Family Size and Educational Attainment in England and Wales

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Research question

Does large family size (having many siblings) *cause* lower educational attainment?

- There is a well established **negative association** between family size and educational attainment.
- Often interpreted in causal terms as **'resource dilution'** (Blake, 1989) or **'quantity–quality tradeoff'** (Becker, 1991).
- But parents who have more children are likely to be different from those with fewer children. The association might be spurious due to **omitted variable bias**.
- Parents probably make fertility decisions and educational investment decisions jointly. **Treating family size as an exogenous variable is problematic.**

Previous research

A large literature showing a negative association between family size and educational attainment.

- **Consistent**: 'one of the most consistent findings in the status attainment literature' (Downey, 1995, p. 746).

  'it remains inarguable that large sibships inhibit educational attainment' (Kuo and Hauser, 1997, p.73).
- **Large effect size**: 'typically exceed those of all other familial variables . . . with the exception of parental education' (Steelman *et al.*, 2002, p.248).
- **Stronger than birth order or sex composition effects.**

Instrumental variable approach

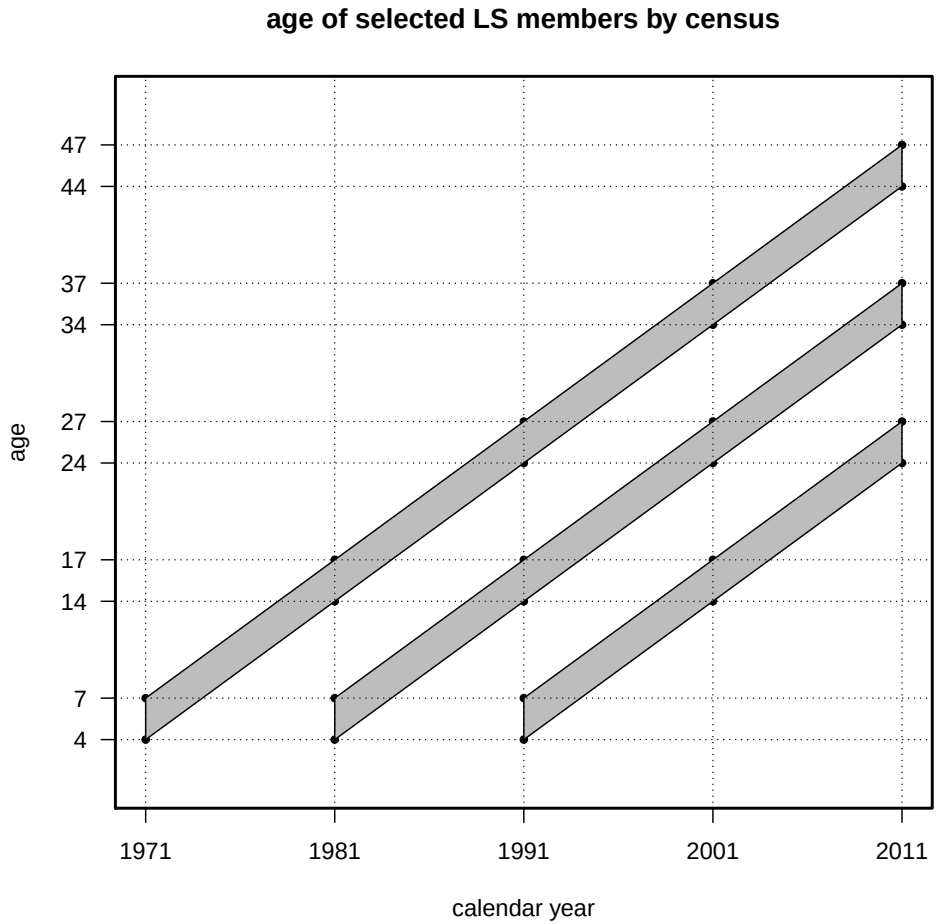
- Instrumental variable approach offers a way to test whether large family size causes lower educational attainment.
- A valid instrument
  - Correlates strongly with the endogenous variable (family size).
  - Does not affect the dependent variable (education) except through the endogenous variable.
- Most commonly used IV in the literature: **twin births**.
  - As twinning is a random occurrence, it is arguably an exogenous source of difference in family size.
  - But the details of implementation matter.
- A second commonly used IV: **sex composition** of the sibling group.

Office for National Statistics Longitudinal Study (LS)

- Linked census and life events data for approximately one per cent of the population of England and Wales.
- Original LS sample consisted of all those enumerated in the 1971 census who were born on one of four selected dates in a calendar year.
- New data for sample members were added at the 1981, 1991, 2001 and 2011 censuses.
- The four birth dates were used to add new members at each census and between censuses.
- Data available for each LS member include not only their own census return but also equivalent detail for every member of their household, although only LS members themselves are linked over time.

Data: construction of analytical sample

- Restrict to cases where mother was 16–39 of age when LS member was born.
- We select LS members aged 4–7 in the 1971, 1981 and 1991 censuses, forming three cohorts ('baseline').
  - Born in 1964–67, 1974-77, and 1984–87 respectively.
- Link to info in 1981, 1991, 2001 censuses when they were aged 14–17 ('baseline +10).
- Further link to info in 1991, 2001, 2011 censuses when they were aged 24–27 ('baseline +20'), or beyond.



Data: construction of analytical sample (cont'd)

- Use household roster (sex, DoB, relationship to first person in census form) to identify with whom LS members lived at various censuses.
- Info from 'baseline' (aged 4–7).
  - Sex and year of birth.
  - Age of mother when LS members were born.
  - Region.
  - Housing tenure.
  - Educational attainment and NSSEC of LS members' parents.
- Info from 'baseline' and 'baseline + 10'.
  - Whether lived with both parents up to their mid-teens.
  - Number of siblings.
  - Number of maternities (births) of LS members' mother.
  - LS members' place in the birth order.
  - Whether there were multiple births in LS members' household (instrumental variable).

Data: construction of analytical sample (cont'd)

- Info from 'baseline + 20 (or beyond)': whether LS members have a first degree (dependent variable).
- Some caveats.
  - **Sample attrition**: around 90% of LS members of each cohort were enumerated in the next census, dropping to around 75% at 'baseline + 20'.
  - **Identifying parents and siblings**:
    - Inference based on sex and DoB.
    - Not always possible to identify parents with certainty, esp. in multi-generational households.
    - Step-parents and step-siblings often indistinguishable from their biological counterparts.
  - **Number of siblings and birth order**: might miss much older and/or much younger siblings. 1971 census asked women to report number of births given within marriage, correlation with our estimate of sibling numbers is very high, $r = .91$.
  - **Measurement errors**: we don't know who filled in the census form.

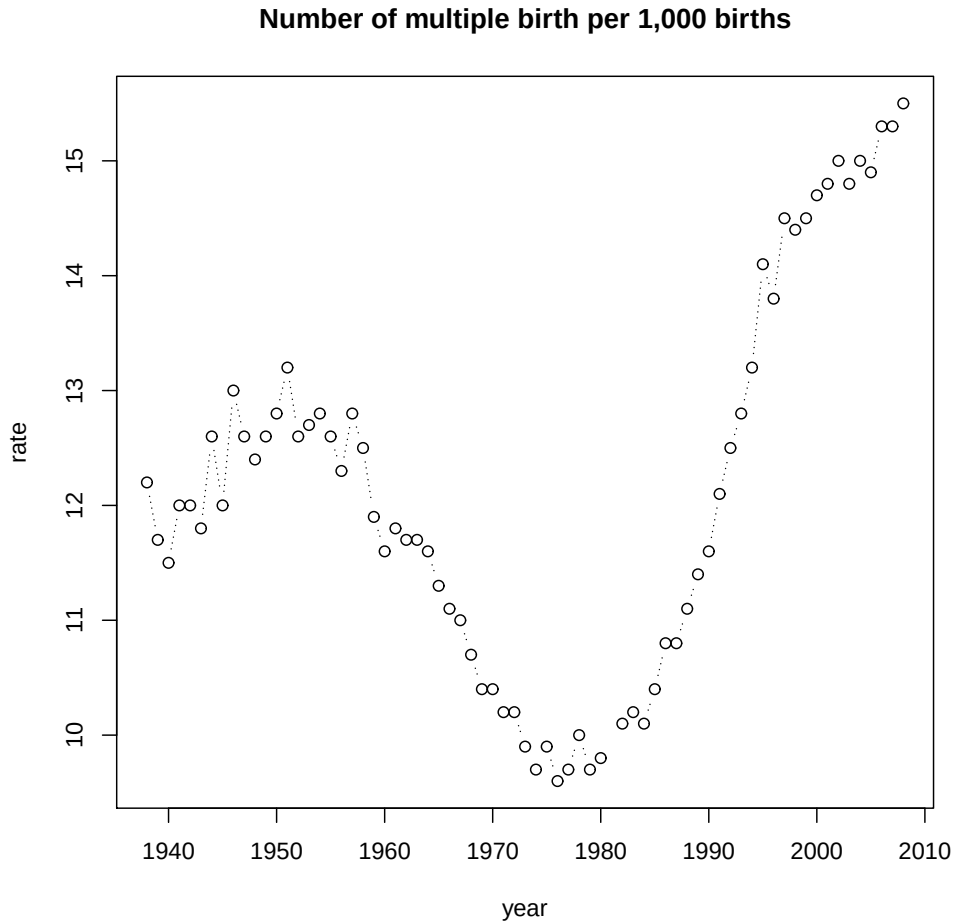
Why LS is well-suited to addressing our research question

- Large sample size:
  - Twin births are arguably a source of exogenous variation in family size, but relatively rare $\Rightarrow$ need a larger sample size.
- LS is Longitudinal rather than cross-sectional.

  There are other IV studies based on data from a single census, essentially cross-sectional in nature.
  - They use intermediate educational variables, e.g. types of school attended, grade repetition, not educational attainment, as dependent variable.
  - Have more measurement error in key variables (e.g. number of siblings).

Multiple births as an instrument variable: possible issues

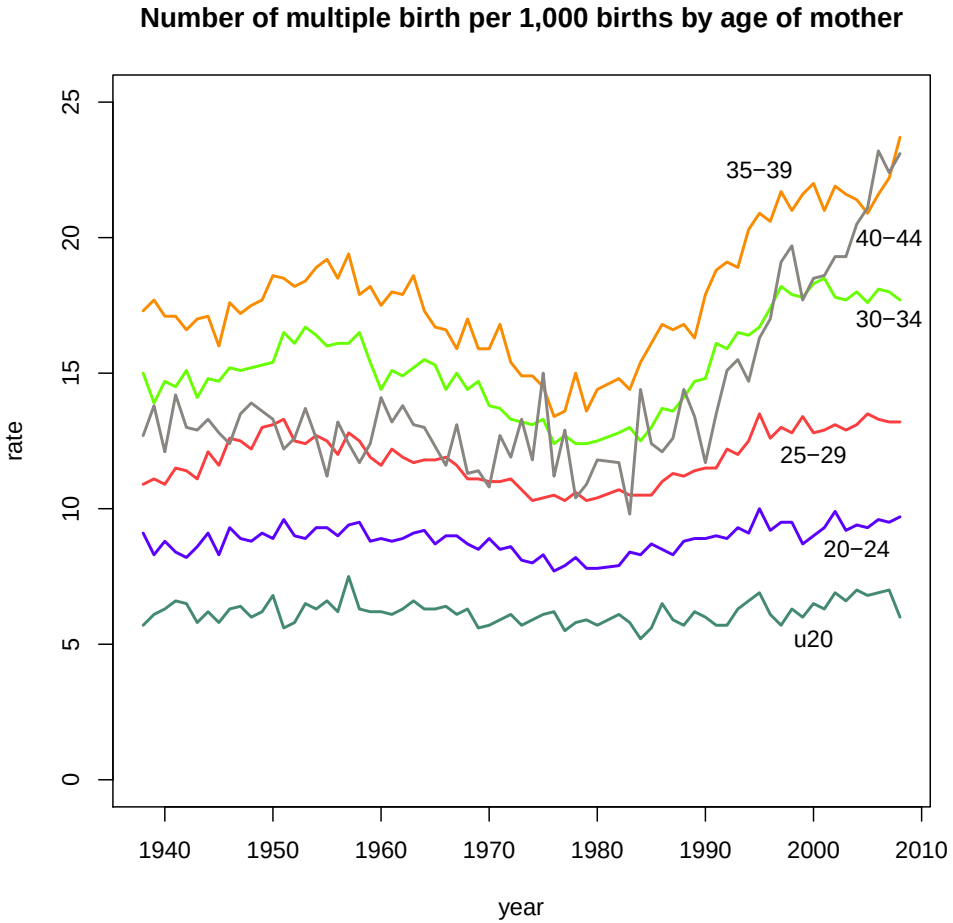
- Multiple births also affect child spacing, not just family size.
- Twins and non-twins differ in many ways, e.g. birth weight.
- Still subject to omitted variable bias, e.g. multiple births are more common among older mothers, IVF treatment, and probably unobserved characteristics.
- HFEA: about 1 in 80 births following natural conception are multiples; compared to 1 in 4 births after IVF.



Source: ONS Birth Statistics, Series FM1, various years.

Have multiple births become less exogeneous due to IVF?

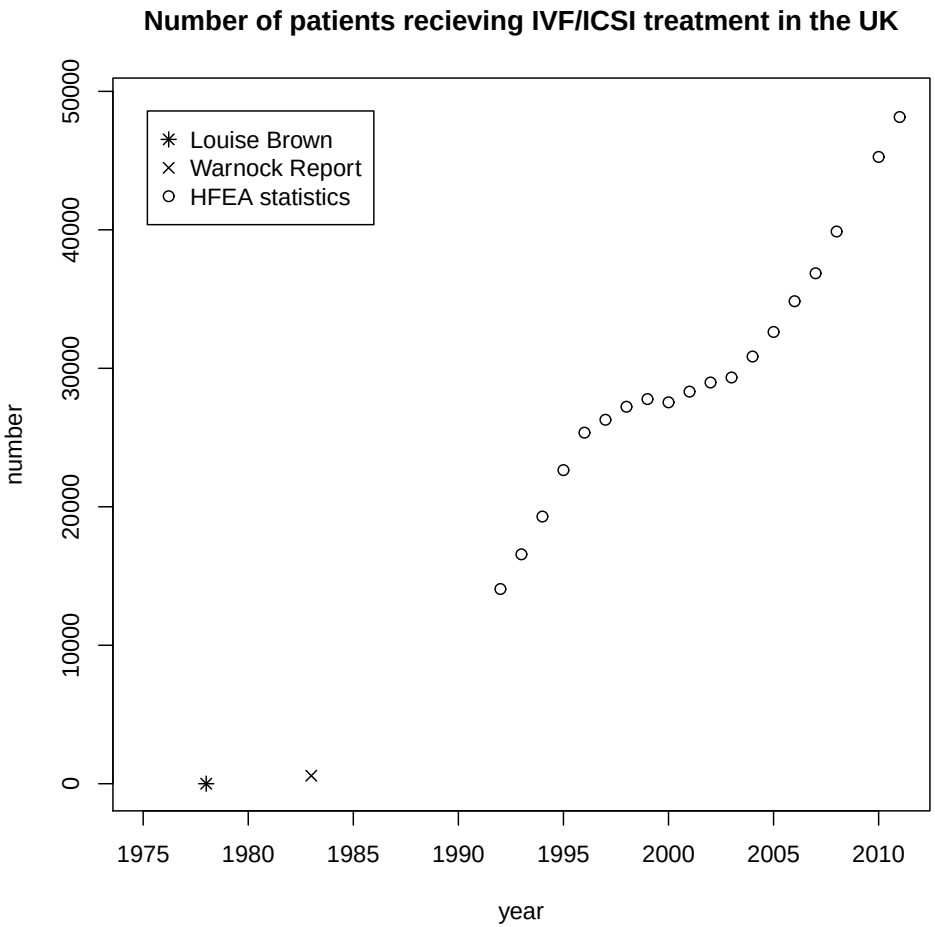
- Multiple birth rates rise progressively with mother's age, except for those aged 40–44. (Trend for mothers aged 45+ not shown.)
- Trends much flatter within age (esp for mothers below age 30).
- Overall trend (up to mid-1980s, at least) driven mainly by the changing distribution of mother's age.



Source: ONS Birth Statistics, Series FM1, various years.

Trend in fertility treatment

- Between 1992 (first full-year HFEA stat) and 2010, number of IVF/ICSI patients rose from 14,061 to 48,147.
- 1984 Warnock Report: 'In 1983 there were 967 laparoscopies performed for 579 women.'
- Our three birth cohorts were born in 1964–67, 1974–77, 1984–87.
- First "test-tube baby", Louise Brown, was born in 1978.
- IVF was not available to our first and second cohorts and probably not very assessible to our third cohort.



Source: HFEA reports, various years; and the 'Warnock Report

Distribution by number of siblings and cohort

Table: Distribution of LS members by number of siblings (column %)

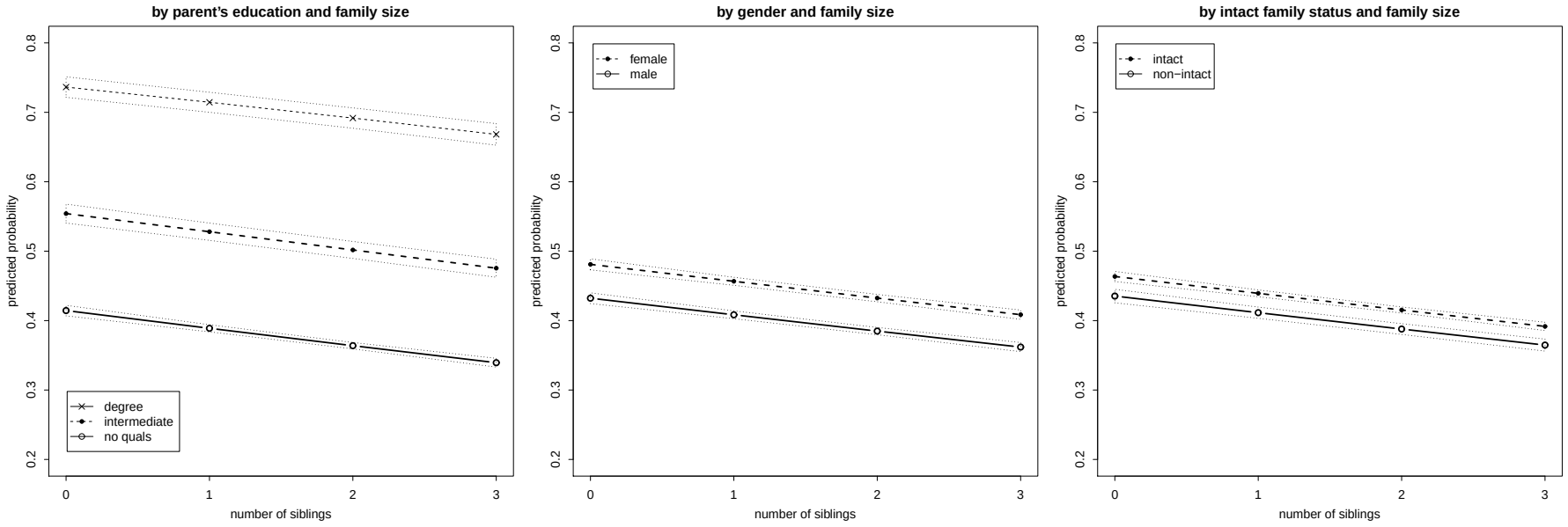
	1971	1981	1991	overall
0	6.47	8.00	8.75	7.64
1	34.99	47.41	43.75	41.40
2	29.34	27.27	29.43	28.76
3	15.99	11.04	11.84	13.23
4	7.10	3.70	3.72	5.04
5	3.30	1.44	1.52	2.19
6	1.54	0.62	0.55	0.96
7	0.70	0.29	0.25	0.43
8	0.32	0.16	0.11	0.21
9	0.16	0.02	0.04	0.08
10	0.06	0.01	0.02	0.03
11+	0.02	0.01	0.01	0.01
N	32063	24060	25922	82045

Probit regressions (N=57,350)

	β	*s.e.*	β	*s.e.*	β	*s.e.*
age within coh	-.015	.004	-.014	.004	-.015	.004
female	.142	.011	.143	.011	.144	.011
mother's age	.014	.001	.028	.001	.029	.001
intact family	.088	.013	.084	.013	.083	.013
intermediate	.404	.018	.385	.018	.385	.018
degree	.964	.023	.930	.024	.928	.024
class 2	-.141	.017	-.140	.017	-.140	.018
class 3	-.287	.021	-.284	.021	-.283	.021
class 4	-.423	.024	-.421	.024	-.420	.024
class 5	-.488	.024	-.483	.024	-.484	.024
class 6	-.590	.024	-.588	.024	-.588	.024
class 7	-.622	.029	-.632	.029	-.630	.029
social tenant	-.437	.014	-.413	.014	-.414	.014
private tenant	-.234	.021	-.228	.021	-.227	.021
# sibling	-.075	.005	.017	.006	-.072	.005
birth order			-.170	.008		
adj birth order					-.392	.018
constant	-.442	.046	-.664	.047	-.467	.046

Note: region dummies included in the models but not shown.

Effect size in probit model with adjusted birth order



- Parental educational attainment dominates (about 33% between degree and no qualifications).
- Family size effect (about 6% in the range of 0–3) comparable to the gender difference (about 5%), but larger than that between intact and non-intact families (about 2%)..

IV-probit

Consider the effects on an older child of having an extra younger sibling because of multiple births.

- Subsample 1: LS members were first-born in families with 2+ births and multiple birth, if it happened, was at the second birth.
- Subsample 2: LS members were first or second-born in families with 3+ births and multiple birth, if it happened, was at third birth.
- Subsample 3: LS members were first, second or third-born in families with 4+ births and multiple birth, if it happened, was at fourth birth.

IV-probit (cont'd)

	probit		ivprobit				
			first stage		second stage		
Subsample 1: first child in families with 2 or more births							
	β	*s.e.*	β	*s.e.*	β	*s.e.*	*N*
# sibling	-.025*	.012			-.064	.098	19527
instrument: twin at 2nd birth			1.608*	.087			
Subsample 2: first and second children in families with 3 or more births							
# sibling	-.109*	.017			-.060	.128	15057
adj birth order	-.470*	.050			-.425*	.128	
instrument: twin at 3rd birth			1.614*	.094			
Subsample 3: first, second and third children in families with 4 or more births							
# sibling	-.088*	.025			.158	.188	6918
adj birth order	-.418*	.065			-.267*	.135	
instrument: twin at 4th birth			1.698*	.167			

Note: * $p < .05$

Summary and discussion

- Using multiple births as IV, no evidence that larger family size *causes* a lower probability of getting a degree.
  - Parents choose both fertility level and educational investment in children.
  - Sawhill's 'Drifting into parenthood'.
- Parental educational attainment is by far the more important determinant.
- Also consider sex composition as a further IV $\Rightarrow$ similar result.
- Also consider social class attainment by mid-30s $\Rightarrow$ similar result.

Acknowledgments

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- This work contains statistical data from ONS which is Crown Copyright. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates.
- The derivation of 1971 and 1981 NSSEC & Goldthorpe classes is provided in Bukodi and Neuburger (2009) 'Data Note. Job and occupational histories for the NSHD 1946 Birth Cohort' as part of the ESRC Gender Network Grant, Project 1 'Changing occupational careers of men and women', Reference: RES-225-25-2001. The code was kindly provided by Erzsebet Bukodi and adapted for use in the LS by Buscha and Sturgis as part of the ESRC grant 'Inter-cohort Trends in Intergenerational Mobility in England and Wales: income, status, and class (InTIME)', Reference: ES/K003259/1.

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Descriptive statistics

Table: Descriptive statistics

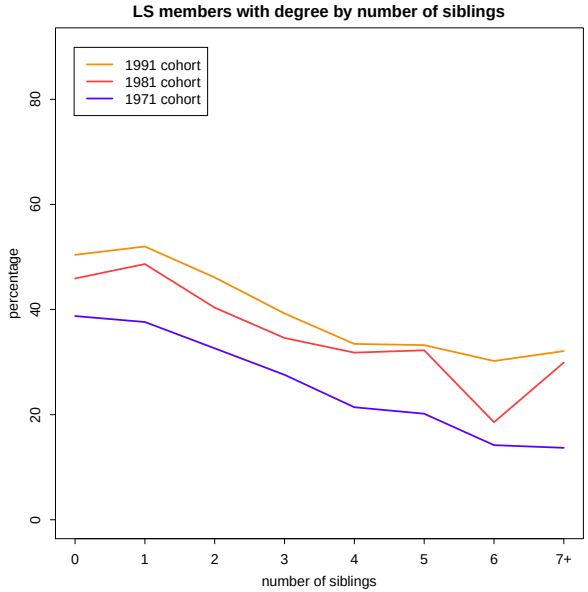
	1971	1981	1991	overall
degree	32.0	43.3	47.3	39.7
home owner	53.7	62.6	67.3	60.6
social tenant	32.3	30.8	26.5	30.0
private tenant	14.1	6.6	6.3	9.4
parent edu (none)	82.7	80.6	77.3	80.4
parent edu (inter)	12.0	8.7	10.0	10.4
parent edu (degree)	5.3	10.7	12.7	9.3
parent class 1	13.7	17.0	18.6	16.3
parent class 2	26.9	30.1	31.3	29.3
parent class 3	13.5	13.3	13.7	13.5
parent class 4	9.5	11.3	9.4	10.0
parent class 5	12.3	10.4	8.4	10.5
parent class 6	15.0	11.2	12.4	13.1
parent class 7	9.2	6.7	6.1	7.5

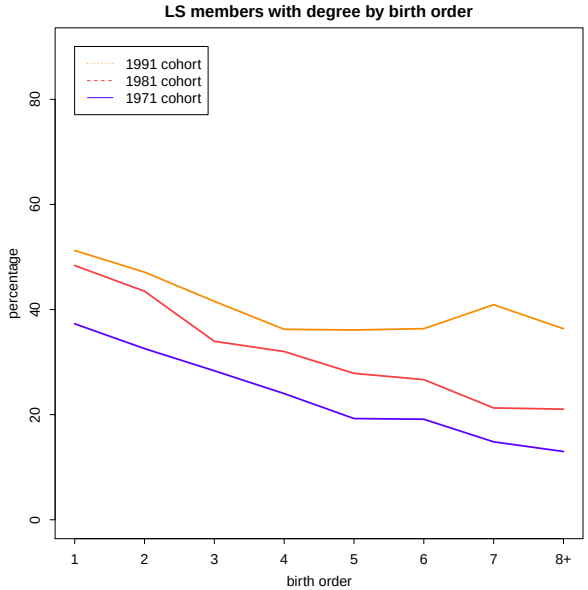
Descriptive statistics (cont'd)

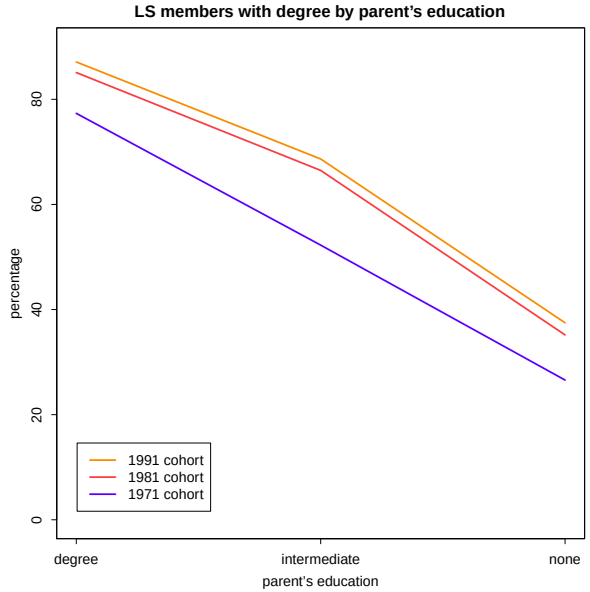
Table: Descriptive statistics

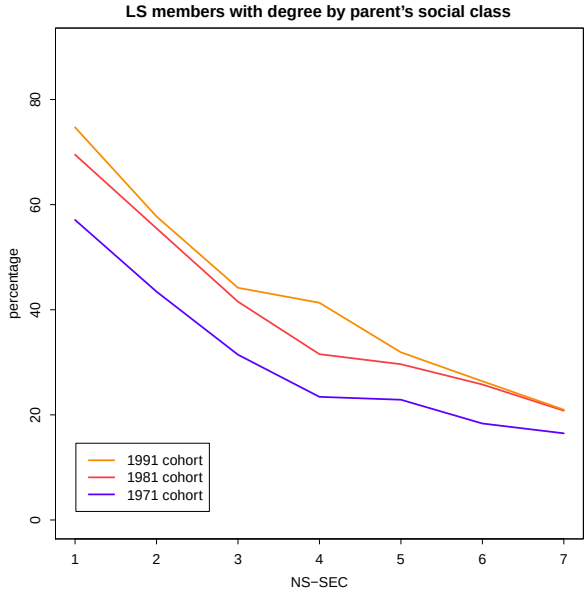
	1971	1981	1991	overall
female	49.1	49.0	49.0	49.0
intact family	63.9	59.7	50.1	58.3
twin births	3.6	2.9	3.2	3.3
LSM is part of twin	1.9	1.7	1.9	1.9
mum's age (mean)	26.8	26.2	26.9	26.7
mum's age (sd)	5.3	4.8	5.0	5.0
siblings (mean)	2.1	1.6	1.7	1.8
siblings (sd)	1.4	1.2	1.2	1.3
birth order (mean)	2.1	1.9	1.8	2.0
birth order (sd)	1.3	1.0	1.0	1.1

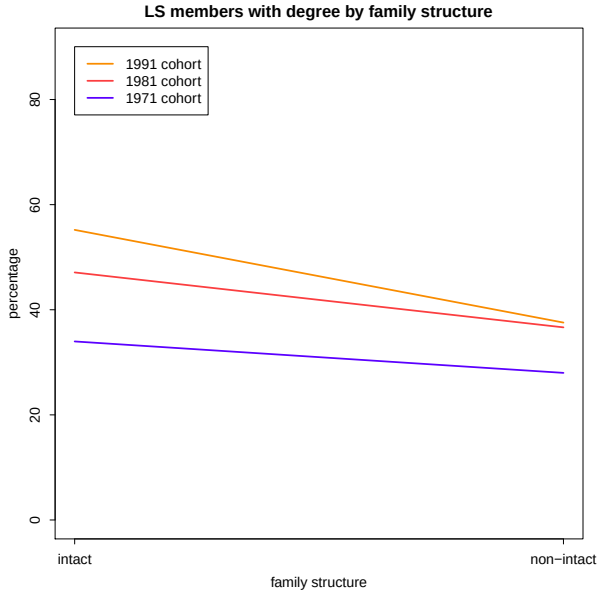
Bivariate associations (within cohort)

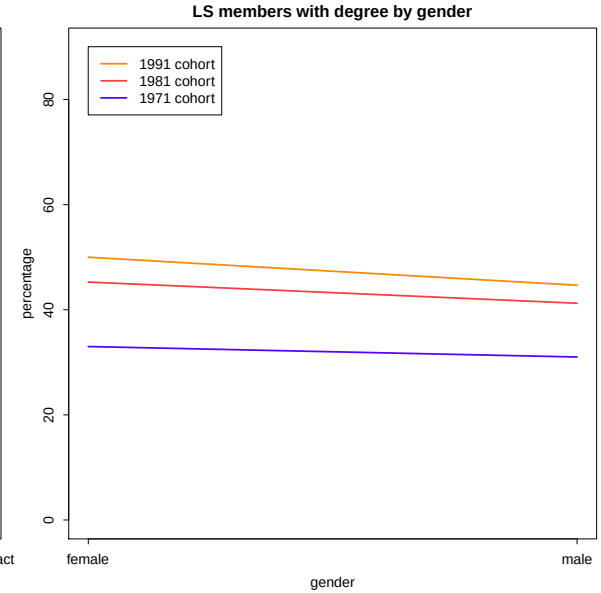












Family size and birth order

- Family size and birth order are quite highly correlated (Iacovou, 2007).
  - Issues in estimating both family size and birth order in the same model.
- Booth and Kee (2009) propose an adjusted birth order:

$$\text{adj. birth order} = \frac{\text{birth order}}{\text{average birth order}} = \frac{\text{birth order}}{(\#\text{ siblings} + 2)/2}$$

- Correlation matrix:

	# of siblings	birthorder
birth order	.69	
adj. birth order	.09	.76

Previous research (continued)

- **Policy matters.** Park (2008, p.874) uses PISA data and reports cross-national variation in the negative sibship effect.

  > *'[C]ountries with stronger public support for childcare, universal child benefits, larger public expenditures on education and family, show a much less negative effect of growing up in large families.'*

- **As does context.** Maralani (2008) uses data from Indonesia and show that in urban areas the association between family size and children's schooling changed over cohort from positive to negative. In rural areas, there is no association at all for all cohorts.
- **A spurious association?** Guo and VanWey (1999) use NLSY data and fixed effects model and show no sibship size effect on test score.
  - But see debate with Downey *et al.* (1999), Phillips (1999).

Instrumental variables and 2SLS

- Rosenzweig and Wolpin (1980) first propose using multiple births as IV, and show a family size effect with a small data set from India.
- Black *et al.* (2005, p.669) use Norwegian register data and show that 'when we include birth order or use twin births as instrument, family size become negligible.'
- Angrist *et al.* (2010) use linked census and register data from Israel and multiple IVs (multiple births, sex composition) to show no family size effects.
- Ponczek and Souza (2012) use Brazilian 1991 census data and twin births as IV and show that children in larger families are more likely to work and have worse educational outcomes.
- Maralani (2008) uses miscarriages as IV as sensitivity test.