Inequality in Health

Lecture XI: Intergenerational Transmission

Dr Martin Karlsson

University of Duisburg-Essen

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Outline

Recap of Last Lecture

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- Pandemics might cause economic downturns – either directly via increases in morbidity and mortality, or via preventive measures.
- However, pandemics can vary with respect to socioeconomic gradients in incidents:
  - AIDS/HIV pandemic especially in Sub-Saharan Africa; high-risk groups in developed countries
  - Small gradient in case of Black Death
- Spanish flu 1918-1920 most severe pandemic in past century with up to 100m deaths:
  - Evidence of SES gradient in mortality
  - Pandemic increasing socioeconomic inequality
  - quite similar to current COVID-19 pandemic
- First results for COVID-19 find low-SES groups to be especially vulnerable.

Introduction

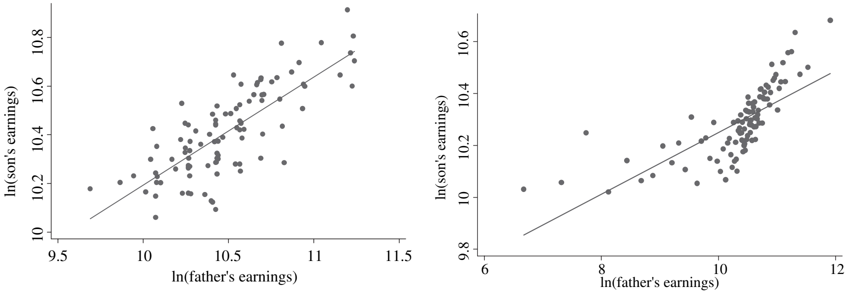
Introduction

- The **persistence of inequalities** within societies is a well-known empirical fact.
- Intergenerational correlations exist for several stratification measures
  - in particular father's **earnings** and son's earnings
  - but also **occupation**, **education** and other measures of social status.
- The intergenerational (father-son) correlation of total **earnings** is estimated to be around 0.4-0.5 in the U.S. (Bratsberg et al., 2007).
- 70% of black children raised in poorest American **neighbourhoods** live in poorest neighbourhoods as adults (Sharkey, 2008).

Introduction

- It is a matter of debate to what extent such persistence is due to:
  - **Endowment** acquired from one's parents
  - **Environmental** characteristics (e.g. SES, public health).
- **Interactions** between one's endowment and environment are also likely to play a role.
- A strong relationship between parental socioeconomic status and children's future outcomes seen as problematic: **lack of equal opportunities** (children cannot choose the family they are born into).

Intergenerational Associations in Income



(a) UK: sons 1991/99, fathers 1974 (b) DK: sons 1998/2000, fathers 1980/81

Figure 1. Intergenerational earnings mobility. Source: Bratsberg et al. (2007).

- Higher intergenerational earnings mobility in Denmark than in the UK.

Intergenerational Mobility in Germany

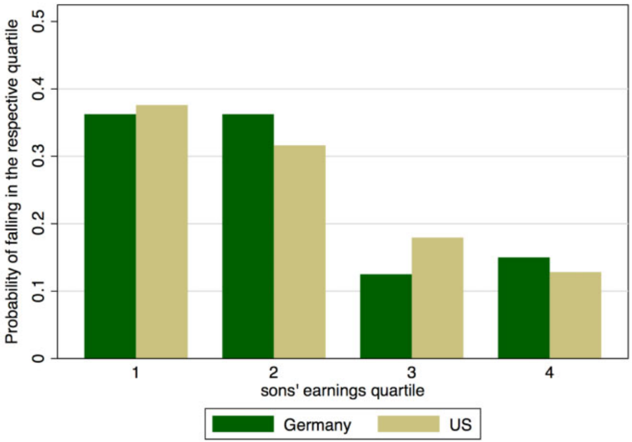


Figure 2. Intergenerational Earnings Mobility – From bottom Quartile. Source: Schnitzlein (2016).

Intergenerational Transmission of Health

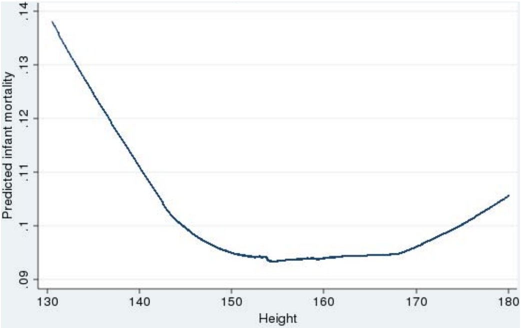


Figure 3. IMR & mother's height. Source: Bhalotra and Rawlings (2013).

- Height used as an indicator of permanent maternal health: reflects all the cumulated shocks from conception to adult age.

Terminology

- Most studies on intergenerational mobility based on some version of

$$y_{i,t} = \beta y_{i,t-1} + \theta w_{it} + \lambda z_{i,t-1} + \epsilon_{i,t} \tag{1}$$

  where y_{it} is log earnings.
- Parameter β: **intergenerational earnings elasticity**.
  - If father was 50% above mean, what percentage above average do we expect for son?
  - If $\mathrm{Var}\,(y_{i,t}) \approx \mathrm{Var}\,(y_{i,t-1})$, $\beta \approx \rho\,(y_{i,t}, y_{i,t-1})$.
- Estimates for the U.S. and U.K. typically ~ 0.5, for Scandinavia ~ 0.25. Other European ~ 0.3.
- Alternatives:
  - **Rank mobility**: $R_{it} = \alpha + \beta R_{i,t-1} + \epsilon_i$. Less risk of bias (attenuation, life cycle).
  - **Absolute income mobility**. Cf. Chetty et al. (2017); Manduca et al. (2020).

Absolute Income Mobility

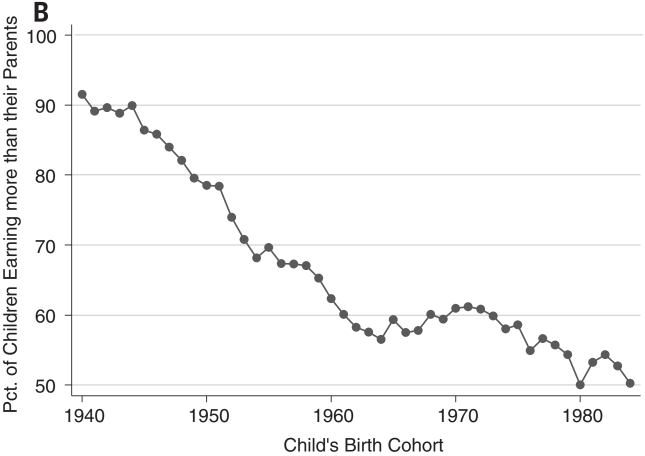


Figure 4. Absolute Mobility by Cohort in the U.S. Source: Chetty et al. (2017).

Earnings

Table 1. Intergenerational Earnings Mobility in Sweden (Lindahl et al., 2015).

	Ancestor	
Offspring	Grandparent (Generation 1)	Parent (Generation 2)
Log(earnings) – Parent (Generation 2)	0.356***	
	(0.040)	
	[0.307]	
N	803	
Log(earnings) – Child (Generation 3)	0.184***	0.303***
	(0.044)	(0.043)
	[0.141]	[0.268]
N	1,174	1,174
Prediction	0.108	
Standard error	(0.020)	
t-statistic for difference	1.58	

Standardized estimates in brackets. The reported standard errors (in parentheses) are clustered on families.

Other Dimensions

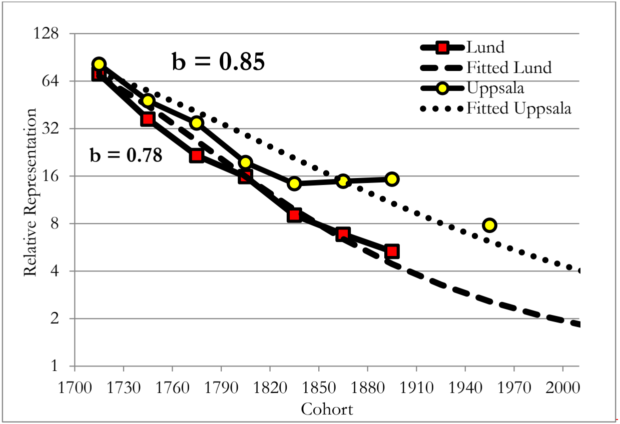


Figure 5. Latinised Surnames in Lund and Uppsala (Clark, 2012).

Other Dimensions

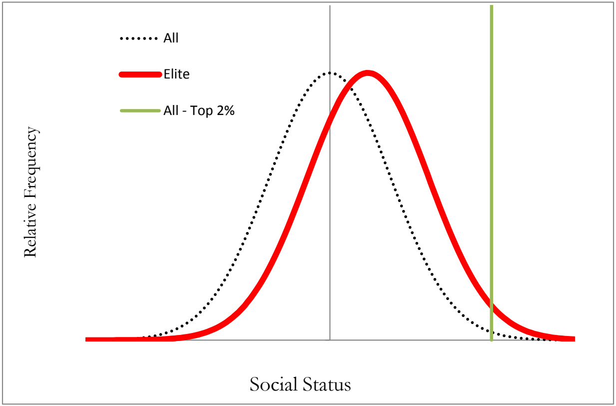


Figure 6. Deriving b from elite over-representation (Clark, 2012).

Conflicting Evidence

- (Clark, 2012) shows remarkable grip of old (pre-1800) elites over
  - Elite professions (Doctors, Attorneys)
  - Royal Academies (Swedish Academy of Sciences etc.)
  - Elite Universities.
- Intergenerational elasticities b in the range $0.7 - 0.9$ rather than 0.3.

Table 2. Different intergenerational elasticities over several generations.

No. Generations	b =0.3	b =0.75
2	0.09	0.563
3	0.027	0.422
4	0.008	0.316

- No sign of improvement between 1800–2000.
- Similar patterns in other countries.
- But b for earnings equals $0.25 - 0.3$ (U.S. $0.5 - 0.6$).

Modelling Intergenerational Transmission

Baseline

- Consider a simple model to study the intergenerational transmission of a socioeconomic outcome y (Braun and Stuhler, 2018):

$$y_{i,t} = \beta_{-1} y_{i,t-1} + \epsilon_{i,t} \tag{2}$$

where

$y_{i,t}$ outcome for **offspring** generation t in family i
$y_{i,t-1}$ outcome for **parent** generation $t-1$ in family i
$\epsilon_{i,t}$ error term.

- β_{-1} captures to what extent the socioeconomic indicator y is transmitted across generations.

The Fallacy

- May extend Eq. (2) to capture the degree of IGT between the outcome of the offspring generation $y_{i,t}$ and previous generations.
- Coefficient sequence $\{\beta_{-1}, \beta_{-2}, \beta_{-3}, \ldots, \beta_{-m}\}$ represents the **persistence** of SES outcome y across m generations.
- **Extrapolation**: if we consider the grandparents' generation $y_{i,t-2}$,

$$\beta_{-2} = \frac{\mathrm{Cov}(y_{i,t}, y_{i,t-2})}{\mathrm{Var}(y_{i,t-2})} = \frac{\mathrm{Cov}(\beta_{-1}y_{i,t-1} + \epsilon_{i,t}, y_{i,t-2})}{\mathrm{Var}(y_{i,t-2})} = (\beta_{-1})^2.$$

- $\beta_{-m} = (\beta_{-1})^m$ is the **multigenerational persistence** of inequality.
- **Fallacy**: $\epsilon_{i,t}$ is uncorrelated with $y_{i,t-1}$ (see Eq. 2), but it is not necessarily uncorrelated with $y_{i,t-2}$.

Introduction

- Evidence of **excess persistence** – inequalities across generations decrease slowly over time:

$$\beta_{-m} > (\beta_{-1})^m \quad \forall m > 1.$$

- Can interpret excess persistence through the lenses of an intergenerational model of inequality.
- This holds if SES is transmitted **indirectly** through inheritance of an **underlying latent factor**.
- The underlying latent factor represents e.g. **abilities**, **preferences** or other characteristics that in turn influence the SES outcome of the following generations.

The Latent Factor

- Consider a one-parent, one-child family structure.
- We model inheritance of the **latent factor** $l_{i,t}$:

$$y_{i,t} = \rho l_{i,t} + u_{i,t} \quad (3)$$

$$l_{i,t} = \lambda l_{i,t-1} + v_{i,t} \quad (4)$$

where

ρ **transferability** coefficient

λ **heritability** coefficient

$u_{i,t}$, $v_{i,t}$ error terms uncorrelated with each other and with past values.

- **Heritability**: offspring t inherits their unobserved endowment l from the parent according to λ.
- **Transferability**: the inherited endowment translates into the observed outcome according to ρ.

Intergenerational Persistence

- Normalize the variance of $y_{i,t}$ and $l_{i,t}$ to 1.
- Observed correlation in outcome y between generation t and generation $t-m$:

$$\begin{aligned}\beta_{-m} &= \mathrm{Cov}(y_{i,t}, y_{i,t-m}) \\ &= \rho^2 \,\mathrm{Cov}(l_{i,t}, l_{i,t-m}) \\ &= \rho^2 \lambda^m\end{aligned}$$

- Given Eq. (3) and (4), consider the intergenerational transmission coefficients across 3 generations t, $t-1$, $t-2$:

$$\begin{aligned}\beta_{-1} &= \frac{\mathrm{Cov}(y_{i,t}, y_{i,t-1})}{\mathrm{Var}(y_{i,t-1})} = \rho^2\lambda \\ \beta_{-2} &= \frac{\mathrm{Cov}(y_{i,t}, y_{i,t-2})}{\mathrm{Var}(y_{i,t-2})} = \rho^2\lambda^2 = \beta_{-1}\lambda\end{aligned}$$

Extrapolation Error

- Extrapolation error η:

$$\eta = (\beta_{-1})^2 - \beta_{-2} = (\rho^2 - 1)\rho^2\lambda^2.$$

- $\eta < 0$ for $0 < \rho < 1$ and $0 < \lambda < 1$.
- Implicit assumption in the **iterated regression** procedure: $\boldsymbol{\rho = 1}$, i.e. **perfect transferability** between outcomes and latent factor.
- If the underlying latent factor transfers just **imperfectly** to outcomes, i.e. $\mathbf{0 < \boldsymbol{\rho} < 1}$, then $\beta_{-m} > (\beta_{-1})^m$.
- The resulting persistence of the socioeconomic outcome (and therefore inequality) is **higher** than the extrapolation from parent-child measures suggests.

Heritability and Transferability

- The persistence of outcome y across generations β_{-m} decreases with:
  1. The **persistence** of the unobserved **endowment** $l_{i,t}$, expressed by λ: $\lambda = \mathrm{Cov}(l_{i,t}, l_{i,t-m})$.
  2. The degree of **transferability** of such latent variable $l_{i,t}$ to the outcome, captured by ρ.
- Persistence across m generations is governed by λ rather than ρ:
  - 2 generations: $\beta_{-2} = \beta_{-1}\lambda$
  - 3 generations: $\beta_{-3} = \beta_{-1}\lambda^2$
  - ...

Empirical Application

The Role of Genes vs Environmental Mechanisms

- Thompson (2014): role of **genetics** in the intergenerational transmission of health.
- Estimates the extent of genetic transmission of health based on the persistence of chronic health conditions across **two** generations (parents-children).
- To identify the role of genetics, compare differences in outcomes for a sample of **biological** versus **adopted** children.
- **Genetic factors** include both sets of genes that influence health status and specific susceptibility genes.

The Role of Genes vs Environmental Mechanisms

The share of IGT not explained by genetic factors is likely driven by **environmental factors** that are **shared** between parent and child:

1. **Socioeconomic status**: persistent correlation between health and SES measures
   - Neighbourhood characteristics
   - Air quality
   - Food availability and prices
   - ...
2. Access and **healthcare services** utilization: children are often covered by parents' insurance plans and often parents make decisions about their children's health care utilization.
3. Health behaviors/**lifestyle**: behaviors like healthy eating or doing sports easily shared between parents and children.

A Model of Health Transmission Applied

Consider a CES (Constant Elasticity of Substitution) production function for health:

$$h = A\left[\alpha g^{\gamma} + (1-\alpha)e^{\gamma}\right]^{\frac{1}{\gamma}}$$

with $\gamma \leq 1$, $0 \leq \alpha \leq 1$ and

- h health status
- g genetic factors influencing h
- e environmental factors influencing h.

A Model of Health Transmission Applied

- If $\gamma = 1$, the CES function is a linear of perfect **substitutes** function:

$$h = A\left[\alpha g + (1-\alpha)e\right].$$

  genetic g and environmental factors e have independent, **additively separable** influences on health h.
- If $\gamma = 0$ in the limit, the CES function is a Cobb-Douglas function:

$$h = Ag^{\alpha}e^{(1-\alpha)}.$$

- For γ approaching $-\infty$, we have a perfect **complements** production function.
- g and e are not likely to be additively separable – we also expect **gene-environment interactions** to play a role:

$$-\infty < \gamma < 1.$$

Data

- National Health Interview Survey (NHIS): representative survey conducted annually in the U.S., waves **1998-2012**.
- Information on health status, health conditions and healthcare use for **125,000 parent-child** pairs (biological and adoptive).
- **Chronic health conditions** considered in the analysis:
  1. Asthma
  2. Chronic headaches/migraines
  3. Diabetes
  4. Hay fever.

Intergenerational Transmission: Baseline Regression

$$health_{i,t} = \alpha + \beta \cdot health_{i,t-1} + X_i'\gamma + \varepsilon_i \tag{5}$$

where

- $health_{i,t}$ health outcome for individual i in the children generation t
- $health_{i,t-1}$ health outcome for i's parents (parents generation: $t-1$)
- X_i' vector of demographic controls (age, race, gender of parents and children) and survey year
- ε_i error term.

Identification of Genetic Component

Estimates of genetic influences **unbiased** if these assumptions hold:

1. The **assignment** of adoptees to parents is as good as **random**.
   - Issue: if healthier parents can adopt children who are also healthier on average (positive selection).
   - Although there are no genetic links between adoptive parents and adoptees, there would still be genetic similarities between them and the relevance of the "true" genetic endowment would be **underestimated**.
2. Characteristics of biological and adoptive families that are likely to influence IGT are **comparable**.
   - Children from adoptive families grow up in more favorable health circumstances (have health check ups more often; more likely to have health insurance).

Baseline

Table 3. Baseline intergenerational transmission estimates.

	Asthma	Chronic headaches	Diabetes	Hay fever
Parent has condition (β)	0.170	0.084	0.006	0.276
	(0.004)	(0.003)	(0.001)	(0.005)
Percent increase (β/prevalence)	158%	185%	345%	356%
Observations	124,265	100,999	124,372	123,611

*, **, *** indicate statistical significance at the 10%, 5% and 1% level respectively. Indicators of the survey year and of the age, gender and race of both parents and children included. Robust standard errors in parenthesis.

Results suggest that health problems are very **persistent** across generations.

The Role of Genetics

Table 4. Intergenerational transmission by adoption status.

	Asthma		Chronic headaches		Diabetes		Hay fever		Height		Chicken pox	
	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted
Parent has condition	0.170***	0.126***	0.084***	0.059***	0.006***	0.003	0.276***	0.221***	0.357***	-0.095	0.144***	0.138***
	(0.004)	(0.029)	(0.003)	(0.018)	(0.001)	(0.006)	(0.005)	(0.031)	(0.013)	(0.069)	(0.003)	(0.028)
Observations	124,265	2416	100,999	2200	124,372	2423	123,611	2403	10,648	274	118,720	2228
% change among adoptees	-25.9%		-29.7%		-43.5%		-19.9%		-126.6%		-4.4%	
Correlations among MZ twins	0.312		0.457		-		0.594		0.937		-	

*, **, *** indicate statistical significance at the 10%, 5% and 1% level respectively. Indicators of the survey year and of the age, gender and race of both parents and children included. Robust standard errors in parenthesis.

- IGT transmission weaker for adopted than for biological children.
- Results in line with the assumption that adoptees are not selectively assigned according to parental health status.

Controls Included

Are differences in **family characteristics** main driver of differences in transmission between biological and adoptive children?

Table 5. Intergenerational transmission by adoption status.

	Asthma		Chronic headaches		Diabetes		Hay fever		Height		Chicken pox	
	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted	Biological	Adopted
Parent has condition	0.164***	0.108***	0.081***	0.043***	0.006***	0.004	0.275***	0.207***	0.349***	-0.069	0.140***	0.157***
	(0.005)	(0.030)	(0.003)	(0.020)	(0.002)	(0.006)	(0.006)	(0.033)	(0.014)	(0.073)	(0.004)	(0.030)
Observations	105,344	2128	85,544	1933	105,424	2133	104,799	2116	9980	261	101,222	1966
% change among adoptees	-34%		-47%		-27%		-25%		-120%		12%	

*, **, *** indicate statistical significance at the 10%, 5% and 1% level respectively. Indicators of the survey year and of the age, gender and race of both parents and children included. Robust standard errors in parentheses. Additional controls: family's income to needs ratio, reporting parent's years of educational attainment, indicators of whether the child is covered by a health insurance plan, whether the child had a routine checkup in the past year, whether the parent is a current smoker.

Summary of Results

- Thompson analyzes intergenerational associations in **chronic health outcomes** across two generations and estimates to what extent such associations are due to genetics.
- The **genetic component** of the IGT transmission of chronic health conditions accounts for 20-30% of the total transmission.
- The remaining associations is likely due to:
  - **Environmental** factors.
  - **Interactions** between genetic endowment and environment: genes expression triggered by environmental conditions.
- Unobservable family characteristics affecting IGT of health in a different way between biological and adopted children could still be an issue.
- Results are however robust to the inclusion of observable family traits.

More on IGT Literature: The Case of Germany

Intergenerational Transmission of Inequality

- Braun & Stuhler (2015) explore empirically long-run **inequality persistence** using data from the German Life History Study and the Berlin Aging Study (19^{th}-20^{th} century).
- Information on:
  - **Occupations** (3 generations)
  - **Educational attainment** (4 generations)
- They find that the degree of persistence of SES is similar across multiple generations.
- Average IGT correlation for education (3 generations): 0.26.
- 20% to 65% higher than comparable estimates for Sweden (Lindahl et al, 2015).

Intergenerational Transmission of Health and SES Gradient

- Coneus and Spiess (2012) evaluate the IGT of health between 2 generations (parent and children) using data from the German Socio-Economic Panel (SOEP), waves 2003-2008.
- Correlation between parents' and child health measures:
  1. **Anthropometric measures**: weight and height/length
  2. **Self-rated** health (for children: rated by mothers)
  3. **Disorder** information (yes/no): asthma, bronchitis, middle-ear infections (children only).
- Children health measured twice: at birth (0-19 months) and 2 years later (children 2-3 y.o.).
- Evidence of intergenerational correlations in health above all for very young children (i.e. health measured at birth).
- For anthropometric measures: evidence of a **health gradient** increasing in the child's **age**.
  - IGT correlation: 0.12 to 0.15.

Intergenerational Transmission from Children to Parents

- Lundborg and Majlesi (2018):
  - The authors exploit exogenous variation due to a compulsory schooling reform in Sweden in the 1950s and 1960s to identify the effect of **children's schooling** on their **parents' longevity**.
  - They find that **female schooling affects their fathers' longevity**, especially in case of low socio-economic background.
- De Neve and Fink (2018):
  - An education reform in Tanzania in 1974 is exploited to determine the impact of **children's primary schooling attainment** on **parental survival**.
  - An additional year of primary schooling is found to **reduce** the probability of both **maternal and paternal death**.

Summary and Conclusions

Summary and Conclusions

- In addition to the **intergenerational transmission** of **SES** (income, education etc.), evidence that **health** outcomes transmit across generations.
- Increasing interest in economic research about:
  - Transmission **mechanisms**
  - Health-SES **gradient**.
- Recent studies aim at disentangling the effect of **genes**, **environment** and the **interaction** between the two in order to quantify the contribution of each of these on the IGT of health.
- Comparing adoptees with biological parent-child pairs, Thompson (2014) estimates that the genetic component accounts for just **20 to 30**% of the intergenerational association for several chronic health conditions.

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