Web Appendix for Scandinavian Fantasy: The Sources of Intergenerational Mobility in Denmark and the U.S.

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Table A1: Income levels by deciles, Denmark and the U.S.

Quantile	5th	10th	20th	30th	40th	50th	60th	70th	80th	90th	95th
Individual income											
Total gross income incl. public transfers											
Denmark	20,998	26,235	32,582	37,348	41,077	44,692	48,629	53,120	59,994	72,920	88,338
U.S.	2,213	7,450	14,482	20,145	27,491	34,273	43,620	53,116	67,403	93,884	122,228
Total gross income excl. public transfers											
Denmark	83	7,928	25,252	33,064	37,890	42,137	46,464	51,378	58,428	71,775	87,378
U.S.	1,500	5,829	14,615	21,406	28,976	35,281	43,923	53,693	68,280	96,020	124,193
Net-of-tax income											
Denmark	16,593	20,612	25,702	29,074	31,762	34,264	36,834	39,817	43,808	50,936	59,365
U.S.[A]	7,685	11,006	18,101	25,022	27,774	31,963	37,161	43,404	51,680	66,936	80,740
Wage earnings plus public transfers											
Denmark	13,005	22,573	30,446	35,662	39,729	43,402	47,261	51,721	57,877	69,846	83,985
U.S.	5,034	9,475	15,053	21,448	29,228	35,034	43,879	51,971	67,805	93,641	122,382
Household income											
Total gross income incl. public transfers											
Denmark	26,814	34,317	47,876	63,531	76,066	84,231	92,270	101,342	112,937	133,814	157,002
U.S.	11,524	19,649	31,277	42,969	54,457	66,776	80,220	98,054	119,445	157,116	195,481
Total gross income excl. public transfers											
Denmark	2,282	21,096	40,438	53,254	67,466	77,934	86,934	96,257	108,221	129,378	152,501
U.S.	7,081	17,090	29,448	41,653	53,329	65,267	78,744	96,202	118,338	155,561	194,539
Net-of-tax income											
Denmark	20,860	26,868	36,643	48,426	58,080	64,166	69,561	75,368	82,438	94,561	108,039
U.S.	11,601	19,365	29,370	37,659	45,929	55,157	65,490	77,448	92,365	115,961	142,651
Household income per adult											
Total gross income incl. public transfers											
Denmark	23,900	28,519	34,942	39,081	42,321	45,597	49,138	53,349	59,187	69,893	82,124
U.S.	8,050	12,027	19,248	25,927	31,531	37,607	45,045	53,674	65,649	86,557	106,874
Total gross income excl. public transfers											
Denmark	1,967	15,539	28,195	34,887	39,117	42,847	46,618	51,055	56,912	67,780	79,912
U.S.	3,374	10,140	18,090	24,538	30,811	36,883	44,636	53,326	65,414	85,897	106,546
Net-of-tax income											
Denmark	18,547	22,304	27,073	30,023	32,372	34,570	36,841	39,448	42,924	49,072	56,187
U.S.	7,685	11,006	18,101	25,022	27,774	31,963	37,161	43,404	51,680	66,936	80,740

Note: Table shows income levels across quantiles in 2010 USD. Rows labeled *Denmark* show income measured in 2010–2012 for the full population of children born in Denmark from 1973–1975, and rows labeled *U.S.* show income levels measured in 2011 for children born 1973–1975 in the U.S. March CPS data.
[A]: Calculated as per adult household income.

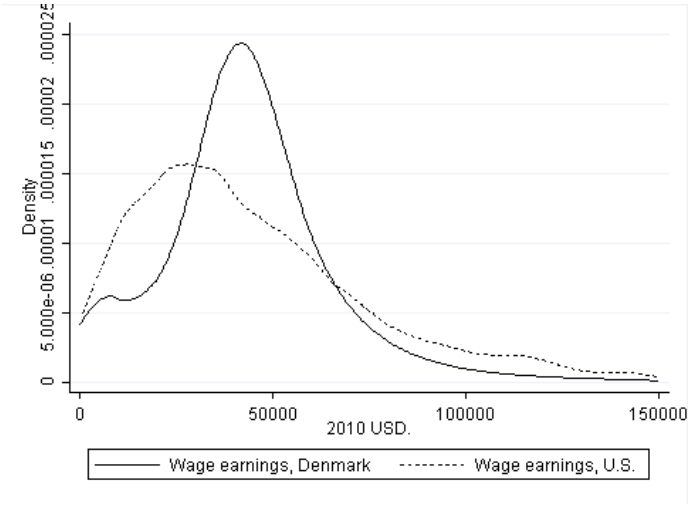
Table A2: IGE estimates with different income measures, Denmark and the U.S., with equal year of birth distributions

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
With same year of birth distribution									
	0.339***	0.312***	0.253***	0.446***	0.079***	0.289***	0.061***	0.419***	0.208***
	(0.008)	(0.055)	(0.006)	(0.054)	(0.005)	(0.044)	(0.004)	(0.058)	(0.006)
Observations	47,485	621	47,485	621	47,485	621	47,485	621	47,485
With same number of observations per year and same year of birth distribution									
	0.308***	0.312***	0.246***	0.446***	0.039***	0.289***	0.046***	0.419***	0.164***
	(0.086)	(0.055)	(0.050)	(0.054)	(0.043)	(0.044)	(0.030)	(0.058)	(0.046)
Observations	621	621	621	621	621	621	621	621	621

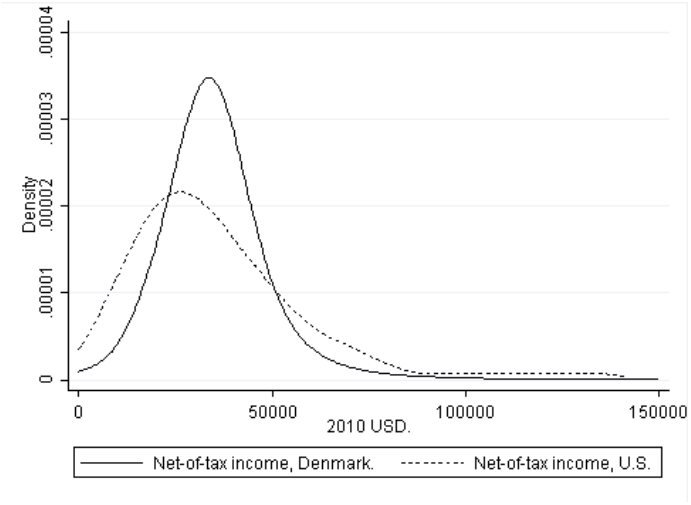
Note: Table shows coefficients (β^{IGE}) and standard errors from regressions of child's log income on parental log income for Denmark and the U.S. with similar year of birth distribution for Denmark as observed in the PSID data. For Denmark, we use full population register data for children born in 1972–1978 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as average in 2010–2012. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.
Income variables otherwise defined as detailed in Table 1.

Figure A1: Income distributions, Denmark and the U.S. in 2011

(a) Wage earnings



(b) Net-of-tax (disposable) income



Note: Figure shows wage earnings and total net-of-tax income for Denmark and the U.S., for cohorts born 1973–1975. For Denmark, income is measured in 2011 using administrative register data. For the U.S., income is measured in 2011 using March CPS data. For the U.S. net-of-tax income, we report household income (individual income plus the income of a spouse if cohabiting or married) divided by number of adults in the household. The figures only include positive incomes.

Table A3: IGE estimates with different income measures, Denmark and the U.S., controlling for child's highest completed grade

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
β^{IGE}	0.208***	0.181 ***	0.168 ***	0. 302***	0.051 ***	0.203 ***	0.045 ***	0.265 ***	0.133 ***
	(0.004)	(0.044)	(0.003)	(0.056)	(0.003)	(0.046)	(0.002)	(0.059)	(0.003)
β^{HCG}	0.118 ***	0.149 ***	0.062 ***	0.123 ***	0.133 ***	0.140 ***	0.069 ***	0.137 ***	0.056 ***
	(0.001)	(0.012)	(0.001)	(0.018)	(0.001)	(0.019)	(0.001)	(0.018)	(0.000)
Observations	149,190	621	149,190	621	149,190	621	149,190	621	149,190

Note: Table shows coefficients (β^{IGE}) and highest completed grade, and the corresponding standard errors from regressions of child's log income on parental log income and child's highest completed grade for Denmark and the U.S. For Denmark, we use full population register data for children born in 1973–1975 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.
Income variables defined as detailed in Table 1. IGE coefficients are estimated conditional on child's highest completed grade.

Table A4: IGE estimates with different income measures, Denmark and the U.S., controlling for parents education

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
β^{IGE}	0.288***	0.193***	0.206***	0.300***	0.050***	0.167***	0.037***	0.257***	0.163***
	(0.005)	(0.050)	(0.004)	(0.062)	(0.003)	(0.049)	(0.002)	(0.066)	(0.003)
Observations	149,190	621	149,190	621	149,190	621	149,190	621	149,190

Note: Table shows coefficients (β^{IGE}) and standard errors from regressions of child's log income on parental log income for Denmark and the U.S. while controlling for average of parents' education. For Denmark, we use full population register data for children born in 1973–1975 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.
Income variables defined as detailed in Table 1. IGE coefficients are estimated conditional on the average of parents' highest completed grade (replacing the average with mother's highest completed grade if information for father is missing, and vice versa).

Table A5: IGE estimates with different income measures, Denmark and the U.S., including zeros

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
β^{IGE}	0.491***	0.218***	0.290***	0.181***	0.144***	0.208***	0.083***	0.211***	0.245***
	(0.005)	(0.036)	(0.003)	(0.034)	(0.003)	(0.036)	(0.003)	(0.038)	(0.003)
$\rho_{Child,Parents}\frac{sd(Child)}{sd(Parents)}$	$0.246\frac{1.069}{0.535}$	$0.222\frac{1.235}{1.261}$	$0.201\frac{0.491}{0.340}$	$0.195\frac{1.072}{1.156}$	$0.118\frac{1.208}{0.989}$	$0.211\frac{1.228}{1.248}$	$0.094\frac{0.730}{0.821}$	$0.204\frac{1.202}{1.162}$	$0.174\frac{0.446}{0.317}$
Observations	166,359	702	166,359	702	166,359	702	166,359	702	166,359

Note: Table shows coefficients (β^{IGE}) and standard errors from regressions of child's log income on parental log income for Denmark and the U.S. while imputing missing and zero incomes with $1,000. For Denmark, we use full population register data for children born in 1973–1975 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.

Total gross income excl. public transfers =

1 Denmark: All taxable income including wage earnings, profits from own business, capital income, and foreign income excluding all public transfers (both taxable and non-taxable).

2 U.S.: All taxable income including earnings (payroll income from all sources, farm income, and the labor portion of business income), asset income (such as rent income, dividends, interest, income from trust and royalties, and asset income from business), and private transfers (such as income from alimony, child support, and help from relatives and others).

Total gross income incl. public transfers =

3 Denmark: All taxable income including wage earnings, public transfers, profits from own business, capital income, and foreign income.

4 U.S.: All taxable income including earnings, asset income, private transfers, and public transfers (such as social security income, SSI, TANF, ETC, other welfare income, retirement, pension, unemployment, and workers compensation).

Wage earnings =

5 Denmark: Taxable wage earnings and fringes, labor portion of business income, and non-taxable earnings, severance pay, and stock-options.

6 U.S.: Payroll income from all sources (such as wages and salaries, bonus, overtime income, tips, commissions, professional practice, market gardening, additional job income, and other labor income), farm income, and the labor portion of business income.

Wage and transfers =

7 Denmark: Taxable wage earnings and fringes, labor portion of business income, and non-taxable earnings, severance pay, and stock-options, plus taxable and non-taxable public transfers (social assistance, unemployment benefits, labor market leave, sick leave assistance, labor market activation, child benefits, education grants, housing support, early retirement pension, disability pension, and retirement pension).

8 U.S.: Payroll income from all sources, farm income, labor portion of business income, and public transfers.

Net-of-tax total gross income =

9 Denmark: *Total gross income* minus all final income taxes paid in given year. We do not have information on individual net-of-tax income from the PSID.

Table A6: Rank-rank estimates with different income measures, Denmark and the U.S.

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
Including zeros									
β^{RR}	0.273***	0.356***	0.253***	0.370***	0.205***	0.324***	0.177***	0.316***	0.229***
	(0.002)	(0.038)	(0.002)	(0.038)	(0.002)	(0.038)	(0.002)	(0.038)	(0.002)
Excluding zeros									
β^{RR}	0.274***	0.245***	0.253***	0.295***	0.208***	0.227***	0.177***	0.224***	0.229***
	(0.002)	(0.037)	(0.002)	(0.037)	(0.002)	(0.037)	(0.002)	(0.037)	(0.002)

Note: Table shows coefficients from rank-rank estimation (β^{RR}) and standard errors from regressions of children's rank in their income distributions on parental rank in their income distributions for Denmark and the U.S. For Denmark, we use full population register data for children born in 1973–1975 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.

Total gross income excl. public transfers =

1 Denmark: All taxable income including wage earnings, profits from own business, capital income, and foreign income excluding all public transfers (both taxable and non-taxable).

2 U.S.: All taxable income including earnings (payroll income from all sources, farm income, and the labor portion of business income), asset income (such as rent income, dividends, interest, income from trust and royalties, and asset income from business), and private transfers (such as income from alimony, child support, and help from relatives and others).

Total gross income incl. public transfers =

3 Denmark: All taxable income including wage earnings, public transfers, profits from own business, capital income, and foreign income.

4 U.S.: All taxable income including earnings, asset income, private transfers, and public transfers (such as social security income, SSI, TANF, ETC, other welfare income, retirement, pension, unemployment, and workers compensation).

Wage earnings =

5 Denmark: Taxable wage earnings and fringes, labor portion of business income, and non-taxable earnings, severance pay, and stock-options.

6 U.S.: Payroll income from all sources (such as wages and salaries, bonus, overtime income, tips, commissions, professional practice, market gardening, additional job income, and other labor income), farm income, and the labor portion of business income.

Wage and transfers =

7 Denmark: Taxable wage earnings and fringes, labor portion of business income, and non-taxable earnings, severance pay, and stock-options, plus taxable and non-taxable public transfers (social assistance, unemployment benefits, labor market leave, sick leave assistance, labor market activation, child benefits, education grants, housing support, early retirement pension, disability pension, and retirement pension).

8 U.S.: Payroll income from all sources, farm income, labor portion of business income, and public transfers.

Net-of-tax total gross income =

9 Denmark: *Total gross income* minus all final income taxes paid in given year. We do not have information on individual net-of-tax income from the PSID.

Table A7: IGE estimates with different income measures, Denmark and the U.S., by gender

	Gross income excl. public transfers		**Gross income incl. public transfers**		**Wage earnings**		**Wage earnings and public transfers**		**Net-of-tax total gross income**
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Denmark	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*	*U.S.*	*Denmark*
Males									
β^{IGE}	0.379***	0.306***	0.321***	0.457***	0.094***	0.291***	0.084***	0.472***	0.266***
	(0.006)	(0.078)	(0.005)	(0.082)	(0.005)	(0.057)	(0.004)	(0.074)	(0.004)
Females									
β^{IGE}	0.328***	0.241***	0.222***	0.384***	0.071***	0.253***	0.041***	0.314***	0.177***
	(0.006)	(0.095)	(0.004)	(0.101)	(0.004)	(0.062)	(0.004)	(0.083)	(0.002)

Note: Table shows coefficients (β^{IGE}) and standard errors from regressions of child's log income on parental log income on for Denmark and the U.S. by gender of the child. For Denmark, we use full population register data for children born in 1973–1975 and for the U.S., we use PSID data for children born in 1972–1978. For Denmark, parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively. For the U.S., parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured as last year income at ages 34–41, 33–40, 32–39, 31–38, 30–37, 30–36, and 30–35 for the 1972, 1973, 1974, 1975, 1976, 1977, and 1978 cohorts, respectively.
Income variables defined as detailed in Table 1.

Table A8: Covariance matrix: Intergenerational income elasticity, wage income, Denmark

	Wage income	
	Child	Parents
Wage income, child	1.442	
Wage income, parents	0.140	0.970

IGE, wage income $= \frac{0.140}{0.970} = 0.145$

Note: Table shows covariance matrix used to construct $\beta^{IGE} = \frac{cov(child,parent)}{var(parent)}$. Income measures for parents and child are the same in each regression, i.e., parent wage on child's wage, etc. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.
Wage income = taxable wage earnings (including self-employment income) and fringes, and non-taxable earnings, severance pay, and stock-options.
Number of observations: 163,123.

Table A9: Covariance matrix: Intergenerational income elasticity, wage income and profits from own business, Denmark

Aggregated measure	Wage income and profits	
	Child	Parents
Wage income and profits, child	1.169	
Wage income and profits, parents	0.131	0.290

Individual components	Wage income		Profits from business	
	Child	Parents	Child	Parents
Wage income, child	1.442			
Wage income, parents	0.140	0.970		
Profits, child	-0.336	-0.046	0.399	
Profits, parents	-0.012	-0.649	0.049	0.617

$$\text{IGE, wage income and profits from business} = \frac{0.049+0.140-0.012-0.046}{0.970+0.617+2*(-0.649)}$$
$$= \frac{0.131}{0.290} = 0.451.$$

Note: Table shows covariance matrix used to construct $\beta^{IGE} = \frac{cov(child,parent)}{var(parent)}$.
- Profits from own business is calculated as ln(wage income + profits from business)–ln(wage income) such that IGE can be calculated as the sum of intergenerational covariances divided by parental variances/covariances as reported in the table.
- Income measures for parents and child are the same in each regression, i.e., parent wage on child's wage, etc. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.
Wage income = taxable wage earnings (including self-employment income) and fringes, and non-taxable earnings, severance pay, and stock-options.
Profits from own business = Profits from independent business or firm including foreign business income and net revenue from employed spouse. Excluding capital revenue and expenses.
Number of observations: 163,123.

Table A10: Covariance matrix: Intergenerational income elasticity, total gross income excluding public transfers, Denmark

Aggregated measure	Total gross income excl. transfers	
	Child	Parents
Total gross income excl. transfers, child	1.130	
Total gross income excl. transfers, parents	0.140	0.285

Individual components	Wage income		Profits from business		Capital income	
	Child	Parents	Child	Parents	Child	Parents
Wage income, child	1.442					
Wage income, parents	0.140	0.970				
Profits, child	-0.336	-0.046	0.399			
Profits, parents	-0.012	-0.649	0.049	0.617		
Capital income, child	-0.018	0.001	-0.012	-0.001	0.022	
Capital income, parents	-0.0003	-0.104	0.009	0.086	0.0002	0.032

$$\text{IGE, total gross income } \textit{excluding} \text{ public transfers} = \frac{0.131+0.0002-0.001+0.001+0.009-0.0003}{0.290+0.032+2*(-0.104)+2*(0.086)}$$
$$= \frac{0.140}{0.285} = 0.490$$

Note: Table shows covariance matrix used to construct $\beta^{IGE} = \frac{cov(child,parent)}{var(parent)}$.
- Profits from own business is calculated as ln(wage income + profits from business)–ln(wage income).
- Capital income is here defined as the residual to total gross income excluding transfers, and is calculated as ln(total gross income excl. transfers)–ln(wage income + profits from business) such that IGE can be calculated as the sum of intergenerational covariances divided by parental variances/covariances as reported in the table.
Income measures for parents and child are the same in each regression, i.e., parent wage on child's wage, etc. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.
Wage income = taxable wage earnings (including self-employment income) and fringes, and non-taxable earnings, severance pay, and stock-options.
Profits from own business = Profits from independent business or firm including foreign business income and net revenue from employed spouse. Excluding capital revenue and expenses.
Capital income = Capital income including stock income and foreign income.
Number of observations: 163,123.

Table A11: Covariance matrix: Intergenerational income elasticity, total gross income including public transfers, Denmark

Aggregated measure	Total gross income incl. transfers	
	Child	Parents
Total gross income incl. transfers, child	0.240	
Total gross income incl. transfers, parents	0.034	0.116

Individual components	Wage income		Profits from business		Capital income		Transfers	
	Child	Parents	Child	Parents	Child	Parents	Child	Parents
Wage income, child	1.442							
Wage income, parents	0.140	0.970						
Profits, child	-0.336	-0.046	0.399					
Profits, parents	-0.012	-0.649	0.049	0.617				
Capital income, child	-0.018	0.001	-0.012	-0.001	0.022			
Capital income, parents	-0.0003	-0.104	0.009	0.086	0.0002	0.032		
Transfers, child	-0.699	-0.054	-0.034	-0.024	0.006	-0.005	0.564	
Transfers, parents	-0.065	-0.104	-0.004	-0.019	0.0003	-0.003	0.045	0.083

$$\text{IGE, total gross income } \textit{including} \text{ public transfers} = \frac{0.140+0.045+0.0003-0.004-0.065-0.005-0.024-0.054}{0.285+0.083-2*(0.003)-2*(0.019)-2*(0.104)}$$

$$= \frac{0.034}{0.116} = 0.290$$

Note: Table shows covariance matrix used to construct $\beta^{IGE} = \frac{cov(child,parent)}{var(parent)}$.
- Profits from own business is calculated as ln(wage income + profits from business)–ln(wage income).
- Capital income is here defined as the residual to total gross income excluding transfers, and is calculated as ln(total gross income excl. transfers)–ln(wage income + profits from business).
- Transfers is calculated as ln(total gross income incl. transfers)–ln(total gross income excl. transfers) such that IGE can be calculated as the sum of intergenerational covariances divided by parental variances/covariances as reported in the table.
Income measures for parents and child are the same in each regression, i.e., parent wage on child's wage, etc. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.
Wage income = taxable wage earnings (including self-employment income) and fringes, and non-taxable earnings, severance pay, and stock-options.
Profits from own business = Profits from independent business or firm including foreign business income and net revenue from employed spouse. Excluding capital revenue and expenses.
Capital income = Capital income including stock income and foreign income.
Transfers = Taxable and non-taxable public transfers (social assistance, unemployment benefits, labor market leave, sick leave assistance, labor market activation, child benefits, education grants, housing support, early retirement pension, disability pension, and retirement pension).
Number of observations: 163,123.

Table A12: Covariance matrix: Intergenerational income elasticity, total net-of-tax (disposable) income, Denmark

Aggregated measure	Total net-of-tax income	
	Child	Parents
Total net-of-tax income, child	0.199	
Total net-of-tax income, parents	0.025	0.101

Individual components	Wage income		Profits from business		Capital income		Transfers		Taxes	
	Child	Parents	Child	Parents	Child	Parents	Child	Parents	Child	Parents
Wage income, child	1.442									
Wage income, parents	0.140	0.970								
Profits, child	-0.336	-0.046	0.399							
Profits, parents	-0.012	-0.649	0.049	0.617						
Capital income, child	-0.018	0.001	-0.012	-0.001	0.022					
Capital income, parents	-0.0003	-0.104	0.009	0.086	0.0002	0.032				
Transfers, child	-0.699	-0.054	-0.034	-0.024	0.006	-0.005	0.564			
Transfers, parents	-0.065	-0.104	-0.004	-0.019	0.0003	-0.003	0.045	0.083		
Taxes, child	-0.043	-0.008	0.003	0.001	0.001	-0.0004	0.013	0.002	0.010	
Taxes, parents	-0.015	-0.059	0.004	0.028	-0.0002	0.006	0.006	0.010	0.001	0.015

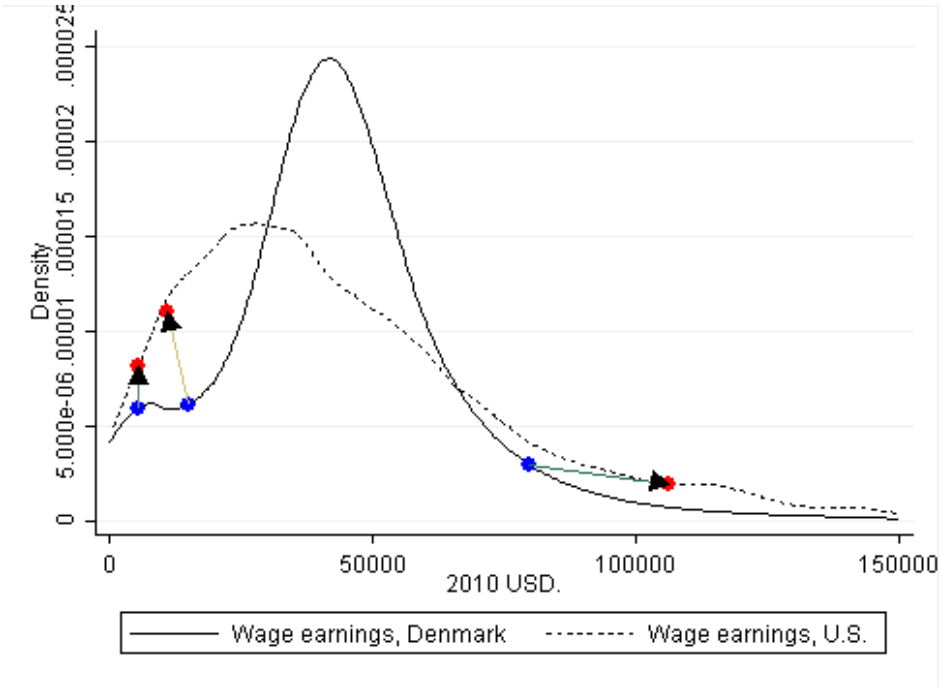
IGE, total net-of-tax income *including* public transfers $= \frac{0.034-0.015+0.006-0.0002+0.004+0.002-0.0004+0.001-0.008}{0.116+0.015+2*0.010+2*0.006+2*0.028+2*(-0.059)}$
$= \frac{0.025}{0.101} = 0.245$

Note: Table shows covariance matrix used to construct $\beta^{IGE} = \frac{cov(child,parent)}{var(parent)}$.
- Profits from business is calculated as ln(wage income + profits from business)–ln(wage income).
- Capital income is here defined as the residual to total gross income excluding transfers, and is calculated as ln(total gross income excl. transfers)–ln(wage income + profits from business).
- Transfers is calculated as ln(total gross income incl. transfers)-ln(total gross income excl. transfers).
- Taxes is calculated as ln(total net-of-tax income)–ln(total gross income incl. transfers) such that IGE can be calculated as the sum of intergenerational covariances divided by parental variances/covariances as reported in the table.

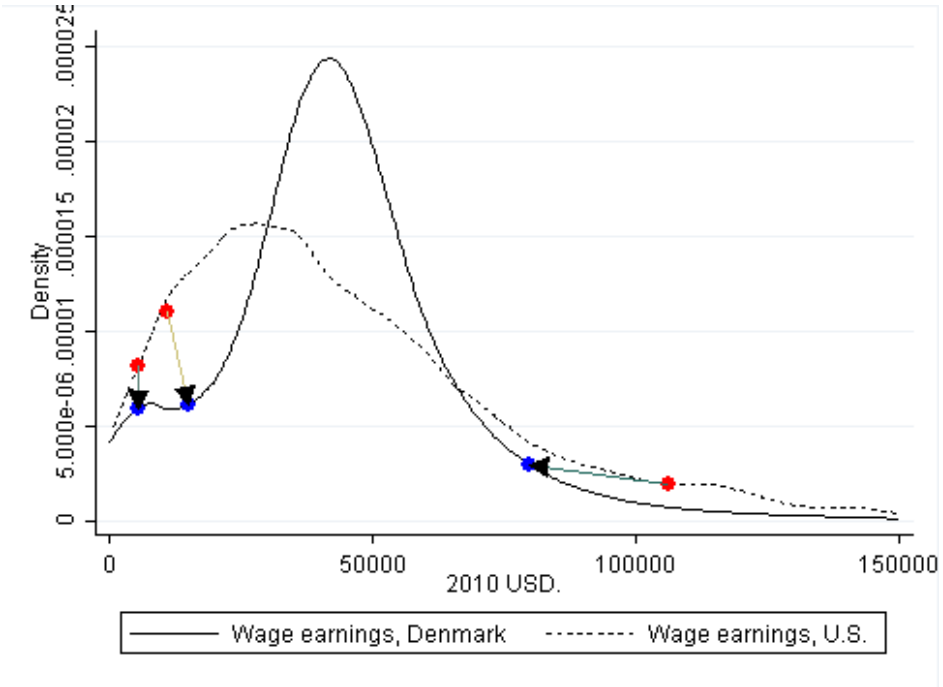
Income measures for parents and child are the same in each regression, i.e., parent wage on child's wage, etc. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.
Wage income = taxable wage earnings (including self-employment income) and fringes, and non-taxable earnings, severance pay, and stock-options.
Profits from own business = Profits from independent business or firm including foreign business income and net revenue from employed spouse. Excluding capital revenue and expenses.
Capital income = Capital income including stock income and foreign income.
Transfers = Taxable and non-taxable public transfers (social assistance, unemployment benefits, labor market leave, sick leave assistance, labor market activation, child benefits, education grants, housing support, early retirement pension, disability pension, and retirement pension).
Taxes = Total taxes paid as wage income tax, including business, property, and capital income taxes.
Number of observations: 163,123.

Figure A2: Wage earnings transformation, from Denmark to the U.S. and vice versa

(a) Wage earnings transformation, Danish to U.S. distribution



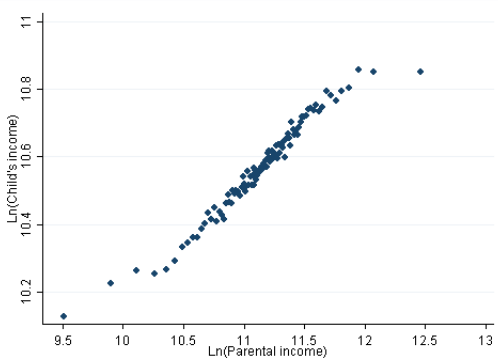
(b) Wage earnings transformation, U.S. to Danish distribution



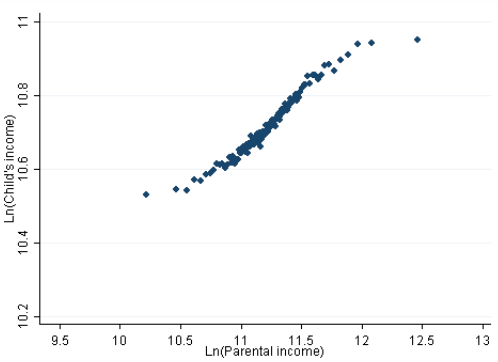
Note: Figures show wage earnings distributions for the U.S. and Denmark. The arrows provide an illustration of how distributions from the U.S. are mapped to Danish distributions and vice versa. Mapping is performed for each percentile and not just the three arrows shown in each figure.

Figure A3: Child-parent income plots, Denmark

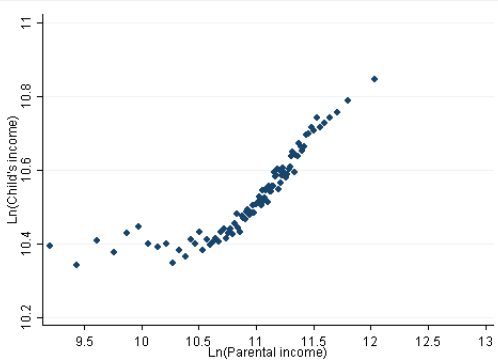
(a) Total gross income excl. transfers



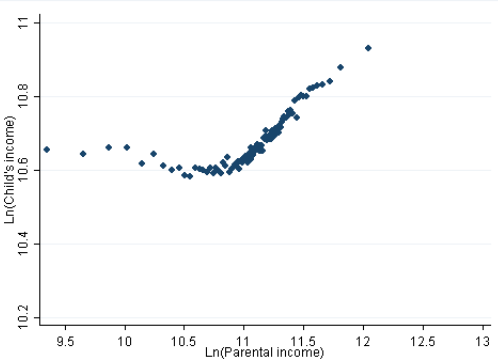
(b) Total gross income incl. transfers



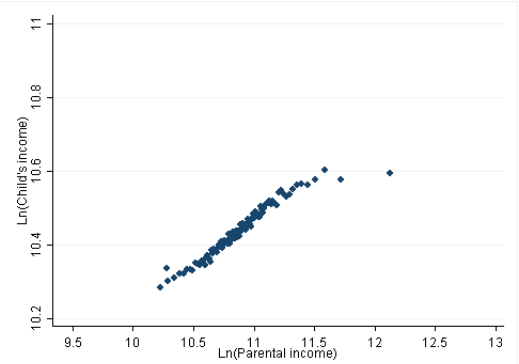
(c) Wage income



(d) Wage income plus transfers



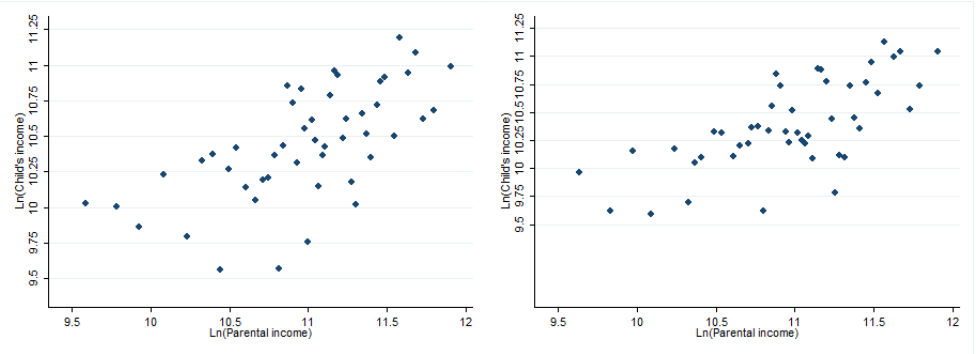
(e) Total net-of-tax income incl. transfers



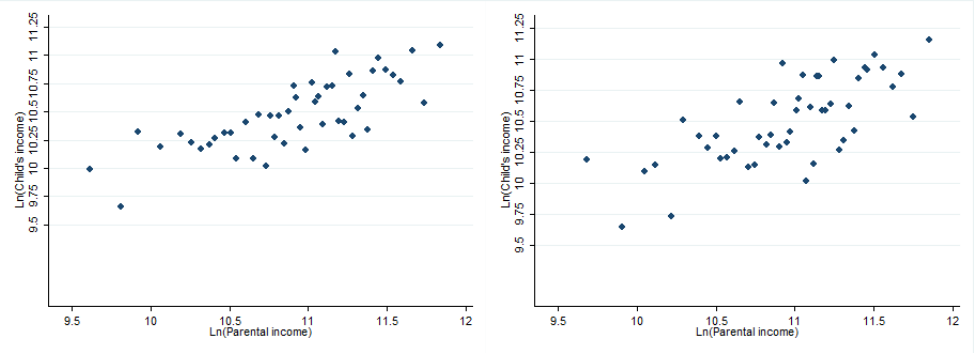
Note: Figure shows scatterplots of parental log income on child's log income for children born in 1973–1975. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.

Figure A4: Child-parent income plots, Denmark

(a) Total gross income excl. transfers **(b)** Total gross income incl. transfers

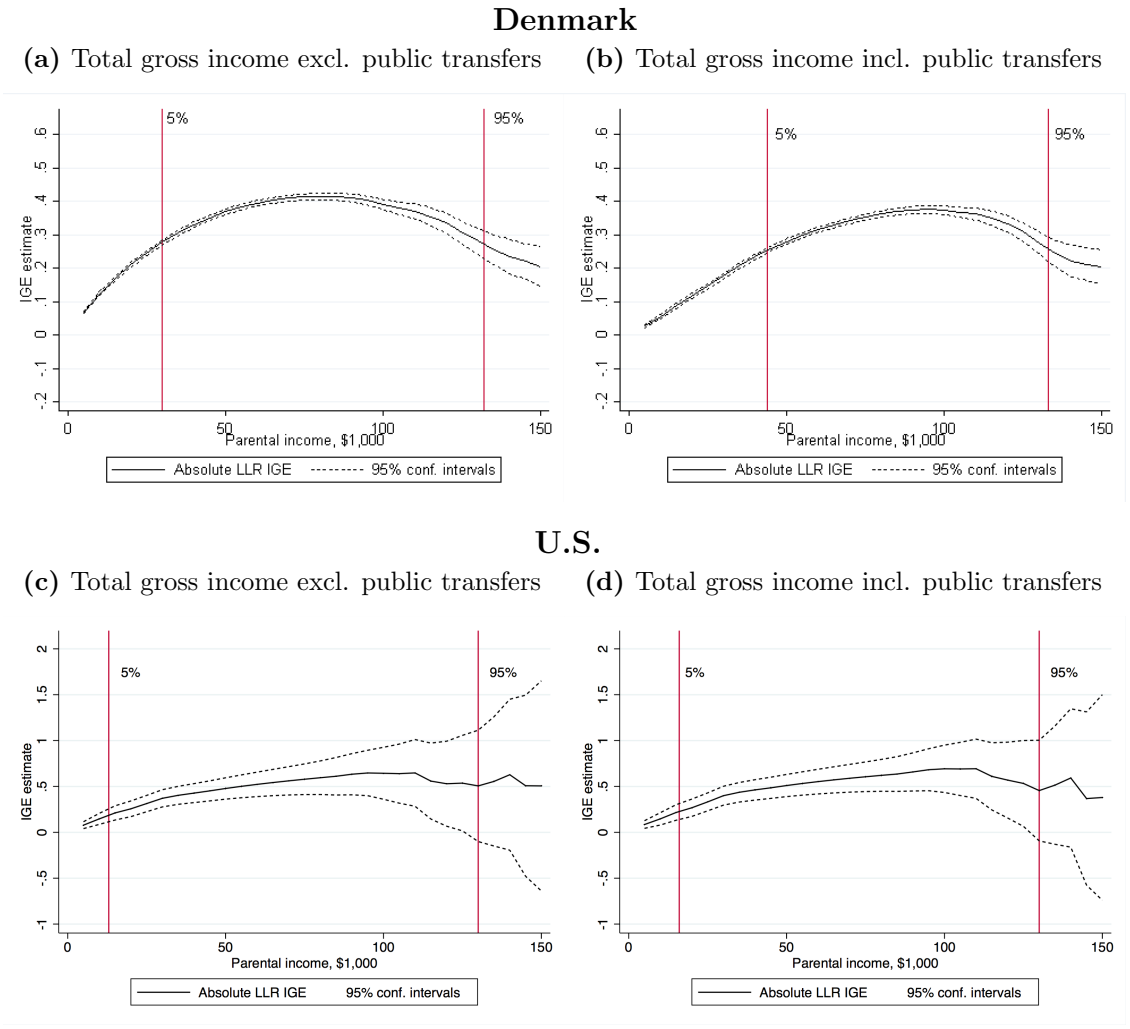


(c) Wage income **(d)** Wage income plus transfers



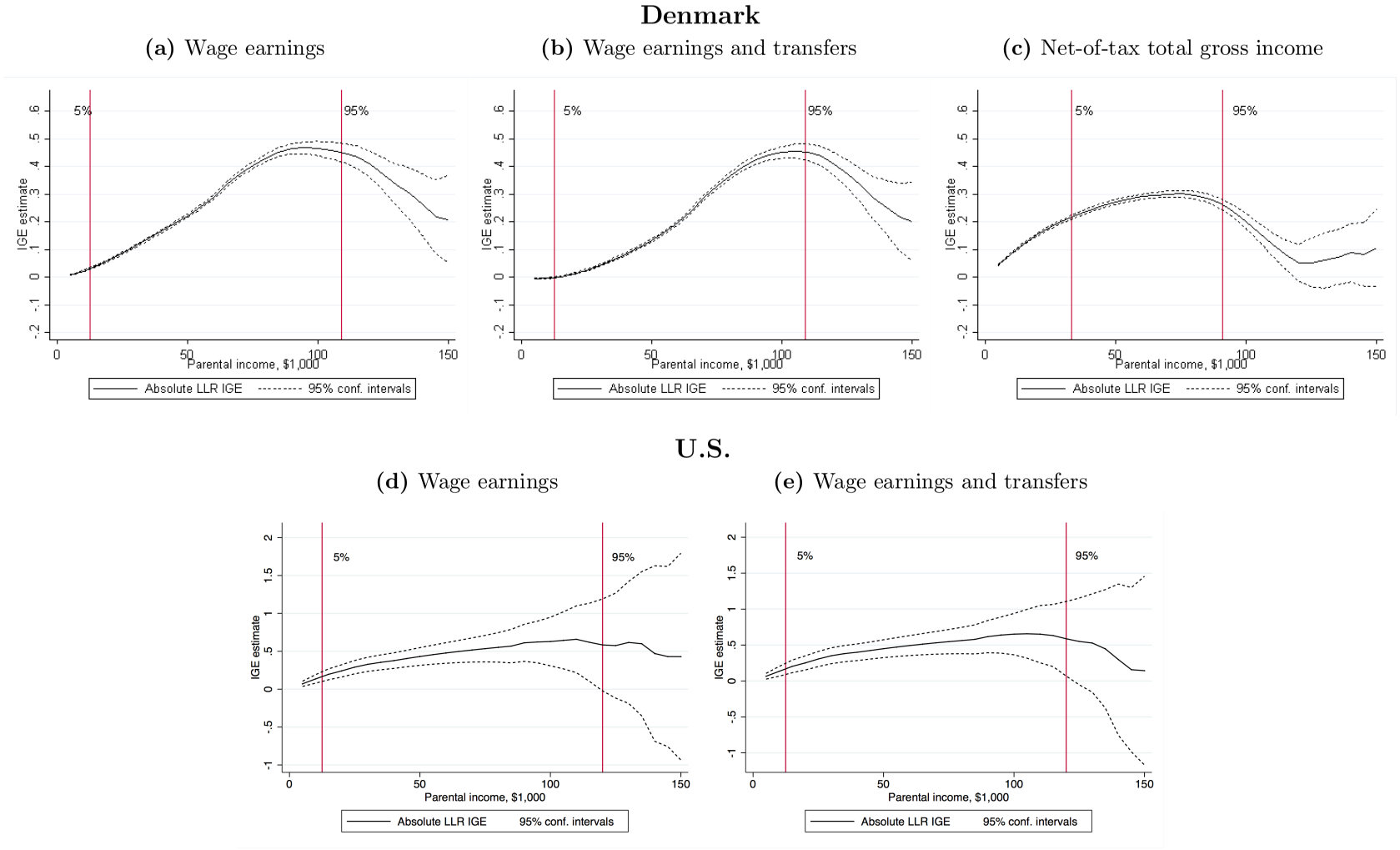
Note: Figure shows scatterplots of parental log income on child's log income for children born in 1973–1975. Parental income is measured as a 9 year average from the child's 7th to 15th year and the child's income is measured at ages 35–37, 36–38, and 37–39 for the 1975, 1974, and 1973 cohorts, respectively.

Figure A5: Local Intergenerational Income-Elasticity in Denmark and the U.S., estimated using absolute income



Note: Figures show estimated Intergenerational Income-Elasticities of wage income plus public transfers for Denmark (a, b) and the U.S. (c, d). Figures a and b have been constructed using full population register data from Denmark, and Figures c and d and have been constructed using PSID data. The figures show local linear regression slopes of children's income on parental income. Estimates have then been converted to change in percentages relative to the base for each point of parental income Y_0^P. LLRs are weighted using kernels of absolute income. Standard errors for Figures a and b have been constructed from 50 bootstraps and standard errors for Figures c and d have been constructed from 1,000 bootstraps.
The vertical lines indicate the 5th and 95th percentiles in the respective income distributions (except for *Total gross income excl. public transfers* and *Total gross income excl. public transfers* in Denmark, because the 99th income percentiles in the full population register data are above $150,000).

Figure A6: Local Intergenerational Income-Elasticity in Denmark and the U.S., estimated using absolute income, cont.



Note: Figures show estimated Intergenerational Income-Elasticities of wage income plus public transfers for Denmark (a, b, c) and the U.S. (d, e). Figures a, b, and c have been constructed using full population register data from Denmark, and Figures d and e and have been constructed using PSID data. The figures show local linear regression slopes of children's income on parental income. Estimates have then been converted to change in percentages relative to the base for each point of parental income Y_0^P. LLRs are weighted using kernels of absolute income. Standard errors for Figures a, b, and c have been constructed from 50 bootstraps and standard errors for Figures d and e have been constructed from 1,000 bootstraps.
The vertical lines indicate the 5th and 95th percentiles in the respective income distributions (except for *Total gross income excl. public transfers* and *Total gross income excl. public transfers* in Denmark, because the 99th income percentiles in the full population register data are above $150,000).

A.2 Supplements to Section 3

Table A13: Expenditure on educational institutions as a percentage of GDP, by source of funding and level of education

	Pre-primary			*Prim., secon., and post-secon. non-tertiary*			*Tertiary*			*All levels*		
	Public[1]	Private[2]	Total	Public[1]	Private[2]	Total	Public[1]	Private[2]	Total	Public [1]	Private[2]	Total
Denmark	1.30	0.11	**1.41**	4.3	0.1	**4.4**	1.8	0.1	**1.9**	7.5	0.4	**7.9**
Norway	0.48	0.03	**0.51**	4.9	na	**na**	1.6	0.1	**1.7**	7.3	na	**na**
Sweden	0.72	0.00	**0.72**	3.9	0.0	**3.9**	1.6	0.2	**1.8**	3.2	0.2	**6.3**
United States	0.33	0.14	**0.47**	3.4	0.3	**3.7**	0.9	1.8	**2.7**	4.7	2.2	**6.9**

Note: Table shows public, private, and total expenditures on education as percentages of GDP in 2013 for Denmark, Norway, Sweden, and the U.S.
[1]: Including public subsidies to households attributable for educational institutions, tuition and fees (U.S.), and direct expenditure on educational institutions.
[2]: Net of public subsidies attributable for educational institutions.
Source: Organisation for Economic Co-operation and Development (2014).

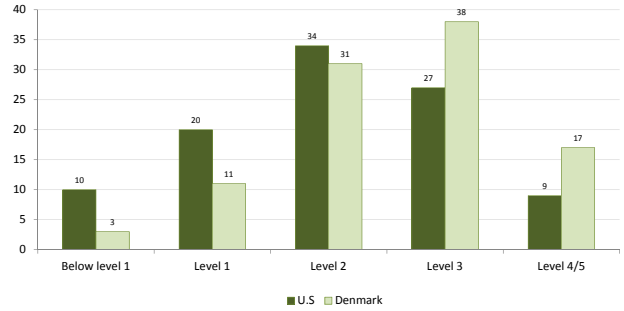
Table A14: Educational levels and source of finance, Denmark and the U.S.

	Denmark		U.S.	
Age	*Level/Grade*	*Public funding*	*Level/Grade*	*Public funding*
0	52 weeks leave shared between parents	$200–600 per week publicly funded		
1	Daycare or family care	$14,000 funded (75%) from municipality*		
2	Daycare or family care	$14,000 funded (75%) from municipality*		
3	Preschool, daycare, or family care	$10–14,000 funded (75%) from municipality*	Preschool	Most states: free below poverty line†
4	Preschool	$10,000 funded (75%) from municipality*	Preschool	Most states: free below poverty line†
5	Preschool	$10,000 funded (75%) from municipality*	Preschool	Most states: free below poverty line†
6	Kindergarten	Funded by municipality	Kindergarten	Funded by school district, state, and federal
7	1st grade	-	1st grade	-
8	2nd grade	-	2nd grade	-
9	3rd grade	-	3rd grade	-
10	3rd grade	-	4th grade	-
11	6th grade	-	5th grade	-
12	5th grade	-	6th grade	-
13	7th grade	-	7th grade	-
14	8th grade	-	8th grade	-
15	9th grade	-	9th grade, high school	-
16	1st year gymnasium or vocational	Funded by municipality/state	10th grade, high school	Funded by school district, state, and federal
17	2nd year gymnasium or vocational	Fund. by municipality/state + educational support	11th grade, high school	Funded by school district, state, and federal
18	3rd year gymnasium or vocational	-	12th grade, high school	Funded by school district, state, and federal
19	1st year university/college	Funded by state + educational support	College, undergraduate, freshman	Funded by state, federal, and private donations/tuition
20	2nd year university/college	-	College, undergraduate, sophomore	Funded by state, federal, and private donations/tuition
21	3rd year university/college	-	College, undergraduate, junior	Funded by state, federal, and private donations/tuition
22	4th year university/college	-	College, undergraduate, senior	Funded by state, federal, and private donations/tuition
23	5th year university	-	Varying graduate	Funded by state, federal, and private donations/tuition
24	1st year PhD	Public scholarships for tuition/income	Varying graduate	Funded by state, federal, and private donations/tuition
25	2nd year PhD	Public scholarships for tuition/income	Varying graduate	Funded by state, federal, and private donations/tuition
26	3rd year PhD	Public scholarships for tuition/income	Varying graduate	Funded by state, federal, and private donations/tuition

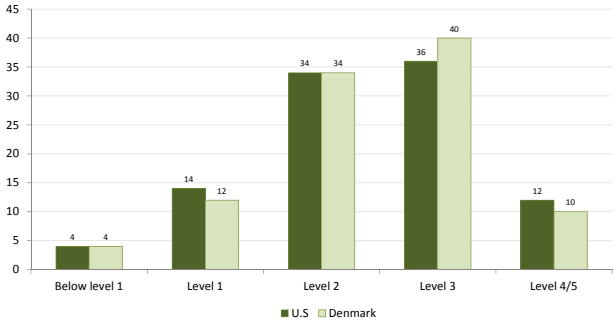
*: Highest rate of parental payment. Means tested for low incomes where subsidies increase to 100%.
†: Eligibility rules for Head Start: http://eclkc.ohs.acf.hhs.gov/hslc/standards/hspps/1305/1305.4%20age%20of%20children%20and%20family%20income.htm.
Note: Table provides an broad overview of the *educational ladders* in Denmark and the U.S. together with levels of public funding at each educational level.
Source: Denmark: Denmark Ministry of Education, Ministry of Children, Gender Equality, Integration, and Social Affairs, Statistics Denmark. U.S.: http://nces.ed.gov/.

Figure A7: Percentage of adults ages 16 to 65 at each level of proficiency, 2012

(a) PIAAC numeracy scale



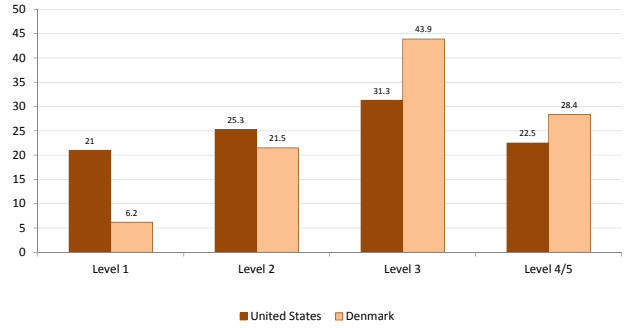
(b) PIAAC literacy scale



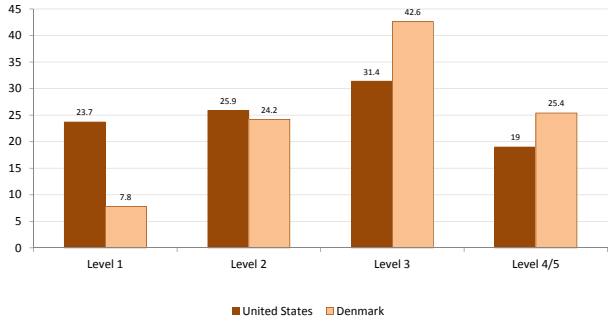
Source: National Center for Education Statistics (2013).

Figure A8: Percent of population aged 16–65, IALS 1994–1998

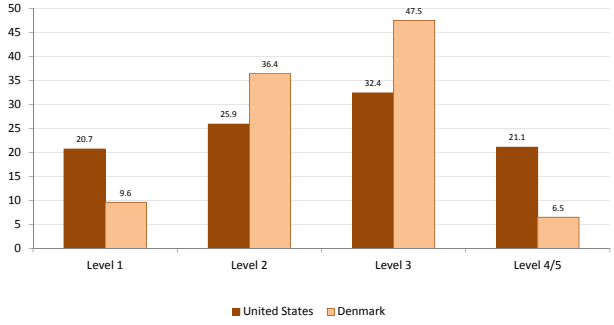
(a) Quantitative literacy level



(b) Document literacy level

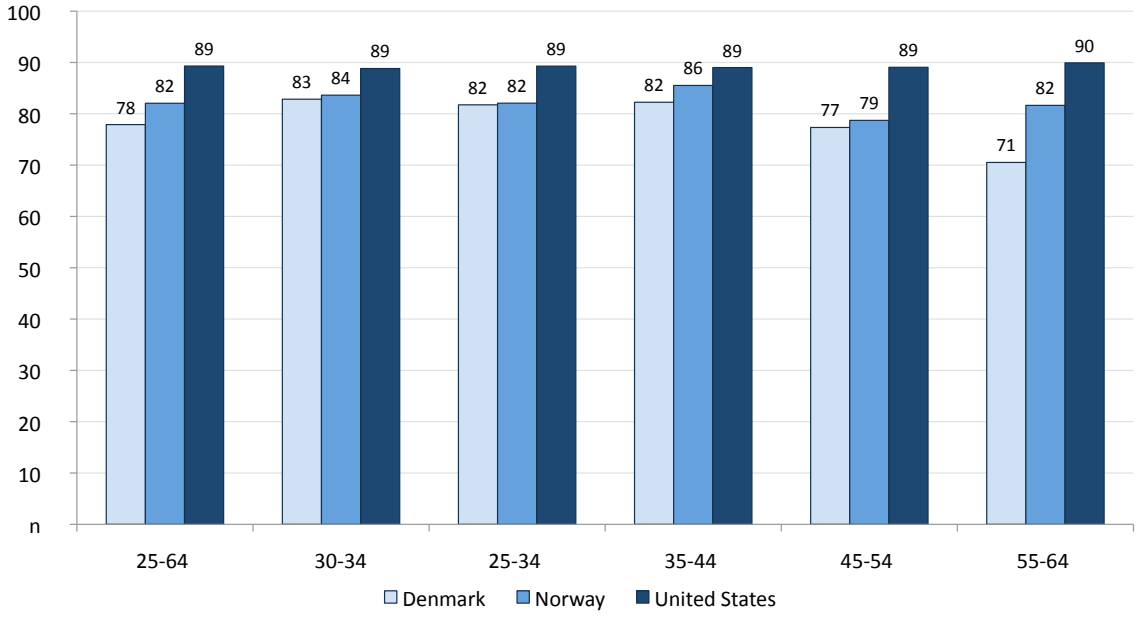


(c) Prose literacy level



Source: Organisation for Economic Co-operation and Development (2000).

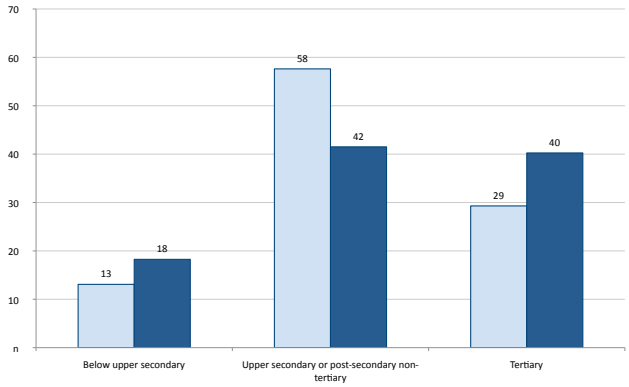
Figure A9: Proportion of the population that has attained at least upper secondary education, by age group (2012), Denmark, Norway, and the U.S.



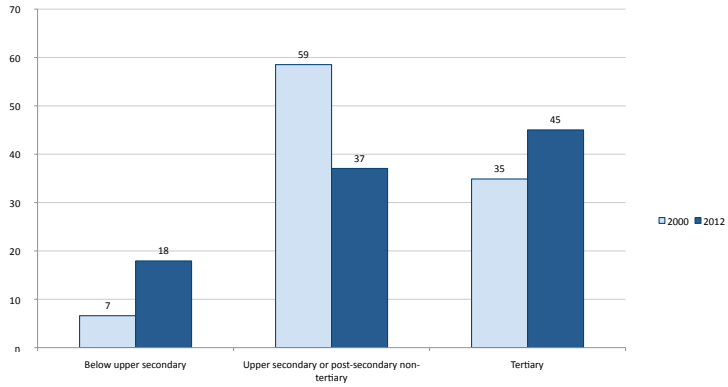
Note: Figure shows proportion of the population that has attained at least upper secondary education, by age group in 2012, for Denmark, Norway, and the U.S.
Source: Organisation for Economic Co-operation and Development (2014, Table A1.2a).

Figure A10: Levels of educational attainment in 2000 and 2012, Denmark, Norway, and the U.S.

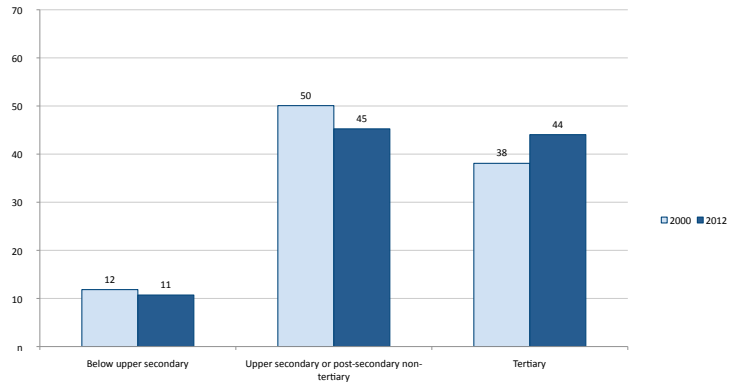
(a) Denmark



(b) Norway

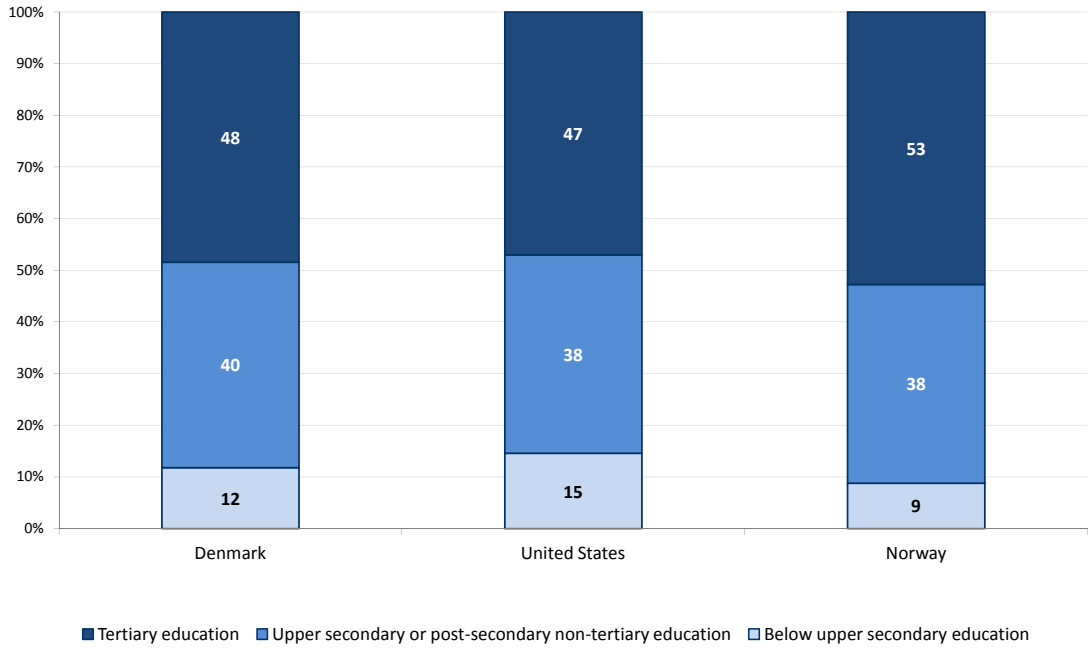


(c) U.S.



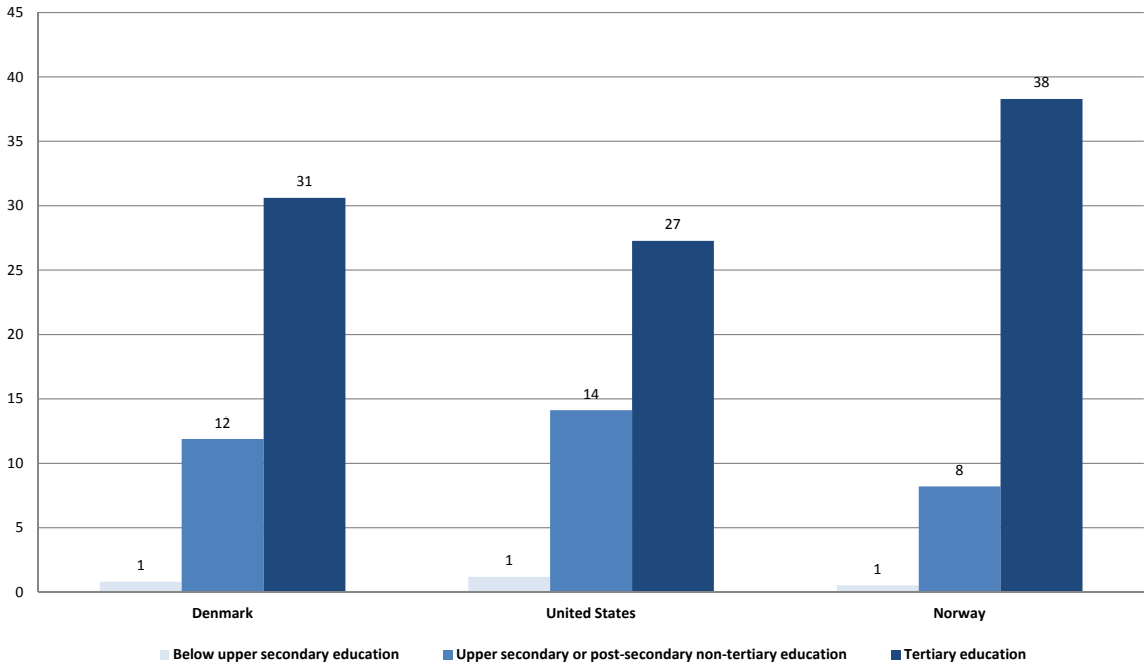
Note: Figure shows fraction of 25–34 year olds with below upper secondary, upper secondary or post-secondary (non-tertiary), and tertiary education in 2000 and 2012, for Denmark, Norway, and the U.S. *Source:* Organisation for Economic Co-operation and Development (2014, Table A1.4a).

Figure A11: Parents' educational attainment in the total population of 20–34 year olds, Denmark, Norway, and the U.S.



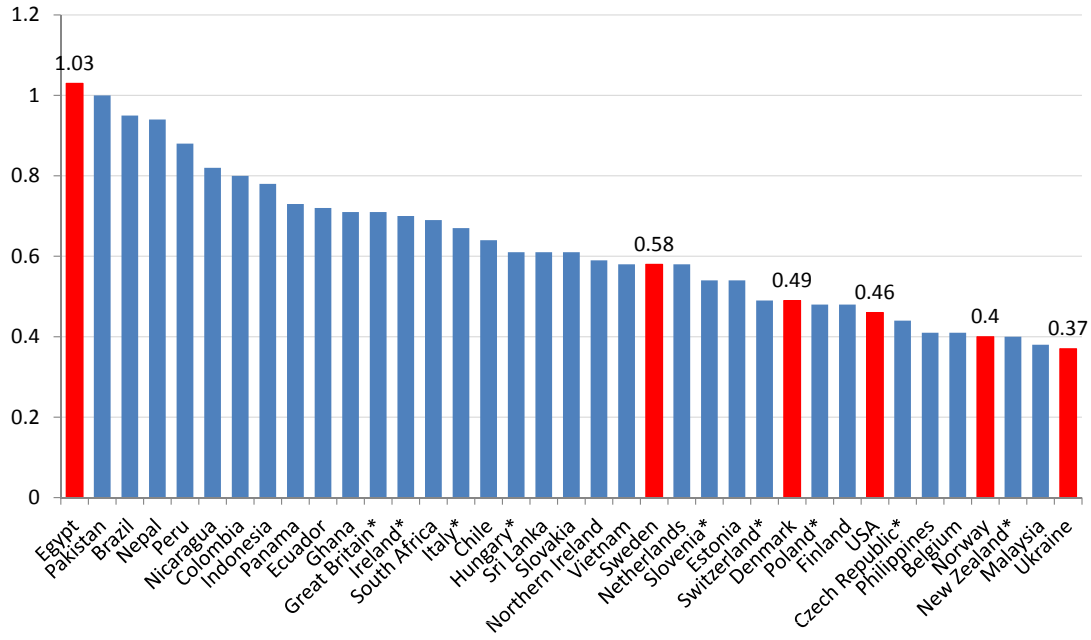
Note: Figure shows fraction of parents with different levels of educational attainment (below upper secondary, upper secondary or post-secondary (non-tertiary), and tertiary education) in 2012, for full populations (students and non-students) in Denmark, Norway, and the U.S.
Source: Organisation for Economic Co-operation and Development (2014, Chart A4.1).

Figure A12: Total enrollment in tertiary education of 20–34 year olds by parents' educational attainment (below upper secondary, upper secondary or post-secondary (non-tertiary), and tertiary education) in 2012, for Denmark, Norway, and the U.S.



Note: Figure shows proportion of 20–34 year olds in tertiary education, by parents' educational attainment (below upper secondary, upper secondary or post-secondary (non-tertiary), and tertiary education), as fraction of all 20–34 year olds, in 2012, for Denmark, Norway, and the U.S.
Source: Own calculations based on Organisation for Economic Co-operation and Development (2014, Chart A4.1).

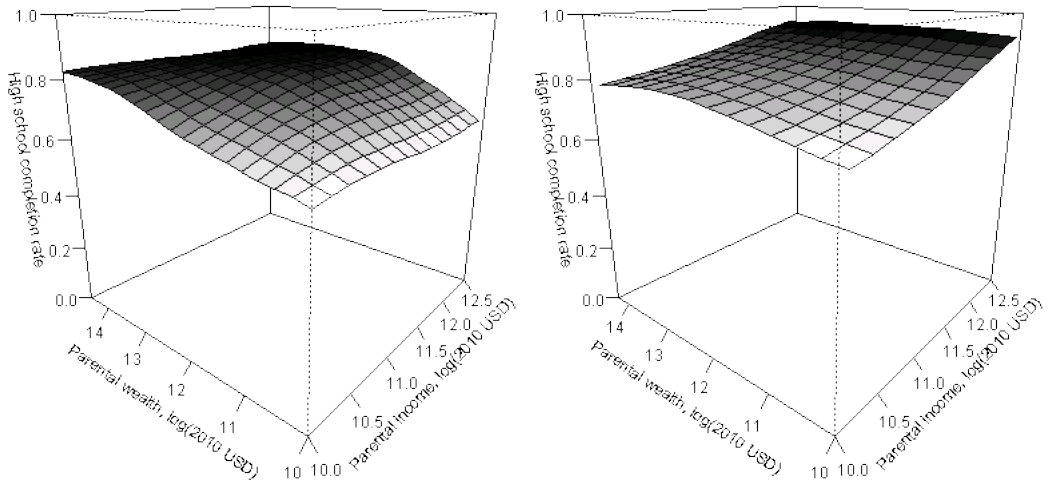
Figure A13: Intergenerational education coefficients from average parent-child schooling, ages 20–64



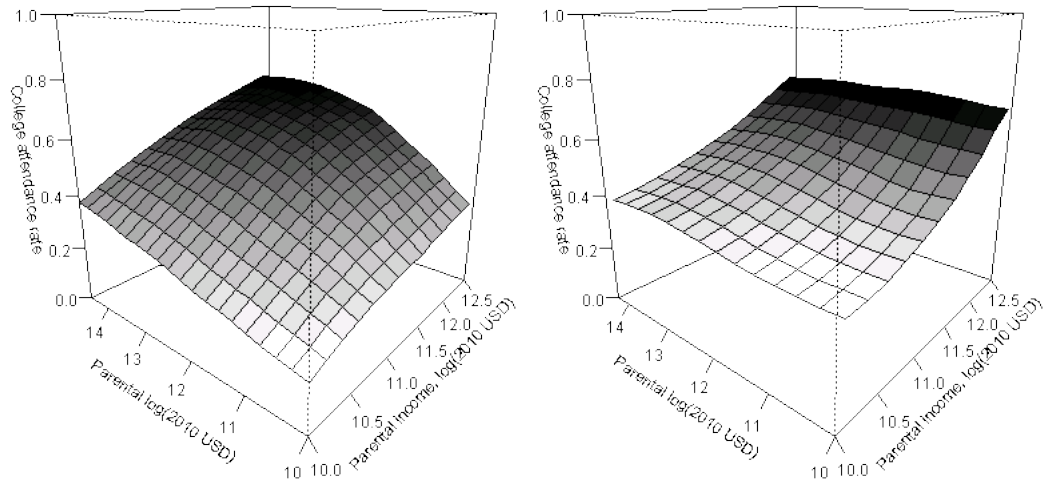
Note: Figure shows coefficients from children's years of schooling on average parents' years of schooling measured in the population aged 20–64, for different countries. Surveyed between 1994 and 2004, except Peru (1985), Malaysia (1988) and Pakistan (1991). * Ages 20 to 64 or 65 only.
Source: Hertz et al. (2008).

Figure A14: High school completion and college attendance by parental income and wealth level (where there is overlap in support)

(a) High school completion, U.S. **(b)** High school completion, Denmark



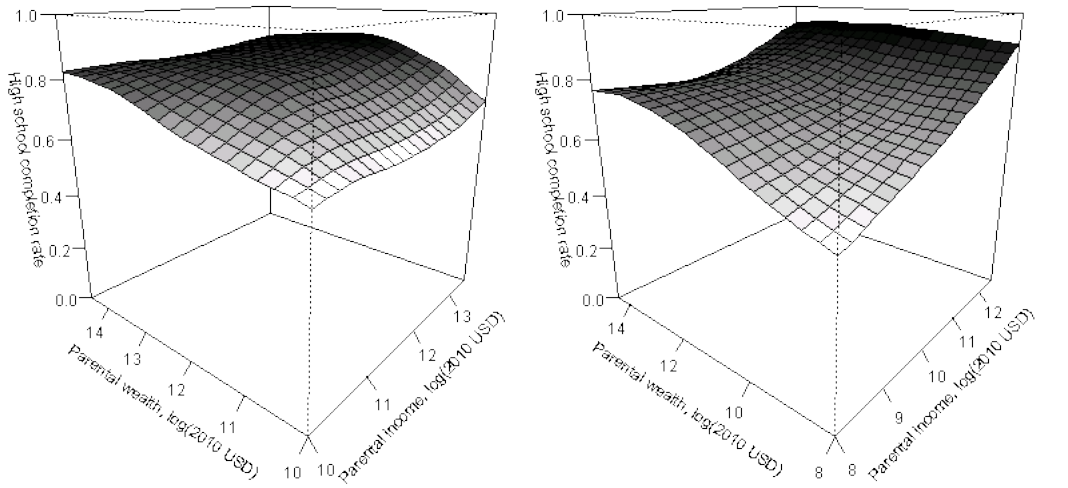
(c) College attendance, U.S. **(d)** College attendance, Denmark



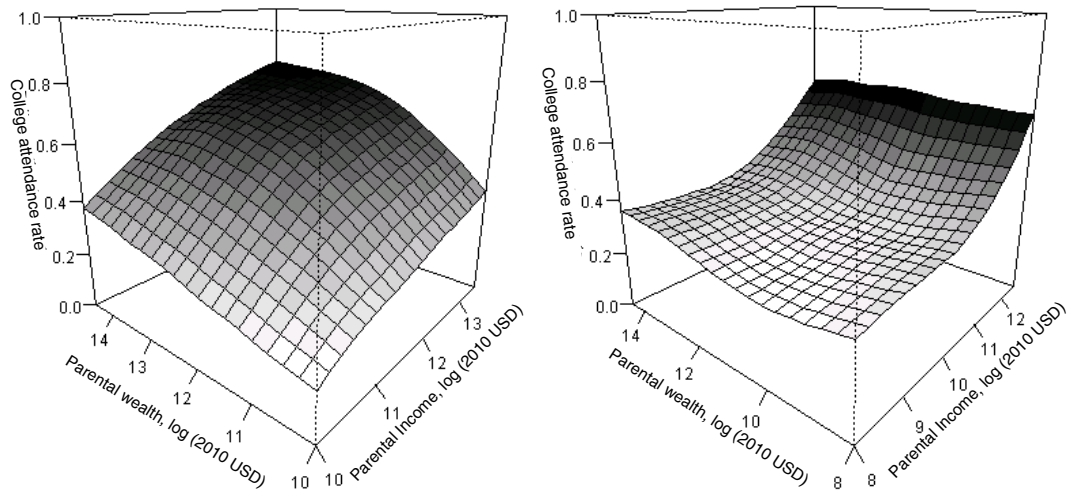
Note: Figures show children's high school completion and college attendance rates by parental levels of income and net wealth for the ranges of income and wealth where we have overlap in support between the two countries. The figures are constructed using data from the CNLSY for the U.S. and administrative register data on the full cohort born in 1987 for Denmark. In the CNLSY data, we measure income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure income as the sum of the mother's and father's wage earnings. For both countries, we measure income as average income between the child's 3rd and 15th year. For the U.S., we measure assets as reported net assets in the CNLSY. For Denmark, assets are measured as net assets (excluding pension savings) from income and wealth data reported to tax authorities. In both countries, we measure assets at age 15 of the child. The corresponding results by parental income and wealth quantiles are shown in Figure A16 and the figures for the full ranges of support in each country are shown in Figure A14. Colors indicate levels of the outcome variable on the z-axis (high school completion and college attendance). Lighter indicates a lower levels and darker indicates higher level of the outcome.

Figure A15: High school completion and college attendance by parental income and wealth level (all observed levels of income and wealth)

(a) High school completion, U.S. **(b)** High school completion, Denmark



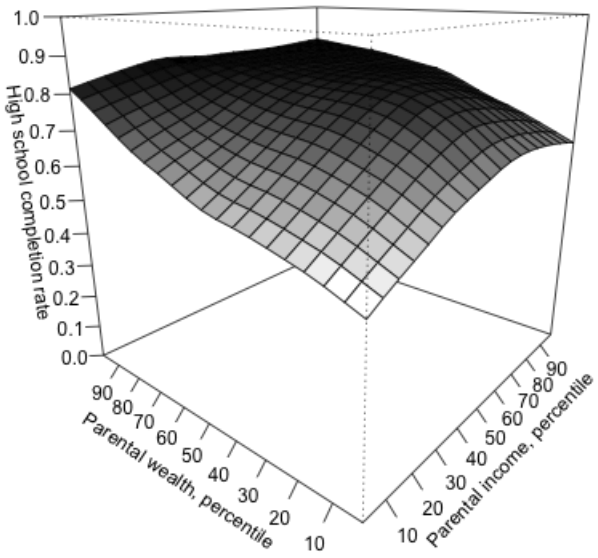
(c) College attendance, U.S. **(d)** College attendance, Denmark



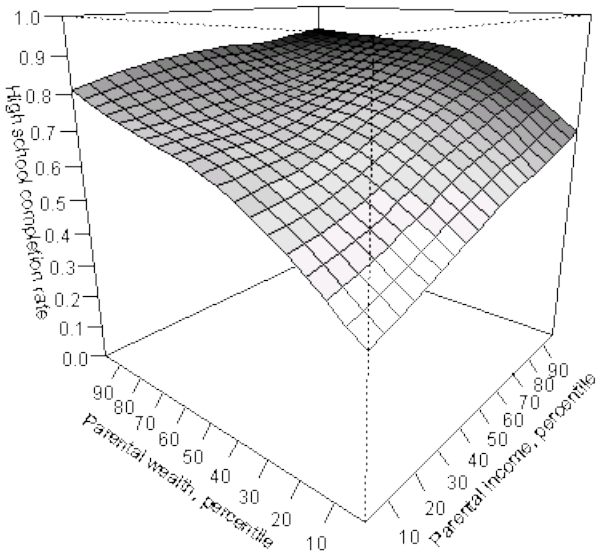
Note: Figures constructed using data from the CNLSY for the U.S. and administrative register data on the full cohort born in 1987 for Denmark. In the CNLSY data, we measure income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure income as the sum of the mother's and father's wage earnings. For both countries, we measure income as average income between the child's 3rd and 15th year. For the U.S., we measure assets as reported net assets in the CNLSY. For Denmark, assets are measured as net assets (excluding pension savings) from income and wealth data reported to tax authorities. In both countries, we measure assets at age 15 of the child. The corresponding results by parental income and wealth quantiles are shown in Figure A16. Colors indicate levels of the outcome variable on the z-axis (high school completion and college attendance). Lighter indicates a lower levels and darker indicates higher level of the outcome.

Figure A16: High school completion and college attendance by parental income and wealth rank

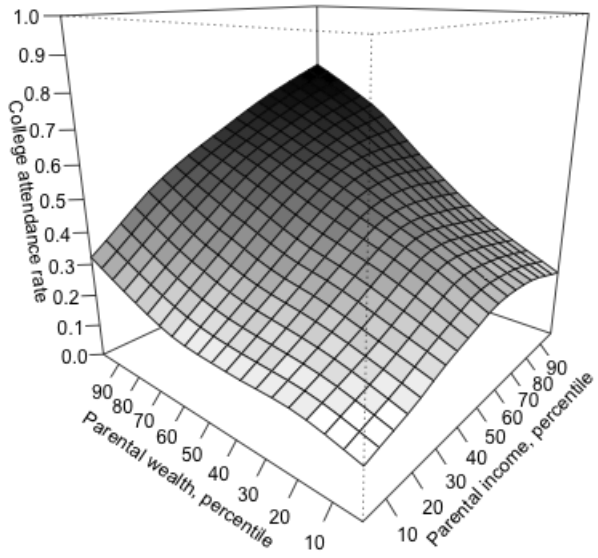
(a) High school completion, U.S.



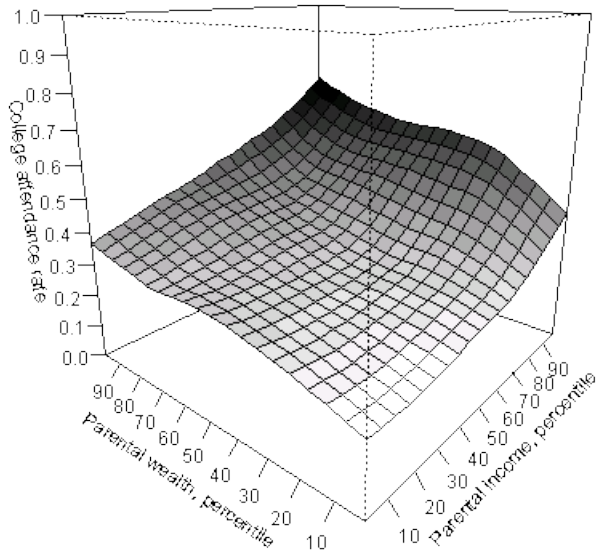
(b) High school completion, Denmark



(c) College attendance, U.S.



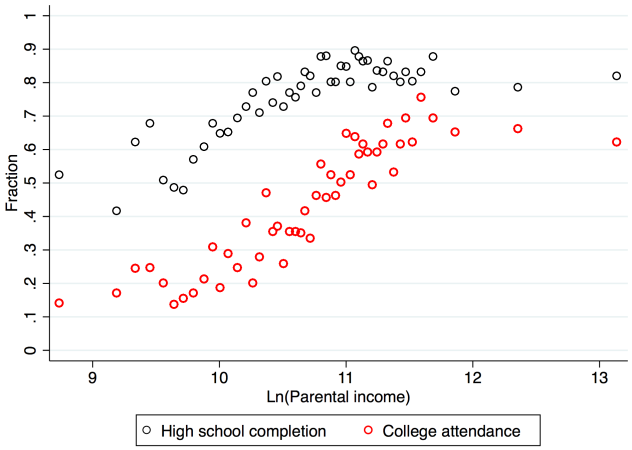
(d) College attendance, Denmark



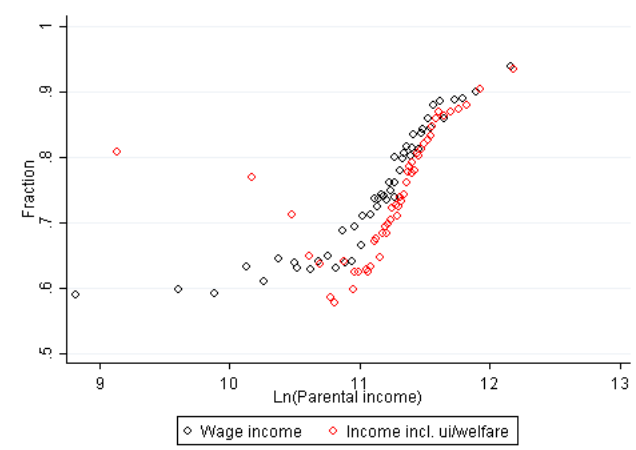
Note: Figures constructed using data from the CNLSY for the U.S. and administrative register data for Denmark. In the CNLSY data, we measure income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure income as the sum of the mother's and father's wage earnings. For both countries, we measure income as average income between the child's 3rd and 15th year. For the U.S., we measure assets as reported net assets in the CNLSY. For Denmark, assets are measured as net assets (excluding pension savings) from income and wealth data reported to tax authorities. In both countries, we measure assets at age 15 of the child. The figures correspond to Figure A14. Colors indicate levels of the outcome variable on the z-axis (high school completion and college attendance). Lighter indicates a lower levels and darker indicates higher level of the outcome.

Figure A17: Schooling and log of parental wage income and wage income including UI and welfare, U.S. vs. Denmark

(a) High school completion and college attendance, U.S.



(b) High school completion, Denmark

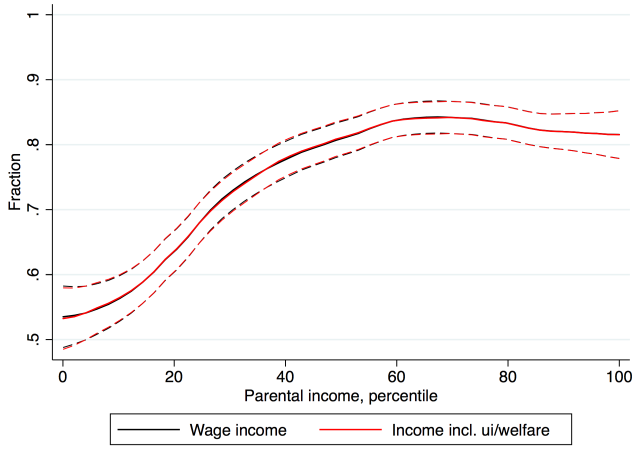


(c) College attendance, Denmark

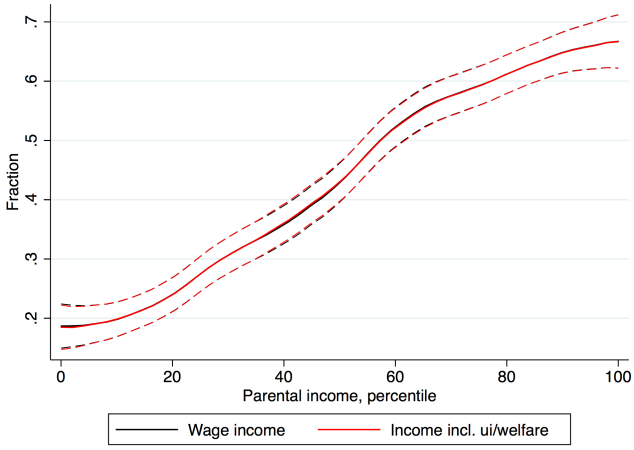
Note: Figures show high school completion and college attendance rates by parental income levels (permanent wage or permanent wage plus public transfers), using the CNLSY and the full cohort born in 1987 in Denmark. In the CNLSY data, we measure wage income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure wage income as the sum of the mother's and father's wage earnings. In both countries, wage income + UI/welfare is measured as wage income and all information on reception of public benefits (survey information from CNLSY in the U.S. and register data from tax records in Denmark). For both countries, we measure income as average income between the child's 3rd and 15th year. Bins calculated as means of every second income percentile for each income measure, respectively. Results for wage income + UI and welfare benefits in the U.S. not shown.

Figure A18: Schooling and parental income rank by parental wage income or wage income including UI and welfare, U.S. vs. Denmark

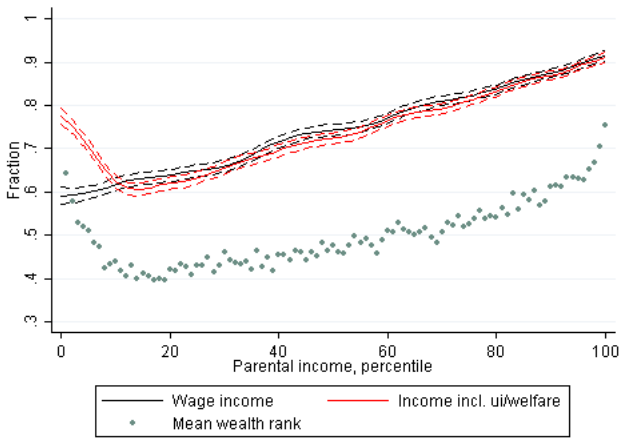
(a) High school completion, U.S.



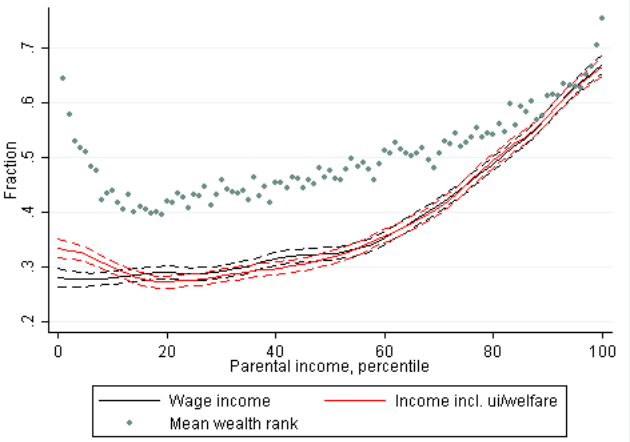
(b) College attendance, U.S.



(c) High school completion, Denmark



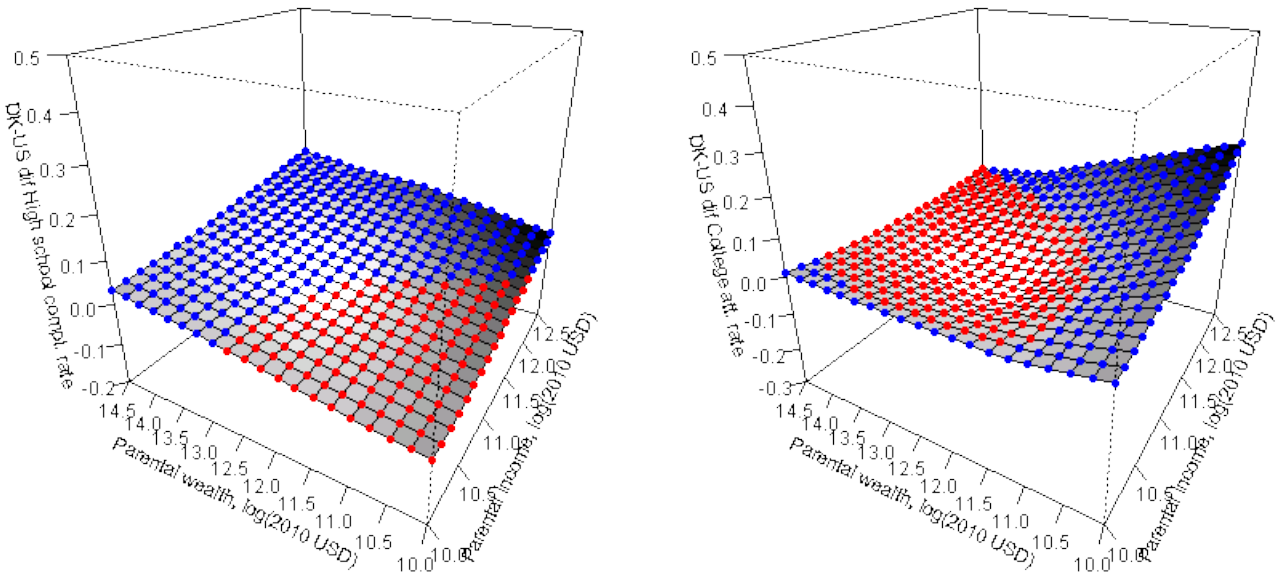
(d) College attendance, Denmark



Note: Figures show high school completion and college attendance rates for Denmark and the U.S. constructed from CNLSY data and the cohort born in 1987 in Denmark. The dashed lines indicate 95% confidence intervals. Scatterplots in Figures c and d shows parental mean wealth rank by bins of percentiles of wage income plus public benefits.

Figure A19: U.S./Denmark differences in high school completion and college attendance by parental income and wealth level

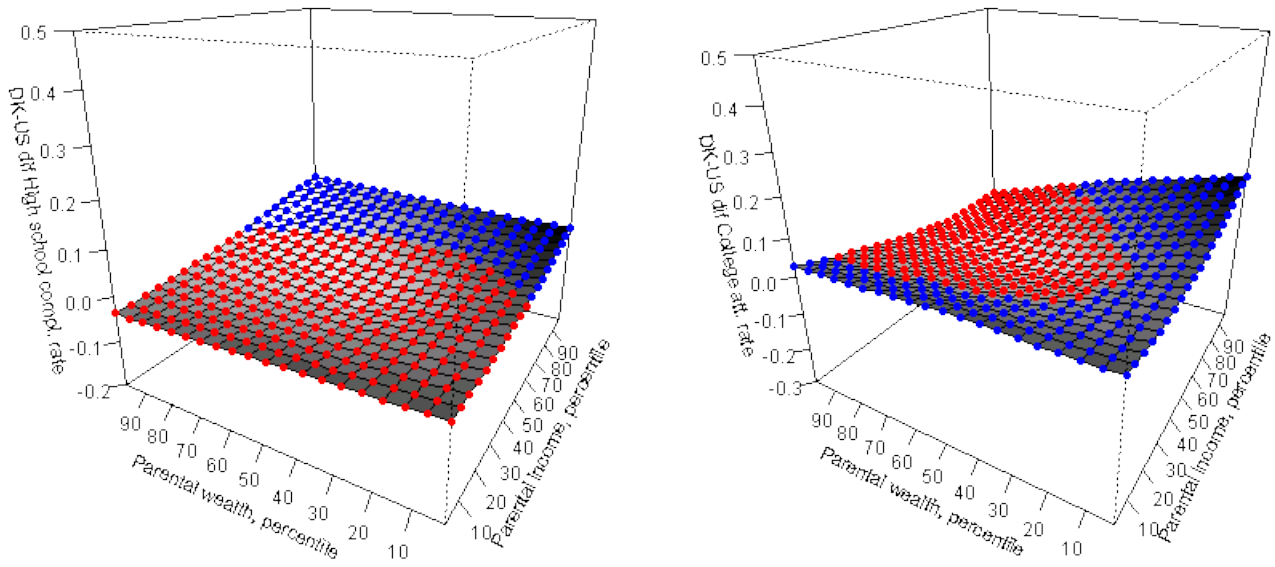
(a) High school completion **(b)** College attendance



Note: Figures constructed using data from the CNLSY for the U.S. and administrative register data on the full cohort born in 1987 for Denmark. Figures show U.S. level of college attendance minus the Danish level by log levels of parental permanent income and wealth.
In the CNLSY data, we measure income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure income as the sum of the mother's and father's wage earnings. For both countries, we measure income as average income between the child's 3rd and 15th year. For the U.S., we measure assets as reported net assets in the CNLSY. For Denmark, assets are measured as net assets (excluding pension savings) from income and wealth data reported to tax authorities. In both countries, we measure assets at age 15 of the child.
The corresponding results be parental income and wealth quantiles are shown in Figure A20.
Red indicates that the U.S. level is higher than the Danish level for a given combination of parental income/wealth. Blue indicates that the Danish level is higher than the U.S. level for a given combination of parental income/wealth.

Figure A20: U.S./Denmark differences in high school completion and college attendance by parental income and wealth rank

(a) High school completion **(b)** College attendance



Note: Figures constructed using data from the CNLSY for the U.S. and administrative register data for Denmark. In the CNLSY data, we measure income using the sum of the mother's and her spouse's self-reported wage earnings and for Denmark, we measure income as the sum of the mother's and father's wage earnings. For both countries, we measure income as average income between the child's 3rd and 15th year. For the U.S., we measure assets as reported net assets in the CNLSY. For Denmark, assets are measured as net assets (excluding pension savings) from income and wealth data reported to tax authorities. In both countries, we measure assets at age 15 of the child. The figures correspond to Figure A19. Red indicates that the U.S. level is higher than the Danish level for a given combination of parental income/wealth. Blue indicates that the Danish level is higher than the U.S. level for a given combination of parental income/wealth.

Table A15: Regression coefficients for high school completion and college attendance on parental resources, with equal year of birth distributions and sample sizes

	(1) *U.S., CNLSY*	(2) *Denmark, cohort 1987*	(3) *Denmark, cohort distribution as in CNLSY*	(4) *Denmark, cohort distribution and sample size as in CNLSY*
Parental permanent wage income ages 3–15	0.033***	0.066***	0.061***	0.058***
	(0.009)	(0.003)	(0.002)	(0.008)
Parental wealth (net assets) age 15	0.020***	0.037***	0.043***	0.043***
	(0.003)	(0.001)	(0.001)	(0.004)
College attendance				
Parental permanent wage income ages 3–15	0.063***	0.061***	0.058***	0.058***
	(0.010)	(0.003)	(0.002)	(0.008)
Parental wealth (net assets) age 15	0.022***	0.034***	0.033***	0.030***
	(0.003)	(0.001)	(0.001)	(0.004)
Observations	3,268	39,539	50,006	3,268

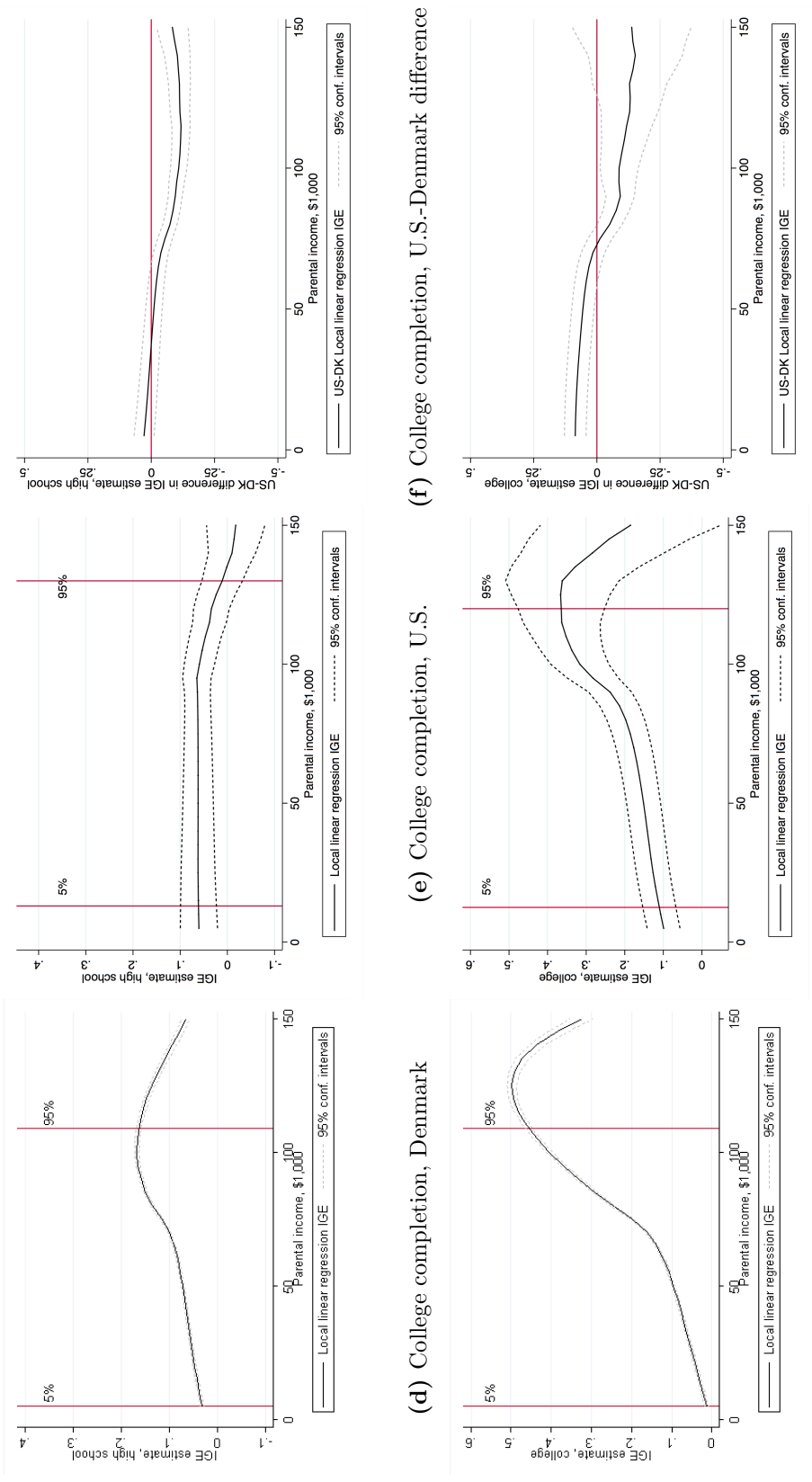
Note: Table shows regression coefficients of children's high school completion and college attendance on parental permanent wage income and wealth for the U.S. and Denmark as shown in Table 4 (columns 1 and 2), and using Danish data with similar cohort distribution as in the CNLSY sample in column 3 and Danish register data with similar cohort distribution and sample size as in the CNLSY sample in Column 4.
$^{+}$: $p < 0.1$, *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

Table A16: Regression coefficients for high school completion and college attendance on ranks of parental resources using different conditioning sets

	(1)	(2)	(3)	(4)	(5)	(6)
U.S., High school completion						
Parental permanent wage income ages 3–15	0.1650***	0.1280***	0.1005***	0.1434***	0.0687+	0.0803*
	(0.0351)	(0.0369)	(0.0364)	(0.0348)	(0.0366)	(0.0366)
Parental wealth (net assets) age 15	0.2006***	0.1678	0.1438***	0.1340***	0.1368***	0.0980**
	(0.0349)	(0.0381)	(0.0352)	(0.0343)	(0.0352)	(0.0366)
Denmark, High school completion						
Parental permanent wage income ages 3–15	0.2743***	0.2126***	0.1978***	0.2518***	0.1693**	0.0377***
	(0.0076)	(0.0092)	(0.0082)	(0.0077)	(0.0090)	(0.0049)
Parental wealth (net assets) age 15	0.2363***	0.1661***	0.1849***	0.2261***	0.1507***	0.0072
	(0.0076)	(0.0080)	(0.0089)	(0.0076)	(0.0085)	(0.0074)
Δ Parental permanent wage income ages 3–15	-0.1093	-0.0846	-0.0973	-0.1084	-0.1006	0.0426
p-value	0.002	0.026	0.009	0.002	0.008	0.250
Δ Parental wealth (net assets) age	-0.0357	0.0017	-0.0411	-0.0921	-0.0139	0.0908
p-value	0.171	0.968	0.258	0.009	0.701	0.015
U.S., College attendance						
Parental permanent wage income ages 3–15	0.3757***	0.2566***	0.2466***	0.3069***	0.1876***	0.1645***
	(0.0390)	(0.0514)	(0.0408)	(0.0389)	(0.0439)	(0.0422)
Parental wealth (net assets) age 15	0.3152***	0.2497***	0.2287***	0.2506***	0.2134***	0.0181
	(0.0388)	(0.0495)	(0.0393)	(0.0384)	(0.0044)	(0.0411)
Denmark College attendance						
Parental permanent wage income ages 3–15	0.3549***	0.2443	0.1976***	0.2745***	0.1713***	0.1424***
	(0.0100)	(0.0095)	(0.0090)	(0.0086)	(0.0101)	(0.0069)
Parental wealth (net assets) age 15	0.2176***	0.1355***	0.1384***	0.2058***	0.1052***	-0.0081
	(0.0090)	(0.0080)	(0.0084)	(0.0084)	(0.0089)	(0.0081)
Δ Parental permanent wage income ages 3–15	0.0208	0.0123	0.0490	0.0324	0.0163	0.0221
p-value	0.610	0.814	0.241	0.416	0.718	0.605
Δ Parental wealth (net assets) age	0.0976	0.1142	0.0903	0.0448	0.1082	0.0262
p-value	0.014	0.023	0.025	0.254	0.016	0.532
Residualing by:						
θ^C, θ^{NC}		X			X	X
Family background			X		X	X
School characteristics				X		X

Note: Table shows regression coefficients of children's high school completion and college attendance on ranks of parental permanent wage income and wealth (0-1) while gradually increasing conditioning set with skills, family background, and school characteristics. Table is constructed using data from the CNLSY for the U.S. and administrative register data on the full cohort born in 1987 for Denmark. The table also show *p*-values from tests of equal slope coefficients against a two-sided alternative.
Family background variables: child gender (0/1), immigrant/minority (0/1), urban region (0/1), siblings, mother's age at birth, and mother's years of schooling.
School characteristics for the U.S. include: grade for how teachers care about students, grade for whether school is considered safe, a dummy for whether child feels peer pressure to work hard, a dummy for whether child feels peer pressure to skip school, a dummy for whether child has received sex education in school, and a dummy for whether child attends private school. School characteristics for Denmark include: for each school, the means of previous cohort's mother's age at birth, mother's high school completion, and mother's college attendance, high school completion, and college attendance.
Observations: U.S. 3,268; Denmark 39,539.
+: $p < 0.1$, *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

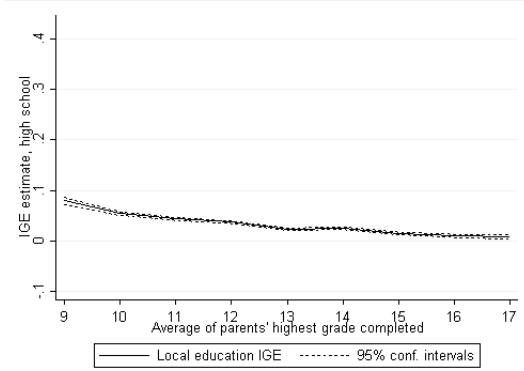
Figure A21: Local Intergenerational Elasticities between children's education and parental log wage earnings, absolute income weights



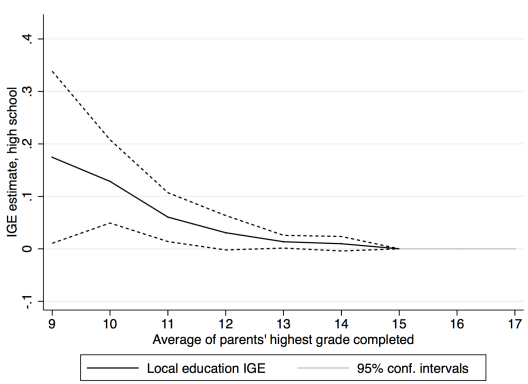
Note: Figures 7a, b, d, and e show local linear regression slopes of children's education (high school completion, college graduation) on log of parental wage earnings for Denmark and the U.S. Figures 7c and f show U.S.-Denmark difference in local Intergenerational Elasticities between children's education and parental log gross income including transfers.
High school completion is defined as highest completed grade ≥ 12, college graduation as highest completed grade ≥ 15. LLRs are weighted using kernels of absolute income. Standard errors constructed from 50 and 1,000 bootstraps, respectively.
The vertical lines mark the 5th and 95th percentiles in the data.

Figure A22: Local Intergenerational regressions between children's high school completion / college graduation and average of parents' highest completed grade

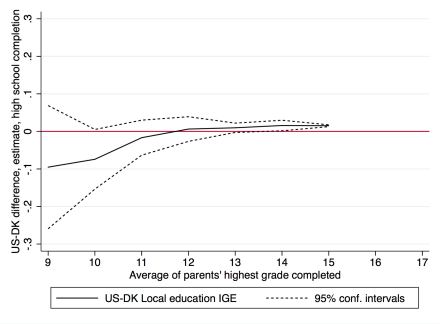
(a) High school completion, Denmark



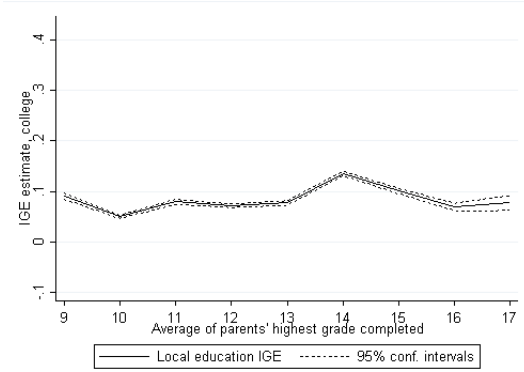
(b) High school completion, U.S.



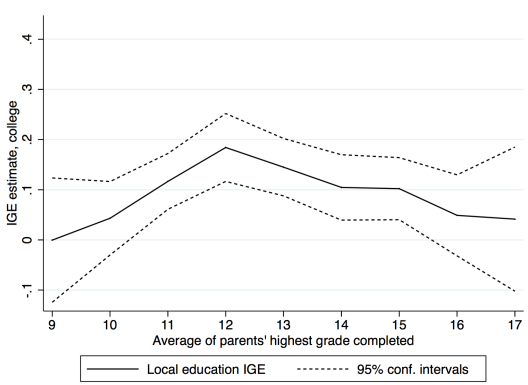
(c) High school completion, U.S.-Denmark difference



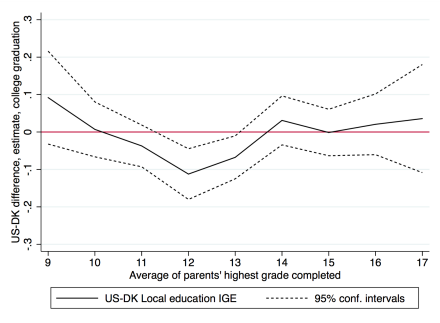
(d) College completion, Denmark



(e) College completion, U.S.



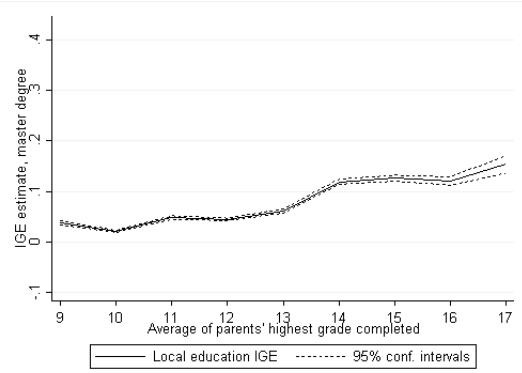
(f) College completion, U.S.-Denmark difference



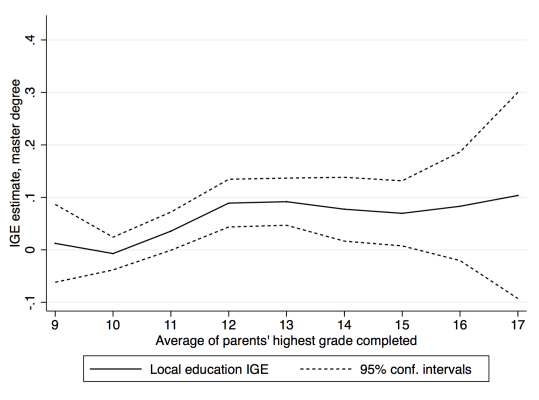
Note: Figures A22a, b, d, and e show local linear regression slopes of children's education (high school completion, college graduation) on average of parents' highest grade completed for Denmark and the U.S. Figures A22c and f show U.S.-Denmark difference in local linear regression slopes between children's education and average of highest grade completed.
High school completion is defined as highest completed grade ≥ 12, college graduation as highest grade completed ≥ 15.
U.S. estimates for high school completion are not reported for parents' average highest grade completed above 15 because there is no variation in the PSID sample.
Standard errors constructed from 50 and 1,000 bootstraps, respectively.

Figure A23: Local Intergenerational regressions between children's master degree / highest grade completed and average of parents' highest grade completed

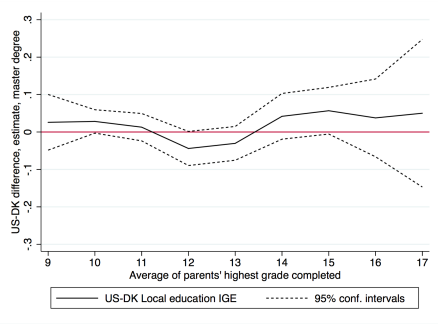
(a) Master degree, Denmark



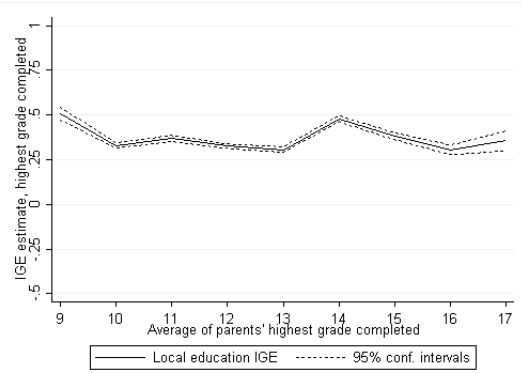
(b) Master degree, U.S.



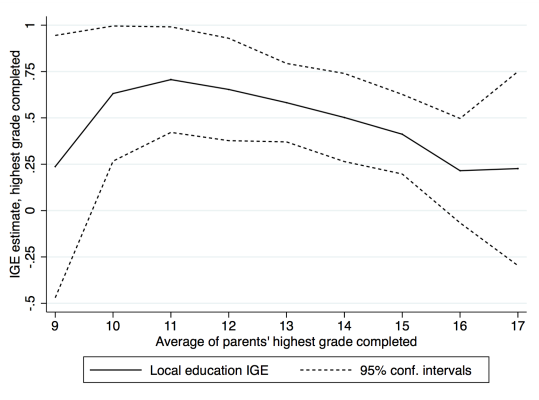
(c) Master degree, U.S.-Denmark difference



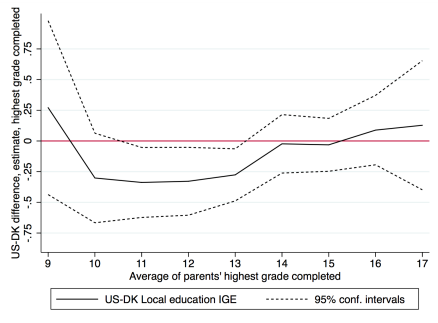
(d) Highest grade completed, Denmark



(e) Highest grade completed, U.S.



(f) Highest grade completed, U.S.-Denmark difference



Note: Figures A22a, b, d, and e show local linear regression slopes of children's education (master degree, highest grade completed) on average of parents' highest completed grade for Denmark and the U.S. Figures A22c and f show U.S.-Denmark difference in local linear regression slopes between children's education and parental log gross income including transfers.
Master degree is defined as ≥ 17, highest grade completed top-coded at 17.
Standard errors constructed from 50 and 1,000 bootstraps, respectively.

B Understanding Trends in Inequality in the U.S. and Denmark

This Appendix investigates the factors leading to the more compressed wage distribution in Denmark compared to the U.S.

B.1 Income

Figure A25 shows trends in wage income and wage income plus public transfers for high school dropouts, high school graduates, and college graduates.[1] In order to facilitate comparisons we use Danish register data and U.S. CPS data.[2] We measure income as wage earnings or wage earnings plus public transfers. Figures A25a, A25b and Figures A25c, A25d show the results for the U.S. and Denmark, respectively. Figures A25a and A25c present the results for the birth cohorts 1927–1958, where income is measured as average income at ages 53 and 54. Figures A25b and A25d present the corresponding results for birth cohorts 1947–1978 using income measured at ages 33 and 34.[3]

The figure shows that in Denmark, wages are more compressed and high school and college premia are not higher during the 1980s than they were 50 years earlier, while schooling premia in the U.S. have more than doubled throughout the same 50 year period. Figure A25a shows that, in the U.S., wage income for individuals with no high school has decreased substantially

[1] Figures A34 and A35 depict the corresponding evolutions by gender. The figures confirm that the trends described in this section are shared by both sexes and not driven by women's increased labor force and employment rates.

[2] We construct the samples using similar definitions for both countries. For Denmark, we use administrative register data with information on income and education measured at ages 53–54 for the cohorts born in 1927–1958 (because the Danish data is only available from 1980 and onwards), and income and education measured at ages 33–34 for the cohorts born in 1947–1978. Each cohort contains around 50,000–70,000 individuals. For the U.S., we use CPS data for civilian, non-institutionalized citizens aged 33–34 and 53–54 in each wave. We obtain samples consisting of 116,604 individuals from the 1927–1958 cohorts and 169,860 individuals from the 1947–1978 cohorts. For the Danish data, we measure the income for the former group at ages 53–54 and for the latter group at ages 33–34 in the CPS data.

[3] Figure A25 contains several limitations: that they are not causal estimates and that they do not measure income at the same age, among others. Hence, Figures A25a and A25c may capture both a generation effect and changes that have happened later in their life, while A25b and A25d only incorporate the former mechanism.

between the birth cohorts 1927 and 1958, while high school and college graduates' income has increased; the high school premium doubled and the college premium increased by 25–30% over this 30 year period. Figure A25b shows that income for high school dropouts and graduates stagnated for later cohorts in the U.S., while college graduates' income levels increased by 20–30%. Thus, the difference between high school dropouts' and college graduates' income measured at ages 33–34 has increased by 50% from the 1947 cohort to those born in the late 1970s. For Denmark, we see a different evolution across the same cohorts. From Figure A25c we see that income levels increased monotonically from cohorts born during early 1930s to the early 1950s. The increases were relatively larger for high school dropouts in earlier cohorts, while for later cohorts (Figure A25d), only high school graduates experienced an absolute and relative income increase. Hence, from cohorts 1927 to 1958, the least educated experienced a large absolute and relative increase in income, while recently high school premia have risen 50–75% and college premia have stagnated.

The evolution in income should be viewed relative to the evolution in employment rates (which we will show in Figure A32). As employment rates of high school dropouts in the U.S. have remained relatively constant, the lower income levels suggest that the reduction stems from lower wages, whereas the corresponding employment rates in Denmark dropped by 30% from 1955 to 1985. Yet high school dropouts' average wage income only decreased by 10%, implying that their wage rates increased.

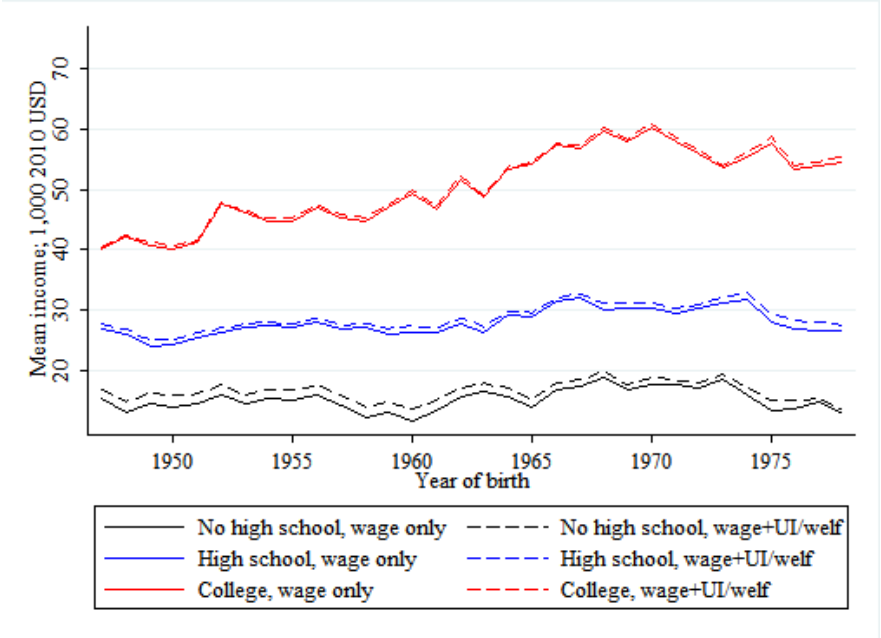
Also, Figures A28a and A28b show wage income and wage income plus public transfers at age 26 for high school dropouts by levels of cognitive and non-cognitive skills. Income levels in Denmark, irrespective of skills, are substantially above U.S. levels. Hence, the cross-country difference is not driven by low incomes for the very least skilled U.S. high school dropouts, but rather an overall level difference.

Finally, Figures A25a and A25b also illustrate the schism in levels of public benefits between the U.S. and Denmark. In the U.S., income levels hardly differ by whether we include or exclude public transfers from income, but they substantially affect the results for

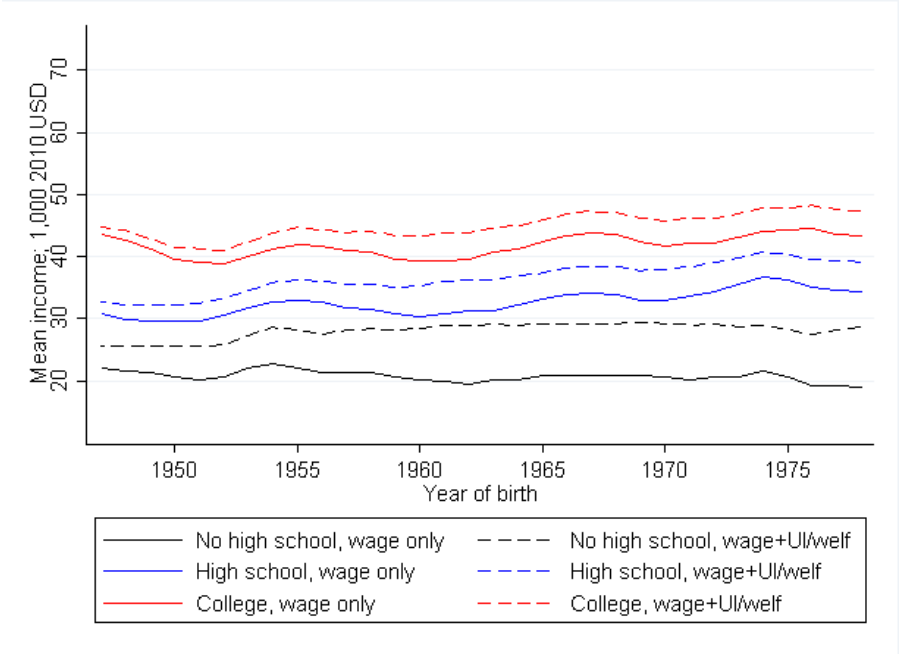
Denmark. As seen from Figures A25c and A25d, public transfers constitute an increasing fraction of income in Denmark, in particular for individuals who have not completed high school. Here, average wage earnings decreased by 10% from the 1947 birth cohort to the 1978 birth cohort, while wage earnings plus public transfers increased by 10%.

Figure A24: Wage earnings and wage earnings plus public transfers levels by education, cohorts 1947–1978

(a) U.S., cohorts 1947–1978



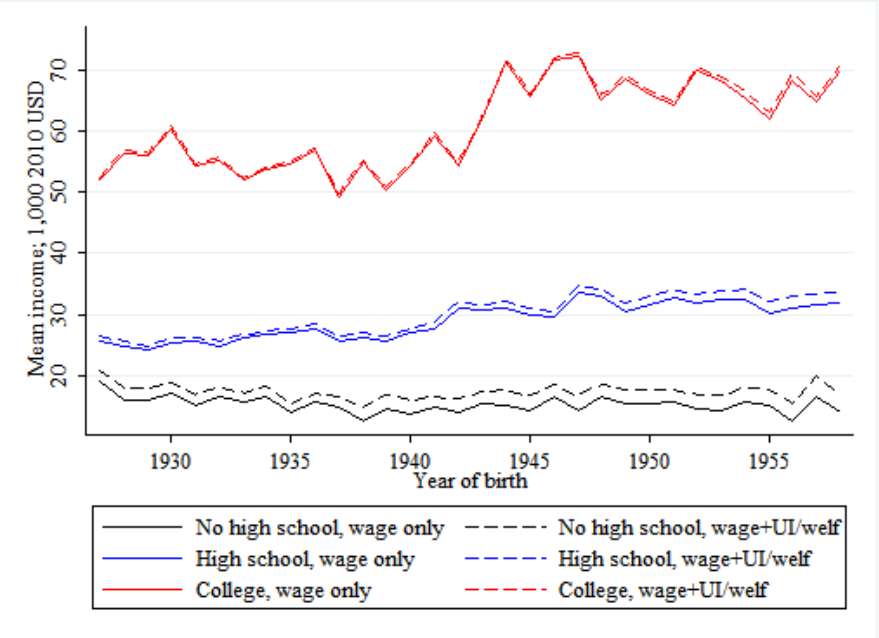
(b) Denmark, cohorts 1947–1978



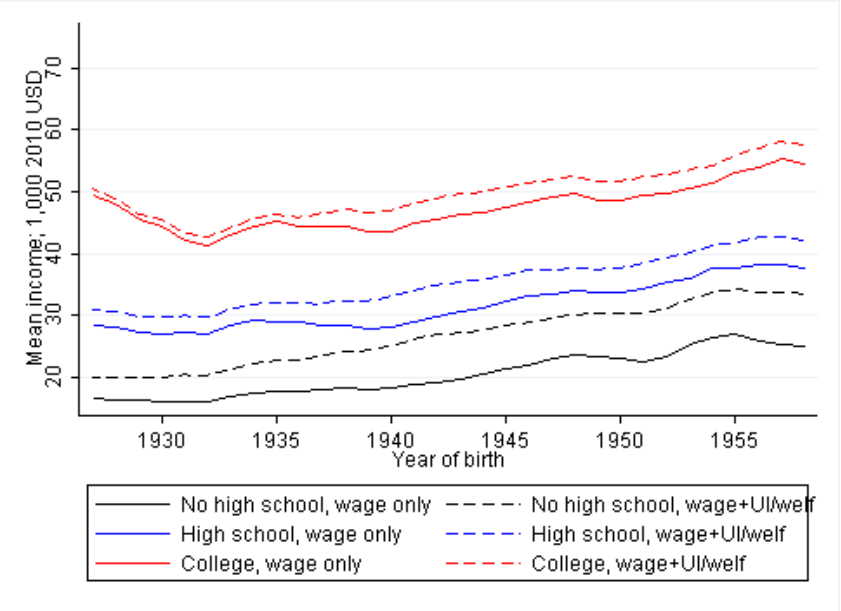
Note: Figures show levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 33–34. Figures constructed from Danish administrative register data and U.S. March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). *Less than high school/high school dropout*: less than 12 years of schooling; *High school graduates*: 12–14.9 years of schooling; *College graduates*: 15 + years of schooling.

Figure A25: Wage earnings and wage earnings plus public transfers by education, cohorts 1927–1958

(a) U.S., cohorts 1927–1958



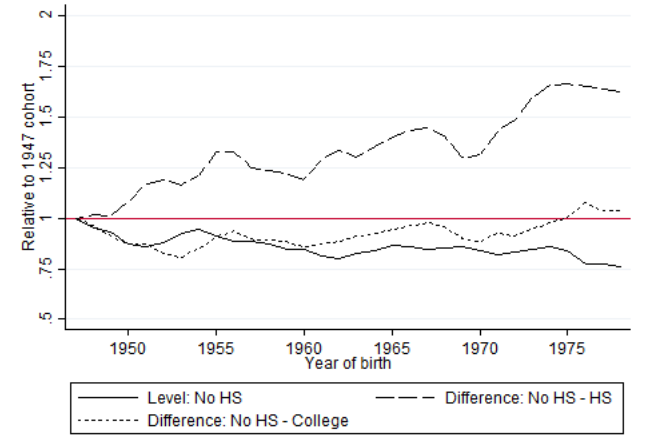
(b) Denmark, cohorts 1927–1958



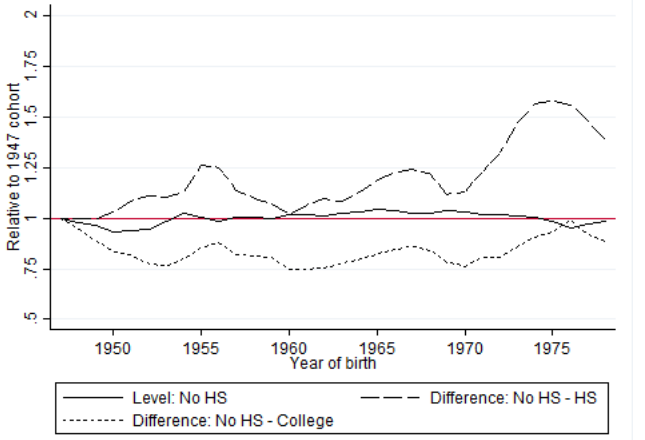
Note: Figures show levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 53–54. Figures constructed from Danish administrative register data and U.S. March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). *Less than high school/high school dropout*: less than 12 years of schooling; *High school graduates*: 12–14.9 years of schooling; *College graduates*: 15 + years of schooling.

Figure A26: Evolution of schooling premiums at ages 33–34, cohort 1947–1985, indexed

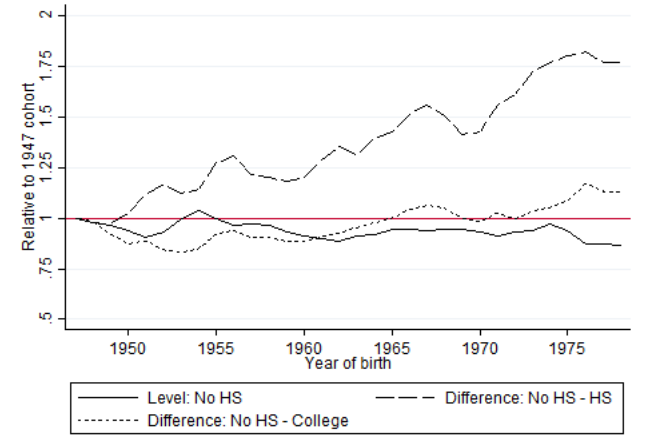
(a) Gross income excl. public transfers



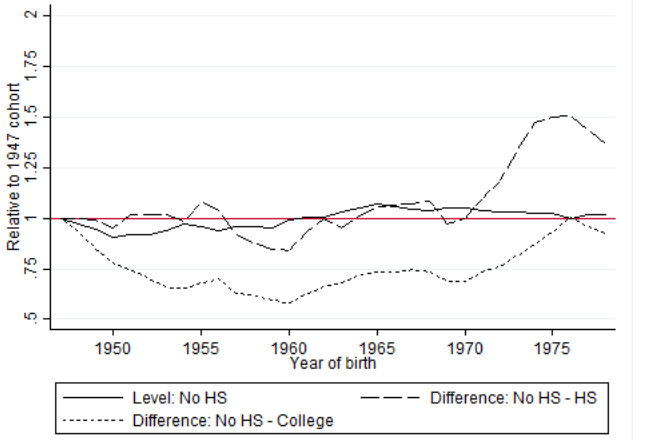
(b) Gross income incl. public transfers



(c) Wage income



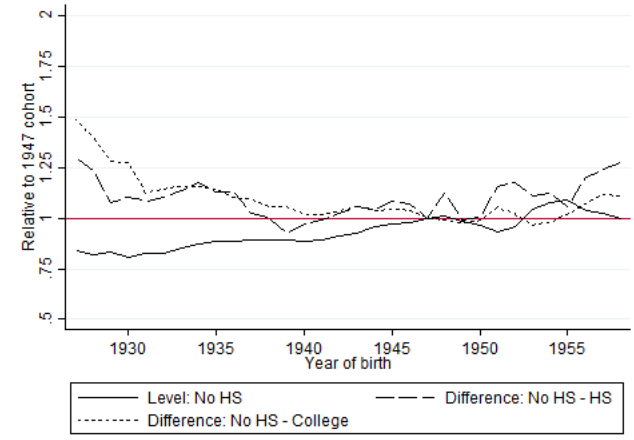
(d) Net-of-tax income



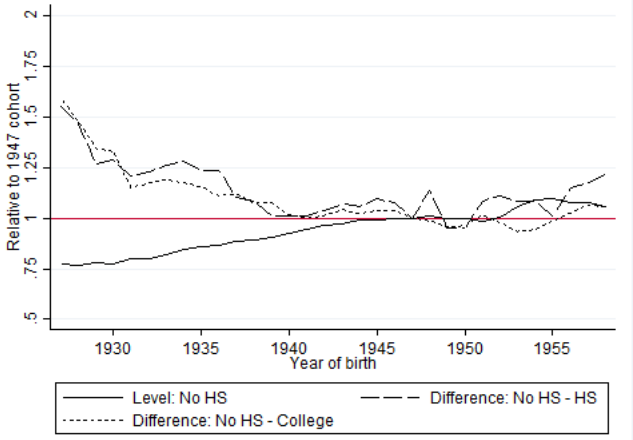
Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947*, and high school and college graduates indexed relative to *the high school/college premium in cohort of 1947*. Figures are constructed using levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 33–34.

Figure A27: Evolution of schooling premiums at ages 53–54, cohort 1927–1958, indexed

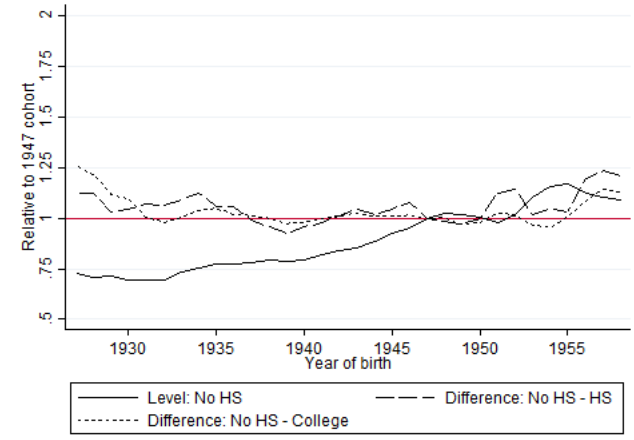
(a) Gross income excl. public transfers



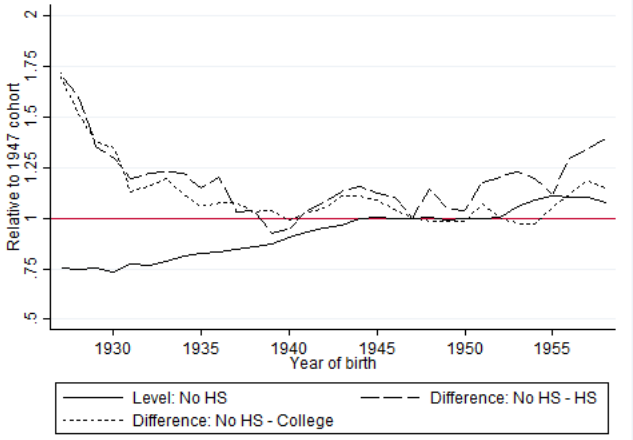
(b) Gross income incl. public transfers



(c) Wage income



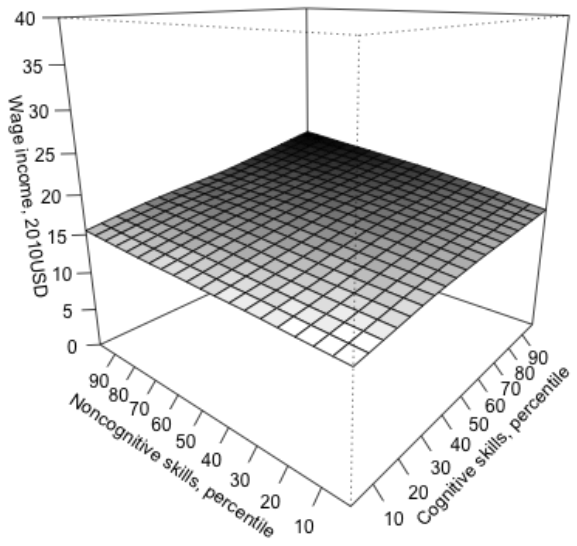
(d) Net-of-tax income



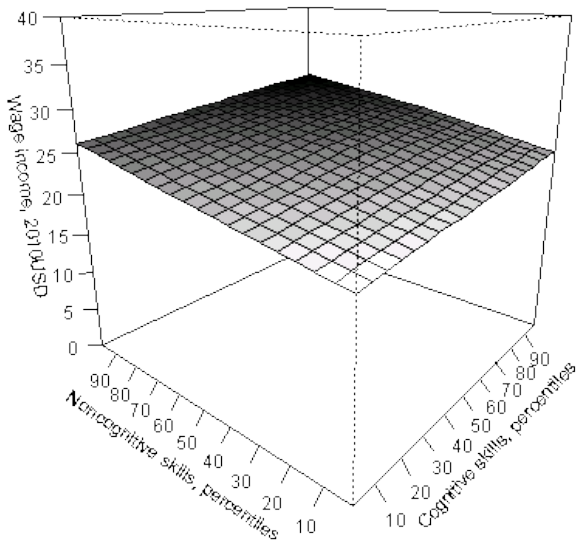
Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947* and high school and college graduates indexed relative to *the high school/college premium in cohort of 1947*. Figures are constructed using levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 53–54.

Figure A28: Income by cognitive and non-cognitive skills, for high school dropouts

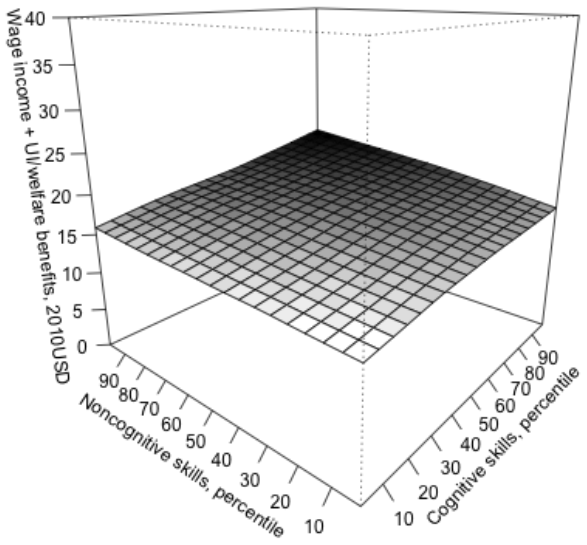
(a) Wage income, U.S.



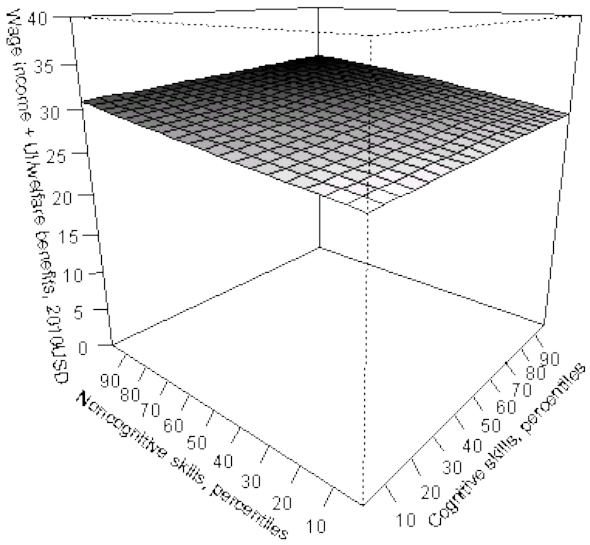
(b) Wage income, Denmark



(c) Wage income + public transfers, U.S.



(d) Wage income + public transfers, Denmark



Note: Figures constructed using data from the CNLSY for the U.S. and administrative register data for Denmark. The figures show levels of wage income at age 26 for high school dropouts in the U.S. and Denmark, by levels of cognitive and non-cognitive skills. For the U.S., we measure cognitive skills by PIAT scores and non-cognitive skills by BPI scores (antisocial, headstrong, and hyperactive domains.) For Denmark, we use exam grades on math and physics to estimate cognitive skills and grades on organization/neatness to estimate non-cognitive skills. In both countries, we measure income at age 26. Colors indicate levels of the outcome variable on the z-axis (wage earnings and wage earnings plus transfers). Lighter indicates a lower levels and darker indicates higher level of the outcome.

One may point to the universal child care and educational systems as explanations for the wage difference for low-educated individuals (Esping-Andersen et al., 2012). If the skills for the least educated in Denmark are higher than in the U.S., this may explain the cross-country differences. Yet a more likely mechanism draws on compressed wages arising from welfare policies. Rosen (1997), Edin and Topel (1997), Freeman et al. (2010), and Fredriksson and Topel (2010) discuss a broad range of likely causes and consequences of wage compression in a symposium on the Swedish welfare state and past decades' reforms while, for example, Aaberge et al. (2000), Pedersen and Smith (2000), and Tranæs (2006) provide similar evidence from Denmark.

Wage floors are determined through different channels in the two countries. In Denmark, a choice has been made (over many decades)[4] to implicitly introduce a high lower bound of income. Individuals who cannot meet the corresponding minimum productivity level receive the equivalent by public benefits, work in publicly subsidized jobs, or, as Figure A32 below suggests, become employed in public sector jobs. This is very different from the U.S. system.

Tranæs (2006) briefly discusses and compares the lower bounds of wages between Denmark and the U.S..[5] In the U.S., minimum wages set the wage floor with only small compensation rates for the least skilled individuals whose productivity falls below this (low) threshold. In Denmark, the wage floor is determined by the levels of public benefits. Figure A29 illustrates this and the general wage compression in Denmark.

Figure A29a shows the U.S. cumulative density of hourly wages conditional on employment

[4]Present day's labor market in Denmark is the result of a long series of policies which include:

- The September accord, 1899 (*September forliget*), set the base and rules governing collective bargaining.
- The unemployment insurance law of 1907 (*Den Danske Lov om Arbejdsløshedskasser, 9. April 1907*). The bill introduced private UI funds to insure employees. The compensation paid by the funds was (and continues to be) heavily subsidized. The core elements of the law remain today.
- The social reform of 1933 which was a collective of bills: *Lov om Arbejdsanvisning og Arbejdsløshedsforsikring* (U.I.), *Lov om offentlig Forsorg* (welfare benefits), *Lov om Folkeforsikring* (health care coverage), *Lov om Forsikring mod Følger af Ulykkestilfælde* (occupational injuries).
- The public sector expansions during the 1960s and 1970s introducing universal child care/preschools.

[5]We do not wish to argue for or against any mechanisms that drive the increasing schooling premia in the U.S., but only outline the core differences in the lowest wage level between the two countries.

and the federal minimum wage rate for individuals aged 25–59 in 2006. Likewise, Figure A29b (Figure 1.1 from Tranæs, 2006) illustrates that the levels of public benefits serve as a wage floor in Denmark. The figure shows the cumulative distribution of mean hourly wages conditional on employment and the cumulative distribution of self-rated hourly wage potential for Danes aged 25–59 in 2006.

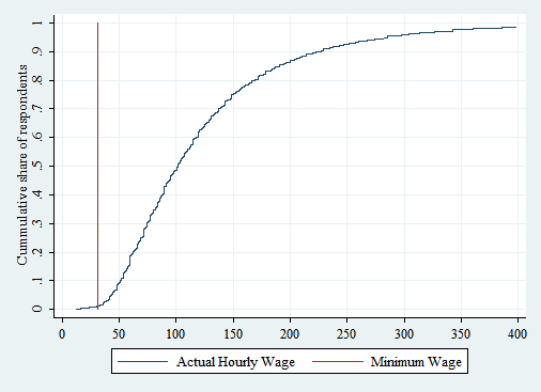
The figures show that only very few report wage rates below the minimum wage in the U.S. and that none work in jobs with hourly wages below the hourly wage equivalent of highest rate of social assistance in Denmark.[6] On the one hand, by comparing the two figures it is evident that there is a substantial mass of individuals in the U.S. that earn less than the wage floor in Denmark; around 15% of U.S. incomes fall below the Danish level of social assistance. On the other hand, the mass of high wage rates are higher in the U.S. than in Denmark. Virtually all Danes earn below DKK 300 per hour while approximately 5% of U.S. wage earners have hourly wages that are higher. Moreover, a sizeable fraction in Denmark rate their own productivity lower than the lowest observed level of hourly wages. However, jobs paying wages below this threshold have been eradicated, likely across many decades (which also made minimum wages set by law superfluous), because social assistance is means tested (deducted 1:1 from any wage earnings).[7] Thus, any returns to work below the level of benefits are nullified.

[6]For immigrants in Denmark, who are often not entitled to unemployment benefits (as many are uninsured), the wage floor is set by the level of social assistance instead.

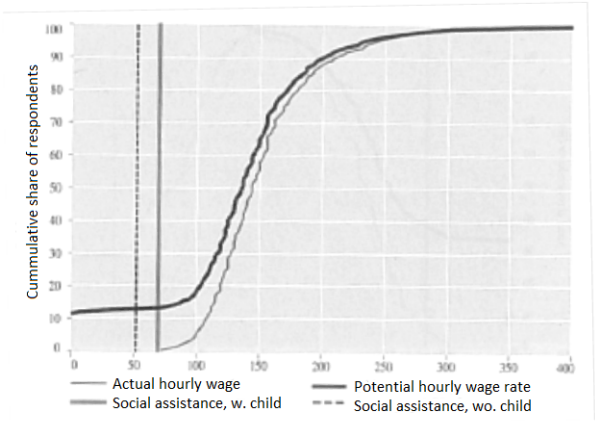
[7]The reason was a fear that public benefits might otherwise result in a downwards wage push.

Figure A29: Wage floors in Denmark and the U.S., hourly wages

(a) Actual hourly wages in the U.S.



(b) Actual/potential hourly wages in Denmark



Note: Figure A29a shows cumulative density of hourly wage rates in the U.S. using Merged Outgoing Rotation Groups (MORG) 2006 and the federal minimum wage rate from: http://www.dol.gov/whd/minwage/chart.htm. Figure A29b (Figure 1.1 from Tranæs, 2006, pp. 21) shows hourly wage rates and self-rated potential hourly wage rates for non-immigrants aged 25–59. The vertical dashed line marks the 2006 hourly wage equivalent of the levels of social assistance for a single full-time recipient, without children, aged 25 or above. The vertical solid line marks the 2006 hourly wage equivalent of the levels of social assistance for a full-time recipient with children, aged 25 or above. All numbers in Figure A29b are in 2006 DKK.

B.2 Educational Transitions

We now examine trends in transition matrices of father's to children's educational levels. Thus, we also obviate the problems that might arise from nonequivalence of highest grade completed. Transition matrices are estimated across birth cohorts from 1955–1985 and presented in Figure A30.

Figures A30a and A30b show that the fractions of children who have not completed high school, conditional on father's education, are roughly constant across the 30 year period. But the seemingly constant rate masks strong underlying trends. From Figure A30e we see that rates of college completion are almost unchanged for children from high school dropout fathers, whereas college completion rates have doubled for children of fathers who had completed college themselves. In conclusion, the figures show that past decades' increases in levels of schooling to a large degree have been driven by children from college-educated parents, to a small degree by children whose parents had high school as highest completed

education, and to a very small extent by children from high school dropouts.

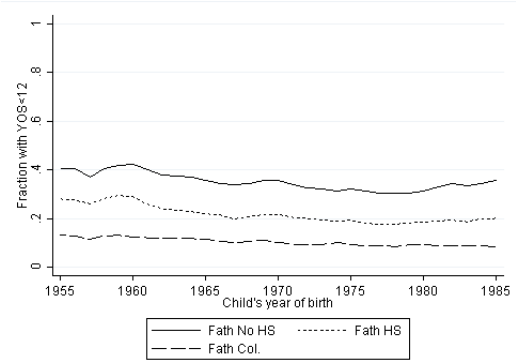
Figures A30b, A30d, and A30f show the corresponding numbers for the U.S. by combining the NLSY79 and NLSY97 data sets. The figures show that the transmission rates in the U.S. were very different from those found in Denmark for the cohorts born in the late 50s and early 60s. Yet the figure also shows that there are only minor cross-country differences for children born in the first half of the 80s. The conditional fractions of high school dropouts have increased while the conditional rates of high school and college completions has decreased, which brings the U.S. level on par with the Danish.

Figure A39 shows trends in regression coefficients from children's years of schooling on parental years of schooling and parental income rank for Denmark by birth cohort. The figure confirms the pattern from Figure A30e. Estimated coefficients increase monotonically from children born in the late 50s to the late 80s, thus mirroring the strong increase in college graduation rates for children whose fathers had completed college. For the most recent cohorts available, the Danish IGE of schooling is at the level Hertz et al. (2008) report for both Denmark and the U.S.

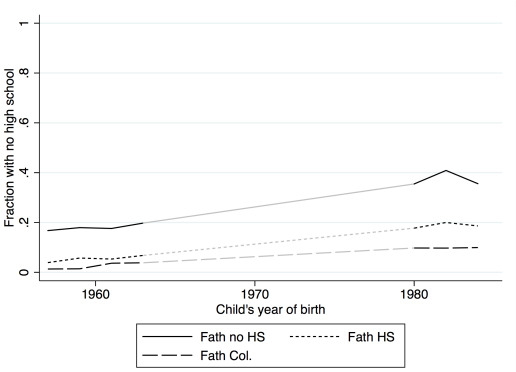
In conclusion, there are no discrepancies in intergenerational mobility measured by educational transmissions between the U.S. and Denmark when we consider the most recent available cohorts. Hence, educational mobility does not explains differences in intergenerational income mobility between Denmark and the U.S.

Figure A30: Transition, father's education and child's education, Denmark and the U.S.

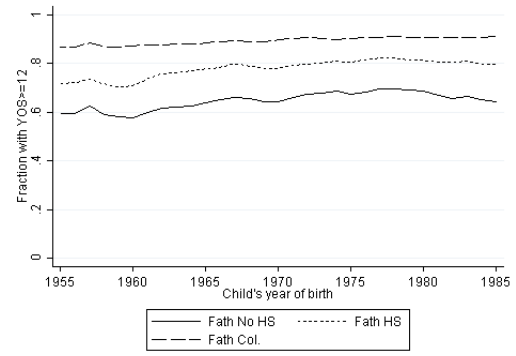
(a) Children with no high school, Denmark



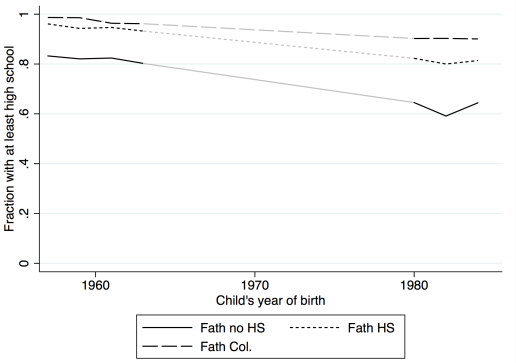
(b) Children with no high school, U.S.



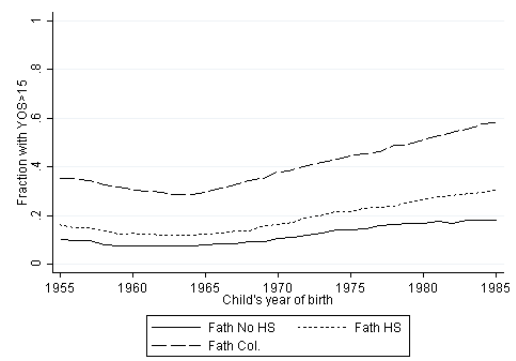
(c) Children with at least high school, Denmark



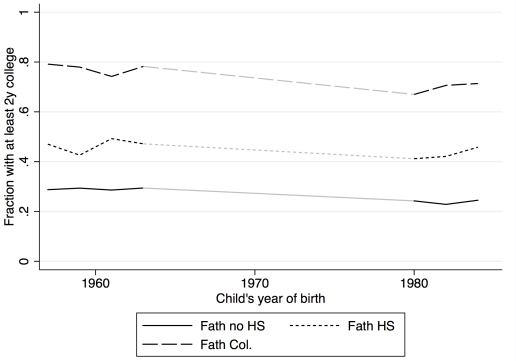
(d) Children with at least high school, U.S.



(e) Children with college as highest, Denmark



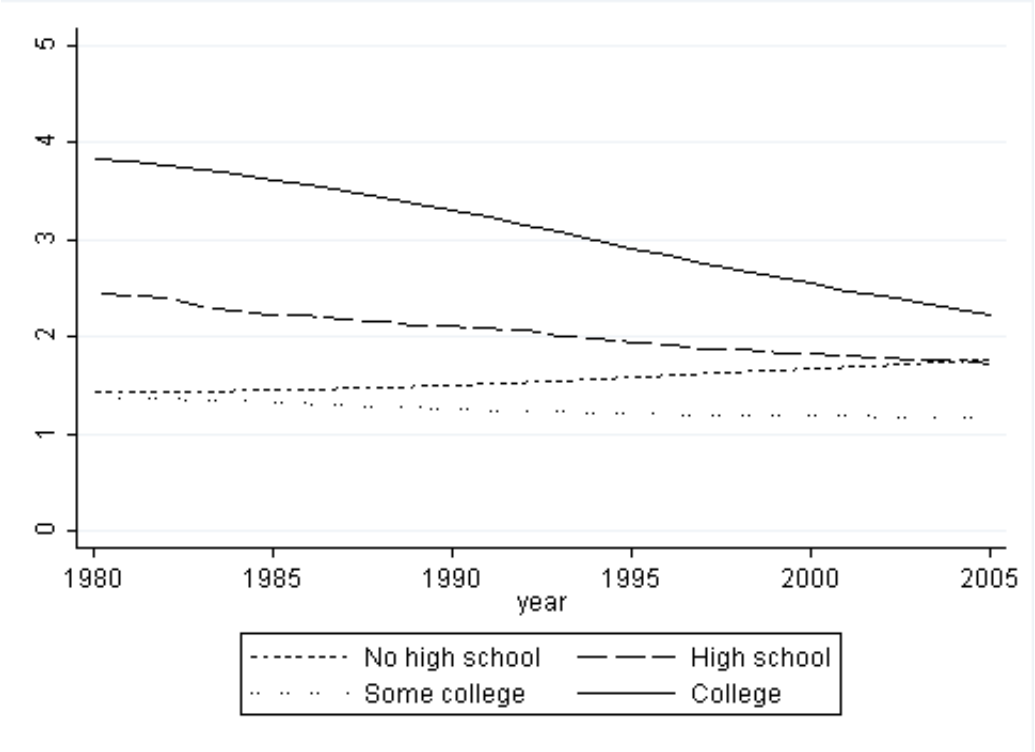
(f) Children with college as highest, U.S.



Note: Figures for Denmark are constructed using full cohorts born between 1955 and 1985 with highest grade completed measured at 27. Figures for the U.S. are constructed using the NLSY79 and NLSY97 samples. Cohorts 1957–1964 are constructed using the NLSY79 and cohorts 1980–1984 are constructed using the NLSY97. The grey lines are illustrative and link the 1964 cohort to the 1980 cohort, and do not necessarily reflect actual trends during that period. *No high school/dropout*: less than 12 years of schooling; *High school*: 12–14.9 years of schooling; *College*: 15 years of schooling or above.

In the analysis above (and others throughout the paper), differences in assortative mating of parents may explain trends and cross-country differences. We do not address these issues directly, but instead refer the reader to Eika et al. (2014) who study this issue in Norway and the U.S. Figure A31 shows trends in educational assortative mating in Denmark. The figure corresponds to Figure 4 in Eika et al. (2014), suggesting that their findings on Norway apply to Denmark as well.

Figure A31: Trends in educational assortative mating, Denmark



Note: The figure shows rates of educational assortative mating for equal levels of educational attainment: $AM_{h,w} = \frac{P(educ_h=i \bigcap educ_w=i)}{P(educ_h=i)P(educ_w=i)}$ $h : Husband$, $w : Wife$.
Levels of educational attainment are redefined relative to remainder of the paper in order to follow the definitions for Norway in Eika et al. (2014): below high school: years of schooling < 12; high school: years of schooling $= 12$; some college: years of schooling $\in [12, 25]$; college: years of schooling ≥ 15. The sample includes all non-immigrant married couples where the average of their age was between 26 and 60 in the year in question (around 1,000,000 couples each year).

B.3 Employment

Figures A32a and A32b show rates of employment and labor force participation at age 26 for high school dropout by birth cohort. Figure A32a shows that employment rates in Denmark dropped from around 0.75 for the 1955 cohort to around 0.55 for the 1985 cohort. In Figure A32b we see an even steeper reduction when we consider rates of labor force participation for high school dropouts in Denmark from around 90% in the 1955 cohort to only 60% in the 1985 cohort. Figure A32c illustrates that the corresponding numbers in the U.S. have been stable over the period depicted. Hence, for U.S. children born in the late 1950s and early 1960s, employment and labor force participation rates for high school dropouts were around 20%-points lower than those in Denmark, but for the 1980 birth cohorts, the U.S. and Danish rates were at very similar levels. Thus, overall rates of employment and labor force participation may have added to social mobility in Denmark relative to the U.S. in previous decades, but this does not seem to be the case for recent years.

Figures A32c and A32d present occupational trends[8] measured at age 26 for high school dropouts and individuals who have high school as highest completed education. Figure A32c shows that for high school dropouts in Denmark, the share of employment in welfare occupations as share of total employment has quadrupled over a 20 year period.[9] Figure A32d shows occupational patterns at age 26 among employed high school dropouts by birth

[8]We use the Danish version of the International Standard Classification of Occupations from the International Labour Organisation as reported by Statistics Denmark and construct the U.S. equivalent from CPS data using similar occupational categories. *Welfare*: jobs for high school dropouts are low-skilled/unskilled assisting work in health care sector, nursing work, teaching and care work, nanny, child-minder, assisting care work in institutions, and care work in private homes; *Manual/production*: are low-skilled/unskilled farming, foresting, hunting, fishing, production work, and vocational work; *Sales/services*: are low-skilled/unskilled work in the sales and service sector, excluding welfare-related jobs; *Office/clerk*: work includes all low-skilled/unskilled clerks and office work. For high school and college these definitions include skilled jobs in the same sectors. For the U.S., we define occupations as: *Care*: occupations related to health care assistance, nursing, child care, and teaching; *Sales/Services*: occupation related to sales and services except for *Care* occupations defined above; *Office*: occupations related to office work; *Manual*: occupation related to physical work done by people in production, operation, assembly, transportation, agriculture, forestry, fishing, crafts and related areas.

[9]Many of the tasks in the Danish welfare sector are performed by stay-at-home moms, other family members (non-market agents), or private institutions in the U.S. which may affect female labor supply (Kolm and Lazear, 2010), if not only crowding out informal non-parental care (Havnes and Mogstad, 2011).

cohort for the U.S. The trends and levels in the U.S. are very different from those in Denmark. Rates of employment in welfare-related occupations are almost 30%-points lower than in Denmark and rates of manual or production work is around 10-20%-points higher than in Denmark, albeit gradually declining. Also, work in sales/services is around 10%-points above the Danish level.

In conclusion, the figures emphasize that a large and rapidly increasing fraction of the least educated are working with some of Scandinavian welfare states' core tasks. As earnings differentials are smaller than in the private sector (see, e.g., Pedersen et al., 1990; Zetterberg, 1990), a large public sector share of total employment may in itself contribute to lower inequality (Aaberge et al., 2002).[10]

Additionally, wage compression as shown in Figures A25–A29 may also explain the underlying mechanisms in educational and employment patterns. As incentives to educate decrease along with returns to education (Fredriksson and Topel, 2010), initial equating mechanisms from early education might be offset by later distortions, thereby putting educational mobility in Denmark and the U.S. back on par (see Sections 1 and 3.3, and Figure A32 in this section). Moreover, Rosen (1997) and Edin and Topel (1997) argue that public employment is the main driver of overall employment rates, because wage compression is associated with close to constant private employment rates. This could result in the occupational patterns seen in Figure A32, where we show that almost 40% of Danish high school dropouts with employment work in public welfare jobs.

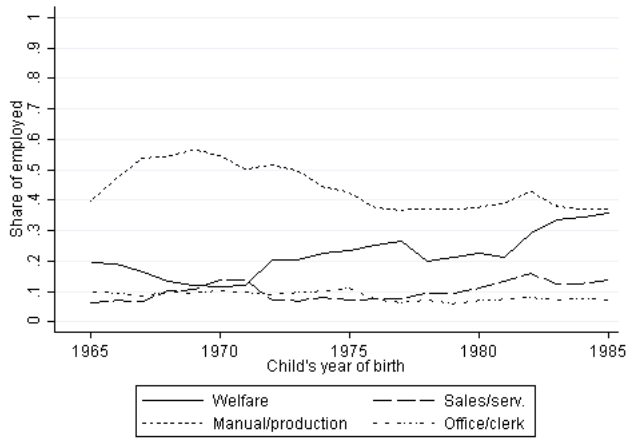
[10]In 2013, the public sector share of total employment was 35% in Denmark and 14% in the U.S.

Figure A32: High school dropouts' labor market attachment at age 26

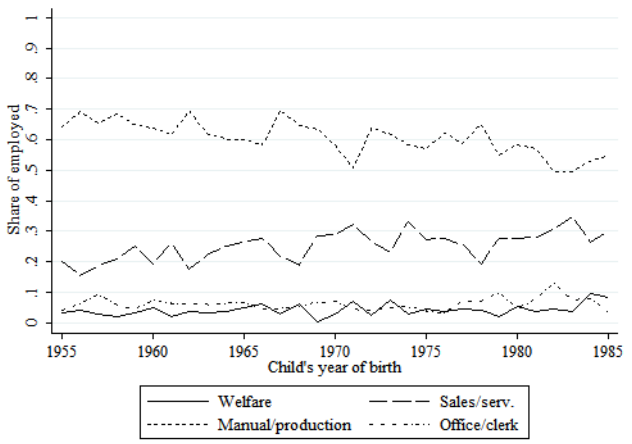
(a) Employment and labor force participation rates, Denmark

(b) Employment and labor force participation rates, U.S.

(c) Occupations, Denmark



(d) Occupations, U.S.



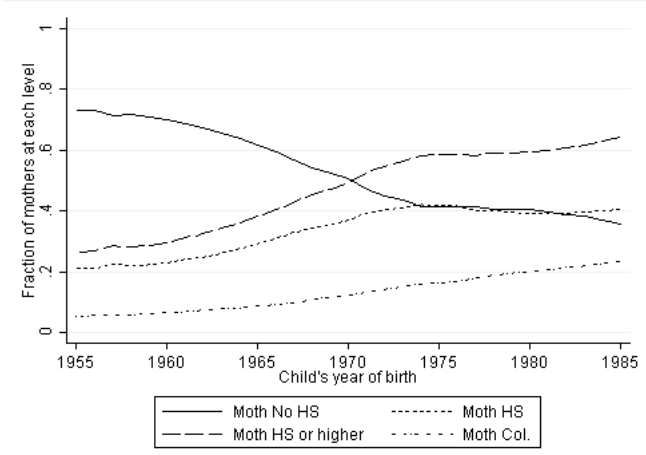
Note: Figure (a) constructed from administrative register data on cohorts born 1955–1985 and their parents in Denmark. Figure (b) constructed from March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). The sample consists of civilian, non-institutionalized citizens at age 26 in each wave. Number of observations used to create the chart is 74,562 (of whom 9,949 were high school dropouts). Employment is defined as being at work or being absent from work but having a job during the time preceding the interview week. Labor Force Participation is defined as being employed or actively looking for a job during the time preceding the interview week. *Less than high school/high school dropout*: less than 12 years of schooling.
Figure (c) constructed using the same data as Figure (a). Vocations used in Figure (c) defined using the Danish version of the International Standard Classification of Occupations from the International Labour Organisation (ILO) as reported by Statistics Denmark. Welfare jobs for high school dropouts/high school graduates are defined as unskilled/intermediate-skilled care related jobs (related to, e.g., children, elderly, and health). Figure (d) constructed using the same data as Figure (b). Vocations defined via March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). Occupational categories were defined in the following way: *Care*: occupations related to health care assistance, nursing, child care, and teaching; *Sales/Services*: occupation related to sales and services except for *Care* occupations; Office: occupations related to office work; *Manual*: occupation related to physical work done by people in production, operation, assembly, transportation, agriculture, forestry, fishing, crafts and related areas. *Less than high school/high school dropout*: less than 12 years of schooling; *High school graduates*: 12–14.9 years of schooling; *College graduates*: 15 + years of schooling.

It may not be possible to reproduce this mechanism in other contexts. The Scandinavian countries are small and demographically homogeneous in comparison with the U.S. and even other European countries. Large transfers, wage compression, and a large welfare sector, financed through heavy taxation as means to increase minimum standards of living, might not be a viable road to follow for the U.S.. Indeed, foreigners often look to Scandinavia wondering how such high levels of taxation can be combined with tax compliance and economic activity. Kleven (2014) investigates and discusses this paradox, and he emphasizes close to full third-party information of income to tax authorities (maximizing tax compliance) and broad tax bases to avoid tax avoidance, together with large public spendings that focus on complementing work as essentials.

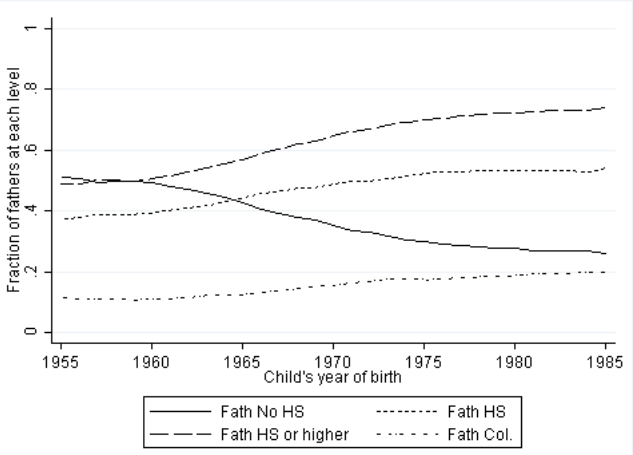
B.4 Supplementary Figures to *Understanding Trends in Inequality in the U.S. and Denmark*

Figure A33: Trends in mother's, father's, and children's education, cohort 1955–1985, Denmark

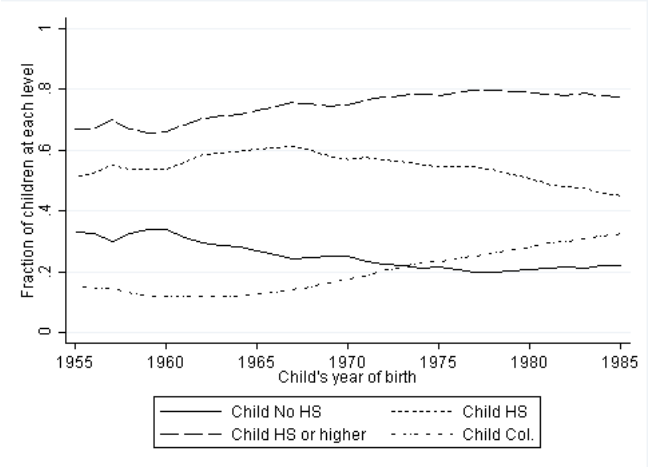
(a) Mothers



(b) Fathers



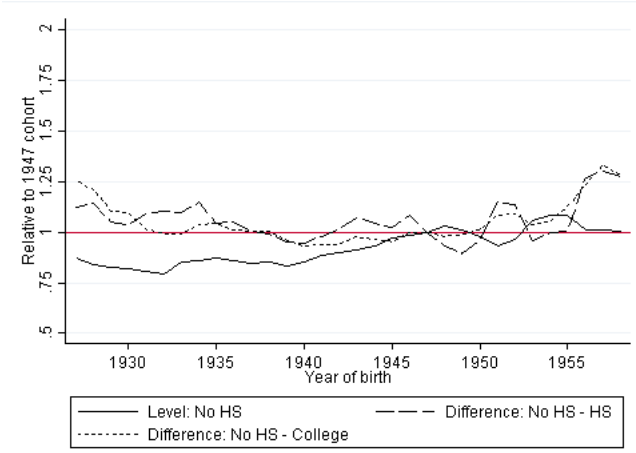
(c) Children



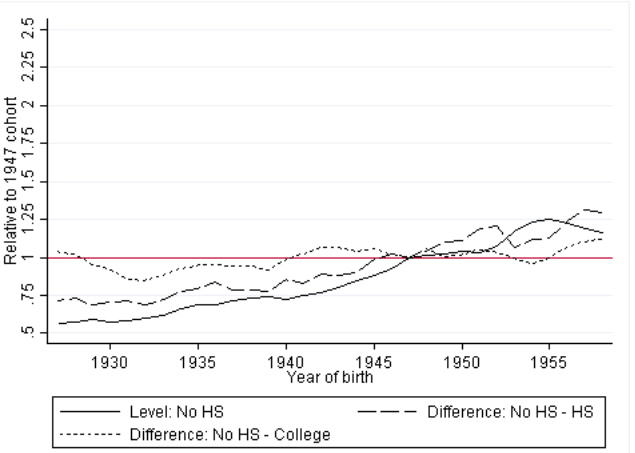
Note: Figures show mean levels of education by birth cohort in Denmark.

Figure A34: Trends in wage income returns to schooling by gender, Denmark

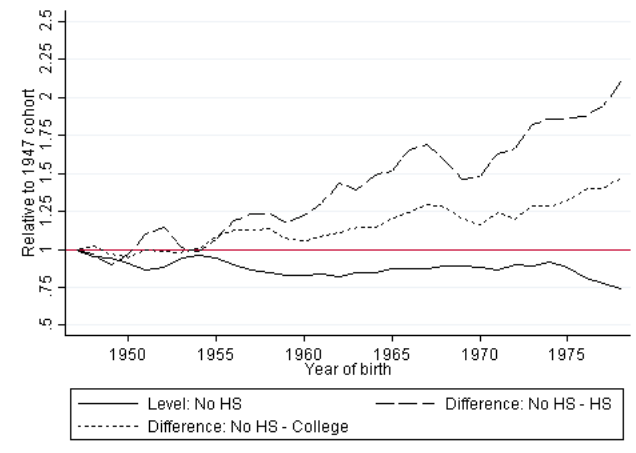
(a) Evolution of income differences at ages 53–54, males, cohort 1927–1958



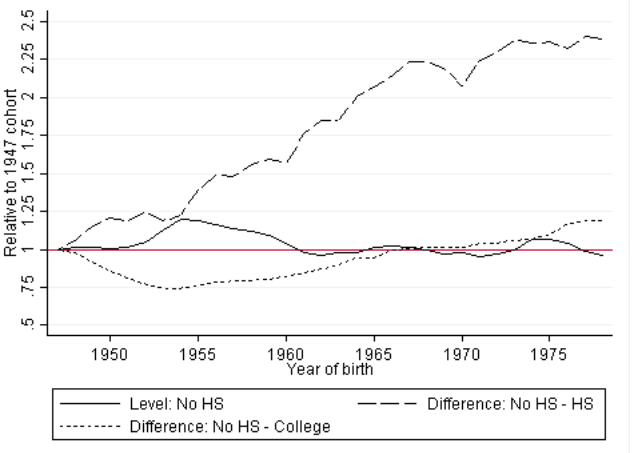
(b) Evolution of income differences at ages 33–34, females, cohort 1927–1948



(c) Evolution of income differences at ages 33–34, males, cohort 1947–1978



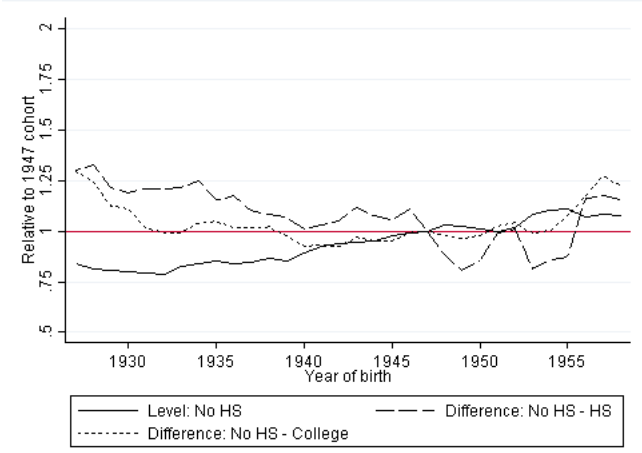
(d) Evolution of income differences at ages 33–34, females, cohort 1947–1978



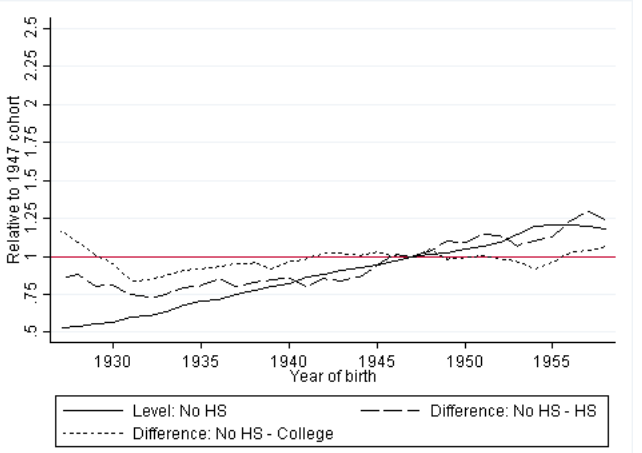
Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947*, and high school and college graduates indexed relative to that *high school/college premium in cohort of 1947*.

Figure A35: Trends in wage plus public benefit returns to schooling by gender, Denmark

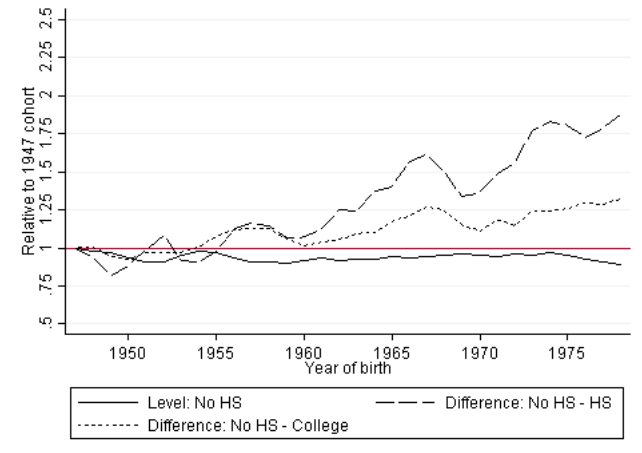
(a) Evolution of income differences at ages 53–54, males, cohort 1927–1958



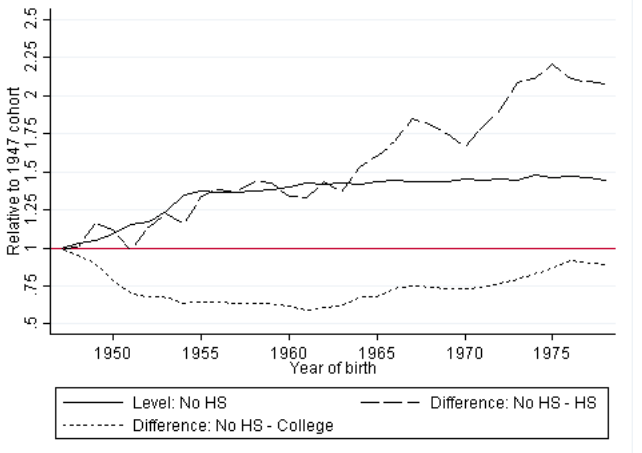
(b) Evolution of income differences at ages 53–54, females, cohort 1927–1948



(c) Evolution of income differences at ages 33–34, males, cohort 1947–1978



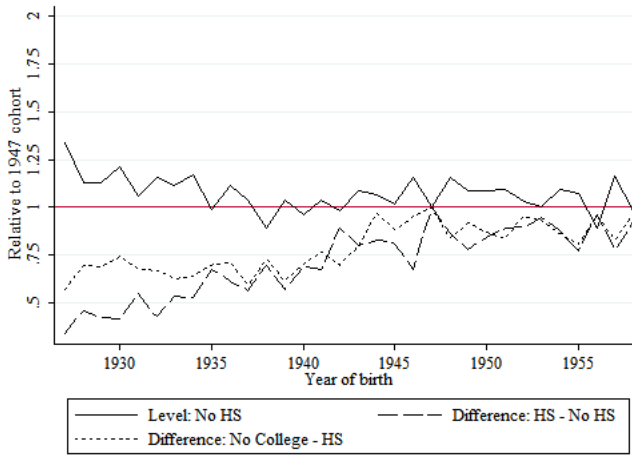
(d) Evolution of income differences at ages 33–34, females, cohort 1947–1978



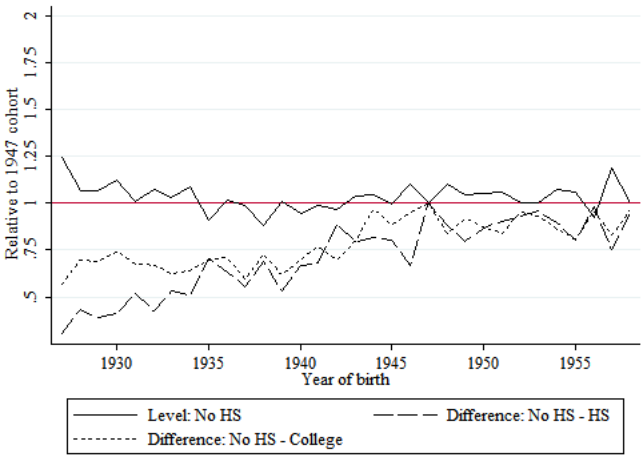
Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947*, and high school and college graduates indexed relative to that *high school/college premium in cohort of 1947*.

Figure A36: Evolution of schooling premiums at ages 53–54, cohort 1927–1958

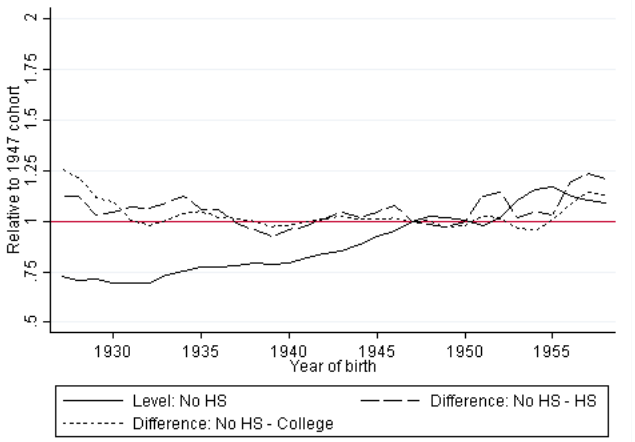
(a) U.S., wage earnings



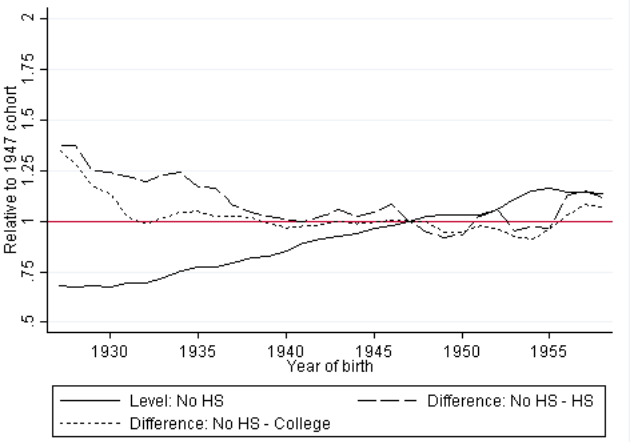
(b) U.S., wage earnings + public benefits



(c) Denmark, wage earnings



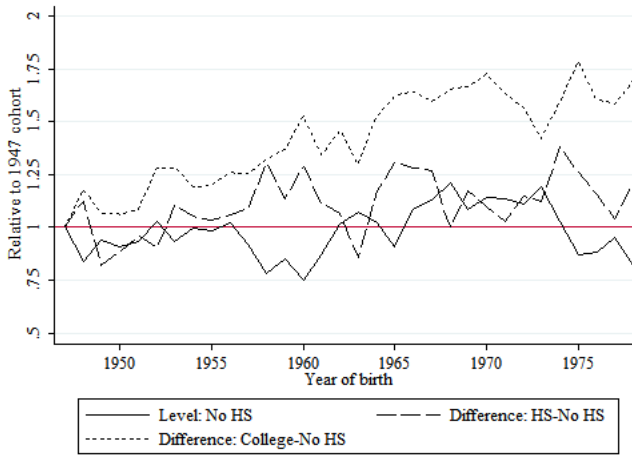
(d) Denmark, wage earnings + public benefits



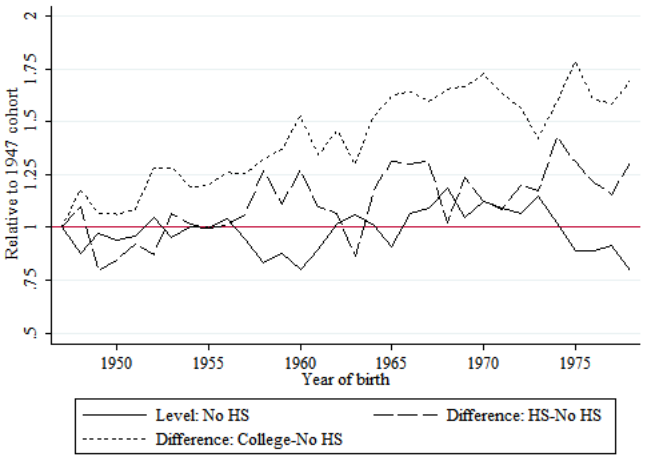
Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947*, and high school and college graduates indexed relative to that *high school/college premium in cohort of 1947*. Figures are constructed using levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 53–54 in Figures a and c and at ages 33–34 in Figures b and d. Figures constructed from Danish administrative register data and U.S. March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). *Less than high school/high school dropout*: less than 12 years of schooling; *High school graduates*: 12–14.9 years of schooling; *College graduates*: 15 + years of schooling.

Figure A37: Evolution of schooling premiums at ages 33–34, cohort 1947–1978

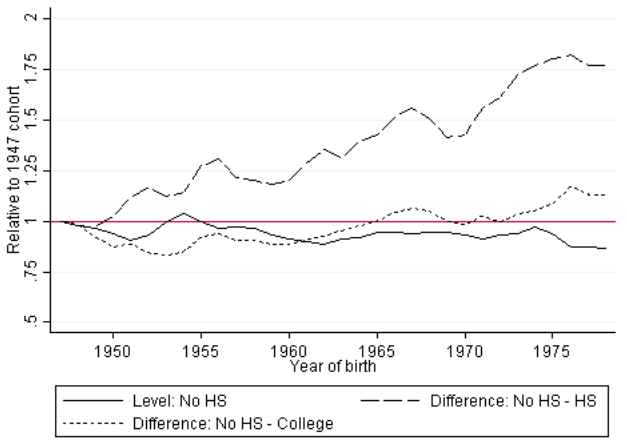
(a) U.S., wage earnings



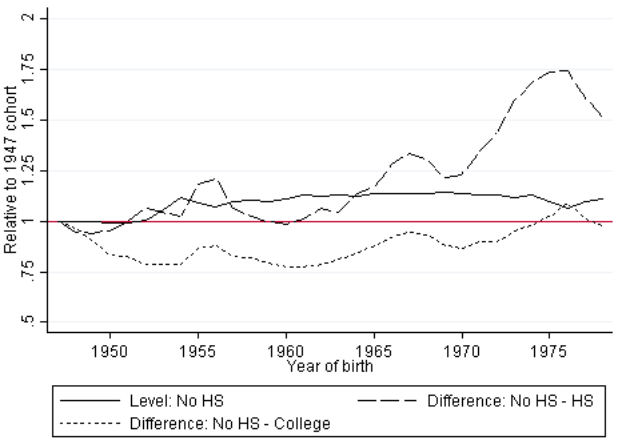
(b) U.S., wage earnings + public benefits



(c) Denmark, wage earnings

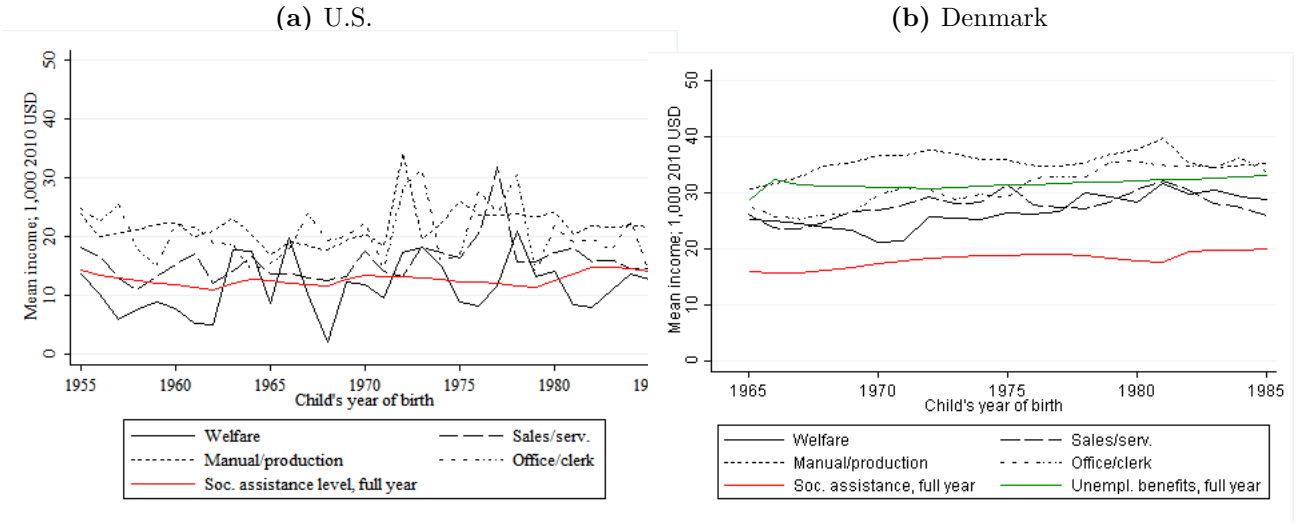


(d) Denmark, wage earnings + public benefits



Note: In the figures are high school dropout levels indexed relative to the respective difference from *high school dropout level from cohort of 1947*, and high school and college graduates indexed relative to that *high school/college premium in cohort of 1947*. Figures are constructed using levels of income from wage earnings and wage earnings plus public transfers by education. Income is measured at ages 53–54 in Figures a and c and at ages 33–34 in Figures b and d. Figures constructed from Danish administrative register data and U.S. March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). *Less than high school/high school dropout*: less than 12 years of schooling; *High school graduates*: 12–14.9 years of schooling; *College graduates*: 15 + years of schooling.

Figure A38: Evolution of average wage earnings at age 26 for high school dropouts by occupation, cohort 1965–1985



Note: Figures show levels of income from wage earnings for high school dropouts in the U.S. and Denmark by birth cohort. Income is measured at age 26. Figures constructed from Danish administrative register data and U.S. March Current Population Survey (CPS, 1981–2011) from Integrated Public Use Microdata Series (IPUMS). *Less than high school/high school dropout*: less than 12 years of schooling.

Figure A39: Coefficients of intergenerational associations, Denmark

(a) Parental income rank, child's highest grade completed

(b) Parental highest grade completed, child's highest grade completed

Note: Figures show regression coefficients—for each of the cohorts born in Denmark between 1965 and 1983—of child's highest grade completed measured at age 30 regressed on (a) parental income rank measured when third child was 25 and (b) parents' highest grade completed.

C Income Metrics and Rank-Rank Estimations of Intergenerational Mobility

The results reported in the text indicate that choice of outcome and income metric could affect the size and curvature of the parent-child associations. Using dummy variables as outcomes has likely made the results and curvature differ particularly much between two aspects of schooling, because the margins of variation are largely limited to certain regions of the income distributions. In this subsection we now turn our attention to the potential impact of different income metrics and wage compression for parents. In order to elucidate this particular point we will focus on non-binary outcomes (income and years of schooling), and use data from earlier cohorts in the Danish register data. We use data on all children born in Denmark between 1973 and 1979 who had not died or migrated before 2012. Also, both of the children's parents should be known and alive at least until the child's 15th year.

This results in a sample of around 410,000 child-parent pairs. We measure children's income as a three year average of income from 2010 to 2012 (from ages 31–33,...,37–39) and parental income as a nine year average of mother's and father's income from the child's 7th to 15th year (years 1980–1988,...,1987–1995).

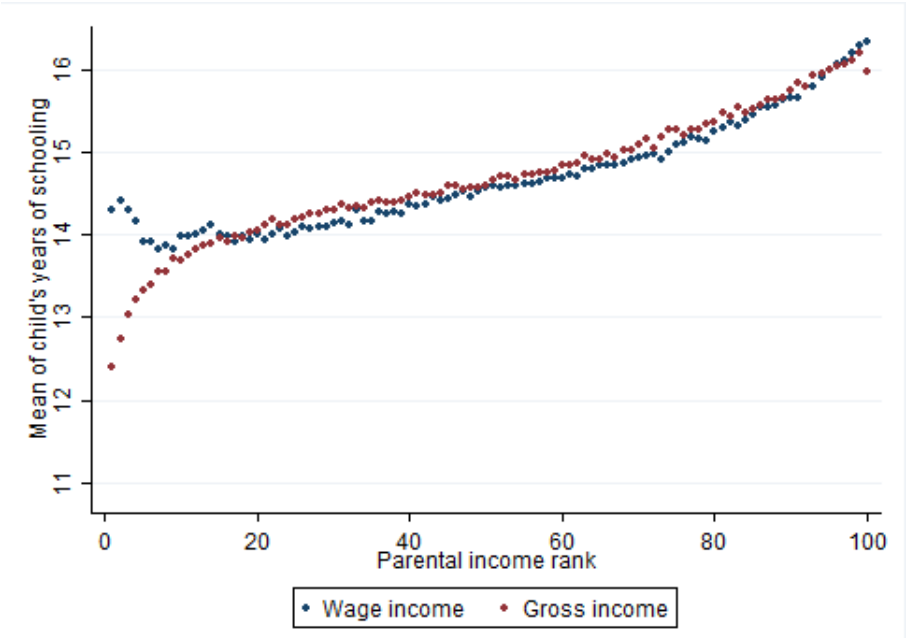
We consider the five different income metrics from the main paper: gross income excluding public transfers, total gross income including public transfers, wage earnings, wage earnings and public transfers, and total net-of-tax income. Figure A40a shows example scatterplots of children's average income rank by bins of parental income percentiles. Likewise, Figure A40b shows scatterplots of children's average years of schooling by bins of parental income percentiles. The figures show that there is little difference between the pattern of the parent-child associations between outcomes, but substantial differences between income metrics in the tails of parental income distributions, the lower tail in particular. While there are few differences shown by measuring parental income as gross income or net-of-tax income, large gaps exist between wage earnings and the other two income metrics.

Table A17 shows the corresponding rank-rank and rank-schooling regression coefficients together with the estimated 'extremum-slope' slope between the 1st and 100th percentiles. Rank-rank slopes increase by 25% to around 0.25–0.27 when we consider gross income instead of wage earnings. Likewise, the slope between parental income rank and child's years of schooling increase range between 0.017 to 0.027 depending on income metric of choice. The differences become even more striking for the extremum-slopes between the 1st and 100th percentile which differ by as much as 75%.

Figure A40: Differences in rank slopes by income measures, Denmark

(a) Rank-rank of child and parental income by dif. income measures

(b) Child's highest grade completed by ranks from dif. parental income measures



Note: Figures show mean of child's income rank and children's highest grade completed by bins of parental income percentiles. Income is measured either as wage income or gross income including capital income (9 year averages measured when child was aged 7–15). In Figure a, children's income (3 year averages from ages 37–39) is measured by the same income measure as parents' income. Zero wage earnings are not randomized into the rank distribution.

Table A17: Intergenerational correlations between income and years of schooling, and various parental income, Denmark metrics

	Gross income excl. public transfers	Gross income incl. public transfers	Wage earnings	Wage earnings and public transfers	Net-of-tax total gross income
Child income rank					
Rank-income slope	0.273***	0.253***	0.205***	0.177***	0.229***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Slope from 1–100	0.398***	0.332***	0.216***	0.170***	0.271***
	(0.010)	(0.0010)	(0.009)	(0.010)	(0.0010)
Child years of schooling					
Rank-schooling slope	0.027***	0.025***	0.020***	0.017***	0.022***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Slope from 1–100	0.037***	0.030***	0.020***	0.015***	0.023***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)

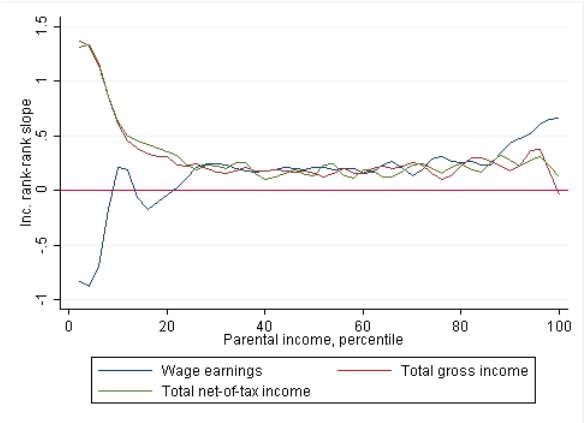
Note: Table shows difference from p1 to p100 from Figure A40a.
$^{+}$: $p < 0.1$, *: $p < 0.05$, **: $p < 0.01$, ***: $p < 0.001$.

Figures A41a and A41b show the slopes corresponding to the rank-rank and rank-schooling plot from Figure A40. As evidenced by the previous figure, the slopes from wage earnings and total gross income, and net-of-tax income are highly different. For both outcomes, the slope is negative or zero at the lowest quintile of parental income when measuring this as wage earnings. In contrast, the two other income metrics result in slopes which are at their steepest point in the bottom of the distributions. There is no difference between the parent-child between the 20th and the 80th percentile, while at the top of the income distributions the slopes diverge again. Here, the slope of wage earnings is higher than that of gross income or net-of-tax income. The underlying reason is evident from Figures A41c and A41d. Figure A41c shows the distribution of the three income metrics and A41d shows the step size from one percentile in the income distribution to the next measured in DKK. The figure shows the difference between the lowest income in the 10th percentile and the lowest income in the 11th percentile. The figures show that, in absolute terms, differences between the lowest percentiles of the wage earnings distribution are zero (or even not identified in the case of many zero-earners), while it is higher than 50,000 DKK (approximately 9,000 USD) for gross

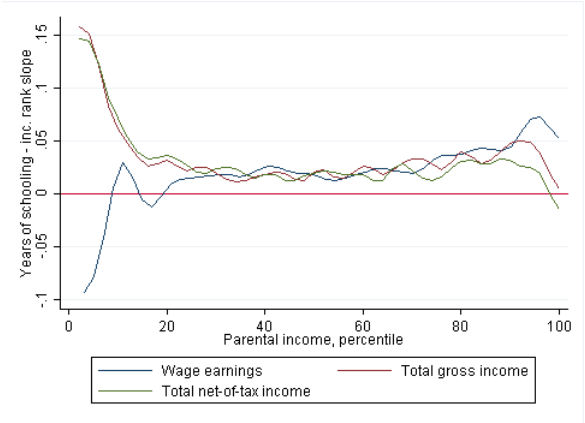
income and net-of-tax income. Likewise, the step sizes increase substantially for all of the income metrics in the upper tail of the income distribution which reflect the long tail of high incomes.

Figure A41: Slopes, distributions, and absolute differences between percentiles by different income measures, Denmark

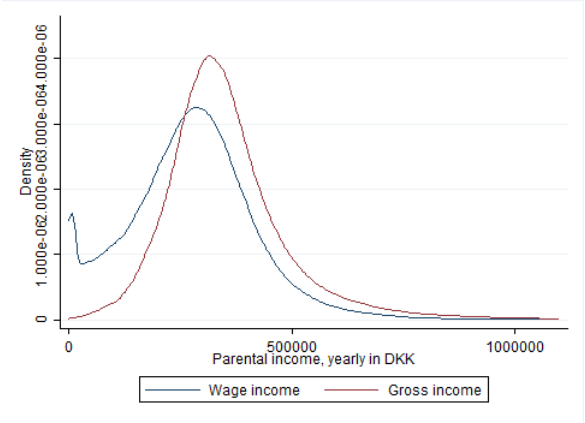
(a) Slope, rank-rank of income, cf. fig. A40a



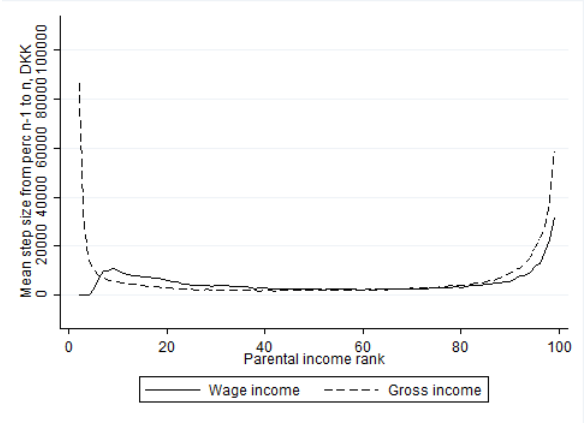
(b) Slope, child's HGC-parental income rank, cf. fig. A40b



(c) Densities income distributions



(d) Step size from percentile n to n+1 for different income measures



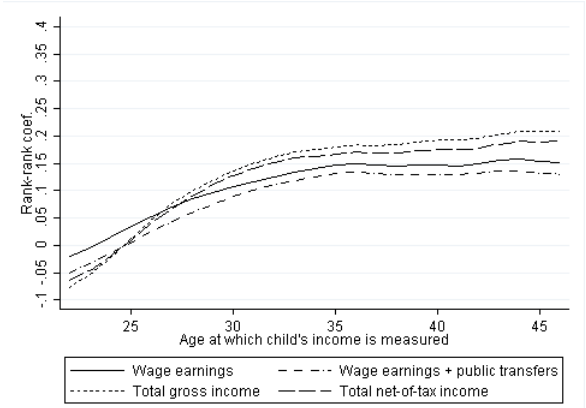
Note: Figures show slopes (a–b), income distributions (c), and step sizes from percentile n to n+1 (d), for wage income and total gross income (including capital income).

The results presented in this section are not to be taken as universally applicable results

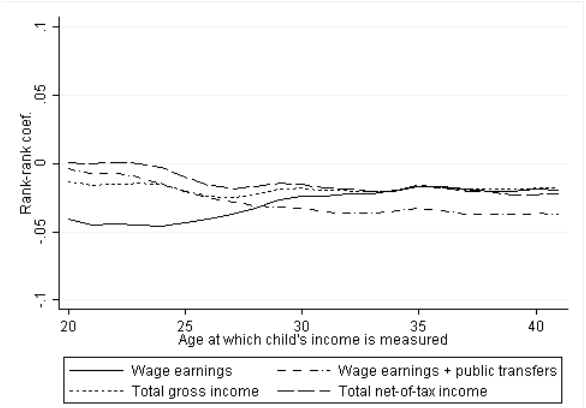
as they likely arise from the specific income distributions, wage compression, and level of public transfers in Denmark. Still, the results highlight how income distributions affect shapes and even magnitudes of intergenerational comparisons. A key finding is that the potential impacts are largest at the bottom of the income distributions (at least when we consider rank/percentiles of income). This is particularly important because it shows that estimates like intergenerational income elasticities depend highly on income distribution, and potentially also on the fraction of individuals who have spells where they have zero earnings. Hence, estimates of IGE may be mechanically reduced as unemployment rates increase, even when public benefits are included, because convexity increases with the fraction of zero earners.

Figure A42: Life cycle bias: rank-rank slopes by age of child, Denmark

(a) Varying age at which child's income is measured



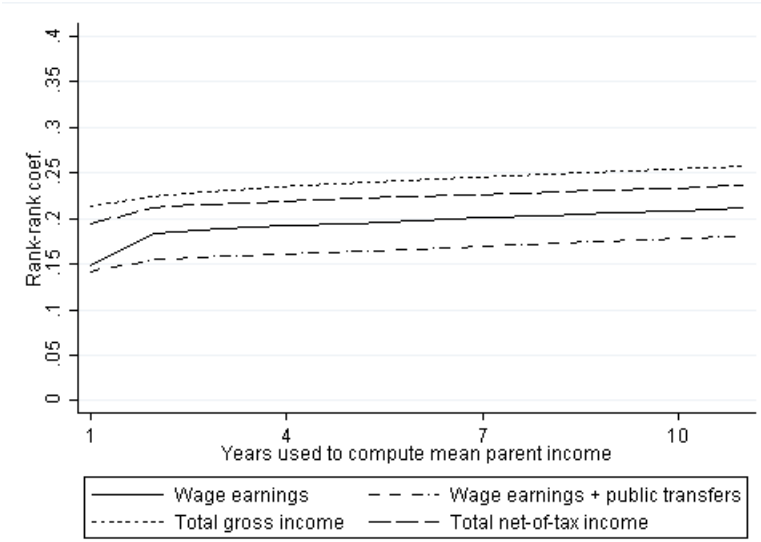
(b) Varying age at which child's and parents' income is measured



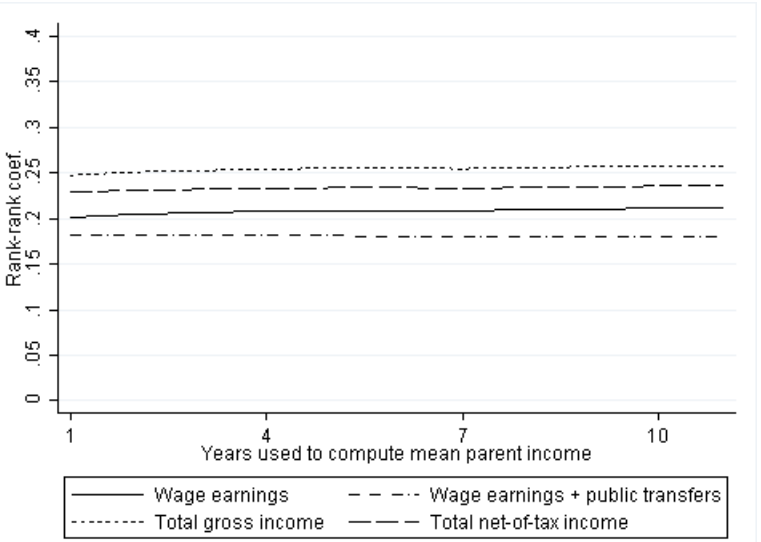
Note: These figures correspond to Fig III A presented in Chetty et al. (2014, pp. 1579). Figure A shows OLS coefficients of child's income rank within own cohort on parental income rank by different ages of measurement. Each measurement is a two year average of children's income and a four year average of parental income. Children's income is measured at age t and t+1 (such that the point at, e.g., age 25 corresponds to average income of age 25 and 26) whereas parental income is an average of income measured between ages 15 and 18 of the child. We use the cohort of children born in Denmark in 1965 who have any reported income at some point between 1980 and 2012. Also, children need to have both a mother and father identified in the registers from 1980 to 1983. The resulting sample is 50,473.
Figure B shows the difference between OLS coefficients of rank-rank regressions when both parental income and child's income is measured at different ages of the child. Each measurement is a two year average of children's income and a four year average of parental income. Children's income is measured at age t and t+1 (such that the point at, e.g., age 25 corresponds to average income of age 25 and 26) whereas parental income is an average of income measured between ages 10 and 13/20 and 23 of the child. As we do not have income data for earlier than 1980, we use the cohort born in 1970 to gain information on parental income from the year the child turned 10. The same data limitation applies as in Figure A, which results in a sample of 52,591 individuals.

Figure A43: Attenuation bias: rank-rank slopes by number of years used to measure parental income and by different income measures

(a) Using data from earlier years and adding later years



(b) Using data from later years and adding earlier years



Percent 'bias' using two years of parental income relative to using permanent income (12 year average)

Parents' income measured:	**Age 5–7**	**Age 18–20**
Wage earnings:	0.32	0.03
Wage earnings incl. UI/welfare:	0.15	0.00
Total gross income:	0.12	0.03
Total net-of-tax income:	0.14	0.02
Observations	163,672	163,672

Note: These figures correspond to Fig III B presented in Chetty et al. (2014, pp. 1579). Figures A and B show OLS coefficients of child's income rank within own cohort on parental income rank by how many years of income data used to define parent's income. In Figure A, we measure parental income when the child was 5 to 7 years old (depending on cohort) and gradually add subsequent years of income data. In Figure B, we use income data from the year the child turned 17 to 19 (depending on cohort) and gradually add income data for preceding years. We measure children's income as average of income from 2010 to 2012. We use the full cohorts in Denmark born between 1973 and 1975 and limit the data to those who have any reported income between 2010 and 2012, and the children need to have both a mother and father identified in the registers from 1980 to 1990. The resulting sample is 163,672.

D Note on Rank-Regression

This note follows the estimation procedure and outline of rank-regression from Sawyer (2009). We consider a paired data (Y_i, X_i), which in the present case is children's and parent's income (or the log of). The objective is to estimate a one-dimensional β in the following equation:

$$Y_i = \mu + \beta X_i + e_i. \tag{D.1}$$

A vast number of estimators of β exists. The modal statistic, the *ordinary least squares* estimator, is found by minimizing the square of residuals, thus weighing extreme observations relatively high. An alternative, the *rank-regression* estimate, is found by minimizing the product of ranked residuals, thus putting less weight on extreme observations and more weight on mid-rank observations.

In practice, the rank-regression estimator is the result of a minimization of the sum of the product of residuals $(Y_i - \beta X_i)$ and centered ranks of residuals $(R_i^c(\beta))$:

$$\begin{aligned} \min_{\beta} D(\beta) &= \sum_{i=1}^{n} R_i^c(\beta)(Y_i - \beta Y_i) \\ &= \sum_{i=1}^{n} (R_i(\beta) - (n+1)/2)(Y_i - \beta Y_i), \end{aligned} \tag{D.2}$$

where $R_i(\beta)$ is the rank of $Y_i - \beta Y_i$ among all $Y_i - X_i$. Moreover, we can subtract any constant, thus obviating μ, because the sum of the mid-rank (centered rank) $R_i(\beta) - (n+1)/2$ across all individuals is zero by construction. The slopes between each (X_j, X_i) (for $X_j \neq X_i$) can be defined as $\beta_{ij} = (Y_j - Y_i)/(X_j - X_i)$. We now define the sorted slopes—from the lowest to the highest—as:

$$\{W_k : 1 \leq k \leq N\} = \frac{Y_j - Y_i}{X_j - X_i} \ : \ 1 \leq i < j \leq n \ \text{ and } \ X_j \neq X_i. \tag{D.3}$$

Our objective is to estimate the minimum of $D(\beta)$, i.e., where the derivative of $D(\beta)$ is

zero. The order of the residuals $Y_i - \beta X_i$ will be the same as the order of the X's for values below the β that minimizes $D(\beta)$, and the opposite order for values above. Define Q as:

$$Q = \sum_{i=1}^{n} R_i^c(X) X_i > 0 \tag{D.4}$$

where X_i is not constant. Define the initial slope of $D(\beta)$ between W_0, W_1 as $S_0 = -Q$ and all subsequent S_k's as:

$$S_k = -Q + \sum_{p=1}^{k} |X_{j_p} - X_{i_p}|.^{11} \tag{D.5}$$

From the construction of Q and S_k, the slope W_k that minimizes $D(\beta)$ is given by the S_k that satisfies:

$$k_0 = min\ \{k\ :\ S_k > 0\} \tag{D.6}$$

for $1 \leq k \leq N$, because the product of residuals and ranks of residuals will be increasing on each side of this point k_0. The *rank-regression estimate* $\hat{\beta}$ will be given as:[12]

$$\hat{\beta} = W_{k_0} = \frac{Y_{j_{k_0}} - Y_{i_{k_0}}}{X_{j_{k_0}} - X_{i_{k_0}}} \ \text{ if } \ S_{k_0 - 1} < 0 < S_{k_0}. \tag{D.7}$$

In practice, we estimate β by drawing a random sample of the full data as the calculating and sorting for all individual difference quotients. We estimate standard errors from 50 bootstraps.

E Note on Empirical Copulas

A copula is a multivariate probability distribution which we employ to describe the dependence between children's and parents' income. The foundation for copulas arise from Sklar's theorem stating that an n-dimensional distribution function F can be divided into two distinct terms:

[11] k is the sorted rank of slopes which we sum over until 0. p is the individual observations from the first to the pth observation. So for $k = 3$, we have $|X_{j_1} - X_{i_1}| + |X_{j_2} - X_{i_2}| + |X_{j_3} - X_{i_3}|$. In the way Q is defined, this sum will equal Q at the median sorted observation.

[12] In the special case where $S_{k_0 - 1} = 0$, the estimate $\hat{\beta} = \frac{W_{k_0 - 1} - W_{k_0}}{2}$.

the marginal distribution functions $F_i(x) = P(x_i \leq x)$ and the copula C:

$$F(x_1, ..., x_n) = C(F_1(x_1), ..., F_n(x_n)). \tag{E.1}$$

In the case with two continuous variables (income) X_1 and X_2, the copula $C(u, v)$ will be $P(U \leq u, V \leq v)$. This is useful in the present case of describing the dependence between parental and children's income, because the tail dependence in income distributions is notoriously difficult to determine.

In practice, we estimate the (nonparametric) empirical copulas. By taking the empirical distribution:

$$F_{i,j}(x) = \frac{1}{N}\sum_{i=1}^{N}\mathbf{1}(X_{i,j} \leq x),\ i = 1, ..., N\ ;\ j = 1, 2, \tag{E.2}$$

and the corresponding copula $(\hat{U}, \hat{V})$, we can define the empirical copula as:

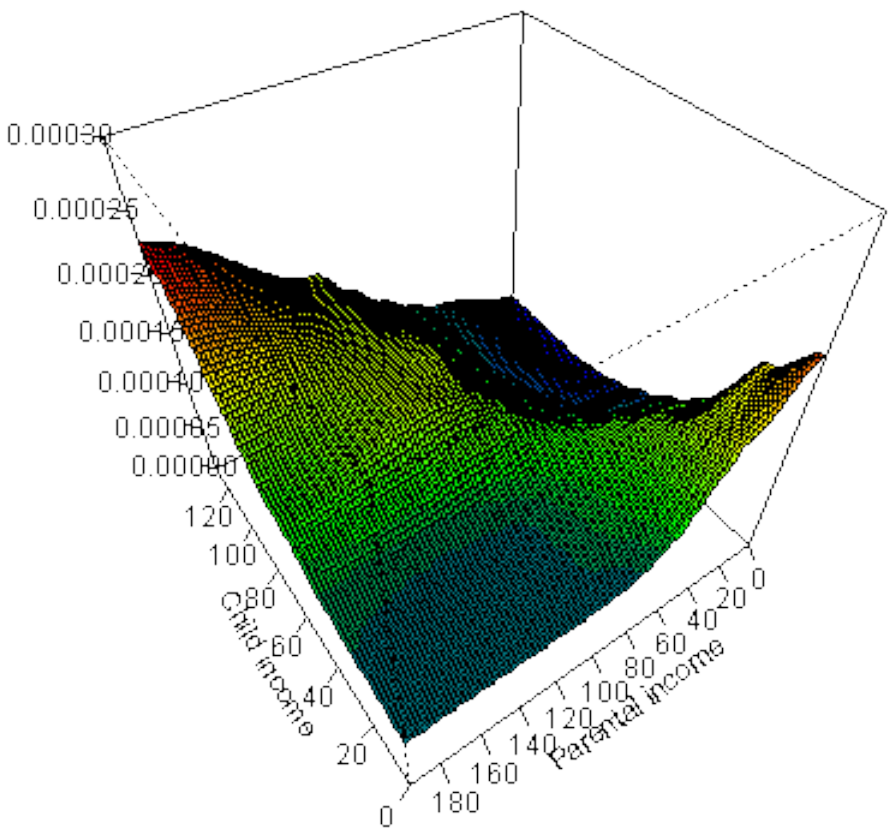
$$\hat{C}(u, v) = \frac{1}{N}\sum_{i=1}^{N}\mathbf{1}(\hat{U}_i \leq u, \hat{V}_i \leq v). \tag{E.3}$$

One straightforward way of writing $\hat{U}$ and $\hat{V}$ is as the rank of each observation $R_i(X_i)$. Hence, the empirical copula becomes the empirical distribution of children's and parents' income ranks.

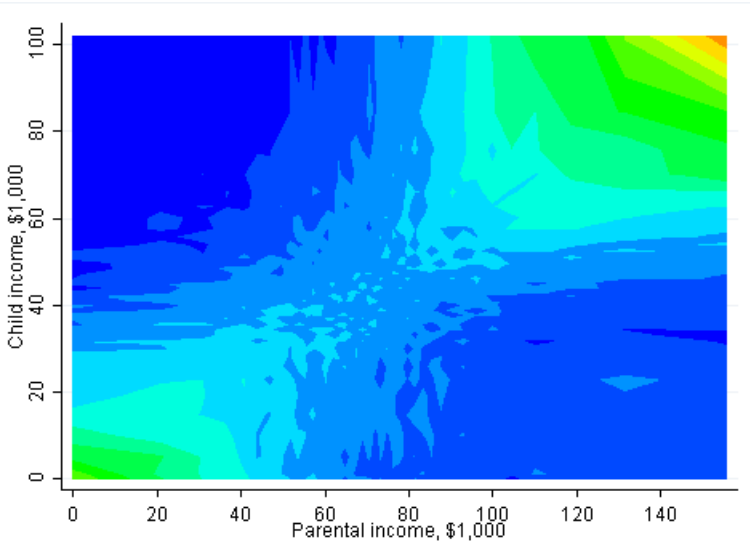
In the graphical presentation of the copula results in Figures A44–A47, we replace each income rank $R_i(X_i)$ by the minimum income level within each rank in order to obviate the undesirable attribute of income ranks: that they are detached from actual income levels.

Figure A44: Gross income excluding public transfers, empirical copula

(a) 3D Copula



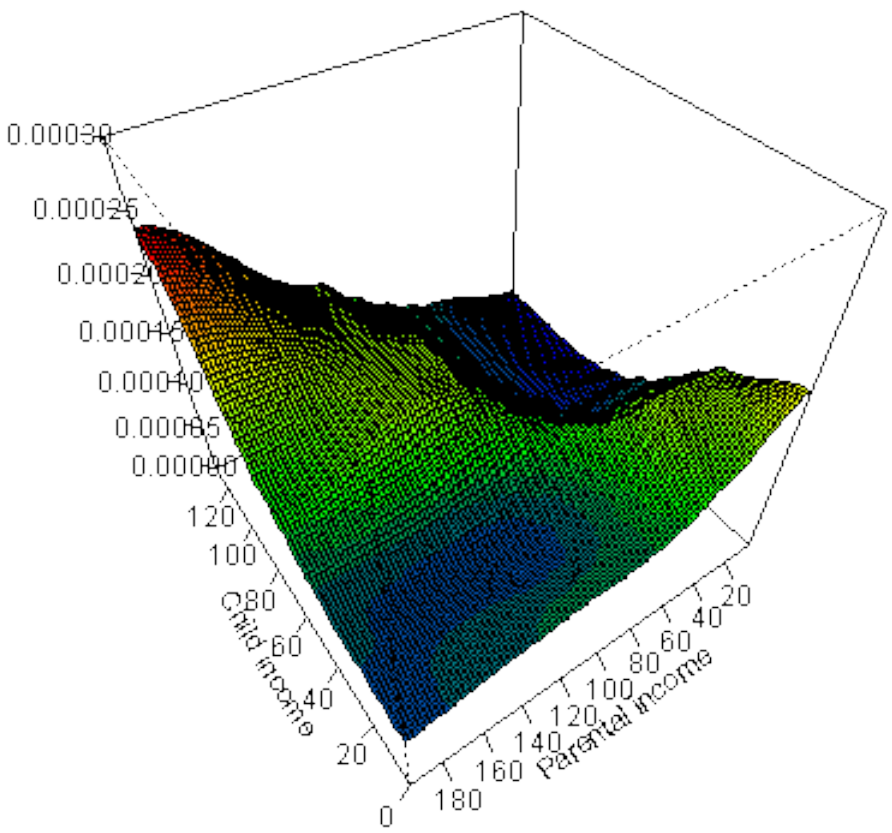
(b) Copula heatmap



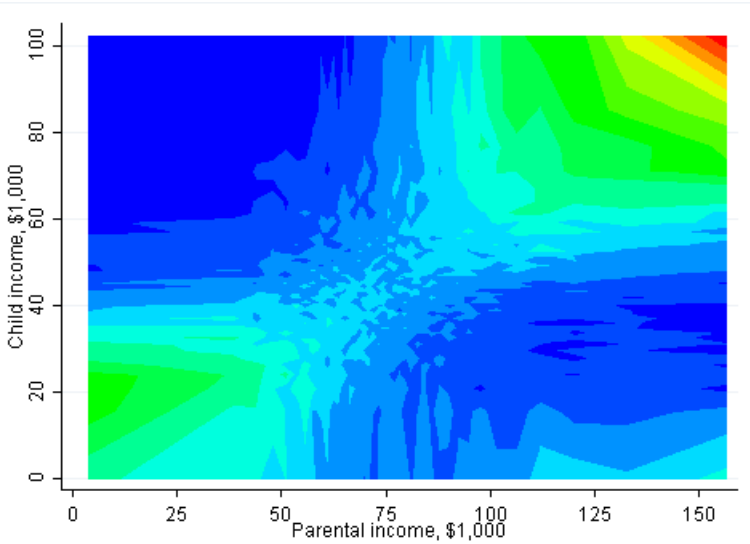
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$. Figure A44a shows the copula in a 3-dimensional plot and Figure A44b shows the same copula as a 2-dimensional heatmap.
The figures (colors and z-axis) depict the copula densities, which illustrate the (non-linear) intergenerational dependence of income across levels of parents and childrens income. Going from green to blue, there is a weaker intergenerational dependence of income (lower density). Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density). The figure shows that the strongest dependence is present in the tails at high-high and low-low values of income as opposed to mid-range income levels.
For a further description of copulas, see Web Appendix E.

Figure A45: Gross income including public transfers, empirical copula

(a) 3D Copula



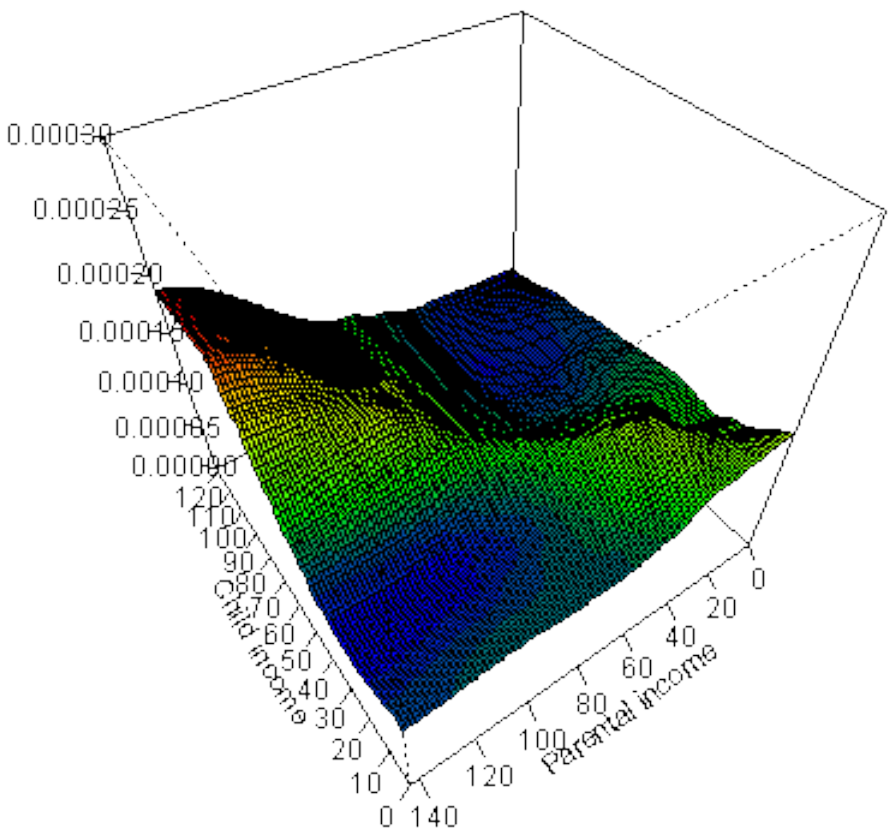
(b) Copula heatmap



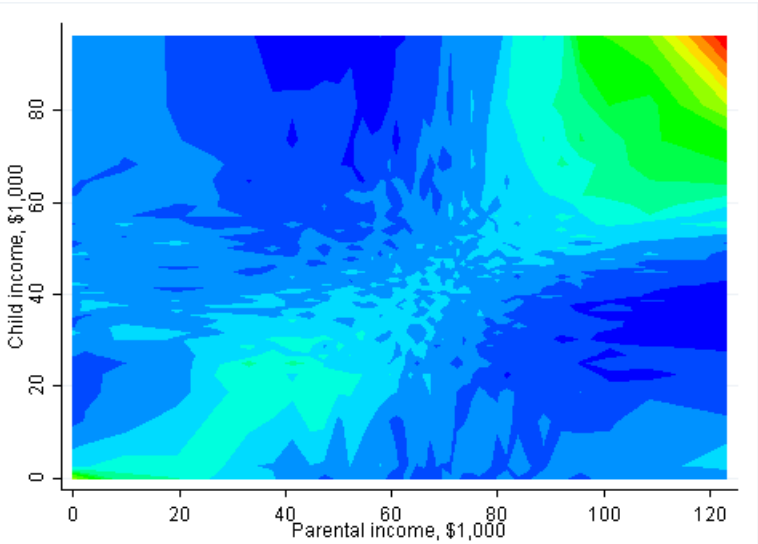
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$. Figure A45a shows the copula in a 3-dimensional plot and Figure A45b shows the same copula as a 2-dimensional heatmap.
The figures (colors and z-axis) depict the copula densities, which illustrate the (non-linear) intergenerational dependence of income across levels of parents and childrens income. Going from green to blue, there is a weaker intergenerational dependence of income (lower density). Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density). The figure shows that the strongest dependence is present in the tails at high-high and low-low values of income as opposed to mid-range income levels.
For a further description of copulas, see Web Appendix E.

Figure A46: Wage income and public transfers, empirical copula

(a) 3D Copula



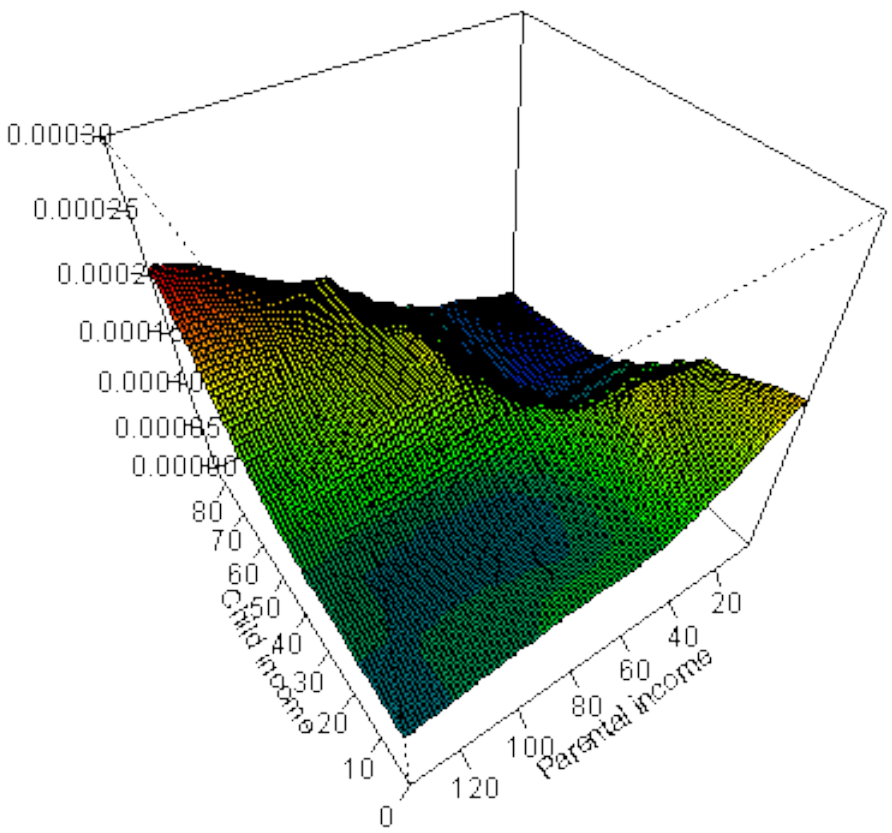
(b) Copula heatmap



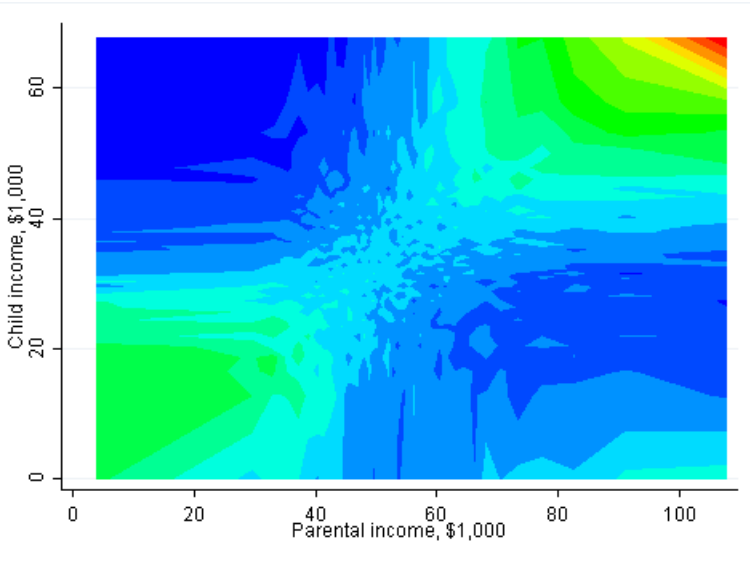
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$. Figure A46a shows the copula in a 3-dimensional plot and Figure A46b shows the same copula as a 2-dimensional heatmap.
The figures (colors and z-axis) depict the copula densities, which illustrate the (non-linear) intergenerational dependence of income across levels of parents and childrens income. Going from green to blue, there is a weaker intergenerational dependence of income (lower density). Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density).. The figure shows that the strongest dependence is present in the upper tail at high-high values of income as opposed to low- and mid-range income levels.
For a further description of copulas, see Web Appendix E.

Figure A47: Net-of-tax income including public transfers, empirical copula

(a) 3D Copula



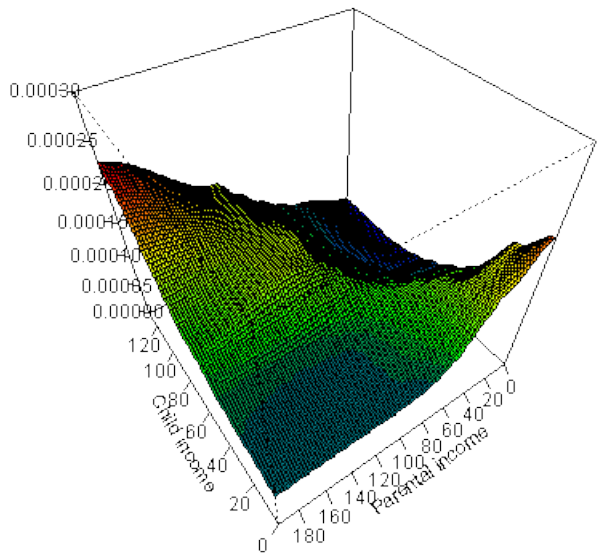
(b) Copula heatmap



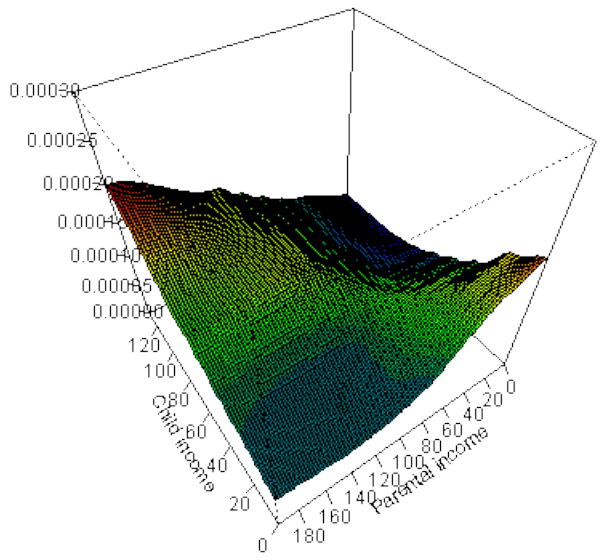
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$. Figure A47a shows the copula in a 3-dimensional plot and Figure A47b shows the same copula as a 2-dimensional heatmap.
The figures (colors and z-axis) depict the copula densities, which illustrate the (non-linear) intergenerational dependence of income across levels of parents and childrens income. Going from green to blue, there is a weaker intergenerational dependence of income (lower density). Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density).. The figure shows that the strongest dependence is present in the upper tail at high-high values of income as opposed to low- and mid-range income levels.
For a further description of copulas, see Web Appendix E.

Figure A48: Gross income excluding public transfers, copula from actual income, simulated normal distribution

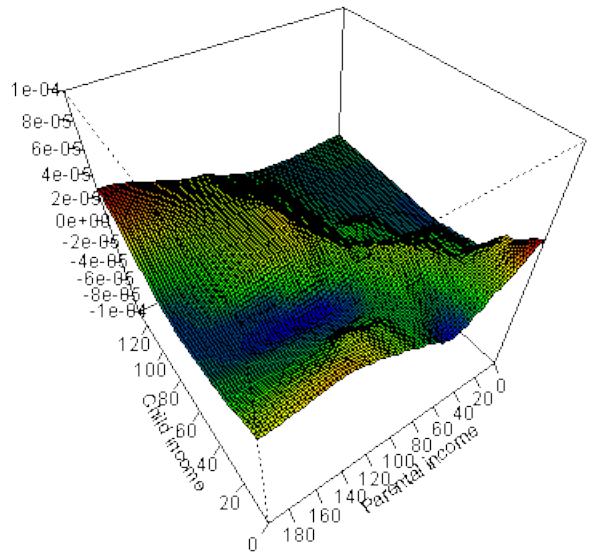
(a) Actual



(b) Bivariate normal distribution



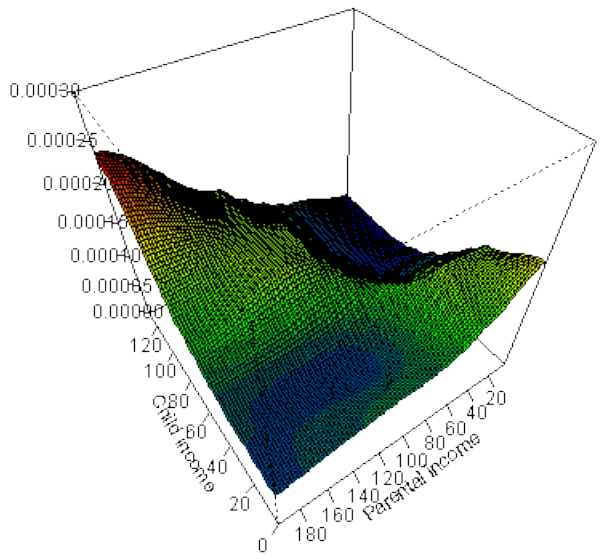
(c) Actual-normal difference



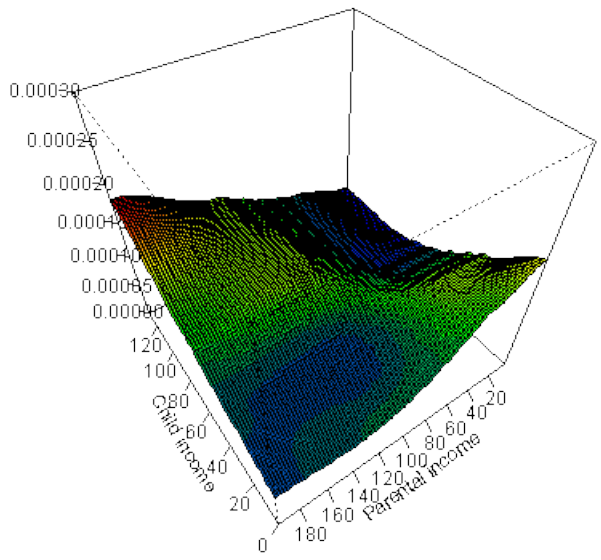
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. Figure (a) shows copulas derived from actual data, Figure (b) shows the copula derived from a simulated bivariate normal distribution with correlation as observed between parents' and children's log gross income excluding public transfers (0.246, see Table A5) and median/variance as observed in the actual income data, and Figure (c) shows the level difference between (a) and (b) where a positive value reflects that the actual level is above the simulated normal level. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$.
Going from green to blue, there is a weaker intergenerational dependence of income (lower density). Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density).. The figures show that the actual intergenerational tail dependence in the data is stronger than what is predicted from a bivariate normal distribution.
For a further description of copulas, see Web Appendix E.

Figure A49: Gross income including public transfers, copula from actual income, simulated normal distribution

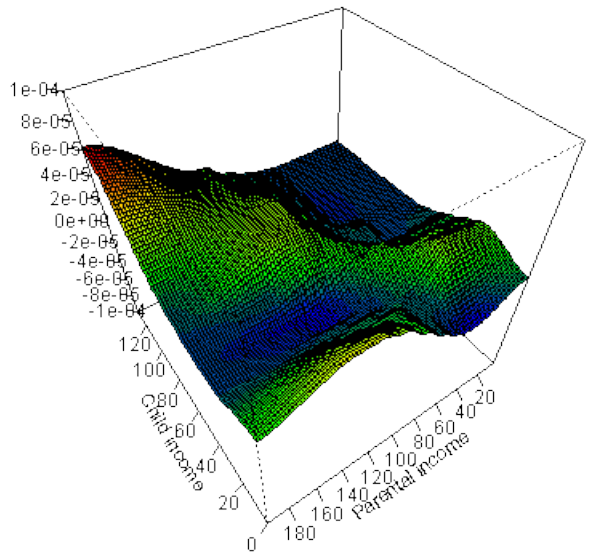
(a) Actual



(b) Bivariate normal distribution



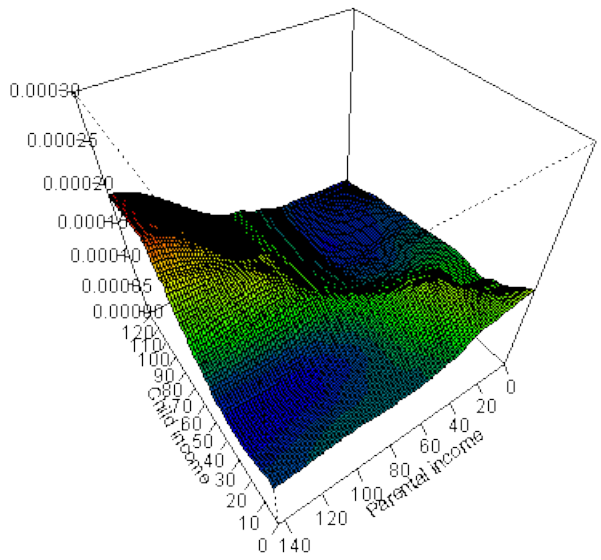
(c) Actual-normal difference



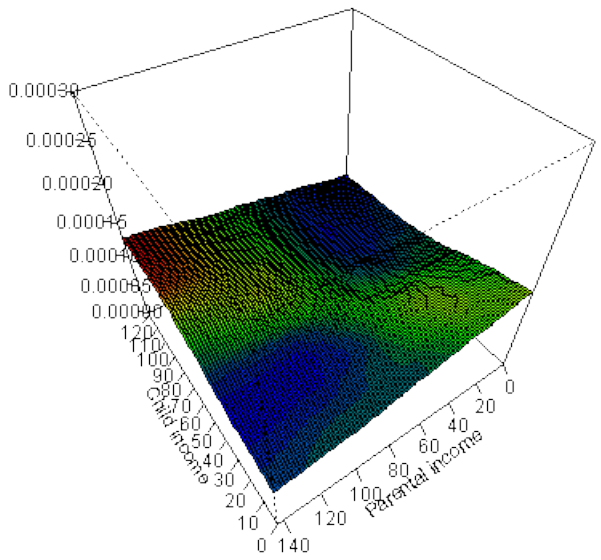
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. Figure (a) shows copulas derived from actual data, Figure (b) shows the copula derived from a simulated bivariate normal distribution with correlation as observed between parents' and children's log gross income excluding public transfers (0.201, see Table A5) and median/variance as observed in the actual income data, and Figure (c) shows the level difference between (a) and (b) where a positive value reflects that the actual level is above the simulated normal level. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$.
Going from green to blue, there is a weaker intergenerational dependence of income (lower density).. Going from green via yellow to red, there is a stronger intergenerational dependence of income (higher density). The figures show that the actual intergenerational upper tail dependence in the data is stronger than what is predicted from a bivariate normal distribution. For a further description of copulas, see Web Appendix E.

Figure A50: Wage income and public transfers, copula from actual income, simulated normal distribution

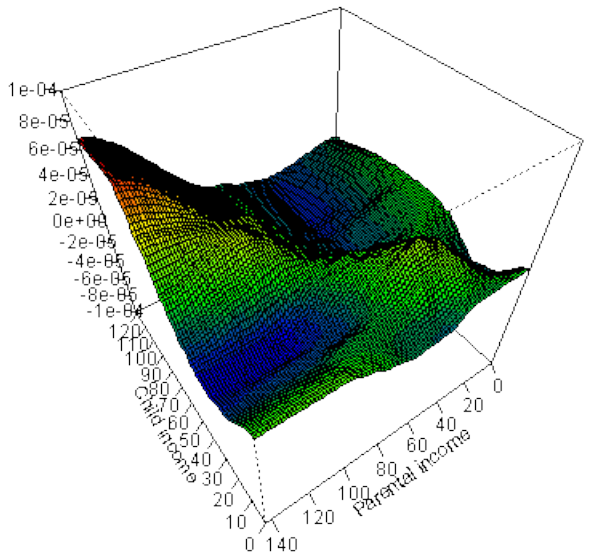
(a) Actual



(b) Bivariate normal distribution



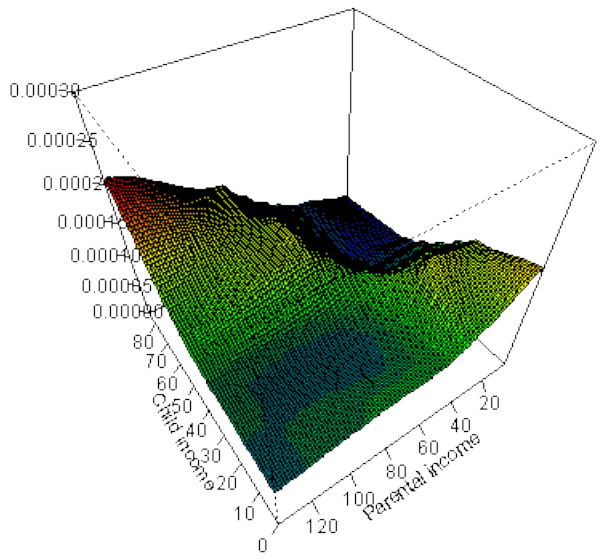
(c) Actual-normal difference



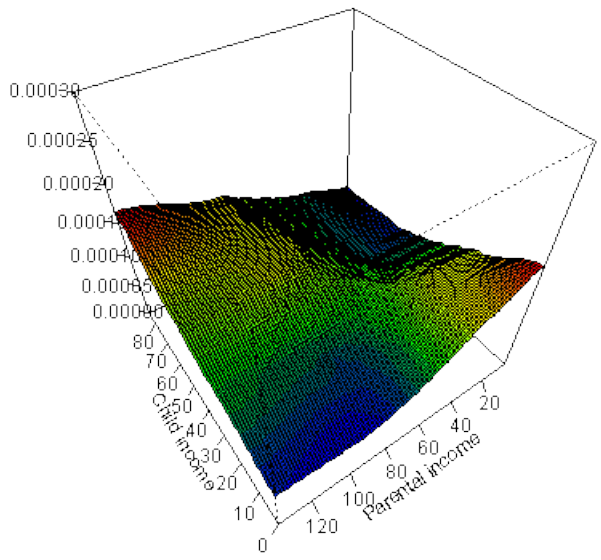
Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. Figure (a) shows copulas derived from actual data, Figure (b) shows the copula derived from a simulated bivariate normal distribution with correlation as observed between parents' and children's log gross income excluding public transfers (0.094, see Table A5), and Figure (c) shows the level difference between (a) and (b) where a positive value reflects that the actual level is above the simulated normal level. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$.
Going from green to blue, there is a weaker intergenerational dependence of income. Going from green via yellow to red, there is a stronger intergenerational dependence of income. The figures show that the actual intergenerational upper tail dependence in the data is stronger than what is predicted from a bivariate normal distribution.
For a further description of copulas, see Web Appendix E.

Figure A51: Net-of-tax income including public transfers, copula from actual income, simulated normal distribution

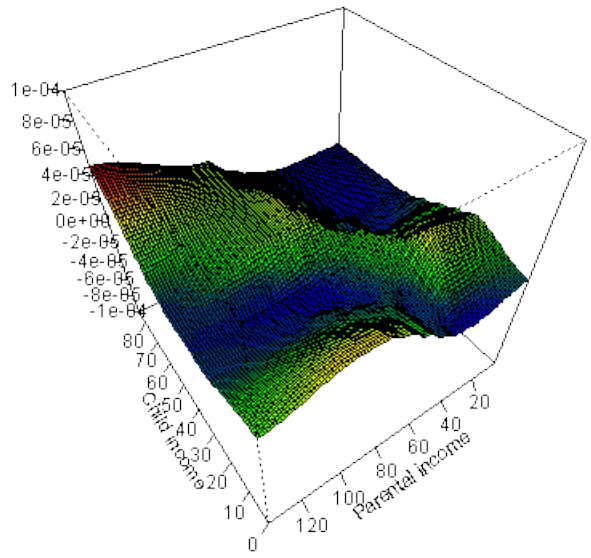
(a) Actual



(b) Bivariate normal distribution



(c) Actual-normal difference



Note: The figures show empirical copulas defined as the joint empirical distribution of rank-transformed data, and each cell corresponds to the marginal rank distribution. Figure (a) shows copulas derived from actual data, Figure (b) shows the copula derived from a simulated bivariate normal distribution with correlation as observed between parents' and children's log gross income excluding public transfers (0.174, see Table A5), and Figure (c) shows the level difference between (a) and (b) where a positive value reflects that the actual level is above the simulated normal level. In the figures' x-axis and y-axis, ranks have been transformed to levels using the within percentile $min(Income_i)$.
Going from green to blue, there is a weaker intergenerational dependence of income. Going from green via yellow to red, there is a stronger intergenerational dependence of income. The figures show that the actual intergenerational upper tail dependence in the data is stronger than what is predicted from a bivariate normal distribution while the lower tails is a little weaker than what is predicted from a bivariate normal distribution.
For a further description of copulas, see Web Appendix E.

F Data Appendix

This section describes the data sources and the main variables used for the analysis in the main text and in the Web Appendix. For the U.S., we use data from the CPS, NLSY79, CNLSY, NLSY97, and PSID, and for Denmark we use Danish full population administrative register data. This section consists of three parts. First, we describe the U.S. data sources and samples, second we describe the Danish data sources and samples, and finally, we provide summary statistics.

F.1 U.S. Data

We use data from the NLS surveys. They are nation-wide surveys for fixed panels, sponsored by the U.S. Bureau of Labor Statistics. The NLS surveys follow representative populations (or their children) in annual or biannual surveys.[13] Data on a wide range of areas are collected, including education, income, demographic characteristics, family relations, labor market outcomes, cognitive test scores, behavioral questionnaires, crime outcomes, and health, among others. Second, we use data from the Current Population Survey, a monthly survey of households conducted by the Bureau of Census for the Bureau of Labor Statistics.[14] It provides cross-sectional information on education, income, labor market outcomes, and demographic characteristics, among others. We use annual information from the March CPS from 1980 to 2011.

NLSY79 The NLSY79 is an annual (and later, biannual) survey of individuals aged 14–19 in 1979. We limit the sample to consist of civilian citizens which reduces the original sample of 12,686 individuals to the final sample size of 6,111 individuals. We measure own highest completed grade at the latest available year and the father's highest completed grade as

[13] For further documentation, see www.nlsinfo.org.

[14] For further documentation, see http://www.bls.gov/cps/cps_over.htm#faq and http://www.census.gov/cps/data/.

reported by the respondents. Educational categories are defined in the same way as the Danish longitudinal sample (see below): *Less than high school* - less than 12 years of schooling, *High school graduates* - 12–14.9 years of schooling, *College graduates* - 15 + years of schooling.

CNLSY The CNLSY is a longitudinal survey of children whose mothers took part in the original National Longitudinal Survey of Youth in 1979. For the early years, the surveys were annual and for the later years the surveys were biannual (as part of the NLSY79). For the early childhood years, information is provided solely from the mother/parents/caretaker (except some test scores/ratings of the child), while during adolescence, the youth also provide much of the survey information. Of the 11,504 children included in the CNLSY data, we restrict the data to only include children of the representative NLSY79 sample.

We use the Peabody Individual Achievement Test (PIAT) scores to measure cognitive skills. The CNLSY features three sets of PIAT scores; reading recognition, reading comprehension, and math. For non-cognitive skills we use the antisocial, headstrong, hyperactivity subscales from the Behavior Problem Index (BPI). The measures of cognitive skills and non-cognitive skills are in accordance with those of Heckman et al. (2006) and Cunha and Heckman (2008).

We define both high school completion and college attendance as dummy variables. High school completion is determined using the questions on whether the child (youth) has a high school diploma/GED or not.[15] We define college attendance as a report of either full- or part-time enrollment in college. As we use information on educational attainment up until age 21, we restrict the sample to cohorts born in 1990 or earlier. In addition to information on own characteristics, we include information on the mother's characteristics and household income measured at age 15 from the original NLSY data. We use the sum of the mother's and her spouse's reported wage income[16] and assets to measure household income and wealth, respectively. We measure wealth when the child was 15 years old and income as the average

[15] Cameron and Heckman (1993), Heckman and Rubinstein (2001), and Cunha and Heckman (2008) show that these two concepts are not equivalent. However, omitting GED from the definition of high school completion would likely reduce the similarities of Denmark and the U.S., as the Danish measure of high school completion also includes a variation of the GED (HF).

[16] Results are robust to using gross income, including UI and welfare transfers.

income between the child's 3rd and 15th year. We restrict the sample to individuals for whom we observe at least one test score for both cognitive and non-cognitive skills, along with parental income. The CNLSY contain information on birth characteristics for all children, while some of the test scores and questionnaires are missing or not reported. This leaves us with a sample of 3,268 individuals.

NLSY97 The NLSY97 is an annual (and later, biannual) survey of individuals aged 14–19 in 1997. The full survey sample consists of 8,984 individuals. We limit the sample to consist of the cross-sectional civilian citizens to arrive at the final sample size of 6,746 individuals. We measure own highest completed grade at the latest available year and father's highest completed grade as reported by the respondents. Educational categories are defined in the same way as the Danish longitudinal sample (see below): *Less than high school* - less than 12 years of schooling, *High school graduates* - 12–14.9 years of schooling, *College graduates* - 15 + years of schooling.

PSID The Panel Study of Income Dynamics (PSID) is a longitudinal survey (annual until 1998, biannual from 1999) from the U.S. The survey was first conducted in 1968 with a representative sample of more than 18,000 individuals (in 5,000 families). The survey also follows children from the original families, which have now grown into adulthood.

In our analysis in Section 2, we use only the Survey Research Center component of the sample and exclude the Survey of Economic Opportunity component. The extract used include childrens born between 1972 and 1978, yielding a sample of 621 parent-child matches.

We use more years to measure average income in the U.S. than in Denmark (see below), in order to obviate the problem that many in PSID have no-reports in some years. If we for example only used three years as we do for the child-generation in Denmark, many observations would be based on only one measure of income. This is not a problem in the Danish register data.

CPS In order to construct long-run trajectories of income by educational level, we use the March Current Population Survey (CPS, 1968–2014) from Integrated Public Use Microdata Series (IPUMS). The sample consists of civilian, non-institutionalized citizens. We use parents in 1987 and individuals aged 36–38 in 2011 (Section 2.2), and individuals aged 33–34 and 53–54 in each wave from 1980–2014 (Section B), where we obtain samples consisting of 116,604 individuals from the 1927–1958 cohorts and 169,860 individuals from the 1947–1978 cohorts. We measure the income for the former group at ages 53–54 and for the latter group at ages 33–34.

Wage is measured as sum of wage and salary income, non-farm self-employment income, and farm self-employment income. *Wage+UI/Welf* is measured as sum of *Wage* measure, income from unemployment benefits and welfare income, which includes Social Security Income, Supplemental Security Income (SSI), and other public assistance income. *Wage* and *Wage+UI/Welf* is all reported income excluding negative business and farm income. Wage and Salary income was adjusted for top coding following procedure in Autor et al. (2008). All calculations are weighted by CPS sampling weights and are deflated using the PCE deflator. Educational categories are defined in the same way as the Danish longitudinal sample (see below): *Less than high school* - less than 12 years of schooling, *High school graduates* - 12–14.9 years of schooling, *College graduates* - 15 + years of schooling.

We use the March Current Population Survey (CPS, 1981–2011) to construct occupational categories. The sample consists of civilian, non-institutionalized citizens with less than a college degree at age 26 in each wave. Number of observations used to create the chart is 53,705. Employment is defined as being at work or being absent from work but having a job during the time preceding the interview week. Again, educational categories are defined as: *Less than high school* - less than 12 years of schooling, *High school graduates* - 12–14.9 years of schooling. Occupational Categories are defined in the following way: "Care" - occupations related to health care assistance, nursing, child care, and teaching; "Sales/Services" - occupation related to sales and services except for "Care" occupations

defined above; "Office" - occupations related to office work; "Manual" - occupation related to physical work done by people in production, operation, assembly, transportation, agriculture, forestry, fishing, crafts and related areas.

F.2 Danish Data

For all information for Denmark we use administrative register data. All of the main data sources from the Danish administrative register data recorded by Statistics Denmark contain a unique individual identifier which allows us to link information on demographic characteristics, educational attainment, income, and welfare benefits for the entire Danish population at any given time between 1980 and 2013.[17] The data also includes parents' unique individual identifiers. Using these, we link the information of the children to parents' income, demographic characteristics, and educational attainment.

Cohorts of 1973–1975 For the analysis in Section 2, we use all children born in Denmark. We choose to use the cohorts of 1973–1975 do not use 1972–1978 cohorts (as in the PSID for the U.S., see above) as main specification for Denmark because the Danish register data starts in 1980 which will imply that we miss the first year for parents to children born in 1972 and because the last years of income would be measured at an too early age for the 1976–1978 children.

We discard individuals who migrate or whose parents migrate, and individuals for which we have no identification of their father and mother (each around 3% of the sample). Danish income data is based on tax-records. Some types of income (for example business profits and tax payments) may be shifted between tax-years to smooth income or as a result of tax avoidance. Likewise, as a result of shifting of income and tax-payments, a non-trivial share of individuals have negative incomes within a given year. However, as we base our income measures on averages across several years, these year-to-year fluctuations will be offset and

[17] For general information on Danish register data in English, the reader is referred to: http://www.dst.dk/en.

we only have a remaining miniscule number of individuals with negative incomes over several years—we discard these individuals from the analysis. The final sample size is 166,359, of which 149,190 child-parent matches have positive incomes throughout the years we measure income.

1987 Cohort as Panel We use the entire cohort of children born in Denmark in 1987. Using a unique individual identifier, we link schooling outcomes in the educational register to exam grades from the grade registers. We measure skills using grades from the 9th grade (the final year of compulsory schooling) and discard all children who have not completed compulsory schooling because they attend special needs schooling. We measure cognitive skills[18] using final math exam grades (written), math midterm grades (written), final physics exam grades and non-cognitive skills using organization/neatness grades[19] from the Danish written exam, Danish written midterm, and math written exam. We define high school completion as having completed an education that requires at least 12 years of schooling, and college as having been enrolled into an education that requires at least 15 years of schooling.[20] Figure A52 illustrates how the two schooling outcomes are affected by our definitions.

Using the parental unique identifier, we link the information of the children to parents' income and wealth, demographic characteristics, and mother's educational attainment. We use parents' annual wage income to construct the measure of household income and assets at the end of the year to construct the measure of household wealth. We measure parents'

[18] As test scores of grades are highly associated with non-cognitive skills (Borghans et al., 2011a,b), we use residuals from the cognitive measures regressed on the non-cognitive measures in the measurement system.

[19] One concern is that our measures of non-cognitive skills are closer related to academic achievement than to socio-emotional skills. We do not consider this to be an issue in the present case. When we estimate factor loadings and perform variance decompositions from the two factors on outcomes, DUI and psychiatric admissions, these outcomes are significantly more associated with non-cognitive (socio-emotional) skills than cognitive skills. The factor for non-cognitive skills explains around three and five times as much of the variance in DUI and mental disorders compared to the factor for cognitive skills.

[20] The Danish educational system is rooted in a Northern European tradition and is not directly comparable to the U.S. system, while secondary and tertiary educations in Denmark are highly comparable to those in countries as Germany and Norway. Our definition of 'high school' and 'college' brings the U.S. and Danish system closer, both qualitatively and in population means. However, this simplification of the Danish educational ladder reduces comparability to other Scandinavian schooling systems, unless similar simplifications are made there as well.

wealth in 2002 (at age 15) and income as average wage income between the child's 3rd and 15th year. We define high school completion as more than 12 years of completed schooling until age 22 and college attendance until age 25, because college enrollment is usually a few years later in Denmark compared with the U.S.. We restrict the sample to children whose parents have non-negative household wage income in 2002. This results in a sample of 39,539 children.

We use grades to estimate ages 15–16 cognitive and non-cognitive skills for the 1987 cohort and the DALSC sample. Table A18 summarizes the Danish grading system. When we estimate skills, we keep the relative distance between each of the individual grades in the Danish system.

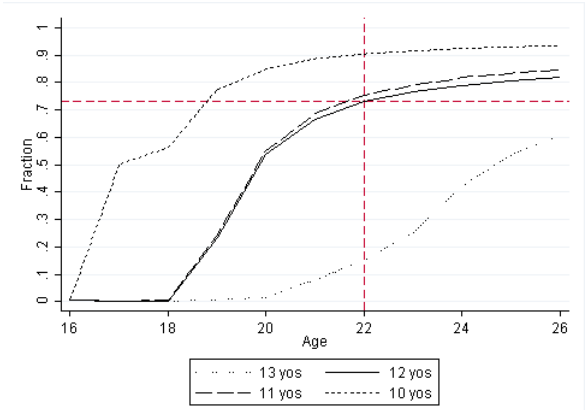
Table A18: Summary of Danish grading

Grade in Denmark	*Content*	*ECTS Grade*	*U.S. Grade*
12	Excellent in all aspects	A	A+ or A
10	Very good, only minor weaknesses	B	A- or B+
7	Good, some weaknesses	C	B
4	Fair, some major weaknesses	D	B- or C+
02	Adequate, minimum acceptance level	E	C
00	Fail, inadequate	Fx	D
-3	Fail, unacceptable in all aspects	F	F

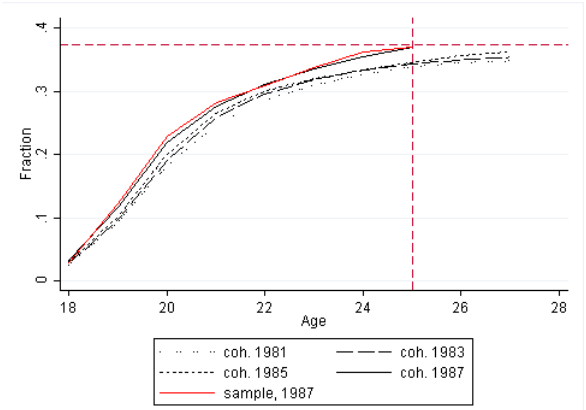
Source: Ministry of Education, proclamation on grading:
https://www.retsinformation.dk/forms/R0710.aspx?id=25308#B2.

Figure A52: Impact of schooling definitions of rates of high school completion and college attendance, Denmark

(a) High school completion, by highest grade completed and age



(b) College attendance, by cohort and age



Note: Figures show rates of high school completion and college attendance by various definitions in Denmark. Both figures are constructed using administrative register data. Figure A is constructed using the 1987 sample (based on the full cohort) used throughout the paper. It shows potential rates of high school definition across age and highest grade completed. Figure B is constructed using register data for the full cohorts born in 1981, 1983, 1985, and 1987, and the 1987 sample used throughout the paper. It shows rates of college attendance by the definition used in the paper across age and cohorts.

F.3 Summary Statistics

Table A19: Summary of sample selection

Sample selection	**Observations**
U.S.: CNLSY	
Original CNLSY sample	11,504
From representative sample	5,422
Born 1990 or earlier	4,023
With test scores information	3,268
U.S.: PSID	
All children born 1972–1978	1,257
Children born 1972–1978 in the Survey Research Center component	860
Income reported from age 30 or above	702
With positive incomes	621
Denmark: Cohort 1987	
Born in Denmark in 1987, and in Denmark and with educational information 2006–2012	52,915
Parental information throughout childhood	49,945
Skipped grade or early school start (exam before 2002)	48,323
With test score information 2002 (attended exam and not in special needs school)	39,539
Denmark: Cohorts 1973–1975	
Born in Denmark 1973–1975 and with residential information/present in Denmark, age 10	205,613
In Denmark and with income information 2010–2012	195,270
With ID of both parents	175,780
With non-negative incomes and parents not emigrated/died before child age 15	166,359
With positive incomes	149,190

Note: Table shows main sample selection criterions and corresponding sample sizes for our main data sources that we use. U.S. data: CNLSY and PSID; Danish data: Register data of cohort of 1987 and cohorts of 1973–1975.

Table A20: Summary statistics of covariates

	CNLSY, U.S.	**1987, Danish Cohort**
Gender (boy=1)	0.52	0.51
	(0.50)	(0.50)
Minority/immigrant	0.16	0.04
	(0.37)	(0.20)
Siblings	1.53	1.78
	(1.17)	(0.90)
Mother's age at birth	23.58	27.93
	(4.21)	(4.68)
Mother high school	0.92	0.65
	(0.26)	(0.47)
Mother college	0.33	0.38
	(0.47)	(0.49)
Observations	3,268	39,539

Table A21: Summary statistics of skill measures and outcomes

	CNLSY, U.S.	**1987, Danish Cohort**
Educational outcomes		
High school	0.75	0.74
	(0.43)	(0.37)
College	0.43	0.38
	(0.50)	(0.49)
Cognitive skills		
Measure 1	101.43	5.69
	(15.68)	(3.00)
	(65-135)	(-3,0,2,7,10,12)
Measure 2	104.30	6.04
	(15.68)	(3.09)
	(65-135)	(-3,0,2,7,10,12)
Measure 3	98.70	6.46
	(13.47)	(2.65)
	(65-135)	(-3,0,2,7,10,12)
Non-cognitive skills		
Measure 1	1.39	6.48
	(1.58)	(1.85)
	(0-6)	(-3,0,2,7,10,12)
Measure 2	2.40	6.04
	(1.69)	(1.89)
	(0-5)	(-3,0,2,7,10,12)
Measure 3	1.75	6.00
	(1.60)	(2.06)
	(0-5)	(-3,0,2,7,10,12)
Observations	3,268	39,539

Note: All skill measures are redefined to increase in skill levels.

Table A22: Overview of data sets used for analysis in section 3.3 for Denmark and the U.S.

	U.S.		Denmark	
Conditioning set	*Content of measure*	*Source*	*Content of measure*	*Source*
Non-cognitive skills	Behavioral Problem Index	Questionnaire ratings reported by mother, CNLSY survey data	Scores tanking behavior and orderliness of work and conduct during academic year, effort made in neatness of final essay and math test	Test scores, register data
Cognitive skills	Peabody Individual Achievement Test, reading recognition, math, reading recognition, reading comprehension	Test scores, CNLSY survey data	Exam grades, calculus math/algebra, physics; residualized from non-cognitive scores	Test scores, register data
Family background	Child gender, immigrant/minority, urban region, mother's age at birth, siblings, mother's age at birth, mother's years of schooling	CNLSY survey data	Child gender, immigrant/minority, urban region, mother's age at birth, siblings, mother's age at birth, mother's years of schooling	Register data
School background	School and peer characteristics	Mother's and child's ratings, CNLSY survey data	Means of previous school cohorts' characteristics	Register data

Note: Table outlines the information and sources used as condition sets in Tables 4 and A16.
The data sources, the construction of the data, and the variables are described and summarized in Section F (summary in Tables A20 and A21 in the Web Appendix).

Table A23: Summary of income definitions

Income measure	Denmark	U.S.
1 Total gross income incl. public transfers	All taxable income including wage income, public transfers, profits from own business, capital income, foreign income	All taxable income including wage income, public transfers, profits from own business, capital income, foreign income
2 Total gross income excl. public transfers	Taxable income including wage income, profits from own business, capital income, foreign income excluding all public transfers (both taxable and non-taxable).	Taxable income including wage income, profits from own business, capital income, foreign income excluding public transfers paid to individual such as (welfare public assistance, social security, disability, unemployment compensation, education support
3 Net-of-tax total income incl. public transfers (disposable income)	All taxable income including wage income, public transfers, profits from own business, capital income, foreign income minus all final income taxes paid in given year	Total gross (pre-tax) income from taxable sources minus individual retirement plan contributions, alimony paid, medical savings accounts, non-reimbursed employee business expenses, property taxes paid by the household during the previous calendar year, the federal retirement payroll deduction of an individual filing federal income taxes, and federal income tax liability, state income tax liability, and Social Security retirement payroll deductions for an individual or for a couple filing a joint tax return plus Earned Income Tax Credit for an individual or couple filing a federal income tax return
4 Wage earnings	Taxable wage income and fringes, and non-taxable income, severance pay, and stock-options plus taxable and non-taxable	Wage income and pre-tax income from self employment (business/farm)
5 Wage earnings plus transfers	**4** plus social assistance, unemployment benefits, labor market leave, sick leave assistance, labor market activation, child-benefits, education grants, housing support, early retirement pension, disability pension, and retirement pension.	**4** plus public transfers paid to individual such as welfare public assistance, social security, disability, unemployment compensation, education support

Variables used for Denmark (see www.dst.dk for further information):
1 Total gross income incl. public transfers = perindkialt
2 Total gross income excl. public transfers = perindkialt-overforsindk
3 Net-of-tax total gross income = perindkialt-skattotny
4 Wage earnings = loenmv
5 Transfers = overforsindk
Variables used for Denmark (see www.dst.dk for further information):
1 Total gross income incl. public transfers = INCTOT
2 Total gross income excl. public transfers = INCTOT-(INCSS+INCWELFR+INCGOV+INCSSI+INCUMENP+INCEDUC+INCVET +INCSURV+INCRETIR+INCWKCOM)
3 Net-of-tax total gross income = adjginc-fedtax-statetax-fica-fedretir+eitcred-proptax
4 Wage earnings = INCWAGE+INCBUS+INCFARM+INCWKCOM
5 Transfers = INCSS+INCWELFR+INCGOV+INCSSI+INCUMENP+INCEDUC+INCVET +INCSURV+INCRETIR

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