A multilevel SEM to estimate the effects of childhood SECs on midlife health

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Substantive Research Question

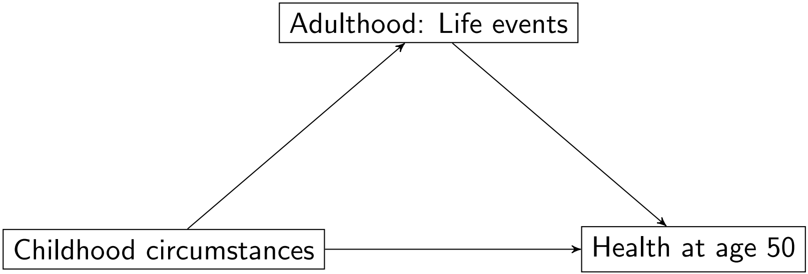

Figure 1 : A general joint modelling framework to explore the potential pathways between childhood circumstances, life events and health in mid-life.

Review of previous work

Main interest

How to include latent summaries of childhood SEC as predictors of a distal outcome?

- 1-step approach
  - Problem: unintended circular relationship.
- naive 3-step approaches (modal class, pseudo class)
  - Problem: misclassification, underestimated/overestimated standard errors.
- Advanced 3-step approaches (ML)

A general 3-step ML approach I

- 1-LV: Vermunt (2010), Asparouhov and Muthén (2014).
- Multiple LVs: Zhu et al. (2017): generalisation& robustness test.

Steps

- Step 1: Estimate separate latent class models for categorical predictors.
- Step 2: Calculate misclassification probabilities.
- Step 3: Estimate models of interest, with categorical LVs as predictors.

A general 3-step ML approach II

- Notation: Us (indicators for Cs), Ms (most likely class membership), Z (distal outcome).
- Assumption: $C_1 \perp\!\!\!\perp M_2 | C_2$; $C_2 \perp\!\!\!\perp M_1 | C_1$, $Z \perp\!\!\!\perp Us | C_1, C_2$.

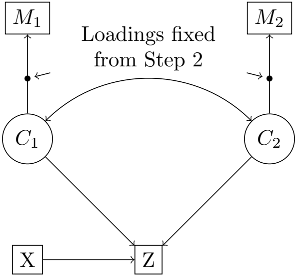

Figure 2 : The 3-step approach with two latent categorical variables C_1 and C_2.

Extension: RE discrete-time EHA I

Childhood SECs $\rightarrow$ *time-to-event outcome*

- Two associated survival processes: time to first partnership formation, time to recurrent partnership dissolutions (selection).
- Joint model: allow for association through an individual-specific random effect term (but with differential effects).
- Data: NCDS 1958 with co-residential partnership records on duration, partnership type, outcome (e.g. separated, married).

Extension: RE discrete-time EHA II

Discrete-time survival data

- Denote by y_{ij} the duration of episode j of individual i, which is fully observed if an event occurs $(\delta_{ij} = 1)$ and right-censored if not $(\delta_{ij} = 0)$.
- Data restructuring: convert the observed data (y_{ij}, δ_{ij}) to a sequence of binary responses (y_{tij}), indicating whether an event has occurred in time interval $[t, t+1)$.
- Discrete-time hazard function: $h_{tij} = Pr(y_{tij} = 1 | y_{t-1,ij} = 0)$.
- Multilevel model: dissolutions are recurrent.

Extension: RE discrete-time EHA III

Step 3 is a random effects logit model, allowing for a log-linear structure between LVs.

$$\log\left(\frac{h_{tij}}{1-h_{tij}}\right) = \alpha_t + \beta^T \mathbf{X}_{tij} + \sum_{k_1=1}^{K_1-1} \tau_{k_1}^{C_1} I(C_{1i}=k_1) + \sum_{k_2=1}^{K_2-1} \tau_{k_2}^{C_2} I(C_{2i}=k_2) + u_i$$

- α_t is the baseline hazard function
- $\mathbf{X}_{tij}$ is the vector of time-varying and time-invariant predictors
- $\tau_{k_1}^{C_1}$ and $\tau_{k_2}^{C_2}$ are the class-specific coefficients of LVs
- $u_i \sim N(0, \sigma_u^2)$ is the individual-specific unobserved random effect

Extension: structural equation models

Recall the substantive research question:

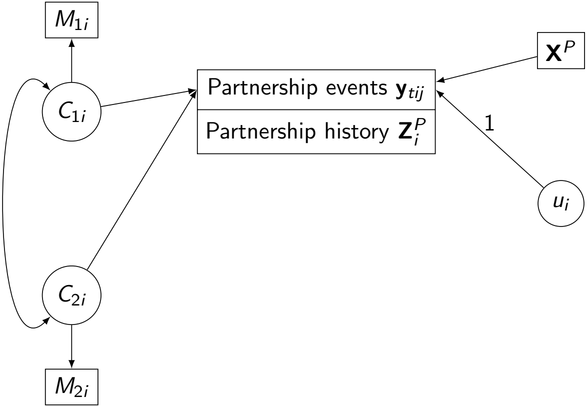

Figure 3 : A general path diagram of a multilevel SEM with factorised individual-level random effects.

Extension: structural equation models

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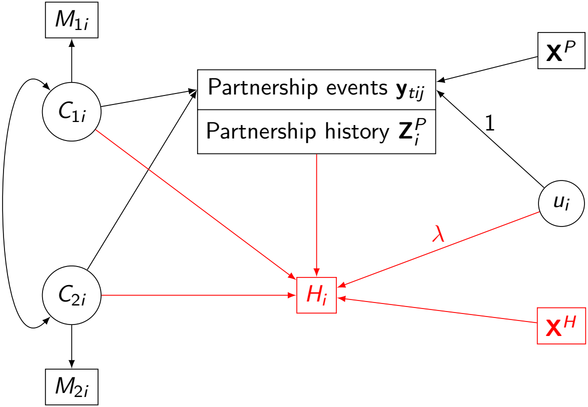

Figure 3 : A general path diagram of a multilevel SEM with factorised individual-level random effects.

Advantages of the framework

- LCA: measurement error of a set of measurements, longitudinal typology over 4 childhood waves, FIML (only CMs with no information in ALL 4 waves are dropped)
- Joint modelling handles endogeneity of $\mathbf{Z}_i^{(P)}$ in the health model.
- Allow for differential effects (λs) of a common set of individual-specific unobservables (u_i) on the hazard of union formation, separation and later health.
- Generalisability:
  - Can handle data with complex structures (e.g. multilevel, longitudinal, mixed response types)
  - Multivariate health outcome, multiple related processes (e.g. dropout, health, partnership)$\rightarrow$ better identification of σ_u^2 (factor model)
  - Different cross-process residual structures $\rightarrow$ sensitivity tests.

Substantive findings I

- Outcome: binary general health status at age 50.
- LCA for each dimension of childhood SECs $\rightarrow$ entropy> 0.7. Associated LVs: Social class, financial difficulty, material hardship, family structure.
- Other covariates adjusted in the health submodel: early life health (e.g. BMI at 16); adjusted in partnership submodels (e.g. number of pre-school children, education level, number of previous partners).

Substantive findings II

Table 1 : Health50 ON childhood SECs

Latent categorical variables	3-step SEM Est.	(SE)
Social class (ref.=High)		
Low	0.41**	(0.188)
Medium	0.34**	(0.115)
Financial difficulty (ref.=Low)		
High	0.53**	(0.207)
Material hardship (ref.=Low)		
Medium	0.34**	(0.106)
High	0.36**	(0.119)
Family structure (ref.=Stable)		
Unstable	0.08	(0.133)

$^{**}p < 0.05, ^{**}p < 0.1$

Substantive findings III

Table 2 : Health on partnership history

Variables	3-step SEM Est.	(SE)
Total number of partners before age 50 (ref.=1)		
0	0.08	(0.307)
2	0.02	(0.127)
3+	0.10	(0.233)
Age at 1^{st} relationship	−0.09**	(0.046)
% time single	1.02**	(0.376)
Random effects parameters		
σ_u^2	1.15**	(0.132)
$\lambda^{(H)}$	−0.13	(0.123)
$\lambda^{(F)}$	−0.27**	(0.066)
$\lambda^{(D)}$	1	

$^{**}p < 0.05, ^{**}p < 0.1$

Substantive findings IV

Table 3 : Partnership history (Formation) ON childhood SECs

Latent categorical variables	3-step SEM Est.	(SE)
Social class (ref.=High)		
Low	0.04	(0.081)
Medium	0.14**	(0.043)
Financial difficulty (ref.=Low)		
High	0.23**	(0.098)
Material hardship (ref.=Low)		
Medium	0.04	(0.041)
High	0.04	(0.048)
Family structure (ref.=Stable)		
Unstable	0.10**	(0.052)

$^{**}p < 0.05, ^{**}p < 0.1$

Substantive findings V

Table 4 : Partnership history (Dissolution) ON childhood SECs

Latent categorical variables	3-step SEM Est.	(SE)
Social class (ref.=High)		
Low	−0.02	(0.149)
Medium	−0.05	(0.084)
Financial difficulty (ref.=Low)		
High	−0.11	(0.177)
Material hardship (ref.=Low)		
Medium	−0.13	(0.079)
High	−0.27**	(0.095)
Family structure (ref.=Stable)		
Unstable	0.29**	(0.107)

$^{**}p < 0.05, ^{**}p < 0.1$

Summary I

1. Among the four dimensions of childhood SECs, lower male heads social class, financial difficulty and material hardship have a long-lasting impact on poorer health at age 50, even after controlling for partnership situation during adulthood.
2. The impact of family instability on later health, however, is fully explained by the impact of the cohort members' own partnership experiences.
    - Unstable family structure $\rightarrow$ early partnership formation (OR=1.11, 95% CI=[1.00,1.22]), early separation (OR=1.34, 95% CI=[1.08, 1.65]) and increased chance of poor midlife health.
3. Among individuals who formed their first partnership at the same age, those who spent more time single have a significantly higher risk of poor health at age 50 (OR=2.77, 95% CI=[1.33,5.80]).

Summary II

4. Estimates of random effect parameters suggest
   - Influences of a common set of unobserved time-invariant characteristics on three processes do exist.
   - A negligible residual association due to time-invariant unobservables between poor midlife health and tendency of dissolution.
     - What is u_i? Individual-level characteristics associated with formation, dissolution processes and midlife health. e.g. latent ambition at work.
   - A negative residual association ($\hat{\lambda}^{(F)} < 0, \hat{\lambda}^{(D)} > 0$):
     High values of $u_i \rightarrow$ delay first partnership union, higher dissolution risk.
   - A positive residual association ($\hat{\lambda}^{(F)} < 0, \hat{\lambda}^{(H)} < 0$):
     High values of $u_i \rightarrow$ delay first partnership union, better midlife health.

References

Asparouhov, T. and Muthén, B. (2014). Auxiliary variables in mixture modeling: Three-step approaches using mplus. *Structural Equation Modeling: A Multidisciplinary Journal*, 21(3):329–341.

Vermunt, J. K. (2010). Latent class modeling with covariates: Two improved three-step approaches. *Political Analysis*, 18(4):450–469.

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Repeated measurements of childhood SECs I

Measurements of social class

- Based on the occupation of the male head of the cohort member's family. The original coding in the four childhood waves followed the UK official guidance (General Registrar's Social Class) in 1951, 1960, 1966, 1970. Referring to works of Kuh (2003), Chandola et al. (2006) and Case et al. (2011).
- Six ordinal categories: unemployed, unskilled, partially skilled, skilled, managerial and professional.
- Cases with a single mother, the maternal grandfather's social class is used if available; otherwise, occupation is coded as missing.

Repeated measurements of childhood SECs II

Measurements of financial difficulty

- Coded in binary using multiple indicators following Bartley et al. (2003).
- At the birth sweep, 1 if a cohort member's father is in a low social class; At age 7, 1 if the father is in the last two social class categories or has requested supplementary benefits or claims to be in financial difficulty. At ages 11 and 16, 1 if there is at least one positive answer to the questions related to financial hardship (being a recipient of free school meals, being a recipient of benefits and father belonging to the last two social class categories). Note that benefits include official supplementary benefits, unemployment support and family income support.

Repeated measurements of childhood SECs III

Measurements of material hardship

- Ordinal variable with five categories (from low to high) derived from a summary of yes or no questions related to the following four aspects, following Schoon et al. (2003).
- The existence of overcrowding, no full sole use of household amenities, not owning the property and recipient of support benefits. Answers to these four questions were collected repeatedly at ages 7, 11 and 16 (no question is available at birth sweep).

Repeated measurements of childhood SECs IV

Measurements of family structure

- A nominal variable with five categories following Hobcraft et al. (1998) and British Association of Adoption and Fostering.
- The five situations from poor to good are as follows:
  - In care or in foster care or in other similar situations
  - Cared for by other blood relatives
  - Cared for by a single parent (includes individuals cared for by natural parents who are divorced or separated)
  - Cared for by step parents (includes individuals cared for by one natural parent and one step parent)
  - Cared for by joint parents (includes individuals cared for by two natural or adoptive parents)

Longitudinal typologies in childhood: age 0, 7, 11, 16.

Table 5 : Distribution of childhood measures by age (in percentages)

Measure	Category	0 years	7 years	11 years	16 years
Social Class	Unemployed	0.05	1.80	2.60	2.78
	Unskilled	8.71	4.55	3.58	2.72
	Partially skilled	11.09	11.51	11.76	7.90
	Skilled	51.71	41.58	35.42	29.22
	Managerial	11.18	11.48	12.64	11.19
	Professional	3.90	4.03	3.89	3.04
	Missing	12.64	23.79	30.37	43.17
Financial Difficulty	Yes	8.76	12.23	17.25	13.69
	No	78.60	59.38	55.77	48.19
	Missing	12.64	28.39	26.99	38.11
Material Hardship	Low	-[a]	19.67	24.18	23.72
	Low to medium	-	19.66	21.63	20.75
	Medium	-	18.43	19.70	13.89
	Medium to high	-	6.26	6.72	2.52
	High	-	1.10	1.05	0.16
	Missing	-	34.89	26.71	38.96
Family Structure	Others[b]	-	0.43	0.56	0.72
	Blood relatives	-	0.25	0.29	0.34
	Single parent	3.62	3.01	3.98	6.18
	Step parents	0.18	1.41	2.80	2.79
	Joint parents	89.99	73.91	66.79	52.87
	Missing	6.21	20.99	25.58	37.11

Notes:

a: dash = not available

b: Others = in care/in foster care/in other situations

The Causal Effect of Education on Chronic Health Conditions: Quasi-Experimental Evidence from Two UK Reforms

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Motivations

1. The relationship between education and health (morbidity, health-related behaviours, mortality, inter-generational) is one of the most extensively researched topics in the social sciences and medicine – Google Scholar has over <u>600,000 entrees</u>

2. Hundreds (perhaps thousands) of studies show that low education is correlated with worse health outcomes and worse health-related behaviours (SES gradient)

3. Many potential pathways (or mechanisms) linking education to health, mostly positive – Grossman (1972) model of the demand for health – efficiency (skills); education leads to higher wages (income), which might be used to buy better health

4. Fewer studies identify the causal effect of education on health outcomes

   i.e. children are not randomised to leave school or further education at different ages

5. Economists have been key players in using quasi-experiments (reforms), but there is a large amount of variation in the results across studies

Correlation to Causation

A. Large Literature had has largely focused on increases in the compulsory school leaving age (MSLA) that has occurred in many countries since WWII to help identify the causal effect of an additional year of schooling on health and health-related behaviours (but also wages, crime, cognition, life satisfaction, personality traits)

- Evidence from MSLA reforms has now been provided for Australia, Canada, Denmark, France, Germany, Italy, the Netherlands, Norway, Romania, Sweden, the UK, and the US etc.…

B. In contrast, very few studies have focused on further / higher education

C. While there is no convincing evidence that increased education leads to worse adult health outcomes, the results of this literature are very mixed:

Correlation to Causation

Some studies provide some evidence that the extra year of schooling induced by these reforms led to significant improvements in health (mostly mortality) or health behaviours:

Adams, 2002; Arendt, 2005; Lleras-Muney, 2005; Oreopoulos, 2007; Siles, 2009; van Kippersluis et al., 2011; Kemptner et al., 2011; Banks and Mazzonna, 2012; Brunello et al., 2016; Crespo et al., 2014; Fischer et al., 2013; Fletcher, 2015; Li and Powdthavee, 2015; Davies et al., 2018

Other studies have found little or no supporting evidence of such a causal effect:

Mazumder, 2008; Oreopoulos, 2008; Albouy and Lequien, 2009; Lindeboom et al., 2009; Jurges et al., 2012; **Clark and Royer, 2013**; Johnston et al., 2015; Siles, 2015; Meghir et al., 2017; Malamud et al., 2018

A number of studies have found results that differ by gender and across MSLA reforms

Powdthavee, 2010; Banks and Mazzonna, 2012; Brunello et al., 2013; Gathmann et al., 2015

Evidence of Education on Morbidity in the UK
(using 1947 (age 14-15) and/or 1972 (age 15-16) reforms)

(1) Siles (2009; GHS 1980-2004) found that an extra year of schooling significantly reduces the probability of having a long-term illness in adulthood by up to 7.5 percentage points

(2) Powdthavee (2010; HSE 1991-2007) found that using the 1947 MSLA reform that an extra year of schooling significantly reduced the probability of adulthood hypertension. However, no significant effect was found using the 1972 reform (12 year bandwidth – 30,000 observations; no month of birth)

(3) Jurges et al. (2013; HSE 1993-2006) found no significant effect of increased schooling on biomarkers relevant for heart disease (i.e. C-reactive protein and blood fibrinogen)

Evidence of Education on Morbidity in the UK
(using 1947 and/or 1972 reforms)

(4) Clark and Royer (2013) provide reduced-form estimates using data from the 2001 Census, and 2SLS estimates using pooled data from the GHS and HSE (1991-2004), and found no significant effect of an extra year of schooling on the probability of having a long-term condition (<u>or mortality</u>); varying bandwidths

(5) Davies et al. (2018; UK Biobank) found significant effect for diabetes and mortality using 1972 reform, but conclude that "education is not the panacea implied by naïve multivariate regression".

"Another strength of our study is that it uses one of the largest samples to date to investigate the effects of education on a wide range of outcomes"

(i.e. n=22,000, one year either side of reform)

Expansion of British Educational Attainment

(1) The only paper that we are aware of that has used the large expansion in British educational attainment to identify the causal effect of education on morbidity is James (2015), who also used pooled data from the HSE (1991-2012)

Finds evidence that extra year of schooling, "Had an effect in reducing BMI. For other health measures (self-reported general health, long term or limiting illnesses), blood pressure and health behaviours (smoking and drinking) there were small to no improvements."

- the age range of the sample is only 23 to 34; birth cohorts 1962-1980

Data

- Pooled data from the UK's Quarterly Labour Force Survey (QLFS) over the period **2001q3-2015q4**; UK's biggest dataset with information about types of chronic conditions; QLFS has a rotating panel design; each individual (household) is surveyed for up to 5 quarters
- Around **50,000** responding households each quarter
- QLFS primarily collects information on earnings, employment, education, occupation, training, hours of work and personal characteristics; used to provide national and local area labour market statistics
- Total sample of just under **5 million** observations
- When we omit proxy responses and those born outside of the UK who arrived after age 10, and allow for tight bandwidths by month of birth, we have around **300,000** observations per quasi-experiment (reform)
- Data on **17 'types'** of chronic health conditions; month/year of birth; years of schooling

Health Information in QLFS

Do you have any health problems or disabilities that you expect will last for more than a year?

1 yes
2 no

Do you have…

1 problems or disabilities (including arthritis or rheumatism) connected with your arms or hands?
2 ...legs or feet?
3 ...back or neck?
4 do you have difficulty in seeing (while wearing spectacles or contact lenses)?
5 difficulty in hearing?
6 a speech impediment
7 severe disfigurement, skin conditions, allergies?
8 chest or breathing problems, asthma, bronchitis?
9 heart, blood pressure or blood circulation problems?
10 stomach, liver, kidney or digestive problems?
11 diabetes?
12 depression, bad nerves or anxiety?
13 epilepsy?
14 severe or specific learning difficulties (mental handicap)?
15 mental illness or suffer from phobias, panics or other nervous disorders?
16 progressive illness not included elsewhere (e.g. cancer not included elsewhere, multiple sclerosis, symptomatic HIV, Parkinson's disease, muscular dystrophy)?
17 other health problems or disabilities?

Limitation:

Self-reported health

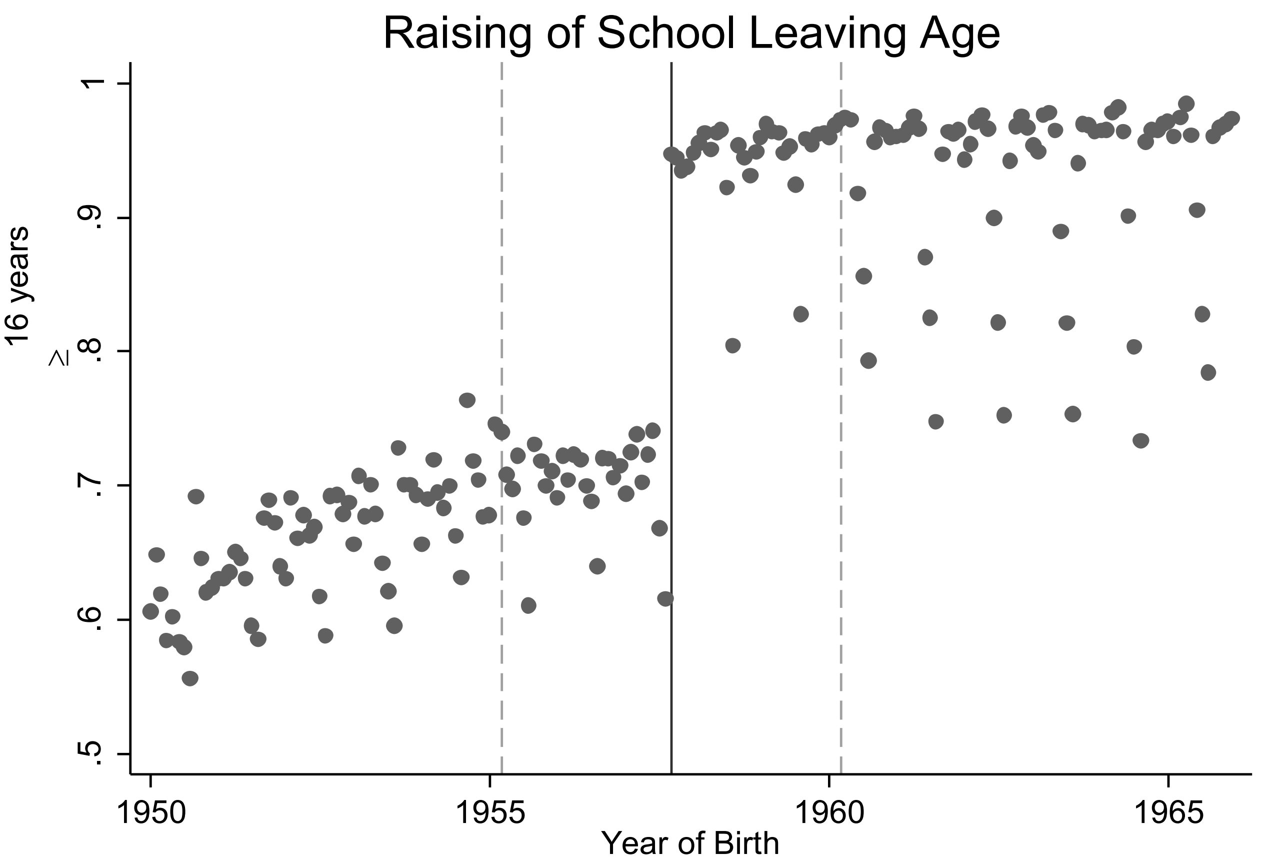
- awareness?
- diagnosis?

Reform (1): 1972 Change in Compulsory School Leaving Age

- On the 1st September 1972 the minimum SLA was raised from 15 to 16. This affected people born from September 1957; we do not use the 1947 reform
- The extra year kept students in high school for another year and meant that more received formal qualifications (‘O’ levels and CSE’s)
- Broadly speaking, the reform change forced students that would previously have left school at the earliest opportunity to stay in school for one more year
- Generates estimates that may be very different from the effects of an extra year at other points of the education distribution
- The change has been found by a number of studies to increase the earnings of affected cohorts for both males and females

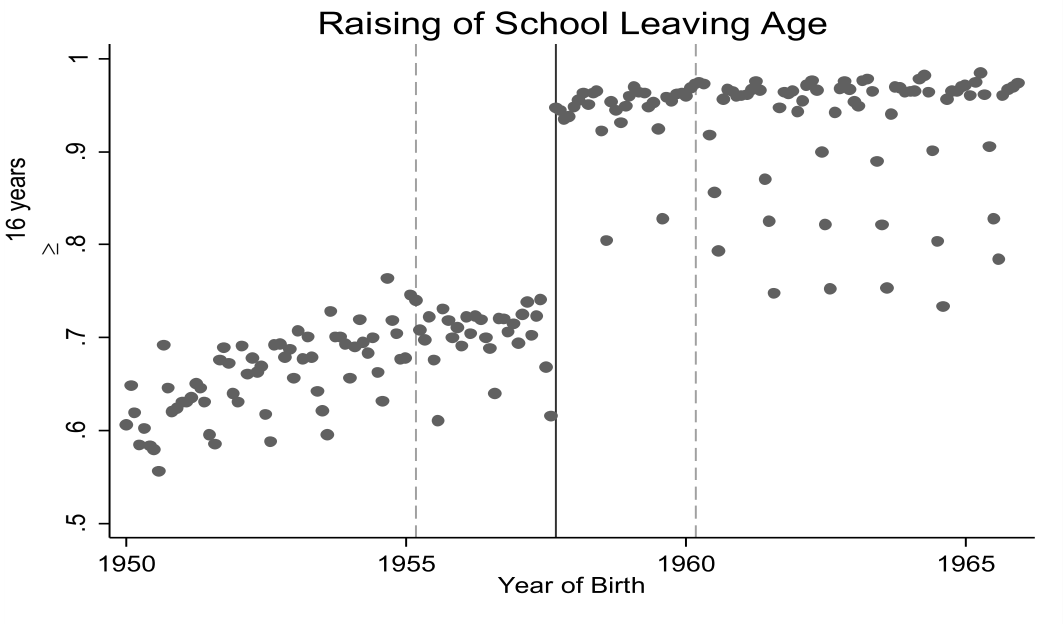
	Raising of School Leaving Age Sample
Male	0.43
Age	49.90
Married or cohabitating	0.70
Non-white	0.02
Age completed full-time education	17.22
Employee	0.67
Self-employed	0.11
Unemployed	0.03
Health problem or disability	0.40
Survey years included	2001 - 2015
Years of birth included	1955-1960
Sample size	261,796

Reform (1): Increase in Compulsory School Leaving Age in 1972

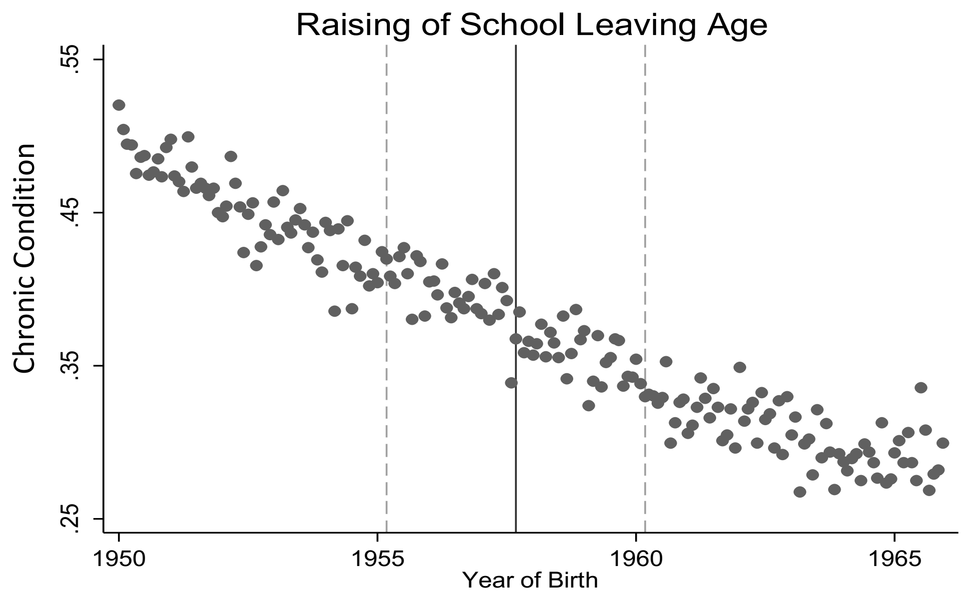


Non-compliance is driven by those born in June, July, and August. These summer-borns could finish school once the ‘O’ level exams were completed (May/June), thus before the age of 16

Controlled for with month of birth dummies



Raising of School Leaving Age
≥ 16 years
.5
.6
.7
.8
.9
1
1950
1955
1960
1965
Year of Birth



Raising of School Leaving Age
Chronic Condition
.25
.35
.45
.55
1950
1955
1960
1965
Year of Birth

(Fuzzy) Regression Discontinuity Framework

Two-stage least squares model, using as the instrumental variable an indicator that the individual was born after 1st September 1957 (turned 15 years old after 1st September 1972).

In the first-stage equation we estimate the effects of the reform on educational attainment:

$$E_{ict} = \alpha_0 + \alpha_1 D_{ic} + f(R_{ic}) + \mathbf{X}'_{ict}\alpha_2 + \varepsilon_{ict} \qquad (1)$$

E_{ict} : age individual *i* born in cohort *c* surveyed at time *t* completed full-time education

D_{ic} : binary variable indicating whether the individual was born after 1st September 1957

R_{ic} : 'running' variable measuring birth month and a vector of exogenous characteristics; linear function with different slopes on either side of the birth date threshold (local linear approach)

$\mathbf{X}_{ict}$: vector includes a third-order polynomial in age, and dummy variables for gender, year of survey (2002-20015), quarter of survey, month of birth (Jan-Dec), and interactions between month-of-birth dummies and being born after 1st September 1957

This model is estimated using a sample of individuals born within **60 months** of the 1st September 1957 birth date threshold (March 1955 to February 1960); a relatively narrow window that is made feasible by the large sample size of the QLFS

- Estimated α_1 = 0.344 (F-statistic = 21.4)
- Reform increased average years of education by 0.344 years, generated primarily by a 23 percentage point increase in the proportion of students leaving school at age ≥ 16 years.
- Proportion of students obtaining 'O'-levels increased by 4.6 percentage points.
- Zero effects on leaving school at age ≥ 17 years and obtaining A-level qualifications

In the second-stage equation we estimate the effect of educational attainment (years of full-time education) on health:

$$H_{ict} = \beta_0 + \beta_1 E_{ict} + g(R_{ic}) + \mathbf{X}'_{ict}\beta_2 + u_{ict} \tag{2}$$

H_{ict} : binary variable representing a health problem of any type or a particular health problem

Similar to equation (1), $g(R_{ic})$ is a is a linear function of month-year of birth with different slopes on either side of the threshold

Table 2: Impact of Raising the Compulsory School Leaving Age on the Likelihood of having a Health Problem and/or Disability

	Mean	OLS	IV	
Health problem or disability of any type	0.398	-0.072***	0.012	95% CI [-0.067, 0.091]
		(0.006)	(0.041)	
Number of health problems or disabilities	0.746	-0.317***	-0.005	
		(0.020)	(0.127)	
Heart, blood pressure or blood circulation problems	0.130	-0.036***	-0.024	
		(0.004)	(0.028)	
Problems or disabilities with back or neck	0.128	-0.054***	0.020	
		(0.004)	(0.028)	
Problems or disabilities with legs or feet	0.126	-0.053***	-0.002	
		(0.004)	(0.027)	
Problems or disabilities with arms or hands	0.096	-0.045***	0.011	
		(0.004)	(0.025)	
Chest or breathing problems, asthma, bronchitis	0.083	-0.032***	0.034	
		(0.004)	(0.025)	
Depression, bad nerves or anxiety	0.070	-0.035***	0.003	
		(0.003)	(0.021)	
Stomach, liver, kidney or digestive problems	0.061	-0.024***	-0.006	
		(0.003)	(0.020)	
Diabetes	0.046	-0.005*	-0.058***	95% CI [-0.099, -0.015]
		(0.003)	(0.022)	
Severe disfigurements, skin conditions, allergies	0.036	-0.013***	0.024	
		(0.002)	(0.016)	
Mental illness, phobias, panics, other nervous disorders	0.033	-0.022***	-0.007	
		(0.002)	(0.015)	

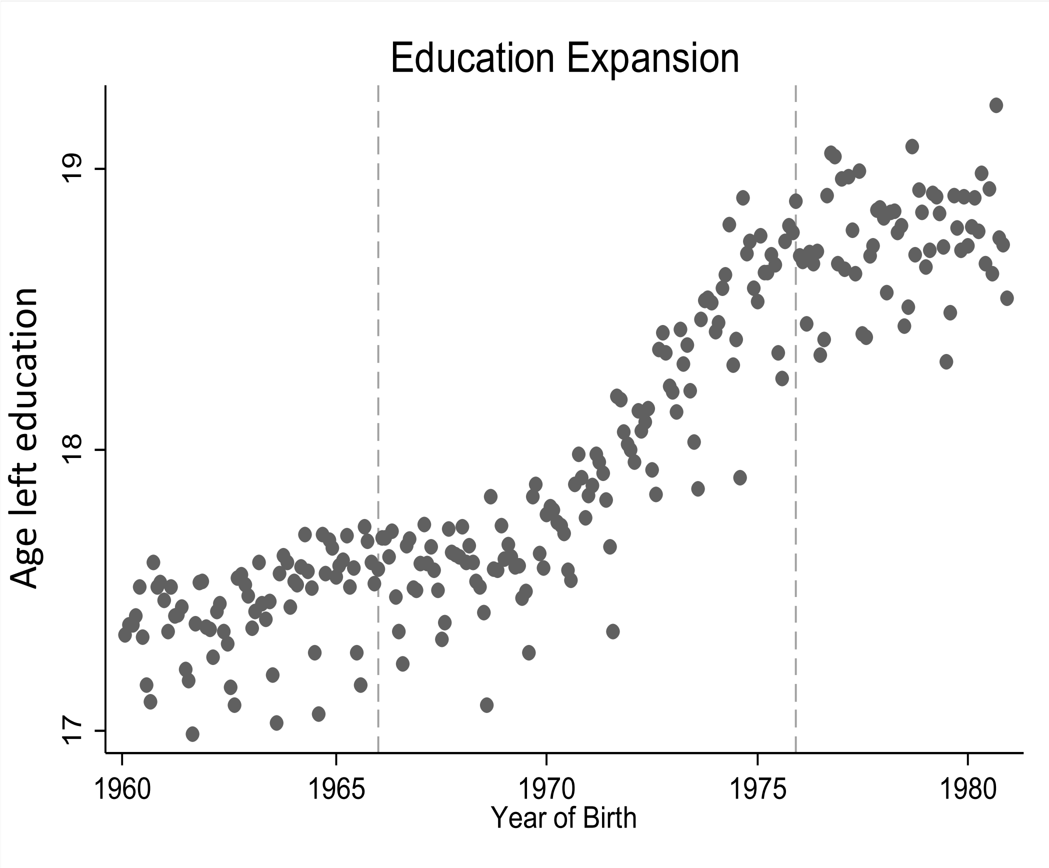
Reform (2): Educational Expansion in the UK

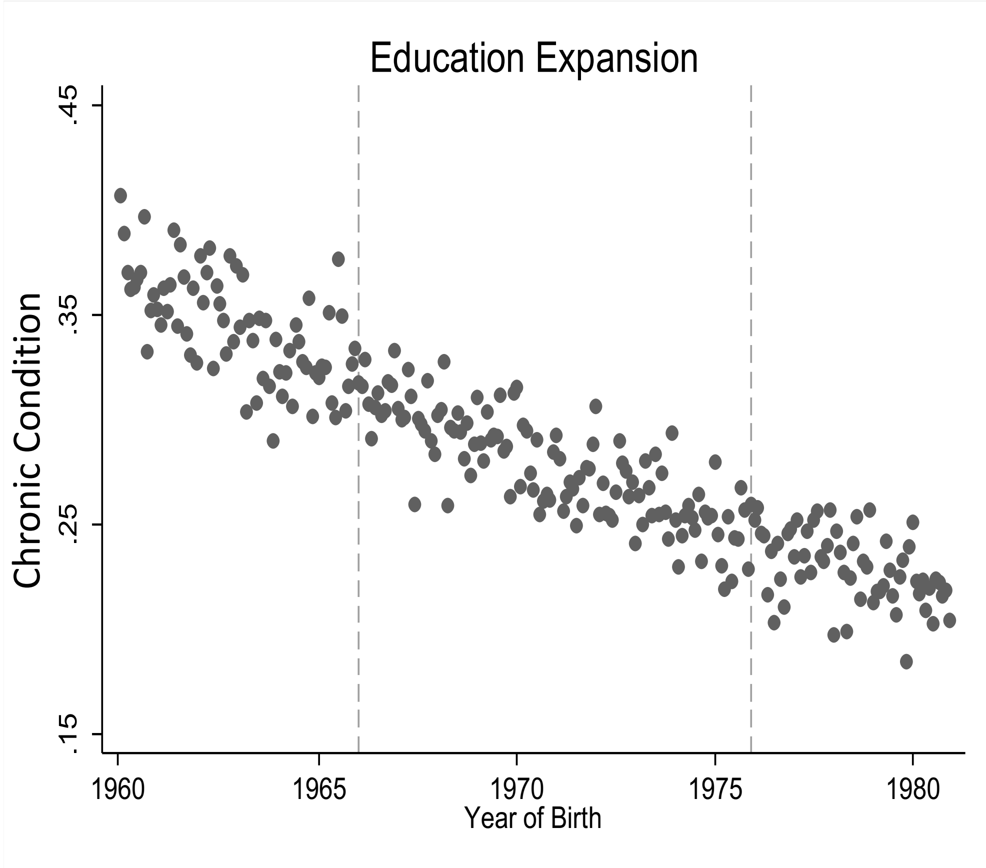
- During the early 1990s an large increase in educational attainment occurred in the UK
- Proportion of young people entering full-time higher education institutions increased from around 15% to 33%
- Led to significantly increased wages (Devereux and Fan, 2011)
- Led to changes throughout the education distribution
- Local treatment effect close to average treatment effect?

Main Drivers of Educational Expansion

1. Large increase in the supply of degree-level places occurred when the Further and Higher Education Act of 1992 enacted changes in higher education funding and administration, leading to 35 polytechnic institutions to become universities
2. Higher education institutions were incentivised to increase enrolment by the Government’s decision to reduce the per student grant and by relaxing limits on student recruitment (Walker and Zhu, 2008)
3. In 1986 the age 16 school-level qualification – Certificates of Secondary Education (CSE) and ‘O’ levels, were replaced by the General Certificates of Secondary Education (GCSE). This included changes in performance assessment and grading, effectively increasing the proportion of students attaining high grade passes. This in-turn encouraged students to stay in school beyond the compulsory age of 16 (Blanden and Machin, 2004)
4. Movement from manufacturing to services and perceived increases in the return to education (Blanden and Machin, 2004; Devereux and Fan, 2011)

Impact of Expansion on Education by Month of Birth (QLFS)





	Raising of School Leaving Age Sample	Education Expansion Sample
Male	0.43	0.40
Age	49.90	39.52
Married or cohabitating	0.70	0.68
Non-white	0.02	0.05
Age completed full-time education	17.22	17.94
Employee	0.67	0.70
Self-employed	0.11	0.10
Unemployed	0.03	0.04
Health problem or disability	0.40	0.28
Survey years included	2001 - 2015	2006-2015
Years of birth included	1955-1960	1966-1975
Sample size	261,796	303,450

We estimate the effect of the education expansion by modelling the relationship between the health of individual *i* (H_{ict}) and the average educational attainment (age left full time education) of *i*'s cohort ($\overline{EA}_c$):

$$H_{ict} = \gamma_0 + \gamma_1 \overline{EA}_c + a_{ct} + h(c) + \mathbf{W}'_{ict}\gamma_2 + v_{ict} \qquad (3)$$

a_{ct} : age fixed-effects

$h(c)$: linear function of year of birth (cohort)

$\mathbf{W}_{ict}$: includes dummy variables for gender, year of survey, quarter of survey, month of birth, and wave number. It also includes the unemployment rate experienced by different cohorts at age 18, which controls for potential correlation between labour market conditions and the education expansion.

The parameter of primary interest in equation (3) – γ_1 – is identified from across cohort covariation in educational attainment and health

- Validity of this modelling approach depends on whether there exist important cohort health effects that are correlated with the across-cohort growth in educational attainment, after accounting for age and time fixed-effects, a cohort-specific unemployment rate, and a linear cohort trend.

- Notably, the cohort trend term $h(c)$ will control for observable and unobservable time-invariant cohort-specific predictors of health, under the assumption that these factors evolve linearly across cohorts (Bedard and Deschênes, 2006; veterans example)

- Importantly, $\hat{\gamma}_1$ is little changed when the cohort trend term is excluded; though, standard errors are smaller. The second approach we use to control for direct cohort health effects is to restrict the included birth cohorts to a relatively narrow 10-year window (1966 to 1975; 30+)

Table 3: Impact of Education Expansion on the Likelihood of having a Health Problem and/or Disability

	Mean	OLS	RF	
Health problem or disability of any type	0.280	-0.017***	-0.007	95% CI [-0.031, 0.017]
		(0.001)	(0.012)	
Number of health problems or disabilities	0.471	-0.051***	0.018	
		(0.002)	(0.030)	
Heart, blood pressure or blood circulation problems	0.045	-0.005***	0.002	
		(0.000)	(0.006)	
Problems or disabilities with back or neck	0.073	-0.009***	0.001	
		(0.000)	(0.007)	
Problems or disabilities with legs or feet	0.060	-0.008***	0.007	
		(0.000)	(0.006)	
Problems or disabilities with arms or hands	0.043	-0.006***	-0.001	
		(0.000)	(0.005)	
Chest or breathing problems, asthma, bronchitis	0.071	-0.004***	0.003	
		(0.000)	(0.007)	
Depression, bad nerves or anxiety	0.062	-0.008***	0.008	
		(0.000)	(0.006)	
Stomach, liver, kidney or digestive problems	0.040	-0.003***	-0.003	
		(0.000)	(0.005)	
Diabetes	0.019	-0.002***	-0.008**	95% CI [-0.016, -0.0002]
		(0.000)	(0.004)	
Severe disfigurements, skin conditions, allergies	0.029	-0.001***	0.006	
		(0.000)	(0.004)	
Mental illness, phobias, panics, other nervous disorders	0.030	-0.005***	0.003	
		(0.000)	(0.005)	

Provisional Conclusions

1. Using two reforms to aid causal identification, and the largest UK data set used to date to focus on chronic health conditions, we find little evidence to suggest that additional education leads to a substantively lower probability of having a wide range of conditions in mid-life (but we cannot rule out small effects)
2. The one exception is diabetes, which is found using both reforms; we also find that this effect increases with age
3. Our results are robust to both reforms, alternative band-widths, functional forms
4. Main limitation: self-reported chronic health conditions; but results consistent with Clark and Royer's findings for mortality, and Davies et al. for diabetes
5. Results point to more research needed that focuses on the causal effect of different 'types' and 'quality' of education on health outcomes

Measuring inequalities in health over the life-cycle: age-specific or life-cycle perspective?

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Introduction

- Health status is a dynamic outcome that evolves along the lifecycle (Galama et al., 2013; Grossman, 1972)
- Previous studies have shown socioeconomic health inequalities increase with age until a certain age when they decrease due to the population selection effect (Deaton and Paxson, 1998; Van Kippersluis et al., 2010; Van Kippersluis et al., 2009)
- <u>However</u> most health inequality studies focus on snap shots of inequalities, rarely consider health inequalities <u>over the **whole** lifecycle</u>
- Measuring inequalities over the lifecycle requires dealing with two dimensions: **ages** and **individuals**

Age-specific perspective

The age specific perspective firstly measures inequality *between individuals* at each age period and then aggregate inequalities *over different ages*

	Period 1	**Period 2**	**Period 3**	**Period 4**
Individual 1	Health $_{11}$	Health $_{12}$	Health $_{13}$	Health $_{14}$
Individual 2	Health $_{21}$	Health $_{22}$	Health $_{23}$	Health $_{24}$

- Ethical Perspective

This perspective highlights the impact of the **transitory component** of health (health shocks) on the evolution of health inequalities and points out some specific age problems

Lifecycle perspective

The lifecycle perspective measures inequality over the lifecycle firstly by aggregating health ***over different ages*** and then measuring inequality by aggregating this lifecycle measure of health ***over individuals***

	Period 1	**Period 2**	**Period 3**	**Period 4**
Individual 1	Health $_{11}$	Health $_{12}$	Health $_{13}$	Health $_{14}$
Individual 2	Health $_{21}$	Health $_{22}$	Health $_{23}$	Health $_{24}$

- Ethical Perspective

This perspective **respects the trajectory** of the health outcome and the inter-temporal choices of each individual at each time point. A good health status at some point in the lifecycle could compensate a poor health status at another point in the lifecycle.

Measuring inequalities in health in a lifecycle perspective is comparable to measuring inequalities in permanent income

The aim

- To propose a methodology to measure health inequality over the lifecycle from both the **age-specific** and **lifecycle perspectives**
  - Do the alternative ethical principles matter?

- To account for the discrete nature of self-assessed health and measure inequalities using two non-parametric (robust) dominance criteria

- To investigate whether including death as an additional potential health status makes a difference on the findings.

- Empirical application: 1958 National Cohort Development Study

Bob and Ann – the example (1/3)

Let us consider 2 individuals and 2 age periods (Fleurbaey, 2010)

- At each period they can either be in *Poor* or *Good* health.
- We assume **anonymity** towards **age** and **individuals**

- Age-specific perspective: inequalities with a concern for periods in which they occur

- Lifecycle perspective: compensation between periods and statement in terms of difference between health statuses over the lifecycle.

- The difference between the perspectives comes from which of the two dimensions between *ages* or *individuals* is **first** considered when aggregating.

Bob and Ann – the example (2/3)

Situation 1	Young	Old
Bob	Good	Poor
Ann	Poor	Good

Situation 2	Young	Old
Bob	Good	Poor
Ann	Good	Poor

Lifecycle perspective respects the trajectory and compensation

Under the anonymity criterion, the two situations are identical in terms of both welfare and inequality.

Situation 1 = Situation 2

Age-specific perspective first aggregates over individuals at each period and then over periods
One observes health inequality in Situation 1 but not in Situation 2:

Situation 2 > Situation 1

Bob and Ann – the example (3/3)

Situation 1	Young	Old
Bob	Good	Poor
Ann	Poor	Good

Situation 3	Young	Old
Bob	Good	Good
Ann	Poor	Poor

Lifecycle perspective exhibits the permanent component of health

Situation 1 > Situation 3

Age-specific perspective highlights the impact of the transitory component of health. Under the anonymity criterion, the 2 situations are identical in terms of both welfare and inequality.

Situation 1 = Situation 3

Health indicators (1/3)

- Let us assume an individual *i* lives at most *T* periods with health status *H* measured at each period $t=1,\ldots, T$ by a qualitative and ordered indicator H_{it} with k ordered response items h_k ($k=1,\ldots, K$)

- The lifetime health trajectory of *i* is given by the vector

$$(H_{i1}, H_{i2}, \ldots, H_{it}, \ldots, H_{iT-1}, H_{iT})$$

- K can represent the 4 items of self-assessed health:

  (i) poor, (ii) fair, (iii) very good, (iv) excellent

- Death can be included as an additional item to account for differences in age at death (*the least desirable health status*) as follows:

  (i) dead, (ii) poor, (iii) fair, (iv) very good, and (v) excellent

Health indicators (2/3)

Let us consider Ann and Bob live T=4 periods as follows

	Childhood	Adolescence	Adulthood	Ageing
Bob	Excellent	Fair	Poor	Dead
Ann	Excellent	Poor	Fair	Dead

Can we define a lifecycle health indicator for each perspective?

- **Age-specific perspective:** the vector of 4 periods provides directly an age-specific health indicator.

- **Lifecycle perspective** (less obvious) The health trajectory of individual *i* over the lifecycle can be summarised as a lifetime health distribution

$$(f_i(h_1), f_i(h_2), \ldots, f_i(h_{K-1}), f_i(h_K)) \qquad (0.25; 0.25; 0.25; 0; 0.25)$$

where the frequency $f_i(h_k)$ corresponds to the proportion of lifetime lived in each potential health status ordered from worst to best.

Health indicators (3/3)

We order all potential individual's lifetime health distributions according to the leximin criterion and use this rank as a lifecycle health indicator:

(1) (1; 0; 0; 0; 0)

(2) (0.75; 0.25; 0; 0; 0)

(3) (0.75; 0; 0.25; 0; 0)

(4) (0.75; 0; 0; 0.25; 0)

(5) (0.75; 0; 0; 0; 0,25)

(6) (0.50; 0.50; 0; 0; 0)

(7) (0.50; 0.25; 0.25; 0; 0)

(8) (0.50; 0.25; 0; 0.25; 0)

(9) (0.50; 0.25; 0; 0; 0.25)

(10) (0.50;0; 0.50; 0; 0)

….. (0; 0; 0; 0; 1)

Measuring inequality (1/6)

- Inequality in health over the life cycle is identified based on the ordering of the conditionnal distributions of health indicators according to two circonstances (father occupation and region of birth)

- Life cycle perspective relies on a unique ordering based on the comparison of distributions over groups of the lifecycle health indicator

- In the age specific perspective, we considere that the distribution of one group is preferable to one of another
  - If its distribution is never dominated at any age: weak dominance
  - If its distributions dominate at all ages: strong dominance

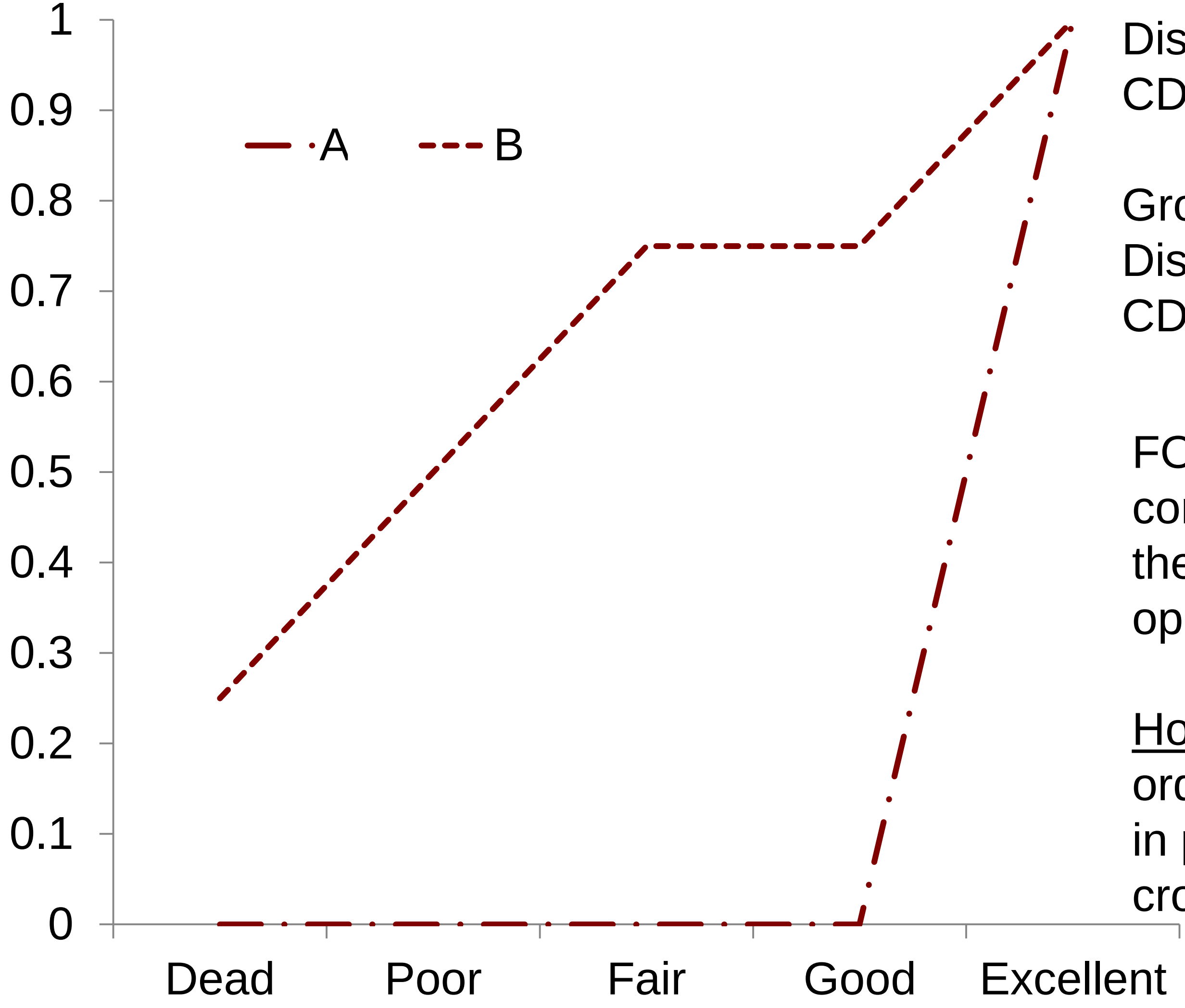
- Two specific ordering criteria for ordered and qualitative attributes are used
  - First order stochastic dominance
  - Hammond dominance

Measuring inequality (2/6)

First order stochastic dominance: Comparison of CDFs and social situations strictly better in terms of expected outcomes if one CDF is strictly below another CDF at each point of the distribution:

Distribution C_1 *first order dominates* Distribution C_2 if $\forall h_k, F_{C1}(h_k) \leq F_{C2}(h_k)$ then $H_{C1} \geq_{FO} H_{C2}$ in terms of welfare with F_{C1} and F_{C2} the CDFs

Measuring inequality (3/6)



Group A:
Dist: (0; 0; 0; 0; 1)
CDF: (0; 0; 0; 0; 1)

Group B:
Dist: (0.25; 0.25; 0.25; 0; 0.25)
CDF: (0.25; 0.50; 0.75; 0.75; 1)

FOSD widely used when comparing CDFs particularly in the context of inequality of opportunity (Lefranc et al., 2009)

However, it does not allow ordering all CDFs distributions, in particular in the case of crossing distributions.

Measuring inequality (4/6)

Group A:

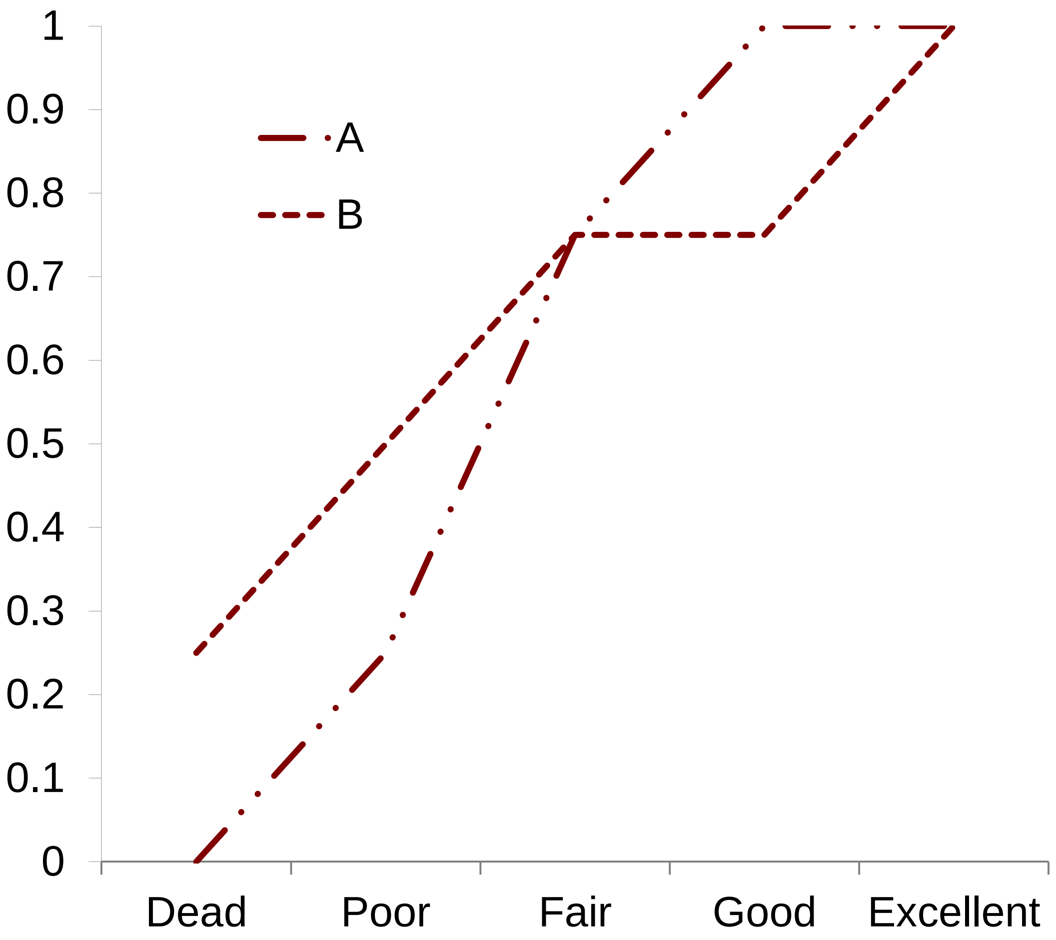
Dist: (0; 0.25; 0.50; 0.25; 0)

CDF: (0; 0.25; 0.75; 1 ; 1)

Group B:

Dist: (0.25; 0.25; 0.25; 0; 0.25)

CDF: (0.25; 0.50; 0.75; 0.75; 1)



Measuring inequality (5/6)

Hammond Dominance (Gravel et al. 2014, Hammond 1976)

- Comparison of CDFs giving a larger weight to the poorer category
- Consistent with the hypothesis that the social planner is averse to the poorer health statuses
- Corresponds to a reduction of inequality within the distribution via a set of transfers that “reduces the gap” between two individuals

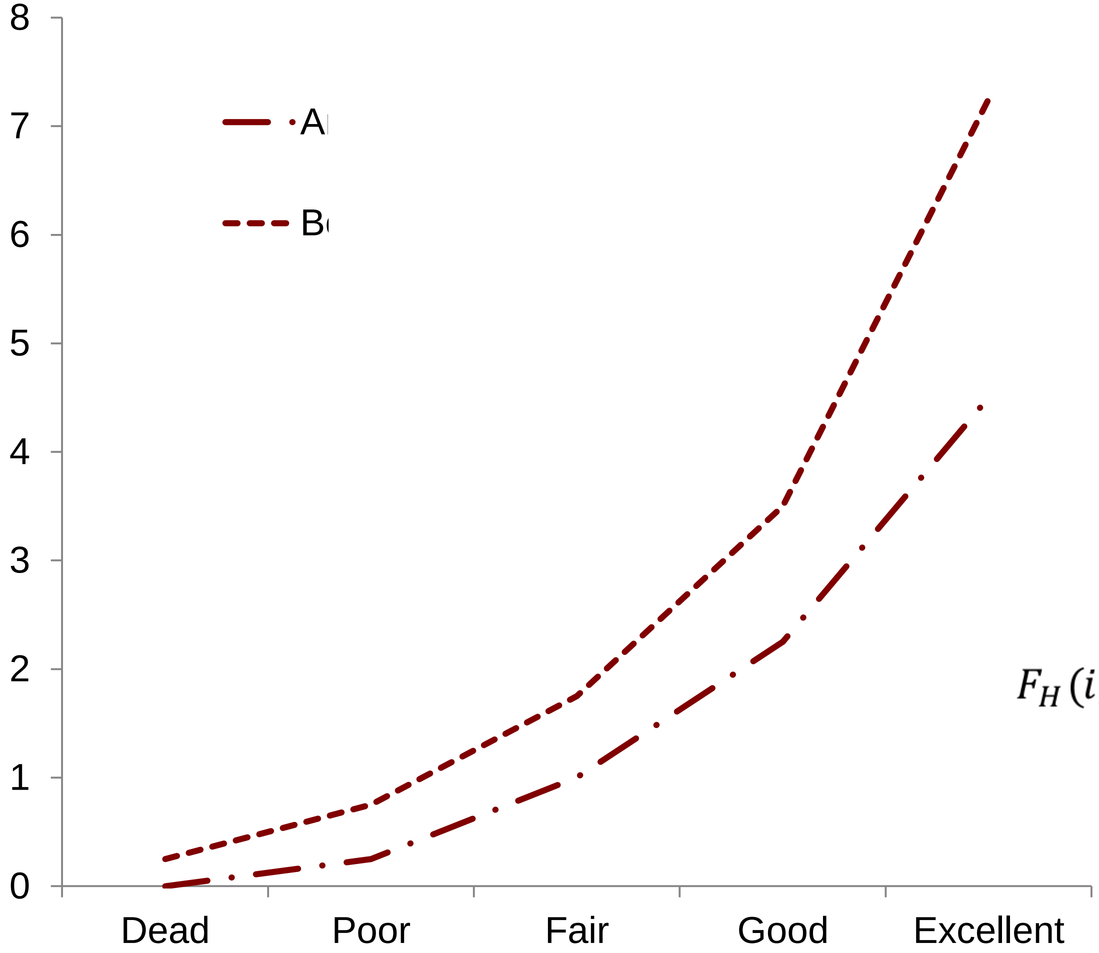
Distribution C_1 *dominates* distribution C_2 *according to Hammond* if $\forall x,\ F_{HC1}(x) \leq F_{HC2}(x)$ with F_{HC1} *and* F_{HC2} *the Hammond distributions of health status*

$$F_H(i;s) = \sum_{h=1}^{i} \frac{(2^{i-h})n_h^s}{n}$$

Measuring inequality (6/6)

Group A distribution: (0; 0.25; 0.50; 0.25 ; 0)

Group B distribution: (0.25; 0.25; 0.25; 0; 0.25)



$$F_H(i;s) = \sum_{h=1}^{i} \frac{(2^{i-h})n_h^s}{n}$$

Empirical illustration

- National Child Development Study (NCDS) : a longitudinal study with all the people born in one week in March 1958 in England, Scotland and Wales
- Inclusion of individuals followed at six adult waves (5472 without mortality) / of all individuals included in 1958 (6608 with mortality)

Table 1: Distribution of health status and mortality at each wave (in %)

SAH	23 yo 1981	33 yo 1991	42 yo 2000	46 yo 2004	50 yo 2008	54 yo 2012
Dead	4.99	6.10	6.88	7.60	8.37	9.24
Poor	0.61	1.24	2.49	5.79	3.88	4.45
Fair	6.29	9.55	11.63	13.82	10.63	11.93
New good					26.49	29.54
Old good	44.27	48.42	49.21	42.81		
Very good					31.88	32.69
Old excellent	43.84	34.68	29.79	29.99		
New excellent					18.74	12.16

Lifecycle dominance tests according to father professional status (without mortality)

Table A4: Lifecycle dominance tests according to father professional status (without mortality)

Column dominates Row	Health at each age						
Health aggregated over the lifecycle	I	II	III n.m.	III m.	IV	V	No father
I		?.?... .	..?... .	....	....	....	....
II	?F?FFF H		..?... .	...... ?	....	....	....
III n.m.	FF?FFF F	FF?HHF F		?.. ?. ? H	?.. ?.. H	?..... H	?..... H
III m.	FFFFFF H	FFFFFF ?	?FF?F? .		?..... .	??.... .	?..... .
IV	FFFFFF H	FFFFFF F	?FF?FF .	?FFFFF H		. ?... ? .	??.... .
V	FFFFFF F	FFFFFF F	?FFFFF .	??FFFF F	F?HHH? H		??..H. ?
No	FFFFFF F	FFFFFF F	?FFFFF .	?HFFFF H	??FHHH H	??FH.H ?	

F represents Stochastic Dominance at first order
H represents Hammond dominance
. represents being dominated at first order dominance or H
? represents when we cannot conclude on dominance

Father professional status	
Professional	I
Managerial/Technical	II
Skilled non manual	III n.m.
Skilled manual	III m.
Partly skilled	IV
Unskilled	V
No male head	No

Lifecycle dominance tests according to father professional status (with mortality)

Table A5: Lifecycle dominance tests according to father professional status (including mortality)

Column dominates Row	Health at each age						
Health aggregated over the lifecycle	I	II	III n.m.	III m.	IV	V	No father
I		....	....	....	....	....	....
II	FFFFFF F		....	....	....	....	....
III n.m.	FFFFFF F	FFFHHF F		....	....	....	....
III m.	FFFFFF F	FFFFFF F	FFFFFF F		???? H	....	....
IV	FFFFFF F	FFFFFF F	FFFFFF F	??.. ?. .		....	....
V	FFFFFF F	FFFFFF F	FFFFFF F	FFFFFF F	FFFFFH F		. ??FFH .
No	FFFFFF F	FFFFFF F	FFFFFF F	FFFFFF F	FFFFFH F	F??... H	

F represents Stochastic Dominance at first order
H represents Hammond dominance
. represents being dominated at first order dominance or Hammond
? represents when we cannot conclude on dominance

Father professional status	
Professional	I
Managerial/Technical	II
Skilled non manual	III n.m.
Skilled manual	III m.
Partly skilled	IV
Unskilled	V
No male head	No

Lifecycle dominance tests according to region of birth (without mortality)

Table A6: Lifecycle dominance tests according to region at birth (without mortality)

Column dominates Row	South West	South East	Center	North	Wales	Scotland
South West		..?.?..	?......	?......	??.....	F.?....
South East	FF?F?HH		H?.?...	??.....	???...H	F?...?.
Center	?FFHHFH	.?F?FFH		.??....	???...H	??H..H.
North	?FFFFFH	??HHFHH	H??HHHH		??H?.?H	F???HH.
Wales	??FHHHH	???HFH.	???HHH.	??.?H?.		?.??HH.
Scotland	.H?FFHH	.?FFF?H	??.FF.H	.???..H	?H??..H	

F represents Stochastic Dominance at first order
H represents Hammond dominance
. represents being dominated at first order dominance or Hammond
? represents when we cannot conclude on dominance

Lifecycle dominance tests according to region of birth (with mortality)

Table A7: Lifecycle dominance tests according to region of birth (including mortality)

Column dominates Row	South West	South East	Center	North	Wales	Scotland
South West		....	....	....	....	....
South East	FFFFHF H		?HH?.. .	.??... .	??H?.. .	....
Center	FFFFFF H	?..?FF H		....	?.?... .	....
North	FFFFFF H	F??HFH H	HHHHHH H		??.?.. .	....
Wales	HHHHHH H	??.?FH H	?H?HHH H	??.?HH H		....?? .
Scotland	HFFFFF H	HHFFFF H	HHFFFH H	HHFFFH H	HHHH?? H	

F represents Stochastic Dominance at first order

H represents Hammond dominance

. represents being dominated at first order dominance or Hammond

? represents when we cannot conclude on dominance

Conclusion

- Complementarity between the two perspectives :
  - Lifecycle perspective: a global view of inequalities in health
  - Age-specific perspective: importance of the dynamic of health inequalities

- No social planner or government administration oversees an individuals' entire life-cycle:
  - A lifecycle approach is useful as it gives the long term view
  - An age-specific approach is useful to inform specific policies aimed at reducing inequalities in health and/or income at different lifecycle stages

Some strong assumptions

Anonymity of age in lifecycle

- We do not introduce any discount rate for health over time: what if it matters?
- ‘Fair Innings’ argument (Williams 2001): priority given to younger people in health care (QALY maximisation).

Aversion to the poorer health statuses

- Hammond dominance relies on the comparison of CDFs giving a larger weight to the poorer health category
- Should we always assume death is a bad thing?
  - Not systematically obvious that all poor health statuses will always be preferred to death (e.g. suicide)
  - People might report health states to be worse than death (Macran and Kind, 2001)

Thanks for your attention

Understanding the mechanisms through which adverse childhood experiences affect lifetime economic outcomes

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Background

- Child poverty has dramatic consequences on human development

  (eg Bird 2013, Duncan et al. 2012, Duncan et al. 2010, Wiborg and Hansen 2009, Barajas et al. 2007, Bradley and Crowyn 2002, Duncan et al. 1998)

- Costs to society
  - 1% of GDP in the UK (Blanden et al. 2010)
  - 1-4% in the United States (Holzer et al. 2007).

- Official child poverty predominantly defined as lack of access to financial resources: income or consumption thresholds

  (eg Roosa et al. 2005, Whiteford and Adema 2007, Adamson 2012)

Background

What are the tangible explanations for the harmful impact that poverty can have on children and their families?

(Evans and Kim 2010, Evans 2004)

- more family turmoil, violence, separation from their families, instability, and chaotic households;
- less social support; parents are less responsive, more authoritarian, less likely to nurture/protect children (Gershoff et al. 2007, Hart and Risley 1995).
- Environment of childhood poverty: "cumulative rather than singular exposure to a confluence of psychosocial and physical environmental risk factors" (Evans 2004; p. 77).

"The true measure of child poverty is parenting"

(Heckman 2011, p. 4)

Adverse childhood experiences

- Cumulative risks: adverse childhood experiences (ACEs)
  (Felitti et al. 1998, Dube et al. 2003, Anda et al. 2006)

- Definition: measures of maltreatment & family dysfunction

- Link between ACEs and health well documented (> 60 studies)
  → **many methodological problems.**

- NCDS: Kelly et al. (2013a; 2013b); Solis et al (2015): high-dose ACEs and cancer, mortality, and general wear and tear.

- Many other studies that explore education, CS/NCS, crime

ACEs and economic outcomes

– Unemployment/employment status
  Metzler et al. (2017), Sansone et al. (2012), Covey et al. (2013), Liu et al. (2013)

– Sexual abuse & income: Font and Maguire-Jack (2016)

– Conti et al. (2017) – NCDS/other UK cohort data

→ Note: Most studies use self-reported, retrospective measures

– Court substantiations: Currie and Widom (2010) – 8,000$ loss

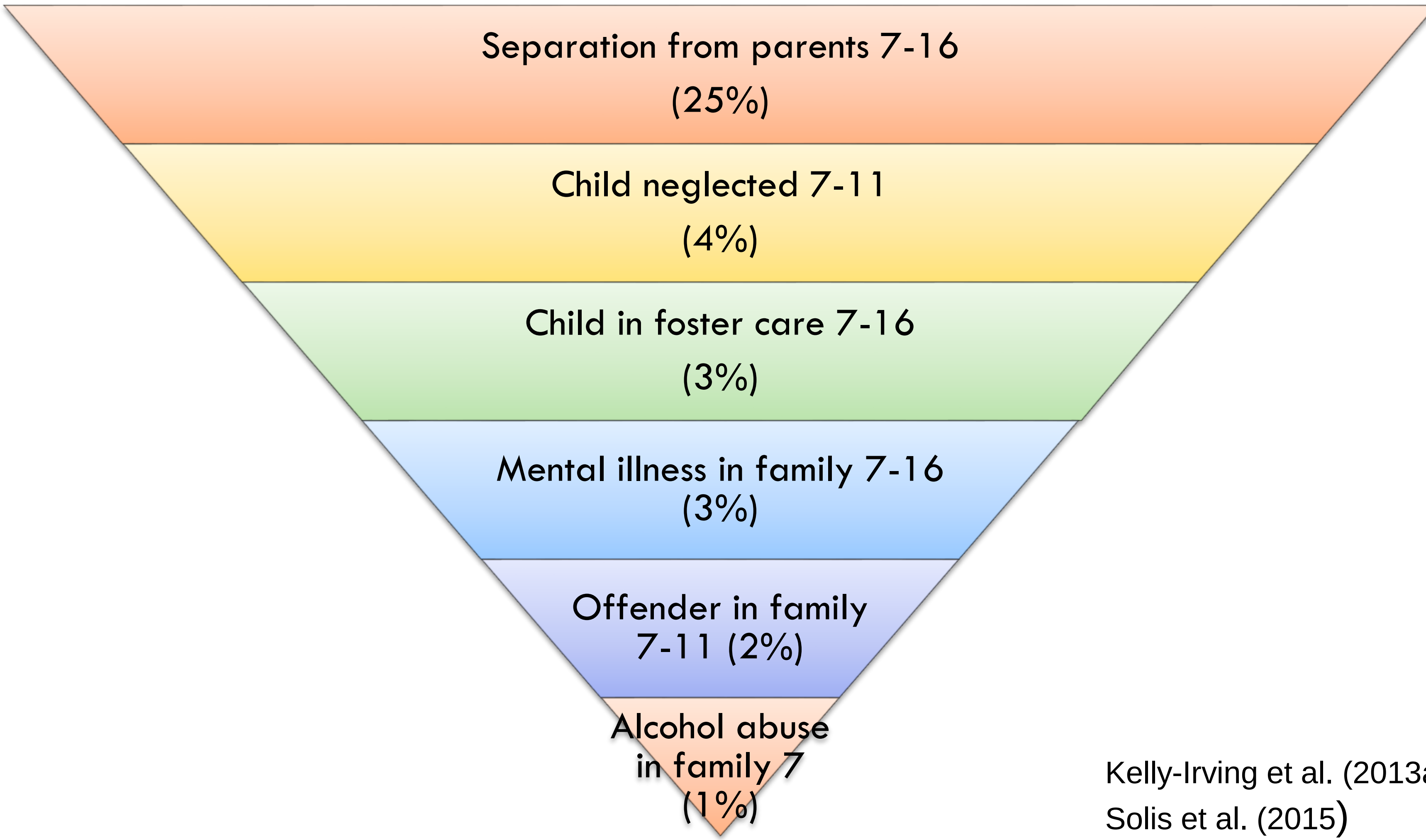
→ **We don't know the productivity penalty of ACEs**

What we do:

1. Study the relationship between ACEs and age 55 economic outcomes: Income, welfare dependence, subjective poverty
2. Prospective measure of ACE, partially based on teacher reports Kelly-Irving et al. (2013a) and Solis et al (2015)
3. Study the mechanisms through which ACE is linked to Age 55
4. Control for potential confounders
5. Study attrition (N≈5,000)
6. What we cannot do:
   - Control for family fixed effects

   (Fletcher and Schurer (2017), Currie and Tekin (2012), Slade and Wissow (2007))
   - Obtain exogenous variation in ACE

ACE measure: sum of six adverse events



Kelly-Irving et al. (2013a)
Solis et al. (2015)

Age 55 economic outcomes

Earnings

(avg:1,236£)

- Net monthly income (2011£) in main job after tax and other deductions.

Subjective poverty

(10%)

- =1: quite/very difficult
- =0: getting by/able to get by
- "How well would you say you personally are managing financially these days?"

Welfare dependence

(17%)

- =1: transfers
- =0: no transfers
- "do you or your partner currently receive a reg. payment from any of the following sources?" government transfers, tax credits, and benefits.

Control variables

1. Individual characteristics:
   - Sex
   - Premature (< 37 weeks of gestation) & low birth weight (< 2500g).
2. Family composition:
   - Age of the mother when she gave birth (whether a teenager, young adult mother, or mature aged mother);
   - Number of siblings in the family and birth order.
3. Childhood socioeconomic background:
   - Parental education: age at which the father and the mother left full-time education;
   - Father's occupation (if the father is present);
   - Geographic location in which the family resides.

Model

Univariate:

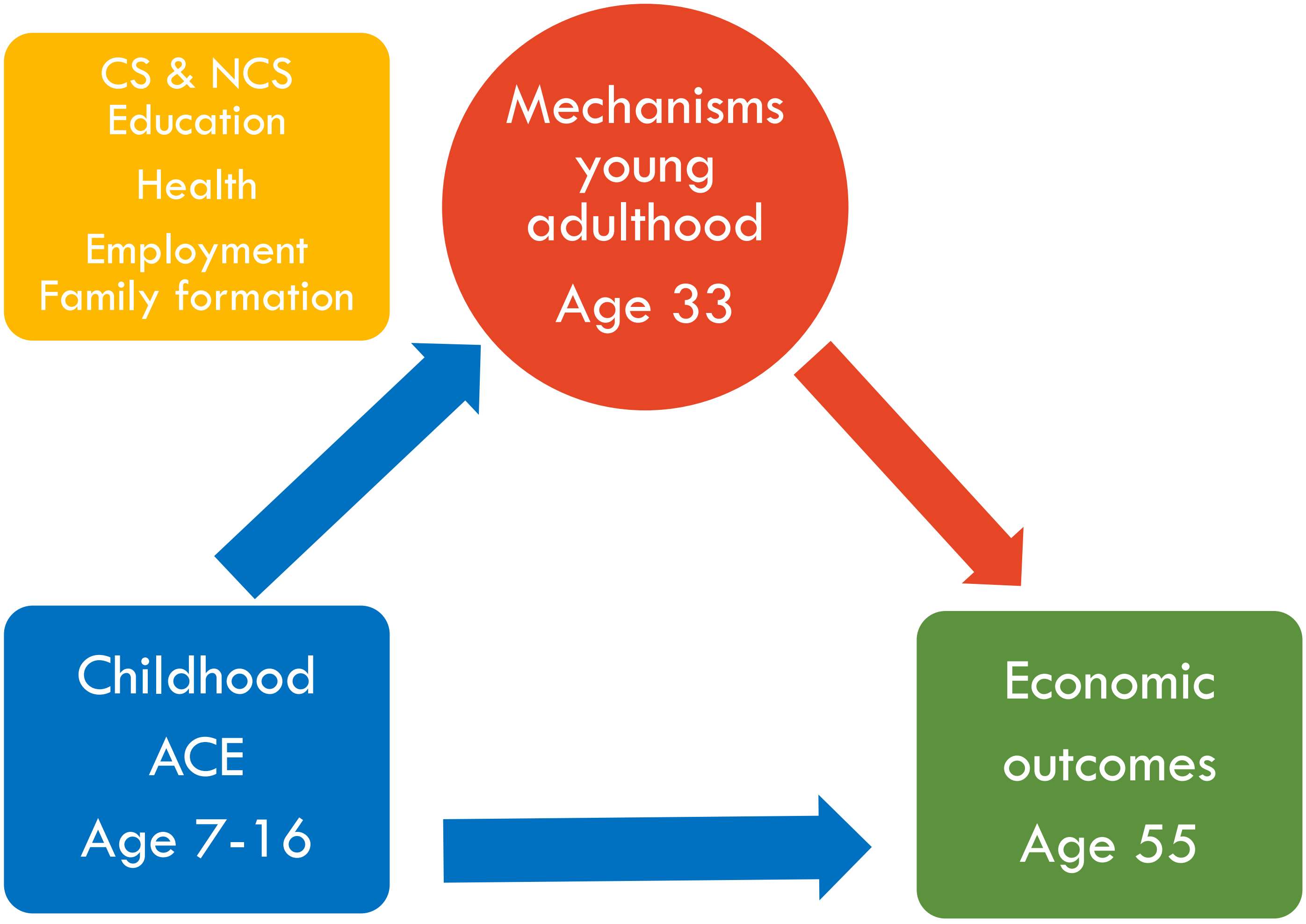
$$Y_i = \beta_0 + \beta_1 ACE_i + \varepsilon_i, \text{ (1)}$$

Multivariate

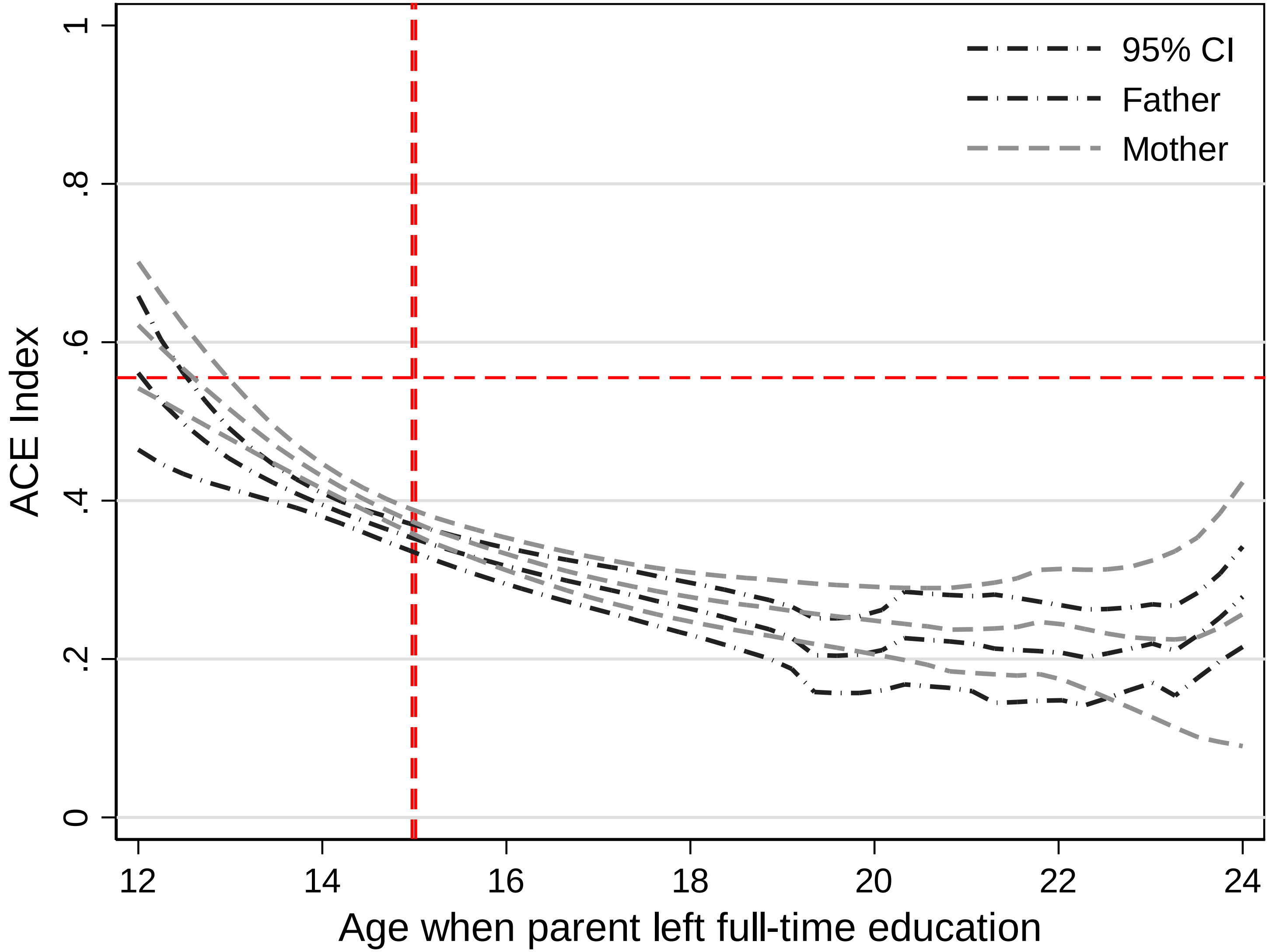
$$Y_i = \propto_0 + \boldsymbol{\propto_1} ACE_i + \propto_2 X_i + \varepsilon_i. \text{ (2)}$$

Decomposition of relationship of ACE with economic outcomes by mediators

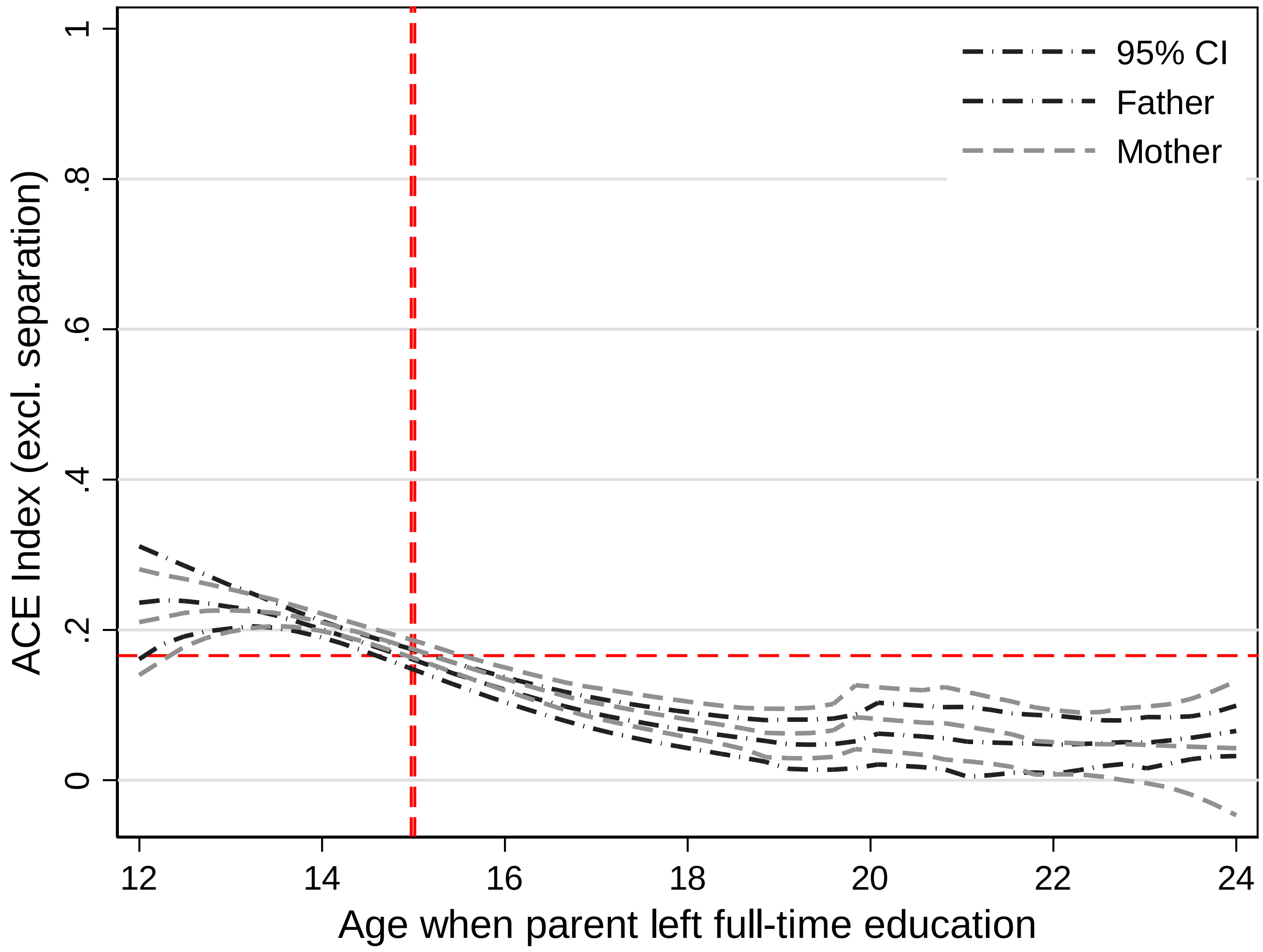
Heckman and Pinto (2015)
applied in Heckman et al. (2013)



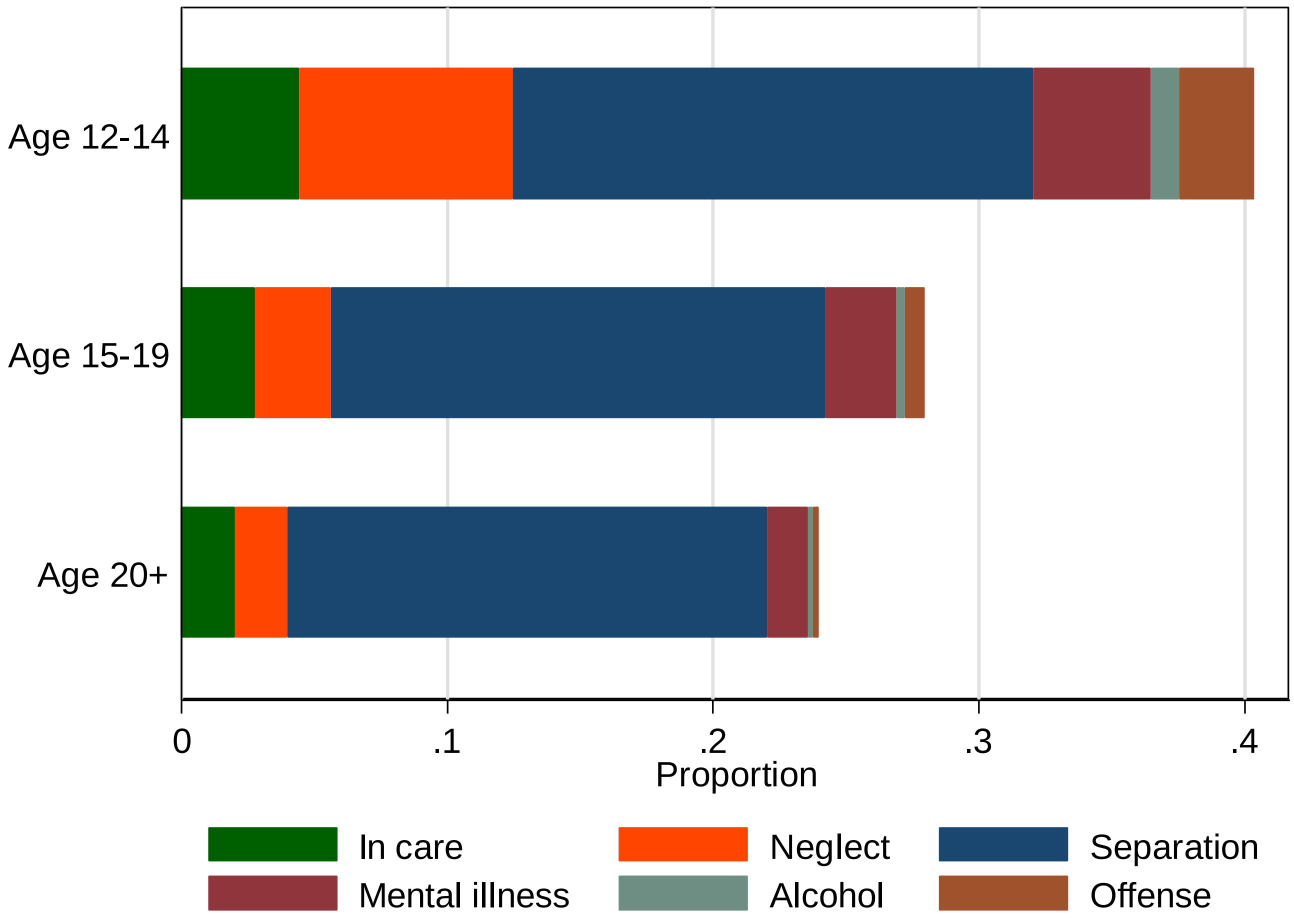
The socioeconomic gradient in ACE



The socioeconomic gradient in ACE (excl. separation)



Socioeconomic gradient by parental education (father)



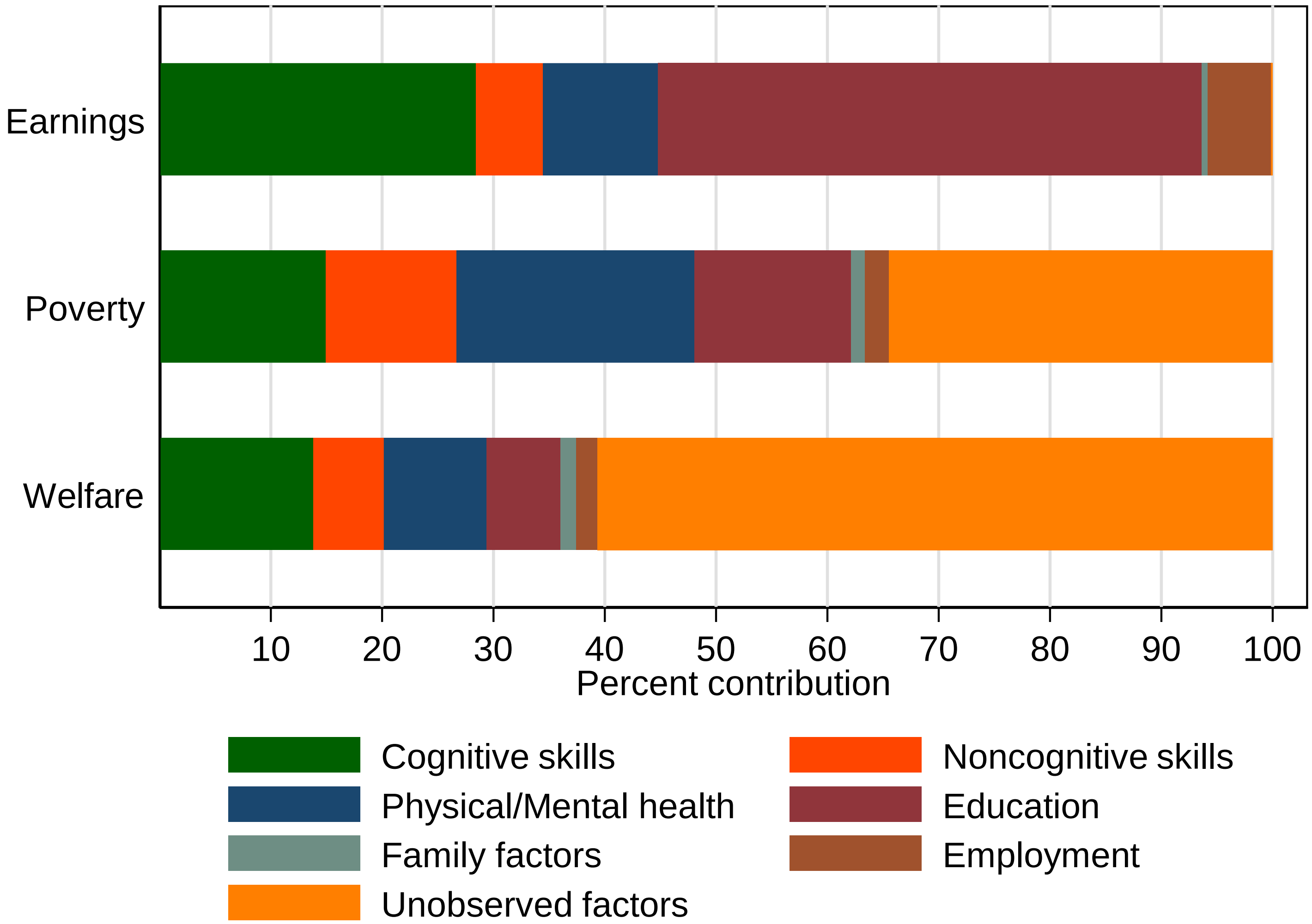
Relationship between ACE index and economic outcomes

ACE	Log net earnings		Welfare dependence		Subjective poverty	
	Raw	Controls	Raw	Controls	Raw	Controls
Index	-.106***	-.073**	.055***	.051***	.039***	.034***
(0-6)	(.031)	(.032)	(.009)	(.010)	(.007)	(.008)
Index>1	-.275***	-.192**	.121***	.106***	.046**	.032
(0,1)	(.090)	(.088)	(.027)	(.028)	(.021)	(.021)
Mean	7.124		0.165		.091	
#Obs	2,793		5,084		5,042	
			Significance levels: *** 0.01 ** 0.05 * 0.10			
Note on robustness: coefficients tend to be larger when excluding separation from ACE Index.						

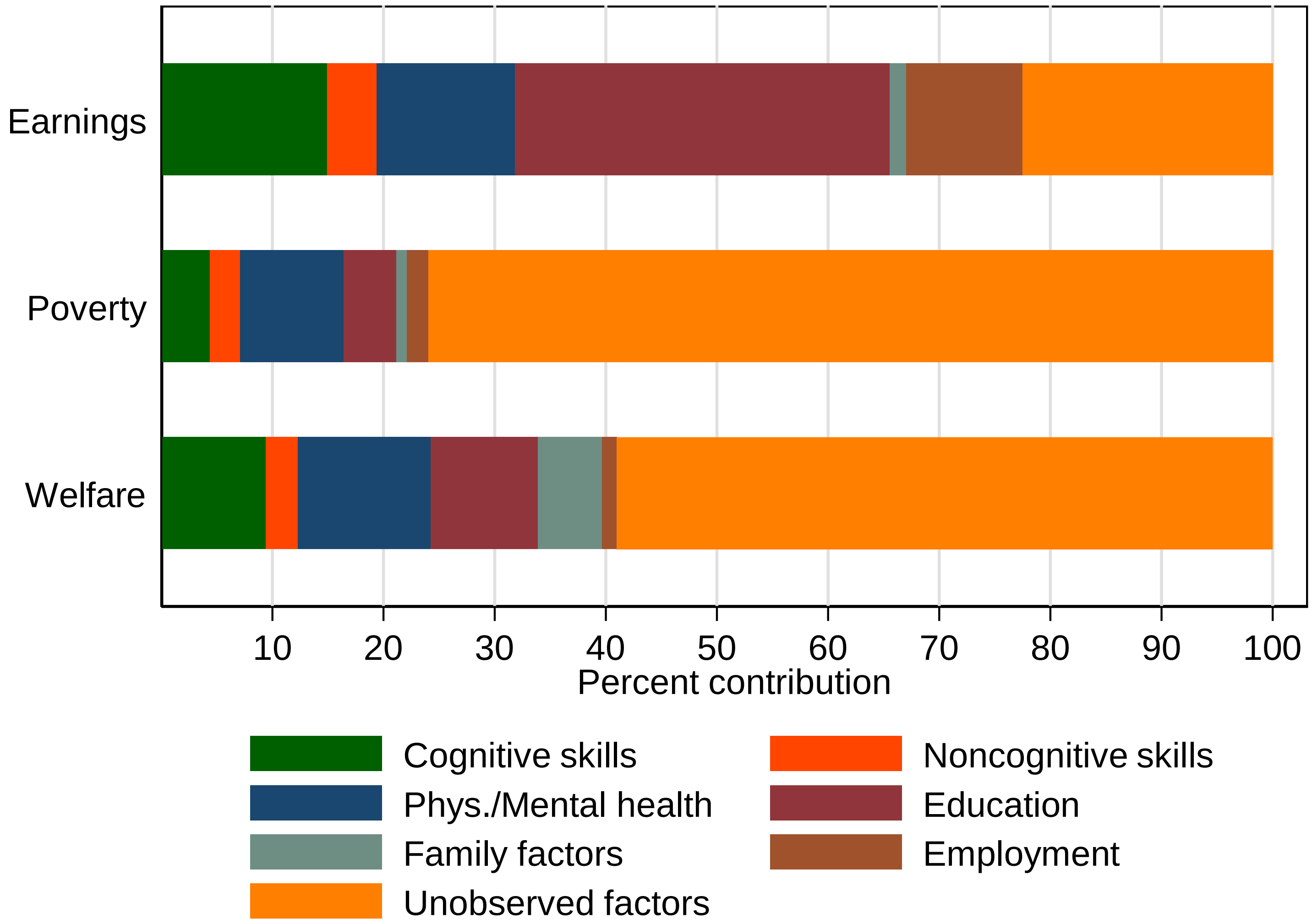
Relationship between components of ACE and economic outcomes

ACE Component	Log net earnings		Welfare dependence		Subjective poverty	
(0, 1)	**Raw**	**Control**	**Raw**	**Control**	**Raw**	**Control**
In care	-.213*	-.140	.109***	.098***	.042	.031
Neglect	-.228**	-.225**	.140***	.132***	.060***	.053***
Separation	-.094*	-.068	.048***	.045***	.037***	.027**
Mental illn.	-.107	-.033	.064**	.051*	.080***	.080***
Alc. abuse	-.247	-.087	.053	.045	.046	.029
Offender	-.247*	-.067	.106**	.082*	.134***	.119***
				Significance levels: *** 0.01 ** 0.05 * 0.10		

Decomposition results for neglect



Decomposition results for ACE>1



Note on attrition

	Final sample		Drop-out sample		P-value
	N	Mean/ Prop π_1	N	Mean/ Prop π_2	$H_0: \pi_1 = \pi_2$
ACE	5760	0.05	9645	0.09	0.000***
ACE index	5760	0.38	9645	0.7	0.000***
In care	5748	0.03	9554	0.05	0.000***
Neglect	5183	0.04	8835	0.08	0.000***
Separation	5745	0.25	9615	0.51	0.000***
Mental illn.	5570	0.03	9320	0.04	0.000***
Alc. abuse	4880	0.01	8177	0.01	0.004**
Offender	5570	0.02	9306	0.03	0.000***
Low SES	5048	0.56	9662	0.76	0.000***
Significance levels: *** 0.01 ** 0.05 * 0.10					

Conclusion

- Strong SES gradient in ACE (1/2 vs 1/5) – yet children in more privileged families experience ACE
- ACE earnings penalty: 20%
- Main driver is **neglect**: 19-23%
- Main mechanism: Formal education & cognitive skills by age 33
- Mechanisms are less well explained for WD & SP
- Systematic attrition is likely to downward bias the relationship
- Lack of causal identification
- Teacher assessments contain valuable information