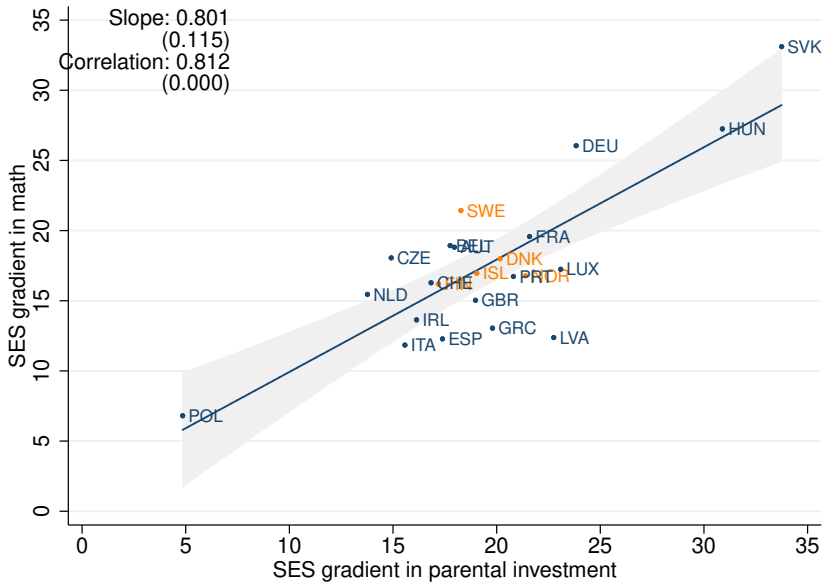
SES gradients in learning and parental investment

2003

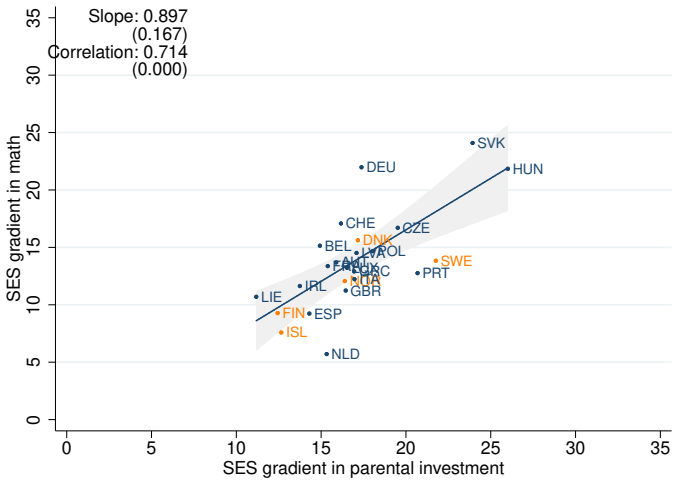


2018

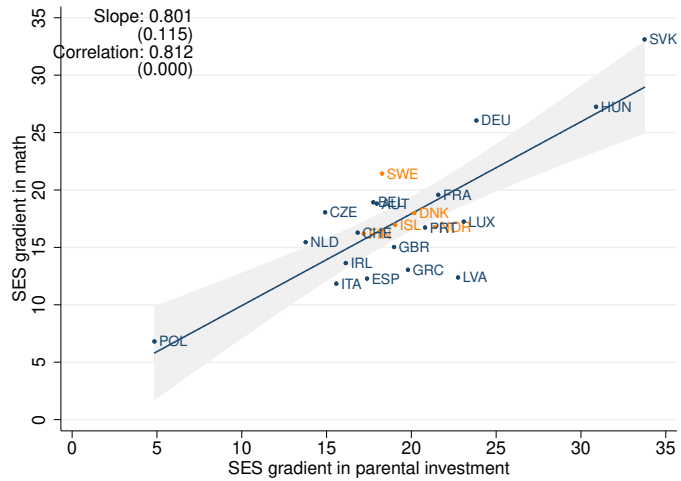


SES gradients in learning and parental investment

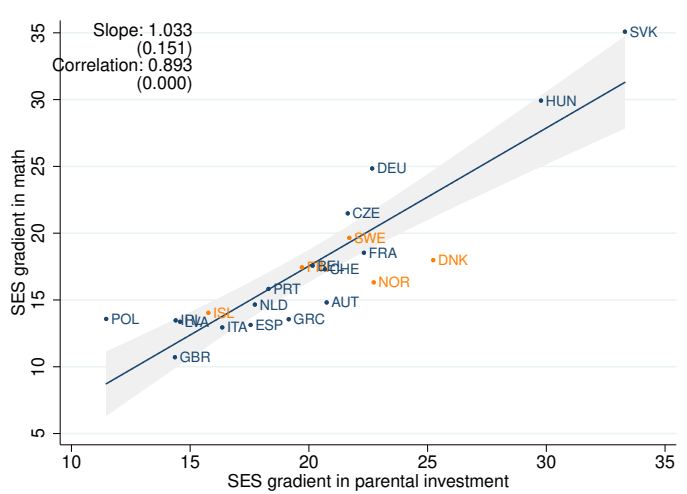
2003



2018



After COVID-19 (2022)



No correlation between SES gradients in learning (2022) & school closures (2020)

figure

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Panel estimates

Exploit panel of SES gradients in learning for country c at time t

$$\beta_{tc}^{math} = \gamma X_{tc} + \tau_t + \alpha_c + \epsilon_{tc}$$

- β_{tc}^{math}: **SES gradients** in learning for country c and cohort t
  (higher number corresponds to lower mobility)
- X_{tc}: SES gradients in parental investment, socio-economic, institutional, education system variables
- τ_t: **Year** fixed effects
- α_c: **Country** fixed effects
- γ measures the effect of economic variables on the intergenerational mobility in learning, once we control for country-specific unobservable characteristics
- Standard errors clustered at the country level

Panel estimates: SES gradients in learning

	SES gradients in math						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP per capita	-1.477						
	(4.119)						
Returns to secondary school		0.106*					
		(0.053)					
Difference top & lowest tax rates on personal income			0.028				
			(0.066)				
Government expenditure on education (% of GDP)				-0.342			
				(0.565)			
School segregation					7.840		
					(11.276)		
SES gradient in parental investment						0.564***	
						(0.129)	
Observations	160	118	137	117	159	142	
R^2	0.802	0.841	0.808	0.819	0.802	0.881	
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. Table presents the panel estimates of SES gradients in learning on economic variables with year and country fixed effects. The estimates of upward and SES gradients are based on a regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. Clustered standard errors at the country level (*** p<0.01, ** p<0.05, * p<0.1).

Robustness to outliers | Robustness to other definitions | Robustness to compositional changes

Why do SES gradients in parental investment differ across countries?

Panel estimates: SES gradients in learning

	SES gradients in math						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP per capita	-1.477						-5.149
	(4.119)						(5.433)
Returns to secondary school		0.106*					0.051
		(0.053)					(0.086)
Difference top & lowest tax rates on personal income			0.028				0.083
			(0.066)				(0.110)
Government expenditure on education (% of GDP)				-0.342			-0.354
				(0.565)			(0.563)
School segregation					7.840		2.549
					(11.276)		(15.906)
SES gradient in parental investment						0.564***	0.631***
						(0.129)	(0.189)
Observations	160	118	137	117	159	142	74
R^2	0.802	0.841	0.808	0.819	0.802	0.881	0.916
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. Table presents the panel estimates of SES gradients in learning on economic variables with year and country fixed effects. The estimates of upward and SES gradients are based on a regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. Clustered standard errors at the country level (*** p<0.01, ** p<0.05, * p<0.1).

Robustness to outliers | Robustness to other definitions | Robustness to compositional changes

Why do SES gradients in parental investment differ across countries?

Why do SES gradients in parental investment differ across countries?

These results are not driven by changes in inequality in these countries

- No correlation between inequality in ESCS and SES gradients in parental investment figure

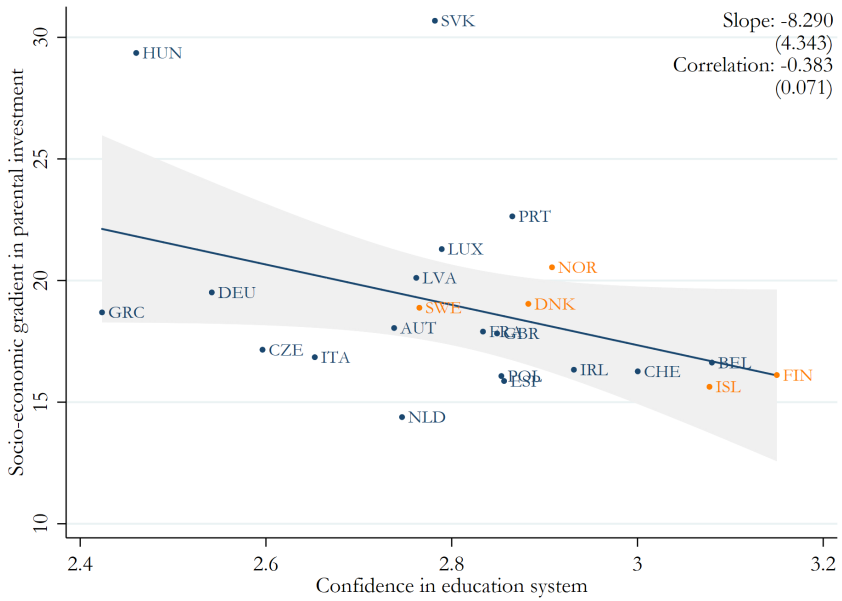
We search for potential predictors of SES gradients in parental investment

- From the 2017 European Value Study (EVS) and 2009 International Social Survey Programme (ISSP) on social inequality.

Two variables, related to social norms, are correlated with SES gradients in parental investment:

1. confidence in the education system,
2. perception that success depends strongly on parental wealth

Why do SES gradients in parental investment differ across countries?



Similarly, Heckman and Landerso (2017, 2022) compare mobility in education and income in Denmark and the United States

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Measuring the intergenerational transmission of learning

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Concluding remarks

⇒ Document **SES gradients** in test scores and parental investment in **Europe across 8 cohorts**, using PISA data:

1. SES gradients in test scores have failed to close,
2. if anything they have increased *more* in Nordic and Eastern countries.

⇒Strong relationship between **SES gradients in parental investment** and **learning**, even after **controlling for country and year fixed effects**.

- SES gradients in parental investment explains more than 50% of the variation.

⇒ **Policy implications:**

- While social policies contribute to addressing SES gradients in learning, family still play an important role in perpetuating these gaps
- Alternative policies could open up bottlenecks on the path to success

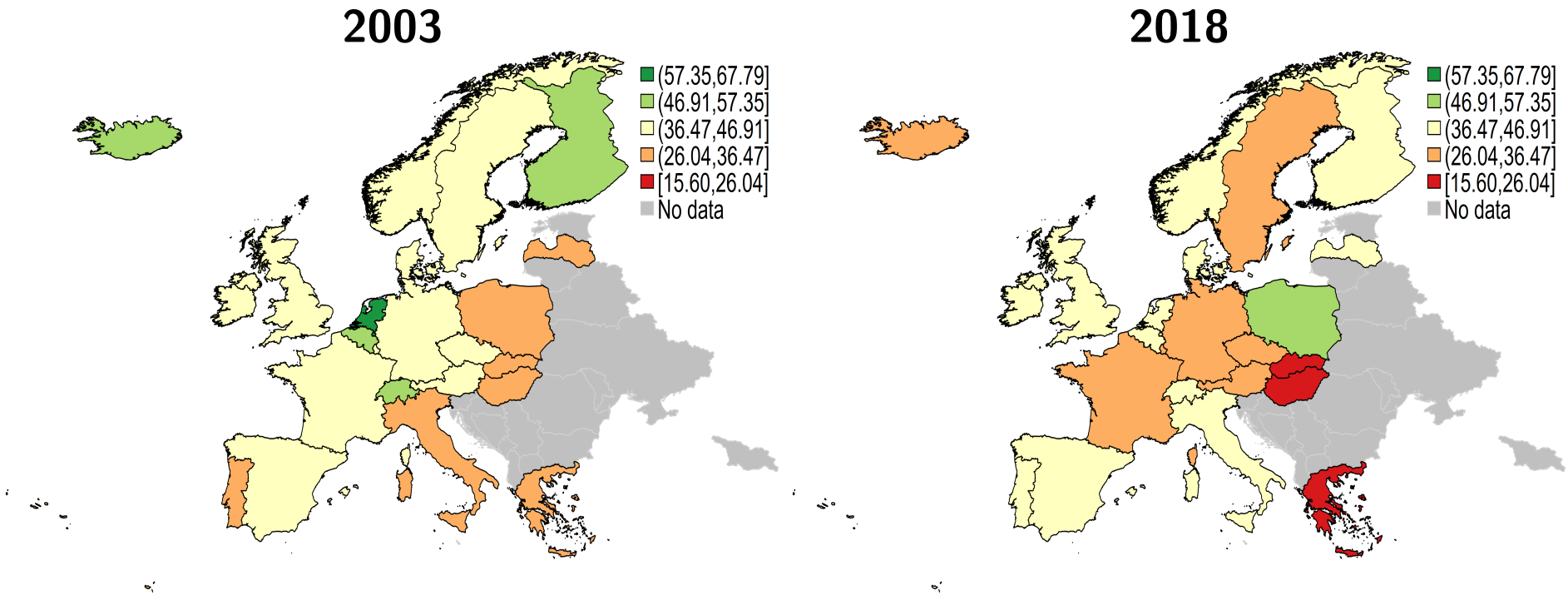
Computing the rank at European vs. within-country level

Back

1. European level rank
   - Advantage: immobility measure is **easier to compare across countries**.
   - If the **test score distributions may differ** markedly across countries, such **differences can obscure the interpretation** of the results.
   - For example, country **A is a lot more unequal than B** $\Rightarrow$ Strong mechanical force towards measuring less mobility in A than in B.
   - Reason: it takes a **lower absolute change in income in country B to move up (or down)** any given percentile, compared to A, since in B the income distribution is more compressed.
2. Within-country rank
   - Alternative: compute the **within-country rank**
   - Disadvantage: it makes **comparability across measures harder**

The geography of upward mobility (math)

back

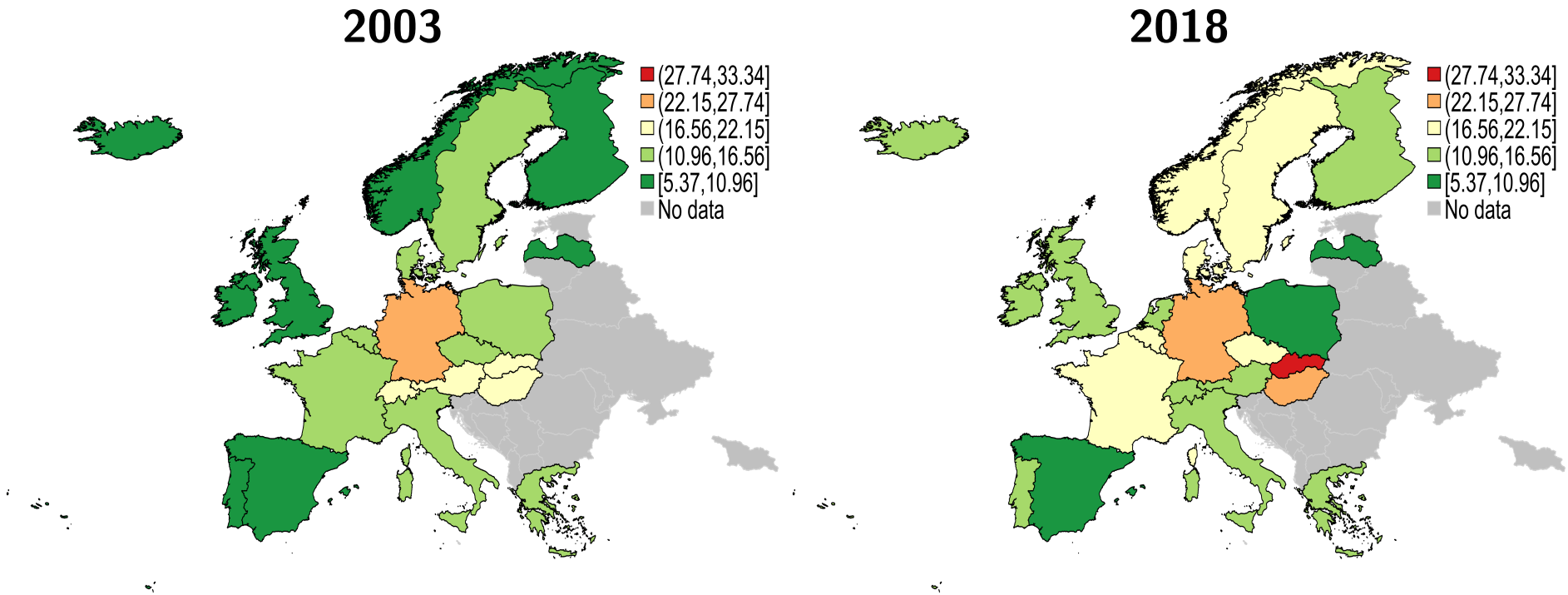


Trends in SES gradients in learning (math)

Back

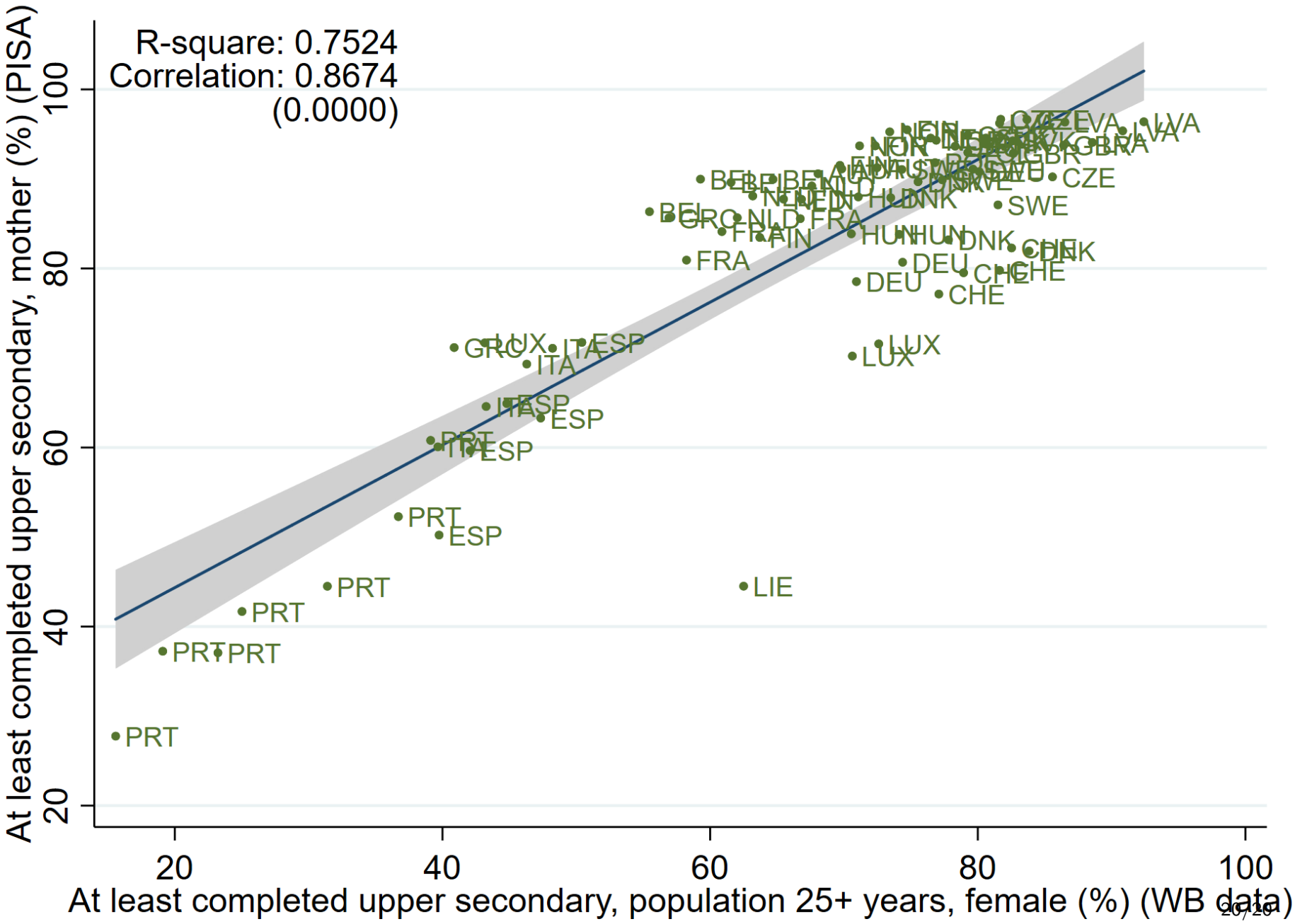
The geography of SES gradients (reading)

back



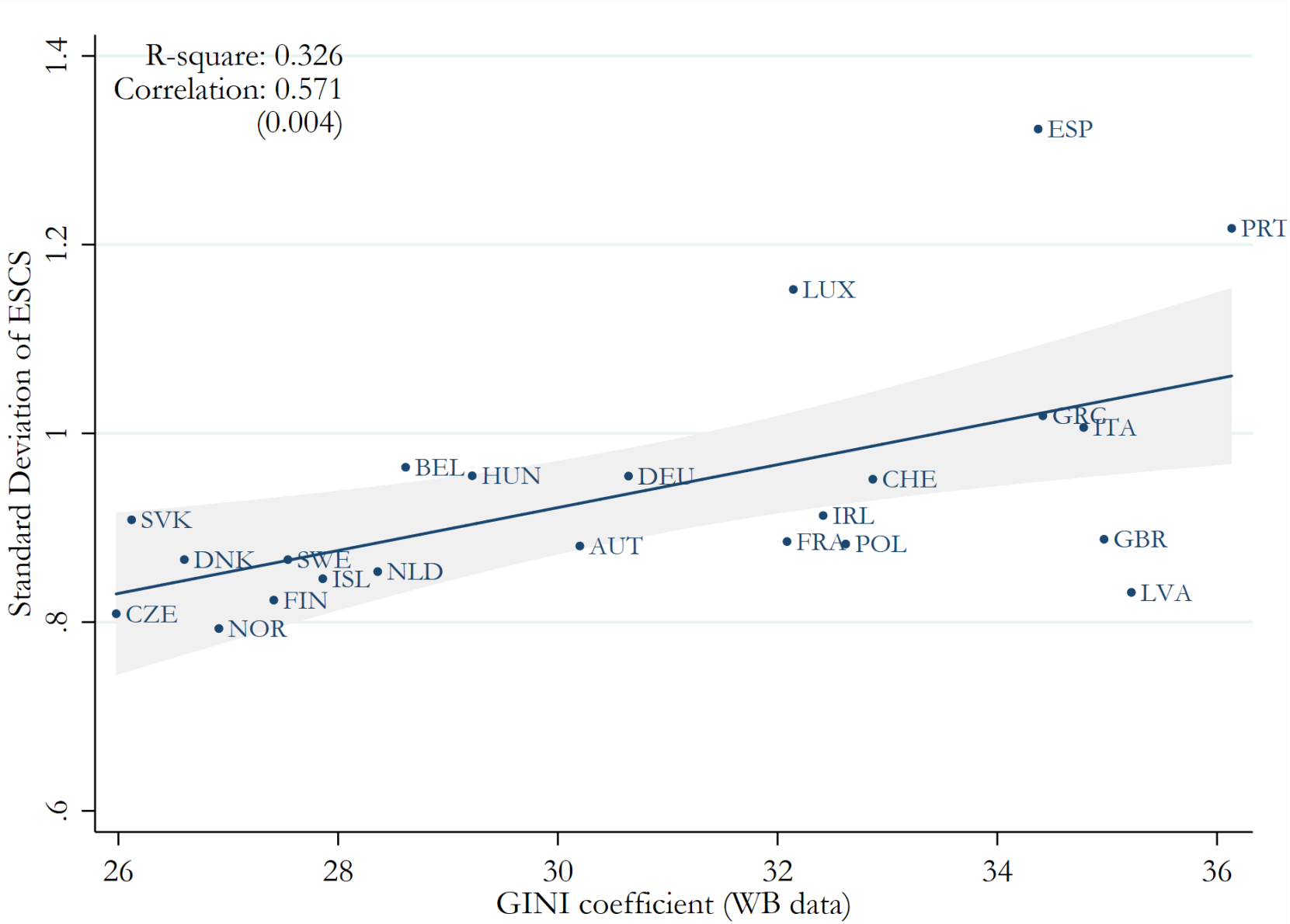
Correlation between PISA and WB education

Back



Correlation between PISA ESCS and GINI coefficient from the World Bank

Back



The trends in upward mobility in learning (math)

Back

Mobility and mothers' education

Back

	SES gradients		Upward mobility	
% mothers with less than upper secondary education	-0.107	-0.027	0.127	0.119
	(0.070)	(0.105)	(0.084)	(0.172)
Observations	142	142	142	142
R^2	0.076	0.817	0.044	0.830
Country FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes

Note. The Table presents the regression of relative and upward mobility (math) on the proportion of mothers with less than upper secondary education from the PISA database (2003-2018). The estimates of upward and SES gradients are based on the regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. The estimates are presented with and without country and year fixed effects. Clustered standard errors at country level (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Mobility and migrant students

Back

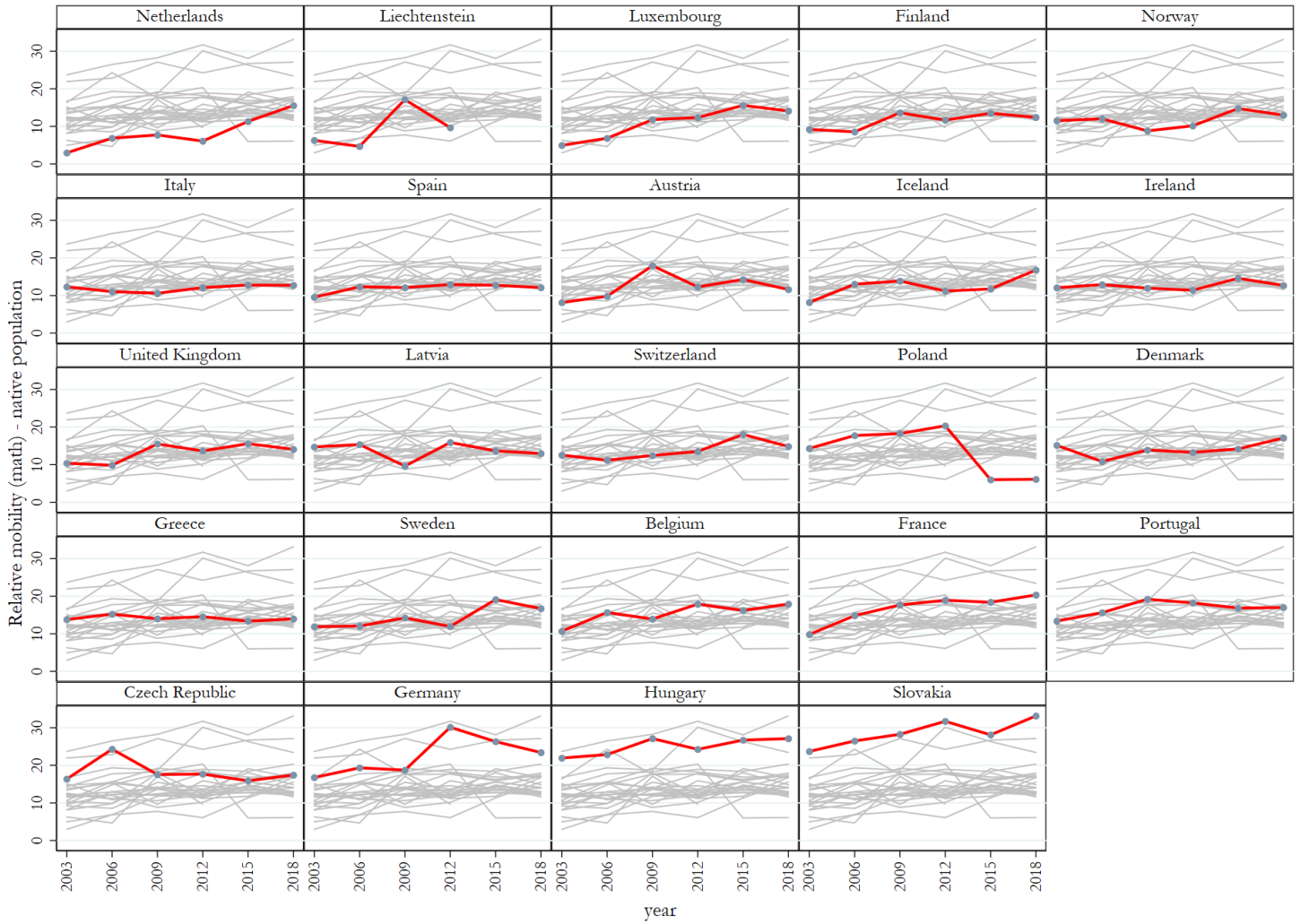
	SES gradients		Upward mobility	
% migrant students	0.014	0.091	0.148	-0.126
	(0.074)	(0.110)	(0.144)	(0.193)
Observations	142	142	142	142
R^2	0.001	0.819	0.036	0.829
Country FE	No	Yes	No	Yes
Year FE	No	Yes	No	Yes

Note. The Table presents the regression of relative and upward mobility (math) on the proportion of migrant students from the PISA database (2003-2018). The estimates of upward and SES gradients are based on the regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. The estimates are presented with and without country and year fixed effects. Clustered standard errors at country level (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

The trends in SES gradients (rank of reading score)

Back

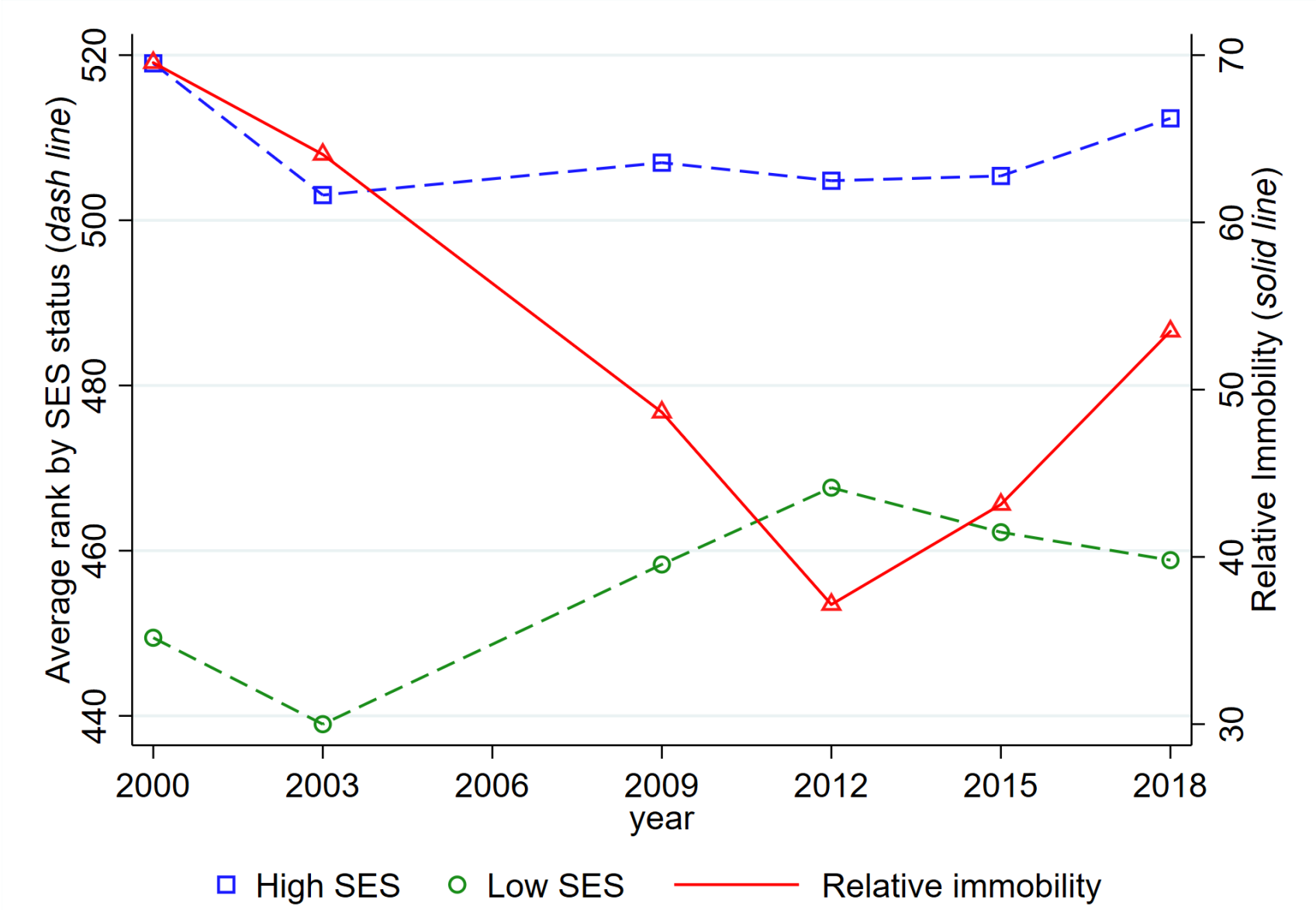
Trends in SES gradients (math) - native students



Correlation between main measure and measure on sample of native students: 0.91

Back

United States



Measuring SES gradients in parental investment

back

Factor model with categorical items to measure parental investment $(I)_{itc}$, combining information on the home learning environment (e.g., the child's access to study conditions, technology, books, etc) variables

$\Rightarrow$ Factor model ensures comparability across countries and over time

For each student i, country c and cohort t we estimate:

$$R(I)_{itc} = \alpha^{I}_{tc} + \beta^{I}_{tc} HS^{P}_{itc} + e_{itc}$$

- $R(I)_{itc}$ is the parental investment percentile rank (rank computed at European level) for student i, at time t, living in country c.
- HS^{p}_{itc} is an indicator variable taking value 1 if i's mother has completed at least upper secondary education, and 0 otherwise.
- β^{I}_{tc} measures the SES gradients in parental investment for cohort t and country c.

Measuring Parental Investment

Back

To construct a measure of parental investment that is comparable across countries and over time, we use a factor model. Assuming each latent item, $m_{ict}^{*,j}$ for question j, is additively separable in the logarithm of the latent factor, we have:

$$m_{ict}^{*,j} = \alpha_{ct}^{j} + \lambda_{t}^{j\top} lnI_{ict} + \varepsilon_{ict}^{j} \tag{1}$$

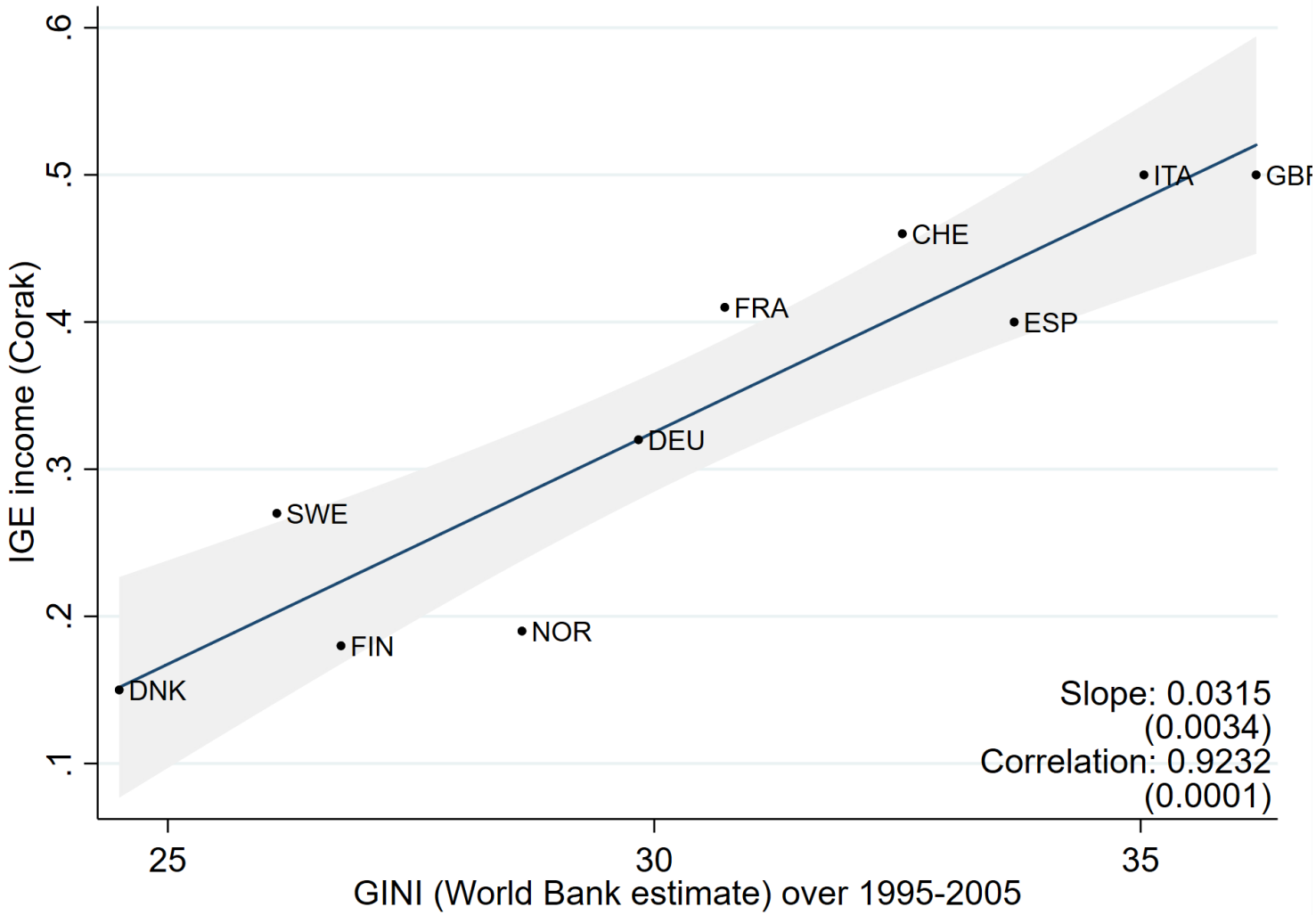
Depending on the nature of $m_{ict}^{*,j}$ (continuous, binary, or categorical) we need to specify different models.

The questions used of the parental investment index:

- Possessions desk
- Possessions study place
- Possessions computer
- Possessions software
- Possessions textbooks
- Possessions ¡technical reference books¿
- Possessions dictionary
- Possessions literature
- Possessions poetry
- Possessions art
- How many books at home

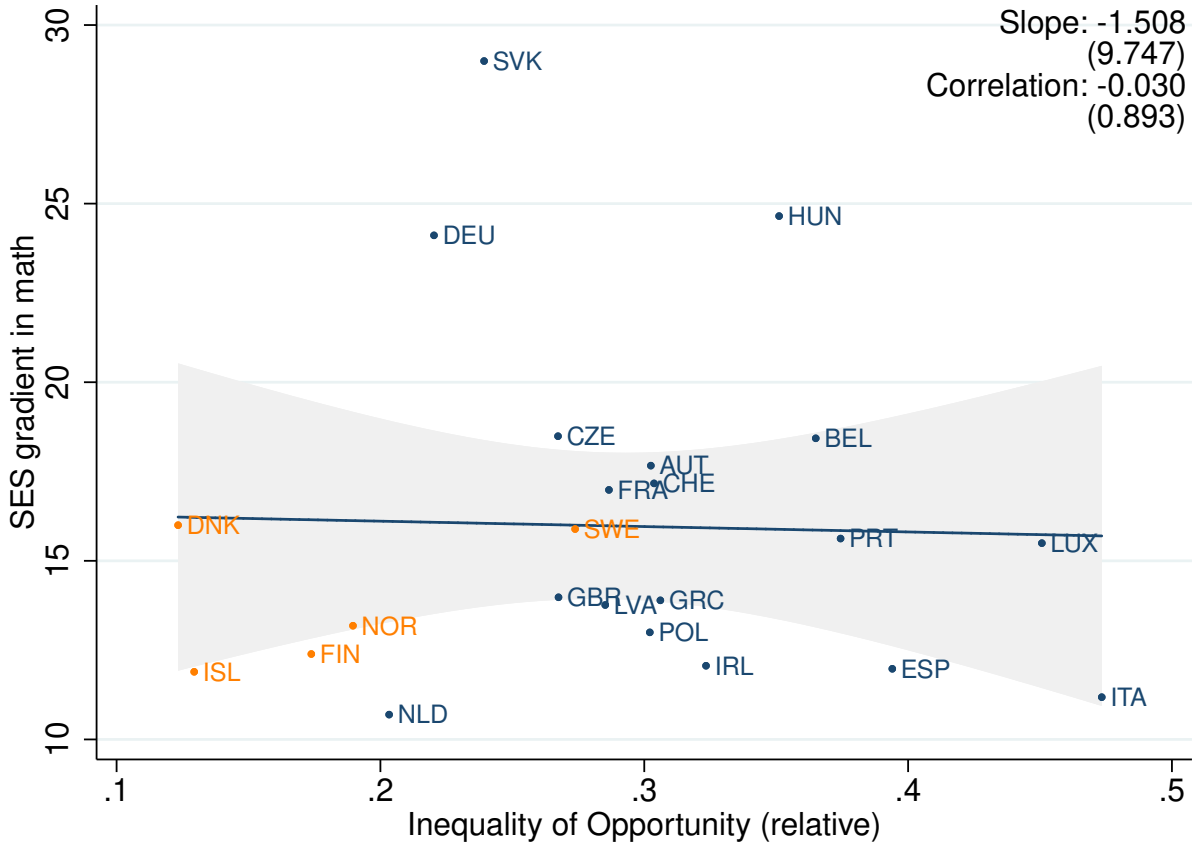
Corak (2013) Gatsby Curve

Back



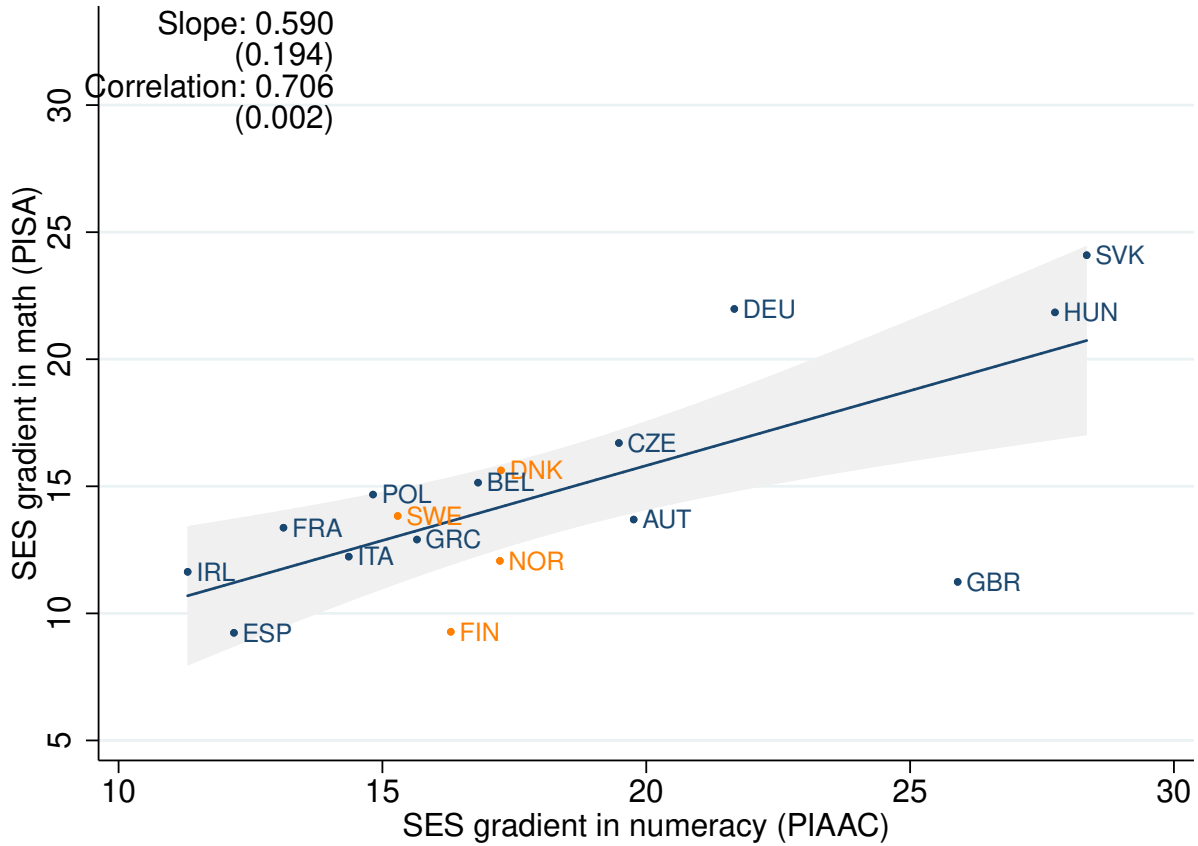
SES gradients in learning and inequality of opportunity (relative)

back



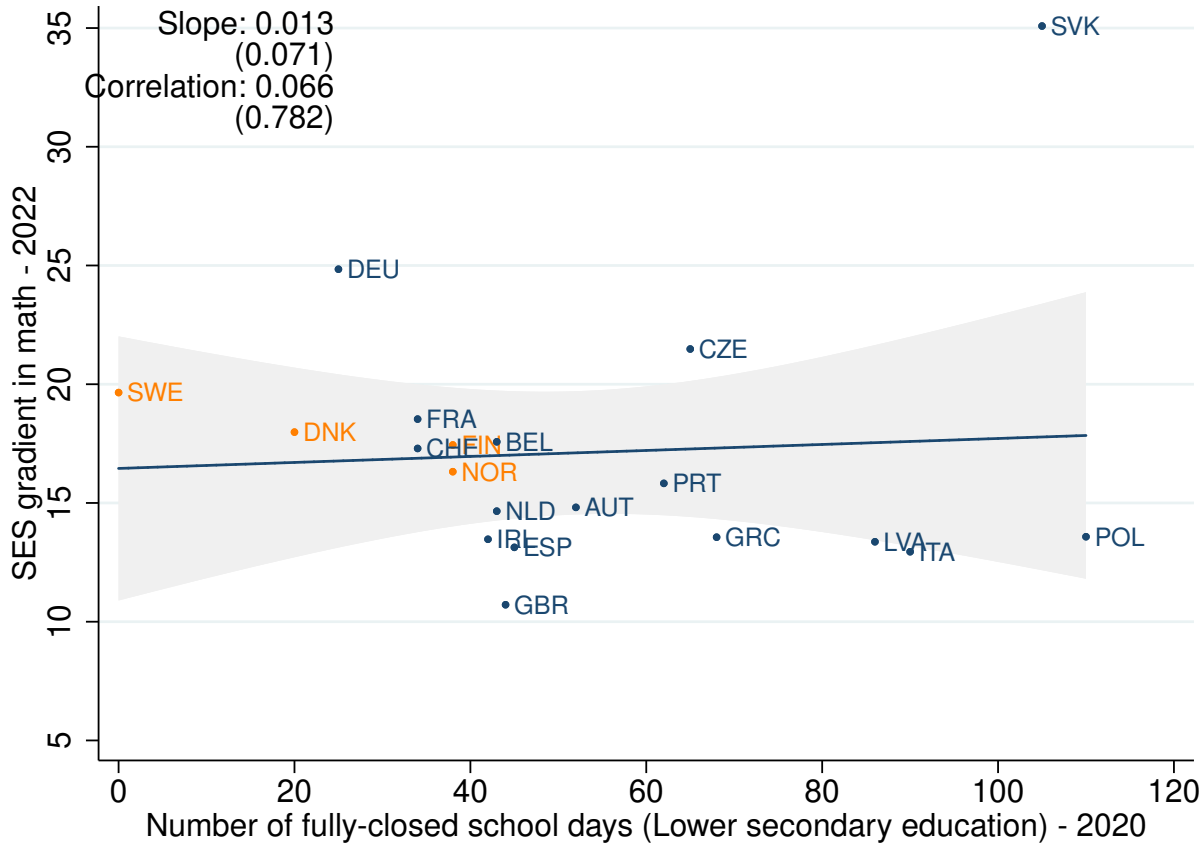
Correlation between PIAAC and PISA in same cohort (born 1987)

back



SES gradients in learning (2022) and school closures (2020)

back



Robustness to outliers back

	SES gradients (math)					
Excluding	AUT	BEL	CHE	CZE	DEU	DNK
SES gradient in parental investment	0.845***	0.866***	0.864***	0.858***	0.825***	0.841***
	(0.129)	(0.124)	(0.125)	(0.127)	(0.140)	(0.128)
Observations	23	23	23	23	23	23
R^2	0.579	0.605	0.593	0.598	0.643	0.570
Excluding	ESP	FIN	FRA	GBR	GRC	HUN
SES gradient in parental investment	0.828***	0.831***	0.845***	0.838***	0.840***	0.849***
	(0.132)	(0.132)	(0.129)	(0.128)	(0.127)	(0.187)
Observations	23	23	23	23	23	23
R^2	0.560	0.561	0.576	0.569	0.575	0.483
Excluding	IRL	ISL	ITA	LIE	LUX	LVA
SES gradient in parental investment	0.828***	0.828***	0.824***	0.879***	0.859***	0.853***
	(0.131)	(0.133)	(0.130)	(0.121)	(0.123)	(0.123)
Observations	23	23	23	23	23	23
R^2	0.563	0.558	0.570	0.586	0.584	0.590
Excluding	NLD	NOR	POL	PRT	SVK	SWE
SES gradient in parental investment	0.821***	0.862***	0.836***	0.881***	0.678***	0.841***
	(0.137)	(0.119)	(0.131)	(0.114)	(0.150)	(0.128)
Observations	23	23	23	23	23	23
R^2	0.548	0.604	0.562	0.599	0.362	0.570

Note. The Table presents the robustness to outliers for SES gradients in learning and SES gradient in parental investment. The relationship between SES gradients in learning and SES gradient in parental investment is re-estimated by excluding each country one by one. The estimates of SES gradients are based on equation (**??**), regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Robustness to compositional changes

back

	SES gradient in learning				
SES gradient in parental investment	0.841***	0.803***	0.870***	0.836***	0.661**
	(0.128)	(0.108)	(0.146)	(0.127)	(0.240)
% migrant students			0.057	0.075	-0.029
			(0.083)	(0.083)	(0.104)
% mothers with less than upper secondary education		-0.070**		-0.079**	-0.129***
		(0.032)		(0.029)	(0.042)
Observations	24	24	24	24	21
R^2	0.570	0.608	0.585	0.633	0.758
Other controls	No	No	No	No	Yes
	Upward mobility				
SES gradient in parental investment	-1.483***	-1.461***	-1.427***	-1.415***	-1.057***
	(0.174)	(0.182)	(0.185)	(0.197)	(0.242)
% migrant students			0.109	0.103	-0.087
			(0.073)	(0.077)	(0.152)
% mothers with less than upper secondary education		0.043		0.029	0.069
		(0.069)		(0.076)	(0.091)
Observations	24	24	24	24	21
R^2	0.646	0.651	0.666	0.668	0.781
Other controls	No	No	No	No	Yes

Note. The table shows that the association in the cross section between the SES gradient in learning outcomes and the SES gradient in parental investment remains robust, when controlling for compositional factors, such as the percentage of first/second-generation migrant students and the percentage of mothers with less than a high school education. Other controls are: *socio-economic variables* (returns to secondary school from the OECD, and country GDP per capita from the World Bank database); *institutional variables* (the progressivity of the tax system, proxied by the difference between the top and lowest tax rates on personal income, and spending in public education from the World Bank database) and *education system variables* (age at which academic tracking starts from Eurydice and school level segregation, which we measure from the PISA data as the R-squared from regressing the ESCS index on school fixed effects). Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Robustness to compositional changes

back

	SES gradient in learning				
SES gradient in parental investment	0.564***	0.579***	0.561***	0.575***	0.682***
	(0.129)	(0.120)	(0.127)	(0.120)	(0.189)
% migrant students			0.034	0.025	-0.168
			(0.090)	(0.083)	(0.171)
% mothers with less than upper secondary education		-0.079		-0.078	-0.136
		(0.067)		(0.065)	(0.153)
Observations	142	142	142	142	74
R^2	0.881	0.884	0.882	0.884	0.919
Other controls	No	No	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes
	Upward mobility				
SES gradient in parental investment	-0.750***	-0.783***	-0.744***	-0.780***	-0.954***
	(0.229)	(0.212)	(0.227)	(0.212)	(0.230)
% migrant students			-0.050	-0.026	0.464*
			(0.161)	(0.149)	(0.256)
% mothers with less than upper secondary education		0.189		0.188	0.432*
		(0.131)		(0.130)	(0.209)
Observations	142	142	142	142	74
R^2	0.874	0.880	0.874	0.880	0.935
Other controls	No	No	No	No	Yes
Country FE	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes

Note. The table shows that the association in the panel between the SES gradient in learning outcomes and the SES gradient in parental investment remains robust, when controlling for compositional factors, such as the percentage of first/second-generation migrant students and the percentage of mothers with less than a high school education. Other controls are: *socio-economic variables* (returns to secondary school from the OECD, and country GDP per capita from the World Bank database); *institutional variables* (the progressivity of the tax system, proxied by the difference between the top and lowest tax rates on personal income, and spending in public education from the World Bank database) and *education system variables* (school level segregation, which we measure from the PISA data as the R-squared from regressing the ESCS index on school fixed effects). Clustered standard errors at the country level (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Robustness to other definitions of SES gradients in learning

back

	SES gradients					
Definition	$\beta_{tc}^{math-father}$	β_{tc}^{read}	β_{tc}^{math-c}	$\beta_{tc}^{math-uni}$	$\beta_{tc}^{math-med}$	ρ_{tc}^{math}
SES gradient in parental investment	0.935***	0.714***	1.022***	1.132***	0.445***	35.650**
	(0.096)	(0.105)	(0.153)	(0.211)	(0.144)	(15.735)
Observations	24	24	24	24	24	23
R^2	0.687	0.492	0.649	0.631	0.275	0.198
	Upward mobility					
Definition	$\alpha_{tc}^{math-father}$	α_{tc}^{read}	α_{tc}^{math-c}	$\alpha_{tc}^{math-uni}$	$\alpha_{tc}^{math-med}$	μ_{tc}^{math}
SES gradient in parental investment	-1.381***	-1.375***	-1.000***	-0.924**	-0.941***	-15.093*
	(0.124)	(0.231)	(0.256)	(0.377)	(0.167)	(8.293)
Observations	24	24	24	24	24	23
R^2	0.662	0.626	0.517	0.164	0.326	0.074

Note. The Table presents the robustness to other definitions of SES gradients in learning for the relationship between SES gradients in learning and SES gradient in parental investment. $\beta_{tc}^{math-father}$ is the measure of SES gradients in math when using the father's education dummy instead of the mother's, β_{tc}^{read} is the main measure of SES gradients in reading , β_{tc}^{math-c} is SES gradients in math when rank is computed within the country, $\beta_{tc}^{math-uni}$ is SES gradients in math , $\beta_{tc}^{math-med}$ is SES gradients in math , ρ_{tc}^{math} is SES gradients using the rank of the parents' ESCS. α_{tc}^{math} is the main measure of upward mobility in math , $\beta_{tc}^{math-father}$ is the main measure of upward mobility in math when using the father's education dummy instead of the mother's, α_{tc}^{read} is the main measure of upward mobility in reading , α_{tc}^{math-c} is upward mobility in math when rank is computed within the country, $\alpha_{tc}^{math-uni}$ is upward mobility in math, $\alpha_{tc}^{math-med}$ is upward mobility in math, μ_{tc}^{math} is upward mobility using the rank of the parents' ESCS. Robust standard errors (*** p<0.01, ** p<0.05, * p<0.1).

Robustness to outliers back

	SES gradients (math)					
Excluding	AUT	BEL	CHE	CZE	DEU	DNK
SES gradient in parental investment	0.557***	0.572***	0.560***	0.552***	0.555***	0.565***
	(0.131)	(0.127)	(0.133)	(0.146)	(0.141)	(0.131)
Observations	136	136	136	136	136	136
R^2	0.882	0.882	0.883	0.892	0.873	0.883
Excluding	ESP	FIN	FRA	GBR	GRC	HUN
SES gradient in parental investment	0.568***	0.554***	0.575***	0.571***	0.570***	0.563***
	(0.129)	(0.132)	(0.127)	(0.129)	(0.129)	(0.131)
Observations	136	136	136	136	136	136
R^2	0.877	0.880	0.883	0.881	0.884	0.863
Excluding	IRL	ISL	ITA	LIE	LUX	LVA
SES gradient in parental investment	0.564***	0.565***	0.560***	0.553***	0.569***	0.573***
	(0.131)	(0.131)	(0.132)	(0.133)	(0.131)	(0.131)
Observations	136	136	136	138	136	136
R^2	0.880	0.882	0.879	0.884	0.882	0.894
Excluding	NLD	NOR	POL	PRT	SVK	SWE
SES gradient in parental investment	0.590***	0.581***	0.392***	0.572***	0.607***	0.593***
	(0.117)	(0.122)	(0.112)	(0.129)	(0.122)	(0.113)
Observations	136	136	136	136	136	136
R^2	0.887	0.885	0.887	0.883	0.841	0.897

Note. The Table presents the robustness to outliers for SES gradients in learning and SES gradient in parental investment. The relationship between SES gradients in learning and SES gradient in parental investment is re-estimated by excluding each country one by one. The estimates of SES gradients are based on equation (**??**), regression of the rank of the math score on a dummy equal to 1 if mother has at least upper secondary. The rank is computed at the European level. Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

Robustness to other definitions of SES gradients in learning

back

	SES gradients					
Definition	$\beta_{tc}^{math-father}$	β_{tc}^{read}	β_{tc}^{math-c}	$\beta_{tc}^{math-uni}$	$\beta_{tc}^{math-med}$	ρ_{tc}^{math}
SES gradient in parental investment	0.438***	0.502***	0.634***	0.687***	0.138**	18.020
	(0.087)	(0.118)	(0.124)	(0.111)	(0.065)	(11.711)
Observations	142	142	142	142	142	137
R^2	0.889	0.880	0.889	0.857	0.681	0.885
	Upward mobility					
Definition	$\alpha_{tc}^{math-father}$	α_{tc}^{read}	α_{tc}^{math-c}	$\alpha_{tc}^{math-uni}$	$\alpha_{tc}^{math-med}$	μ_{tc}^{math}
SES gradient in parental investment	-0.522***	-0.596***	-0.612***	-0.276	-0.285*	-10.382
	(0.160)	(0.167)	(0.149)	(0.190)	(0.139)	(10.635)
Observations	142	142	142	142	142	137
R^2	0.883	0.878	0.903	0.854	0.811	0.749

Note. The Table presents the robustness to other definitions of SES gradients in learning for the relationship between SES gradients in learning and SES gradient in parental investment. $\beta_{tc}^{math-father}$ is the measure of SES gradients in math when using the father's education dummy instead of the mother's, β_{tc}^{read} is the main measure of SES gradients in reading , β_{tc}^{math-c} is SES gradients in math when rank is computed within the country, $\beta_{tc}^{math-uni}$ is SES gradients in math , $\beta_{tc}^{math-med}$ is SES gradients in math , ρ_{tc}^{math} is SES gradients using the rank of the parents' ESCS. α_{tc}^{math} is the main measure of upward mobility in math , $\beta_{tc}^{math-father}$ is the main measure of upward mobility in math when using the father's education dummy instead of the mother's, α_{tc}^{read} is the main measure of upward mobility in reading , α_{tc}^{math-c} is upward mobility in math when rank is computed within the country, $\alpha_{tc}^{math-uni}$ is upward mobility in math, $\alpha_{tc}^{math-med}$ is upward mobility in math, μ_{tc}^{math} is upward mobility using the rank of the parents' ESCS. Robust standard errors (*** p<0.01, ** p<0.05, * p<0.1).

SES gradients in other traits and in parental investment

back

Definition	**SES gradients in**					
	Read	Science	Occupational aspiration	Educational aspiration	Being on time	Self-efficacy
SES gradient in parental investment	0.714***	0.708***	0.009***	0.012***	0.005*	0.709***
	(0.105)	(0.129)	(0.001)	(0.002)	(0.002)	(0.128)
Observations	24	24	24	24	24	24
R^2	0.492	0.435	0.545	0.486	0.152	0.644

Note. The Table presents the correlation between SES gradients in other traits and the socio-economic gradient in parental investment (averaged over the PISA years). The estimates of SES gradients are the regression of trait on a dummy equal to 1 if mother has at least upper secondary. Robust standard errors (*** $p<0.01$, ** $p<0.05$, * $p<0.1$).

The trends in SES gradients in learning (math)

Back

SES gradients in other traits

	SES gradient in					
	Math	Read	Science	Educational aspiration	Occupational aspiration	Being on time to school
Math	1					
Read	0.962***	1				
Science	0.963***	0.980***	1			
Educational aspiration	0.473**	0.367*	0.345	1		
Occupational aspiration	0.541***	0.386*	0.361*	0.766***	1	
Being on time to school	0.536***	0.565***	0.571***	-0.047	-0.015	1

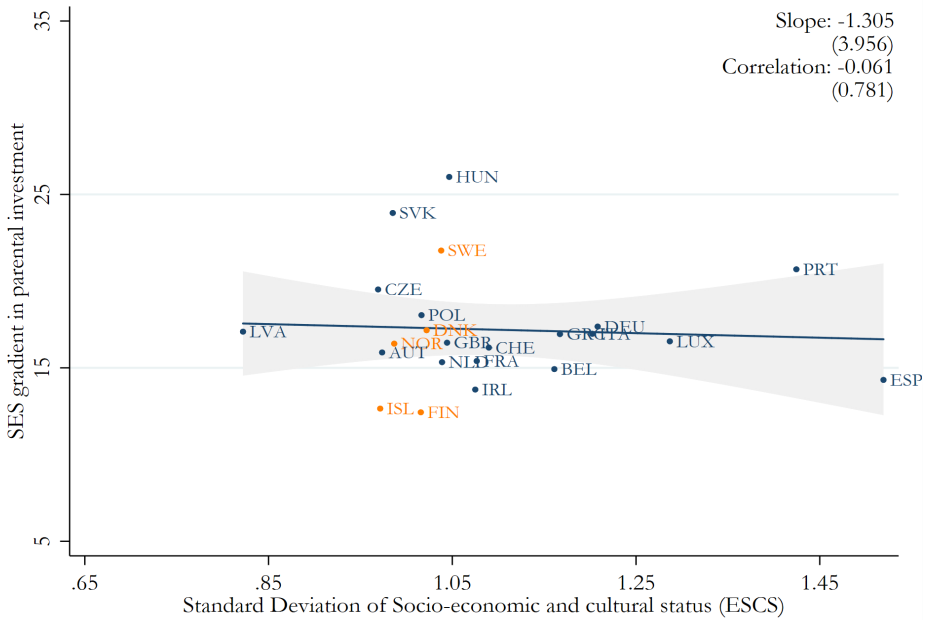
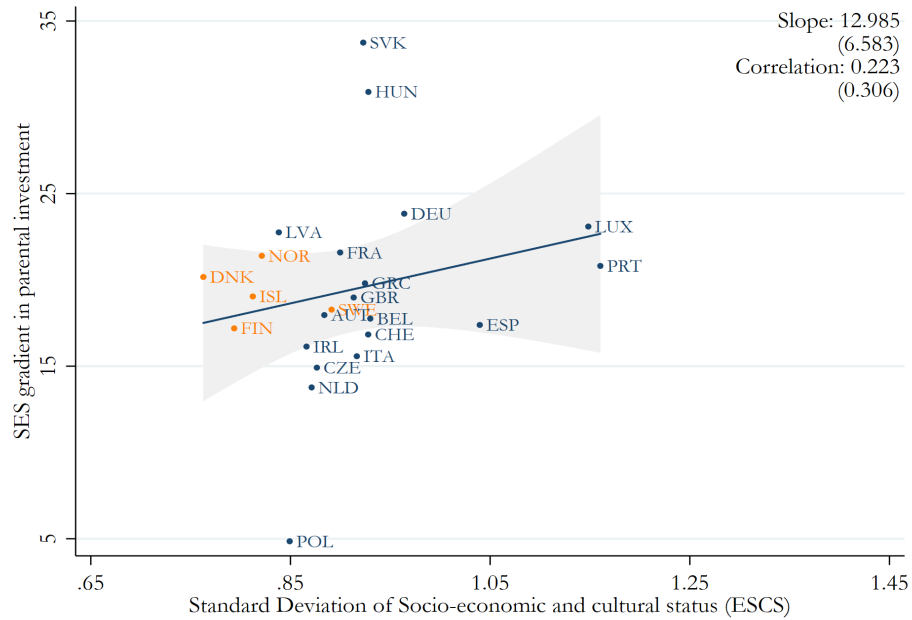
Note. The table presents the correlation among different measures of SES gradients for 2018. Each measure has been estimated by regressing the outcome of interest on dummy equal to 1 if mother has at least upper secondary. (*** p<0.01, ** p<0.05, * p<0.1).

⇒ We find a similar **strong correlation** between SES gradients in other traits and SES gradients in parental investment table

Correlation between SES gradients in parental investment and inequality in ESCS

back

2003



2018