How Missing Men Lead to Missing Women: 
Revising Natural Sex Ratios at Birth for the Fragile Male 

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ABSTRACT
Estimates of missing women rely critically on estimates of the natural sex-ratio at birth (SRB). Current estimates ignore in utero male fragility, where male conceptions are disproportionately terminated in the presence of maternal stress. Using natality data from the United States, we document large correlations between a wide range of predictors of spontaneous terminations and SRBs, such as education, poverty, age, parity, birth interval, and even month, day, and time of birth. We show that controlling for maternal stress overturns many commonly held beliefs about natural SRBs. By correcting existing age, parity, and interval estimates by employing woman fixed effects, we show that there should be more “missing men” at birth than currently observed in many developing nations, implying that globally the number of missing women is underestimated by about 30%, and that 20% of the increased SRBs over the past 50 years are due naturally to the demographic transition.

BACKGROUND
• Missing Women at Birth
  • The difference between the number of girls born, and the number that should be born given the natural sex ratio at birth.
  • A common measure of gender discrimination against women and girls
• Male In Utero Fragility
  • Male conceptions are more likely to be spontaneously terminated before birth in the presence of maternal stress.
• Combining the Two?
  • If male in utero fragility exists, then this implies countries with different maternal stress profiles (from socioeconomic status, maternal age at birth, birth interval, etc.) should have different natural sex ratios at birth.

BASELINE AGE AND EDUCATION ESTIMATES
• Birth femininity decreases with maternal age and education

DATA
• Demographic and Health Surveys (DHS)
  • Birth histories for 2.3 million women and 8.7 million children
  • Over 200 surveys from 77 low- and middle-income countries
• 1990 US Census
  • Approximately 2.4 million children across 900,000 women
  • Most recent Census asking how many children ever born

METHODOLOGY
• Linear regression model which non-parametrically estimates the effect of each single year of age (A), birth interval (I), and each parity (O) on the probability of a male birth given a birth occurs.
• Innovation: Include a woman fixed effect to control for the fact that healthier women will have both more males and more births.

$P_{ma}(F|S,B = 1) = \alpha_0 + \sum_{A \in B} \alpha_A + \sum_{I \in B} \alpha_I + \sum_{O \in B} \alpha_O + E(p_{ma}(A,O,I,B = 1))$

BASELINE COUNTRY PARITY ESTIMATES
• For both the US and sub-Saharan Africa we find substantial birth feminization by parity.
• This result only appears with the inclusion of a women fixed effect.
• This finding is consistent with the fragile male phenomenon.

US Parity Results

Sub-Saharan Africa Parity Results

BASELINE AGE AND EDUCATION ESTIMATES

Sub-Saharan Africa Age Results

Sub-Saharan Africa Education Results

COUNTERFACTUAL RESULTS
• Using the results from the US and sub-Saharan Africa, we calculate a counterfactual “natural” sex ratio at birth for India, given India’s age, parity, and interval profile.
• We find that the baseline “natural” sex ratio at birth for India is too high, implying that there is more sex-selective behavior in India than previously believed.
• Our estimates imply that missing women at birth in India are underestimated by 30-50%.
• However, 20% of the increase in Indian sex ratios likely happened naturally, due to falling parity, longer birth intervals, and increasing maternal age at birth.

India Counterfactual Sex Ratio Paths

05/11/2019