Intergenerational Wealth Formation Over the Life-Cycle: Evidence from Danish Wealth Records 1984-2013

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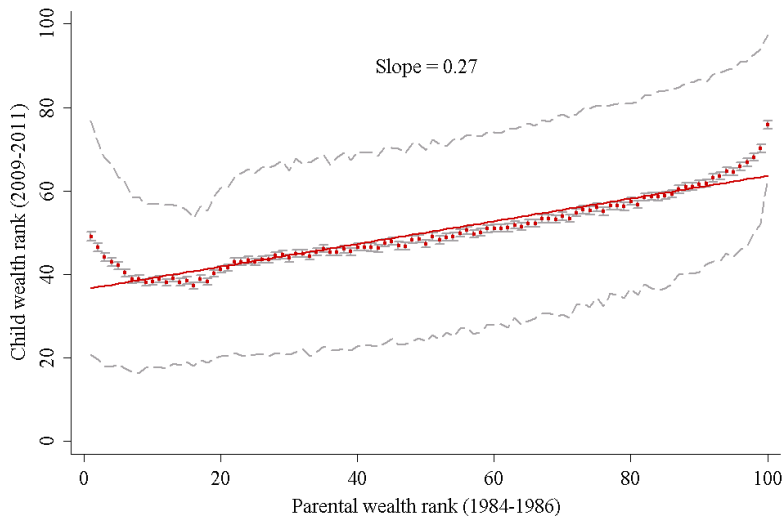
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  - Large (**0.35**) at age 20
  - Declining (to **0.17**) until early 30s
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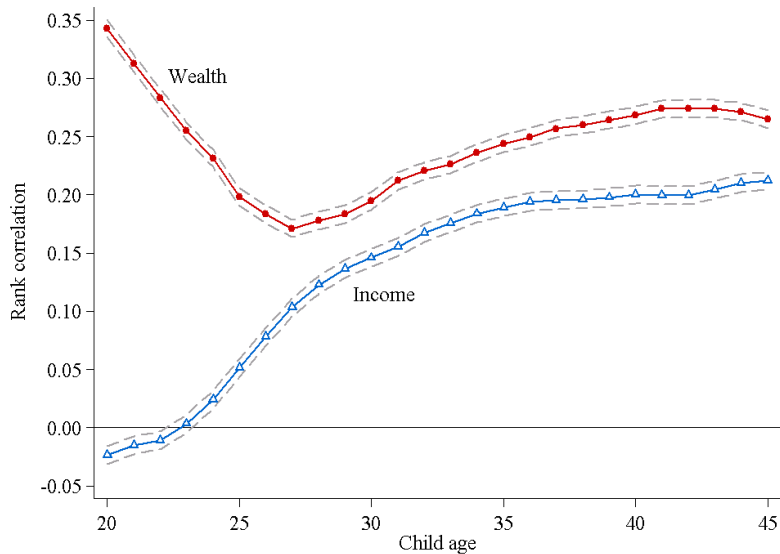
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- ...after bequests
  - Bequests quantitatively important (1/3 of average wealth on impact)
  - Wealth correlation increases on impact to **0.37**

Correlation of wealth rank of parents and children

Slope = 0.27

Child wealth rank (2009-2011) — vertical axis
Parental wealth rank (1984-1986) — horizontal axis

Mean child wealth rank · P25 and P75 - - - 95% conf. interval ⊢—⊣ OLS fit —

Wealth and income correlation over life-cycle

Wealth at a point time is a *fraction* of **lifetime resources**: not all income and transfers yet received, some consumption has already happened.

Income is one component of lifetime resources, transfers are another.

We propose a simple **theoretical framework** that clarifies the relationship between measures of mobility in terms of wealth, income and lifetime-resources

Why lifetime resources: measure of **consumption opportunities**

Correlation of **lifetime resources** may be inferred by (appropriately) estimating wealth correlation when parents and children are **at the same stage of their life-cycles**

We can estimate it in a way consistent with theory when both parents and children are in their **40s** and majority (80%) before bequests: our preferred estimate is **0.25**

We can also estimate this relationship at other ages, though with more empirical issues, and obtain similar results

Wealth correlation holding parents' and children's age the same
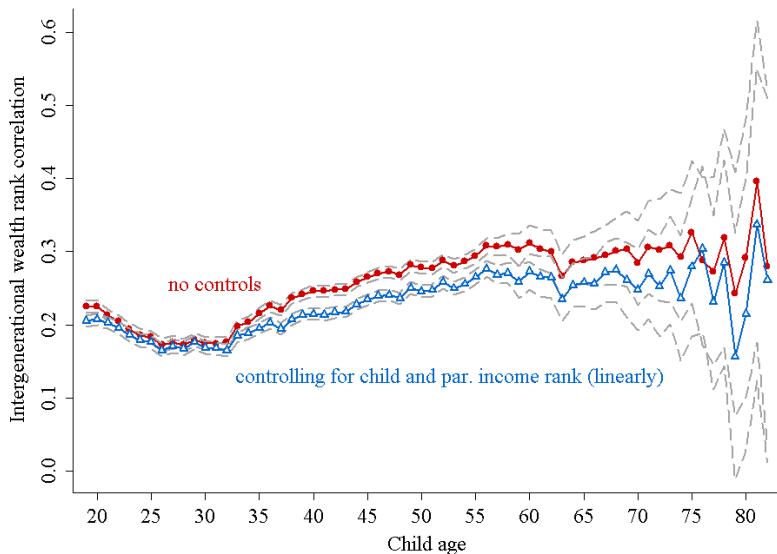
Lifetime resources: the role of bequests

Why not measure it *after* bequests? Data limitation: we can't observe wealth after bequests for both parents and children (we don't know when grandparents die).

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What lifetime resources potentially miss: flow of non-consumption benefits from wealth (control, economic power, political influence)

Wealth information

- Denmark had a wealth tax until 1996
- Since then, asset information used for tax enforcement (cross-checking of wealth changes and income)
- Major categories of assets third party reported by banks, financial institutions, government agencies — deposits, stocks, bonds, value of property, debts and liabilities of many different kinds
- Property value assessed based on detailed information about property and also used for taxation of imputed rent on property
- Assets and debts of non-corporate firms
- Major categories not included: pensions throughout; after 1996: corporate non-publicly traded assets, cars, cash. Anything else that is concealed from tax authorities
- Data break in 1996 (more categories self-reported up until that point, third party reporting increased) but overlap allows to check for consistency

Sample and timing

- Parents and children can be linked for children born after 1960 (before 1960 the link is incomplete)
- Wealth observed for 1984-2013
- Main analysis:
  - children who are 45-50 in 2010
  - both parents alive in 1986
  - children's wealth and income measured as average over 2009-2011, parental wealth and income as average over 1984-1986.
- Life-cycle patterns and sensitivity analysis using measurement in other years,
- For bequest analysis: children with one living parent in 2009, compare those with parent who did vs did not die in 2010.
- **Wealth ranking**: Ranks from 0-100 within each age cohort

Summary statistics — baseline sample

	Children		Parents	
	Mean	SD	Mean	SD
Age	47.2	1.7	47.9	5.1
Income	372,700	344,491	365,804	343,859
Value of assets	1,468,104	4,222,321	1,399,431	3,397,146
Value of liabilities	960,840	2,793,953	757,098	2,325,781
Net wealth	507,264	2,510,350	642,333	2,267,429
Percentiles of wealth				
20th	-132,788		0	
40th	32,386		21,114	
60th	330,869		351,527	
80th	849,631		1,212,174	
Share men	0.51		0.49	
Share married	0.63		0.88	
Share self-employed	0.07		0.17	
Observations	363,857		727,714	

Correlation of wealth rank of parents and children

Slope = 0.27

Child wealth rank (2009-2011) (y-axis)
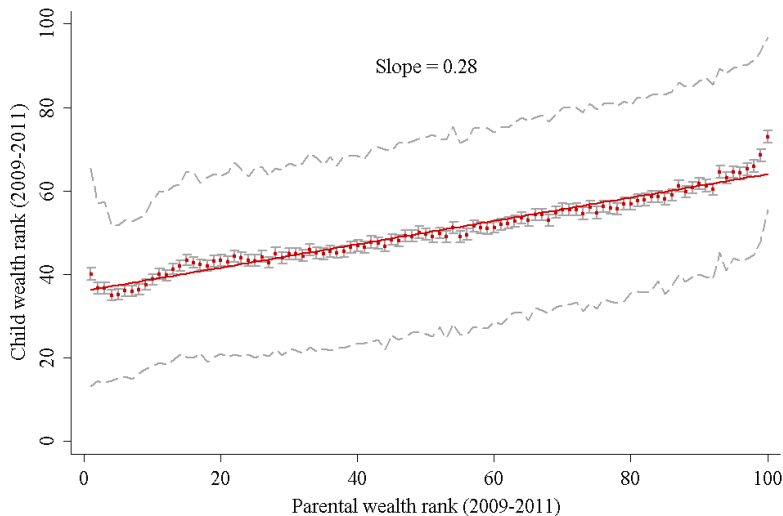Parental wealth rank (1984-1986) (x-axis)
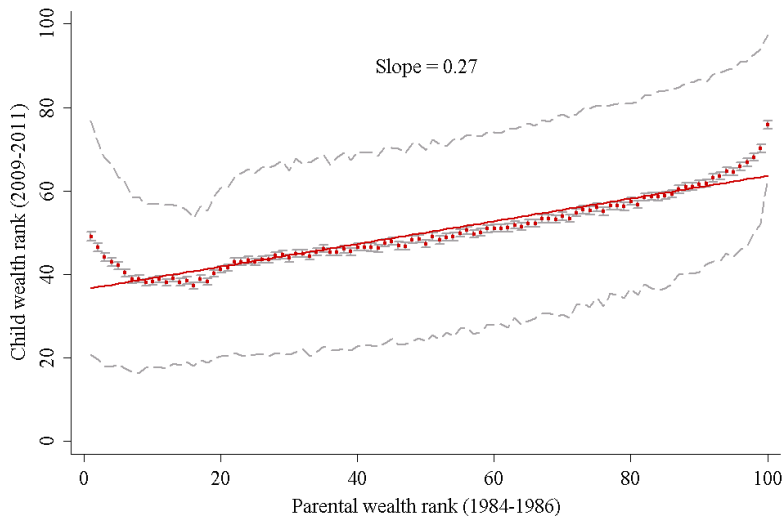
Mean child wealth rank ·   P25 and P75 - -   95% conf. interval ⊢⊣   OLS fit —

Wealth rank correlation — no self-employed
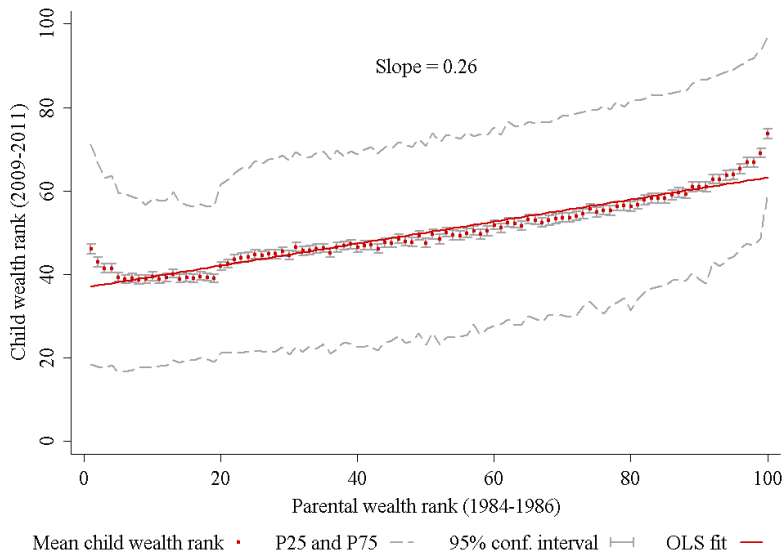
Wealth rank correlation — parents in 2009-2011
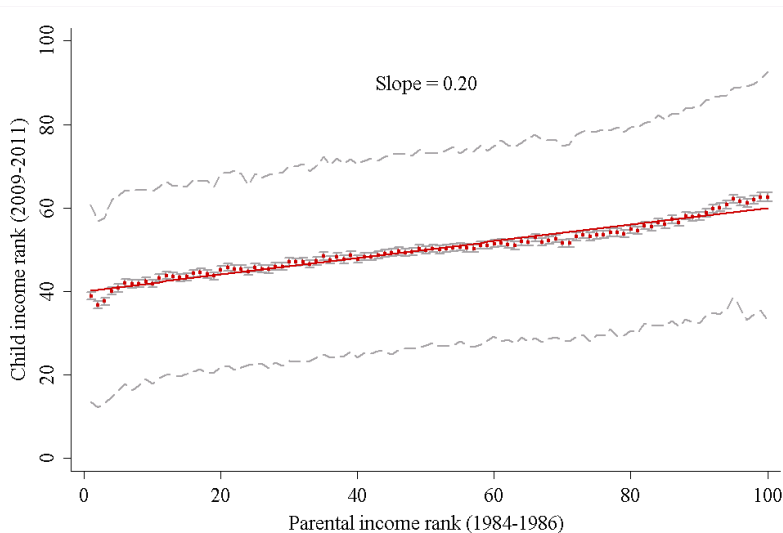

Slope = 0.28

Child wealth rank (2009-2011)

Parental wealth rank (2009-2011)

Mean child wealth rank •   P25 and P75 - - -   95% conf. interval ⊢—⊣   OLS fit —

Correlation of income rank of parents and children

Slope = 0.20

Child income rank (2009-2011)

Parental income rank (1984-1986)

Mean child income rank •   P25 and P75 – –   95% conf. interval ⊢—⊣   OLS fit —

Wealth mobility — estimates

	Child wealth				
	(1)	(2)	(3)	(4)	(5)
					Par. alive, 1997-1999, age controls
		Parents alive in 2011	Parental wealth 1997-1999	Age controls	
	Baseline				
A. Rank transformation					
Parental wealth	0.272	0.250	0.305	0.260	0.269
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
Observations	363,857	157,314	271,600	363,857	156,297
B. Log transformation					
Parental wealth	0.238	0.236	0.256	0.231	0.248
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
Observations	207,266	92,054	162,444	207,266	94,750
C. IHS transformation					
Parental wealth	0.215	0.191	0.284	0.194	0.230
	(0.002)	(0.004)	(0.003)	(0.002)	(0.004)
Observations	363,857	157,314	271,600	363,857	156,297

Lifetime resources R_g

$$R_g = Q_{g-1} + Y_g$$

where Q_{g-1} are lifetime transfers from parents and Y_g is lifetime income

$$Q_{g-1} = q_{g-1} + b_{g-1}$$

where q_{g-1} are inter-vivos gifts and b_{g-1} are bequests.

Lifetime income

$$Y_g = e_{g-1} + u_g$$

where e_{g-1} is parental investment in human capital of a child

Intergenerational linkages

Two general channels: transfers and human capital investment

$$Q_{g-1} = \alpha_Q \cdot R_{g-1} \qquad\qquad e_{g-1} = \alpha_e \cdot R_{g-1}$$

α_e and α_Q reduced form, but can micro-founded using
Cobb-Douglas preferences with joy-of-giving motive
$\frac{1-\alpha_e-\alpha_Q}{T} \sum_{i=1}^{T} \ln(C) + \alpha_e \ln(e) + \alpha_Q \ln(Q)$

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Then,

$$R_g = Y_g + Q_{g-1} = e_{g-1} + Q_{g-1} + u_g = (\alpha_e + \alpha_Q) \cdot R_{g-1} + u_g$$

Intergenerational relationship of lifetime resources is measured by

$$\beta_R = \alpha_e + \alpha_Q$$

This is our parameter of interest

Income mobility

$$\begin{aligned}
Y_g &= \alpha_e \cdot R_{g-1} + u_g \\
Y_{g-1} &= \alpha_e \cdot R_{g-2} + u_{g-1} \\
R_{g-1} &= (\alpha_e + \alpha_Q) \cdot R_{g-2} + u_{g-1}
\end{aligned}$$

implies that

$$Y_g = (\alpha_e + \alpha_Q) \cdot Y_{g-1} - \alpha_Q \cdot u_{g-1} + u_g$$

In the presence of transfers ($\alpha_Q \neq 0$), permanent income mobility underestimates lifetime resources mobility ($\alpha_e + \alpha_Q$).

One needs to specify when wealth is measured.

Wealth mobility

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Notation: by age t, the person will have

- received fraction ρ^t of lifetime income
- received fraction γ^t of lifetime transfers (both inter-vivo and beqests)
- spent fraction ζ^t of lifetime resources (on consumption, human capital investments, gifts and bequests)

Wealth at time t:

$$w_g^t = \rho^t Y_g + \gamma^t Q_{g-1} - \zeta^t R_g$$

so that

$$w_g^t = \left((\gamma^t - \zeta^t)\alpha_Q + (\rho^t - \zeta^t)\alpha_e \right) \cdot R_{g-1} + (\rho^t - \zeta^t)u_g$$

Wealth mobility (continued)

Analogous to the case of income except for age dynamics

Relationship between child's wealth at t and parental wealth at s:

$$w_g^t = (\alpha_e + \alpha_Q) \cdot \xi_t^s \cdot w_{g-1}^s - \nu_t^s \cdot u_{g-1} + (\rho^t - \zeta^t) \cdot u_g$$

where

$$\xi_t^s \equiv \frac{(\gamma^t - \zeta^t)\alpha_Q + (\rho^t - \zeta^t)\alpha_e}{(\gamma^s - \zeta^s)\alpha_Q + (\rho^s - \zeta^s)\alpha_e}$$

and

$$\nu_t^s \equiv \gamma^t \alpha_Q + \rho^t \alpha_e - \zeta^t (\alpha_e + \alpha_Q)(\rho^s - \zeta^s)$$

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$$\nu_t^s \equiv \gamma^t \alpha_Q + \rho^t \alpha_e - \zeta^t(\alpha_e + \alpha_Q)(\rho^s - \zeta^s)$$

Wealth mobility measured at child's age t and parent's age s is:

- Different than $\alpha_e + \alpha_Q$ because of the ξ_t^s term
- Biased if $\nu_t^s \cdot u_{g-1}$ not dealt with

Addressing the bias

In order to obtain estimate the coefficient on w_{g-1} (i.e. $(\alpha_e + \alpha_Q)\xi_t^s$) we need to deal with the presence of $v_t^s u_{g-1}$

Recall that $Y_g = (\alpha_e + \alpha_Q)Y_{g-1} - \alpha_Q u_{g-1} + u_g$, solve for u_{g-1}, substitute for it in terms of Y_g, Y_{g-1} and u_g to obtain

$$w_g^t = (\alpha_e + \alpha_Q) \cdot \xi_t^s \cdot w_{g-1}^s - \frac{v_t^s}{\alpha_Q} \cdot Y_{g-1} - v_t^s \frac{\alpha_Q + \alpha_e}{\alpha_Q} \cdot Y_g$$

$$+ (\rho^t - \zeta^t - \frac{v_t^s}{\alpha_Q}) \cdot u_g$$

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$$+ (\rho^t - \zeta^t - \frac{v_t^s}{\alpha_Q}) \cdot u_g$$

Addressing the bias: estimate intergenerational mobility while controlling for permanent income of parents and children

Life-cycle dynamics of wealth mobility

$$\zeta_t^s = \frac{(\gamma^t - \zeta^t)\alpha_Q + (\rho^t - \zeta^t)\alpha_e}{(\gamma^s - \zeta^s)\alpha_Q + (\rho^s - \zeta^s)\alpha_e}$$

Intuition: the exact relationship to parental resources varies over the life-cycle

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Observations:

- When $\zeta_t^s = 1$, we will recover $\alpha_e + \alpha_Q$

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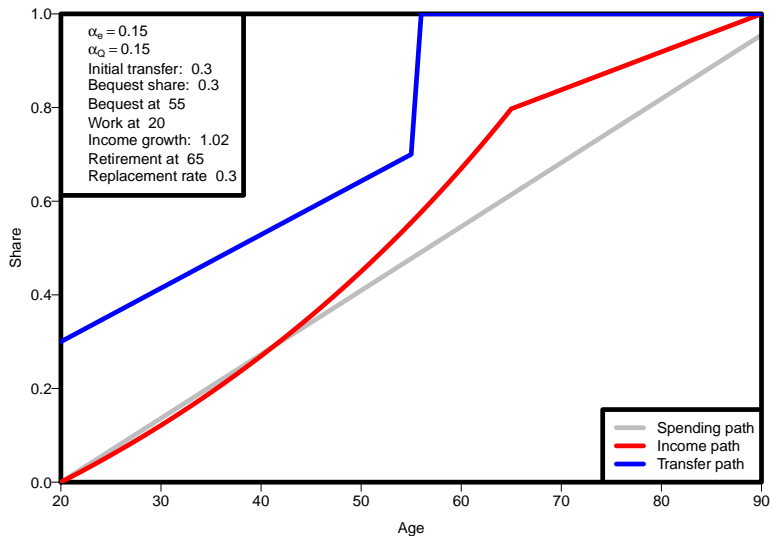
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Life-cycle dynamics of wealth mobility

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- No inter-vivos gifts $\gamma^t = 0$: $\zeta_t^s < 0$ early on
- Life-cycle dynamics: hold s constant, vary t

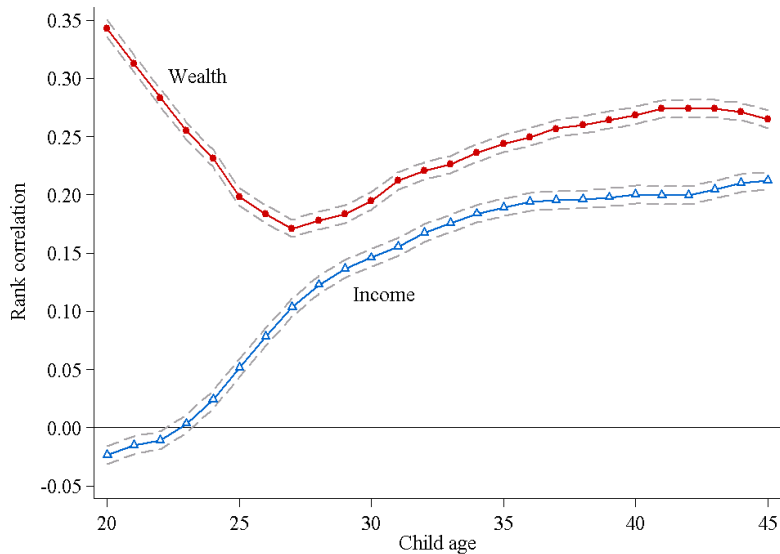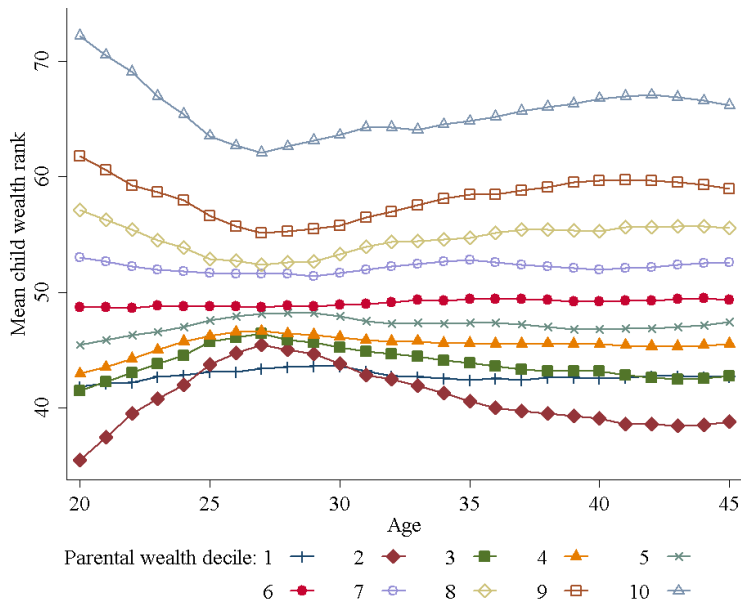# Interenerationality mobility over life-cycle — illustration
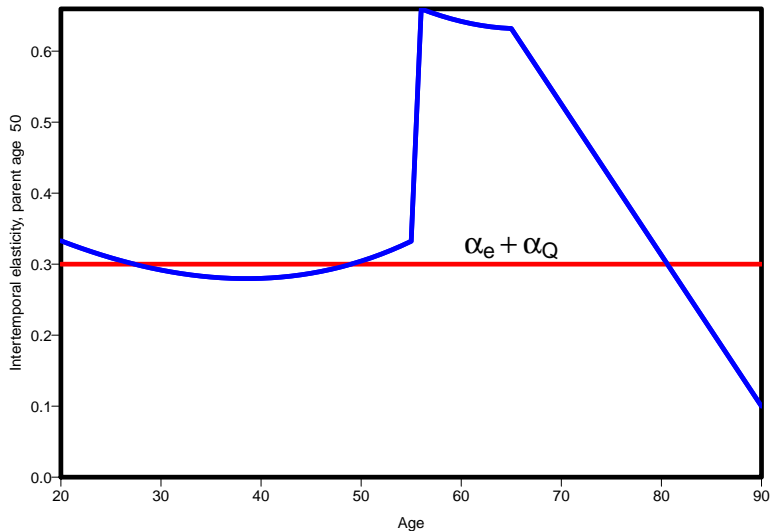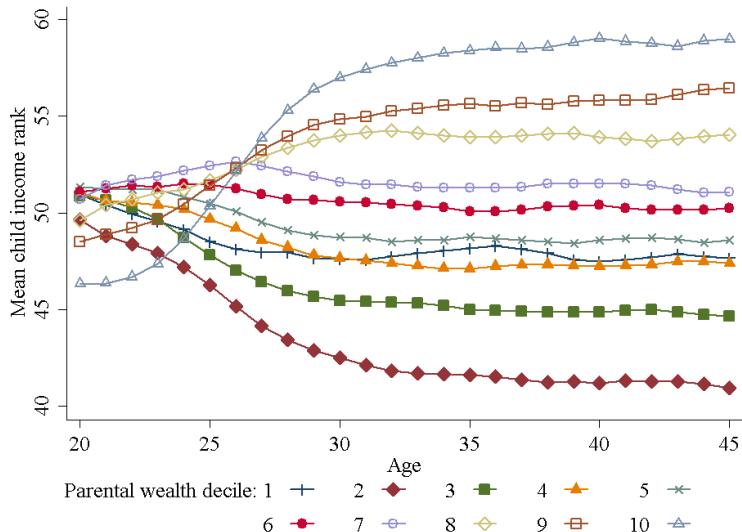
Wealth and income correlation over life-cycle

Wealth correlation over life-cycle by parental wealth decile

Mean child wealth rank vs. Age. Parental wealth decile: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10.

Income correlation over life-cycle by parental wealth decile

Wealth correlation over life-cycle — over time

Figure: Intergenerational rank correlation (y-axis, 0.00 to 0.40) plotted against Year (x-axis, 1985 to 2010) by age groups.
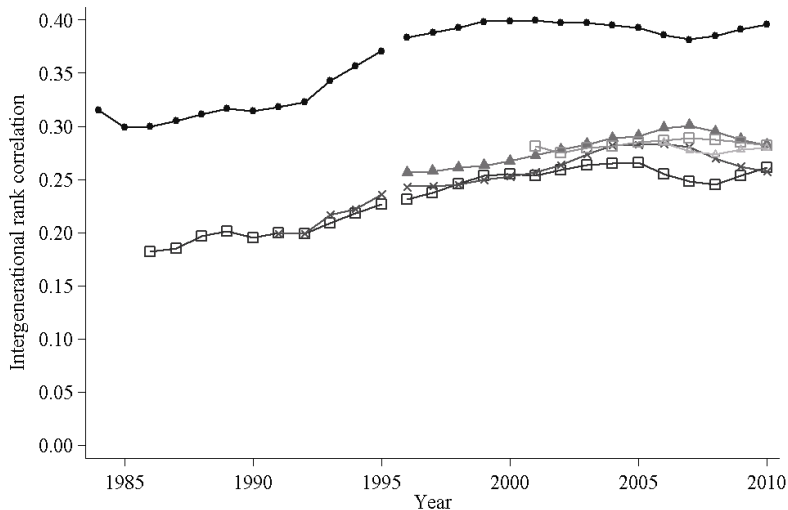
Age groups: 18-25 ●, 26-30 ⊟, 31-35 ✕, 36-40 ▲, 41-45 ⊡, 46-51 △

Summary statistics — bequest sample

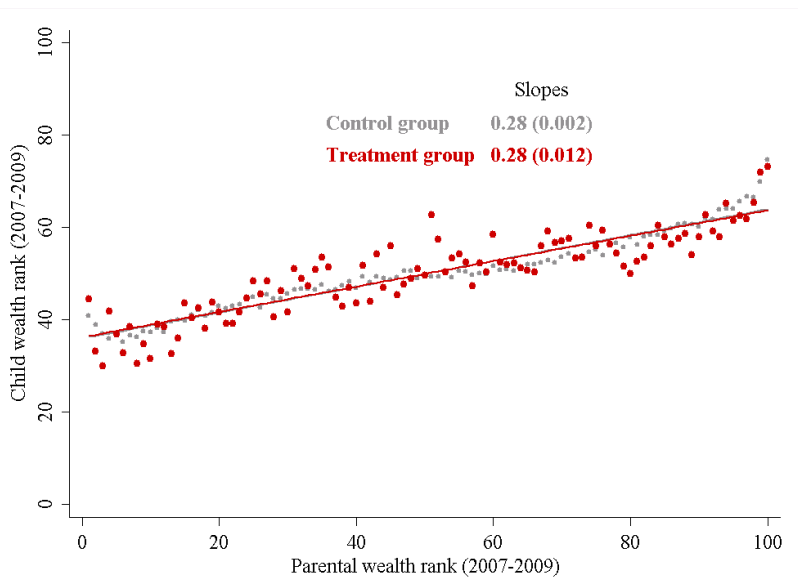|	Children (2007–2009)		Parents (1984–1986)	
	Control group	Treatment group	Control group	Treatment group
Mean wealth	650,980	587,172	576,116	558,412
20th percentile	-92,882	-95,734	8,561	8,866
40th percentile	73,392	52,949	247,371	234,737
60th percentile	454,867	414,489	540,218	526,611
80th percentile	1,041,054	992,703	921,644	924,750
Mean income	346,836	335,738	297,496	251,436
20th percentile	204,846	188,503	156,135	89,420
40th percentile	294,833	289,118	243,481	193,533
60th percentile	357,507	350,909	323,777	279,595
80th percentile	450,467	440,436	411,161	378,062
Observations	135,335	5,708	135,335	5,708

Wealth rank correlation before bequests

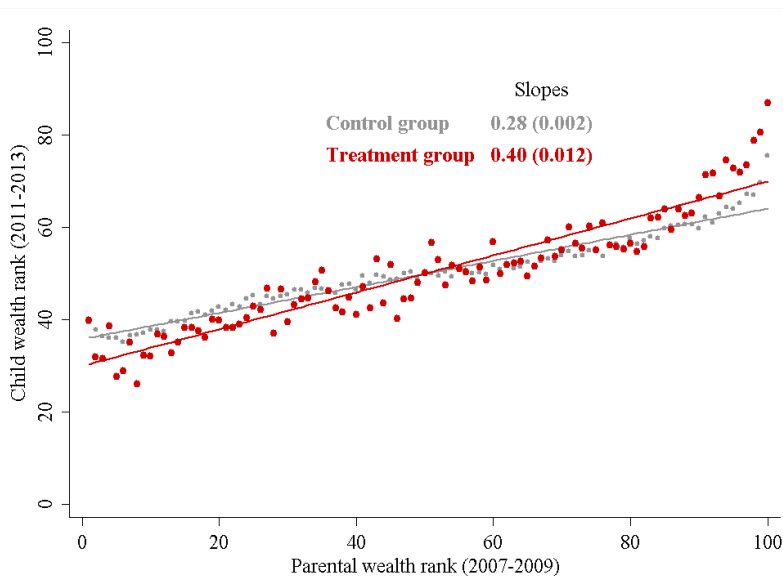# Wealth rank correlation after bequests

Rank correlation before bequests — parents in 2009-11

Summary so far

- Parents and children in their late 40s
  - Nonparametric evidence of wealth correlation — almost linear rank relationship
  - Rank wealth correlation of 0.27, robust
  - Much larger than ("permanent") income correlation
  - Similar for logs/IHS
- U-shape over life-cycle
  - Large correlation early on — evidence of inter vivos transfers
  - Consistent with life-cycle wealth accumulation dynamics
- Bequests increase intergenerational correlation significantly on impact
- Relationship to lifetime resources? Recall theory:
  - Measure wealth at the same stage of life-cycle
  - Control for permanent income of parents and children

Rank correlation of wealth and lifetime resources

	(1) Child wealth	(2) Child income	(3) Child wealth	(4) Child wealth
Parental wealth rank (1984–1986)	0.272*** (0.002)		0.240*** (0.002)	0.235*** (0.002)
Parental income rank (1984–1986)		0.200*** (0.002)	0.004* (0.002)	
Child income rank (2009–2011)			0.191*** (0.002)	
Child and parent income percentile				X
Observations	363,857	363,857	363,857	363,857
Adj. R-squared	0.074	0.040	0.110	0.114

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Correlation of wealth and lifetime resources — log specification

	(1) Child wealth	(2) Child income	(3) Child wealth	(4) Child wealth
Log parental wealth	0.227***		0.205***	0.184***
(1984–1986)	(0.003)		(0.003)	(0.003)
Log parental income		0.107***	0.039***	
(1984–1986)		(0.003)	(0.004)	
Log child income			0.342***	
(2009-2011)			(0.006)	
Child and parent income percentile dummies				X
Observations	190,145	190,145	190,145	190,145
Adj. R-squared	0.043	0.010	0.084	0.117

Standard errors in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$
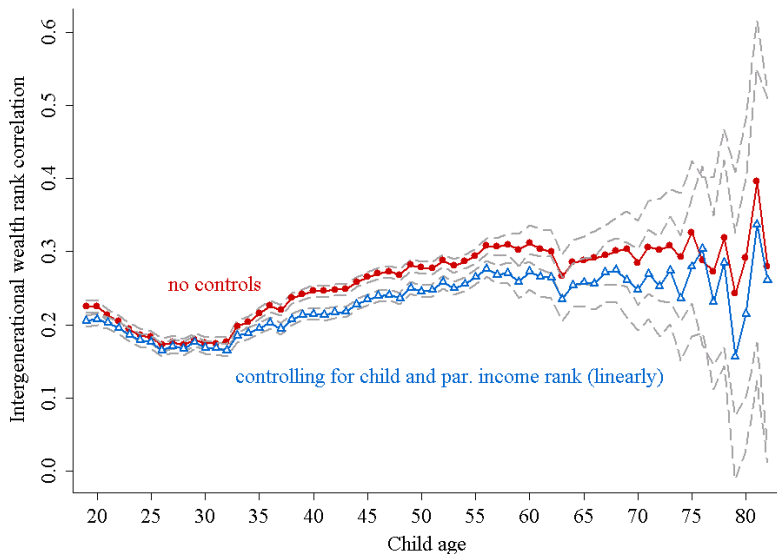
Wealth correlation over life-cycle, with controls

No controls

Controlling for permanent income

Wealth rank correlation

Child age
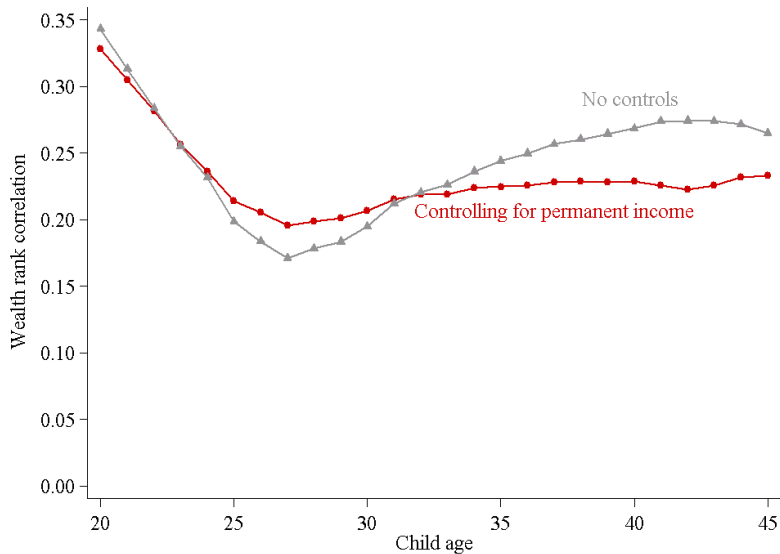
Rank correlation of wealth before and after bequests

| | Child wealth rank | | | |
| | Before parental death (2007-2009) | | After parental death (2011-2013) | |
	Control group	Treatment group	Control group	Treatment group
	A. No income controls			
Intergenerational wealth rank correlation	0.277 (0.003)	0.295 (0.013)	0.273 (0.003)	0.375 (0.012)
	B. Controlling for child and parental income			
Intergenerational wealth rank correlation	0.231 (0.003)	0.256 (0.013)	0.238 (0.003)	0.342 (0.013)
Observations	135,335	5,708	135,335	5,708

Measuring correlation at the same stage of life-cycle

- Estimate when parents and children are about 45: 0.25
- Estimate for the same group right after parents die: 0.34
- The latter corresponds to parents and children at different stages of life-cycle (children post-bequest, parents — unknown)
- Theory: we should get the same result at any stage of life-cycle
- Problems with implementation at other ages:
  - Children 30 in 2010, parents 30 in 1985 — we can't observe permanent income of children
  - Children 60 in 2010, parents 60 in 1985 — we can't observe permanent income of parents
  - Incomplete data coverage for children born before 1960 (those over age 50 in 2010)
- With this caveat, let's do the best we can: estimate wealth rank correlation measuring children and parental wealth at the same age, while controlling for income at 45-50 or the closest current income that one we can observe

Wealth correlation holding parents' and children's age the same

Conclusions

- Baseline wealth rank correlation of 0.27, income correlation of 0.20
- However, there is no single wealth correlation
- Wealth correlation has a U-shape pattern over the life-cycle.
- In particular, it reveals the importance of inter vivos gifts
- Bequests quantitatively large and have large impact on measured wealth correlation
- Appropriately estimated wealth correlation may be used to infer correlation of lifetime resources — that correlation is 0.25 when measured pre-bequests
- However, as far as we can estimate it, the correlation holding the stage of life-cycle constant is quite stable past the age of 35