

# Birth order and children's health outcomes



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# Our hypothesis

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We hypothesize that we will find differences in child health outcomes in India:

- By birth order
- By gender
- And the intersection of birth order and gender

# How did we come to this hypothesis?

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In much of Asia (e.g. India, Bangladesh, China, and S Korea), there are strong mortality differentials along each of these dimensions:

- Girls have much higher probability than boys, of being aborted and of dying in early childhood
- Within each gender, clear pattern of higher probability of abortion/mortality with rising birth order
- And the pattern of worsening outcomes is much sharper amongst girls than boys. So later-born boys do a little worse than firstborn boys, but later-born girls do far worse than firstborn girls

We hypothesize that these patterns also manifest themselves in the health outcomes of surviving children

# Underlying theories 1:

## Why would girls do worse than boys?

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Reasons for the gender differential is attributed to much lower value of girls to their parents, because of cultural prescriptions that require:

- daughters to move away after marriage
- sons to support their parents in their old age

## Underlying theories 2:

### Why might later-borne children have worse outcomes?

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Behrman and Taubman posit several theories to explain this:

- ❑ *Biological*, children of higher birth order are less healthy, so parents may prefer to invest more in children of lower birth orders
- ❑ *Dilution of resources* for investing in later-borne children:
  - Dilution of household resources for investing in children, as the number of children in the family increases
  - Dilution of mother's attention as the number of children rises. The firstborn can have the mother's undivided attention in the first year of life, which is the most crucial stage for the child
- ❑ *Diminishing marginal returns* of children:
  - Resource tightening : unanticipated births tighten household resource constraints, so later-born children do worse
  - The present discounted value of children's earnings to parents is larger for older children (whose earnings will materialize earlier) than for younger ones (whose earnings will be just additional to those of their older siblings)

Behrman and Taubman also offer theories for why later-born children might do better than firstborns:

- parents have more resources when they are older
- parents learn more effective childrearing skills

# Where this study fits into the literature

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Several studies have looked at differentials in child human capital outcomes:

- by birth order (irrespective of gender)
- by gender (irrespective of birth order)
- and -- esp in South Asia -- many studies on mortality differentials by gender *and* birth order.

There is less work on differentials (other than mortality) by gender and birth order.

Rohini Pande examined differentials in child anthropometry and immunization by gender and birth order in India, using the DHS 1992-3 survey

We do the same using the 3 DHS surveys conducted till now, and will examine (1) differentials within each survey, and (2) trends over time

# Data

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- ❑ India's National Family Health Survey (NFHS/DHS) data waves 1992, 1998 and 2005
- ❑ Sample of young children <36 months
- ❑ We look at:
  - individual immunization outcomes (BCG, DPT, Polio, Measles)
  - full immunization (all vaccines)
- ❑ Vaccination schedule:
  - BCG at birth,
  - Polio, DPT – 3 shots by 14 weeks
  - Measles – at 9 months

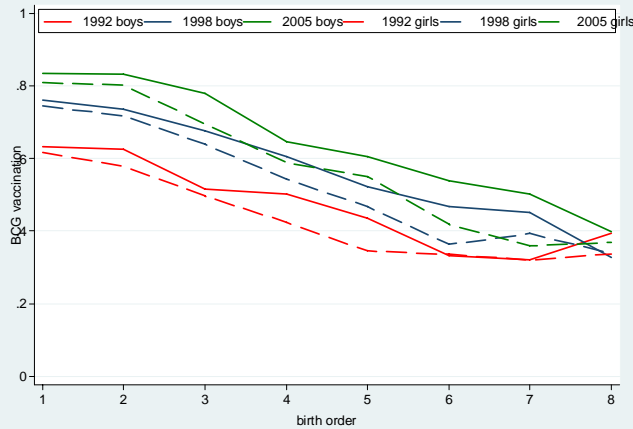
# What do we observe in the data?

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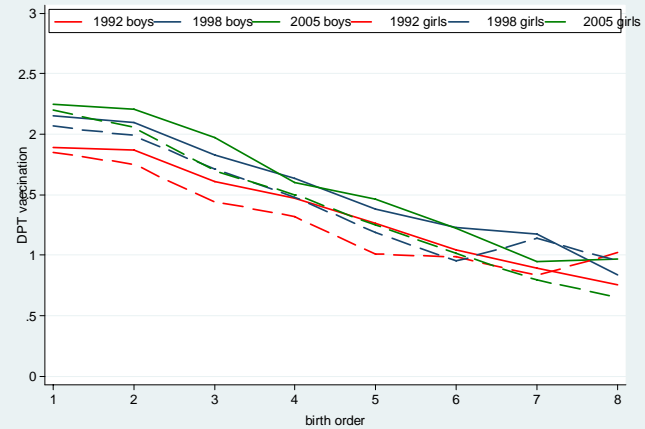
- We observe that later born children experience disadvantage in immunization compared to the earlier born
- Shifts over time:
  - for all children
  - between the later-born and earlier-born
  - between girls and boys

# Observed vaccination by year, birth order and gender

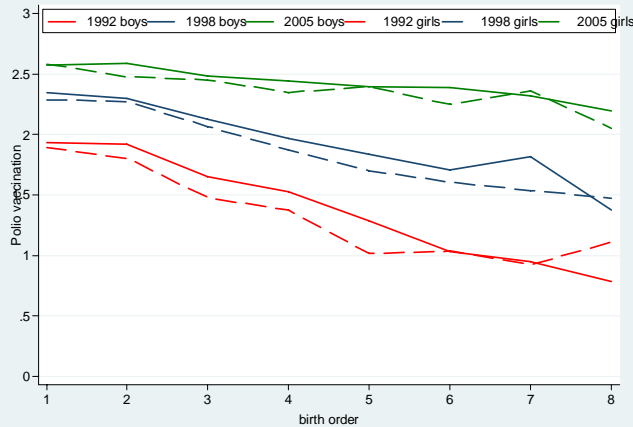
BCG



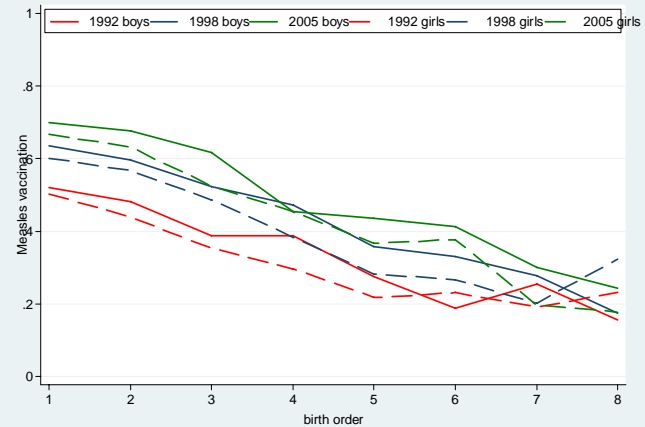
DPT



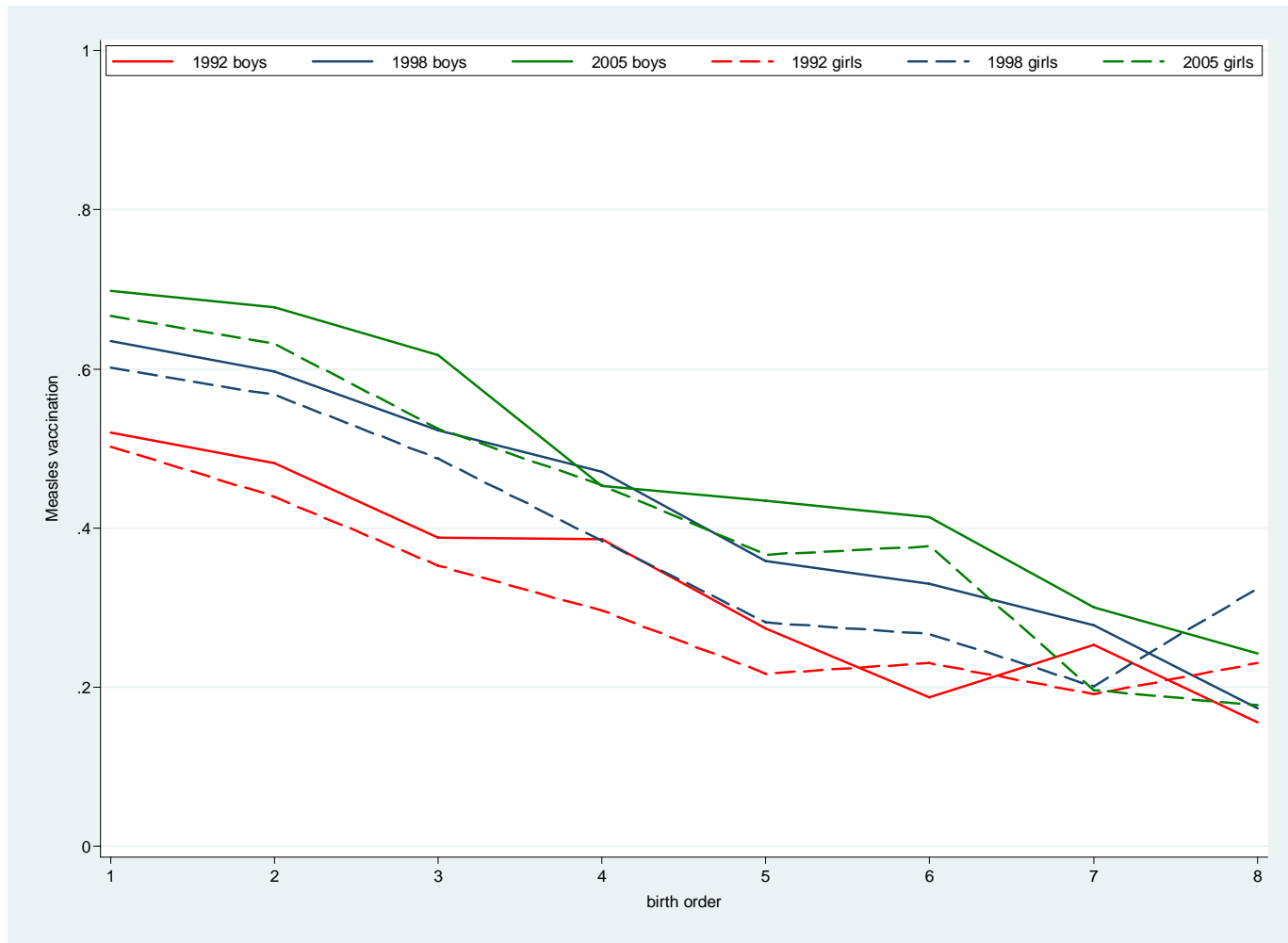
Polio



Measles



# Measles vaccination by year, birth order and gender



# Possible problem of endogeneity

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- ❑ Parents may decide jointly on both quantity of children and their health outcomes
- ❑ Birth order is related to the number of children, hence there might be a problem of endogeneity
- ❑ A possible solution: instrumental variable approach
  - Family size is instrumented with a variable that affects family size, but does not affect directly the outcome
  - Instruments used for this purpose:
    - ❑ Twins
    - ❑ Gender combination of the older siblings
  - It is not straightforward to show, however, that these events do not have a direct effect on the outcome in our case. For example, parents of children of different gender may be more willing to provide different rooms to boys and girls, thus reducing crowding in the house (Goux&Maurin, 2005), and this may have a direct effect on the outcome (health). Similarly, twins may represent an unusual pressure on the family resources, and may not be equivalent to two separately born children.

# Explanatory variables

Household characteristics	
State	Set of dummy variables
Urban	Dummy urban/rural location
Household size	Set of dummy variables for household size
Wealth	First component of the wealth index based on the assets that the household owns
Wealth 2	Square of wealth, see above
Parents' characteristics	
Religion of household head	Set of dummy variables for the main religions
Caste	Dummy variable, equals 1 if household head belongs to a scheduled caste
Tribe	Dummy variable, equals 1 if household head belongs to a scheduled tribe
Mother's age	Current age of the child's mother
Mother's age squared	Square of the current age of the child's mother
M_works	Dummy variable, equals 1 for working mothers
M_tv	Dummy variable, equals 1 if mother watches TV at least once per week
M_radio	Dummy variable, equals 1 if mother listens to radio at least once per week
Child's characteristics	
Male	Gender of the child, equals 1 for boys. All estimations run separately by gender.
Age	Age of the child in months
Birth order	Birth order of this child. Higher values correspond to younger children.
Older brothers	Dummy variable equal to 1 if there were any surviving brothers at the time this child was born.

# Results of the regression analysis (probit specification)

1992	Full immunization		BCG		DPT		Polio		Measles	
	boys	girls	boys	girls	boys	girls	boys	girls	boys	girls
2nd born	-0.073	-0.170***	-0.005	-0.190***	0.003	-0.161***	0.004	-0.161***	-0.092*	-0.209***
3rd born	-0.214***	-0.301***	-0.202***	-0.348***	-0.079	-0.348***	-0.083	-0.371***	-0.204***	-0.393***
4th born	-0.136	-0.353***	-0.125*	-0.431***	-0.088	-0.304***	-0.095	-0.326***	-0.121	-0.445***
5th born	-0.415***	-0.508***	-0.255***	-0.609***	-0.299***	-0.512***	-0.348***	-0.639***	-0.421***	-0.658***
6th born	-0.605***	-0.479***	-0.435***	-0.635***	-0.328***	-0.575***	-0.370***	-0.637***	-0.634***	-0.588***
7th born	-0.264	-0.512***	-0.443***	-0.530***	-0.379**	-0.582***	-0.378**	-0.576***	-0.324**	-0.619***
8+ born	-0.593***	-0.486**	-0.218	-0.553***	-0.521***	-0.506***	-0.542***	-0.572***	-0.532***	-0.554***
Number of observations	12,355	11,787	17,226	16,528	15,302	14,739	15,302	14,739	12,374	11,814

2005	Full immunization		BCG		DPT		Polio		Measles	
	boys	girls	boys	girls	boys	girls	boys	girls	boys	girls
2nd born	-0.106*	-0.097	-0.019	-0.134**	-0.080	-0.159**	-0.059	-0.121*	-0.135*	-0.130*
3rd born	-0.033	-0.172*	0.047	-0.278***	-0.148*	-0.262***	-0.046	-0.080	-0.056	-0.168*
4th born	-0.324***	-0.182	-0.139	-0.454***	-0.291***	-0.294***	-0.024	-0.118	-0.296***	-0.192*
5th born	-0.300**	-0.410***	-0.184	-0.508***	-0.294**	-0.555***	-0.200	-0.068	-0.264**	-0.494***
6th born	-0.264	-0.213	-0.215	-0.741***	-0.321**	-0.553***	-0.139	-0.144	-0.155	-0.271
7th born	-0.737***	-1.255***	-0.496***	-0.993***	-0.922***	-0.868***	-0.248	-0.012	-0.578**	-0.866***
8+ born	-0.528**	-0.676**	-0.586***	-0.791***	-0.607***	-1.189***	-0.242	-0.463**	-0.540**	-0.704***
Number of observations	9,158	8,264	12,405	11,393	11,277	10,283	11,277	10,283	9,180	8,283

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Minimum age depends on outcome: full immunization 9 months, BCG 0 months, DPT 4 months, Polio 4 months, Measles 9 months

# Results of the regression analysis (linear specification)

Weight-for-age	1992		1998		2005	
Birth order	boys	girls	boys	girls	boys	girls
2nd born	0.033	-0.118*	0.038	-0.166**	-0.100*	-0.144*
3rd born	-0.022	-0.149*	0.055	-0.276***	-0.135*	-0.127
4th born	-0.163	-0.250**	0.069	-0.409***	-0.031	-0.184
5th born	-0.056	-0.390***	-0.075	-0.595***	-0.278**	-0.547***
6th born	-0.300**	-0.272*	0.121	-0.410**	-0.221	-0.518***
7th born	-0.260	-0.245	-0.088	-0.452**	-0.393**	-0.596**
8+ born	-0.409	-0.243	-0.140	-1.008***	0.050	-0.299
Number of observations	14,676	14,190	13,552	12,350	11,405	10,481
Height-for-age	1992		1998		2005	
Birth order	boys	girls	boys	girls	boys	girls
2nd born	0.077	0.023	0.159	-0.304***	-0.056	-0.213**
3rd born	-0.067	-0.345**	0.142	-0.391***	-0.193	-0.140
4th born	-0.002	-0.195	0.024	-0.316**	0.034	-0.250
5th born	-0.193	-0.648***	-0.080	-0.623***	-0.209	-0.572***
6th born	-0.028	-0.680**	0.192	-0.857***	-0.153	-0.244
7th born	-0.406	-0.379	0.097	-0.503*	-0.574**	-0.608
8+ born	-0.251	-0.368	-0.246	-0.767***	-0.242	-0.114
Number of observations	11,245	10,801	13,549	12,323	11,351	10,425

note: \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

# Effects of selected explanatory variables

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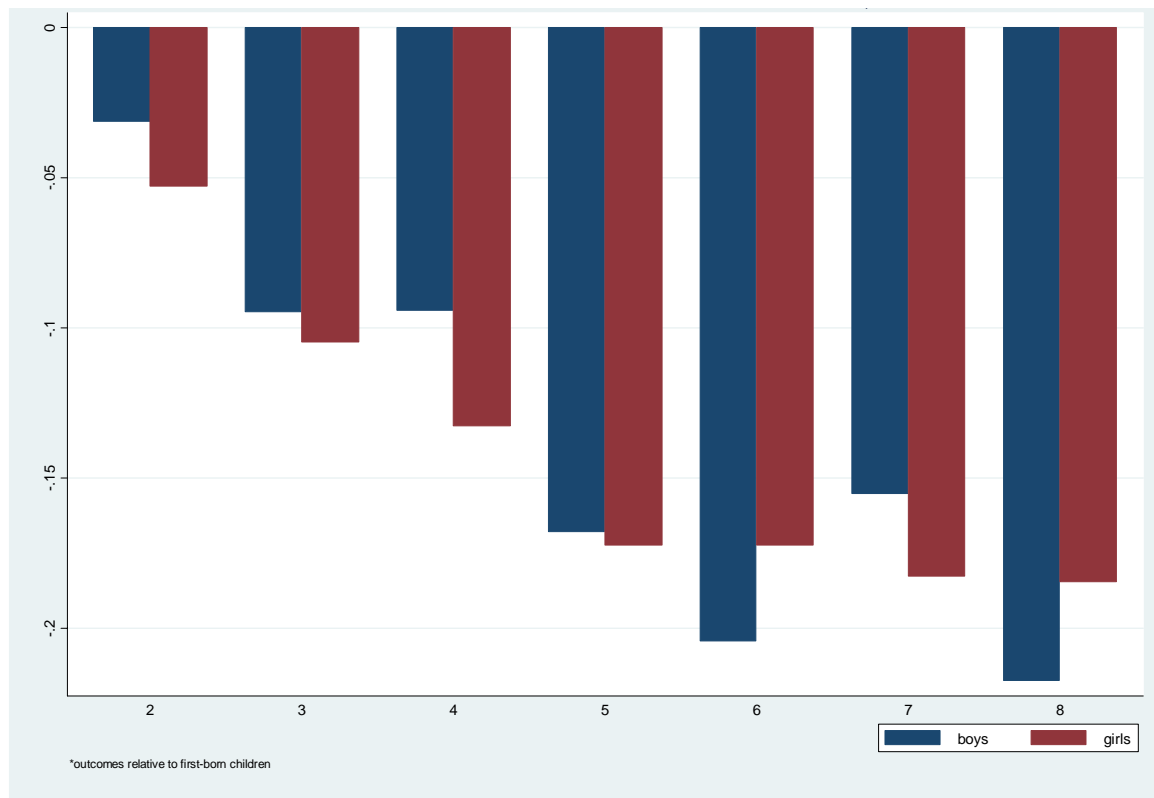
We observe expected effects from other included explanatory variables:

- ❑ Higher levels of parental education are associated with better health outcomes, and mother's education matters more.
- ❑ Household's wealth also has positive contribution, while belonging to a scheduled caste or tribe has a negative impact.
- ❑ Mother's age and exposure to the media contribute positively, however, children of working mothers may be in disadvantage.
- ❑ There is also a significant variation in health outcomes by state

# Results of simulations, 1992

1992	Full Immunization		BCG		DPT		Polio		Measles	
Birth order	boys	girls	boys	girls	boys	girls	boys	girls	boys	girls
2	-3.12%	-5.28%	-1.21%	-6.55%	-1.16%	-5.04%	-1.03%	-5.22%	-4.38%	-7.33%
3	-9.49%	-10.47%	-10.98%	-14.07%	-6.92%	-12.19%	-7.02%	-13.44%	-11.21%	-15.15%
4	-9.44%	-13.28%	-10.92%	-18.93%	-9.67%	-13.06%	-9.85%	-13.96%	-10.86%	-18.49%
5	-16.79%	-17.24%	-17.49%	-26.18%	-17.27%	-18.69%	-18.83%	-22.60%	-21.42%	-25.23%
6	-20.46%	-17.22%	-24.34%	-27.96%	-19.02%	-20.44%	-20.39%	-23.06%	-27.28%	-24.13%
7	-15.53%	-18.30%	-26.03%	-25.81%	-21.32%	-21.20%	-21.86%	-22.34%	-20.81%	-25.57%
8	-21.76%	-18.46%	-21.08%	-27.37%	-25.29%	-20.57%	-26.44%	-22.86%	-27.20%	-24.82%

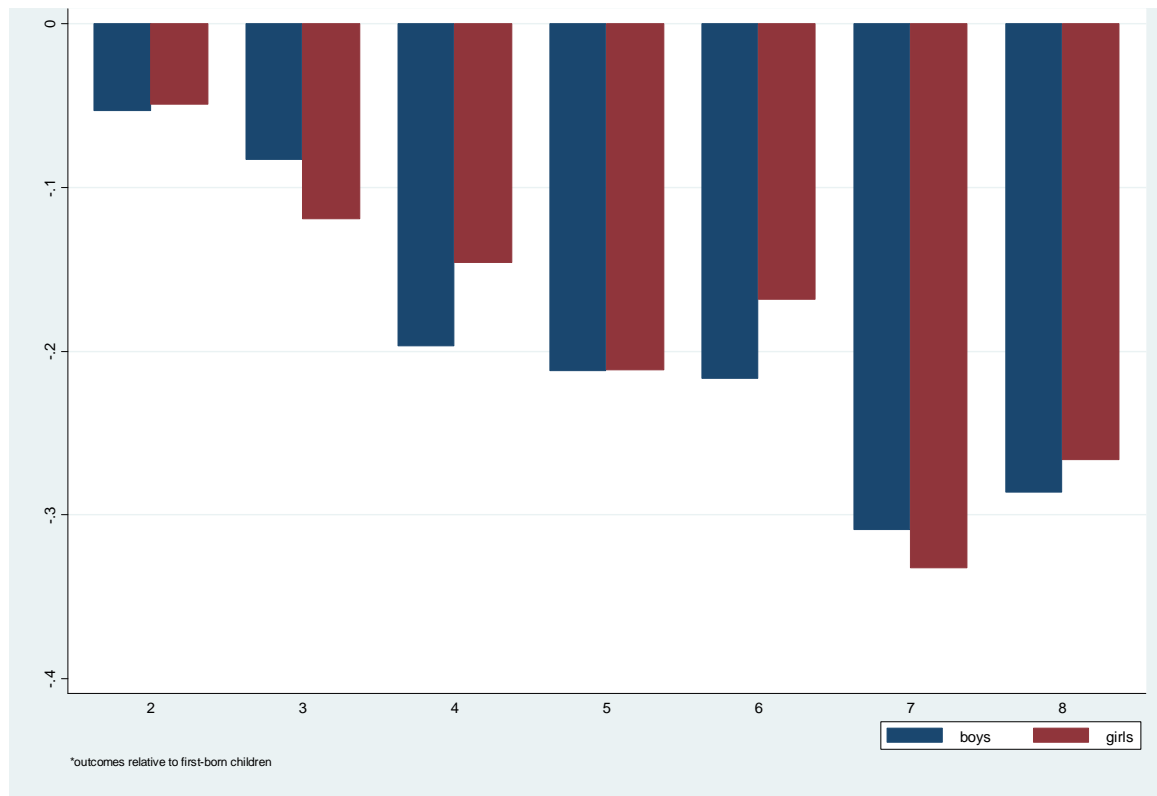
Each child is moved to all possible birth orders in his/her family. Results show the disadvantage that children experience relative to the 1st children



# Results of simulations, 2005

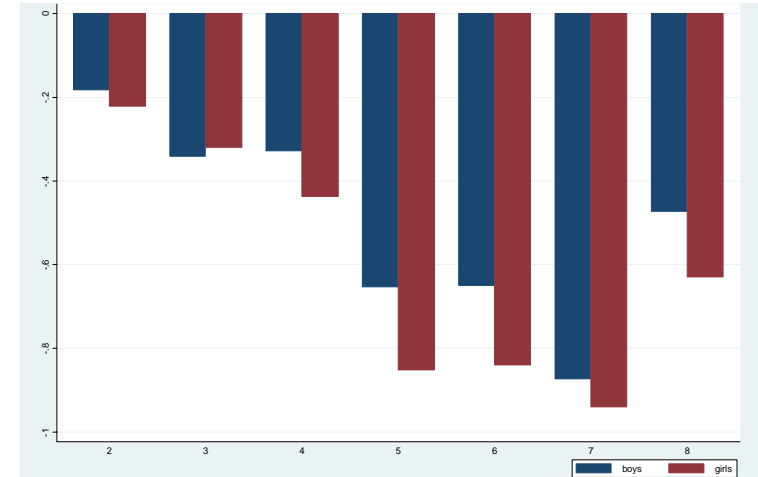
2005	Full Immunization		BCG		DPT		Polio		Measles	
Birth order	boys	girls	boys	girls	boys	girls	boys	girls	boys	girls
2	-5.36%	-4.91%	-2.67%	-5.02%	-4.49%	-6.91%	-2.38%	-4.93%	-6.18%	-5.82%
3	-8.31%	-11.89%	-6.14%	-13.96%	-12.04%	-15.00%	-4.72%	-7.05%	-8.81%	-11.62%
4	-19.72%	-14.57%	-17.19%	-23.03%	-20.08%	-18.45%	-5.59%	-10.54%	-21.11%	-14.68%
5	-21.25%	-21.14%	-22.10%	-26.49%	-22.60%	-26.07%	-13.44%	-9.76%	-23.00%	-25.42%
6	-21.65%	-16.84%	-25.42%	-36.23%	-25.05%	-26.35%	-11.76%	-13.66%	-21.03%	-18.46%
7	-30.96%	-33.25%	-36.87%	-45.46%	-38.73%	-32.67%	-16.36%	-9.01%	-35.80%	-35.79%
8	-28.67%	-26.61%	-41.21%	-39.31%	-34.20%	-36.67%	-16.09%	-25.01%	-36.39%	-31.59%

Each child is moved to all possible birth orders in his/her family. Results show the disadvantage that children experience relative to the 1st children

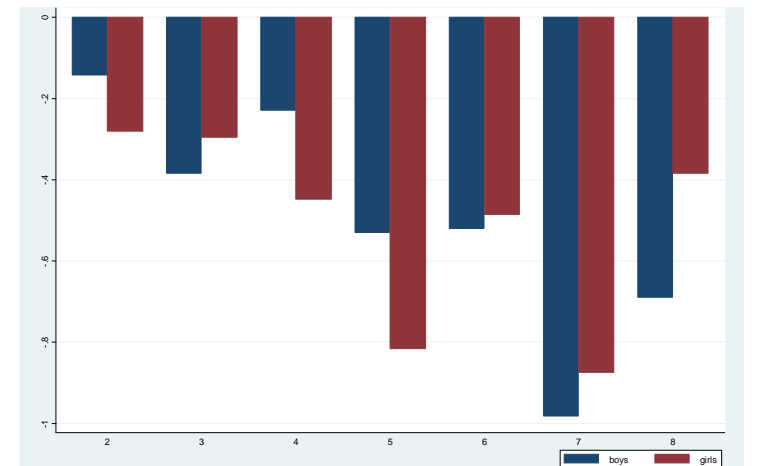


# Anthropomorphic outcomes, simulation results

Weight-for-age	1992		1998		2005	
	boys	girls	boys	girls	boys	girls
second	-0.008	-0.151	-0.040	-0.221	-0.182	-0.221
third	-0.100	-0.219	-0.121	-0.389	-0.341	-0.319
fourth	-0.267	-0.341	-0.183	-0.558	-0.329	-0.438
fifth	-0.174	-0.494	-0.390	-0.749	-0.653	-0.852
sixth	-0.431	-0.381	-0.228	-0.569	-0.650	-0.840
seventh	-0.417	-0.356	-0.465	-0.570	-0.874	-0.941
eight+	-0.579	-0.368	-0.531	-1.140	-0.474	-0.629



Height-for-age	1992		1998		2005	
	boys	girls	boys	girls	boys	girls
second	0.020	-0.012	0.088	-0.368	-0.142	-0.281
third	-0.155	-0.382	0.005	-0.484	-0.384	-0.296
fourth	-0.110	-0.222	-0.170	-0.423	-0.229	-0.448
fifth	-0.314	-0.667	-0.345	-0.713	-0.531	-0.816
sixth	-0.174	-0.671	-0.114	-0.946	-0.520	-0.485
seventh	-0.581	-0.335	-0.261	-0.518	-0.983	-0.875
eight+	-0.432	-0.334	-0.641	-0.794	-0.690	-0.384



The effect of birth order here is measured in terms of z-score (standard deviations)

Each child is moved to all possible birth orders in his/her family

Results show the disadvantage (if negative) by birth order, that children experience relative to the first children

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- Why are results different for immunization and anthropomorphic outcomes?
  - Regression analysis maintains the observed differential in the immunization rates between the earlier- and later-borns.
  - This effect on weight-for-age and height-for-age appears to be weaker.