

Intergenerational mobility: Empirics

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Where we left off last time

- Theory:
 - ▶ Human capital approach: Becker and Tomes (1979)
 - ▶ Goldberger (1989) critique
- Measurement:
 - ▶ Multi-year averages: Solon (1992), Mazumder (2005)
 - ▶ Lifecycle bias: Haider and Solon (2006)
- Empirics:
 - ▶ Adoption studies: Sacerdote (2007) and Björkland *et al.* (2006)
 - ▶ Natural experiment/IV approaches: Black *et al.* (2005)
 - ▶ Within-US geography: Chetty *et al.* (2014)

- 1 Regression analysis using adoptees
 - Sacerdote (2007)
 - Björkland, Lindahl, and Plug (2006)
- 2 Natural experiment/IV estimates
 - Black, Devereux, and Salvanes (2005)
 - Parental education and infant health
- 3 Within-US geography of intergenerational mobility: Chetty et al. (2014)
- 4 Looking ahead

Regression analysis using adoptees

Many psychology/sociology analyses of adoptions to estimate effects of family environments (e.g. heritability of IQ). If:

- 1 Adopted children are randomly assigned to families as infants
- 2 *and* adopted and biological children are treated equally

then adoption is a quasi-experiment randomly assigning children to families \Rightarrow can be used to investigate effects of family environment

Main contributions of recent economics papers

What have economists added?

- 1 *Much* larger sample sizes
- 2 Contexts with quasi-random assignment
- 3 Wider range of outcome variables
- 4 “Treatment effects” framework that relies on fewer assumptions than traditional behavioral genetics framework

Key papers: Sacerdote (2007) and Björkland *et al.* (2006)

Three types of empirical approaches

Black and Devereux (2011) distinguish three types of empirical approaches have been applied to adoptee data:

- 1 Bivariate regression approach (“transmission coefficients”)
- 2 Multivariate regression approach
- 3 Combining information on biological and adoptive parents

Bivariate regression approach (“transmission coefficients”)

- $y_1 = \alpha + \lambda y_0 + \varepsilon$
 - ▶ y_1, y_0 : child and parent outcomes (e.g. log earnings)
 - ▶ Estimate separately for adoptees, non-adopted siblings
- Compare λ for adoptees and non-adoptees
 - ▶ If nurture doesn't matter: $\lambda = 0$ for adoptees (e.g. height)
 - ▶ If genes don't matter: similar λ 's (e.g. purely social outcomes)
 - ▶ Relative value of λ for adoptees, non-adoptees gives an indication of the importance of nature versus nurture
- Do not have a direct causal interpretation

Multivariate regression approach

- $y_1 = \alpha + \lambda_1 S_0^m + \lambda_2 S_0^f + \lambda_3 Z + \varepsilon$
 - ▶ Estimate on a sample of adoptees
 - ▶ S_0^m, S_0^f : education of adoptive mother and father
 - ▶ Z : other family characteristics (income, family size)
- Do not have a direct causal interpretation: not possible to hold “all else” equal and isolate the causal effect of, say, mother’s education
- Can offer suggestive evidence of factors that appear important

Combining information on biological and adoptive parents

- $y_1 = \alpha + \lambda_a y_{0a} + \lambda_b y_{0b} + \varepsilon$
 - ▶ Estimate on a sample of adoptees
 - ▶ Requires data on both biological (b) and adoptive (a) parents
- Model allows a direct comparison of the influence of the characteristics of biological and adoptive parents
- Do not have a direct causal interpretation

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Sacerdote (2007)

New data to analyze a unique quasi-experiment

- Holt International Children's Services, 1964-1985
- Korean-American adoptees
- Quasi-random assignment of children to adoptive families
 - ▶ Conditional on family being certified by Holt to adopt
 - ▶ First-come, first-served policy (useful to keep in mind)
 - ▶ Effective randomization cond'l on adoptee's cohort, gender
 - ▶ Randomization looks valid based on pre-treatment observables

Sacerdote (2007): Data collection

Data collection was a *major* undertaking

- Collaborative effort by Sacerdote and Holt
- Survey administered to adoptees/families in 2004-05
- Public-use version of the data now publicly available:
http://www.dartmouth.edu/~bsacerdo/holt_adoption_public_use2006.dta
- Very careful attention to detail on data collection:
 - ① Low response rate to initial survey of parents (34%): re-surveyed a sample of non-respondents; tested and found responses not significantly correlated with outcomes
 - ② Directly surveyed smaller sample of children, found high degree of correspondence between their responses and parents' reports
- Looks at NLSY, Census to gauge external validity

Sacerdote (2007): Empirical frameworks

Three empirical frameworks:

- 1 Variance decomposition: Behavioral genetics framework
- 2 Treatment effects framework
- 3 Estimation of transmission coefficients

Empirical framework #1: Variance decomposition

Standard behavioral genetics model

$$Y = G + F + S$$

- Y : child outcomes (e.g. years of education)
- G : genetic inputs
- F : family environment
- S : unexplained factors (residual)

Strong assumptions: nature (G) and family environment (F) enter linearly and additively; no interactions

Empirical framework #1: Variance decomposition

Assume G , F , S not correlated. Taking variance of both sides:

$$\sigma_Y^2 = \sigma_G^2 + \sigma_F^2 + \sigma_S^2$$

Divide both sides by variance in the outcome (σ_Y^2), and define:

- $h^2 = \frac{\sigma_G^2}{\sigma_Y^2}$ (heritability)
- $c^2 = \frac{\sigma_F^2}{\sigma_Y^2}$ (family environment)
- $e^2 = \frac{\sigma_S^2}{\sigma_Y^2}$ (error term)

Implies standard behavioral genetics equation:

$$1 = h^2 + c^2 + e^2$$

Variance of child outcomes is the sum of the variance from genetic inputs, the variance from family environment, and the variance from non-shared environment (the residual)

Empirical framework #2: Treatment effects

Less parametric analysis: What is the effect of being assigned to particular family “types” on adoptee outcomes?

- 1 Type one (27% of the sample): highly educated, small families (≤ 3 children, both parents have four years of college)
- 2 Type three (12% of the sample): neither parent has four years of college, ≥ 4 children in family
- 3 Type two (61% of the sample): families not in extreme groups

Why education, family size? Motivated by multivariate analysis

Empirical framework #2: Treatment effects

$$E_i = \alpha + \beta_1 T1_i + \beta_2 T2_i + \beta_3 \text{Male}_i + \gamma A_i + \rho C_i + \varepsilon_i$$

- Estimated on sample of adoptees
- E_i is educational attainment for child i
- β_1 : group 1 vs. group 3
- β_2 : group 2 vs. group 3
- A_i : age indicators (education varies with age)
- C_i : cohort indicators (needed for random assignment)
- Male_i : gender indicator (needed for random assignment)

Education and family size *not* necessarily the relevant channels

Empirical framework #3: Transmission coefficients

$$E_i = \alpha + \delta_1 E_{M_i} + \beta_3 \text{Male}_i + \gamma A_i + \rho C_i + \varepsilon_i$$

- Sample of adoptees
- E_{M_i} : adoptive mother's years of education

$$E_j = \alpha + \delta_2 E_{M_j} + \beta_3 \text{Male}_j + \gamma A_j + \rho C_j + \varepsilon_j$$

- Sample of non-adoptees
- E_{M_j} : (biological) mother's years of education

A comparison of δ_1 and δ_2 is an estimate of how much of the transmission of education (or other outcomes) works through nurture, as opposed to through nature and nurture combined

Descriptive results

Raw means are fascinating (great characteristic of a paper)

Figure 1: Pr(college grad) by family size

- Both adoptees, non-adoptees show steep decline
- Either direct effect, or picking up unobservables

If you're interested, see also Black-Devereux-Salvanes (*QJE* 2005) on effects of family size and birth order

- Use twin births as variation in family size

Descriptive results: Figure 1

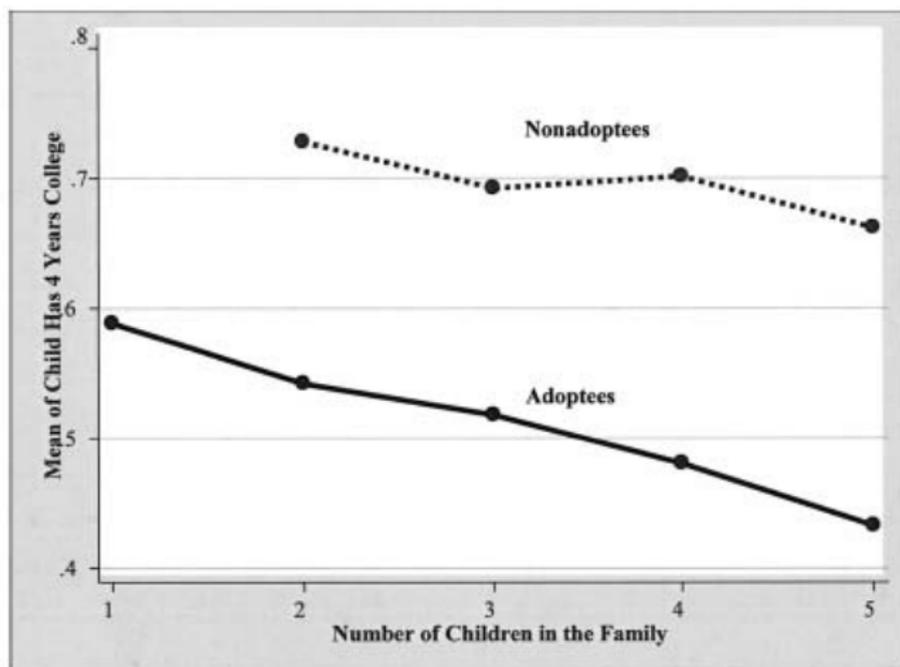


FIGURE I
Mean (College Attendance) By Family Size
Dashed line is for nonadoptees (higher line), solid line is for adoptees.

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Descriptive results

Figure 2: Child's education by mother's education

- Strong transmission of education from mothers to children
- Upward sloping line steeper for non-adoptees

To me, this was very surprising; importance of pre-birth factors?

Descriptive results: Figure 2

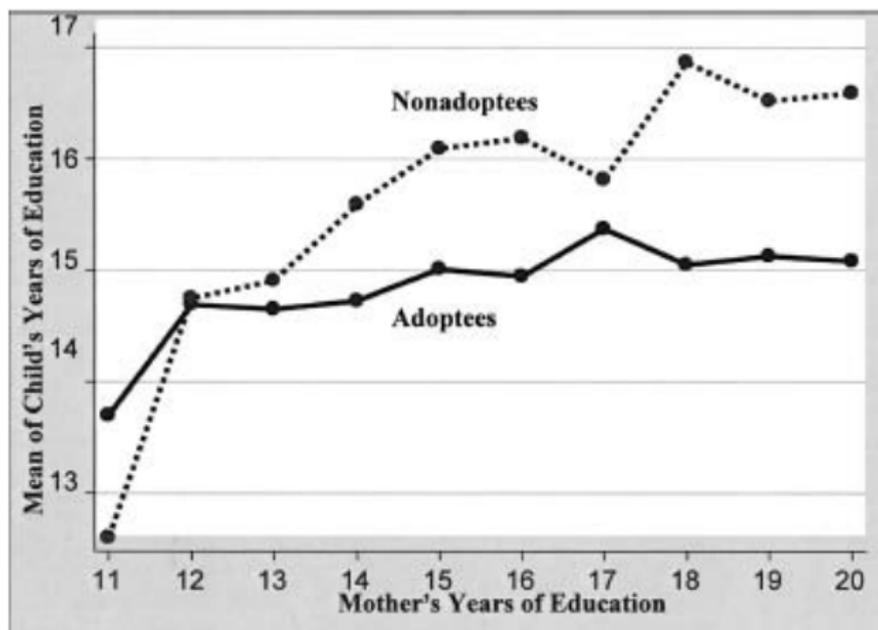


FIGURE II
Mean Child's Years of Education vs. Mother's
Dashed line is for nonadoptees. Solid line is for adoptees.

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Descriptive results

Figure 3: Child's income by family income

- Almost non-existent for adoptees
- Strongly positive for non-adoptees

Again, to me this was very surprising
(although perhaps this is the same “fact” as the education fact)

Descriptive results: Figure 3

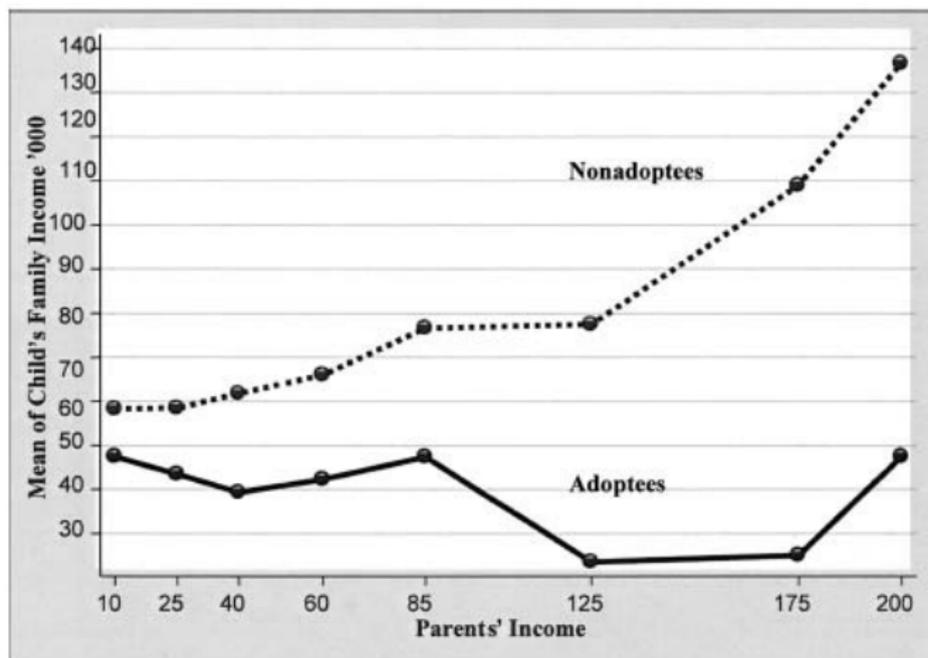


FIGURE III

Mean of Child's Family Income By Parents' Income at Adoption
Dashed line is for nonadoptees (higher line). Solid line is for adoptees.

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Variance decomposition

Bivariate regressions: Table 4, Figure 4

Behavioral genetics decomposition: Table 5

- Correlations in outcomes among sibling pairs after removing age, cohort, and gender effects
- Education: biological siblings have a correlation of 0.34 - 2.4 times larger than the correlation of 0.14 for adoptive siblings
- Drinking: essentially same correlation
- Note income has “usual” problems (single year, life cycle bias)

Bivariate regressions

TABLE IV
CORRELATIONS IN OUTCOMES AMONG PAIRS OF ADOPTIVE SIBLINGS AND PAIRS OF
BIOLOGICAL SIBLINGS

Outcome	Adoptive sibling correlation	Biological sibling correlation	N Adoptive	N Biological
Has 4 years of college	0.135	0.338	1360	578
Highest grade completed	0.157	0.378	1360	578
Family income	0.110	0.277	1314	554
Log (family income)	0.139	0.301	1314	554
Drinks	0.336	0.363	1903	640
Smokes	0.152	0.289	1938	654
Height	0.014	0.443	1910	646
Weight	0.044	0.273	1822	629
BMI	0.115	0.269	1821	629
Overweight	0.087	0.173	1821	629
Attended US News ranked school	0.249	0.416	1360	578
Acceptance rate of school	0.337	0.460	560	245
Married	0.076	0.048	1917	650
Number of children	0.105	0.203	1802	633

I form all possible pairs of siblings within the data set. I purge the outcome variables of variation due to age dummies, cohort dummies, and gender. I report the correlation in outcomes for adoptive sibling pairs and biological sibling pairs. Adoptive sibling pairs occur when either one or both of the siblings in a family are adoptees (and the adoptees do not share a biological mother or father). Biological sibling pairs are those that share a biological mother and father who are also the "nurturing" parents. All of the correlations are statistically different from zero at the 1 percent level except for height and weight among adoptive siblings.

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Bivariate regressions

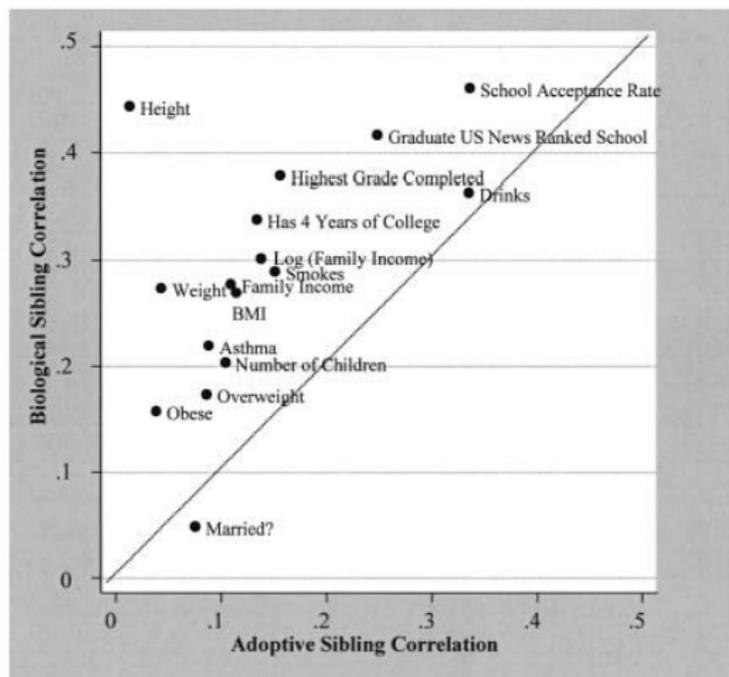


FIGURE IV

Comparison of Adoptive and Nonadoptive Sibling Correlations for Various Outcomes

This graph displays the results in Table IV.

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Behavioral genetics decomposition

TABLE V
PROPORTION OF OUTCOME VARIANCE EXPLAINED BY HERITABILITY, SHARED FAMILY ENVIRONMENT, AND NON-SHARED ENVIRONMENT USING A SIMPLE BEHAVIORAL GENETICS MODEL

Outcome	Proportion explained by nurture (shared family environment)	Proportion explained by nature (heritability)	Unexplained portion (non-shared environment)
Has 4 years of college	0.135	0.406	0.459
Highest grade completed	0.157	0.443	0.400
Family income	0.110	0.334	0.556
Log (family income)	0.139	0.324	0.537
Drinks	0.336	0.055	0.609
Smokes	0.152	0.273	0.575
Height	0.014	0.858	0.128
Weight	0.044	0.458	0.498
BMI	0.115	0.308	0.577
Overweight	0.087	0.172	0.741
Attended US News ranked school	0.249	0.335	0.417
Acceptance rate of school	0.337	0.245	0.418
Married	0.076	-0.056	0.979
Number of children	0.105	0.196	0.699

I use the simple BG model described in the text to decompose the variance in each outcome into the portions attributable to genes (heritability), shared family environment, and non-shared family environment (i.e., the unexplained portion). See equations (2), (2A), and the paragraph that follows.

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Multivariate regressions

Caveat: impossible to definitely separate causal mechanisms

- Table 6: multiple regression estimates
- Mother's education, family size

Multivariate regressions

TABLE VI
REGRESSION OF ADOPTEE OUTCOMES ON FAMILY CHARACTERISTICS

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Child's years of education	Child has 4+ years college	Log child's household income	Child's BMI	Child overweight	Child drinks (yes/no)	Number of children
Mother's years of education	0.097 (0.027)^{a**}	0.023 (0.007)^{**}	0.003 (0.010)	-0.074 (0.055)	-0.007 (0.006)	0.010 (0.006)	-0.017 (0.009)
Number of children	-0.120 (0.050)[*]	-0.026 (0.012)[*]	-0.044 (0.017)[*]	0.106 (0.093)	0.011 (0.010)	0.001 (0.011)	0.016 (0.018)
Log parents' household income	-0.057 (0.098)	-0.001 (0.025)	0.027 (0.038)	-0.229 (0.197)	-0.031 (0.021)	0.008 (0.023)	0.085 (0.035)^{**}
Log (zip code income)	-0.133 (0.286)	0.045 (0.069)	-0.015 (0.104)	-0.232 (0.502)	-0.044 (0.060)	0.045 (0.070)	-0.179 (0.118)
Child is only adoptee in family	-0.058 (0.153)	-0.010 (0.037)	-0.026 (0.054)	-0.222 (0.301)	-0.042 (0.031)	0.026 (0.034)	-0.030 (0.058)
Fraction girls in family	0.078 (0.296)	0.042 (0.073)	-0.241 (0.104) [*]	-0.095 (0.626)	-0.060 (0.064)	0.013 (0.065)	-0.225 (0.105) [*]
Mother drinks	0.097 (0.138)	-0.009 (0.034)	0.016 (0.047)	-0.248 (0.267)	-0.016 (0.029)	0.188 (0.030)^{**}	-0.085 (0.046)
Mother's BMI	-0.028 (0.014) [*]	-0.005 (0.003)	-0.008 (0.005)	0.002 (0.024)	-0.001 (0.003)	0.001 (0.003)	0.003 (0.005)
Child is male	-0.633 (0.163) ^{**}	-0.145 (0.039) ^{**}	-0.285 (0.055) ^{**}	1.704 (0.283) ^{**}	0.192 (0.035) ^{**}	0.090 (0.032) ^{**}	-0.247 (0.049) ^{**}
Constant	15.412 (1.169) ^{**}		4.082 (0.450) ^{**}	26.717 (2.414) ^{**}			1.446 (0.478) ^{**}
Observations	1173	1173	1136	1138	1138	1532	1463
R-squared	0.081		0.124	0.080			0.220

I regress adoptee's outcome on a set of the adoptive family characteristics. Each column is a separate regression. Columns (2), (5), and (6) are probits and $\partial y/\partial x$ is reported. A full set of age dummies and dummies for year of admission to Holt are included in all columns.

^a Robust standard errors in parentheses; I cluster at the family level.

^{*} significant at 5%;

^{**} significant at 1%.

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Treatment effects

Table 7 shows treatment effect estimates

Assignment to a small, highly educated family relative to a lesser educated, large family:

- Increases educational attainment by 0.75 years
- Raises $\Pr(\text{graduate from college})$ by 16.1 pp
- Raises $\Pr(\text{graduate from US News college})$ by 23.1 pp

These are very large estimated effects of family environment

Treatment effects

TABLE VII
TREATMENT EFFECTS FROM ASSIGNMENT TO HIGH EDUCATION, SMALL FAMILY

	Treatment effect "middle group" of families vs. large, less educated	Treatment effect high education small family vs. large, less educated	Nonadoptees: High education small family vs. large, less educated	Effect from a 1 standard deviation change in family environment index
Child's years of education	0.314 (0.226)	0.749 (0.245)**	2.157 (0.264)**	0.845
Child has 4+ years college	0.060 (0.056)	0.161 (0.057)**	0.317 (0.031)**	0.179
Log child's household income	0.071 (0.081)	0.113 (0.089)	0.210 (0.089)*	0.263
Child four-year college ranked by US News	0.082 (0.052)	0.231 (0.060)**	0.365 (0.052)**	0.224
Acceptance rate of child's college	-0.007 (0.035)	0.016 (0.036)	-0.053 (0.032)	0.098
Child drinks (yes/no)	0.099 (0.050)*	0.178 (0.049)**	0.229 (0.041)**	0.280
Child smokes (yes/no)	0.013 (0.044)	-0.006 (0.048)	-0.075 (0.024)**	0.162
Child's BMI	-0.509 (0.460)	-0.941 (0.468)*	-0.929 (0.498)	1.224
Child overweight	-0.030 (0.047)	-0.077 (0.045)	-0.088 (0.048)	0.121
Child obese	-0.020 (0.023)	-0.044 (0.018)*	-0.037 (0.018)*	0.047
Child has asthma	-0.005 (0.028)	0.013 (0.031)	-0.005 (0.034)	0.085
Number of children	-0.070 (0.099)	-0.199 (0.103)*	-0.580 (0.132)**	0.267
Child is married	0.014 (0.050)	0.000 (0.056)	-0.092 (0.053)	0.123

I split the sample into three groups: High education small families are defined as those with three or fewer children in which both the mother and father have a college degree (Type 1). Twenty-seven percent of adoptees are assigned to such a family. Large lesser educated families are defined as those with four or more children and where neither parent has a college degree (Type 3). Thirteen percent of adoptees are assigned to such a family. The remaining families (which are either small or have a parent with a college degree) are Type 2. Column (1) shows the coefficient on the dummy for assignment to Type 2 relative to Group 3. Column (2) shows the coefficient on the dummy for assignment to Type 1 (small high education) relative to Type 3 (large less educated).

Column (3) shows this Type 1 versus 3 "effect" for the non-adoptees. In each row, the effects in Columns (1) and (2) are estimated together with a single regression while Column (3) uses a separate regression. Column (4) shows the effect for the adoptees from a one standard deviation move in an index of shared family environment. This is calculated by taking the square root of the variance share explained by shared family environment in the previous table and multiplying by the standard deviation of the outcome variable; that is, $R \times \sigma_v = \sigma_{\text{vshat}}$ = predicted effect on the outcome from a one standard deviation change in an index of family environment. Standard errors are corrected for within family correlation (1 cluster by family).

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Transmission coefficients

Table 8:

- Mother's education: 0.09 years for adoptees, 0.32 years for non-adoptees \Rightarrow 28% nurture
- No adoptee transmission for BMI, height
- Drinking transmissions nearly equal

Transmission coefficients

TABLE VIII
TRANSMISSION COEFFICIENTS FROM PARENTS TO CHILDREN FOR
ADOPTEEES AND NONADOPTEEES

	(1)	(2)
	Adoptees' Transmission coefficient	Nonadoptees' transmission coefficient
Years of education (mother to child)	0.089 (0.029) ^{a**}	0.315 (0.038)**
Has 4+ years college (mother to child)	0.102 (0.034)**	0.302 (0.037)**
Log household income (parents to child)	0.186 (0.111)	0.246 (0.080)**
Height inches (mother to child)	-0.004 (0.034)	0.491 (0.049)**
Is obese (mother to child)	0.003 (0.020)	0.108 (0.034)**
Is overweight (mother to child)	-0.026 (0.029)	0.174 (0.037)**
BMI (mother to child)	0.002 (0.025)	0.221 (0.045)**
Smokes (0-1) (mother to child)	0.132 (0.088)	0.108 (0.115)
Drinks (0-1) (mother to child)	0.210 (0.033)**	0.244 (0.038)**

I regress the child's outcome on the corresponding outcome for the mother (or in the case of income, the parents). Each cell is from a separate regression which also includes age dummies, dummies for year of admission to Holt, and a dummy for the child being male. For income and education regressions I restrict the sample to children ages 25+. For log (income), I attempt to correct for measurement error in parents' income by instrumenting for the survey measure of parents' income using the parents' income measure reported in Holt records.

^a Robust standard errors in parentheses: I cluster at the family level.

* significant at 5%;

** significant at 1%.

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Useful point of interpretation

One interpretation: US black-white gap in years of schooling and college completion could - based on his results - be produced by a one standard deviation change in family environment

- Is the black-white family gap one standard deviation?
- If so, could suffice to explain b-w educational attainment gap

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Björkland, Lindahl, and Plug (2006)

- Administrative data from Statistics Sweden
- Large sample of adoptees
- Unique aspect: data on both biological, adoptive parents
- Do not have random assignment
 - ▶ Matching via geography?
 - ▶ Cross-checks with Sacerdote helpful here
- Argue you can separate genetics and prenatal environment:
 - ▶ Genetics: fathers/mothers equally important
 - ▶ Prenatal conditions: father's behavior doesn't matter (?)
 - ▶ Father's characteristic measure importance of genetics
 - ▶ Father/mother difference measures importance of prenatal
 - ▶ Important b/c argue prenatal looks small/unimportant

Linear models

$$Y_i^{ac} = \alpha_0 + \alpha_1 Y_j^{bp} + \alpha_2 Y_i^{ap} + v_i^{ac}$$

- j subscript family in which the child is born
- i subscript family in which the child is adopted and raised
- Interpreting α_1 and α_2 requires random assignment
- Table 2 presents estimates

Linear models

TABLE II
ESTIMATED TRANSMISSION COEFFICIENTS IN LINEAR MODELS

	Years of schooling			University			Earnings	Income
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
<u>Own-birth children</u>								
Bio father	.240** (.002)		.170** (.002)	.339** (.004)		.237** (.004)	.235** (.005)	.241** (.004)
Bio mother		.243** (.002)	.158** (.002)		.337** (.004)	.246** (.004)		
<u>Adopted children</u>								
Bio father	.113** (.016)		.094** (.016)	.184** (.036)		.148** (.036)	.047 (.034)	.059* (.028)
Bio mother		.132** (.017)	.101** (.017)		.261** (.034)	.229** (.034)		
Adoptive father	.114** (.013)		.094** (.014)	.165** (.024)		.102** (.026)	.098** (.038)	.172** (.031)
Adoptive mother		.074** (.014)	.021 (.015)		.145** (.024)	.097** (.026)		
Sum of estimates for bio and adoptive fathers	.227** (.019)		.188** (.029)	.349** (.040)		.249** (.059)	.145** (.049)	.231** (.040)
Sum of estimates for bio and adoptive mothers		.207** (.021)	.122** (.016)		.406** (.039)	.326** (.029)		

Standard errors are shown in parentheses; * indicates significance at 5 percent level, and ** at 1 percent level. All specifications include controls for the child's gender, 4 birth cohort dummies for the child, 8 birth cohort dummies for biological/adoptive father/mother, and 25 region dummies of where the biological/adoptive family lived in 1965. The numbers of observations in the second panel for own-birth and adopted children are 94,079/2,125 in columns (1)–(6), 87,079/1,780 in column (7) and 91,932/1,976 in column (8).

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Linear models

The authors draw four conclusions from these results:

- 1 Biological parents matter
- 2 Adoptive parents matter
- 3 Comparing biological and adoptive parent:
 - ▶ Mother matters mostly pre-birth
 - ▶ Fathers matter equally pre- and post-birth
- 4 Total impact of adoptive, biological parents' resources on outcomes of adoptive children is remarkably similar to impact of biological parent's outcomes for biological children

Where available, estimates line up well with Sacerdote's estimates

Non-linear models

$$Y_i^{ac} = \alpha_0 + \alpha_1 Y_j^{bp} + \alpha_2 Y_i^{ap} + \alpha_3 Y_j^{bp} Y_i^{ap} + v_i^{ac}$$

- α_3 positive if birth/adoptive family backgrounds complements
- Non-adoptees: squared parental characteristics
- Table 4 presents estimates
 - ▶ Positive, strong quadratic terms (slight convexity)
 - ▶ Some evidence of interactions

Non-linear models

TABLE IV
ESTIMATED TRANSMISSION COEFFICIENTS IN NONLINEAR MODELS WITH INTERACTIONS

	Years of schooling				University		Earnings		Income	
	Fathers		Mothers		Fathers	Mothers	Fathers	Fathers		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Own-birth children										
Bio parent		-.009 (.015)		-.058** (.017)				-.807** (.075)		-.938** (.064)
Bio parent squared		.011** (.001)		.014** (.001)				.069** (.005)		.077** (.004)
Adopted children										
Bio parent	.050 (.051)	-.222 (.127)	-.055 (.055)	-.472** (.139)	.199** (.045)	.166** (.041)	-.187 (.108)	-.403 (.502)	-1.164* (.525)	-1.342* (.670)
Bio parent squared		.015* (.006)		.023** (.006)				.017 (.037)		.015 (.034)
Adoptive parent	.061 (.043)	-.003 (.090)	-.097 (.050)	-.310** (.121)	.170** (.025)	.108** (.026)	-.293* (.125)	-.076 (.648)	-.995* (.501)	-.998 (.710)
Adoptive parent squared		.004 (.004)		.012* (.005)				-.003 (.043)		.003 (.035)
Bio parent * Adoptive parent	.006 (.004)	.003 (.005)	.018** (.005)	.013* (.005)	-.041 (.074)	.286** (.071)	.043** (.015)	.034** (.010)	.156* (.067)	.151* (.068)

Standard errors are shown in parentheses; * indicates significance at 5 percent level, and ** at 1 percent level. All specifications include controls for the child's gender, 4 birth cohort dummies for the child, 8 birth cohort dummies for biological/adoptive father/mother, and 25 region dummies of where the biological/adoptive family lived in 1965. The numbers of observations in the second panel for own-birth and adopted children are 94,079/2,125 in columns (1)-(6), 87,079/1,780 in column (7), and 91,932/1,976 in column (8).

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- 4 Looking ahead

Natural experiment/IV estimates

Estimating causal effects of specific channels

- Identify variation in e.g. parental education or income that is plausibly unrelated to other parental characteristics
- Almond and Currie (2011): income from welfare programs
- Education: Black, Devereux, and Salvanes (2005)
- Black and Devereux (2011) review other education papers

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Black, Devereux, and Salvanes (2005)

Parents with higher levels of education have children with higher levels of education. Why is this?

- Selection: 'type' of parent has 'type' of child
- Causation: obtaining more education changes parent 'type'

Black *et al.* examine this question in the context of a (drastic) change in compulsory schooling laws in Norway in the 1960s

Empirical strategy

- Pre-reform: 7th grade required
- Post-reform: 9th grade required
- Timing of reform staggered across municipalities
- Norway register data
- 2SLS using reform as an instrument (used in prior papers)

$$S_1 = \beta_0 + \beta_1 S_0 + \beta_2 \text{AGE}_1 + \beta_3 \text{AGE}_0 + \beta_4 M_0 + \varepsilon$$

$$S_0 = \alpha_0 + \alpha_1 \text{REFORM}_0 + \alpha_2 \text{AGE}_1 + \alpha_3 \text{AGE}_0 + \alpha_4 M_0 + \nu$$

First stage: Table 2

TABLE 2—DISTRIBUTION OF EDUCATION TWO YEARS BEFORE AND AFTER THE REFORM

Years of education	Before	After
7	3.5%	1.2%
8	8.9%	1.6%
9	3.4%	12.9%
10	29.6%	26.6%
11	8.5%	8.8%
12	17.2%	19.1%
13	6.7%	6.7%
14	5.4%	5.8%
15	2.7%	3.4%
16+	14.2%	14.1%
<i>N</i>	89,320	92,227

Notes: Before indicates education distribution of cohorts in the two years prior to the reform, while After indicates the distribution of those two years post reform. Note that because the reform occurred in different municipalities at different times, the actual year of the reform varies by municipality.

Courtesy of Sandra Black, Paul Devereux, Kjell Salvanes, and the American Economic Association. Used with permission.

First stage: Table 3a

TABLE 3A—FIRST-STAGE RESULTS

	Full sample of parents		Parents' education <10 years	
	Mother's education	Father's education	Mother's education	Father's education
All	0.142* (.029)	0.192* (.042)	0.749* (.017)	0.795* (.024)
Sons	0.127* (.035)	0.196* (.051)	0.742* (.019)	0.814* (.029)
Daughters	0.161* (.036)	0.197* (.050)	0.755* (.019)	0.779* (.027)

Notes: Each estimate represents the coefficient from a different regression. Robust standard errors in parentheses. First stage also includes dummies for parent's age, parent's municipality, and child's age.

* Significant at 5-percent level.

Courtesy of Sandra Black, Paul Devereux, Kjell Salvanes, and the American Economic Association. Used with permission.

OLS and IV

- As expected, positive OLS of parents', childrens' education
- First stage weak in full sample: focus on restricted sample
 - ▶ Similar OLS, 2SLS estimates
 - ▶ 2SLS estimates more precise
- IV suggests weak evidence of a causal effect

OLS and IV: Table 3

TABLE 3—RELATIONSHIP BETWEEN PARENTS' AND CHILDREN'S EDUCATION

	Dependent variable: Children's education			
	Full sample		Parent's education <10	
	OLS	IV	OLS	IV
Mother—all	0.237* (0.003) <i>N</i> = 143,579	0.076 (0.139)	0.211* (0.017) <i>N</i> = 39,605	0.122* (0.043)
Mother—son	0.212* (0.004) <i>N</i> = 73,663	0.199 (0.185)	0.197* (0.021) <i>N</i> = 20,135	0.176* (0.054)
Mother—daughter	0.264* (0.004) <i>N</i> = 69,916	-0.029 (0.186)	0.225* (0.023) <i>N</i> = 19,470	0.066 (0.063)
Father—all	0.217* (0.003) <i>N</i> = 96,275	0.030 (0.132)	0.200* (0.021) <i>N</i> = 22,148	0.041 (0.062)
Father—son	0.209* (0.004) <i>N</i> = 49,492	0.029 (0.171)	0.151* (0.027) <i>N</i> = 11,235	0.008 (0.071)
Father—daughter	0.226* (0.004) <i>N</i> = 46,783	0.022 (0.186)	0.244* (0.033) <i>N</i> = 10,913	0.081 (0.094)

Notes: Sample includes children aged 25–35. Robust standard errors in parentheses. Each estimate represents the coefficient from a different regression. All specifications include dummies for parent's age, parent's municipality and child's age.

* Significant at 5-percent level.

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First stage and reduced form: Figure 1

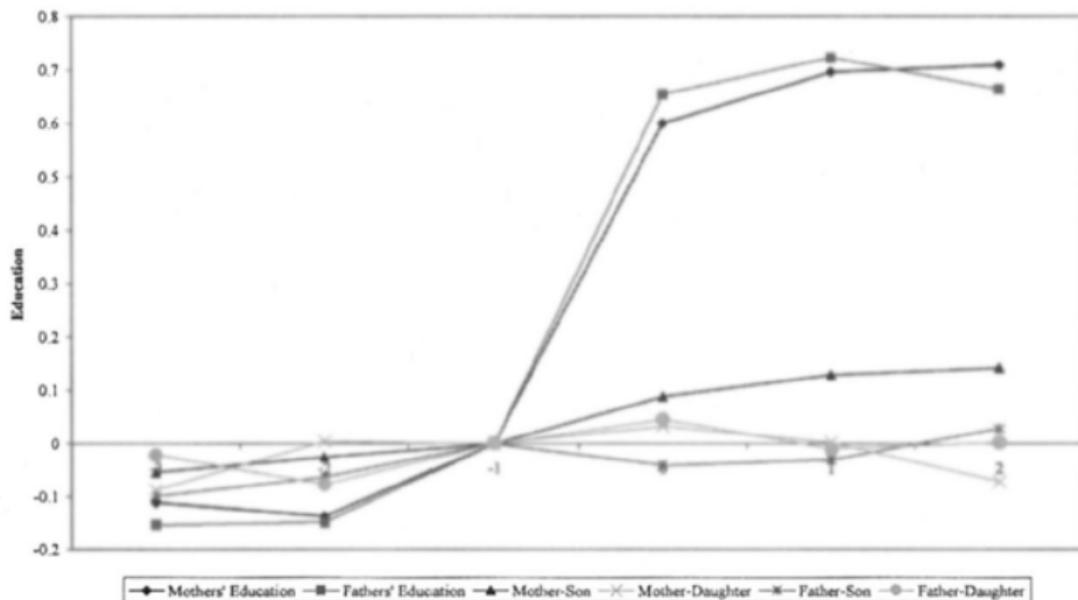


FIGURE 1. EFFECT OF NORWEGIAN EDUCATION REFORM ON EDUCATION FIRST STAGE (EFFECT ON PARENTS) REDUCED FORM (EFFECT ON CHILDREN)

Notes: Estimated on the restricted sample. Lines represent average education for each group with cohort and municipality effects taken out; time zero represents the year of the reform.

Courtesy of Sandra Black, Paul Devereux, Kjell Salvanes, and the American Economic Association. Used with permission.

Black, Devereux, and Salvanes (2005)

Authors conclude: limited support for intergenerational spillovers as a compelling argument for compulsory schooling laws

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Parental education and infant health

- Effect of parental education on infant health
 - ▶ Relevant to mobility because of evidence that infant health has a positive causal effect on later adult outcomes (next class)
- McCrary-Royer (2011): RD on school entry start date
 - ▶ No effect of education on fertility, age at first birth
 - ▶ Small, statistically insignificant effects on birth weight
- Currie-Moretti (2003): college openings
 - ▶ Reduces fertility, increases birth weight
 - ▶ With McCrary-Royer, suggests important heterogeneity

More on early life health next lecture

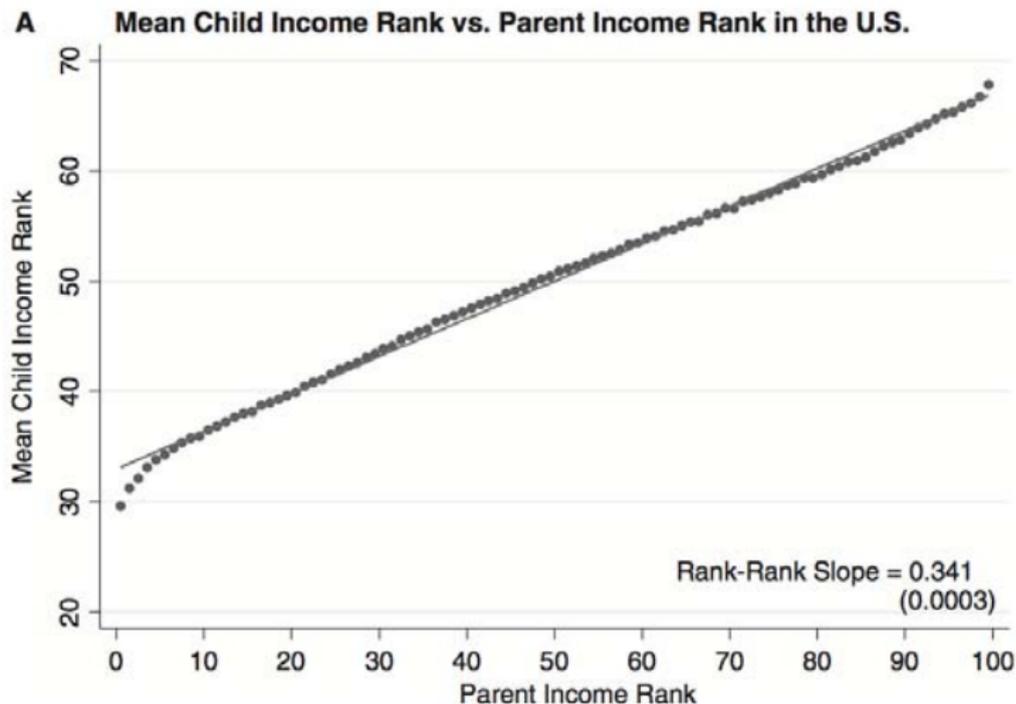
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Within-US geography of intergenerational mobility

- 1980-1982 birth cohorts
- Parental and child income data measured by tax records
- Log-log specification for intergenerational income elasticity discards many families with zero income; alternative rank-rank measure

Rank-rank: Figure 2

Roughly linear: 10 pctile increase in parent income rank
⇒ 3.4 pctile increase in child income rank



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Spatial variation

- Commuting zones at age 16 (ZIP on parents' tax return)
- Two measures:
 - 1 Relative mobility: difference in outcomes between children from top vs. bottom income families within a CZ
 - 2 Absolute mobility: expected rank of children with parents at percentile p in CZ c

Absolute mobility: Figure 6

- Large regional variation + within region variation

A Absolute Upward Mobility: Mean Child Rank for Parents at 25th Percentile (\bar{r}_{25}) by CZ



B Relative Mobility: Rank-Rank Slopes $\frac{r_{100} - r_0}{100}$ by CZ



FIGURE VI

The Geography of Intergenerational Mobility

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Univariate correlations: Figure 8

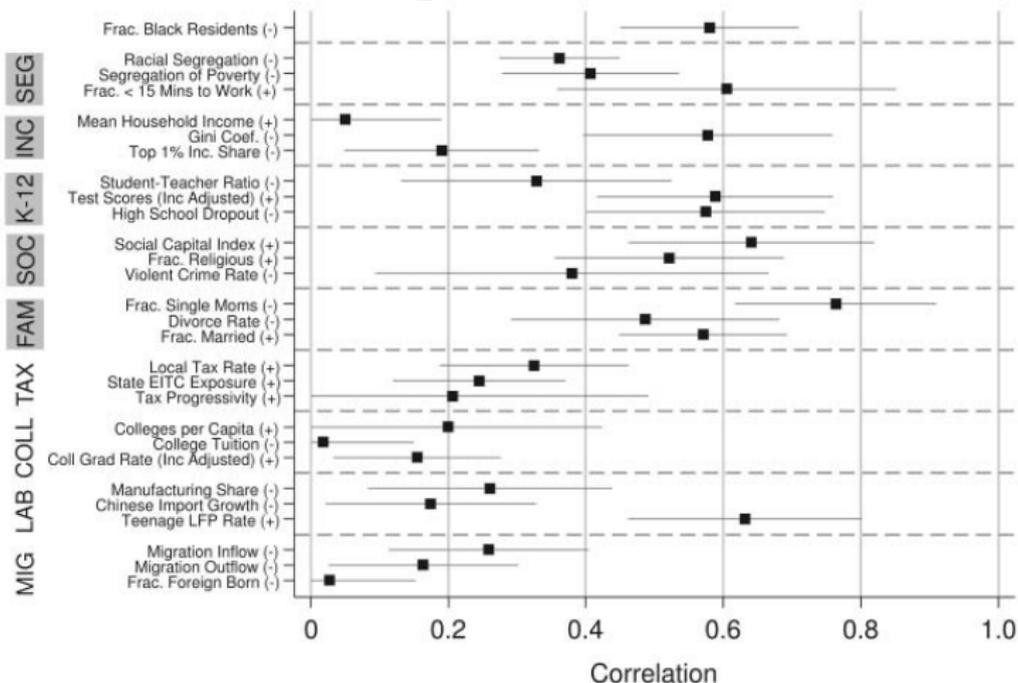


FIGURE VIII

Correlates of Spatial Variation in Upward Mobility

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Looking ahead

Early life determinants of long-run outcomes

- Prenatal environments
- Early childhood environments
- Policy responses

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