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

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Motivation

Social mobility describes to what extent individuals with different initial conditions - outside of their control - have equal chances to succeed.

• Social mobility varies widely across countries (e.g., Corak, 2013), and even across regions within a country (e.g., Chetty et al, 2014).

Human capital formation is a central to models of intergenerational transmission (e.g., Becker and Tomes, 1979, 1987).

• A focus on schooling and learning is important, since human capital formation starts much earlier (e.g., Carneiro and Heckman, 2003).

Generous maternity leave, affordable daycare, extensive social safety nets, excellent universal health care, and high-quality public schools, are all notable features of **Nordic countries**.

• Widespread **belief that such strong public investments** in children contribute to a **levelled playing field** and promote social mobility.

- How has this evolved over the last 20 years?
- And what are the drivers of these changes?
- Are the potential equalizing effects of **public investments** counteracted by the effect of **parental investments** in children ?

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This paper

- Exploit the richness of the Programme for International Student Assessment (PISA) data over 8 cohorts from 2000 to 2022 (PISA data)
- Attention to measurement and comparability of the data across countries by regressing rank of test score on mother's educational attainment
- The socioeconomic (SES) gradients in test scores have failed to close over the last 20 years,
- SES gradients as high in Nordic countries as elsewhere in Europe,
- No evidence of Gatsby curve (relationship between mobility and within-country inequality) in the cross-section and panel,
- Robust relationship between SES gradients in learning and parental investment in the cross-section and panel.
- Equalizing impacts of public investments seems to be undone by parental investments by measuring SES gradients in parental investment (comparable across countries and over time).

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Findings:

- The socioeconomic (SES) gradients in test scores have failed to close over the last 20 years,
- SES gradients as high in Nordic countries as elsewhere in Europe,
- No evidence of Gatsby curve (relationship between mobility and within-country inequality) in the cross-section and panel,
- Robust relationship between SES gradients in learning and parental investment in the cross-section and panel.
- Equalizing impacts of public investments seems to be undone by parental investments by measuring SES gradients in parental investment (comparable across countries and over time).

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Geography and dynamics of social mobility

• Chetty et al. (2014), Hertz et al. (2007), Narayan et al. (2018), Alesina et al. (2021), Neidhofer et al. (2018), Deutscher and Mazumder (2019), Acciari et al. (2019), Bell et al (2018)

 \Rightarrow This paper constructs a measure of SES gradients in learning comparable across countries and over time, addressing concerns about comparability of measures coming from different datasets and cohorts.

Literature

Determinants of social mobility

- Evidence on Gatsby Curve (association between inequality and intergenerational mobility): e.g., Corak (2013), Durlauf, Kourtellos, and Tan(2021), DiPrete (2020), Karlson and Landerso (2021), Mogstad and Torsvik (2021), Blanden et al (2023)
- Landerso and Heckman (2017) and Heckman and Landerso(2022)

 \Rightarrow This paper shows no evidence of Gatsby curve (relationship between mobility and within-country inequality) in the cross-section and panel

 \Rightarrow This paper zooms in on the importance of family background as an explanation for why SES gradients in student learning are not low(er) in countries known for promoting equalizing policies directed towards families with children (such as the Nordic countries).

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PISA data

- The PISA test is **administered every 3 years** to test skills in reading, mathematics and science of students at the **age of 15**.
- Individual-level data coming from 8 waves of the PISA test, starting from 2000
- The PISA tests are explicitly designed to allow comparisons across countries,
 - making also our measure of intergenerational mobility in learning comparable across European countries and over time
- The PISA data include also a **Student**, **Parent and School Questionnaire** in every wave.

Mobility measures

For each country c and cohort t, we estimate:

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

• Rank(Y^k_{itc}): rank of the test score for student *i* in test *k* at time *t* living in country *c* PISA data

The rank of the test score k is computed at the European level. Within country rank

- HS^p_{itc}: dummy equal to 1 if *i*'s mother has at least completed upper secondary education and 0 otherwise Data validation Trends in mothers' education
- β_{tc}^k : measures **relative mobility** for each cohort *t* and country *c*.
 - Higher values correspond to lower mobility, i.e. the difference in learning ranks between children whose mothers have different levels of schooling
- α_{tc}^k : measures **upward mobility** for each cohort *t* and country *c*.
 - Average learning rank for students whose mothers do not have a HS degree. Higher values correspond to more mobility.

Alternative mobility measure

- Defining the indicator varaible as if mothers has completed higher education
 Father's education (both HS and HE)
- Socio-economic and cultures status (ESCS)

$$\mathsf{Rank}(Y_{itc}^k) = \mu_{tc}^k + \rho_{tc}^k \mathsf{Rank}(\mathsf{ESCS}_{itc}^P) + \epsilon_{itc}^k$$

- Rank(Y^k_{itc}): rank of the test score for student *i* in test *k* at time *t* living in country *c* PISA data
- *Rank*(*ESCS*^{*P*}_{*itc*}): Rank of *i*'s index of socio-economic and cultural status (ESCS) Data validation

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The geography of relative mobility (math)



Green areas represent countries with higher levels of mobility (low β_{tc}^{math})

The geography of relative mobility (math)

- Take for example Germany, which is one of the countries with the highest SES gradients in learning in our sample
- In 2003, the relative mobility, β_{tc}^{math} , was equal to 22, while the corresponding value for 2018 was 26.
- This means that, in Germany in 2003, children whose mothers completed upper secondary education were 22 percentiles above children whose mothers did not complete upper secondary education in the European distribution of PISA scores in math.
- This difference rose to 26 percentiles in 2018, which means that learning mobility decreased in Germany during this period.

The geography of upwars mobility (math)

- In 2003, the upward mobility, α_{tc}^{math} , was equal to 39, while the corresponding value for 2018 was 31.
- On average, children whose mothers did not complete upper secondary education scored in 39th percentile of the PISA distribution in 2003, while in 2018 their performance decreased to the 31st percentile.

The trends in relative mobility in learning (math)



The trends in relative mobility in learning (math)

- By 2018, most (but not all) countries have lower levels of relative and upward mobility than in 2003.
- The countries with the lowest levels of relative mobility are Germany, Hungary and Slovakia in both years
- There is however substantial stability between 2003 and 2018 in the relative position of countries in the sample
- The correlation in the estimates of relative mobility across countries between 2003 and 2018 is 0.7
- It is interesting that some of the larger deviations from this stability occur in Nordic countries. Sweden, Finland and Iceland (together with Slovakia and the Netherlands) are among the 5 countries where intergenerational mobility in learning decreased the most between 2003 and 2018

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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.
- Even if we identify important correlates of cross-country variation in SES gradients in learning, it is difficult to establish that they are causal drivers
- It turns out, however, that it is difficult to identify important correlates of SES gradients in learning to start with.
- Surprisingly, there are not many variables strongly correlated with SES gradients in learning.

Cross-country Correlates

- We begin by asking if there is a relationship between SES gradients in learning and inter and intragenerational inequality.
 - There are several reasons why one might observe such relationship.
 - To the extent that human capital is an important determinant of earnings, it is perhaps natural to ask whether there is a relationship relating SES gradients in learning with inequality across countries.

Gatsby Curves (association between inequality and intergenerational mobility) Corak (2013)'s Gatsby Curve



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

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- These somewhat surprising results leads us to undertake further analysis measuring literacy and numeracy using comparable assessments across countries in apopulation of adults using PIAAC - Programme for International Assessment of Adult Competencies.
 - We divide the PIAAC sample into different cohorts (or age groups), and estimate, for each cohort the (cross-country) correlation between SES gradients in test scores and the IGE, and the correlation between SES gradients in test scores and inequality.

Studying older cohorts with Survey of Adult Skills (PIAAC)



45-54 (cohort 1957-1966)



25-34 (cohort 1977-1986)



55 plus (born earlier than 1957)



35-44 (cohort 1967-1976)



What drives differences in learning outcomes across SES groups - cross-section

We consider different sets of variables that can contribute to differences in learning outcomes across SES groups:

- socio-economic variables (returns to secondary school from the OECD, country GDP, and average education of the population 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)
- *education system variables* (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).
- A final variable concerns parental investments in children, in particular, the SES gradients in parental investments.

Measuring the SES gradients in parental investment

Use factor model with categorical items to construct a measure of parental investment $(I)_{itc}$, that is comparable across countries and over time, using information on the home learning environment measured by the child's access to study conditions, technology, and books.

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

$$R(I)_{itc} = \alpha_{tc}^{I} + \beta_{tc}^{I} HS_{itc}^{P} + e_{itc}$$

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

SES gradients in Learning and Parental Investment



SES gradients in Learning and Parental Investment



After COVID-19 (2022)



Correlates of SES gradients in learning

	Relative mobility (math)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log GDP per capita, PPP	-3.392 (2.976)							
Returns to secondary school		0.285* (0.137)						
Difference between top and lowest tax rates on per- sonal income		. ,	-0.051					
Government expenditure on education (% of GDP)			(0.072)	-0.498				
% of population at least completed post-secondary				(0.569)	-0.037 (0.105)			
School tracking age					. ,	-0.987*** (0.319)		
School segregation						· · /	38.188*** (10.742)	
SES gradient in parental investment							. ,	0.841*** (0.128)
Observations	23	22	23	23	21	23	23	24
R ²	0.070	0.193	0.034	0.020	0.004	0.369	0.354	0.570

SES gradients in other traits

	Relative mobility in							
	Math	Read	Science	Educational aspiration	Occupational aspiration	Being on time at 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 at school	0.536***	0.565***	0.571***	-0.047	-0.015	1		

Note. The table presents the correlation among different measures of relative mobility 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).

 \Rightarrow We find a similar strong correlation between SES gradients in other traits and SES gradients in parental investment

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Exploit panel of mobility measures for country c at time t

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

- β^{math}_{tc}: Relative mobility for country c and cohort t (higher number corresponds to lower mobility)
- X_{tc} : inequality, immobility in wealth and immobility in parental investment
- τ_t : Year fixed effects
- α_c : Country fixed effects
- ϵ_{tc} : Standard errors clustered at the country level
- γ measures the effect of economic variables on the intergenerational immobility measure, once we control for country-specific unobservable characteristics

Panel Estimates: determinants of relative mobility

	Relative mobility (math)						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Log GDP per capita, PPP	-2.331 (3.577)						
Returns to secondary school		0.106* (0.053)					
Difference between top and lowest tax rates on per- sonal income			0.028				
Government expenditure on education (% of GDP)			(0.066)	-0.342			
% of population at least completed post-secondary				(0.565)	-0.124		
School segregation					(0.161)	7.888	
SES gradient in parental investment						(11.287)	0.564***
							(0.129)
Observations	160	118	137	117	66	159	142
R^2	0.803	0.841	0.808	0.819	0.866	0.802	0.881
Country FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note. The Table presents the panel estimates of relative mobility on economic variables with year and country fixed effects. The estimates of upward and relative mobility 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).



What drives differences in learning outcomes across SES groups - panel estimates

- There could be several potential drivers of SES gradients in learning.
- For example, the provision of public standardized education services, and the degree of inequality in school quality between schools attended by poor and rich students could in theory play a big role.
- In practice we do not find evidence that this is the case.
- Although we see that the degree to which students segregate into schools based on their SES is associated with SES gradients in learning in the cross section, we do not find such relationship when we look at the panel.

What drives differences in learning outcomes across SES groups - panel estimates

- It is therefore interesting that the main driver of the differences in SES gradients in learning across countries seems to be differences in SES gradients in parental investment in children.
- We cannot rule out that whatever factors drive differences in SES gradients in parental investments across countries or time also has an independent effect on SES gradients in PISA scores.
- It is interesting to think about what these factors may be.

- Nordic countries do not have particularly high or low SES gradients in parental investments. While in 2003, Finland and Iceland had values for these gradients that were among the lowest in Europe (which was not the case for Denmark, Norway, or Sweden),
- by 2018, their values are indistinguishable from the typical European country.
- Even though the quantity and quality of public services available to disadvantaged children may be especially high in these countries, they may not take them up as effectively as more advantaged parents.
- On the top of that, more advantaged parents are still able to invest more in their children than less advantaged parents, and the degree to which they do so is as high in Nordic countries as anywhere else.
- Therefore, it is perhaps not surprising that SES gradients in PISA scores are not especially low in Nordic countries.

- Strikingly, the countries, that have experienced the largest increase in the gradients in parental investments between more and less advantaged families, are Nordic countries: Norway, Finland, Iceland and Denmark.
- These results are however not driven by changes in inequality in these countries.
 - We show that there is no strong correlation between inequality in ESCS and SES gradients in parental investments
- We also 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, which are correlated with SES gradients in parental investment, are related to social norms:
 - confidence in the education system,
 - eprception that success depends strongly on parental wealth

Information on the attitudes towards education to study possible correlates of SES gradients in parental investment:



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

 \Rightarrow argue that the greater incentives to acquire education in the US labor market tend to offset its less favorable investments in the cognitive skills of disadvantaged children.

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

- The socioeconomic gradients in test scores have failed to close,
- If anything they have increased more in Scandinavia and Eastern Europe.

 \Rightarrow **No evidence for Gatsby curve** in the cross-section and panel.

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

- An increase 1 rank in the SES gradients in parental investment translates in an increase in relative mobility by 0.56 rank after controlling for fixed effects
- SES gradients in parental investment explains more than 50% of the variation in relative mobility.

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 \Rightarrow Equalizing impacts of public investments are undone by parental investments in children of rich and poor families.

- The importance of family background as an explanation for why SES gradients in student learning are not low(er) in countries known for promoting equalizing policies directed towards families with children (such as the Nordic countries)
- Importing the same educational and social policies as Nordic countries may not lead to substantial reductions in SES skill gradients among adolescents.

 \Rightarrow Achieving more and better information on this important question is important for policy makers who are responsible for **designing effective measures in the education system**.

Computing the rank at European vs. within-country level

- 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 ⇒ 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.
- Within-country rank
 - Alternative: compute the within-country rank
 - Disadvantage: it makes comparability across measures harder

Correlation of trends in mobility across different measures **Constant**

(1)	(2)	(3)	(4)	(5)
1				
0.985***	1			
0.338***	0.310***	1		
0.363***	0.374***	0.828***	1	
0.282***	0.292***(0.0785	0.143*	1
	(1) 1 0.985*** 0.338*** 0.363*** 0.282***	(1) (2) 1 0.985*** 1 0.338*** 0.310*** 0.363*** 0.374*** 0.282*** 0.292***	(1) (2) (3) 1 0.985*** 1 0.338***0.310*** 1 0.363***0.374*** 0.828*** 0.282***0.292***0.0785	(1) (2) (3) (4) 1 0.985*** 1 0.338*** 0.310*** 1 0.363*** 0.374*** 0.828*** 1 0.282*** 0.292*** 0.0785 0.143*

The geography of upward mobility (math)



The geography of relative mobility (reading)



Percentage of mothers with no High School degree (ISCED equal to 0, 1 or 2) **Box**



Correlation between PISA and WB education



Correlation between PISA ESCS and GINI coefficient from the World Bank



The trends in upward mobility in learning (math)



The trends in relative mobility in reading scores



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The trends in relative mobility (rank of reading score)



The trends in relative mobility (rank-rank score on escs)



Ba29/29

United States



Corak (2013) Gatsby Curve Back



Measuring Parental Investment

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:

$$m_{ict}^{*,j} = \alpha_{ct}^{j} + \lambda_{t}^{j\top} \ln I_{ict} + \varepsilon_{ict}^{j}$$
(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

Panel Estimates: determinants of relative mobility

	Relative mobility (math)		
Log GDP per capita, PPP	-4.117		
	(12.205)		
Returns to secondary school	0.014		
	(0.258)		
Difference between top and lowest tax rates on personal income	0.197*		
	(0.097)		
Government expenditure on education (% of GDP)	0.978		
	(0.966)		
% of population at least completed post-secondary	-0.436		
	(0.576)		
School segregation	-20.300		
	(21.815)		
SES gradient in parental investment	0.889***		
	(0.277)		
Observations	42		
R ²	0.930		
Country FE	Yes		
Year FE	Yes		

Note. The Table presents the panel estimates of relative mobility on economic variables with year and country fixed effects. The estimates of upward and relative mobility 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).

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