Interpreting Trends in Intergenerational Mobility

Martin Nybom* and Jan Stuhler**

*The Swedish Institute for Social Research, Stockholm University
**Centre for Research and Analysis of Migration, University College London

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Motivation

How strongly are differences in economic outcomes transmitted from parents to their children (intergenerational mobility)?

A large literature: from Galton (1886), Becker (1970s-) to ...

*Descriptive measures of persistence.* Most popular, the intergenerational income elasticity: slope in linear regr. of log lifetime income of generation $t$ of family $i$ on parental log lifetime income,

$$y_{i,t} = \alpha + \beta y_{i,t-1} + \varepsilon_{i,t}. \quad (1)$$

Current concern: Is mobility declining? If so, why? Questions of great importance, especially in countries with rising cross-sectional income inequality.
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The “**Great Gatsby Curve**” (Alan Krueger):
High cross-sectional inequality associated with low intergenerational mobility.

Source: Miles Corak, “Inequality from Generation to Generation: The United States in Comparison,” In Robert Rycroft, ed. The Economics of Inequality, Poverty, and Discrimination in the 21st Century (Santa Barbara, California: ABC-CLIO, 2013).
The “Great Gatbsy Curve” (Alan Krueger):
High cross-sectional inequality associated with low intergenerational mobility.

“The persistence in the advantages and disadvantages of income passed from parents to children is predicted to rise by about a quarter for the next generation, as a result of the rise in inequality that the U.S. has seen in the last 25 years.”

Alan Krueger, Chairman of the Council of Economic Advisers (2012)
We show that observed shifts in mobility today can be due to past events, which occurred in previous generations (a long time ago).

Policy or institutional changes affect intergenerational mobility over multiple generations. These responses are often non-monotonic.

An understanding of mobility trends (and levels) requires therefore a dynamic perspective.

(I) Theoretical section
A simultaneous equation model of intergenerational transmission, derived from optimizing behavior of parents.

(II) Empirical application: The Swedish Compulsory School Reform Shifted educational and income mobility in first and second generation?
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(II) **Empirical application: The Swedish Compulsory School Reform**
Shifted educational and income mobility in first and second generation?
A Model of Intergenerational Transmission

Income determined by parental income, human capital, and chance,

\[ y_t = \gamma_{y,t} y_{t-1} + \delta_t' h_t + u_{y,t}. \]  \(2\)

Human capital \( h_t \) (Jx1) by parental income, endowments, and chance,

\[ h_t = \gamma_{h,t} y_{t-1} + \Theta_t e_t + u_{h,t}. \]  \(3\)

Endowments (Kx1) partly inherited (nature and nurture) from parents,

\[ e_t = \Lambda_t e_{t-1} + v_t \]  \(4\)

Assumptions: (i) variables are trendless indices with mean zero (not interested in abs. growth); (ii) consider positive measures, elements of \( \delta_t, \Theta_t, \) and \( \Lambda_t \) are non-negative
Assume cross-sectional variances are constant and normalised to one. Aggregate direct and indirect parental income effects, $\gamma_t = \gamma_y, t + \delta'_t \gamma_h, t$, and the returns to inherited endowments and human capital $\rho'_t = \delta'_t \Theta_t$.

The intergenerational income elasticity in generation $t$ equals

$$\beta_t = \frac{\text{Cov}(y_t, y_{t-1})}{\text{Var}(y_t)} = \gamma_t + \rho'_t \Lambda_t \text{Cov}(e_{t-1}, y_{t-1}). \quad (5)$$

→ Current mobility depends on current transmission mechanisms and cross-covariance between income and endowments in parent generation. Mobility low if income and other favourable endowments concentrated in same families.

→ Populations subject to same policies and institutions can nevertheless have different mobility.
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The Importance of Past Transmission Mechanisms

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The intergenerational income elasticity in generation \( t \) equals

\[
\beta_t = \frac{Cov(y_t, y_{t-1})}{Var(y_t)} = \gamma_t + \rho_t' \Lambda_t Cov(e_{t-1}, y_{t-1}).
\]

\( (5) \)

→ Current mobility depends on current transmission mechanisms and cross-covariance between income and endowments in parent generation.

→ Populations subject to same policies and institutions can nevertheless have different mobility.
Cross-covariance between income and endowments depends in turn on past transmission mechanisms. Iterate backwards,

\[ \beta_t = \gamma_t + \rho_t' \Lambda_t \rho_{t-1} + \rho_t' \Lambda_t \left( \sum_{r=1}^{\infty} \left( \prod_{s=1}^{r} \gamma_{t-s} \Lambda_{t-s} \right) \rho_{t-r-1} \right). \]  

(6)

1. Intergenerational mobility today depends on current and past transmission mechanisms.
2. Mobility differentials across countries may be partly explained by former structural or institutional differences.
3. Institutional changes generate long-lasting trends.
4. Observed shifts in mobility today may be caused by past events.
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2. Mobility differentials across countries may be partly explained by former structural or institutional differences.
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Assume that a **structural change** occurs in generation $T$.  

**Example 1: Contrasting two types of structural changes.** The heritability ($\lambda_t$) or the returns to endowments and human capital ($\rho_t$) change.

What are the implications?

1. Different types of structural changes generate different responses; 
   dynamic pattern may be informative about type of change that occurred

2. Even a one-time change in one mechanism can cause trends over multiple generations

---

\[1\] For simplicity/comparability assume interg. elasticity was in steady state before $T$. Assuming $t \to \infty$, variance-covariance matrix of $(y_t, e_t)$ converges to a steady state ($\to$ parameter restrictions).
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Figure: A change in the heritability of, or returns to, endowments

Note: Numerical example with \( \lambda = 0.6 \), change from \( \rho_1 = 0.7 \) to \( \rho_2 = 0.8 \).
Example 2: Shift towards a more meritocratic economy. Parental status becomes less ($\gamma_1 > \gamma_2$) and own skills more important ($\rho_1 < \rho_2$) in the determination of incomes.

Detrimental for low-skilled children from high-income parents. However, beneficial for talented offspring from poor families, who gain opportunities for upward mobility that were not yet available to their parents.

→ Mobility highest during transition, when a generation faces new institutions, policies or opportunities that differ markedly from conditions in their parents' generation (transitional mobility).
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Figure: Declining impact of parental income and increasing returns to skill

Note: Numerical example with $\lambda = 0.6$, a decline in $\gamma$ from $\gamma_1 = 0.4$ to $\gamma_2 = 0.2$, a rise in $\rho$ from $\rho_1 = 0.5$ to $\rho_1 = 0.7$ at generation $T$. 
Implications?

1. Mobility trends may be a response to events that occurred in past generations, and those responses may be non-monotonic.
2. Changes that enhance mobility in the long-run may nevertheless cause decreasing mobility over multiple generations.
3. Declining mobility today may not reflect a recent deterioration of “equality of opportunity”, but rather major gains made in the past.

Mobility should perhaps be expected to decline over recent cohorts in those countries that became more meritocratic in early 20th century?
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Example 3: Skill-biased technological change. The returns to different types of human capital or endowments change ($\rho_1 \neq \rho_2$).

We show:

$$
\beta_T = \frac{1}{2} (\beta_{T-1} + \beta_{t \to \infty}) - \frac{1}{2} (\rho_2' - \rho_1') \Lambda (I - \gamma \Lambda)^{-1} (\rho_2 - \rho_1). 
$$

(7)

Mobility in generation $T$ equals average of old and new steady-state mobility (first term) plus a purely transitional gain (second term).

2. Countries experiencing a period of stable conditions after more turbulent times may be characterised by negative mobility trends.
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Figure: A swap in prices

Note: Mobility trend over generations in numerical example. In generation $T$ the returns to skill $k$ and $l$ increase from $\rho_{k,1} = 0.3$ to $\rho_{k,2} = 0.6$ and decrease from $\rho_{l,1} = 0.6$ to $\rho_{l,2} = 0.3$ (assume $\gamma = 0.2$, $\lambda = 0.6$).
We argued that changes in the economic environment shift mobility repeatedly over long time periods. Can such dynamic effects indeed be observed empirically?

The Swedish compulsory school reform. Affected birth cohorts from the early 1940s. Compulsory schooling extended to nine years, postponed tracking decisions. Holmlund (2007)

Identification of the reform’s impact facilitated by its gradual implementation across municipalities. Meghir and Palme (2005); Holmlund et al. (2011); Meghir et al. (2011).

Data. Multigenerational data from Swedish administrative registers, census data on educational attainment, area of residence, reform implementation (codes from Helena Holmlund).

Intergenerational sample: 1943-72 cohorts, parents no older than 32 when child born
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Figure: The Intergenerational Education Coefficient over Cohorts

Note: Each dot represents the coefficient from a regression of years of schooling of offspring in the respective birth cohort on years of schooling of their fathers. Based on intergenerational sample (fathers aged below 33, solid line) and subsample (fathers aged below 30, dashed line). Grey bars: 95% confidence intervals.
Note: Share of offspring and fathers subject to school reform over (offspring) cohorts, in source (grey and black areas) and intergenerational sample (dashed line).
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Estimate pooled regression (education):

\[
h_{c|fm,t} = \alpha_1 + \beta_1 h_{t-1} + \alpha_2 R_{cm} + \beta_2 (h_{t-1} \times R_{cm}) + \alpha_3' D_c + \beta_3' (h_{t-1} \times D_c)
+ \alpha_4' D_f + \beta_4' (h_{t-1} \times D_f) + \alpha_5' D_m + \beta_5' (h_{t-1} \times D_m) + \epsilon_{c|fm,t},
\]

where \(h_{c|fm,t}\) (\(h_{t-1}\)) are offspring (father) years of schooling in generation \(t\) (generation \(t-1\)), cohort \(c\) (cohort \(f\)), attending school in municipality \(m\). \(R_{cm}\) equals one if reform in effect for cohort \(c\) in municipality \(m\).

Identifying variation: municipality-specific changes in intergenerational persistence after local introduction of the reform.
## Table: Educational and Income Mobility in First Generation

### Panel A: Education

<table>
<thead>
<tr>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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</thead>
<tbody>
<tr>
<td>education father (# years)</td>
<td>0.359***</td>
<td>0.396***</td>
<td>0.422***</td>
<td>0.427***</td>
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<tr>
<td></td>
<td>(0.00383)</td>
<td>(0.00496)</td>
<td>(0.00750)</td>
<td>(0.0227)</td>
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<tr>
<td>reform</td>
<td>1.407***</td>
<td>0.555***</td>
<td>0.567***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0577)</td>
<td>(0.0672)</td>
<td>(0.0672)</td>
<td></td>
</tr>
<tr>
<td>reform x education father</td>
<td>-0.0969***</td>
<td>-0.0371***</td>
<td>-0.0387***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00632)</td>
<td>(0.00722)</td>
<td>(0.00726)</td>
<td></td>
</tr>
</tbody>
</table>

| N                      | 220335    | 220335    | 220335    | 220335    |

### Panel B: Income

<table>
<thead>
<tr>
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<th>(1)</th>
<th>(2)</th>
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<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>log inc. father</td>
<td>0.164***</td>
<td>0.157***</td>
<td>0.139***</td>
<td>0.143***</td>
</tr>
<tr>
<td></td>
<td>(0.00265)</td>
<td>(0.00362)</td>
<td>(0.0158)</td>
<td>(0.0185)</td>
</tr>
<tr>
<td>reform</td>
<td>-0.0111</td>
<td>0.253*</td>
<td>0.250*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0652)</td>
<td>(0.117)</td>
<td>(0.117)</td>
<td></td>
</tr>
<tr>
<td>reform x log inc. father</td>
<td>0.00510</td>
<td>-0.0196*</td>
<td>-0.0194*</td>
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</tr>
<tr>
<td></td>
<td>(0.00533)</td>
<td>(0.00960)</td>
<td>(0.00960)</td>
<td></td>
</tr>
</tbody>
</table>

| N                      | 199340    | 199340    | 199340    | 199340    |

**dummies & interactions:**
- municipalities: x x
- offspring cohorts: x x
- father cohorts: x

Clustered (municipality level) s.e. in parentheses, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

**Note:** Coefficient estimates pooled regression (column 5) and simplified variants (columns 1-4), based on offspring cohorts 1943-1955 in intergenerational sample.
Figure: The Intergenerational Education Coefficient over Cohorts

Note: Each dot represents the coefficient from a regression of years of schooling of offspring in the respective birth cohort on years of schooling of their fathers. Based on intergenerational sample (fathers aged below 33, solid line) and subsample (fathers aged below 30, dashed line). Grey bars: 95% confidence intervals.
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Did the reform affect intergenerational mobility in the next generation?

Adapt pooled regression for next generation,

\[ h_{cfm', t} = \alpha_1 + \beta_1 h_{t-1} + \alpha_2 R_{fm'} + \beta_2 (h_{t-1} \times R_{fm'}) + \alpha_3' D_c + \beta_3' (h_{t-1} \times D_c) + \alpha_4' D_f + \beta_4' (h_{t-1} \times D_f) + \alpha_5' D_m' + \beta_5' (h_{t-1} \times D_m') + \epsilon_{cfm, t}, \]

where the indicator \( R_{fm'} \) equals one if the reform was in effect for the father cohort \( f' \) born in municipality \( m' \).
### Table: Educational and Income Mobility in Second Generation

#### Panel A: Education

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<thead>
<tr>
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<th>(1)</th>
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<tbody>
<tr>
<td>education father (# years)</td>
<td>0.240***</td>
<td>0.238***</td>
<td>0.294***</td>
<td>0.223***</td>
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<tr>
<td></td>
<td>(0.00214)</td>
<td>(0.00298)</td>
<td>(0.00411)</td>
<td>(0.00904)</td>
</tr>
<tr>
<td>reform (father)</td>
<td>-0.904***</td>
<td>-0.768***</td>
<td>-0.768***</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0894)</td>
<td>(0.139)</td>
<td>(0.137)</td>
<td></td>
</tr>
<tr>
<td>reform x education father</td>
<td>0.0534***</td>
<td><strong>0.0655</strong></td>
<td><strong>0.0655</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.00893)</td>
<td>(0.0128)</td>
<td>(0.0126)</td>
<td></td>
</tr>
</tbody>
</table>

| N                        | 111173    | 111173    | 111173    | 111173    |

#### Panel B: Income

<table>
<thead>
<tr>
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<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
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</thead>
<tbody>
<tr>
<td>log inc. father</td>
<td>0.207***</td>
<td>0.211***</td>
<td>0.244***</td>
<td>0.204***</td>
</tr>
<tr>
<td></td>
<td>(0.00380)</td>
<td>(0.00414)</td>
<td>(0.0167)</td>
<td>(0.0215)</td>
</tr>
<tr>
<td>reform (father)</td>
<td>0.331**</td>
<td>-0.498*</td>
<td>-0.509*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.128)</td>
<td>(0.219)</td>
<td>(0.219)</td>
<td></td>
</tr>
<tr>
<td>reform x log inc. father</td>
<td>-0.0286**</td>
<td><strong>0.0410</strong></td>
<td><strong>0.0418</strong></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.0105)</td>
<td>(0.0179)</td>
<td>(0.0179)</td>
<td></td>
</tr>
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</table>

| N                        | 110317    | 110317    | 110317    | 110317    |

**dummies & interactions:**
- municipalities: x x
- offspring cohorts: x
- father cohorts: x x

Clustered (municipality level) s.e. in parentheses, * p < 0.05, ** p < 0.01, *** p < 0.001
Summary

We studied the dynamic relationship between intergenerational mobility and its underlying structural factors.

Theoretical implications:

1. Mobility observed today depends on past policies and institutions, policy or institutional reform tend to generate long-lasting trends.
2. Observed decline in mobility today can stem from gains in equality of opportunity in the past.
3. Mobility will tend to be higher in times of structural changes.

Empirical application:

1. Compulsory school reform increased educational and income mobility in directly affected cohorts born from the 1940s.
2. Substantial second-generation reform effect in cohorts born from the late 1960s; education coefficient and income elasticity increase.
3. Second-generation effect spread out as share of reform parents increases only slowly: likely to persist up to recent birth cohorts.
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We studied the *dynamic* relationship between intergenerational mobility and its underlying structural factors.

Theoretical implications:

1. Mobility observed today depends on *past* policies and institutions, policy or institutional reform tend to generate long-lasting trends.
2. Observed decline in mobility today can stem from *gains* in equality of opportunity in the past.
3. Mobility will tend to be higher in times of structural changes.

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Measuring intergenerational mobility. For example, the intergenerational income elasticity, slope coefficient in a linear regression of log lifetime income of generation $t$ of family $i$ on parental log lifetime income,

$$y_{i,t} = \beta y_{i,t-1} + \varepsilon_{i,t}.$$  

Large empirical literature on mobility differences across countries, groups, and time:


Measuring intergenerational mobility. For example, the intergenerational income elasticity, slope coefficient in a linear regression of log lifetime income of generation $t$ of family $i$ on parental log lifetime income,

$$y_{i,t} = \beta y_{i,t-1} + \varepsilon_{i,t}. \quad (8)$$

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Theoretical Literature

**Interpretation?**

Almost all theoretical work examines the relationship between causal mechanisms and **steady-state** or **long-run** mobility levels. Conlisk, 1969, 1974, Becker and Tomes, 1979, Goldberger, 1989, Solon, 2004

Little theoretical work on **transition paths** between steady states. Atkinson and Jenkins (1984); Solon (2004); Davies et al. (2005)

We argue that transitions between steady states are of particular importance in the study of intergenerational persistence, since

- even a single transmission step — one generation — corresponds to a **very long** time period.
- transitions are often **non-monotonic**
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Figure: A change in the heritability of endowments

Note: Numerical example with $\rho = 0.7$, change from $\lambda_1 = 0.6$ to $\lambda_2 = 0.5$. 
Figure: A change in the heritability of, or returns to, endowments

Note: Numerical example with \( \lambda = 0.6 \), change from \( \rho_1 = 0.7 \) to \( \rho_2 = 0.8 \).
Figure: A swap in prices

Note: Mobility trend over generations in numerical example. In generation $T$ the returns to skill $k$ and $l$ increase from $\rho_{k,1} = 0.3$ to $\rho_{k,2} = 0.6$ and decrease from $\rho_{l,1} = 0.6$ to $\rho_{l,2} = 0.3$ (assume $\gamma = 0.2$, $\lambda = 0.6$).
Figure: Mean and Variance of Years of Schooling over Cohorts

(A) Mean:

(B) Variance:

Note: Mean and variance of years of schooling over offspring cohorts (dashed line) and father cohorts (solid lines) in intergenerational sample.
Note: Recentered data, reform occurs at time zero for each municipality. Panels (a)-(c) summarize the distribution of offspring educational attainment, panel (d) plots intergenerational educational coefficient in cohort before/after reform implementation.
Heterogeneity over Cohorts

The school reform reduced degree to which differences in educational attainment were transmitted from fathers to children by about ten percent.

Surprisingly small effect, given (i) drop of intergenerational coefficient by more than a third during reform introduction and (ii) the sudden trend change in mid-1940s.

Examine heterogeneity in the reform’s effect over time. Interact reform with offspring cohort dummies $D_c$ ...

$$\alpha_2 (R_{cm} \times D_c) + \beta_2 (h_{t-1} \times R_{cm} \times D_c).$$  (9)
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Figure: Heterogeneity in the Reform Effect over Cohorts

Note: Estimates of the reform effect on intergenerational education coefficient over cohorts (black line). Grey bars: 95% confidence intervals.
Figure: Heterogeneity in the Reform Effect over Cohorts

Note: Estimates of the reform effect on intergenerational education coefficient over cohorts (black line) and the respective weights in the pooled coefficient (grey line).