

Why Do Mothers Breastfeed Girls Less Than Boys?

Evidence and Implications for Child Health in India

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Why is there a gender gap in breastfeeding?

- Girls are breastfed for a shorter period than boys in India. Why?
- Parents might value the benefit of breastfeeding more for sons than daughters
 - Confers health benefits, bond with child
 - Analogous to girls getting vaccinated less
- Boys might be physically easier to nurse or harder to wean
- This paper offers a different explanation

Our hypothesis

- Gender gap in breastfeeding is an unintended consequence of mother wanting a future son
- Occurs through two reinforcing channels
- Breastfeeding makes the mother temporarily infertile
- After the birth of a daughter, a mother is more likely to want to conceive again to try for a boy
- Therefore, she will wean the daughter sooner so that she can conceive again

Our hypothesis – second channel

- Breastfeeding doesn't make a mother completely infertile
- If mother becomes pregnant while still breastfeeding, she typically stops breastfeeding
- Want another child → Don't use modern contraception → Get pregnant → Wean older child
- Not driven by contraceptive property of breastfeeding
- Generates same predictions: Future fertility and breastfeeding are negatively correlated

Testable predictions

- When parents want more children, they will breastfeed the current child less
- Shorter duration of breastfeeding for
 - Daughters
 - Children with fewer older brothers
 - Low birth-order children
- Interactions of child's gender, birth order, and mother's ideal family size have specific non-linear effects on breastfeeding
- We test and find support for all of these predictions using household survey data from India

Implications of our findings

- Given health benefits of breastfeeding, our results have implications for child health
- Early weaning of daughters is part of the “missing girls” problem
 - Our estimates suggest that breastfeeding gap accounts for about 15,000 missing girls each year
- Child health will be worse if parents want further children
 - ⇒ Breastfeeding-fertility connection suggests a new “quality-quantity” tradeoff

Outline

- Background on breastfeeding, fertility, and child health
- Model
- Data and empirical strategy
- Empirical results on breastfeeding
 - Birth order
 - Gender
 - Birth order and gender interactions
- Child mortality
- Availability of contraception
- Conclusion

How breastfeeding affects fecundity

- Breastfeeding leads to amenorrhea
- Hormones that regulate menses are disrupted
- Breastfeeding often lowers mother's nutritional status, causing amenorrhea
- 34% of women in our sample cite breastfeeding as the reason for not using artificial contraception

How pregnancy affects breastfeeding

- Breastfeeding does not make a woman completely infertile
- Many mothers quit breastfeeding if they become pregnant or after next childbirth
- 32% of women in our sample cite pregnancy as the reason they stopped breastfeeding

Breastfeeding and health

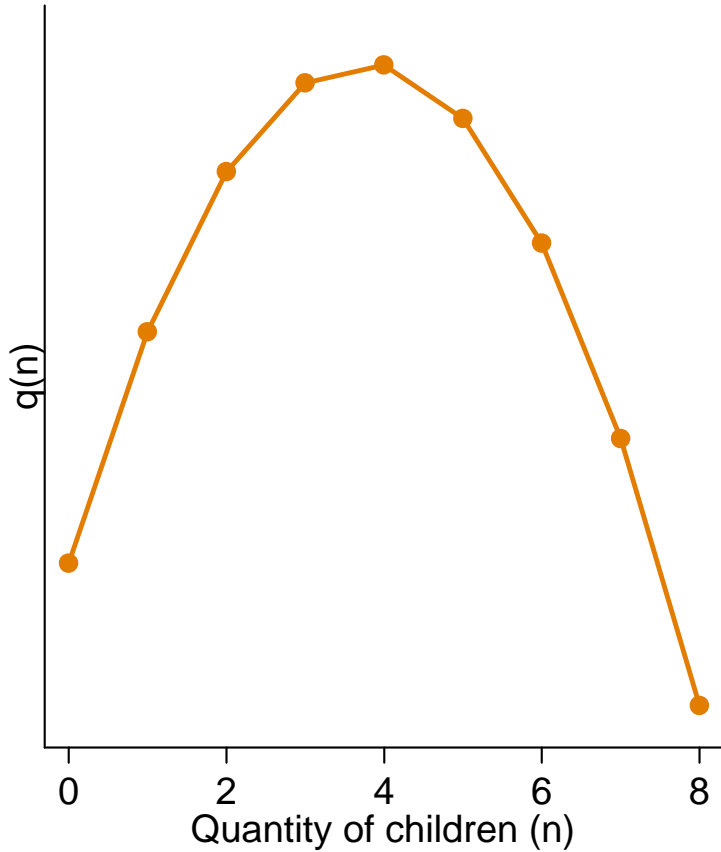
- Breastfeeding protects child from contaminated water and food
- Medical literature finds link between breastfeeding and infant/child mortality, mainly from diarrheal disease
 - True even for toddlers, past age of exclusive breastfeeding
- Hypothesized long-term effects of breastfeeding (obesity, asthma, IQ), but not focus of this paper

Model

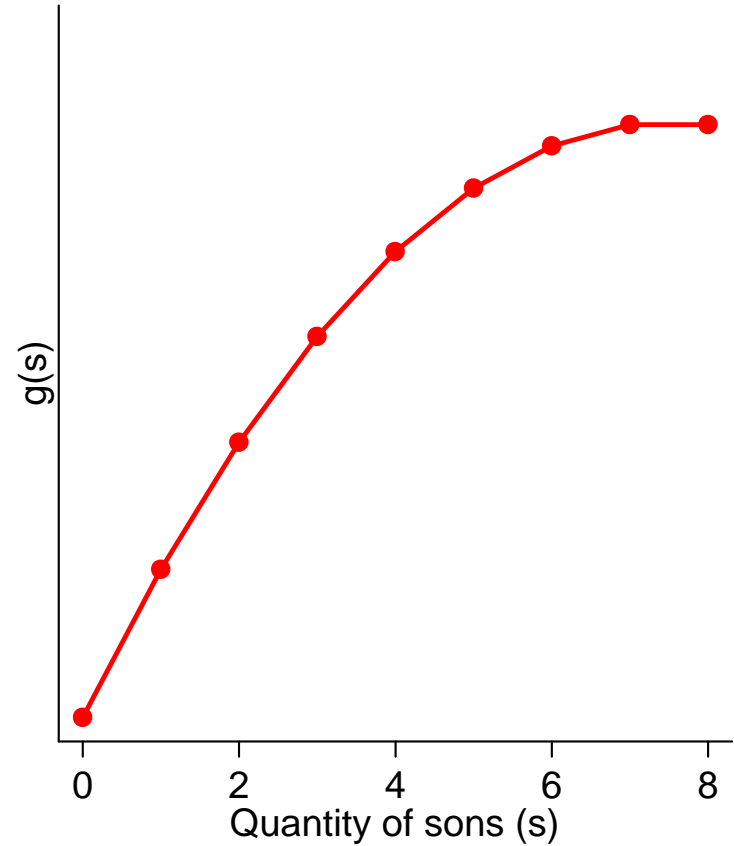
- Model mother's choice of whether to breastfeed
 - Essentially a model of the fertility decision
- Mother gives birth to one child or no children in each of infinite periods
- Mother who just had a child decides whether to breastfeed or not
- Breastfeeding inhibits fecundity: Mother has another child in the next period iff she doesn't breastfeed

Utility from quantity of children and from sons

Net benefit of having n children



Benefit of having s sons



$$u(n, s) = q(n) + \lambda g(s)$$

Utility function

- Utility depends on quantity of children and quantity of sons

$$u(n, s) = \phi f(n) - c(n) + \lambda g(s) \equiv q(n) + \lambda g(s)$$

- Demand for quantity
 - Want to have some children, $q'(\cdot) > 0$ for small n
 - Convex costs and diminishing benefits of quantity so $q' < 0$ for large n
 - Demand for quantity is increasing in parameter ϕ

Utility function

$$u(n, s) = \phi f(n) - c(n) + \lambda g(s) \equiv q(n) + \lambda g(s)$$

- Demand for sons
 - Son preference is increasing in λ
 - Utility is increasing in number of sons with diminishing returns

$$g' > 0 \text{ and } g'' < 0$$

Breastfeeding decision

- Breastfeeding inhibits fertility
- If $b_t = 1$, then $n_{t+1} = n_t$ and $s_{t+1} = s_t$
- If $b_t = 0$, then $n_{t+1} = n_t + 1$, and $s_{t+1} = s_t + 1$ or $s_{t+1} = s_t$, each with probability $1/2$
- Decision problem

$$\begin{aligned} V(n, s) &= \max\{V^{b=1}, V^{b=0}\} \\ &= \max\left\{\frac{u(n, s)}{1 - \beta}, u(n, s) + \beta \left(\frac{V(n + 1, s) + V(n + 1, s + 1)}{2}\right)\right\} \end{aligned}$$

Model's assumptions

- Breastfeeding determines fertility perfectly
- Do not model reverse channel of subsequent conception reducing breastfeeding (would reinforce our predictions)
- Breastfeeding decision is binary
 - Can be thought of as short versus long duration of breastfeeding
 - A mother who wants more children might space her births
 - But a mother who wants to stop having kids breastfeeds more
- Breastfeeding has no ancillary costs or benefits

Predictions

Proposition 1. *Breastfeeding is increasing in birth order.*

Proposition 2.

1. *A boy is more likely to be breastfed than a girl.*
2. *A child is more likely to be breastfed if a larger number of his or her older siblings are male, all else equal.*

Predictions (continued)

Proposition 3. *The largest gap in breastfeeding of boys versus girls is at intermediate birth order.*

- At low birth order, mother will have more kids regardless of sex composition
- At high birth order, she will stop regardless

Predictions related to “ideal family size”

- Net benefits of quantity $q(n)$ are positive up to some value of n and then declining
- Define \hat{n} as quantity up to which sex composition is irrelevant to breastfeeding/stopping decision, for any son preference
- Mothers who vary in ϕ will vary in \hat{n} , or “ideal family size”

Predictions related to “ideal family size”

Proposition 4.

1. *Breastfeeding increases in birth order only once the mother's ideal family size has been reached.*
2. *The gender gap in breastfeeding only arises when the ideal family size has been reached.*

Data

- Pool 3 waves of the India National Family Health Survey (NFHS)
 - Sample of ever-married women age 15 to 49
 - 1992-3, 1998-9, 2005-6
 - Based on Demographic and Health Survey
- Fertility history, breastfeeding, mortality, contraception
- Data on months of breastfeeding for children up to age 3, 4, or 5 (varying by survey wave)
 - Topcode breastfeeding at 36 months

Sample restrictions

- Breastfeeding variable is missing
 - Child has died (breastfeeding is censored)
 - Multiple births
 - Mothers with 8 or more children
- ⇒ About 110,000 observations (children)

Why no mother fixed effect models

- Many mothers have only one child in the 3, 4, or 5 year window
- Having >1 child in sample is more likely if first child was breastfed for a short duration
 - Problem is due precisely to breastfeeding lowering fecundity
 - Mechanical correlation of breastfeeding and birth order
- Composition bias is biggest concern for birth order results
- Even with mother FEs, birth order results alone would not provide strong test of model
 - Mother FEs could not address learning-by-doing story

Descriptive statistics

	Birth order ≤ 2	Birth order > 2	Sons	Daughters
Months of breastfeeding	14.24 [8.739]	15.54 [9.287]	14.99 [9.093]	14.56 [8.880]
Birth order	1.469 [0.499]	4.109 [1.220]	2.579 [1.571]	2.550 [1.563]
Ideal no. of children	2.404 [0.861]	3.164 [1.195]	2.687 [1.067]	2.739 [1.085]
Male	0.513 [0.500]	0.522 [0.500]	1 [0]	0 [0]
Age of child	1.950 [1.262]	1.920 [1.252]	1.939 [1.255]	1.936 [1.261]
Age of mother	23.72 [4.228]	28.64 [4.816]	25.81 [5.097]	25.71 [5.096]
Rural	0.637 [0.481]	0.743 [0.437]	0.677 [0.467]	0.684 [0.465]
Mother's years of schooling	5.597 [5.144]	2.429 [3.767]	4.333 [4.904]	4.227 [4.852]
Observations	64,439	45,744	56,896	53,287

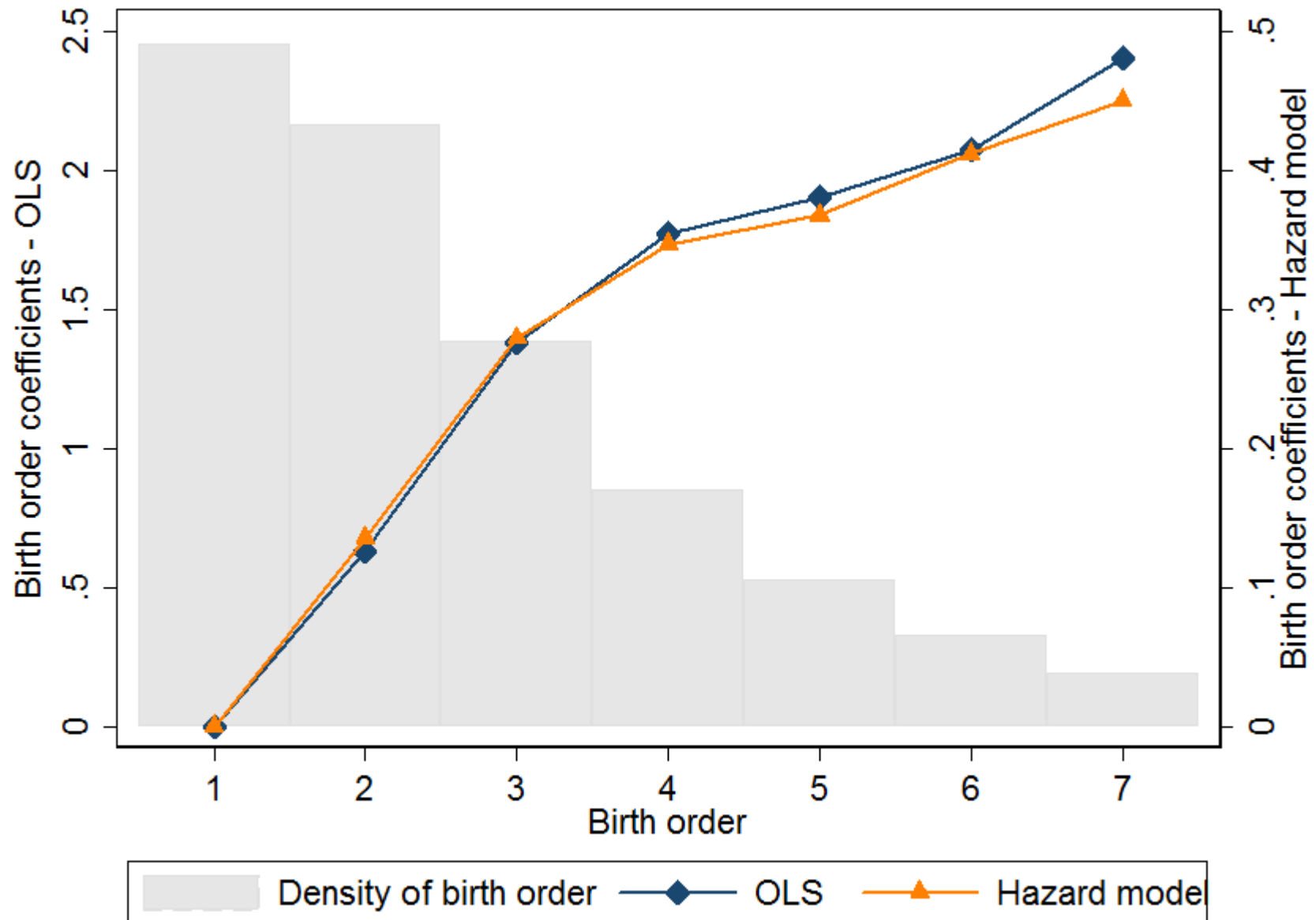
Estimating equation – effects by birth order

- Estimate breastfeeding duration for each value of birth order:

$$BF_{ij} = \sum_k \beta_k \cdot \mathbb{1}(BirthOrder_{ij} = k) + \delta X_{ij} + a_i + \epsilon_{ij}$$

- i is child and j is mother
- Expect β_k to be increasing in k
- Control for child's birth year (quadratic), mother's age (quadratic) and education, state FEs, rural dummy, survey wave FEs
- a_i are age-in-months fixed effects, up to 36 months, due to censoring of breastfeeding duration
- Also estimate hazard regression

Breastfeeding versus birth order



Breastfeeding and birth order

	OLS		Hazard
	(1)	(2)	(3)
Birth order	0.464*** [0.0124]	0.210*** [0.0179]	-0.0612*** [0.00421]
Male		0.391*** [0.0373]	-0.105*** [0.00866]
Mother's years of schooling		-0.121*** [0.00503]	0.0289*** [0.00112]
Rural		0.806*** [0.0478]	-0.181*** [0.0102]
Covariates	No	Yes	Yes
Observations	110183	110183	108616
R-squared	0.503	0.527	

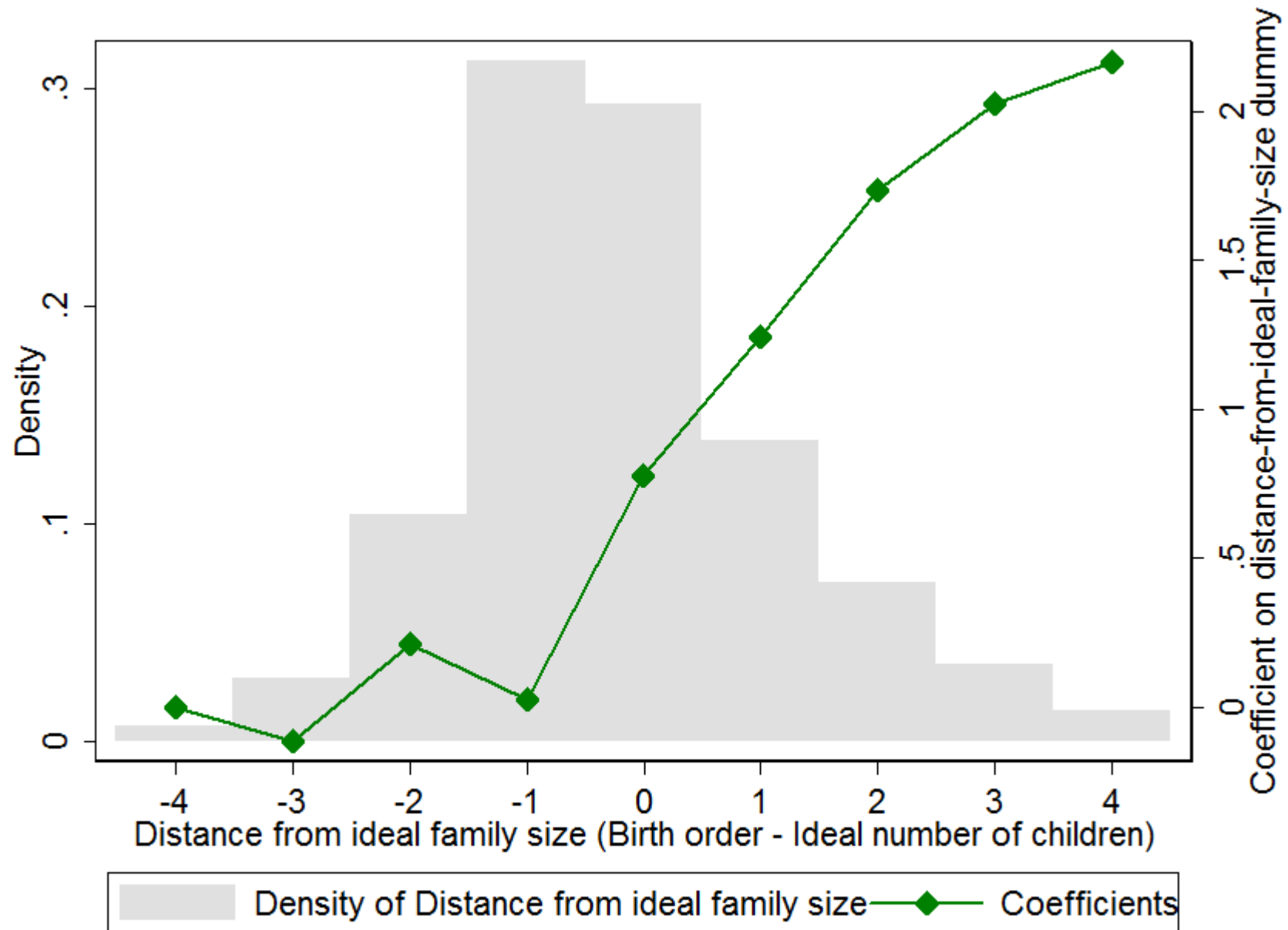
Birth order relative to ideal number of children

- Can also examine birth order relative to the mother's ideal number of children
- Define $\Delta Ideal_{ij} = BirthOrder_i - Ideal_j$ and estimate

$$BF_{ij} = \sum_k \beta_k \cdot \mathbb{1}(\Delta Ideal_{ij} = k) + \delta X_{ij} + \epsilon_{ij}$$

- Prediction is that breastfeeding should increase once you reach your ideal family size, or once $\Delta Ideal = 0$
- Caveat: Ideal family size is ill-defined concept + mothers might rationalize actual fertility

Birth order - “ideal number of children”



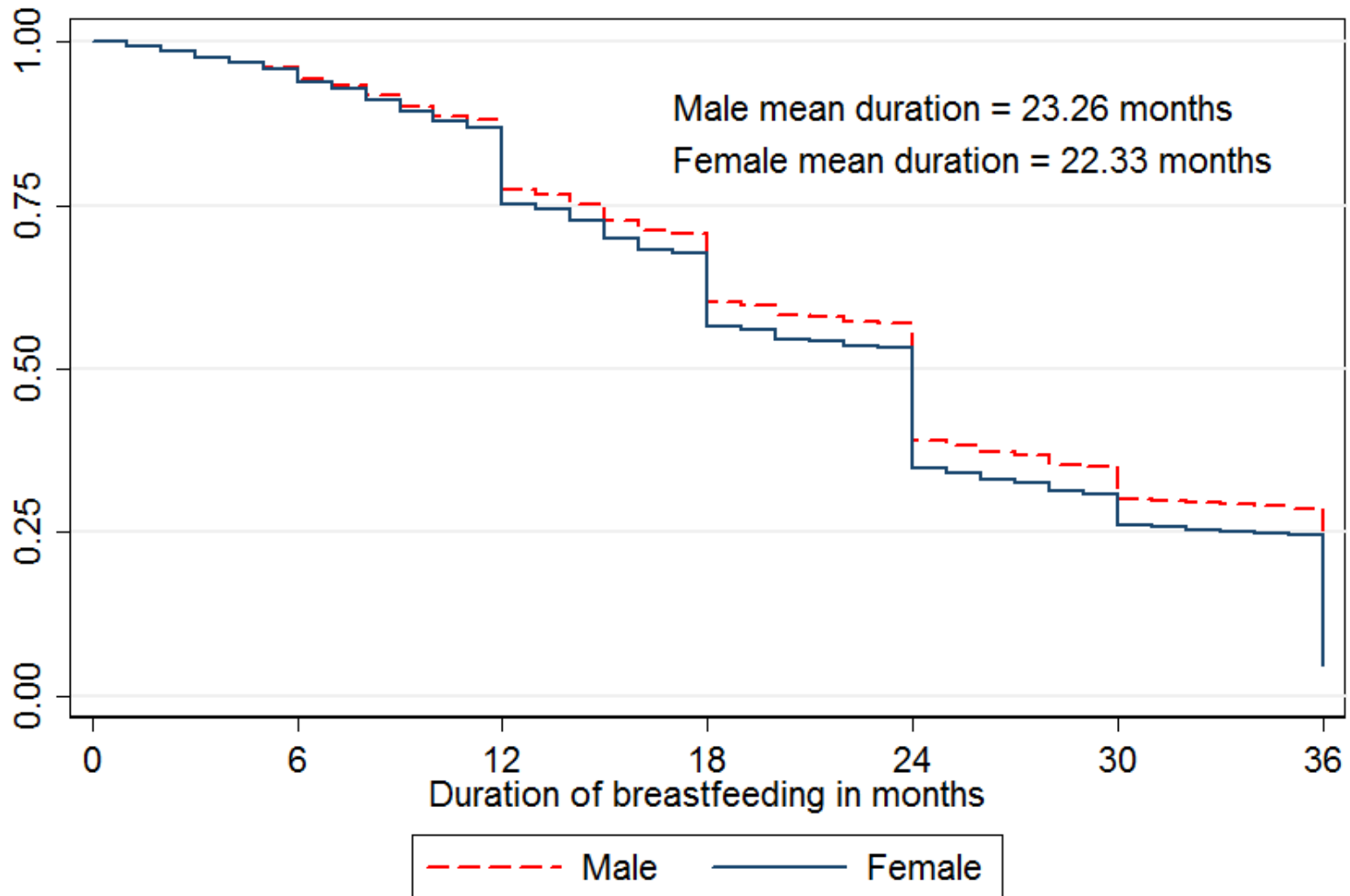
Breastfeeding and ideal family size

	(4)	(5)	(6)	(7)
$\Delta Ideal \geq 0$	1.072*** [0.0399]	0.876*** [0.0454]	0.773*** [0.0745]	0.399*** [0.0742]
$\Delta Ideal$			-0.0242 [0.0426]	0.320*** [0.0436]
$\Delta Ideal \times (\Delta Ideal \geq 0)$			0.441*** [0.0502]	-0.215*** [0.0515]
Male		-0.105*** [0.00866]		0.374*** [0.0385]
Mother's years of schooling		0.0289*** [0.00112]		-0.135*** [0.00489]
Rural		-0.181*** [0.0102]		0.839*** [0.0490]
Covariates	No	Yes	No	Yes
Observations	104456	104456	104456	104456
R-squared	0.496	0.524	0.497	0.524

Predictions related to breastfeeding and gender

- Boys breastfed more than girls
- Children with more older brothers breastfed more
- Gender gap peaks at medium birth order
- Gender gap opens up once ideal family size is reached

Breastfeeding “survival” curve



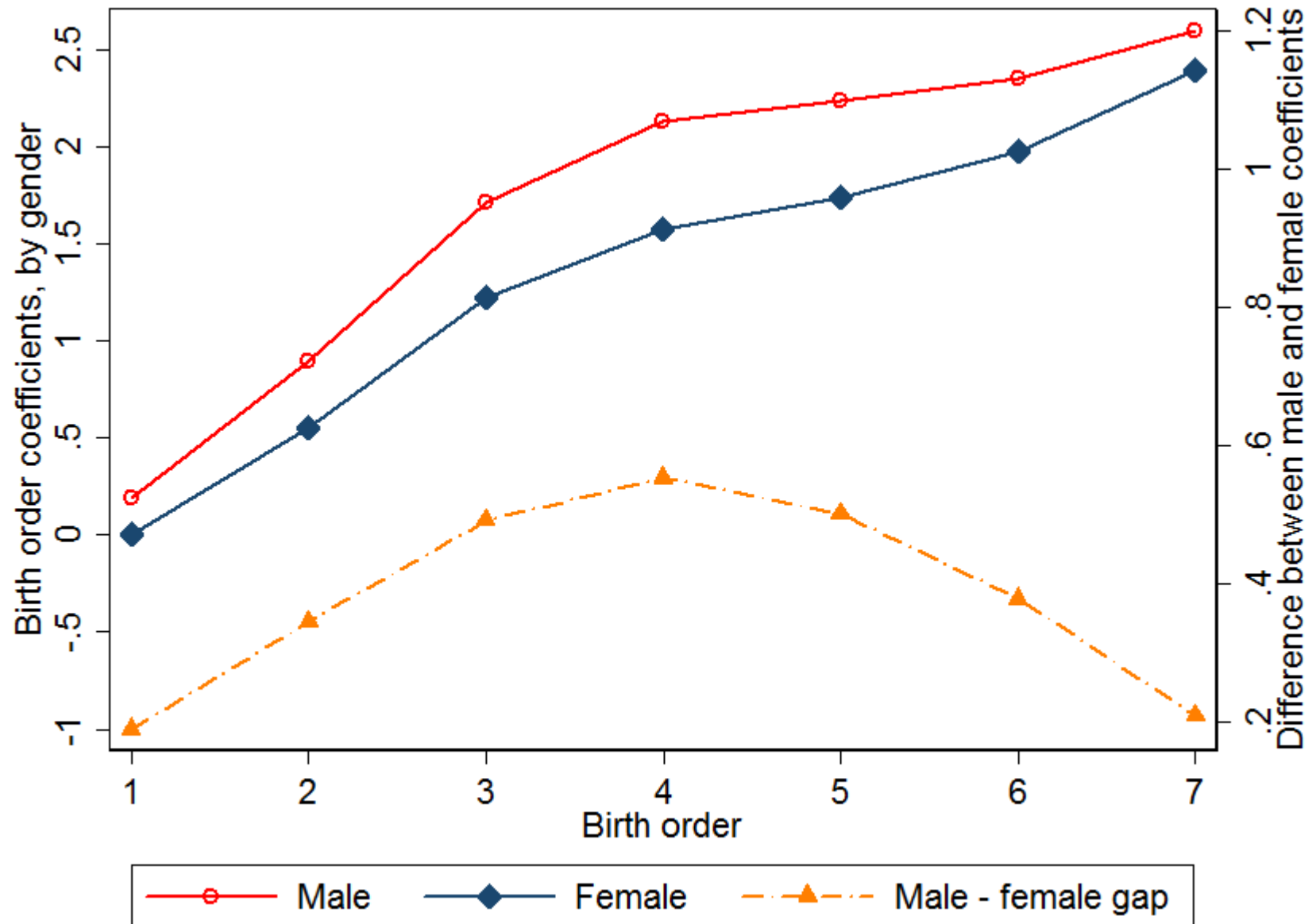
Breastfeeding and gender

	OLS		Hazard	OLS		
	(1)	(2)	(3)	(4)	(5)	(6)
Male	0.368*** [0.0384]	0.389*** [0.0373]	-0.103*** [0.00867]	0.244*** [0.0486]	0.262*** [0.0546]	0.458*** [0.0675]
Mother has at least one son				0.280*** [0.0623]		
Male share of mother's children					0.231*** [0.0751]	
Male x First survey wave						-0.144 [0.0895]
Male x Second survey wave						-0.0654 [0.0929]
Covariates	No	Yes	Yes	Yes	Yes	Yes
Observations	110183	110183	108616	110183	110183	110183
R-squared	0.497	0.527		0.527	0.527	0.527

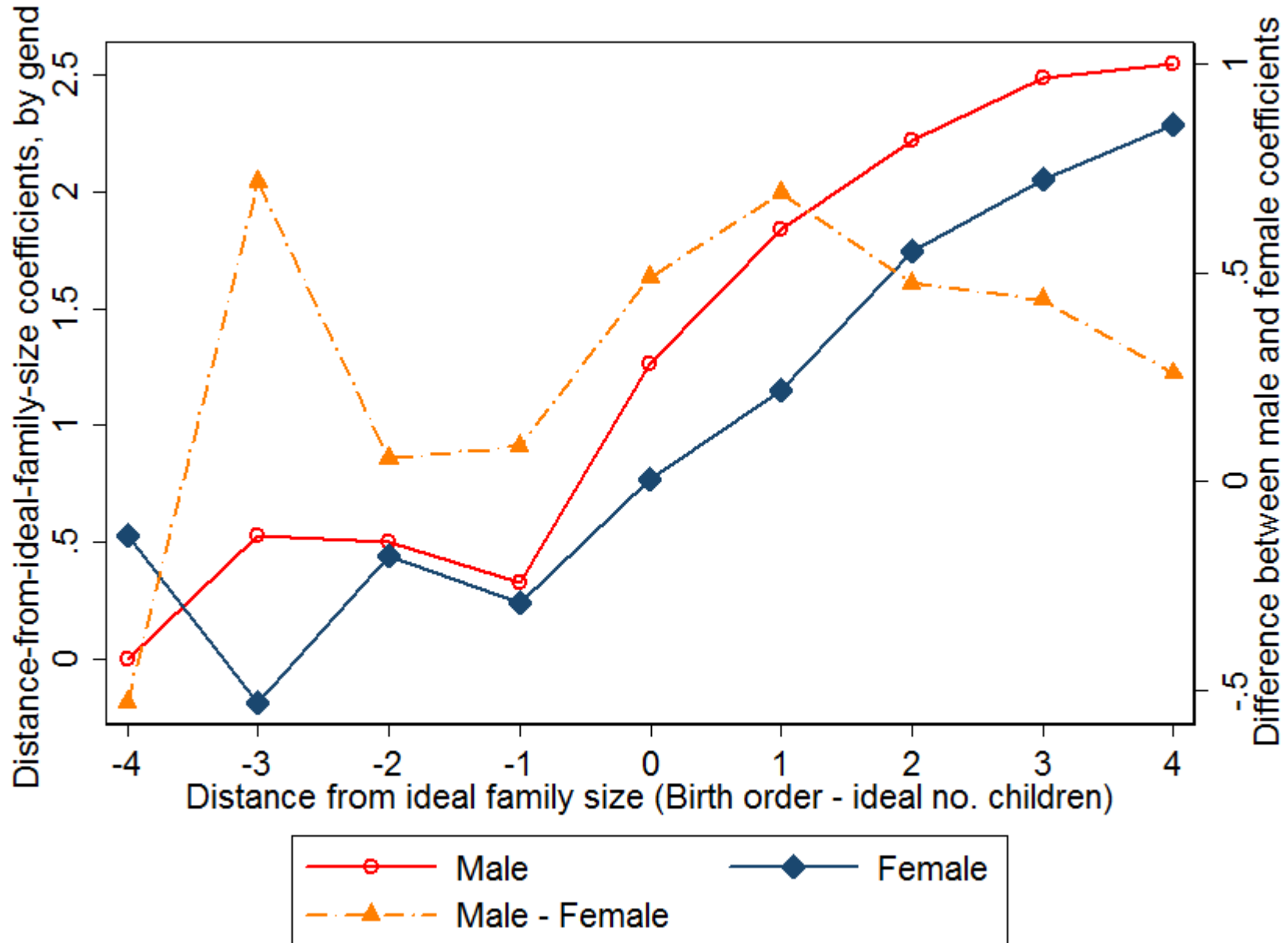
Observed versus completed breastfeeding

- Survival curves indicate that boys and girls *eventually* have a 0.9 month average gap in breastfeeding duration
 - Equivalent to about 4% of girls weaned at 12 months, whereas had they been boys, they would have been breastfed until 36 months
- OLS regressions show smaller gap because some children are 3 months old (no gap), others are 24 months old (some of gap has opened up), etc.
- OLS useful for testing comparative statics
- But when thinking about welfare implications, total gap of 0.9 months is what's relevant

Gender differences in breastfeeding by birth order



Gender differences by Δ Ideal



Gender-birth order interactions

	OLS		Hazard	OLS	
	(1)	(2)	(3)	(4)	(5)
Male	-0.0839 [0.135]	-0.0661 [0.131]	0.0203 [0.0301]	-0.00614 [0.134]	-0.0188 [0.130]
Male x Birth order	0.299*** [0.0944]	0.311*** [0.0923]	-0.0847*** [0.0216]		
Male x Birth order ²	-0.0365*** [0.0135]	-0.0381*** [0.0132]	0.00997*** [0.00316]		
Male x ($\Delta Ideal \geq 0$)				0.548*** [0.150]	0.590*** [0.146]
Male x $\Delta Ideal$				-0.0827 [0.0846]	-0.102 [0.0820]
Male x $\Delta Ideal$ x ($\Delta Ideal \geq 0$)				0.0665 [0.0991]	0.113 [0.0962]
Covariates	No	Yes	Yes	No	Yes
Max effect of male at birth order...	4.09	4.09	4.25	N/A	N/A

Summary of results so far

- A child is weaned sooner when a mother wants additional children
 - Low birth order
 - Few sons
- Sex composition matters most for breastfeeding duration at medium birth order
- Breastfeeding depends on birth order *relative to ideal family size*
 - Breastfeeding duration jumps higher when ideal family size reached
 - Gender gap in breastfeeding opens up once ideal family size is reached, and then closes again at higher parity

Preview of next few slides

- Decompose the gender gap in breastfeeding into the fertility-stopping channel versus other channels
- Test whether effects vary based on measures of son preference
- Run specification test using other health input (vaccinations) as the outcome
- Then turn to implications for child mortality

How much of gender gap in breastfeeding is due to fertility channel?

- Decompose son advantage in breastfeeding two ways
- Find that $2/3$ of gap is due to fertility stopping preferences
- Based on two calculations
 - Assume son advantage conditional on no. of children and no. of sons is due to other channels (e.g., value sons' health)
 - Assume fertility-stopping channel turns on only after the mother's ideal family size is reached

Heterogeneity in son preference

- We test whether gender gap in breastfeeding varies with heterogeneity in son preference
- Gender gap is larger in regions with stronger son preference (measured as sex ratio at birth)
- Gender gap varies with mother's self-reported ideal number of sons
 - Breastfeeding increases when the mother reaches her ideal number of sons

Heterogeneity in son preference

	Regional variation in son pref.		Individual var. in son pref.	
	(1)	(2)	(3)	(4)
Male	-1.922** [0.842]	1.750 [1.892]	0.260*** [0.0456]	0.366* [0.202]
Male x State sex ratio	2.145*** [0.781]	-1.648 [1.760]		
Male x ($\Delta Ideal \geq 0$) x Sex ratio		6.218** [2.529]		
$\Delta IdealSons \geq 0$			0.408*** [0.0890]	
$\Delta Ideal \geq 0$			0.328*** [0.0779]	
Male x ($\Delta IdealSons = 0$)				0.205** [0.0956]
Male x ($\Delta IdealSons > 0$)				-0.0603 [0.129]

Patterns *not* found for vaccinations

Dep. var.: Total number of vaccinations

	(1)	(2)	(3)	(4)	(5)
Male	0.127*** [0.0115]	0.131*** [0.0117]	0.143*** [0.0157]	0.0123 [0.0391]	0.0631 [0.0412]
Birth order	-0.146*** [0.00600]				
$\Delta Ideal \geq 0$		-0.0235 [0.0178]			
Mother has at least one son			-0.0323 [0.0202]		
Male x Birth order				0.0549* [0.0291]	
Male x Birth order ²				-0.00291 [0.00432]	
Male x ($\Delta Ideal \geq 0$)					0.0305 [0.0455]
Additional fixed effects	None	None	Birth order	Birth order	$\Delta Ideal$

Other robustness checks

- Robust to including children who have died (hazard models)
- Patterns found in each survey wave
 - Suggests not an artifact of sex-selective abortion
- Find similar patterns for whether mother has a subsequent child and for birth spacing
 - Here, we can use mother fixed effects, and results similar with mother FEs

Health effects of breastfeeding

- Breastfeeding hypothesized to lower the risk of infant and child mortality
- Mainly because of crowding out contaminated water and food
- Relevant risk is how breastfeeding affects death past infancy
 - Gender gap in breastfeeding opens up at age 1
 - Literature finds that mortality risk is 2 to 3 times as high for 12 month-old to 36-month age range if not breastfeeding
 - Caveat that these correlations might not be isolating causal effects

Breastfeeding and child mortality in India

- Breastfeeding patterns we find line up with 2 facts about excess female mortality in India
 - Excess female mortality mainly seen after age 1 rather than for infants
 - Excess female mortality is not as pronounced for first births
- Of course, breastfeeding is not only explanation for these patterns
- In India as elsewhere, child mortality increases with birth order
 - Opposite direction of our hypothesis
 - Consistent with parents allocating more resources to lower birth-order children

Empirical strategy

- Examine mortality between age 12 and 36 months as outcome
- Estimate same specifications as used for breastfeeding; expect opposite-signed coefficients
- Use mortality between age 1 and 6 months as placebo test
- Compare HHs with and without piped water
 - Helps separate hypothesis from other explanations such girls being born into larger families

Results on mortality, age 1 to 3 years

	Household lacks piped water			Household has piped water		
	(1)	(2)	(3)	(4)	(5)	(6)
Male	-0.00851*** [0.000866]	0.00369 [0.00291]	-0.00522* [0.00285]	-0.00388*** [0.00103]	0.000131 [0.00376]	-0.00828* [0.00437]
Male x Birth order		-0.00619*** [0.00220]			-0.00272 [0.00316]	
Male x Birth order ²		0.000476 [0.000331]			0.000313 [0.000529]	
Male x ($\Delta Ideal \geq 0$)			-0.00485 [0.00324]			0.00581 [0.00462]
Observations	125857	125857	116957	35164	35164	33850
Unpiped - Piped coeff(s) of interest	-0.00465	-0.00350 0.000168	-0.0106			
p-value	0.000560	0.0497	0.0600			

Placebo test – 1-to-6-month mortality

	Household lacks piped water			Household has piped water		
	(1)	(2)	(3)	(4)	(5)	(6)
Male	-0.00115 [0.000742]	0.00642** [0.00263]	-0.00392 [0.00253]	0.00142 [0.00101]	0.00229 [0.00366]	-0.00786* [0.00415]
Male x Birth order		-0.00415** [0.00185]			-0.000335 [0.00296]	
Male x Birth order ²		0.000367 [0.000268]			-0.0000180 [0.000481]	
Male x ($\Delta Ideal \geq 0$)			0.000997 [0.00286]			0.00835* [0.00441]
Observations	122942	122942	114997	34142	34142	33011
<i>Unpipied-Piped</i> coeff(s) of interest	-0.00257	-0.00381 0.000386	-0.00735			
p-value	0.0403	0.259	0.162			

“Missing girls”

- Use mortality estimates from the literature
 - Mortality is 150% higher when not breastfeeding
 - Combine with our coefficient for gender gap in breastfeeding
 - 8,400 missing girls each year
- Use our mortality estimate
 - Triple diff estimate of *Male * Unpipied* for 12-to-36 month mortality minus 1-to-6 month placebo ages as effect of breastfeeding on mortality
 - 21,500 missing girls each year
- Midpoint of 15,000 missing girls a year \Rightarrow 15% of the gender gap in mortality for this age 1 to 3 range
- 9% of gender gap in child mortality (ages 1 to 5)

Access to modern contraception

- Access to modern contraception has theoretically ambiguous effect on breastfeeding
- Could cause mothers to substitute away from breastfeeding to more effective forms of birth control
- Could increase breastfeeding because fewer unwanted pregnancies that cause the mother to wean the first child
- Our suggestive evidence
 - Condoms, IUDs and other reversible methods act as substitute for breastfeeding
 - Sterilization seems to increase breastfeeding

Potential policy implications

- More evidence needed, but reversible birth control seems to crowd out breastfeeding
- May need to pair contraception campaigns with campaigns to promote breastfeeding
- Clean water and modern contraception could be complementary policies

Conclusion

- How long a mother breastfeeds depends on her future fertility
- Several specific predictions are born out in data for India
- New type of quantity-quality trade-off
 - As total fertility falls, average breastfeeding should increase
- Breastfeeding protects against mortality, so could partly explain “missing girls”
 - Underlying cause is son preference
 - But due to demand for sons rather than choice to allocate fewer resources to daughters