

# **Birth Spacing in the Presence of Son Preference and Sex-Selective Abortions: India's Experience over Four Decades**

## **Response to Editors' Comments**

I have attached the revised version of my paper, "Birth Spacing and Fertility in the Presence of Son Preference and Sex-Selective Abortions: India's Experience Over Four Decades." Thank you for the comments and suggestions. Below I outline my response to each issue raised.

## **Comments and My Responses**

The author has undertaken much reorganization and has made very useful clarifications to benefit the reader in the text and tables. Nevertheless, we still find three issues with the writing style:

- (1) Explanations of key concepts or theories need to be spelled out more clearly, particularly for the non-economist. Much has been done in this regard, but further work is still needed.

RESPONSE: With the reorganization of the Conceptual Framework section described below, I now have an early paragraph that explains income and substitution effects in detail and how they tie into fertility decisions with increasing wages for both males and females. I then rely on this detailed explanation for my later discussions of female education and labor force participation. Furthermore, I provide a more in-depth explanation of fertility and investment decisions in children based on the expected return to investment in children's education. Finally, I have reorganized my discussion of how demand for better-educated mothers can increase even if female labor force participation is declining to make it easier to follow for non-economists.

- (2) The arguments do not flow from section to section and paragraph to paragraph. Each section and argument need to be introduced so the reader understands why

this information is being presented in this place. Many times, the author jumps into new arguments without an introduction or transition or explanation.

RESPONSE: As detailed below, I have completely reorganized the Conceptual Framework section to create a better flow and make it easier for the reader to follow. Furthermore, I have added introductory paragraphs to the sections that did not already have these or an equivalent transition ("Conceptual Framework," "Estimation Strategy," "Data," and "How Birth Spacing Changed"). Finally, I have rewritten paragraphs in multiple places in the paper to make it easier to follow the thread of the arguments.

- (3) There is no clear outline of the arguments presented in the Background section. Each argument is presented separately rather than tying into the overall framework and subsequent analyses.

RESPONSE: I have completely reorganized the Conceptual Framework section to address this and Issues (1) and (2) and the examples below. The framework section now begins with an overview of the section, followed by three potential explanations that link fertility and birth spacing decisions: economic conditions, investment in children, and son preference. I then introduce the sex composition of previous children, female education, and area of residence as the primary explanatory variables, which proxy for the explanations and are available in the data. Finally, I tie each of the three primary explanatory variables to the explanations and discuss their predicted effects.

The following are some examples of (1) and (2); however, the author should check the entire paper for similar issues and address (3) as well.

1. In general, each argument in the background section is not clear and fully described for the reader.

- (a) P. 4 first sentence: The author states that female education is a crucial explanatory variable and it matters for fertility, sex ratios, mortality, etc. in a list. It would be useful for the reader to briefly spell out how female education fits into the entire framework looking across all these outcomes. In addition, the second paragraph on measurement of education seems like it belongs in the data section, unless there is some conceptual reason why this information is included here.

RESPONSE: I now introduce female education as a primary explanatory variable after the potential explanations linking fertility and birth spacing. This change allows me to show how female education fits into the explanations and the potential effects of education on birth spacing. I have moved the definitions of education groups to the Data section.

- (b) The 2 paragraphs on female labor force participation on pp. 5-6: The two findings that support the argument that changes in birth spacing are not due to economic reasons are merely listed, leaving the reader to make the connection as to why these facts support the argument herself. The income effect dominating the substitution effect and greater negative elasticity of women's wages need to be explained to readers unfamiliar with these concepts or how they fit together.

RESPONSE: As detailed above, I have reorganized the whole section and now introduce income and substitution effects early and apply these to fertility decisions. This change should make it easier to understand the new explanation for why we are unlikely to see a shortening of birth intervals in India, even with increasing female wages. I have removed the discussion of elasticity (but kept the reference) since this is simply another way of saying that the income effect dominates the substitution effect.

- (c) P. 6 regarding sex selection: "The introduction of sex selection allows parents to

avoid giving birth to girls but increases the expected interval to the next birth.” The reader needs an explanation here of why sex selection increases birth interval length. The author mentions waiting time to conception and other components in the introduction (and footnote). A clear explanation of this argument needs to be reiterated (or moved) here.

RESPONSE: I have moved the original footnote into the text in the Conceptual Framework and expanded the discussion to make it easier to understand. The Introduction section now only says that it takes 6 months or more after an abortion to reach the same point in the next pregnancy and refers to the Conceptual Framework section’s detailed discussion.

- (d) P. 6: “As women’s education increases, their productivity in the production of offspring human capital also increases. With relatively more boys born because of increased access to sexselective abortions and the increasing income potential for (male) offspring, demand for bettereducated women can increase, even if they do not participate in the labor market.” I am unclear as to why this argument is included. It needs explanation. Is this related to length of birth intervals here? Or is this mentioned because women’s education and increasing demand for better-education women will actually lower the sex ratio?

RESPONSE: That was, indeed, a terrible explanation. The argument is precisely the opposite of lowering the sex ratio: the increased demand for better-educated women is associated with a more male-biased sex ratio. With declining female labor force participation, it is clear that educated women are not desired because they bring income to the household. However, suppose better-educated women produce better-educated sons. In that case, this may increase the demand for better-educated women given the strong son preference and the rapidly rising return to male education. The result is that higher female education may be associated with lower fertility, longer spacing, and increased

use of sex selection even if the standard economic explanation based on wages does not hold. The implication is that the usual policy recommendation of increased female education may not change sex selection unless there is a concurrent increase in the relative return to female education in the labor market. I have entirely rewritten the explanation and refer to it when discussing better job opportunities in the Conclusion.

- (e) Pp. 6-7: I do not understand the importance of this argument and how it fits into the authors' story: "If more and "better" parental attention per child results in higher child "quality," we should expect longer birth intervals. However, the evidence on spacing's effect on child quality measures such as IQ and education is mixed for developed countries and nonexistent for developing countries. The exception is health and mortality, where longer spacing does lead to better outcomes, although this relationship weakens with maternal education."

RESPONSE: The idea was to show that longer spacing could be considered an investment in children that may coincide with lower fertility. I have rewritten the paragraph to make this clearer.

- (f) P. 7: The final summary paragraph lists predictions based on the earlier arguments. Yet it is hard to connect these predictions to the paragraphs above. Perhaps predictions could be noted with the earlier arguments.

RESPONSE: With the Conceptual Framework section's new structure, the summary of predictions now directly follows the predictions for the three primary explanatory variables. Hence, it should connect better to the individual predictions.

## 2. Estimation strategy section.

In the first paragraph, it would be useful to clearly outline the analyses that will be undertaken (such as first, I document changes in birth intervals over time and

how influenced by sex selection, second how birth intervals affected fertility, and third how birth intervals affected mortality). As it stands, this section jumps into a discussion of the hazard model and the reader does not know in which analyses it will be used.

RESPONSE: I have added an outline of the three parts of the empirical analysis at the beginning of the section and highlighted that the Estimation Strategy section focuses on the empirical model for birth spacing.

Some additional issue as examples where more clarification is needed:

3. Abstract. Please reorganize to start with a statement of the problem and main aims of the study. As it stands, the abstract is a list of findings, with no context as to the issues/questions the author investigates. Please be cognizant of using terms such as “women most likely to use sexselective abortion.” The reader does not understand how this is measured yet, and may get the false impression that sex-selection abortion is measured directly.

RESPONSE: I now begin the abstract with the changing sex ratio after the introduction of prenatal sex-determination technologies. I then state the main issue: abortions increase birth spacing, but we know little about how birth spacing has changed or the effects of these changes. After this, I highlight the main birth spacing results. Next, I discuss how the rapid lengthening of birth spacing led the period fertility measure to overestimate the decline in cohort fertility substantially. Finally, I cover whether repeated abortions can counteract the other positive effects of longer birth spacing on infant mortality.

Throughout the abstract, I avoid ascribing use of sex-selection to anybody. Instead, I refer to the introduction of prenatal sex-determination technologies and the presumed use of sex-selective abortions.

4. P. 1: The second motivation is unclear. “the combined changes in birth spacing may outpace what we have observed in other countries.” Outpaced means what? decreasing faster, or increasing faster, or sex selection plays more of a role?

RESPONSE: The goal of the sentence was to capture the combined effect from more sex selection and the other changes. I have rewritten the paragraph to emphasize that we do not know how much impact the combined changes will have on birth spacing and remove the imprecise “outpace.” The new sentence is: “The combination of the apparent increasing use of sex selection and the other societal changes can significantly impact birth spacing, but we know little about how much.”

5. Throughout the paper, the author compares the total fertility rate to cohort fertility rate. For the former, is the period fertility rate a more accurate definition?

RESPONSE: I would argue that the total fertility rate is our most commonly used period fertility measures, especially in “public-facing” discussions of fertility behavior changes (see the discussion in Hotz, Klerman, and Willis, 1997; Bongaarts, 1999; Ní Bhrolcháin, 2011). I have clarified whether I am referring to period fertility or cohort fertility throughout the paper.

6. P. 2: the main point of this sentence is unclear: “Counteracting effect is possible if longer birth intervals arise from multiple abortions because the short duration between pregnancies could increase mortality.”

RESPONSE: The idea is that even though the spacing between births becomes longer with sex-selective abortions, the spacing between *pregnancies* may still be very short, as suggested by a prior reviewer. If short pregnancy spacing negatively affects child outcomes, the short pregnancy spacing may dampen or eliminate any positive effects from longer spacing. I have expanded the discussion of this possible counteracting impact in the Introduction.

The new paragraph is:

Second, what is the relationship between infant mortality and the changes in birth spacing and sex selection? In India, birth intervals have traditionally been shorter with fewer sons, contributing to girls' higher mortality risk (Whitworth and Stephenson, 2002; Bhalotra and van Soest, 2008; Maitra and Pal, 2008; Jayachandran and Kuziemko, 2011; Jayachandran and Pande, 2017). Therefore, longer birth spacing may reduce mortality through, for example, diminished sibling competition (Conde-Agudelo, Rosas-Bermudez, Castaño, and Norton, 2012; Molitoris, Barclay, and Kolk, 2019). However, if the spacing between births lengthens because of sex-selective abortions, the spacing between pregnancies may still be very short. Short pregnancy spacing may lead to worse child outcomes because of maternal nutritional depletion and insufficient time to recover from the previous pregnancy. Hence, children born after long birth intervals where multiple abortions have punctuated those intervals may not see the same benefits as children born after a long interval that is not punctuated by abortions.

7. Sometimes the use of the term “birth interval” actually refers to “birth interval length.” Please check the uses of these terms and correct accordingly.

RESPONSE: Thank you for pointing this out. I have corrected this issue in 28 different places in the paper.

8. P. 2: “The key variables are maternal education, the sex of previous children, and the area of residence.” Does the author mean key independent or predictor variables?

RESPONSE: Yes, those are the key explanatory variables. I have added that to the Introduction. If you think that “independent” or “predictor” variables would be better, I would be happy to change that throughout.

9. The author should clearly note that sex selection is not observed and tone down



some conclusions, such as “Sex selection, however, is behind the most substantial increases in birth spacing. The best-educated women with two girls had the most biased sex ratio and the most significant increase in birth intervals.” The author could say that sex selection appears to be behind these findings; or evidence suggests that sex selection is behind these findings, etc. In addition, clarify that those most likely to practice sex selection (women with highest education and two girls) is based on your analysis, not settled in the literature.

RESPONSE: To address this, I have made the following changes:

- Rewritten the Abstract as detailed above
- In the Introduction’s summary of results, I lead with the changes in birth spacing and sex ratios and then say that these are likely arising from sex-selective abortions.
- Specify that the grouping into more and less sex selection when analyzing birth spacing is based on sex ratios and clarify that the use of sex selection is inferred rather than established when analyzing birth spacing.
- In the Conclusion section, I now focus on the lengthening of birth intervals and how these likely arose from sex selection as indicated by the increasingly male-biased sex ratio.

10. While it might be messy to show the confidence intervals in all the figures, is it possible to note some significant differences in the text?

RESPONSE: I tried again to incorporate confidence intervals in the figures, but the only way I could find tripled the number of figures. Instead, I have expanded the discussion of results to include where there are statistically significant differences:

- I now highlighted that tests for statistically significant differences across sex compositions are available in the online appendix.

- In the section on how birth spacing changed, I have added discussions of statistical significance when discussing comparisons across sex compositions.
- In the Conclusion, I have also added that when there are no sons, we now see statistically significant longer—rather than statistically significant shorter—birth intervals than if there is at least one son, rather than merely discussing the reversal.

## References

- BHALOTRA, S., AND A. VAN SOEST (2008): "Birth-spacing, fertility and neonatal mortality in India: Dynamics, frailty, and fecundity," *Journal of Econometrics*, 143(2), 274 – 290.
- BONGAARTS, J. (1999): "The fertility impact of changes in the timing of childbearing in the developing world," *Population Studies*, 53(3), 277–289, PMID: 11624022.
- CONDE-AGUDELO, A., A. ROSAS-BERMUDEZ, F. CASTAÑO, AND M. H. NORTON (2012): "Effects of Birth Spacing on Maternal, Perinatal, Infant, and Child Health: A Systematic Review of Causal Mechanisms," *Studies in Family Planning*, 43(2), 93–114.
- HOTZ, V. J., J. A. KLERMAN, AND R. J. WILLIS (1997): "The Economics of Fertility in Developed Countries," in *Handbook of Population and Family Economics*, ed. by M. R. Rosenzweig, and O. Stark, pp. 275–347. Elsevier B.V.
- JAYACHANDRAN, S., AND I. KUZIEMKO (2011): "Why Do Mothers Breastfeed Girls Less than Boys? Evidence and Implications for Child Health in India," *The Quarterly Journal of Economics*, 126(3), 1485–1538.
- JAYACHANDRAN, S., AND R. PANDE (2017): "Why Are Indian Children So Short? The Role of Birth Order and Son Preference," *American Economic Review*, 107(9), 2600–2629.
- MAITRA, P., AND S. PAL (2008): "Birth spacing, fertility selection and child survival: Analysis using a correlated hazard model," *Journal of Health Economics*, 27(3), 690 – 705.
- MOLITORIS, J., K. BARCLAY, AND M. KOLK (2019): "When and Where Birth Spacing Matters for Child Survival: An International Comparison Using the DHS," *Demography*, 56(4), 1349–1370.
- NÍ BHROLCHÁIN, M. (2011): "Tempo and the TFR," *Demography*, 48(3), 841–861.
- WHITWORTH, A., AND R. STEPHENSON (2002): "Birth spacing, sibling rivalry and child mortality in India," *Social Science & Medicine*, 55(12), 2107 – 2119.