Interpreting Trends in Intergenerational Mobility

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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,

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

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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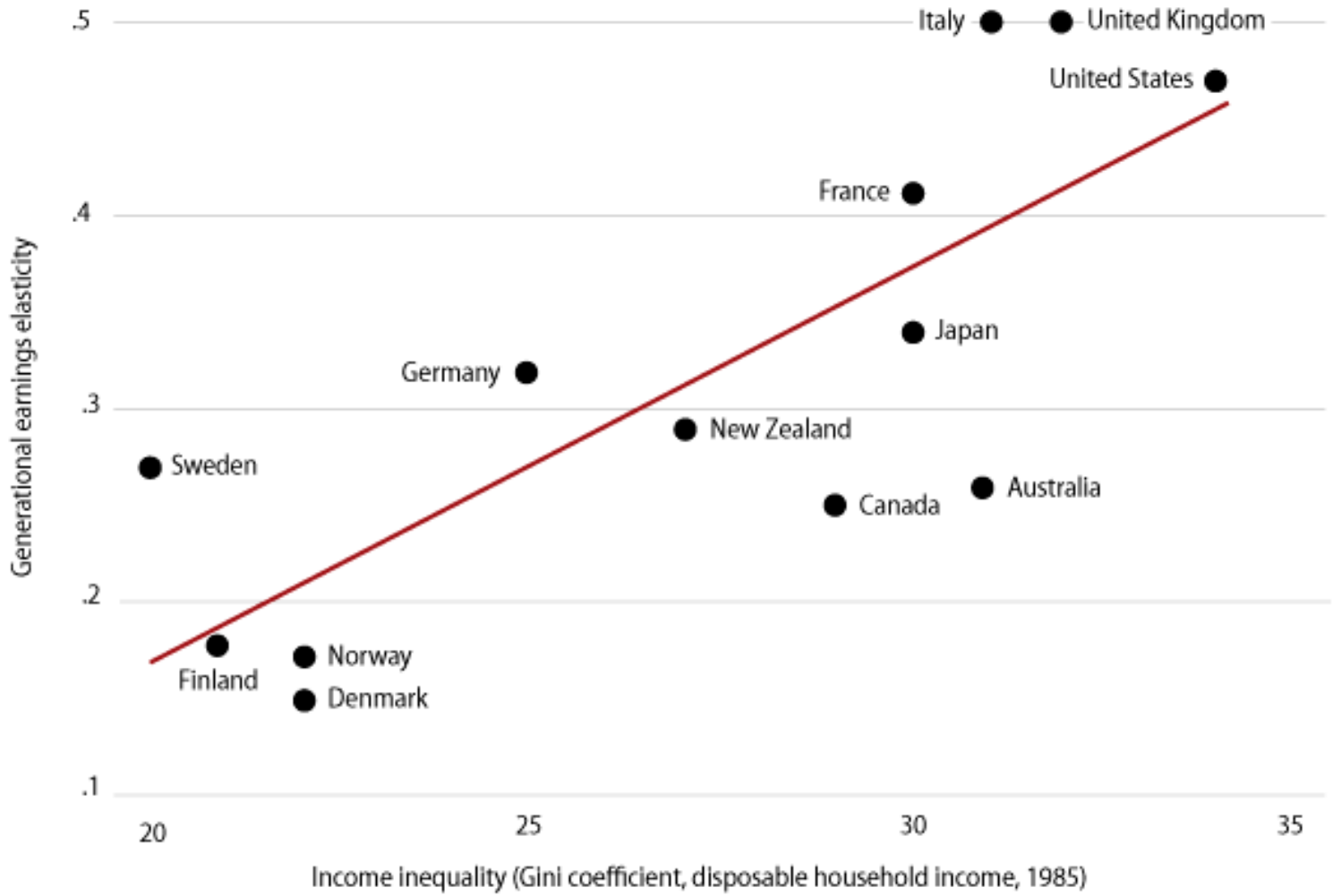
The "**Great Gatbsy Curve**" (Alan Krueger):

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).

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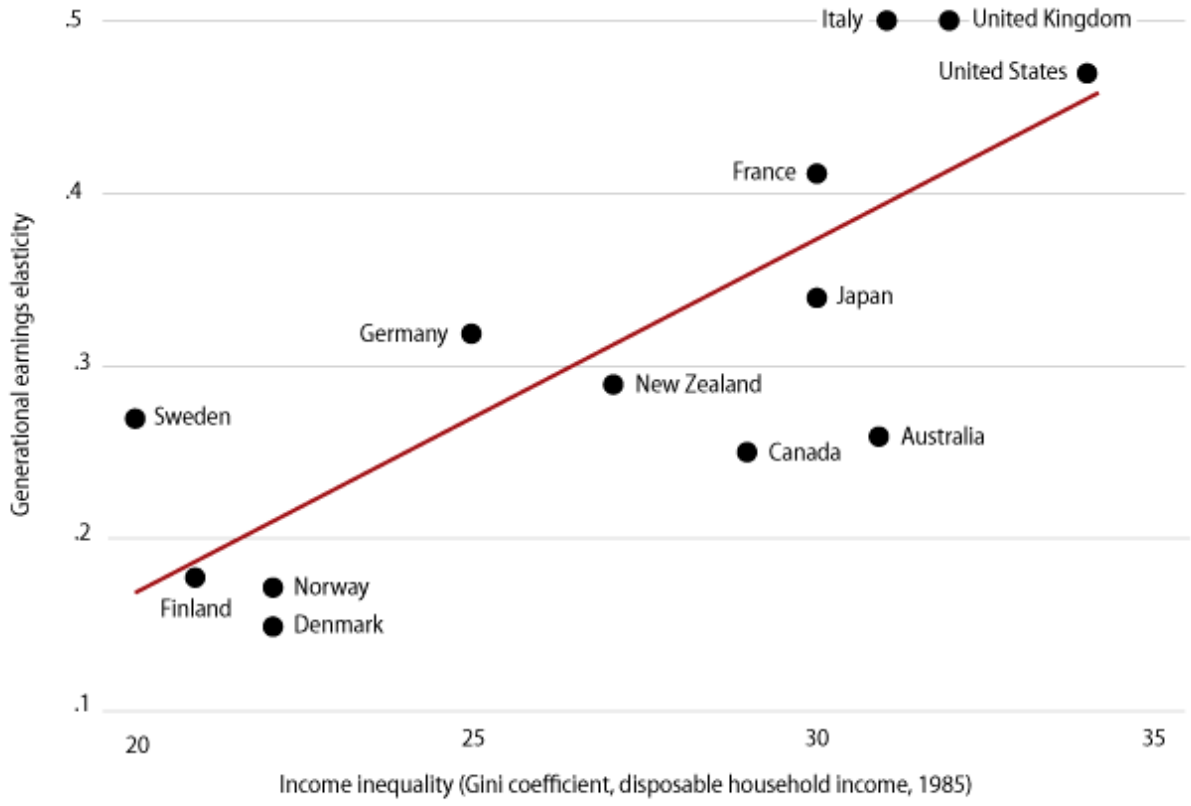

"The persistence in the advantages and disadvantages of income passed from parents to children is predicted to rise by about a quarter for the next generation, as a result of the rise in inequality that the U.S. has seen in the last 25 years."

Alan Krueger, Chairman of the Council of Economic Advisers (2012)

Contribution

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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A Model of Intergenerational Transmission

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

$$y_t = \gamma_{y,t} y_{t-1} + \boldsymbol{\delta}_t' \mathbf{h}_t + u_{y,t}. \quad (2)$$

Human capital $\mathbf{h}_t$ ($Jx1$) by parental income, **endowments**, and chance,

$$h_t = \boldsymbol{\gamma}_{h,t} y_{t-1} + \boldsymbol{\Theta}_t \mathbf{e}_t + \mathbf{u}_{h,t}. \quad (3)$$

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

$$\mathbf{e}_t = \boldsymbol{\Lambda}_t \mathbf{e}_{t-1} + \mathbf{v}_t \quad (4)$$

Assumptions: (i) variables are trendless indices with mean zero (not interested in abs. growth); (ii) consider positive measures, elements of $\boldsymbol{\delta}_t$, $\boldsymbol{\Theta}_t$, and $\boldsymbol{\Lambda}_t$ are non-negative

The Importance of Past Transmission Mechanisms

Assume cross-sectional variances are constant and normalised to one. Aggregate direct and indirect parental income effects, $\gamma_t = \gamma_{y,t} + \boldsymbol{\delta}_t' \boldsymbol{\gamma}_{h,t}$, and the returns to inherited endowments and human capital $\boldsymbol{\rho}_t' = \boldsymbol{\delta}_t' \boldsymbol{\Theta}_t$.

The intergenerational income elasticity in generation t equals

$$\beta_t = \frac{Cov(y_t, y_{t-1})}{Var(y_t)} = \gamma_t + \boldsymbol{\rho}_t' \boldsymbol{\Lambda}_t Cov(\mathbf{e}_{t-1}, y_{t-1}). \tag{5}$$

$\rightarrow$ 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

$\rightarrow$ Populations subject to same policies and institutions can nevertheless have different mobility.

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Cross-covariance between income and endowments depends in turn on past transmission mechanisms. Iterate backwards,

$$\beta_t = \gamma_t + \boldsymbol{\rho}_t' \boldsymbol{\Lambda}_t \boldsymbol{\rho}_{t-1} + \boldsymbol{\rho}_t' \boldsymbol{\Lambda}_t \left(\sum_{r=1}^{\infty} \left(\prod_{s=1}^{r} \gamma_{t-s} \boldsymbol{\Lambda}_{t-s} \right) \boldsymbol{\rho}_{t-r-1} \right). \quad (6)$$

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.
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Assume that a **structural change** occurs in generation T.[1]

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

What are the implications?

1. Different types of structural changes generate different responses
   $\rightarrow$ dynamic pattern may be informative about type of change that occurred
2. Even a one-time change in one mechanism can cause trends over mulitple generations

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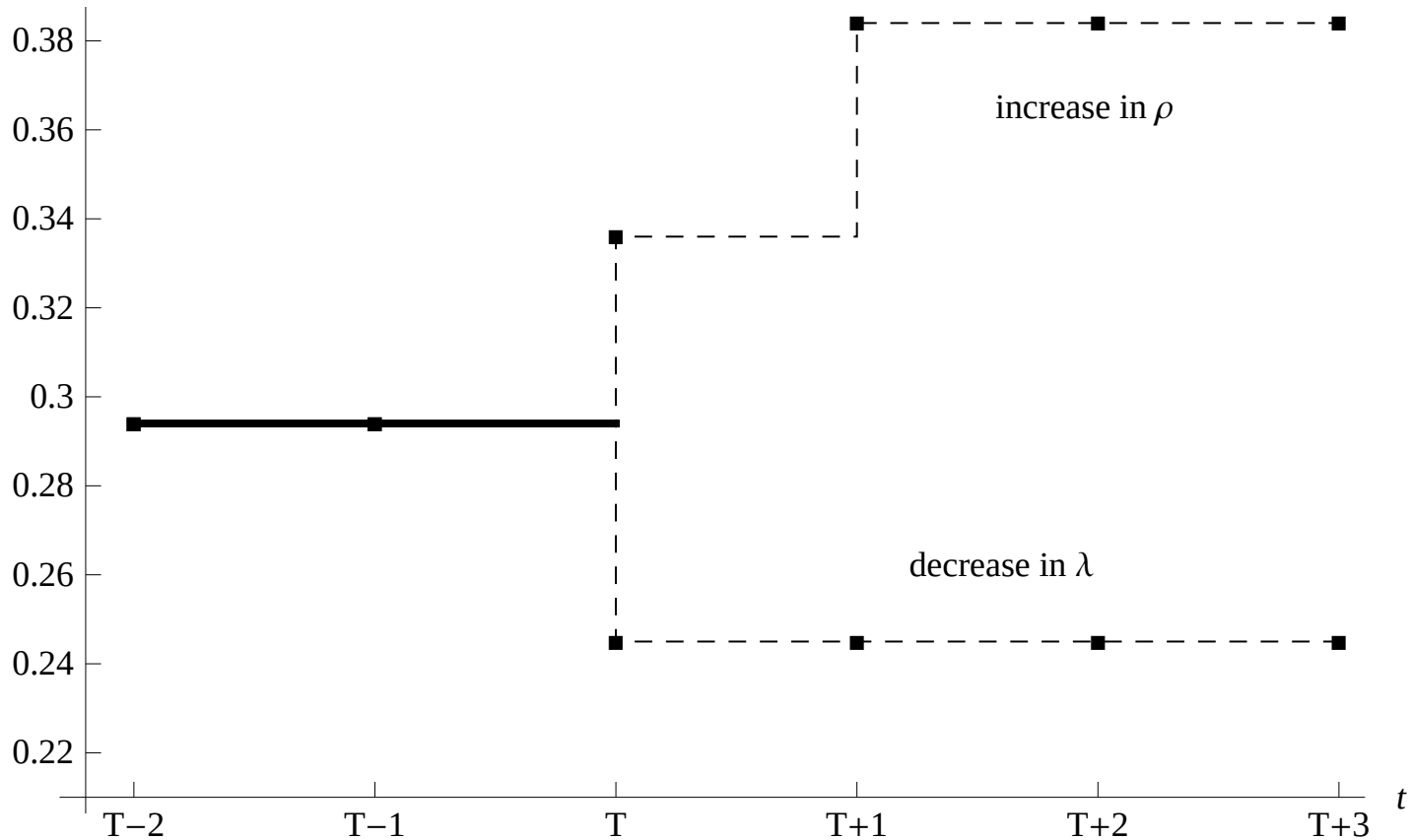
Figure : A change in the heritability of, or returns to, endowments



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.

$\rightarrow$ 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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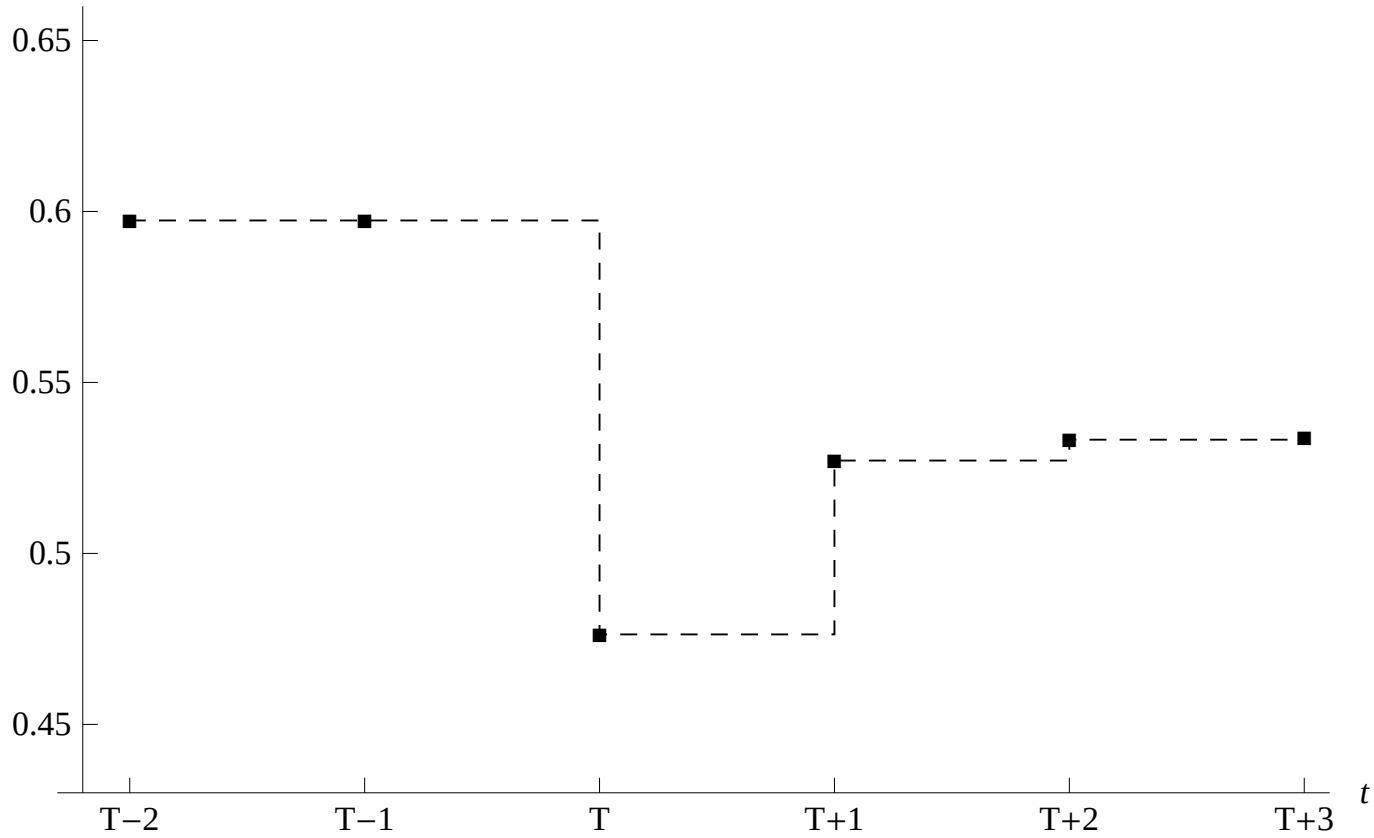
Figure : Declining impact of parental income and increasing returns to skill



Note: Numerical example with $\lambda = 0.6$, a decline in γ from $\gamma_1 = 0.4$ to $\gamma_2 = 0.2$, a rise in ρ 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 ($\boldsymbol{\rho}_1 \neq \boldsymbol{\rho}_2$).

We show:

$$\beta_T = \frac{1}{2}\left(\beta_{T-1} + \beta_{t\to\infty}\right) - \frac{1}{2}\left(\boldsymbol{\rho}_2' - \boldsymbol{\rho}_1'\right)\boldsymbol{\Lambda}\left(I - \gamma\boldsymbol{\Lambda}\right)^{-1}\left(\boldsymbol{\rho}_2 - \boldsymbol{\rho}_1\right). \quad (7)$$

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

1. Times of changes tend to be times of high mobility.
   May explain high US-mobility in late 19th century (Long and Ferrie, 2013).
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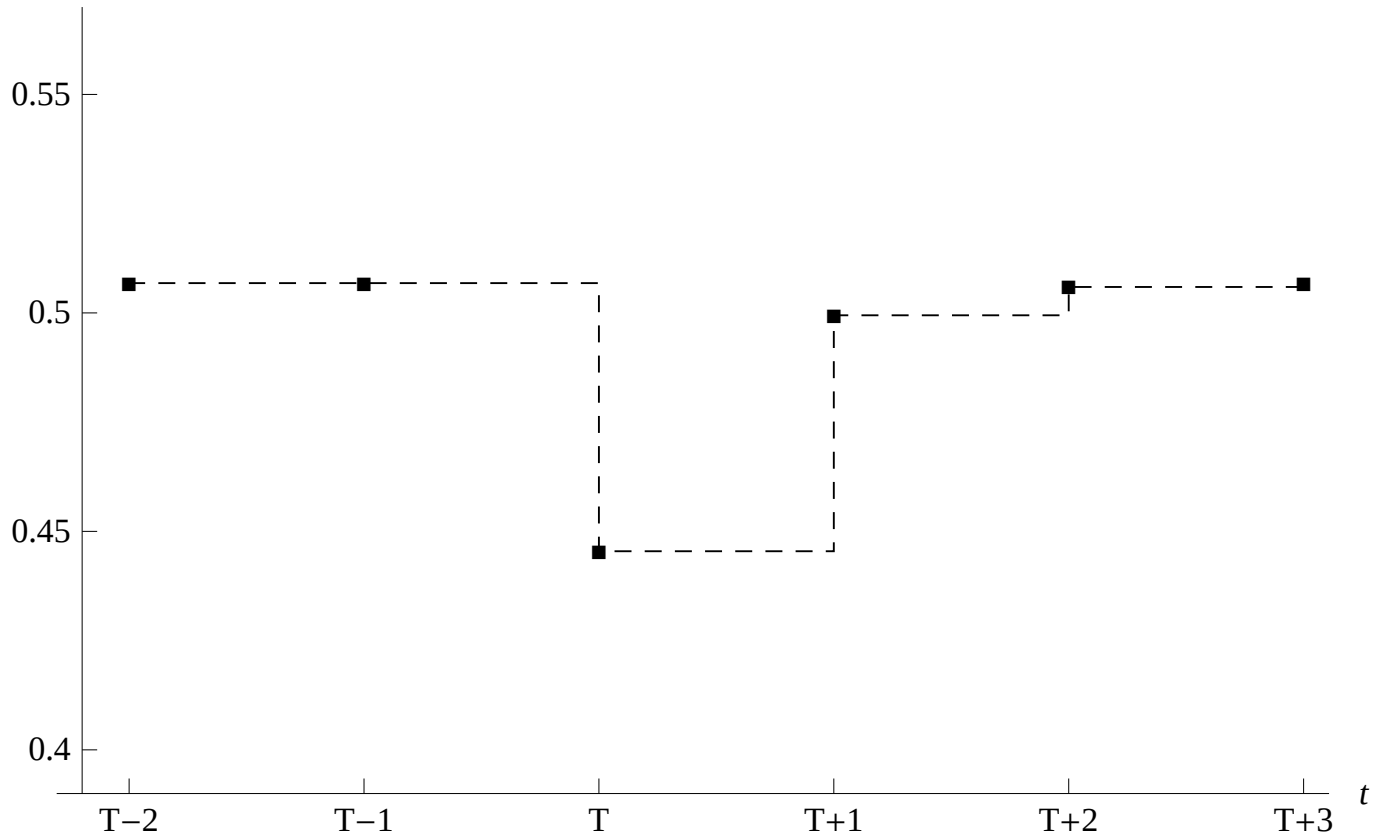
Figure : A swap in prices



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 $\gamma = 0.2$, $\lambda = 0.6$).

Empirical Application

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).
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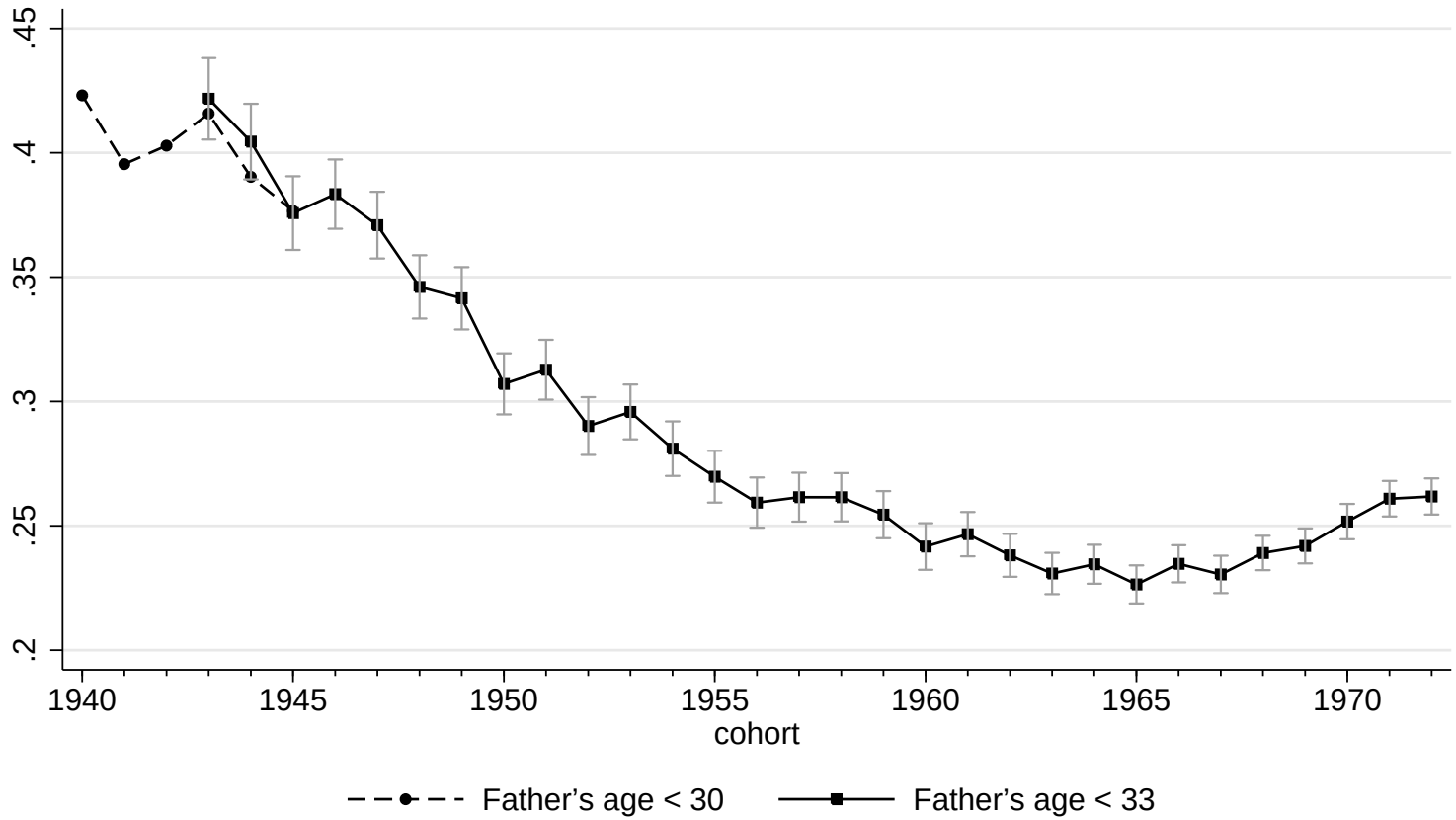
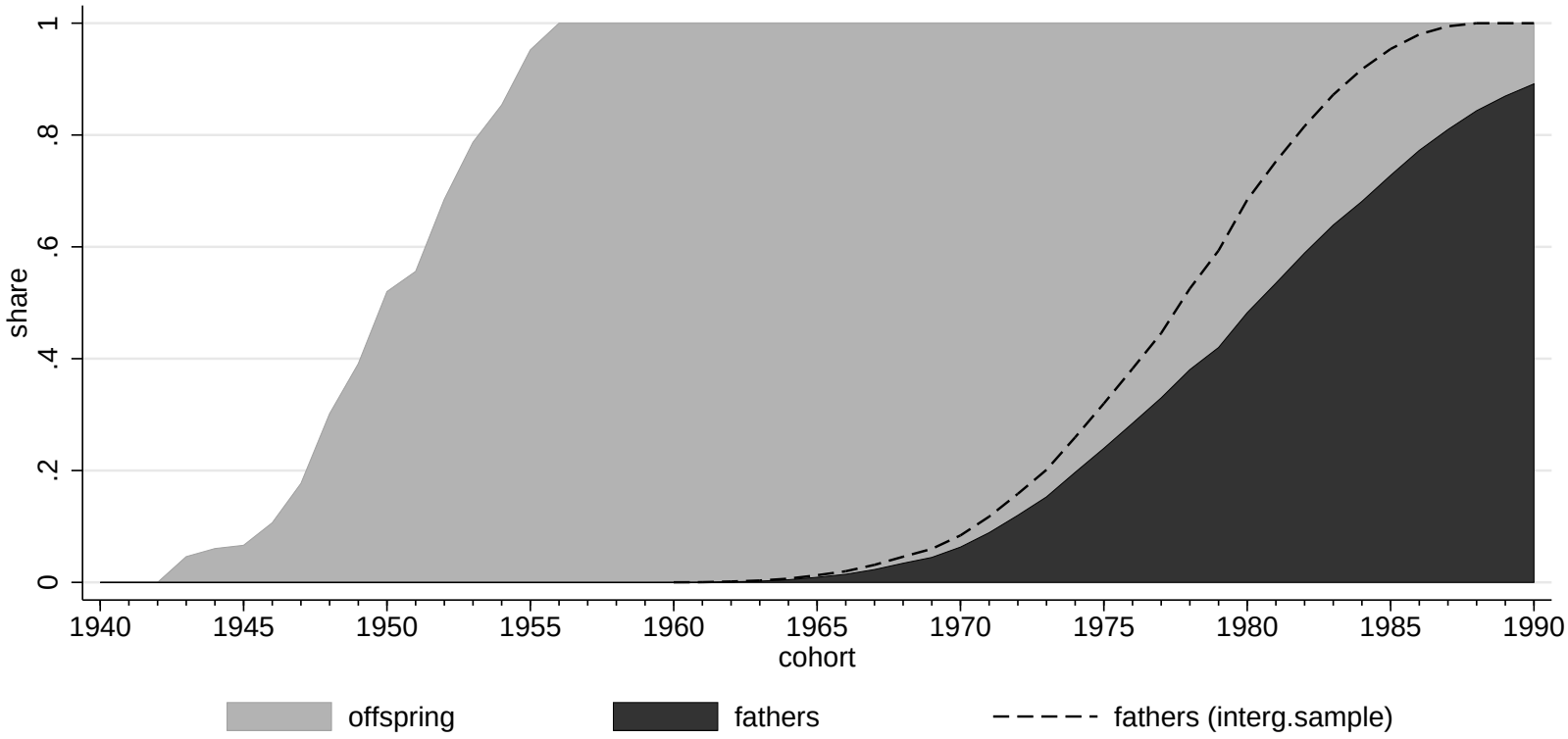
Figure : The Intergenerational Education Coefficient over Cohorts



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.

Figure : Share of Offspring and Fathers Subject to Reform



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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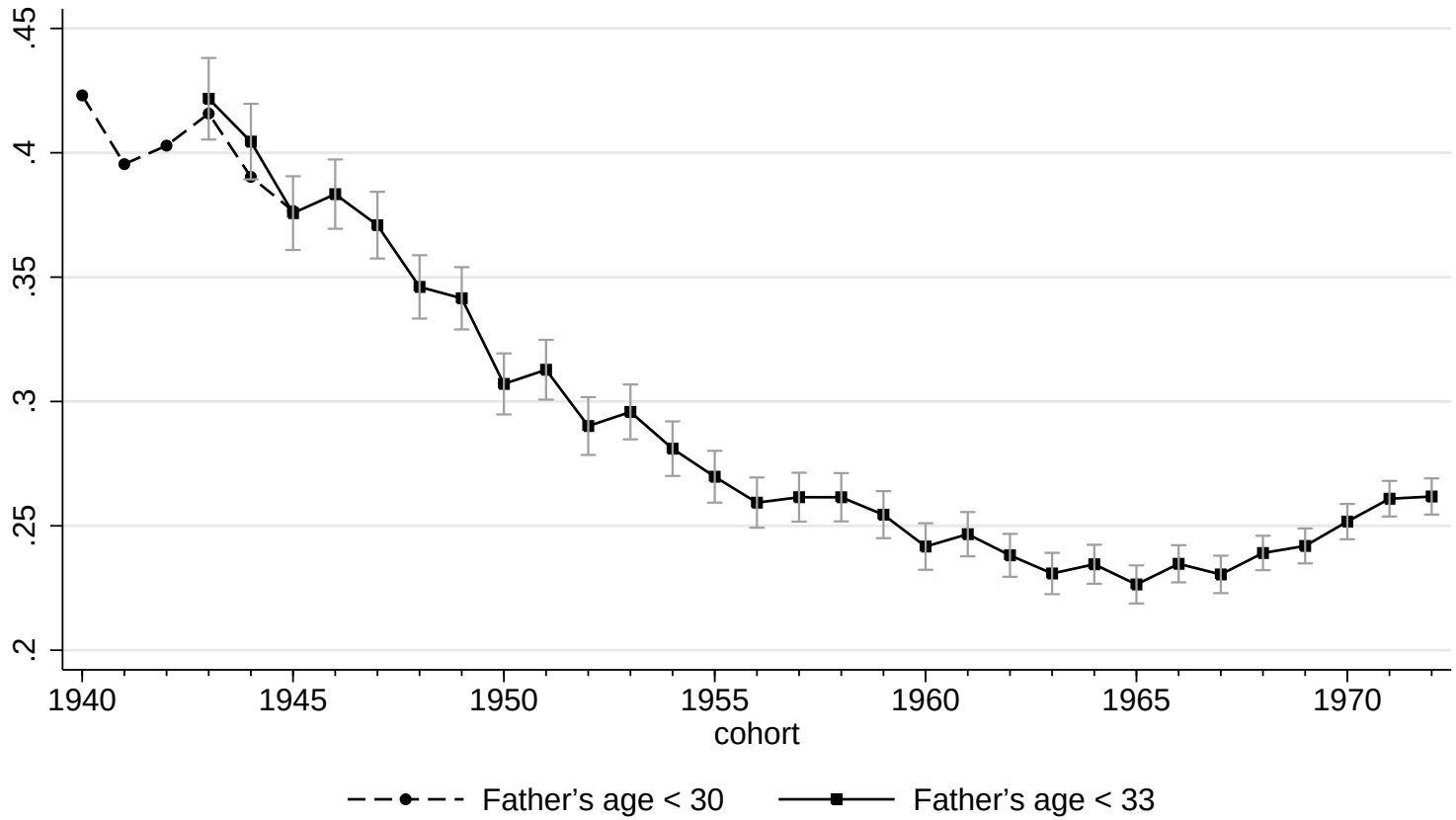

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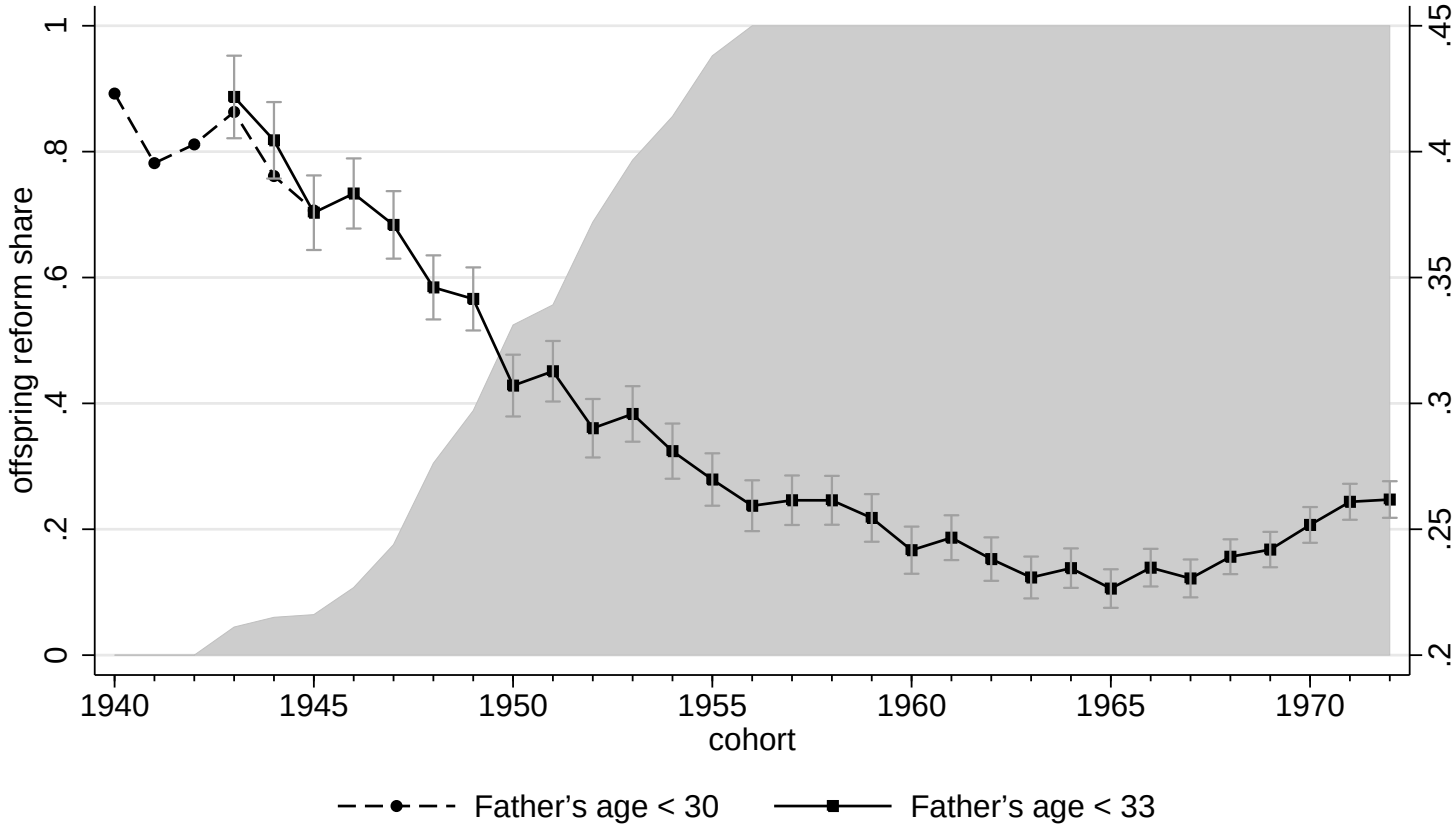

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Difference-in-Differences Estimation, First Generation

Estimate pooled regression (education):

$$h_{cfm,t} = \underbrace{\alpha_1 + \beta_1 h_{t-1}}_{\text{baseline}} + \underbrace{\alpha_2 R_{cm} + \beta_2 (h_{t-1} \times R_{cm})}_{\text{reform effect}} + \underbrace{\boldsymbol{\alpha}_3' \mathbf{D}_c + \boldsymbol{\beta}_3' (h_{t-1} \times \mathbf{D}_c)}_{\text{offspring cohort effect}}$$
$$+ \underbrace{\boldsymbol{\alpha}_4' \mathbf{D}_f + \boldsymbol{\beta}_4' (h_{t-1} \times \mathbf{D}_f)}_{\text{father cohort effect}} + \underbrace{\boldsymbol{\alpha}_5' \mathbf{D}_m + \boldsymbol{\beta}_5' (h_{t-1} \times \mathbf{D}_m)}_{\text{municipality effect}} + \varepsilon_{cfm,t},$$

where $h_{cfm,t}$ (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	education offspring (# years)			
	(1)	(2)	(3)	(4)
education father (# years)	0.359***	0.396***	0.422***	0.427***
	(0.00383)	(0.00496)	(0.00750)	(0.0227)
reform		1.407***	0.555***	0.567***
		(0.0577)	(0.0672)	(0.0672)
reform x education father		-0.0969***	**-0.0371*** **	**-0.0387*** **
		(0.00632)	(0.00722)	(0.00726)
N	220335	220335	220335	220335
Panel B: Income	log income offspring			
	(1)	(2)	(3)	(4)
log inc. father	0.164***	0.157***	0.139***	0.143***
	(0.00265)	(0.00362)	(0.0158)	(0.0185)
reform		-0.0111	0.253*	0.250*
		(0.0652)	(0.117)	(0.117)
reform x log inc. father		0.00510	**-0.0196***	**-0.0194***
		(0.00533)	(0.00960)	(0.00960)
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.

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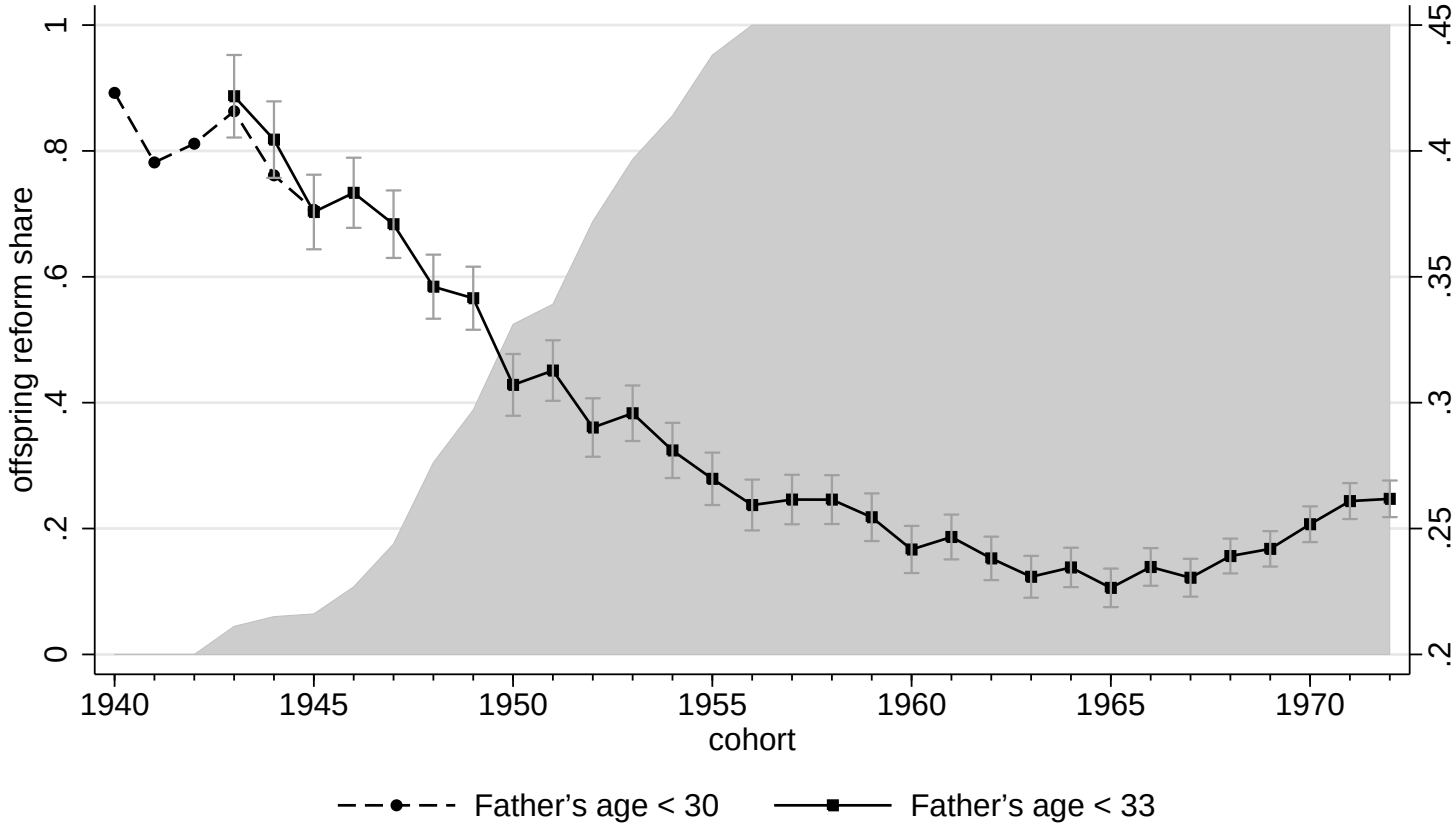

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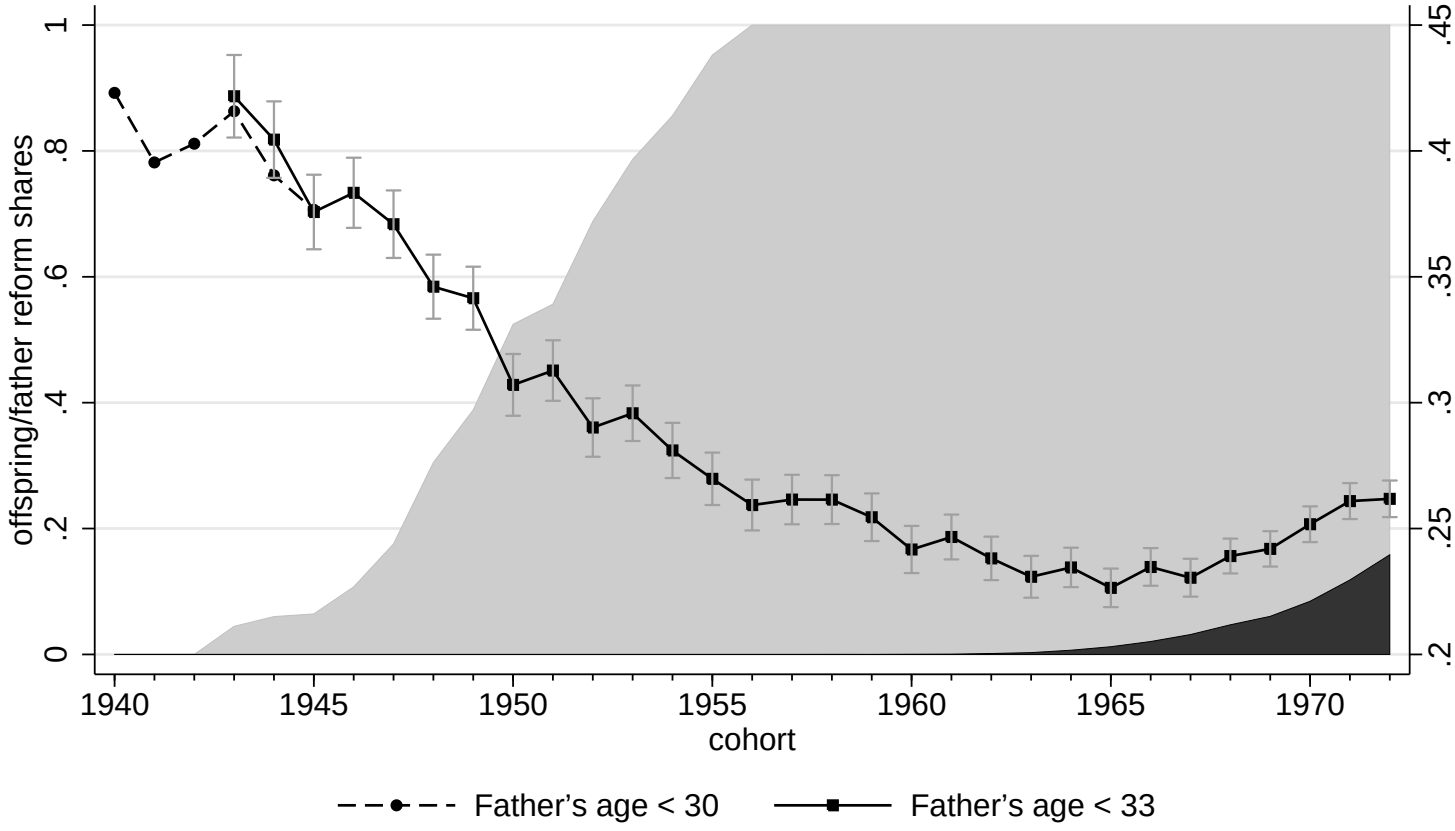

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Second Generation Impact

Did the reform affect intergenerational mobility in the next generation?

Adapt pooled regression for next generation,

$$h_{cfm',t} = \underbrace{\alpha_1 + \beta_1 h_{t-1}}_{\text{baseline}} + \underbrace{\alpha_2 R_{fm'} + \beta_2 (h_{t-1} \times R_{fm'})}_{\text{father reform effect}} + \underbrace{\boldsymbol{\alpha}_3' \mathbf{D}_c + \boldsymbol{\beta}_3' (h_{t-1} \times \mathbf{D}_c)}_{\text{offspring cohort effect}}$$
$$+ \underbrace{\boldsymbol{\alpha}_4' \mathbf{D}_f + \boldsymbol{\beta}_4' (h_{t-1} \times \mathbf{D}_f)}_{\text{father cohort effect}} + \underbrace{\boldsymbol{\alpha}_5' \mathbf{D}_{m'} + \boldsymbol{\beta}_5' (h_{t-1} \times \mathbf{D}_{m'})}_{\text{father municipality effect}} + \varepsilon_{cfm,t},$$

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	education offspring (# years)			
	(1)	(2)	(3)	(4)
education father (# years)	0.240***	0.238***	0.294***	0.223***
	(0.00214)	(0.00298)	(0.00411)	(0.00904)
reform (father)		-0.904***	-0.768***	-0.768***
		(0.0894)	(0.139)	(0.137)
reform x education father		0.0534***	**0.0655*** **	**0.0655*** **
		(0.00893)	(0.0128)	(0.0126)
N	111173	111173	111173	111173
Panel B: Income	log income offspring			
	(1)	(2)	(3)	(4)
log inc. father	0.207***	0.211***	0.244***	0.204***
	(0.00380)	(0.00414)	(0.0167)	(0.0215)
reform (father)		0.331**	-0.498*	-0.509*
		(0.128)	(0.219)	(0.219)
reform x log inc. father		-0.0286**	**0.0410***	**0.0418***
		(0.0105)	(0.0179)	(0.0179)
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 intergenrational 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
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Empirical Literature

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,

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

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

- **US** evidence: Hertz (2007), Levine and Mazumder (2007), Aaronson and Mazumder (2008), Lee and Solon (2009), Ferrie and Long (2013)
- **UK** evidence on declining income mobility: Blanden et al. (2004), Nicoletti and Ermisch (2007), Erikson and Goldthorpe (2010)

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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.
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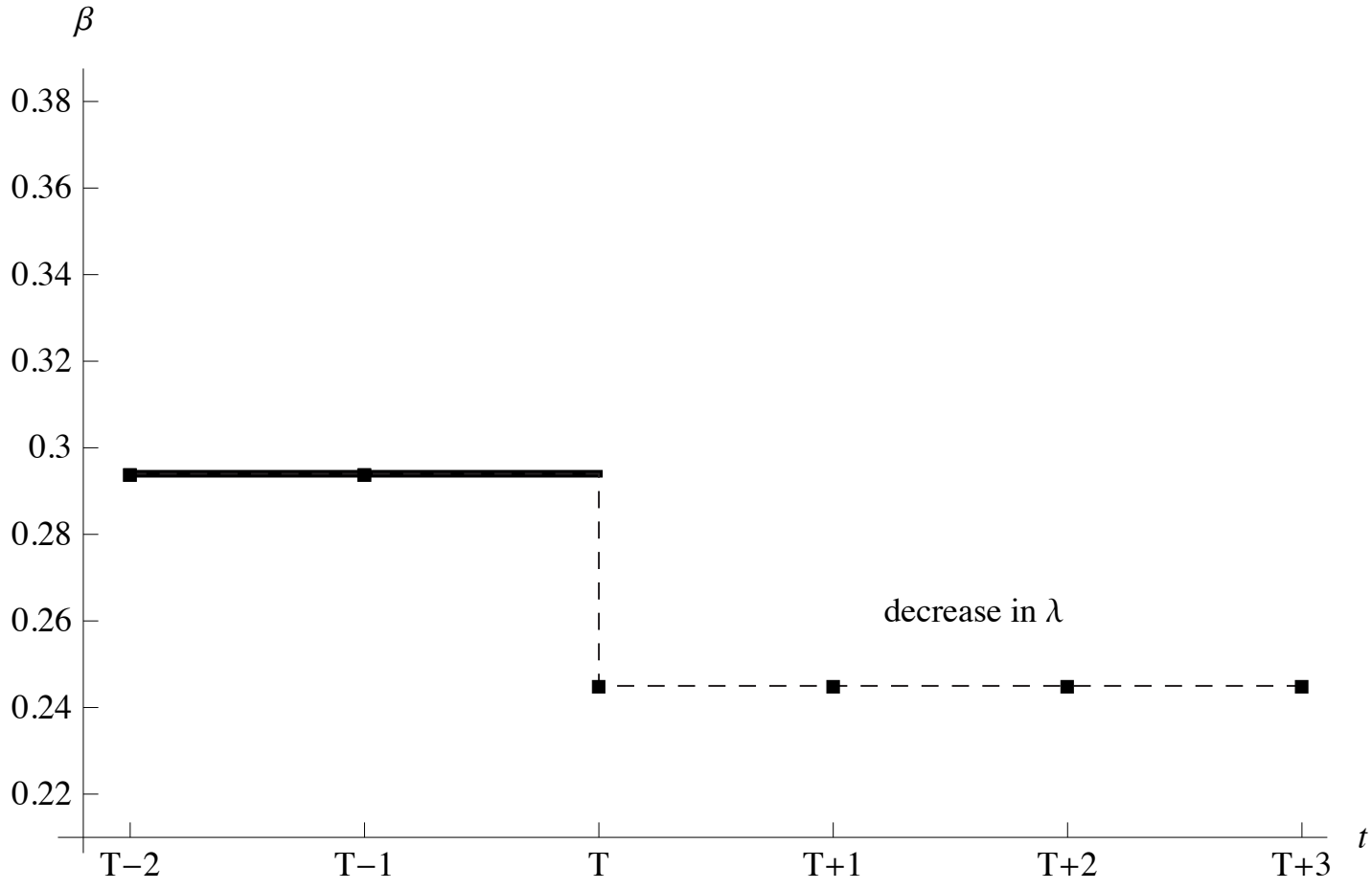
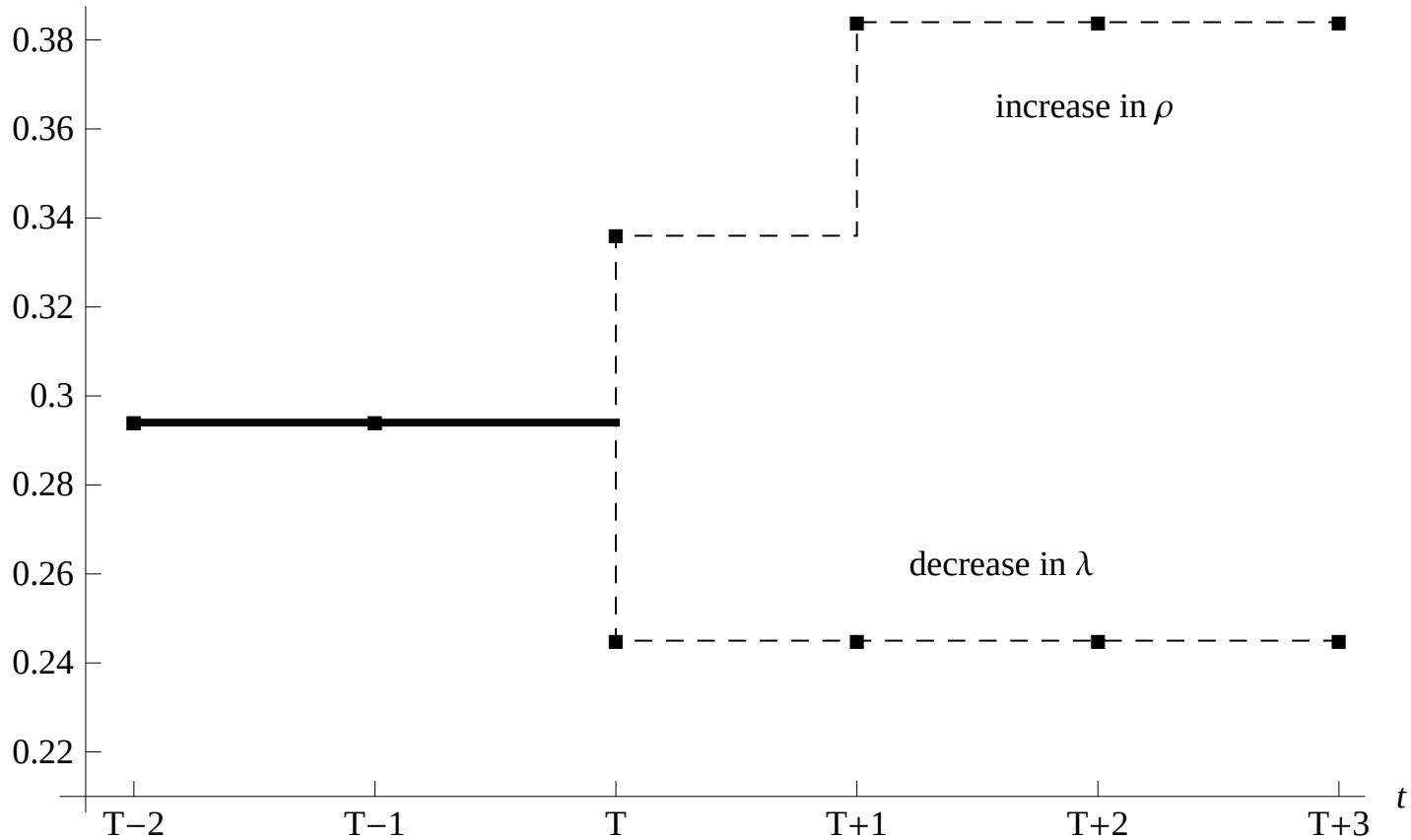
Back

Figure : A change in the heritability of endowments



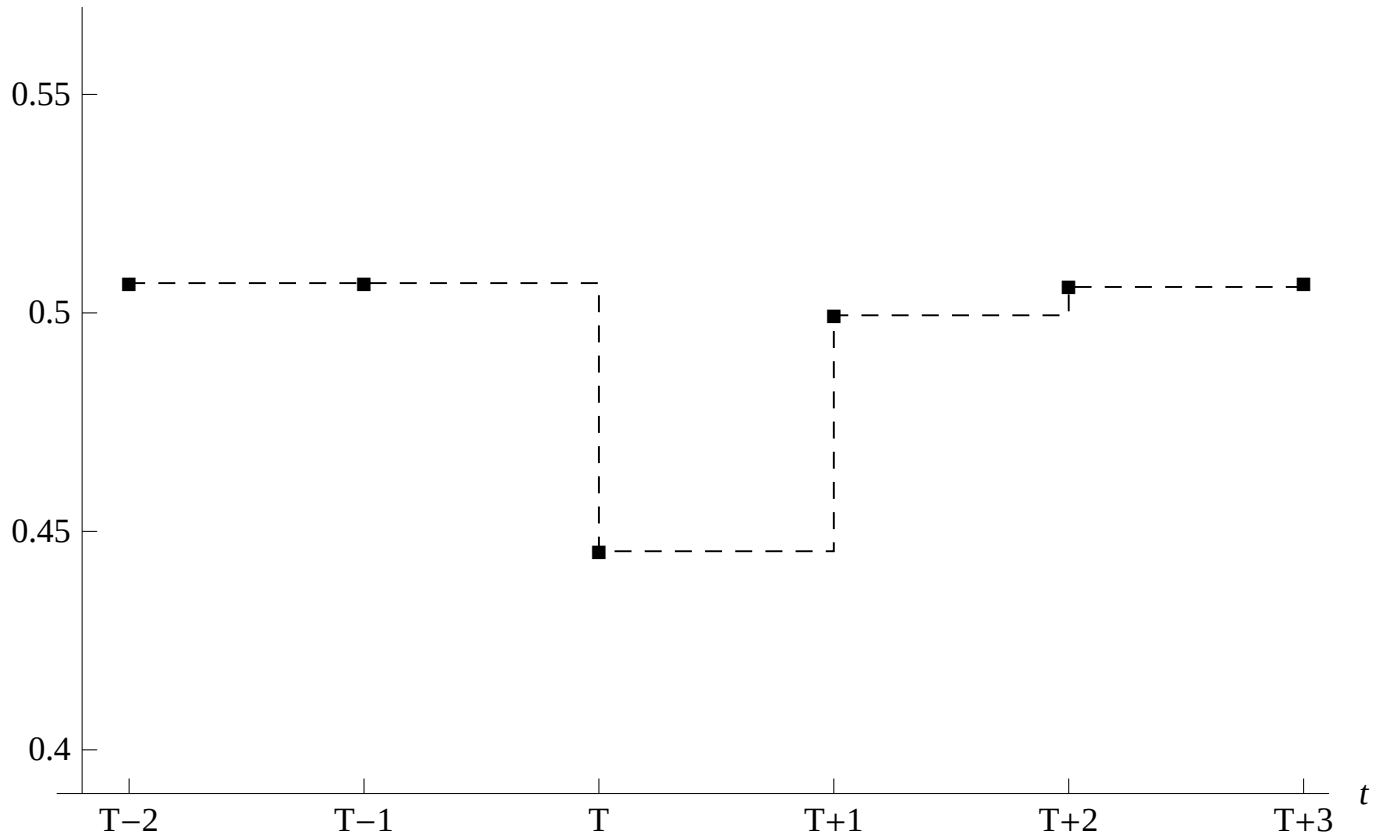
Note: Numerical example with $\rho = 0.7$, change from $\lambda_1 = 0.6$ to $\lambda_2 = 0.5$.

Figure : A change in the heritability of, or returns to, endowments



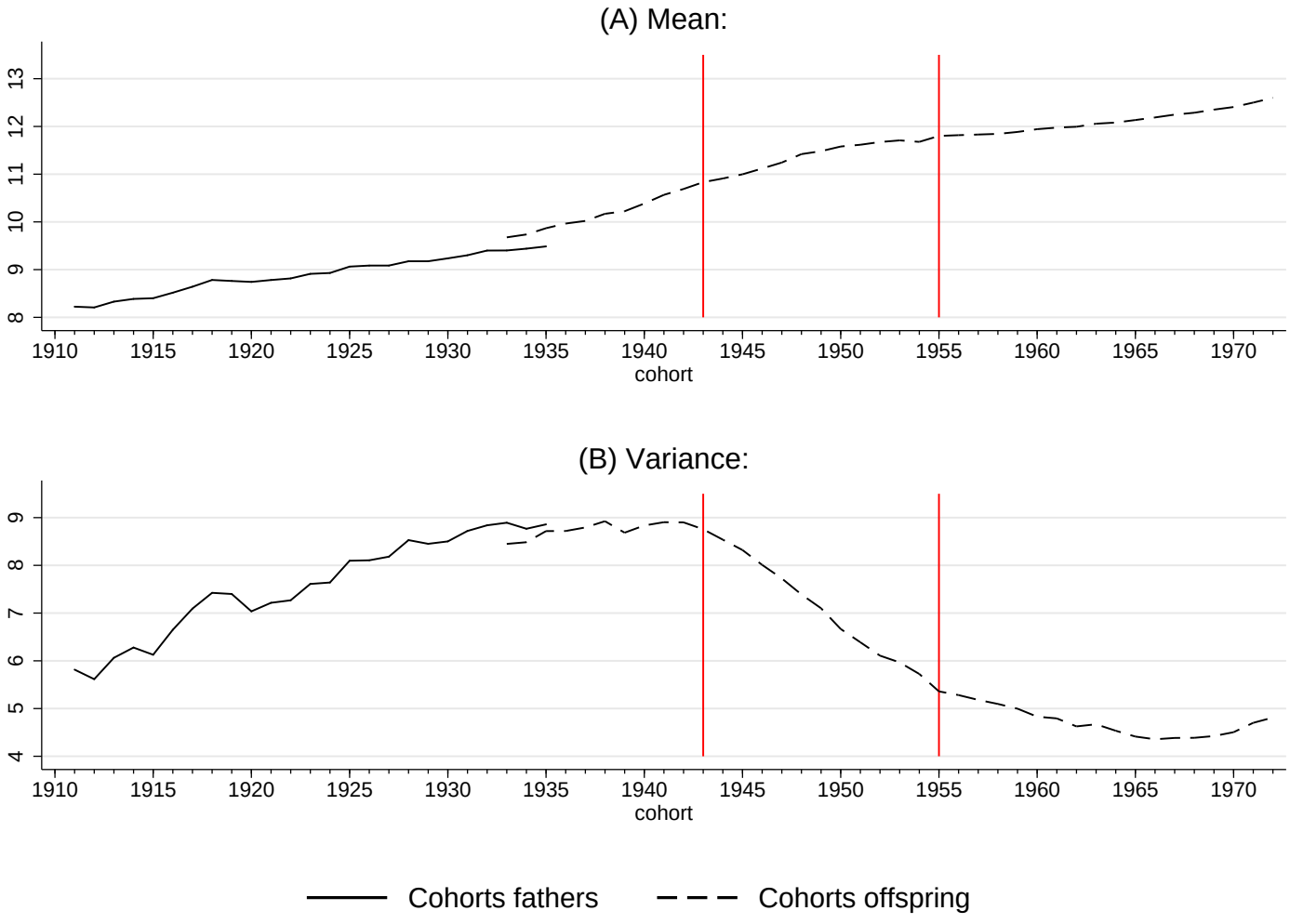
Note: Numerical example with $\lambda = 0.6$, change from $\rho_1 = 0.7$ to $\rho_2 = 0.8$.

Figure : A swap in prices



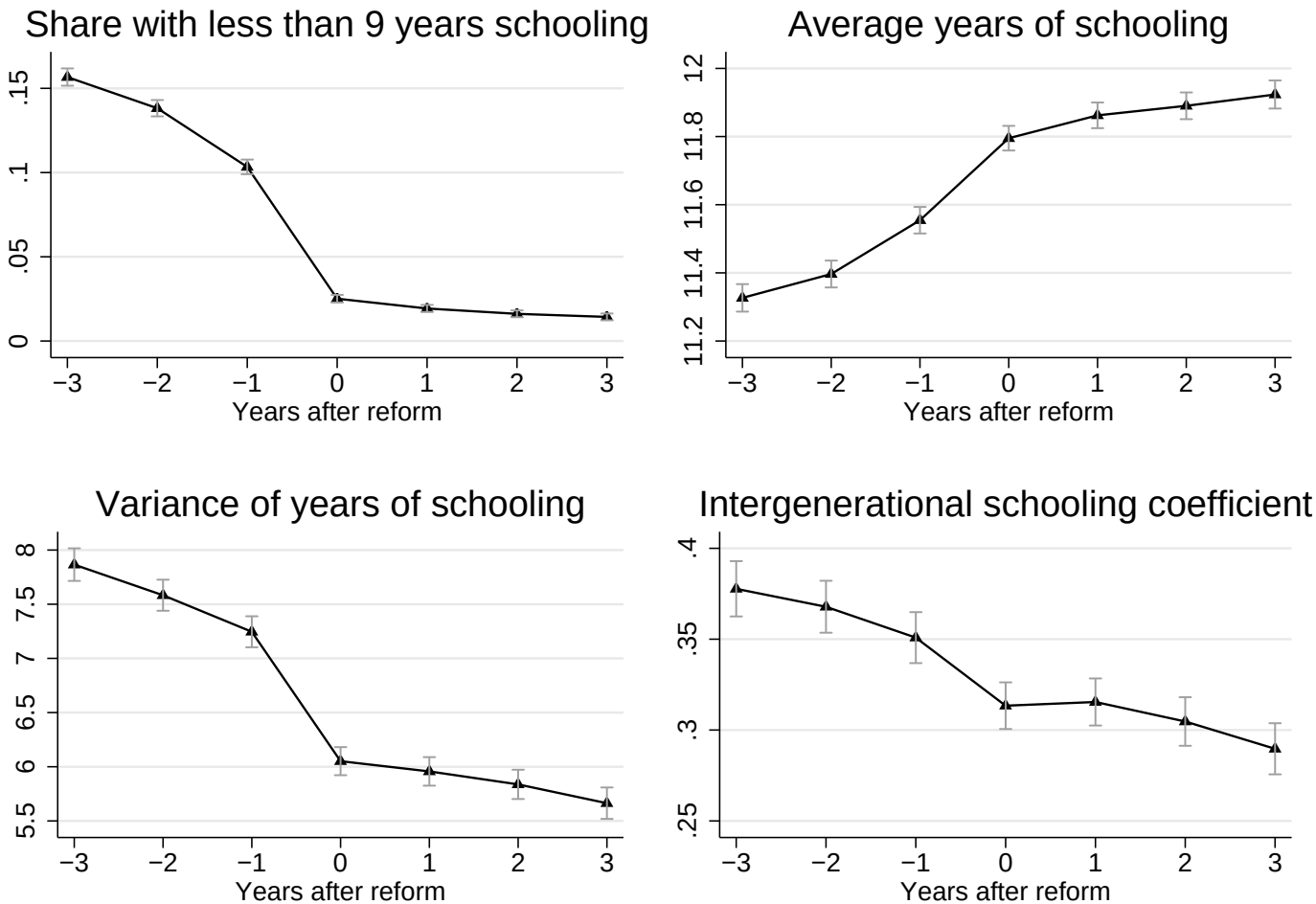
Note: Mobility trend over generations in numerical example. In generation T the returns to skill k and l increase from $\rho_{k,1} = 0.3$ to $\rho_{k,2} = 0.6$ and decrease from $\rho_{l,1} = 0.6$ to $\rho_{l,2} = 0.3$ (assume $\gamma = 0.2$, $\lambda = 0.6$).

Figure : Mean and Variance of Years of Schooling over Cohorts



Note: Mean and variance of years of schooling over offspring cohorts (dashed line) and father cohorts (solid lines) in intergenerational sample.

Figure : Educational Attainment and Mobility, Pre- vs. Post-Reform



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 $\mathbf{D}_c$ ...

$$\boldsymbol{\alpha}_2 (R_{cm} \times \mathbf{D}_c) + \boldsymbol{\beta}_2 (h_{t-1} \times R_{cm} \times \mathbf{D}_c). \tag{9}$$

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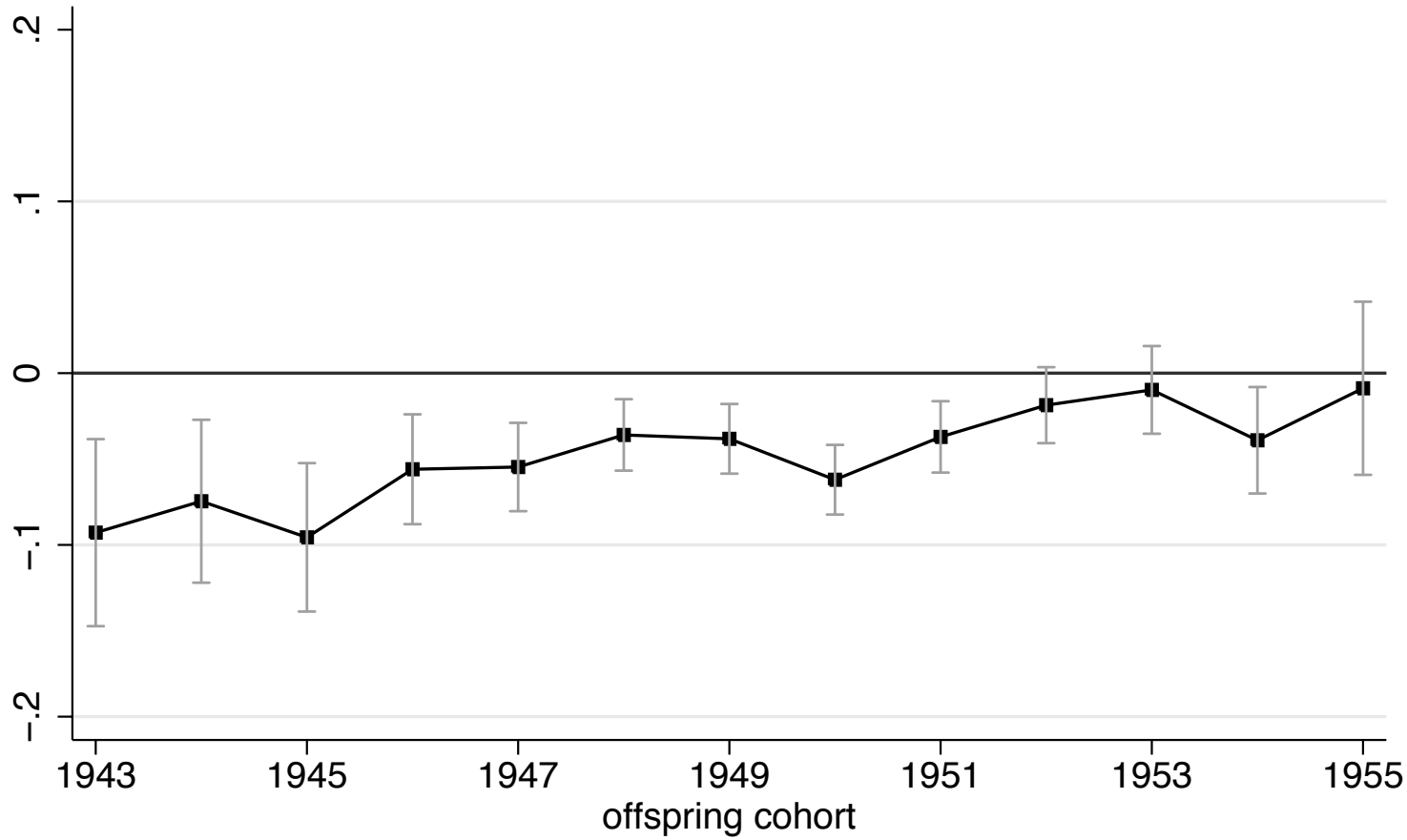
Figure : Heterogeneity in the Reform Effect over Cohorts



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

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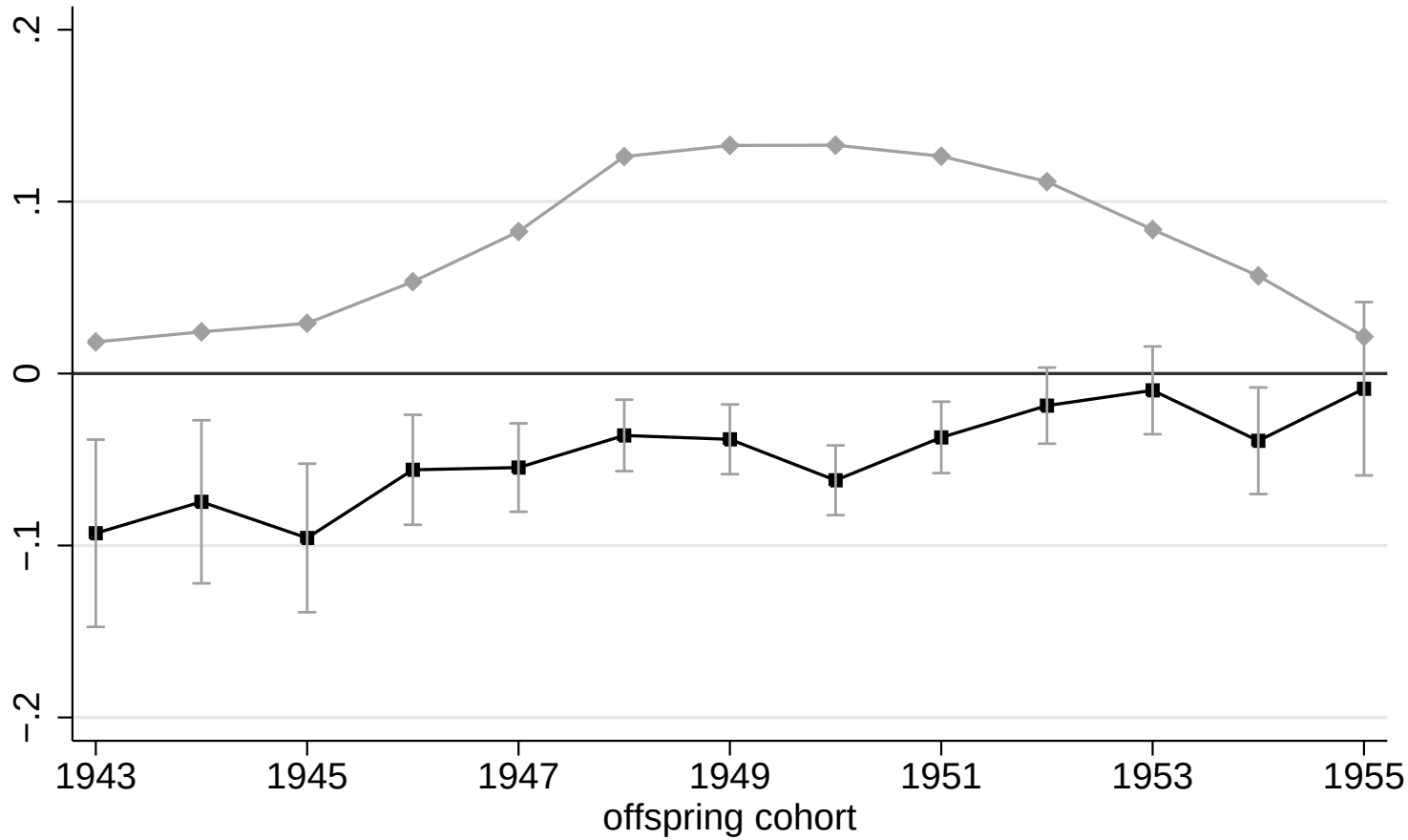

Note: Estimates of the reform effect on intergenerational education coefficient over cohorts (black line) and the respective weights in the pooled coefficient (grey line).