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PUBLIC REDISTRIBUTION AND INTERGENERATIONAL INCOME DEPENDENCY

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Abstract

This study examines intergenerational income dependency in incomes before and after public cash and in-kind transfers. We use administrative data from Denmark and estimate intergenerational dependency with a rank-rank specification. We predict in-kind transfers from childcare, schooling, education, and health care during the working life and find that rank-rank estimates of dependency in income after public in-kind transfers based on annual income at age 35 or 10-year averages are underestimated compared to estimates based on working life transfers. Rank-rank coefficients are reduced by 6% when childcare, school and health care working life transfers are added to disposable income but increases by 16% when education transfers are added, cancelling reductions of other transfers. In comparison, cash transfers reduce income dependency by 8%. Intergenerational dependency may therefore be larger (smaller) than previously assessed in countries with more heavily subsidized education (health) systems.

Keywords: Intergenerational income dependency, In-kind transfer**,** public redistribution

JEL Codes: J62; H2

1. Introduction

A large and growing literature has examined how much an individual's income depend on parental background characteristics such as income and education (Solon 1999; Björklund and Jäntti 2011; Black and Devereux 2011; Deutscher and Mazumder, forthcoming). Most of the literature focuses on earnings, but intergenerational dependency in economic living conditions may be mitigated by public redistribution of income.

This study examines how public income redistribution affect measures of intergenerational income dependency in Denmark using high-quality administrative data. We include cash transfers and in-kind transfers related to childcare, schooling, education, and health care and present rank-rank estimates of intergenerational income dependency.

We measure cash incomes at the age of 35 and at the ages of the parent, when the child was 12 to 18 of age to limit life-cycle bias (Haider & Solon 2006; Nybom & Stuhler 2017). Measuring in-kind transfers at the same ages would, however, mask their influence because in-kind transfers are often targeting earlier or later life stages. We therefore predict in-kind transfers received during the work life from age 18 to 65 and compare the estimates of intergenerational income dependency to estimates based on annual or 10-year averages of in-kind transfers.

2. Data and methods

We define post-transfer income, or extended income, as disposable income plus public in-kind transfers (e.g., Aaberge et al. 2018). To ease comparison, we define pre-transfer income from disposable income as well, where tax payments have been added back and cash transfers withdrawn. Pre-transfer income primarily consists of income from work, self-employment and interest and dividends[1].

We use Danish administrative income data from 1980 to 2017 and data with information on the use of public services from 2008 to 2017[2]. Pre-transfer income and disposable income are measured for the child generation at age 35 to limit life-cycle bias from these income sources (Haider & Solon 2006; Nybom & Stuhler 2017). We include children of a Danish origin born from 1977 to 1982, who

[1] The pre-transfer income concept differs from market income because disposable income used by Statistics Denmark include imputed rent from home ownership, subtract deductible interest payments and adds alimony payments.
[2] We do not collect data on in-kind transfers further back in time because earlier data on daycare has a poorer quality, school enrolment prior to grade 7 is not available, and a reform altered the municipal structure in 2007 (and expenditure on daycare and schooling are from municipal accounts).

we can match with at least one of their parents, and where parental cash income is observed in every year when the child is aged 12 to 18 from 1980 to 2017.

We use equivalized family incomes to account for the fact that many in-kind transfers are distributed at the family level and because public transfers are targeting the welfare of the entire family[3]. The in-kind transfers include transfers related to education and health care for all members of the family, and childcare and schooling for children in the family. The construction of the in-kind transfers is described in Appendix B.

Figure 1 shows that the in-kind transfers peak at different ages from age 18 to 65. Intergenerational income dependency is therefore likely to be measured with substantial life-cycle bias when incomes are measured at a particular age or even a limited age range.

- Figure 1 about here

To avoid such biases, we predict in-kind transfers throughout the working life[4]. Childcare, schooling, and education transfers are predicted using information about the number of children in the family and the highest education attained at age 35 for the child generation, and at the age of the parent when the child is 12 to 18. We predict health care transfers by their insurance value (Smeeding et al. 1982; Aaberge et al. 2018). This is related to the prediction of missing parental income in Björklund & Jännti (1997). We estimate age- and gender specific regressions of individual health care expenditure, controlling for education, region of birth and number of children and adults in the household at the age observed closest to age 35. The estimates are used to predict the health care expenditure for the sample of 35-year-old children and their parents. For each child, we simulate health care expenditure from age 18 to 65, while for the parent, we simulate health care during ages when the child was aged 12 to 18. Descriptive statistics are provided in the appendix (Appendix Table A.1).

Intergenerational income dependency is estimated by means of a rank-rank specification:

$$R_i = \alpha + \beta R_{p(i)} + \gamma_c + \epsilon_{it} \qquad (1)$$

R_i is the rank of income of child i at age a 35, who grew up with parents with income rank $R_{p(i)}$, and γ_c are childbirth cohort fixed effects. The slope, β, is a measure of relative dependency, and it has advantages compared with other measures of intergenerational dependency (Nybom & Stuhler 2017;

[3] Equivalized family income is the sum of incomes in the household divided by the modified OECD equivalence scale.
[4] We have limited the analysis to the working life both because it makes sense when compared against market incomes and cash transfers, but also because elder care starts to dominate in-kind transfers from the age of 70.

Deutscher and Mazumder, forthcoming). Rank-rank plots show that the linear relationship is a fair approximation (Appendix Figure A.1-A.3), and while we present results for children and their fathers, results are qualitatively the same with mothers (Appendix Table A.2-A.4).

3. Findings

Figure 2 compares the annual and predicted in-kind transfers for children by the rank of the extended income for fathers. School transfers are omitted because they show the same pattern as childcare transfers. The figure shows that annual education and health transfers are unrelated to paternal disposable income at age 35, whereas childcare transfers are positively related to paternal disposable income, but that the relationships are reversed when looking at predicted transfers to the right.

- Figure 2 about here

Table 1 shows that the rank-rank coefficient for pre-transfer income is 0.237 and 0.219 for disposable income, and that the difference is slightly larger when incomes are averaged over 10 years. Intergenerational income dependency is therefore reduced ex-post of cash transfers and income taxes.

- Table 1 about here

Table 2 shows the rank-rank coefficients for extended income. Column (1) shows that with annual incomes, intergenerational income dependency is substantially lower than in disposable income, but that income dependency rises when averaging over time and is on the level with disposable income when using predicted working life transfers. Column (2) through (5) show that this downward bias from annual measures is driven by school transfers. They also show that most in-kind transfers slightly reduce intergenerational dependency when measured over the working life, but that intergenerational dependency is driven upwards by education transfers.

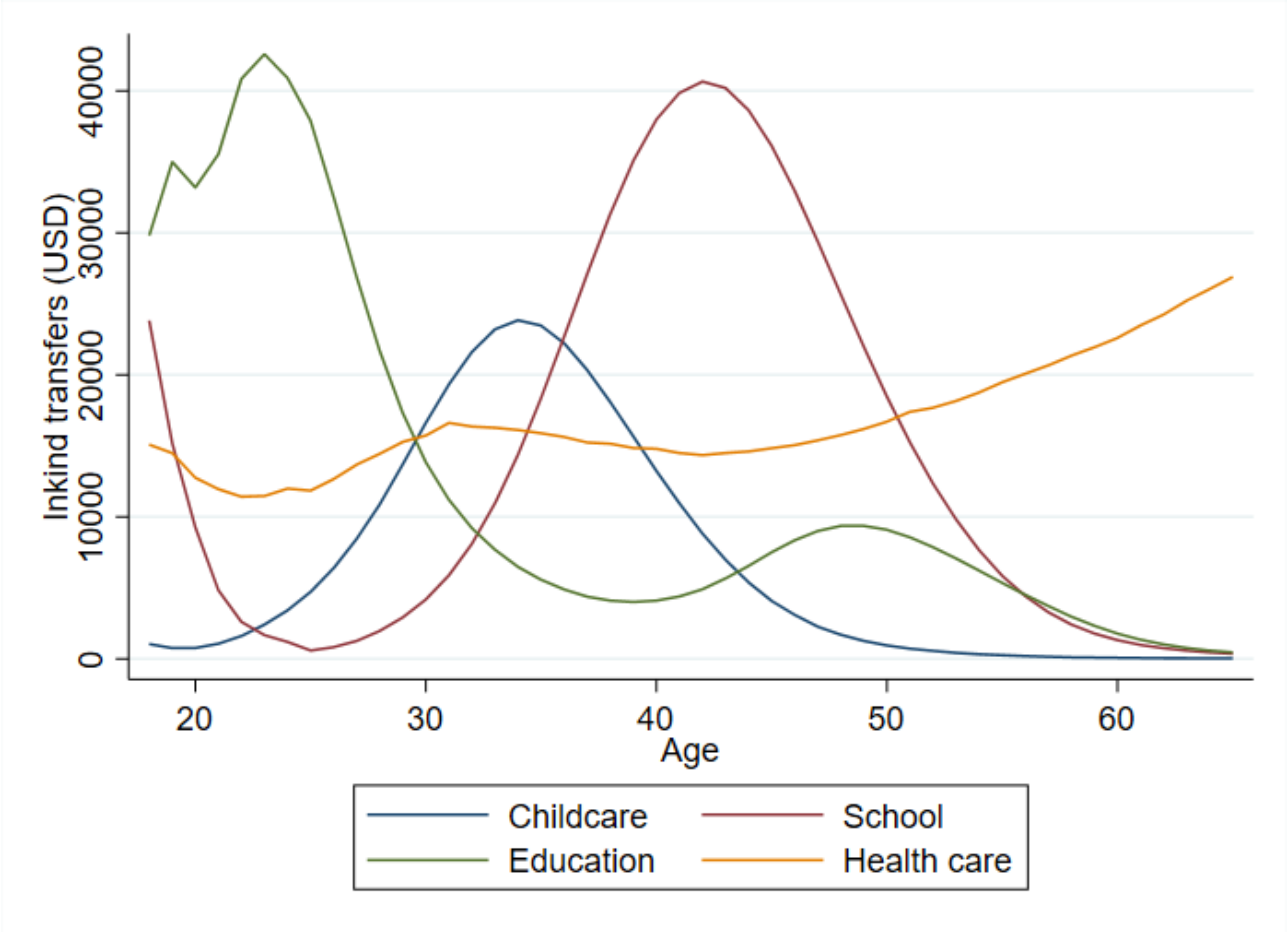
- Table 2 about here

4. Conclusion

The level of intergenerational income dependency is at the heart of many developed country comparisons. We have presented a method for estimating in-kind transfers throughout the working life and examined how inclusion of these transfers affect intergenerational income dependency in Denmark. We show that the influence of in-kind transfers on intergenerational income dependency is larger with predicted working life transfers than with annual or mean in-kind transfers. Public transfers related to childcare, school transfers and health care reduce intergenerational dependency

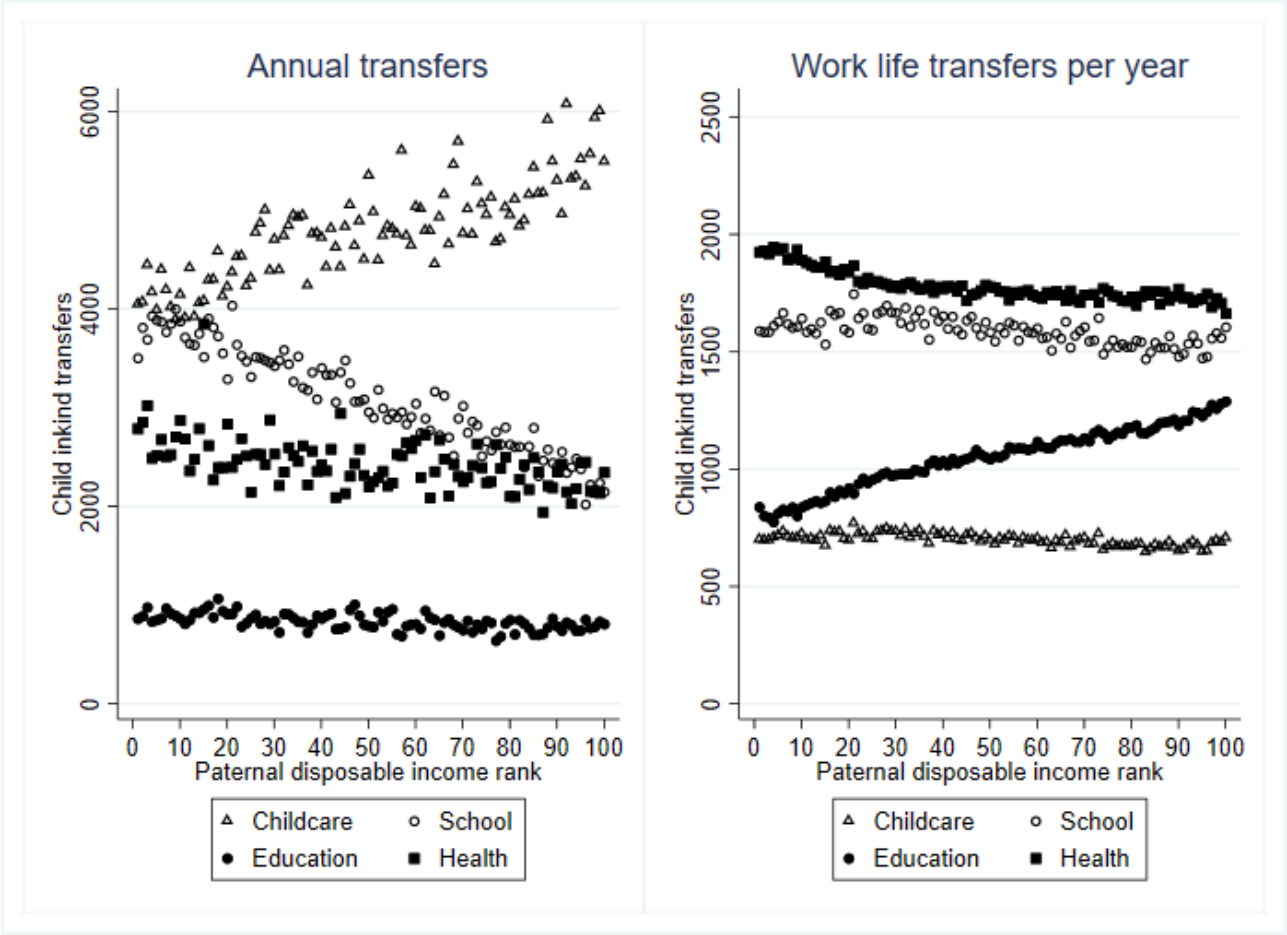
nearly to the same extent as public cash transfers, but intergenerational dependency is driven upwards because of a strong intergenerational link in education. The results can have consequences of international comparisons, suggesting that intergenerational income dependency is (over-) underestimated in countries with heavily subsidized (health-) education systems.

Figure 1: Family equivalized in-kind transfers by age



Note: Annual in-kind transfers for 18 to 65 year-olds from 2008 to 2017 by age.

Figure 2. Annual and predicted working life in-kind transfers, by parental extended income rank



Notes: All incomes are in USD. Father's income is the average over years, when the child was 12 to 18 years of age. Predicted in-kind transfers in the child generation are mean transfers per year over the age of 18 to 65.

Table 1. Rank-rank regressions for pre-transfer income and disposable income.

	Pre-transfer income	Disposable income
	(1)	(2)
Annual child income	0.237***	0.219***
	(0.003)	(0.003)
10-year mean child income	0.248***	0.214***
	(0.003)	(0.003)
Observations	122,760	

Notes: Each coefficient is the slope from a rank-rank regression of child income on paternal income. Results with either annual or mean observed income for children. Paternal income is (pre-transfer or disposable) mean income at ages of the parent where the child is aged 12 to 18. All estimates control for childbirth cohort. Standard errors in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

Table 2. Rank-rank regressions for extended income.

		Separate inkind family transfers:			
	Extended income	Disp + Childcare	Disp + School	Disp + Education	Disp + Health care
	(1)	(2)	(3)	(4)	(5)
Annual child transfers	0.165***	0.210***	0.169***	0.244***	0.198***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
10-year mean child income	0.180***	0.209***	0.185***	0.253***	0.199***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Predicted working life child transfers	0.220***	0.215***	0.205***	0.253***	0.205***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Observations	122753	122753	122753	122753	122753

Notes: Each coefficient is the slope from a rank-rank regression of child extended income on paternal extended income. Extended income is defined by disposable income plus specific or all in-kind transfers. Results with either annual, mean observed income or predicted working life in-kind transfers for children. In-kind transfers are always observed at ages of the parent where the child is aged 12 to 18. All estimates control for childbirth cohort. Standard errors in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

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Appendix A: Additional results

Table A.1. Descriptive statistics for children and their fathers.

	Mean	S.D.	Mean	S.D.	
A. Demographics and cash incomes					
	Child		Father		Intergenerational correlation
Age	35	0.00	43.64	2.69	
Male	0.51	0.50	1.00	0.00	
Children in household	1.36	1.07	1.86	1.01	0.09
Adults in household	1.77	0.49	1.87	0.34	0.05
Pre-transfer income (USD)	50375	34988	40689	21274	0.20
Disposable income (USD)	39495	20988	29444	9968	0.16
B. Predicted working life in-kind transfers per year (USD)					
	Child		Father		Intergenerational correlation
Childcare	700	506	554	328	-0.41
School	1586	1146	1256	744	-0.41
Education	1049	514	909	766	0.61
Health	1783	613	1133	666	0.20
Individuals	122,760		99,170		
Panel C. Annual and 10-year mean transfers for children (USD)					
	Annual		10-year mean		Correlation
Childcare	4789	8729	4148	3803	0.54
School	3087	4570	2132	3009	0.83
Education	836	2579	1554	2103	0.44
Health	2448	7954	2460	4410	0.51

Notes: All incomes are in 1000s USD. Pre-transfer income and disposable income are observed at age 35 for the child, and as the average of father's income when the child was 12 to 18 years of age. Predicted in-kind transfers are annual means from age 18 to 65. Childcare and school transfers are for family members below age 18 and education and health transfers for family members above age 18 of, respectively, child and parent generations.

Table A.2. Descriptive statistics for children and their mothers.

	Mean	S.D.	Mean	S.D.	
A. Demographics and cash incomes					
	Child		Mother		Intergenerational correlation
Age	35.00	1.00	42.40	2.95	
Male	0.51	0.50	0.00	0.00	
Children in household	2.20	0.84	1.34	1.07	0.08
Adults in household	1.86	0.36	1.76	0.49	0.06
Pre-transfer income	50558	41018	34689	23433	0.21
Disposable income	39444	23665	28437	9904	0.18
B. Predicted mean in-kind transfers per year					
	Child		Mother		Intergenerational correlation
Childcare	689	508	1100	306	0.05
School	1562	1151	2494	693	0.53
Education	1051	515	737	772	0.53
Health	1787	614	1678	738	0.27
Individuals	122,760		99,170		
Panel C. Annual and 10-year mean transfers for children					
	Annual		10-year mean		Correlation
Childcare	4766	8606	4111	3822	0.55
School	2981	4518	2145	3023	0.83
Education	841	2593	1523	2092	0.45
Health	2479	18344	2469	4920	0.53

Notes: All incomes are in 1000s USD. Pre-transfer income and disposable income are observed at age 35 for the child, and as the average of mother's income when the child was 12 to 18 years of age. Predicted in-kind transfers are annual means from age 18 to 65. Childcare and school transfers are for family members below age 18 and education and health transfers for family members above age 18 of, respectively, child and parent generations.

Table A.3. Rank-rank regressions for pre-transfer and disposable income for mothers.

	Pre-transfer income	Disposable income
	(1)	(2)
Annual child income	0.267***	0.283***
	(0.002)	(0.002)
10-year mean child income	0.249***	0.249***
	(0.002)	(0.002)
Observations	181719	

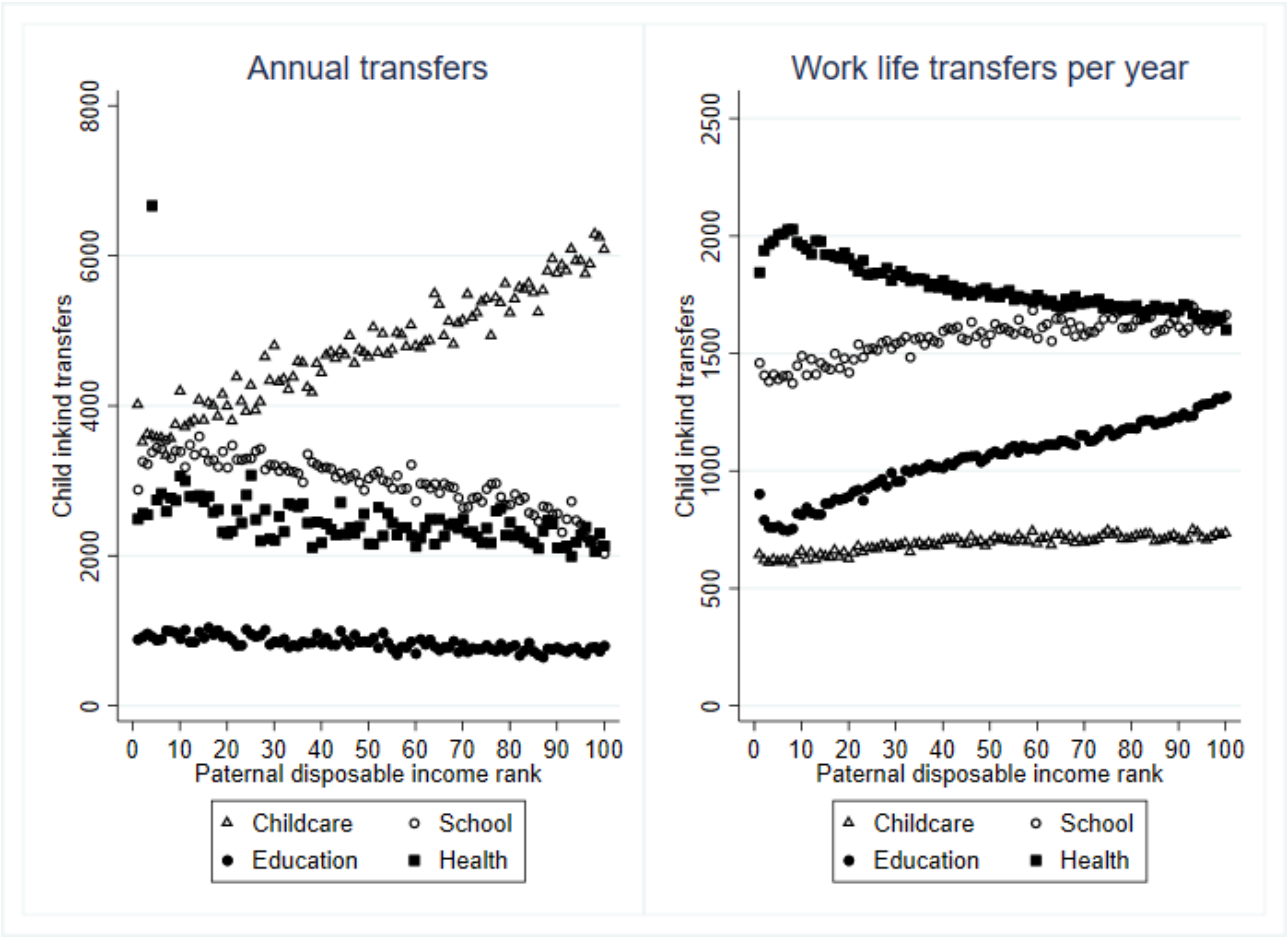
Notes: Each coefficient is the slope from a rank-rank regression of child income on maternal income. Results with either annual or 10-year mean observed income for children. Maternal income is the (pre-transfer or disposable) mean income at ages of the parent where the child is aged 12 to 18. All estimates control for childbirth cohort. Standard errors in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

Table A.4. Rank-rank regressions for extended income for mothers.

		Separate inkind family transfers:			
	Extended income	Disp + Child care	Disp + School	Disp + Education	Disp + Health care
	(1)	(2)	(3)	(4)	(5)
Annual child transfers	0.230***	0.250***	0.217***	0.269***	0.226***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
10-year mean child income	0.239***	0.250***	0.231***	0.275***	0.229***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Predicted working life child transfers	0.272***	0.251***	0.253***	0.311***	0.236***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Observations	181712	181712	181712	181712	181712

Notes: Each coefficient is the slope from a rank-rank regression of child extended income on maternal extended income. Extended income is defined by disposable income plus specific or all in-kind transfers. Results with either annual, mean observed income or predicted working life in-kind transfers for children. In-kind transfers are always observed at ages of the parent where the child is aged 12 to 18. All estimates control for childbirth cohort. Standard errors in parenthesis. * p<0.1 ** p<0.05 *** p<0.01.

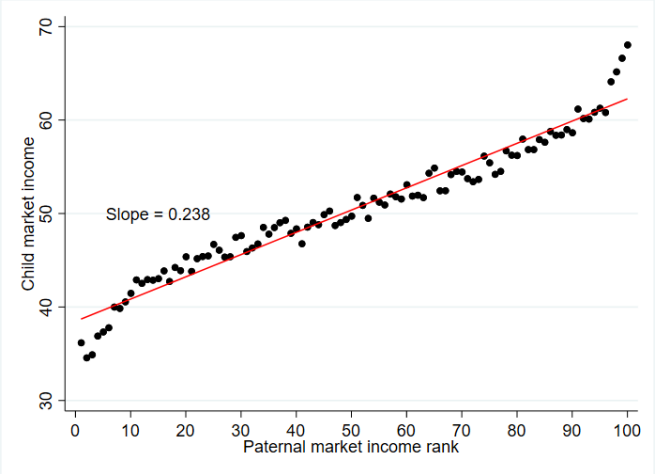
Figure A.1. Annual and predicted working life in-kind transfers, by maternal extended income rank



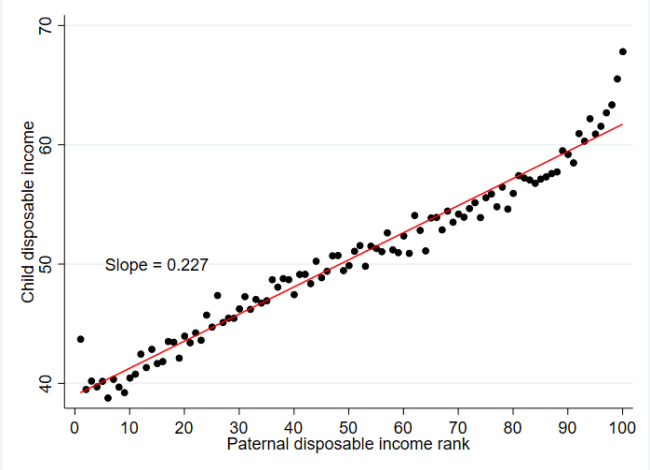
Notes: All incomes are in USD. Mothers' income is the average over years, when the child was 12 to 18 years of age. Predicted in-kind transfers in the child generation are mean transfers per year over the age of 18 to 65.

Figure A.2. Rank-rank plots for fathers

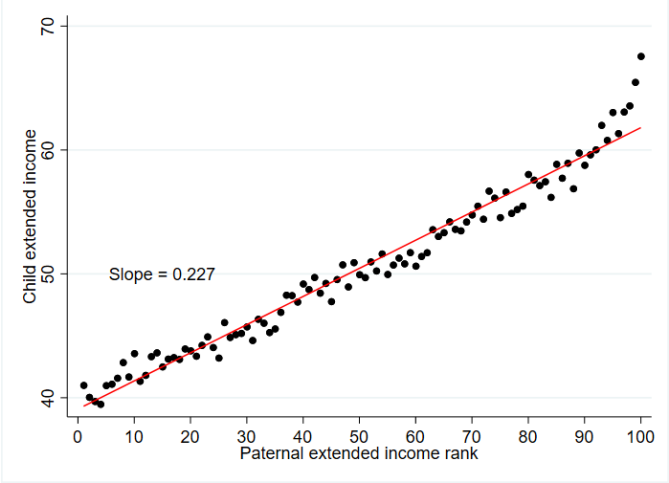
(a) Annual Pre-transfer income



(b) Disposable income



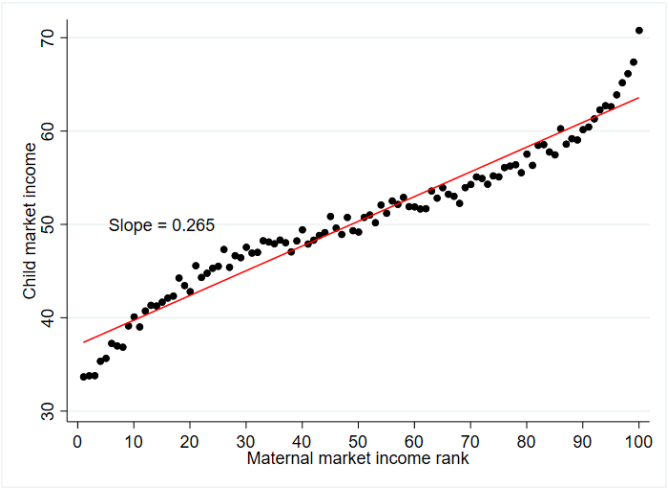
(c) Extended income



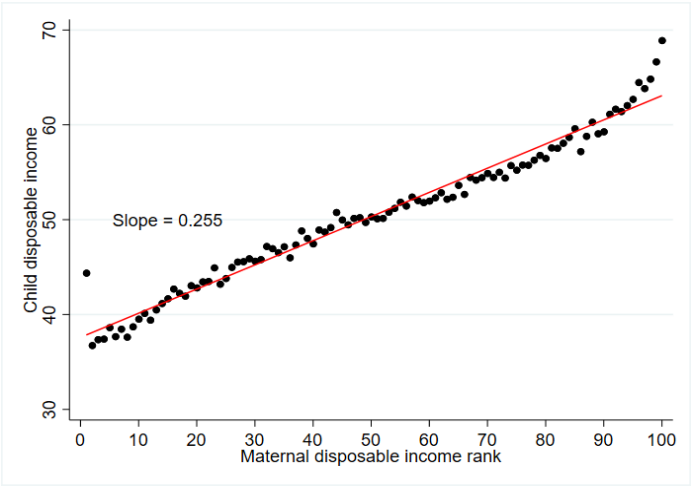
Notes: Child incomes are measured at age 35. Father's income is the average over years, when the child was 12 to 18 years of age. Predicted in-kind transfers in the child generation are mean transfers per year over the age of 18 to 65, while it is from age 12 to 18 for fathers.

Figure A.3. Rank-rank plots for mothers

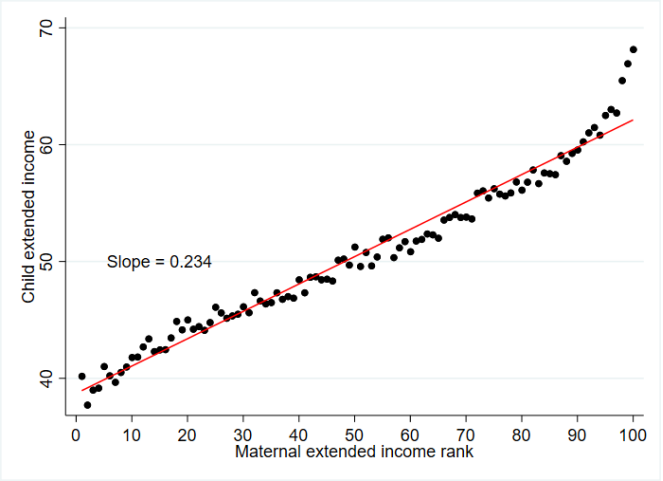
(a) Annual Pre-transfer income



(b) Disposable income



(c) Extended income



Notes: Child incomes are measured at age 35. Mother's income is the average over years, when the child was 12 to 18 years of age. Predicted in-kind transfers in the child generation are mean transfers per year over the age of 18 to 65, while it is from age 12 to 18 for mothers.

Appendix B: Cash Income and in-kind transfers definitions

This appendix describes the construction of cash income and in-kind transfers from administrative register data and other data sources.

Cash income

We consider three types of income: Pre-transfer income, disposable income and extended income. The difference between the three incomes is that different public transfers are sequentially added: Disposable income is pre-transfer income plus cash transfers (minus income taxes), and extended income is disposable income plus in-kind transfers.

We use income definitions used by Statistics Denmark. All incomes are described on Statistics Denmark's webpage, but descriptions are in Danish[1]. A brief extract of the main descriptions is included below, where we include the official names of the register variables from Statistics Denmark.

Pre-transfer income

Pre-transfer income is total income from work and self-employment (ERHVERSINDK_13), private pensions (PRIVAT_PENSION_13), capital income (FORMUEINDK_BRUTTO) and a residual (RESUINK_13).

It also includes an imputed rent from home ownership (LEJEV_EGEN_BOLIG), interest rate expenditures (RENTUDGPR), including those from abroad and from own companies, and a payment made to former spouses and children after divorce (UNDERHOL).

Disposable income

Disposable income is pre-transfer income plus public cash transfers and subtracting income taxes:

Pre-transfer income = disposable income (DISPON_13) - cash transfers (OFF_OVERFORSEL_13) + income taxes (SKATMVIALT_13)

Cash transfers and taxes

Cash transfers include unemployment benefits and social benefits (DAGPENGE_KONTANT_13) and sickness, housing, and child benefits as well as student grants (OVRIG_OVERFORSEL_13) and public pensions including disability and early retirement pensions (OFFPENS_EFTLON_13).

Taxes include national and local income taxes, capital income taxes and private property taxes (SKATTOT_13), as well as compulsory health contributions (Sundhedsbidrag) and compulsory labour market contributions (Arbejdsmarkedsbidrag), (ARBBIDMVALM).

[1] https://www.dst.dk/da/Statistik/dokumentation/Times/personindkomst

In-kind transfers

In-kind transfers are constructed from information on individual utilization of public services times average expenditure for users, where the average is constructed at various level, as described in more detail below.

Childcare

For childcare, schooling, and social care, the average public expenditure is obtained at the municipal level, from information from municipal account data accessed through Statistics Denmark for the period 2008-2017[2].

Public expenditure on childcare is obtained from the following municipal accounts:
5.25.10, Common childcare costs
5.25.11, Family daycare
5.25.12, Nursery
5.25.13, Integrated care
5.25.14, Daycare

We combine this with register information on individual utilization of childcare. From 2009 to 2014, we use the DAGI register, and from 2015 the BOERNFB register. We define a childcare user as a child aged 0-5 who is enrolled in one of the following childcare options: i) nursery, ii) kindergarten, iii) age-integrated institution, and iv) daycare. We cannot distinguish between these types of care prior to 2015. Representativeness is slightly lower prior to 2017.

Elementary schooling

Municipal school expenditure is obtained from the following municipal accounts:
3.22.01 Public schools
3.22.02 Common school costs
3.22.03 Sickness and home-teaching
3.22.04 Psychological and pedagogical counseling
3.22.05 Out-of-school care (SFO)
3.22.06 Pupil school transportation
3.22.07 Teaching for children with special needs, regional school
3.22.08 Teaching for children with special needs, municipal school
3.22.09 Teacher training
3.22.10 Governmental and Private schools
3.22.12 Boarding schools
3.22.14-15 Career counseling (UVU)

Enrolment is obtained from the UDD register. Between 14-18% are enrolled in private schools. Private school expenditure consists of both municipal, national subsidies and private payments. The municipal account data includes private payments at private school, but not the state subsidy for private schools. The two are, as we show below, very alike so we keep the total municipal

[2] https://www.statistikbanken.dk/statbank5a/default.asp?w=1920, TABLE REG31

expenditures, including private payments, as a proxy for total municipal and state subsidies. We cannot back out private payments as we could for childcare because we do not observe private school enrolment.

The total public subsidy (state and municipality) for private school is 76% of average costs on public schools and it constituted DKK 59.659 in 2021[3]. The municipality contributed to private schools with a payment of DKK 39.662 per student, so the state subsidy is approximately DKK 20.000 per child.

If we assume that operating costs of private and public school are the same, the private payments constitute 59.659/0.76 - 59.659 = DKK 18.839, i.e., roughly equal to the state subsidy.

Education

Costs for education are based on institution-specific government grants per student ("Taxametertilskud").

Upper secondary education

Grants for vocational training and high school are obtained from the Ministry of Education: https://www.uvm.dk/institutioner-og-drift/oekonomi-og-drift/regulerede-institutioner/takstkatalog-og-finanslov/takstkatalog.

The average grant includes teaching costs and base costs as well as a subsidy per completed student (Undervisningstakst + færdiggørelsestakst pr. årselev). We exclude grants for special education.

Tertiary education

Grants for tertiary education are obtained from the following sources:

Short-cycle educations[4]:

https://ufm.dk/uddannelse/videregaende-uddannelse/erhvervsakademier/okonomi/tilskud/arkiv-takstkataloger-og-orienteringbreve

Medium-cycle educations[5]:

https://ufm.dk/uddannelse/videregaende-uddannelse/professionshojskoler/okonomi/tilskud

Long-cycle educations:

https://ufm.dk/uddannelse/videregaende-uddannelse/universiteter/okonomi/uddannelsestilskud/bevillinger-til-universitetsuddannelse

Average expenditure include the teaching costs and base costs as well as a subsidy per completed student ("Undervisningstakst", "fællesudgift", "færdiggørelsestakst pr. årselev"). The subsidy per

[3] https://www.friskolerne.dk/fileadmin/filer/Kampagner/Valgmateriale_KV21/Friskole_finansiering_final.pdf (in Danish).
[4] In Danish: "erhvervsakademier
[5] In Danish: "professionsuddannelser".

completed student is added irrespective of completion rates. We use costs from 2015 and onwards and deflate costs in earlier years using the consumer price index.

Health Care

We have access to individual expenditure on hospitalizations and care covered by the National Health Insurance Service from 2008 to 2017.

Hospitalizations

Hospital expenditure is obtained from the DRG-grouped National Patient Register (LPR) where hospitalization records are grouped according to the DRG (Diagnosis Related Groups) categories for inpatient records and the DAGS (Danish Outpatient Grouping System) categories for outpatient records. We include the additional fee for patients hospitalized beyond a given number of days specific to each diagnosis ("langliggerdage"). The National Patient Register is divided into two main areas: somatic health care and psychiatric health care, and we include both.

We add up all DRG/DAGS fees for both somatic- and psychiatric hospitalization records and for both outpatient- inpatient records to generate a variable containing the total individual hospitalization costs in each year.

National Health Insurance system

The National Health Insurance Service Registry (SSR) contains information about individual use of general practice, specialists and other activities supported by the National Health Insurance system. All activities have been given a gross fee which we add up to calculate the total individual costs in each year.

Long-run in-kind transfers

We construct two proxies for long-run in-kind transfers: 1) Mean annual transfers observed prior to age 35 for the child generation, and 2) Predicted working life transfers for the child and parental generation. This section describes the latter.

The outset for the prediction is the literature on extended income, where health care is often valued by its insurance value (Aaberge et al. 2018). The insurance value is often estimated by age, gender and education specific use. Because we have a family perspective, we extend this with the number of children and adults in the family and allow for separate utilization of married persons.

Expenditures on childcare and schooling are calculated as the number of children in the family at age 35 times the costs of 5 years of childcare (from age 1-5) and 10 years of schooling (from age 6-15), assuming unit costs are equal to average national costs in 2017 (in 2015 prices).

We assume that the first child is born at age 25 and each child (if any) two years thereafter. Therefore, childcare expenditures are paid at ages 26-29 in a family with one child, and at ages 26-29 and 32-35 in a family with two children. School expenditures are paid at adult ages 30-39 (when the child is 6-15) for the first child, and at ages 32-42 for the second child, and so on. After

summing the transfers for all children in the family, we use the adult equivalent of childcare and school transfers.

Expenditures on education are calculated as the unit costs in 2017 (in 2015 prices) for the highest attained education times it's designated study time. We assume that individuals with a medium- or long-cycle education has also completed high school.

When predicting working life health care expenditure, we estimate the following age-and gender specific linear regressions:

$$H_{itg} = \alpha_{tg}^{r} + \beta_1^{tg} E_i + \beta_2^{tg} M_i + \beta_3^{tg} n_{ci} + \beta_4^{tg} n_{ai}\, \epsilon_{it}, \mathrm{t} = 18, \ldots 65, \mathrm{g} = 1{,}2$$

Where H_{itg} is health care expenditure on health care utilization for individual *i* with gender *g* at age *t*, α_{tg}^{r} is dummy for being born in parish *r,* E_i is highest level of education, M_i is marital status, and n_{ci}, n_{ai} are the number of children and adults in the family. We use the entire adult population and their health care expenditures from 2002 to 2017 in the estimations. Because we need to predict health care from the age of 35, we fix marital status, education and number of children and adults at the value closest to this age and use them in the regression and the predictions.

With the estimated coefficients we predict health care expenditures for a given individual, at fictive ages from age 18 to 65. We use the mean value per year for all working life transfers, i.e., divide the work life sum of transfers by 47 years. We have also used the annuitized value as in Haider & Solon (2006), and this makes no difference.