Intergenerational mobility: Theory and measurement

Heidi L. Williams

MIT 14.662

Spring 2015

Intergenerational mobility

Inequality in the distributions of earnings, income, and wealth

- Economists long paid more attention to inequality within generations than inequality within families across generations
- Latter more of a focus of sociologists:
  Blau-Duncan (1967) *The American Occupational Structure*

Blau-Duncan (1967) *The American Occupational Structure*

- Enormous impact on the field of sociology
- Focused on social stratification and occupational mobility
- Other "must read" if you are interested: Featherman and Hauser (1978) *Opportunity and Change*

Thought experiment

Solon's 1999 chapter in the *Handbook of Labor Economics*:

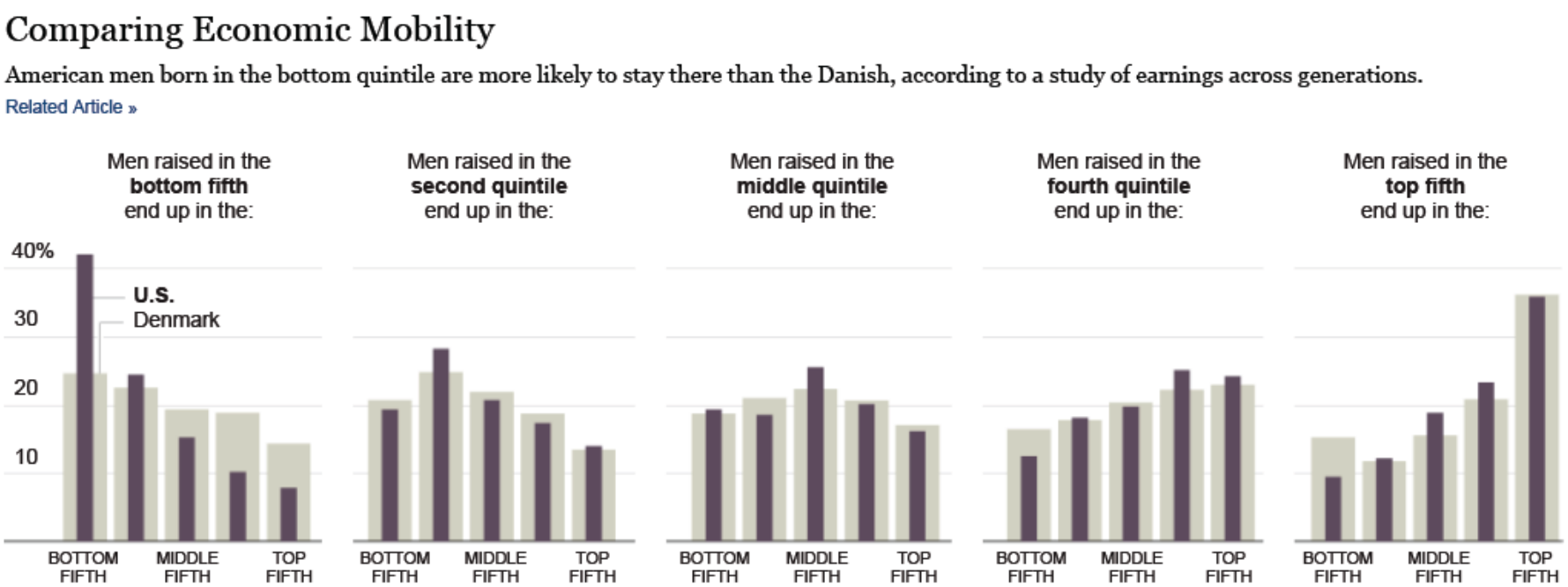
"Imagine two societies: society A and society B. The distribution of earnings is identical in the two societies, so in a within-generation sense the two societies are "equally unequal." But now suppose that in society A, one's relative position in the earnings distribution is exactly inherited from one's parents: if your parents were in the 90^{th} percentile of earnings in their generation it is certain that you place in the 90^{th} percentile of your own generation; if your parents were in the 5^{th} percentile in their generation you inevitably place in the 5^{th} percentile. In contrast, in society B one's relative position in the earnings distribution is completely independent of the position of one's parents: the offspring of parents in the 5^{th} percentile and the offspring of parents in the 90^{th} percentile show the same distribution of earnings."

Public concern over (in)-equality of opportunity

The New York Times

DeParle, Jason. "Harder for Americans to Rise From Lower Rungs." *The New York Times*. January 4, 2012.

NYTimes: Jantti *et al.* (2006)



Source: Jantti *et al.* (2006), IZA Discussion Paper #1938

Motivation

- What (empirically) is the degree of intergenerational mobility?
- What (if anything) should be done from a policy perspective?
- Sources of intergenerational correlation matter for policy

Roadmap for this week

Handbook chapters: Solon (1999), Black and Devereux (2011)

- Theory:
  - Human capital approach: Becker and Tomes (1979)
  - Goldberger (1989) critique
- Measurement: estimation of intergenerational mobility
  - Multi-year averages: Solon (1992), Mazumder (2005)
  - Lifecycle bias: Haider and Solon (2006)
- Empirics: causal mechanisms and within-US variation
  - Sacerdote (2007) and Björkland *et al.* (2006)
  - Black *et al.* (2005)
  - Chetty *et al.* (2014)

Recent focus of *amazing* research in economic history

Not my focus this week, but definitely worth reading:

- Long-Ferrie (2013) "Intergenerational occupational mobility in Britain and the US since 1850"
  - Longitudinal data on 23,000 father-son pairs
  - Find US was indeed 'exceptional' (more mobile) through 1900, but that this advantage was erased by 1950
- Clark (2014) and Clark-Cummins (2012) "Are there ruling classes? Surnames and social mobility in England, 1800-2011"
  - Use rare surnames
  - Track wealth, education, occupation, age at death
  - Find lower mobility than conventionally estimated

Clark-Cummins sources

Wealth:

England and Wales, Index to Wills and Administrations, 1858-2011. Principal Probate registry, London (available online 1861-1898, 1903-1942 at Ancestry.co.uk).

Prerogative Court of Canterbury and Related Probate Jurisdictions: Probate Act Books. Volumes: 1850-57. Held at the National Archives, Kew. (Catalogue Reference: PROB 8/243-250.)

Births and Deaths:

England and Wales, Register of Births, 1837-2005. Available online at Ancestry.co.uk.

England and Wales, Register of Deaths, 1837-2005. Available online at Ancestry.co.uk.

*England and Wales, Register of Births, 2006-*2011. London Metropolitan Archives.

*England and Wales, Register of Deaths, 2006-*2011. London Metropolitan Archives.

Clark-Cummins sources

University Attendance:

Venn, J. A. 1940-54. *Alumni Cantabrigienses, 1752-1900*, 6 vols. Cambridge, Cambridge University Press.

Cambridge University. 1976. *The Cambridge University List of Members, 1976.* Cambridge: Cambridge University Press.

Cambridge University. 1998. *The Cambridge University List of Members, 1998.* Cambridge: Cambridge University Press.

Cambridge University. 1999-2010. *Cambridge University Reporter.* Cambridge: Cambridge University Press.

Foster, Joseph. 1891-2. *Alumni Oxonienses 1715-1886. Oxford: Clarendon Press.*

Oxford University. 2003, 2004, 2006. *The Oxford University Calendar. Oxford: Clarendon Press.*

University of London. 1926. *The Historical Record, 1836-1926.*

Student E-mail Directories:

Durham: http://www.dur.ac.uk/directory/

Oxford: http://www.ox.ac.uk/applications/contact_search/

Imperial College, London: http://www.imperial.ac.uk/collegedirectory/

Cambridge: http://jackdaw.cam.ac.uk/mailsearch/

Graduation Lists – King's College, University of London (2010-11), Southampton University (2007).

Clark-Cummins sources

Others:

UK, House of Commons Papers. 1861. *Paupers in workhouses. Returns from each workhouse in England and Wales, of the name of every adult pauper who has been an inmate of the workhouse during a continuous period of five years.* Vol LV, 201. Cmd. 490.

England and Wales, Censuses, 1841-1901. Available online at http://www.nationalarchives.gov.uk/help-with-your-research/research-guides/census-records/

General Medical Council, 2010, *List of Medical Practitioners.* Available online at www.gmc-uk.org/doctors/register/lrmp.asp

Land Registry, *UK Land Registry database of houses sold in England and Wales since 2000.* Available online at http://www.houseprices.co.uk

Office for National Statistics, *Surnames.* Available online at http://www.taliesin-arlein.net/names/search.php

Solicitors Regulation Authority, *The UK Roll of Solicitors*, 2011. Available online at http://www.lawsociety.org.uk

The General Council of the Bar/Sweet and Maxwell. *The Bar Directory*, 2011. Available online at http://www.legalhub.co.uk

UK Electoral Roll, 1999. Accessed via *UK Info Disk 2000*. i-CD Publishing.

Theory

Two workhorse models: Galton (1877), Becker-Tomes (1979)

- Discuss Becker-Tomes (1979) model (follow Solon 1999)
- Review Goldberger's (1989) critique
- Briefly summarize Mulligan's (1999) empirical assessment

Theory

Intergenerational elasticity a parameter of inherent interest:
what is value added of a theoretical model?

- Becker-Tomes (1979): utility-maximizing behavior
  - Parents consume, invest in their children
  - Model generates strong predictions on effects of policies: provision of public education, Head Start
  - Predictions largely an artifact of specific assumptions: small modifications dramatically alter predictions
- Empirical evidence suggests this is not the "right" model, but gives you a sense of why theory can be useful in this area

Model: Set-up

- Family: one parent (generation $t-1$), one child (generation t)
- Allocate parent's lifetime earnings y_{t-1}: parent's consumption C_{t-1} and investment I_{t-1} in child's earnings capacity
- Budget constraint:

$$y_{t-1} = C_{t-1} + I_{t-1}$$

Note: assumes that parents can't borrow to invest in their children (imperfect capital markets)

Model: Set-up

Technology translating investment I_{t-1} into child's lifetime earnings y_t is:

$$y_t = (1+r)I_{t-1} + E_t$$

where r is a return to parents' human capital investment I_{t-1} and E_t represents combined effect of all other determinants of child's lifetime earnings. Note the functional form assumption for E_t.

Model: Optimization

Parents maximize Cobb-Douglas utility over C_{t-1} and y_t:

$$\begin{aligned} U &= (1-\alpha)\log(C_{t-1}) + \alpha \log(y_t) \\ &= (1-\alpha)\log(y_{t-1} - I_{t-1}) + \alpha \log((1+r)I_{t-1} + E_t) \end{aligned}$$

- Knowledge of E_t is assumed
- $\alpha \in (0,1)$ indexes parent's taste for y_t relative to C_{t-1}

Model: Solving for I_{t-1}, y_t

Optimal choice of I_{t-1}:

$$\begin{aligned} \frac{\partial U}{\partial I_{t-1}} &= 0 \\ \Rightarrow I_{t-1} &= \alpha y_{t-1} - \frac{(1-\alpha)E_t}{1+r} \end{aligned}$$

Once we know level of investment given parental earnings, can solve for child's earnings as a function of parent's earnings. Solving for y_t:

$$\begin{aligned} y_t &= (1+r)I_{t-1} + E_t \\ &= (1+r)\left(\alpha y_{t-1} - \frac{(1-\alpha)E_t}{1+r}\right) + E_t \\ &= \beta y_{t-1} + \alpha E_t \end{aligned}$$

where $\beta = (1+r)\alpha$

Model: Solving for β

If σ_y is constant and E_t is orthogonal to y_{t-1}, then β will measure the correlation between child's and parent's lifetime earnings

- Becker and Tomes argue this condition will generally not hold
- Decompose E_t as $E_t = e_t + u_t$
  - e_t: child's 'endowment' of earnings capacity (aside from the part resulting from the parent's conscious investment I_{t-1})
  - u_t: child's 'market luck' (assumed independent of y_{t-1} and e_t)

Model: e_t

- Assume e_t is positively correlated with e_{t-1}
- First-order autoregressive process:

$$e_t = \lambda e_{t-1} + v_t$$

where $0 \leq \lambda < 1$ and v_t is serially uncorrelated with variance σ_v^2

Model: No longer just β?

As long as $\lambda > 0$, E_t will be positively correlated with y_{t-1} because both depend on the parent's endowment e_{t-1}; in this case, the intergenerational earning correlation is not simply β

$$\begin{aligned} y_t &= \beta y_{t-1} + \alpha E_t \\ &= \beta y_{t-1} + \alpha(e_t + u_t) \\ &= \beta y_{t-1} + \alpha e_t + \alpha u_t \end{aligned}$$

Solon (1999): Limitations of Becker-Tomes

- Ignores non-human capital assets: Becker-Tomes (1986)
- Cobb-Douglas functional form assumption
- Single-parent families: ignores assortative mating
- Single-child families: ignores quantity-quality trade-off

Becker-Tomes: "offsetting effects"

Programs like Head Start may not reduce inequality if they induce compensating decreases in parental expenditures

- Fragile prediction: if effect of luck on child's income were multiplicative rather than additive, no offsetting
- What matters is whether Head Start complements or substitutes with parents' investments

Gelber-Isen (2014)

Testing for offsetting effects

- Data from Head Start Impact Study experiment
- In response to children's Head Start access, parents are *more* involved with their children along a wide variety of dimensions
- Increased investment persistents even when the children are no longer attending Head Start
- Inconsistent with prediction of the Becker-Tomes model

Gelber-Isen (2011): Table 3

Table 3. *Effect of HS on particular parent involvement outcomes. The table shows coefficients and standard errors on the treatment dummy from probit, ordered probit, or IV regressions of parent involvement on HS enrollment. Dependent variable: measures of parent involvement (listed in column headings)*

	(1) Number of Times Read	(2) How long read	(3) Minutes reading	(4) Days with father	(5) Practiced math	(6) Visited art gallery	(7) Track child's learning	(8) Learning materials available
Panel A: During								
HS enrollment	0.21	2.78	18.71	0.91	0.26	0.12	0.37	0.10
	(0.09)***	(0.82)***	(4.79)***	(0.85)	(0.09)***	(0.07)*	(0.09)***	(0.07)
R-squared	--	0.00	0.00	--	--	--	--	--
Log-likelihood	-1956648	--	--	-249374	-1161974	-744096	-548854	-5679
N	7257	7211	7232	1729	3678	7257	3693	3097
Panel B: After								
HS enrollment	0.01	1.46	7.04	1.38	0.15	0.03	--	0.09
	(0.06)	(0.81)*	(4.78)	(0.69)***	(0.07)*	(0.06)		(0.06)
R-squared	--	0.00	0.00	--	--	--	--	--
Log-likelihood	-2003609	--	--	0.00	-1092651	-857878	--	-10212
N	7075	7035	7051	3336	3539	7072	--	5908

Notes: The table shows the results of regressions in which measures of parent involvement are related to HS enrollment or access. The dependent variable in question is listed in each column heading. The regression is a probit in Columns 5 and 6; an ordered probit in Columns 1, 4, and 8; and two-stage least squares in Columns 2, 3, and 7. In Columns 1, 4, 5, 6, and 8, we form the Wald estimate by dividing the coefficient estimate by the first stage (0.68). The table shows coefficient

Goldberger (1989) critique

- Added value relative to Galton (1877)?

$$e_t = (1-c)k + ce_{t-1} + v_t$$

- e_t, e_{t-1}: child's, parent's height
- k: population mean height
- c: inheritability parameter
- v_t: disturbance (assumed independent of past e's)
- Data on heights: $c = \frac{2}{3}$

Mulligan (1999) and previous work

- Galton, Becker-Tomes give many similar predictions
- Auxiliary assumptions needed to generate distinguishing predictions of the Becker-Tomes model
- Distinct implications receive limited empirical support
- Concludes: *"...the challenge facing economists is to produce a model of intergenerational mobility with predictions that are (a) distinct from Galton's, and (b) true."*

Measurement: intergenerational earnings elasticity β

$$log(Y_1) = \alpha + \beta log(Y_0) + \varepsilon$$

Taking logs, deviations from population means, re-write as:

$$y_1 = \beta y_0 + e$$

- Subscript 1: child; subscript 0: parent
- y: permanent earnings
- β: intergenerational earnings elasticity
- $(1 - \beta)$: measure of intergenerational mobility

Measurement: intergenerational correlation ρ

$$\begin{aligned}
\rho_{y_0,y_1} &= \frac{cov(y_0,y_1)}{\sigma_0\sigma_1} \\
&= \frac{cov(y_0,y_1)}{\sigma_0^2} \cdot \sigma_0^2 \cdot \frac{1}{\sigma_0\sigma_1} \\
&= \beta\frac{\sigma_0}{\sigma_1}
\end{aligned}$$

- σ: standard deviation of log earnings
- Equal to elasticity if $\sigma_0 = \sigma_1$
- Correlation factors our cross-sectional dispersion

Measurement: Problem of unobserved permanent income

Defined y as permanent income, but unobserved

- Early estimates: one year of earnings for fathers, sons
  $\Rightarrow$ small intergenerational earnings correlations for US (≤ 0.2)
  $\Rightarrow$ US a highly mobile society?
- Solon (1992) investigated measurement error using PSID:
  ρ much smaller when estimated based on one year of data relative to when ρ estimated on two- to five-year averages
- Table 2: main estimates for multi-year averages
- Table 4: father's years of education as IV for father's income

Solon (1992): Table 2

TABLE 2—OLS ESTIMATES OF ρ FROM LOG EARNINGS DATA

Year of father's log earnings	Measure of father's log earnings				
	Single-year measure	Two-year average	Three-year average	Four-year average	Five-year average
1967	0.386				
	(0.079)				
	[322]	0.425			
		(0.090)			
1968	0.271	[313]	0.408		
	(0.074)		(0.087)		
	[326]	0.365	[309]	0.413	
		(0.081)		(0.088)	
1969	0.326	[317]	0.369	[301]	0.413
	(0.073)		(0.083)		(0.093)
	[320]	0.342	[309]	0.357	[290]
		(0.078)		(0.088)	
1970	0.285	[312]	0.336	[298]	
	(0.073)		(0.084)		
	[318]	0.290	[301]		
		(0.082)			
1971	0.247	[303]			
	(0.073)				
	[307]				

Notes: Standard-error estimates are in parentheses, and sample sizes are in brackets.

Solon (1992): Table 4

TABLE 4—OLS AND IV ESTIMATES OF ρ FOR VARIOUS SINGLE-YEAR INCOME MEASURES IN 1967

Income measure	OLS	IV	Sample size
Log earnings	0.386	0.526	322
	(0.079)	(0.135)	
Log wage	0.294	0.449	316
	(0.052)	(0.095)	
Log family income	0.483	0.530	313
	(0.069)	(0.123)	
Log (family income/poverty line)	0.476	0.563	313
	(0.060)	(0.103)	

Note: Standard-error estimates are in parentheses.

Solon (1992): Take-aways

- ρ more like 0.4, not 0.2
- Subsequent research:
  - Longer averages: Mazumder (2005)
  - Life-cycle bias: Haider and Solon (2006)
- Sociologists had it "right": occupation vs. income

Mazumder (2005)

- Short-term averages problematic given that literature on earnings dynamics suggests transitory shocks are persistent
- Simulation: 5-year averages (as in Solon 1992) are expected to yield estimates of ρ that are biased down by 30%
- New data:
  - 1984 Survey of Income and Program Participation (SIPP)
  - Matched to earnings data from the Social Security Administration's Summary Earnings Records (SER)
- Table 4: 15-year averages suggest $\rho = 0.6$

Mazumder (2005): Table 4

TABLE 4.—INTERGENERATIONAL ELASTICITIES USING SER FOR FATHERS' EARNINGS

Fathers	Elasticity (Standard Error) *N*														
	Sons					Daughters					Pooled				
Log Avg. Earn.	84–85	82–85	79–85	76–85	70–85	84–85	82–85	79–85	76–85	70–85	84–85	82–85	79–85	76–85	70–85
Father Earnings Must Be Positive Each Year															
Drop noncovered fathers	0.253 (0.043) 1262	0.349 (0.059) 1218	0.445 (0.079) 1160	0.553 (0.099) 1111	0.613 (0.096) 1063	0.363 (0.065) 1178	0.425 (0.087) 1124	0.489 (0.110) 1070	0.557 (0.140) 1031	0.570 (0.159) 982	0.308 (0.039) 2440	0.388 (0.052) 2342	0.470 (0.067) 2230	0.559 (0.084) 2142	0.600 (0.093) 2045
Impute noncovered fathers	0.289 (0.050) 1485	0.313 (0.052) 1462	0.376 (0.062) 1433	—	—	0.350 (0.062) 1360	0.395 (0.081) 1339	0.422 (0.096) 1310	—	—	0.322 (0.039) 2845	0.358 (0.048) 2801	0.404 (0.056) 2743	—	—
Drop government & self-employed	0.273 (0.060) 844	0.419 (0.082) 825	0.474 (0.096) 801	0.533 (0.111) 779	0.652 (0.135) 746	0.526 (0.089) 782	0.563 (0.137) 758	0.635 (0.150) 736	0.750 (0.173) 719	0.754 (0.192) 690	0.393 (0.057) 1626	0.487 (0.077) 1583	0.553 (0.086) 1537	0.643 (0.100) 1498	0.707 (0.118) 1436
Allow Some Years of Zero Father Earnings*															
Drop noncovered fathers	0.234 (0.043) 1295	0.334 (0.057) 1268	0.434 (0.069) 1227	—	—	0.312 (0.060) 1201	0.423 (0.065) 1168	0.506 (0.091) 1127	—	—	0.269 (0.034) 2496	0.377 (0.043) 2436	0.472 (0.056) 2354	—	—
Impute noncovered fathers	0.238 (0.042) 1534	0.342 (0.057) 1550	0.403 (0.059) 1571	—	—	0.295 (0.055) 1394	0.384 (0.061) 1406	0.474 (0.080) 1424	—	—	0.266 (0.033) 2928	0.365 (0.042) 2956	0.441 (0.049) 2995	—	—
Drop government & self-employed	0.242 (0.059) 874	0.355 (0.080) 869	0.441 (0.084) 862	0.523 (0.101) 895	0.575 (0.109) 917	0.400 (0.084) 803	0.504 (0.083) 794	0.600 (0.113) 785	0.731 (0.130) 825	0.847 (0.145) 831	0.304 (0.046) 1677	0.422 (0.061) 1663	0.570 (0.073) 1647	0.622 (0.081) 1720	0.703 (0.087) 1748

Dependent variable is children's log average earnings, 1995–1998. All results use tobit specification.

Note: For the dependent variable, probit models based on the 1996 SIPP matched to SER were used to determine if zero earnings reflected noncoverage or nonworker status and were imputed accordingly. For fathers, earnings for those identified as noncovered are either dropped or imputed for the years 1979–1985 as indicated. For the years before 1979, no adjustment is attempted. Earnings for topcoded fathers are imputed using March CPS data for 1970 to 1980 and using 1984 SIPP for 1981 to 1985. Standard errors are adjusted for within family correlation when more than one sibling is present.

*Required years of positive earnings are: 1 for 2-year averages; 2 for 4-year averages; 3 for 7-year averages; 7 for 10-year averages; and 11 for 16-year averages.

Haider and Solon (2006)

- Association of current, lifetime income varies over life cycle
- Important because fathers' earnings measured late in life, whereas sons' earnings measured at young ages

Haider and Solon (2006)

Estimating the intergenerational earnings elasticity β, we have:

$$\text{plim } \hat{\beta} \quad = \quad \beta \lambda_a \theta_a$$

where:

1. λ_a: slope coefficient in linear projection of y_{it} on y_i
2. θ_a: "reliability ratio" (bias from using annual earnings y_{it} to proxy for lifetime earnings y_i); theoretically could be attenuation or amplification, but here attenuation

Haider and Solon (2006)

Major innovation of this paper: new data

- 1951-1991 Social Security Administration (SSA) earnings histories of Health and Retirement Study (HRS) sample
  - Nearly career-long earnings histories
- Figure 2 presents estimates of how λ_a (correlation between earnings at age a and lifetime earnings) and θ_a (additional term measuring the bias in estimate $\hat{\beta}$) varies over life cycle

Haider and Solon (2006): Figure 2

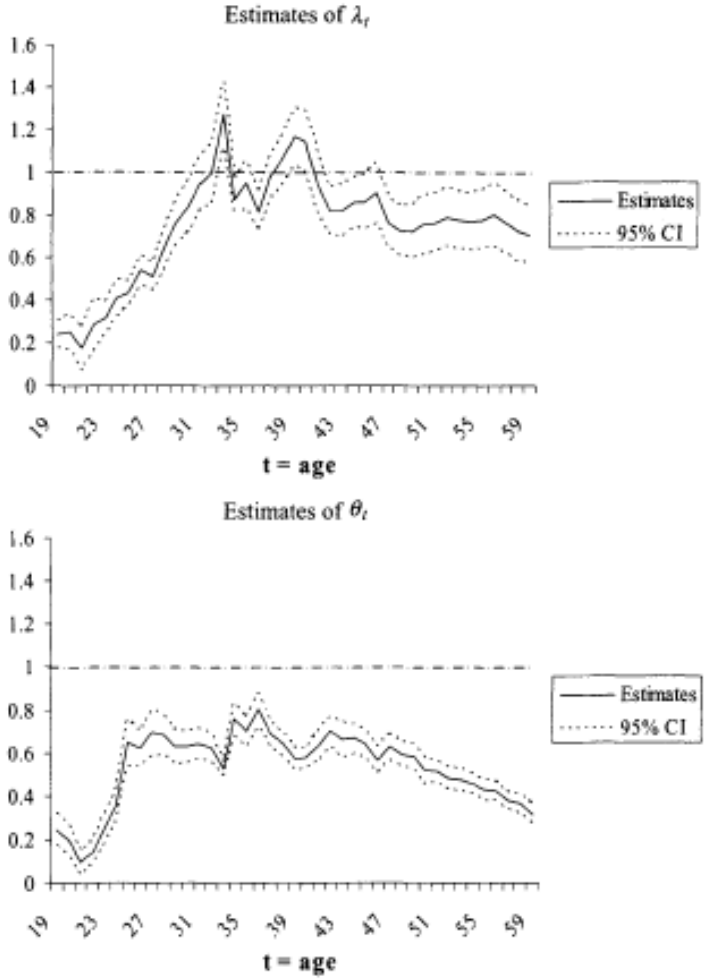


FIGURE 2. MAIN ESTIMATES OF λ_t AND θ_t

Note: The solid lines graph the parameter estimates, and the dotted lines are 1.96 estimated standard errors above and below the solid lines.

Courtesy of Steven Haider, Gary Solon, and the American Economic Association. Used with permission.

Haider and Solon (2006): Take-aways

- Low in 20s: as low as 0.2 before age 25
- Close to 1 in 30s, 40s
- Declines in 50s: 0.6

Suggest there could be large attenuation bias if earnings of sons age 30 or younger are included in an analysis sample

Consensus estimates: US and other countries

How does intergenerational elasticity vary across countries?

- Solon (2002), Black-Devereux (2011)
- US and UK appear less mobile than Canada, Finland, Sweden
  - US: 0.5-0.6
  - UK: 0.3
  - Nordic countries: <0.3
- True after correcting for lifecycle bias
- Solon (2004): model with government investment in children's human capital that may be progressive
  (ratio of $\frac{G}{I}$ decreasing with parental income)

Empirics

- Focus in earlier research: Solon (1999)
  - Estimating intergenerational elasticities
- Focus of more recent research: Black-Devereux (2011)
  - Understanding causal mechanisms
    1. Quantifying relative importance of genes/environment/interaction
    2. Causal effects of individual parental attributes (*e.g.* education)
  - Aims to better inform policy

Black-Devereux (2011)

Different empirical approaches; emphasize two on Wednesday:

1. Adoptee studies: Sacerdote (2007), Björklund *et al.* (2006)
2. Natural experiment/IV studies: Black *et al.* (2005)

Today: Sibling and neighborhood correlations

Sibling and neighborhood correlations

Sibling correlations in earnings provide one measure of intergenerational influences: positive correlations imply that shared genetic and environmental factors cause siblings to be more similar than two randomly chosen members of society

- Solon (1999): consensus estimate of 0.4 for US brothers
- More recent Nordic estimates: 0.15-0.2

Decomposing sibling correlations

Decompose sibling correlation into intergenerational elasticity and s, a measure of all variables shared by siblings unrelated to parental earnings

- One component of s: neighborhood effects
- Page and Solon (2003): use PSID to examine correlations in adult earnings between brothers and between unrelated boys in same neighborhood
  - Correlation for unrelated boys is 0.16: $\frac{1}{2}$ of brothers correlation
  - Likely upper bound because of sorting
  - Can't distinguish causal mechanisms

Moving to Opportunity project

- Large-scale social experiment estimating neighborhood effects
  - Baltimore, Boston, Chicago, LA, and NYC
  - http://www.nber.org/mtopublic/
  - Eligibility: children, living in public housing or Section 8 assisted housing in a high-poverty census tract
  - Random assignment to one of three program groups:
    1. Experimental group: receive a restricted Section 8 voucher that can only be used in a 'low poverty' area (census tract with under a 10 percent poverty rate in 1990)
    2. Section 8 group: receive a regular (non-restricted) voucher
    3. Control group: not offered additional housing assistance

Looking ahead

Intergenerational mobility: More empirics

- Regression analysis using adoptees:
  Sacerdote (2007) and Björkland *et al.* (2006)
- Natural experiment/IV estimates: Black *et al.* (2005)
- Within-US geographic variation: Chetty *et al.* (2014)

14.662 Labor Economics II

Spring 2015