You Want What You Get: The Effect of Realized Fertility on Fertility Preference*

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Abstract

Fertility preferences are critical in understanding fertility trends and in making reproductive policies. However, if fertility itself influences survey reports of preferences, then its usage in policy making gets complicated. This paper investigates whether there exists a causal effect of realized fertility on desired fertility. I exploit two separate sources of exogenous variation in realized fertility, robustly implementing two distinct identification strategies. The first uses the occurrence of twins while the second uses the birth of a female child at first birth to estimate the impact of realized fertility on desired fertility. Using data from 230 rounds of Demographic and Health Surveys from 74 developing countries, I find that having an additional birth causally increases desired fertility by 0.15-0.30. My main result is to identify this causal effect, but my data also allow me to investigate probable mechanism. I show that facts of timing rule out learning that could be consistent with a classical model of causally-prior preferences. Instead, supplementary evidence suggests a behavioral mechanism whereby outcomes influence stated preferences, which could be through reference-dependent preferences, ex-post rationalization, or another behavioral mechanism. The result has important policy and research implications specifically when using fertility preferences to estimate excess fertility, the need for family planning programs, son preference, or as proxies for intrahousehold bargaining.

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1 Introduction

Fertility rates have been falling fast and global fertility rates have gone down below replacement levels (Kearney and Levine, 2022). Macroeconomists argue that this declining fertility leading up to a shrinking population could result in the end of economic growth. (Jones, 2022). alarming headlines about the crashing population are commonplace. And yet, there are those who believe that the Earth is overpopulated. A prevailing high population is causing developing countries to stay poor, they say. Some even believe that overpopulation is causing global warming to persist. So how do population scientists and economists respond? They ask a third question – How many children do people want?

Fertility preferences are an important metric to understand changes in fertility, whether high or low. Fertility has a high momentum, i.e. it cannot change overnight, therefore if someone is concerned about fertility trends, fertility preferences offer a quick way to understand what is coming and what are the factors that are driving these changes. Fertility preferences aren't new to economists. Since Becker (1960) modeled fertility, fertility preferences became central to understanding observed differences between fertility trends. However, what is challenging and has been contentious is the measurement of these preferences.

Like other types of preferences, fertility preferences are also elicited by a simple question: *"How many children would you want"*. Now because we want to measure not just the preferences of those who will have children in the future (prospective preferences), we also want to measure the preferences of those who already have had children (retrospective preferences), mainly to understand whether they met their preferences or not. This modifies the question to *"How many children would you* ***have wanted*** *to have?"*. It is especially this *'have wanted'* that sparks a lot of debate amongst population scientists. The contended question: won't this measure –especially under the context where fertility might be higher than those people desired– be affected by something called ex-post rationalization? Simply put, would individuals say that they did not want to have the child that they had?

This question forms the subject matter of this paper. Specifically, I ask two questions.

First, does having an exogenous increase in the number of children increase desired fertility? Second, is this increase in desired fertility likely due to ex-post rationalization i.e. the desire to avoid the psychological cost of declaring one of your children as 'unwanted'?

I use data from the Demographic and Health Surveys (DHS). DHS conducts the largest nationally representative surveys in most of the developing countries. It is the closest substitute to the vital statistics data for the developed world. I pool 230 surveys from 74 developing countries to get observations on over 3 million women between the ages of 15-49. These surveys consistently ask questions about fertility preferences (see Fig. 1) and are used as the primary source for data on the stated number of desired children (henceforth desired fertility), the closest proxy to fertility preferences.

To estimate an exogenous increase in fertility, I use two instruments that are well-established in the literature to causally increase fertility. First, is the occurrence of twins at first birth. The second instrument I use is the sex of the firstborn child. Specifically, I use the empirical fact that in countries with son preferences, having a first female-born child leads to higher desired fertility because people have more subsequent births to attain their desired number of sons.

I find that for an additional exogenous birth, desired fertility increases by 0.15-0.30 depending on the choice of the instrument. I further find that along with an increase in the total number of children, respondents also change their desired sex mix to match the sex mix of the children they have had. So, the ones who had two boy twins increased their desired number of boys while decreasing their desired number of girls, and the opposite for those with two girl twins. This indicates that individuals anchor their stated preferences to their current realizations. While this already supports the theory of ex-post rationalization, it is possible that experiential learning may drive these results. If people are gaining new information from having additional kids, and that changes their preferences, then the implications for policy might be different.

To distinguish if the effects are driven by experiential learning or ex-post rationalization, I compute the effect of having a girl on desired fertility by the time since first birth, or simply the age of the first child at the time of the survey. I find that for respondents who gave birth to a child 1 year or less ago, the increase in desired fertility is 70% of the increase observed in the total sample. Since respondents with a child less than 1 year of age were yet to realize the additional fertility, the increase could only come from knowing the expected future increase in the number of children. These results not only show evidence in support of ex-post rationalization but also show that individuals may alter their preferences when faced with more certainty about their realistic future fertility.

I conduct several robustness checks to show that the instruments are valid. First, considering the sex of the first child, it is natural to expect that under son preferences, sex-selective abortions may affect the probability of a girl at first birth which may in turn be correlated with desired family size. I show that while sex-selective abortions are prevalent, this isn't a concern for the first birth. Briefly, I show that the probability of the first birth being a girl hasn't gone down over time (as access to sex-selective technologies would have become more available). Further, there isn't any difference in observables for those whose first birth was a girl or a boy. For the twins, there is evidence of some selection. Specifically, women from higher socio-economic status are more likely to give birth to twins. I, therefore, control for the different observables to account for these differences. I further show that the results are similar across different education groups or wealth quintiles, thereby reassuring that they aren't driven by selection.

This paper makes several contributions because fertility is a topic of interest to many disciplines and to policy-making. The first, and most important contribution, is to establish that realized fertility has causal effects on desired fertility. There has been a wide interest in understanding the development and changes in desired fertility, and this paper adds to that literature.(Cleland et al., 2020; Müller et al., 2022; Kebede et al., 2022). The paper further contributes to the literature on the prevalent biases in the current framing of the desired fertility question in the Demographic and Health Survey (Casterline and Han, 2017)and confirms the existence of ex-post rationalization, something that has been speculated in the literature (Bongaarts, 1990; Rackin and Morgan, 2018). The second contribution is to show that the measures of 'undesired' fertility using the desired fertility questions is likely underestimated. Finally, this paper also contributes to the literature in behavioral economics that discusses endogenous preference formation by showing support for ex-post outcomes affecting stated preferences for an extremely important major life decision. (Eil and Rao, 2011; Drobner, 2022)

The rest of the paper is organized as follows. Section 2 provides information on data, Section 3 details the empirical strategy, Section 4 discusses the results, Section 5 delves into possible mechanisms, Section 6 elaborates on the implications for policy and future research, and finally, Section 7 concludes.

2 Data

I use data from the Demographic and Health Surveys (DHS). The DHS has been conducting representative cross-sectional surveys since 1985 and currently covers 84 countries. The survey is administered to a representative sample of women between the ages of 15 and 49 in each survey round. I pool all the 260 cross-sectional surveys conducted between 1985-2022 to conduct the empirical analysis.

The questions pertaining to fertility preferences have stayed consistent between the different rounds and countries, making all the surveys comparable. Specifically, the DHS respondents who have given birth are asked *"If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be?"* whereas those who are yet to give birth are asked *"If you could choose exactly the number of children to have in your whole life, how many would that be?"*. The respondents are then asked to further respond about the desired sex mix of the children that they want or would have wanted. This gives me both measures for desired fertility, as well as desired fertility by sex. A screenshot of the relevant portion of the DHS questionnaire is shown in Figure 1. The primary question about the total number of kids is in panel (a) whereas further questions about sex-mix are in panel (b).

Since I use the nature of the first birth for the empirical analysis, I restrict the sample to women with at least one birth by the time of the interview. I also restrict the sample to only those survey rounds that have information on education, age, and whether women live in rural or urban areas to control for potential differences in women who gave birth to twins v/s who did not. The rationale for controlling for these variables is further discussed in Section 3. After imposing these restrictions I am left with a sample of 230 survey rounds spanning 74 countries and close to 3.3 million observations. The representativeness of the different countries in the final sample is shown in Figure 2. Appendix Table A1 also lists the different countries and the years of survey rounds used in the sample along with both weighted and unweighted shares.

India is the largest contributor with 35% observations and therefore, it would be reasonable to suspect that India might drive all the results. I dropped India from the sample in appendix table A2 and the results still hold. Table 4 also shows the results by the different regions and while there is variance the results are statistically indistinguishable.

Table 1 compares descriptive statistics by the two instruments that are used in the empirical analysis. Columns (1) corresponds to mothers whose first birth was a boy whereas (2) is for those whose first birth was a girl. Column (3) gives the difference between the two. The average respondent in the sample was 20 years of age at the time of first birth. About 32% had no education whereas 62% lived in rural areas consistent with the fact that the sample is composed of women from Low and Middle Income countries. There aren't any notable differences between the women who have had a girl v/s boy at the first birth indicating the quasi-random nature of the sex of the first child other than in the key dependent and independent variables: realized fertility at the time of the survey, which are both higher, as expected, for those whose first birth was a girl. I do a similar comparison for those whose first birth was a twin (column (4)) v/s those whose first birth was a singleton (column (5)) and the corresponding difference in column (6). Twins are more likely to be born to women with high SES status given the complexity of the pregnancy. Therefore I control for the variable indicating higher SES background of the mother in the empirical strategy. Section 3 discusses this issue and some more robustness checks to ensure that the results aren't driven by compositional changes between mothers with twins and without.

3 Empirical Strategy

The main hypothesis that the paper is testing is whether or not desired fertility is affected by realized fertility. Naturally, people who have high desired fertility may also go on to have more kids. This makes a simple OLS unfit to get the causal effect of realized fertility on desired fertility because of selection. I, therefore, utilize the quasi-random nature of the first birth to get exogenous variation in realized fertility. More specifically, I use an Instrument Variable (IV) design with two instruments: (i) the occurrence of twins at first birth; and (ii) the sex of the first born child. In order to estimate the desired causal effect I use the following Two-Stage Least Squares (2SLS) model given by the following estimation strategy:

$$Fertility_{is} = \alpha_0 + Z_{is}\sigma + X_{is}\theta + \gamma_s + \epsilon_{is} \tag{1}$$

$$DesiredFertility_{is} = \beta_0 + \beta_1 \widehat{Fertility}_{is} + X_{is}\phi + \delta_s + \varepsilon_{is} \tag{2}$$

Further, to get the reduced form effect, I estimate the following equation:

$$DesiredFertility_{is} = \eta_0 + \eta_1 Fertility_{is} + X_{is}\lambda + \mu_s + \xi_{is} \tag{3}$$

where:

$Fertility_{is}$ is fertility at the time of survey of individual i in survey round s, Z_{is} represents the instrument used, X_{is} are individual level controls and include age, education level and rural residence, γ_s, δ_s, and μ_s represent survey (country X round) fixed effects in equations 1, 2, and 3 respectively. Finally, $DesiredFertility_{is}$ is the response to the question shown in Figure 1.

Since I am using survey data I use survey weights to get representative estimates. The survey weights are proportional to population so they also help adjust for the different sizes of the countries in the sample. India being a more populous country gets a higher weight for instance. However, as multiple survey rounds from the same countries are pooled, and not all countries have the same number of rounds, this implies that those countries that appear more often have a higher weight. I show that results are similar when not using weights. Finally, for inference purposes, since the DHS has a two-stage clustered sampling process, I cluster the standard errors in all equations at the primary sampling unit.

For β_1 to give an unbiased estimate of the causal effect of realized fertility on desired fertility, the following two assumptions must be satisfied:

- *Relevance*: The instrument must predict realized fertility or that the first stage must exist. More specifically, the coefficient σ, in the equation 1 must be non-zero. In Table 2, Columns (1) and (2) show that the occurrence of twins at first birth increases realized fertility at the time of the survey by 0.664, whereas having a first female birth increases it by 0.127, respectively. This satisfies the first assumption.

- *Exclusion Restriction*: The instrument should not have a direct effect on the outcome (desired fertility in this case) i.e. the only effect the instrument has on the outcome must be through the endogenous variable (realized fertility in this case). The Exclusion Restriction can be violated in two ways. First, if the instrument isn't quasi-random i.e. if people self-select into either having twins or having a girl, then the reasons why they make these selections may have an effect on their desired fertility as well. The second way is if having this type of birth (twins or a first girl) itself has some direct effect on desired fertility. I discuss the feasibility and limitations of this assumption in section 3.1 for the twins instrument and in 3.2 for the sex of the first child instrument.

3.1 Validity of the instrument: Occurrence of twins

There is a big literature using the twins instrument to study the effect of family size on different outcome variables (Angrist and Evans, 1998; Black et al., 2010). This is because of the simplicity of the instrument. The assumption is individuals cannot choose whether or not to have twins, making it quasi-random. It also mechanically increases the number of kids an individual has, as observed in Table 2 making it a perfect instrument to study the effect of realized fertility.

However, recent research has shown that while individuals cannot choose to conceive twins, being able to give birth to twins successfully isn't random. Since giving birth to twins is biologically more taxing than giving birth to singletons, higher SES women are more likely to give birth to twins. Further, it is shown that it is more likely to have twins when using modern IVF methods. Both these phenomena imply that women with higher socio-economic status, who on average are of better health and are more likely to access IVF treatments would be more likely to give birth.

Column (6) of Table 1 that compares observable characteristics of women who gave birth to twins v/s those who did not confirms this hypothesis. Women whose first birth was twins are older, more likely to be urban, more educated, and belong to higher wealth quintiles, all indicators of higher socio-economic status. At this stage, it is important to consider that women with higher socio-economic status tend to have lower desired fertility. Therefore, if there is a direct effect because of the selection on who has twins, it would bias the estimates downwards. Nevertheless, I take a few steps to ensure that the results aren't driven by any selection bias in the twins instrument.

First, I explicitly control for education, age, rural residence, and survey round fixed effects in all regressions to account for these differences. Information on wealth is not available for a significant number of surveys, however, when controlling for the other observable characteristics: education, differences in wealth disappear and therefore controlling for just these variables on which information is available across surveys is sufficient. [1]. The magnitude of the coefficients increases once we control for observables, reinforcing that the bias is negative. Second, I run the analysis separately for the different education status and wealth quintiles and discuss results in detail in section 4.3. Briefly, I find that the results hold for the different wealth quintiles as well as education levels.

It is also worthwhile to consider any other direct effects that giving birth to twins may have on desired fertility. As discussed, giving birth to twins can be more biologically taxing and therefore, it is possible that the process itself alters the desired fertility. While it cannot be argued with certainty as to what the direct effects in such a case would be, given giving birth to twins is more taxing, one would speculate that it should decrease desired fertility, biasing the estimates downwards.

3.2 Validity of the instrument: Sex of the first child

In countries with strong son preference, the first birth being a girl predicts higher fertility as people try for subsequent births to get their desired number of sons (Clark, 2000). This is empirically shown in Table 2 where those with a first girl have a slightly higher realized fertility as opposed to those with first boys. The magnitude is small because not every country in the sample exhibits son preference and even within those with son preference this effect is more pronounced at completed fertility. For instance for women who gave birth right before the survey, the realized fertility at the time of the survey would be the same as both would have one child. However, over their life course, the expected fertility of the women with a girl under son preference is higher. We would use this property later when discussing potential mechanisms in section 5

The biological sex of a child is random, making this instrument fit for this empirical ex-

[1] Appendix Table A2 shows that the results are similar for the subsample with information on wealth quintiles

ercise. Unfortunately, in countries with son preference, there is a strong tendency to perform sex-selective abortions(Bhaskar, 2011). This is a problem since those with a preference for smaller family sizes are more likely to sex-select. Therefore, for two individuals with similar son preferences, the ones who want a smaller family would be more likely to have a boy at first birth (due to sex selection) whereas those with a preference for a bigger family may be ok with having a girl at the first birth. I take a few steps to show that there is little evidence that there is any significant amount of son preference at first birth.

I follow (Anukriti et al., 2022) which also uses the sex of the first child as an exogenous variable and data from the DHS to show that the sex of the first child is indeed quasi-random. The primary argument is that while there is a high prevalence of sex-selective abortions, those happen at higher-order births. In Figure 3 similar to (Anukriti et al., 2022) I plot the the likelihood of a birth being a girl by birth order and existing sex composition. Splitting by sex composition is important since those who haven't had a boy in their first N births would be more likely to sex-select. Panel (a) shows the trend for first birth. The most important takeaway from this panel is that the probability isn't dipping with time. Sex-selective abortions became more possible with access to ultrasounds which happened over time (Bhalotra and Cochrane, 2010). This comparison can be further drawn by comparing the trend in Panel (c) which shows the likelihood at third birth. Clearly, for those with two girls, the ratio dips with time whereas for those with only boys, it stays flat. This shows that there isn't any significant likelihood to sex-select at first birth. Further, Table 1, column (3) shows there aren't any meaningful differences between those whose first birth was a girl versus those whose first birth was a boy. This reassures that the sex of the first birth in this context and data, is as good as random.

Let's now consider some of the other direct effects having a girl may have on desired fertility. For instance, differences have been shown in breastfeeding practices, primarily driven by birth spacing after the birth of a girl (Jayachandran and Kuziemko, 2011). It is important to note that these effects are observed towards the end of the fertility cycle and therefore, aren't a concern for this paper. Another mechanism can be because of the loss of intra-household status as a mother of a girl. It is well documented that mothers of boys have a higher status which may alter the mother's perception towards childbearing and therefore may drive the results. Similar to the twins instrument, while it is difficult to be certain, given these are negative experiences, these mechanisms are also likely to bias the results downwards, if at all.

4 Results

4.1 Raw Differences

Before proceeding to discuss the results from the IV model, I show some descriptive evidence of fertility outcomes affecting desired fertility. In Figure 4 I plot the average desired fertility for different age groups and the nature of the first birth. In panel(a) I compare the desired fertility of those whose first birth was twins v/s those whose first was a singleton whereas in panel (b) I compare those who had a girl v/s a boy at first birth. Both figures also include the average desired for both who had no children at the time of the survey. It should be recalled that I use pooled cross-sectional data conducted in different years and therefore, each age bracket may contain individuals from different birth cohorts. Hence any observed trend in this figure is a combination of both the cohort effect and the changes over the life course of an individual.

As can be observed, for each age group, the average stated desired fertility of those who had twins (or female) is higher than those who had a singleton (or male). These differences are statistically significant. What is interesting is the differences are almost similar irrespective of the age group which can be seen as a proxy for the stage of the fertility cycle an individual is in. Older women would have most likely completed their fertility cycle whereas younger women may still be in the earlier stages. The differences stay similar even with compositional shifts as women who give birth later (and potentially have lower desired fertility) enter these groups.

Given the discussion earlier in section 3.1 about the potential selection in who has twins and who doesn't, it is reassuring that when comparing raw averages for both the instruments the trend is very similar: consistent difference across age groups between desired fertility of the supposed 'treatment' (high fertility) and 'control' (low fertility) groups. The magnitude of the difference is naturally different as the order of magnitude of the first stage is different for both instruments and they have different complier groups as well. We will discuss this in more detail while discussing the results of the IV model in the following subsection 4.2

4.2 Results from the IV Model

I estimate the IV model and report the results in Table 3. Columns (2) and (3) show the reduced form effect or the results from estimating equation 3. This is a more formal estimate of the differences observed in Figure 4 after controlling for the relevant observables as discussed in section 3. Finding a reduced form effect by itself is an important result. Recall, that the question requires respondents to go to a time when they didn't have any children and then state the number of children they would have wanted. Therefore, the positive effect shows that the fertility outcomes that the individual has experienced alter their response, and therefore desired fertility is a function of fertility outcomes.

Occurrence of twins at first birth as opposed to singleton increases desired fertility by 0.098 (column 2) while giving birth to a female v/s a male at first birth increases it by 0.038 (column 3). The big difference is magnitude is again primarily because of the differences in both instruments respective first-stage effects. To understand this simply, take the analogy of two randomized control trials: one with low takeup v/s another with high takeup. Even if both the experiments are similar and should have the same causal effect, the Intent to Treat (ITT) effect, the one with low compliance will show a smaller effect as fewer individuals have been treated, and the one with higher compliance will have a higher effect. In this case, having a girl has low 'take up' for realized fertility i.e. fewer individuals go on to have a larger family as a result of having a girl. This is in part because (i) son preference isn't strong in all countries of the sample and (ii) since we are considering the first birth and normally people have more than 1 child, their desired number of sons may be realized in subsequent births without having to increase their target fertility. We will now move to discuss the IV estimates, which are Local Average Treatment Effects (LATE) and therefore would be more directly comparable.

Let's now consider the IV estimates that provide the causal impact of having one additional child on desired fertility. Columns (4), (5), and (6) show the results from estimating equation 2 for the effect of realized fertility on desired fertility for the twin instrument (4), the first birth being female instrument (5) and in column (6) the effect when using both the instruments together. The estimates imply that having an additional child increases the desired fertility by 0.15-0.30 depending on the choice of instrument. In other words, 15-30% of the respondents increased their desired fertility in response to the additional child that they had.

While there isn't another study that documents the causal effects of fertility on desired fertility, a study was conducted using panel data of a small sample of Kenyan women documenting changes in desired fertility over their life-course (Müller et al., 2022). Their estimates are bigger than what I find. They found that 66% of the 7.2% women who had more children over the course of the study than their initially stated desired fertility, increased their stated desired fertility in subsequent surveys. There are two main differences that can explain the difference: (i) the samples are very different. This paper uses a bigger multi-country sample with potential heterogeneity. (ii) The estimation strategy used in this paper recovers a specific local average treatment effect corresponding to individuals whose fertility goes up because of having a girl child at first birth or having twins at first birth, whereas their study documents a general increase in desired fertility when realized fertility increases. A portion of that increase may for instance come from individuals first increasing their desired fertility and then realizing that increase. This paper, however, because of the causal framework it uses excludes that kind of effect.

4.3 Heterogeneity

The main results discussed in the previous section 4.2 correspond to a large dataset spanning 74 developing countries as discussed in section 2. Further, while the twins instrument should have a similar mechanism in all places, the first girl instrument has relevance only for countries with son-preference which can be checked by the existence of a first stage (Eq. 3). In this section, I will explore whether we see heterogeneity in results for both instruments, along different dimensions such as region, education of the respondent, and wealth quintile of the respondent. In summary, I do not find any substantial differences along any of these margins. I discuss them in a little more detail in the following sections.

4.3.1 Region

Since a lot of countries have much smaller sample sizes, it is difficult to get estimates individually for each country. Therefore, for this analysis, I group them into five different categories based on their continents. The results are shown in Table 4. The top panel shows the results for the twins instrument, whereas the bottom panel shows the results for the first birth is female instrument. Columns (1) and (2) show the first stage and the reduced form estimate, whereas column (3) gives the IV estimate.

The results for the twins instrument are fairly similar across the different groups. The sample size is much smaller for Central Asia which is why the standard errors are larger and the estimate is imprecise. However, all coefficients are very similar to each other and statistically indistinguishable.

The results for the first child is female instrument have a little more variance. However, most of that is coming from not having a first stage. Sub-Saharan Africa has a much bigger coefficient of 2.05 but it is worth noting that it is driven in part because of an extremely small first stage and a smaller reduced form, and hence, it isn't statistically significant.

4.3.2 Education

In this section, I will discuss the heterogeneity of results by education. Similar to the results for the region, I club the education of the respondents into four categories: No education, some or completed primary education, some or completed secondary education, and beyond secondary education. The results are presented in Figure 5 Panel (a). For all the four categories and both the instruments, the results are fairly similar. There is a weakly increasing trend in the effect size with education but the differences aren't statistically significant.

4.3.3 Wealth

Next, let's discuss the differences by wealth. The Demographic and Health Surveys compute the wealth index for all sample households on the basis of asset ownership. Therefore, this estimate isn't a complete account of the wealth of people but is instead a proxy measure using the assets owned by people. I run the IV model for individuals belonging to the different wealth quintiles and report results in Figure 5 Panel (b). Similar to education I do not find any major differences in the estimates for the different wealth quintiles. This should further alleviate concerns that selection in the twins instrument could have potentially driven results.

4.3.4 Wealth

Finally, I discuss the differences by neighborhood parity at the age of 30. To compute these estimates, for each individual I compute the leave out mean parity in their neighborhood (defined by the primary sampling unit) at the age of 30[2]. I then pool them in groups (less than 1, 2-3, 3-4 and 4-5)[3]. The IV model is estimated for these groups and the results

[2]Although the DHS is a cross-sectional dataset, since it collects complete birth histories, including date of births, I can compute the number of births each individual has had at age 30.

[3]The sample is extremely small for an average parity higher than 5, and the estimates are extremely imprecise and therefore, I exclude them from the results.

are reported in Figure 5 Panel (c). Similar to education and wealth I do not find any major differences in the estimates for the different neighborhood parities. This is an interesting find as it shows that learning is potentially unlikely to drive the results. If learning was a potential mechanism we should expect women who are more exposed to children (or for whom having more children is more normalized socially), to have a lower effect. I will discuss the mechanisms in more detail in the next section.

5 Mechanisms

Before discussing the implications of the results in section 6, it is important to understand the potential mechanisms driving the results. In this section, I will discuss three potential mechanisms that may increase realized fertility because of an increase in realized fertility. The most common and suspected explanation is ex-post rationalization. The second is experiential learning and finally, the literature on behavioral economics suggests that a model of reference-dependent preferences can also explain ex-post outcomes altering preferences. I explain each of these briefly below:

- *Ex-post rationalization*: This is one of the most straightforward explanations behind observing these results. Ex-post rationalization simply implies that once individuals commit to a decision they are less likely to believe ex-post that it wasn't the correct decision for them. In this case, this amounts to individuals reporting that the children they had were wanted. So for example, if the target desired fertility was two, and the respondent has a third child, they are less likely to say their desired fertility was two because that would imply their third child was 'unwanted'. By reporting a desired fertility that is more anchored around their current realized fertility, they are able to avoid the potential psychological cost of virtually 'erasing' their youngest child(ren) (Bongaarts, 1990; Müller et al., 2022; Eyster et al., 2022).

- *Experiential Learning*: Another potential mechanism is that of experiential learning. Under this mechanism, we model children as experience goods. Therefore, when individuals experience more of them, they potentially learn something from them, and that gives them more information, which in turn changes their preference (Neelamegham and Jain, 1999).

- *Reference-dependent Preferences*: The last model I consider is that of reference-dependent preferences. As per a model of reference-dependence, an individual's preferences can be a function of their endogenously dependent reference point. (Kőszegi and Rabin, 2006). In this case, having a child could change the individual's reference point which in turn changes their stated preference.

It is tricky to distinguish between reference-dependent preferences or ex-post rationalization in this context. Both have very similar underlying psychological mechanisms as a model of ex-post rationalization is exactly the same as the principle of endowment effect under a model of reference-dependent preferences. Therefore, I would only attempt to tease out whether experiential learning could drive these results.

First, recall that the results were fairly similar for the different regions, age, education, and wealth groups, as well as high and low fertility exposure. If results were to be driven by learning there must be some margins along which learnings are different. One would expect some individuals to have positive learning while some may have negative learning, and the results might be a net of them. The fact that they are similar for different groups, implying that the net effect is similar, seems less plausible.

However, I still conduct some additional analysis in subsequent sections 5.1 and 5.2 with desired sex-mix outcomes in addition to total desired fertility. I also exploit the age of the first child at the time of the survey to get at the extent to which learning might be happening (if at all).

5.1 Change in Sex-mix Preferences

I re-estimate equations 1 and 2 but instead of using *DesiredFertility*, I change the outcome to *DesiredBoys*, *DesiredGirls*, and *DesiredEitherSex*. The results are reported in Table 5. As the table shows for the twins instrument, both the number of *DesiredBoys* as well as *DesiredGirls* go up, whereas for the first female birth instrument, we see an increase in the number of *DesiredBoys*, whereas a decrease in the number of *DesiredGirls*. Since those with a first girl child are likely to have more girls at the end of their fertility cycle as compared to those who had a first boy, this reflects that individuals are potentially aligning their stated preferences to not just the number of children they have (by increasing desired fertility) but also to the sex-mix.

To further illustrate this point, I split the twins instrument by the sex-mix of the twins and report reduced form results in Figure 6. The x-axis indicates the number of boys in twins. Therefore, 0 implies the twins are all girls, 1 implies 1 girl and 1 boy, and 2 implies, both children amongst the twins were boys. As before, all comparisons are relative to those whose first birth was a singleton and include the relevant controls. If individuals align their stated sex-mix preferences to their realized outcomes, we must expect the desired number of boys to increase and the desired number of girls to decrease with the increase in the number of boys in twins. This is exactly what we find in the figure.

What is particularly interesting about both these results, and strongly indicative that learning isn't likely to drive the results, is the decrease in the desired number of children of the opposite sex (than the one realized). There are many potential preference combinations that can explain this. For simplicity, let's consider the case where individuals have a strong preference for two children and a weaker sex-mix preference of one girl and one boy. Under these preferences, the ones having a single child at first birth won't alter their preference, as their ex-ante desired fertility is still higher than realized. Also, everyone with twins wouldn't (plan to) have any more children as they have met their target fertility. This keeps their stated desired fertility as well as stated desired sex-mix the same[4]. However, the ones who have two girls, if they ex-post rationalize, will report they desired to have 2 boys, thereby symmetrically increasing their desired number of boys and decreasing their desired number of girls. Further, since people may have a strong preference for the sex mix as well, they may have subsequent births to realize that (same as the ones who do not have twins) and will end up with a higher number of boys/girls and that is what drives the results. This is consistent with both the findings on the split sex-mix of the twins instrument as well as the first female birth instrument which shows that the results are driven by a higher increase in the desired number of girls than the decrease in the number of boys.

5.2 Early Changes to Desired Fertility

The premise of experiential learning is that one needs to get some feedback from the child itself to learn new information which then helps them revise their stated desired fertility. It is worth noting that while ex-post rationalization may seem similar, it is slightly different. For instance, under strong sex-mix preferences, desired fertility even when realized fertility is less than the ex-ante desired fertility. For instance, if target desired fertility is 1, but there is a strong preference for 1 boy, having a girl increases the target desired fertility as well as increases the desired number of girls via ex-post rationalization. This is similar to the example discussed in the previous section 5.1.

Since I want to completely isolate any effects from the additional number of kids, I cannot consider the twin instrument, as that mechanically increases realized fertility. I instead utilize the first female birth instrument and leverage the age of the first child at the time of first birth. The intuition is that with more time passing between the birth of the first child (the 'treatment') and the survey response, the more the exposure to the additional number of children, and therefore we can observe if the effect changes with exposure to more kids. I,

[4]For simplicity I am assuming that there isn't any effect on desired fertility upon having a first birth. While this is most likely not the case, the result of this exercise isn't altered by relaxing this assumption. Whatever the extensive margin effect of having childbirth is should be similar for those with twin births and is, therefore, differenced out.

therefore, re-estimate the reduced form equation (eq. 3) for different sub-populations split by the age of the first child at the time of the survey. I only estimate the reduced form equation as there would be no first stage for those who are yet to have the additional number of kids – the primary focus of this exercise. The results are graphically represented in Figure 7. Panel (a) corresponds to the results on desired fertility whereas panel (b) shows the same results for the desired number of boys and girls. The bars show the reduced form effect of having a first girl on the relevant outcome, whereas the line shows the results from re-estimating the first-stage equation (eq 1) for the corresponding groups.

For the 1 year group, naturally, the first stage effect is almost zero, as not enough time has passed for individuals to realize an additional number of children. The main takeaway from this result is that even at the 1-year mark when individuals are yet to realize the additional fertility, the increase in desired fertility (0.028) is 70% of the overall estimate (0.040). To make an analogy with a randomized control trial, this result is similar to the anticipation effects that we observe. While the 'treatment' (additional number of kids) hasn't been realized yet, the respondent knows that they have been assigned to the 'treatment' and therefore, they can alter their behavior in anticipation. This is potentially what we are seeing here. Respondents who are compliers of son preference can respond (by changing their desired fertility) to having a first girl without necessarily realizing subsequent births. It is possible that some of the effect is a direct effect of having a girl child, separate from anticipating future births, but as discussed in section 3.2, most feasible mechanisms under the context of son-preference are most likely to negatively influence desired fertility and therefore, unlikely to affect desired fertility. While it would make an interesting exercise to analyze countries without son preference to see if they exhibit any such results (to detect other potential direct effects of having a girl child), however, given the small sample size for those whose first child is less than 1 year of age at the time of the survey, this isn't statistically feasible to do. Finally, looking at panel (b), the same as results discussed in section 5.1 the results are driven by the increase in the desired number of girls being higher than the decrease in the desired number of boys.

So to summarize, it seems unlikely that learning could explain all these results. To learn, we must at least realize, and since there isn't any realization of excess fertility in this last case, it seems implausible that learning can drive results. Rather, ex-post rationalization or a reference point shift (due to the endowment effect) seems as the more likely drivers of the result. This has important implications for the usage of this variable in both policy and research which I discuss next in section 6

6 Implications

6.1 Policy Implications

The most important application of desired fertility in policy has been to indirectly estimate the demand for contraception or family planning programs (Pritchett, 1994; Kaiser, 2011; WHO, 2022). The idea is straightforward in principle: we have data on observed fertility as well as data on desired fertility. If we subtract realized fertility from desired fertility and get a positive number that gives us the 'unwanted fertility' in the population. If we get a positive number, that gives us the 'unmet' demand for children in the population. Simply, put desired fertility is seen as a measure of the demand for children, whereas realized fertility is the supply and we can then form policy to correct any gaps.

Pritchett (1994) for instance, in his very influential paper about aid to high fertility countries for family planning programs argued that since the observed desired fertility is high and can explain most of the high realized fertility, family planning programs are likely not going to work. He hypothesized that there isn't a high prevalence of 'unwanted' fertility in these regions and therefore, no real demand for contraception or family planning programs. He used national-level instruments to exclude the possibility of ex-post rationalization at that time. However, this paper using micro-data and reliable instruments, finds that each additional exogenous child born does increase the desired fertility by 0.15-0.30 and a highly plausible mechanism is ex-post rationalization.

The finding therefore first implies that we cannot rely on desired fertility measures directly to obtain estimates of ‘unwanted’ fertility. Clearly, even when there is a prevalence of ‘unwanted’ fertility, a substantial portion of that can be rationalized by respondents, as observed in this paper, biasing the estimates of ‘unwanted’ fertility downwards. If we construct policy based on these estimates, we are likely to obtain sub-optimal policy as the policy decision itself influences preferences. In the case of high-fertility countries, for instance, the decision to not provide family planning programs increases the realized fertility, which in turn increases desired fertility. If we measure the demand for family planning programs ex-post, we would incorrectly conclude that there is a low demand for family planning programs and hence the policy to not implement or expand family planning programs would be unjustly justified.

While it would be a very useful and tempting exercise to compute true ‘unwanted’ fertility numbers to estimate the current bias in these estimates, we must be cautious in doing so using this paper. It is important to recall that this paper estimates a particular type of local average treatment effect (LATE): that for people who have more children as a result of having twins or as a result of having a girl child. Therefore, we cannot directly uncover the true ‘unwanted’ fertility in the population. While the effect estimated is for each additional birth, it is important to remember that this is for each additional birth that wouldn’t have been born otherwise i.e. the estimates work on a fraction of the unwanted children. So, the estimates from this paper give us a sense of how many of the unwanted children may be rationalized as wanted but are limited in giving us estimates of the number of unwanted children itself. The largest number of unwanted children are potentially born because of lack of access or inability to use contraception, something that the instruments used in this paper do not uncover.

This result has broader implications for policy welfare analysis. While there are studies that find evidence for ex-post rationalization (Eil and Rao, 2011; Drobner, 2022), and hence for alternate methods of using stated preferences. This paper presents evidence from a large-scale multi-country sample for an important life event and therefore lends support to that argument.

6.2 Research Implications

6.2.1 Current Usage

Desired fertility is used by demographers, population researchers, and economists in different settings. These findings foremost caution researchers using desired fertility as a standalone measure. Since the measure is affected by realized fertility itself, the conclusions drawn from its usage can be very different. We already discussed how it affects the calculations for 'unwanted' fertility which is a common usage among demographers.(Casterline and Han, 2017; Bongaarts, 2020; Lin et al., 2020; Casterline and El-Zeini, 2022)

Doepke and Tertilt (2018) uses the difference in desired and realized fertility for instance as a proxy for intra-household bargaining. The idea is that since men usually have high desired fertility, if realized fertility is closer to desired, she would have more power (as she was able to exert control over fertility), whereas if there is a gap, she has less power and is less empowered. Now under ex-post rationalization, the woman who has high power and the one who has low power, under this proxy method will look identical. The one with high power would be expected to have control over her fertility, and therefore, the gap would be small, whereas that with no power, may rationalize all the excess fertility and hence, seem empowered.

Economic papers that study fertility-related health outcomes, have often used desired fertility to understand the marginal effects of sex-selective abortions (Anukriti et al., 2022), future projected sex-ratios under son-preference (Jayachandran, 2017) likelihood of breast-feeding (Jayachandran and Kuziemko, 2011) by using reported desired fertility as the target fertility of households. As we now know treating desired fertility as target fertility is potentially incorrect since it is more a reflection of the realized fertility. Therefore, any marginal effect obtained using desired fertility are contaminated by the effect of later birth outcomes.

6.2.2 Future Research

Fertility preferences are important for us to know for both policy as well as research purposes. They form an important bridge between understanding the causes for fluctuations in fertility trends (Bongaarts and Casterline, 2013) . This paper, however, suggests that desired fertility might not be the best method to use to get at fertility preferences, as they might be ex-post rationalized. While this paper only shows the effects of excess fertility on increasing desired fertility, since it shows the mechanism of ex-post rationalization i.e. rationalizing the state of affairs, it can be speculated that in contexts where realized fertility is lower than desired fertility, individuals may rationalize, and lower their stated desired fertility. We cannot be certain, if the results are symmetric, and we need future research to ascertain that.

In terms of developing newer methods for eliciting fertility preferences, another measure that has been used is prospective preferences (Rackin and Morgan, 2018) . However, the results in Figure 7 which show that desired fertility may increase even under anticipated future fertility shocks don't look promising for prospective measures of fertility either. Individuals, who for instance, are aware of their inability to exert control over their fertility may rationalize that inability in their stated desired fertility making prospective measures similarly flawed.

7 Conclusion

In this paper, I use a large dataset of pooled cross-sectional surveys from 74 developing countries to estimate the causal impact of having an additional child on fertility preferences. I find that the birth of an additional child increases the stated desired fertility by 0.15-.30. I also find that individuals seem to adjust both their total desired fertility as well as the desired fertility by sex of the child to mimic their own realized fertility outcomes. Further, I provide evidence that individuals revise their desired fertility in anticipation of future fertility increases.

This complicates the usage of desired fertility, especially when used as a measure of the demand for children. Desired fertility instead is found to be a function of the supply of children (realized fertility). The results together point towards ex-post rationalization as the potential driver of this relationship. This implies that the estimates of 'unwanted' fertility and 'unmet' demand for contraception are likely biased downwards.

While this paper doesn't propose a new method for measuring fertility preferences, it shows that we must be careful in using the current measures. Future research must be done to develop newer elicitation methods with tests to measure the impact of the exogenous shocks to fertility over these preferences. That would better help us to develop more accurate measures of fertility preferences which in turn will lead us to get true and important estimates of 'unwanted' fertility and 'unmet' demand for children.

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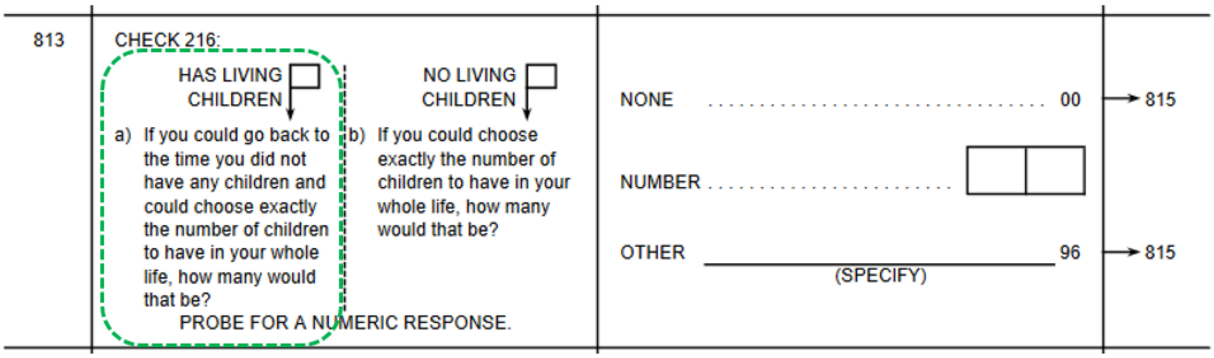
Figures

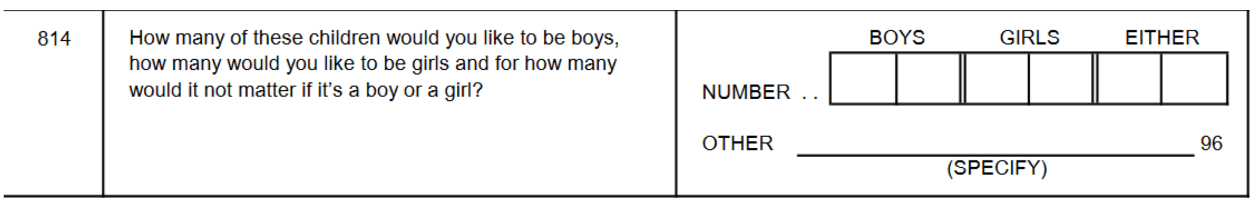
Figure 1: Desired Fertility questions in the Survey

(a) Desired Fertility question



813	CHECK 216: HAS LIVING CHILDREN / NO LIVING CHILDREN a) If you could go back to the time you did not have any children and could choose exactly the number of children to have in your whole life, how many would that be? b) If you could choose exactly the number of children to have in your whole life, how many would that be? PROBE FOR A NUMERIC RESPONSE.	NONE . . . . 00 NUMBER . . . . [ ][ ] OTHER ________ 96 (SPECIFY)	→ 815 → 815

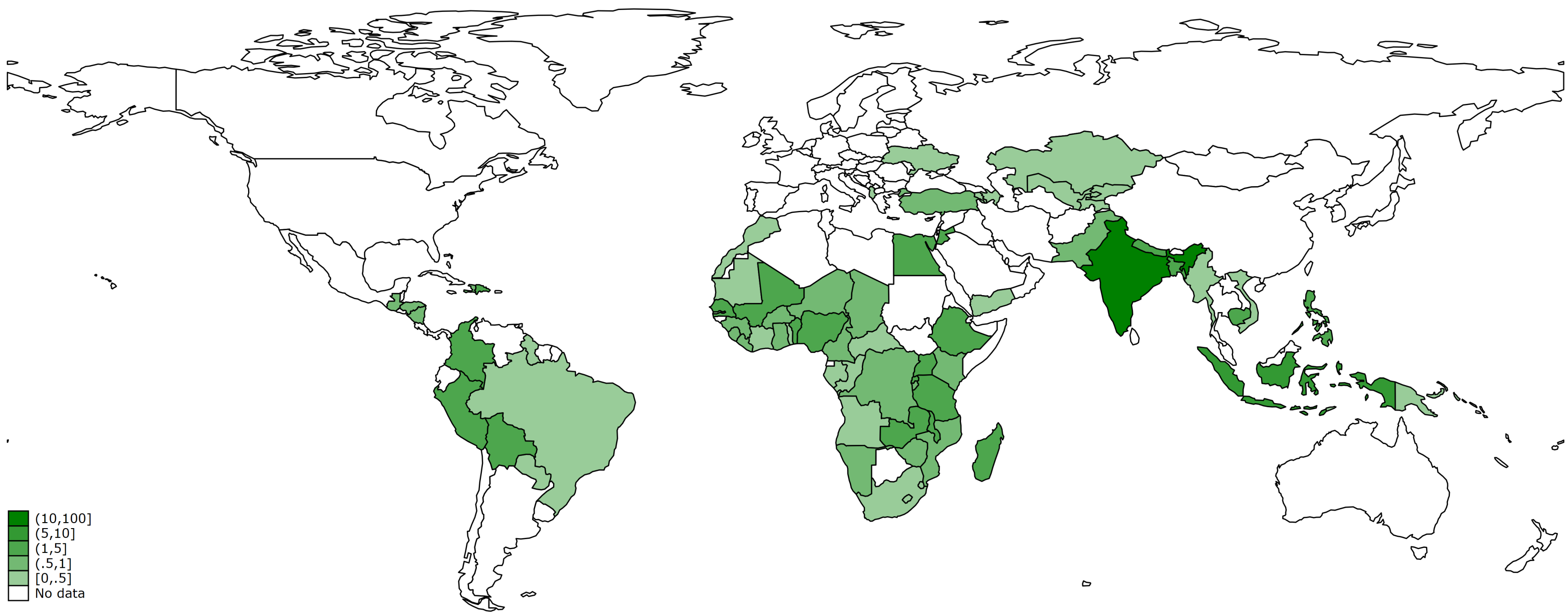
(b) Desired sex-mix question



814	How many of these children would you like to be boys, how many would you like to be girls and for how many would it not matter if it's a boy or a girl?	BOYS GIRLS EITHER NUMBER . . [ ][ ] [ ][ ] [ ][ ] OTHER ________ 96 (SPECIFY)

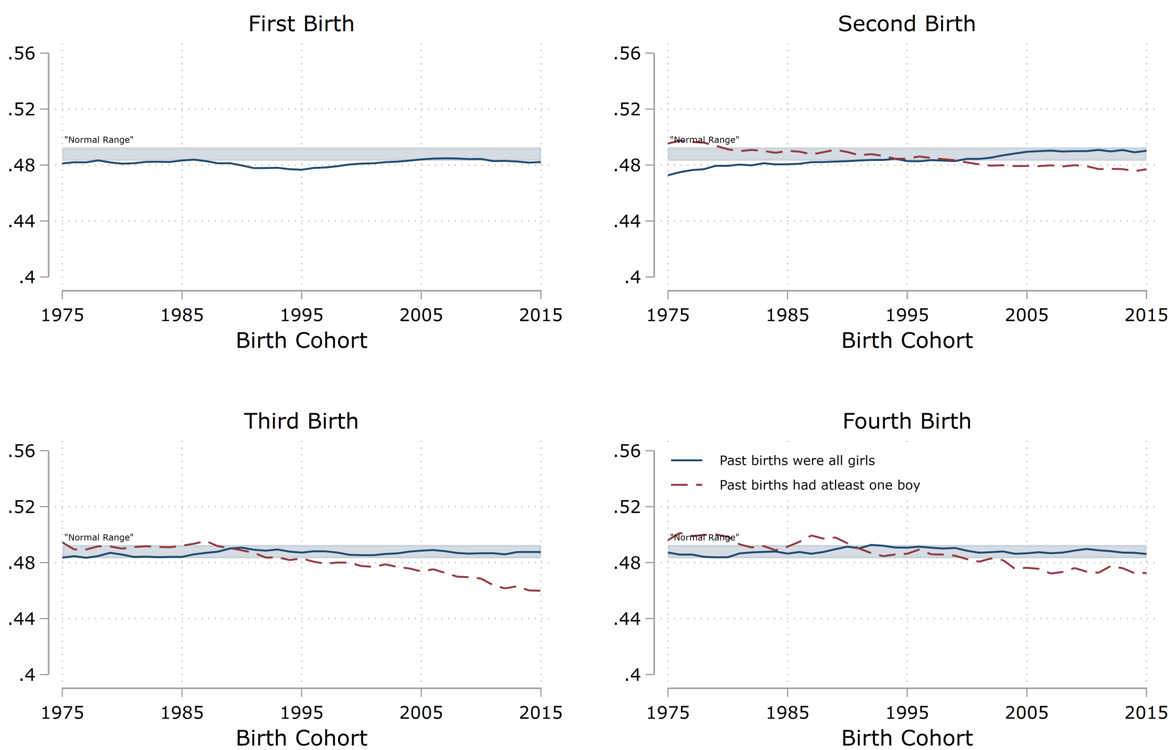
Notes: The figure shows the desired fertility questions from the Demographic and Health Surveys. The top panel corresponds to the question whose response gives the Desired Fertility and the response to the bottom question gives the desired number of boy, girls or children of either sex

Figure 2: Coverage of the DHS Sample: 54% of World Population



Notes: The figure indicates the countries that are part of the analysis sample. The different shades of colors highlight each country's respective proportion in the sample after using sample weights. Unweighted sample distribution showin in the appendix is almost identical.

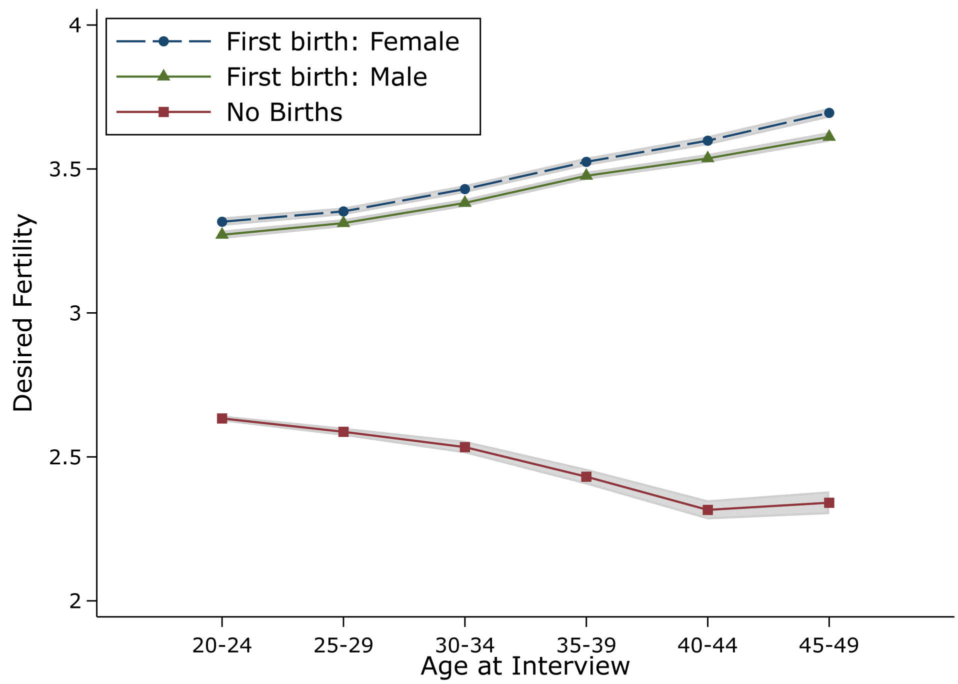
Figure 3: Instrument validity: For first births, the probability of having a girl is at normal levels consistent with exogeneity)



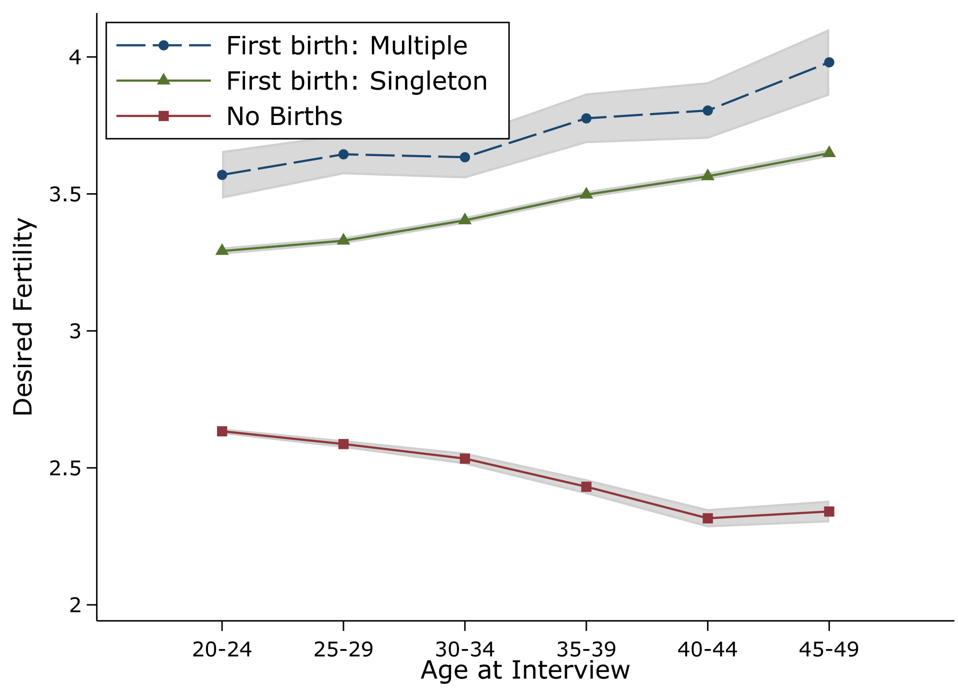
Notes: The figure shows the probability of having a girl at the respective birth order. The solid line is the probability when there is at least one boy in the existing sex-mix (or no child when looking at first birth). The dashed line is the probability when existing sex-mix has no boys. The shaded region is the normal expected probability of sex of the child being female.

Figure 4: Reduced form of main result: Desired Fertility is higher for groups with higher expected Realized Fertility at all age groups

(a) Female v/s Male



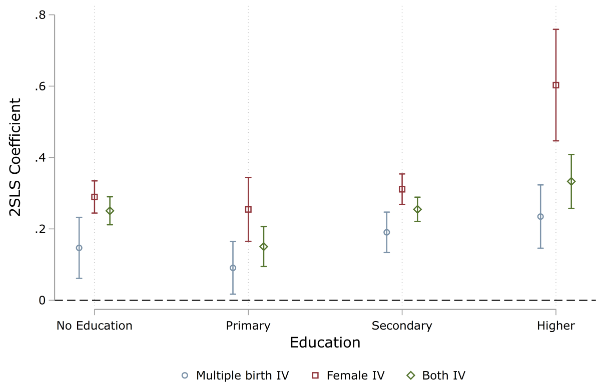
(b) Twins v/s Singleton



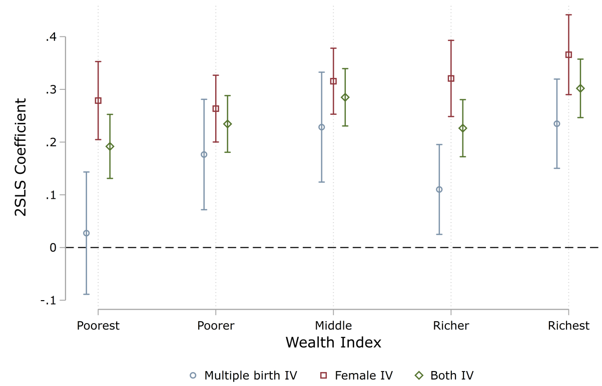
Notes: The figures show the average reported desired fertility by women in different age groups at the time of interview and with the respective type of first birth (or no birth). The shaded region indicates 95% confidence intervals computed using standard errors clustered at the primary sampling unit.

Figure 5: Heterogeneity: Results are similar for different education, wealth, neighborhood parity

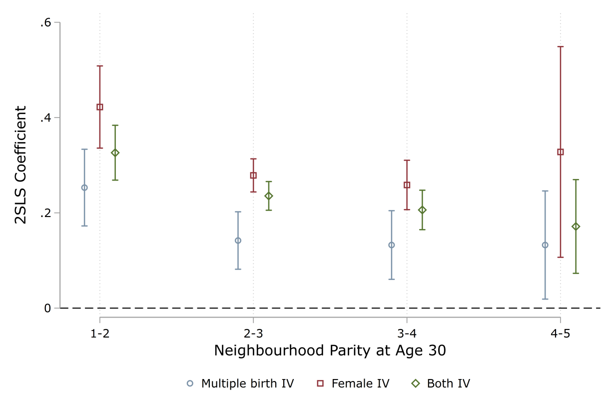
(a) Education



(b) Wealth

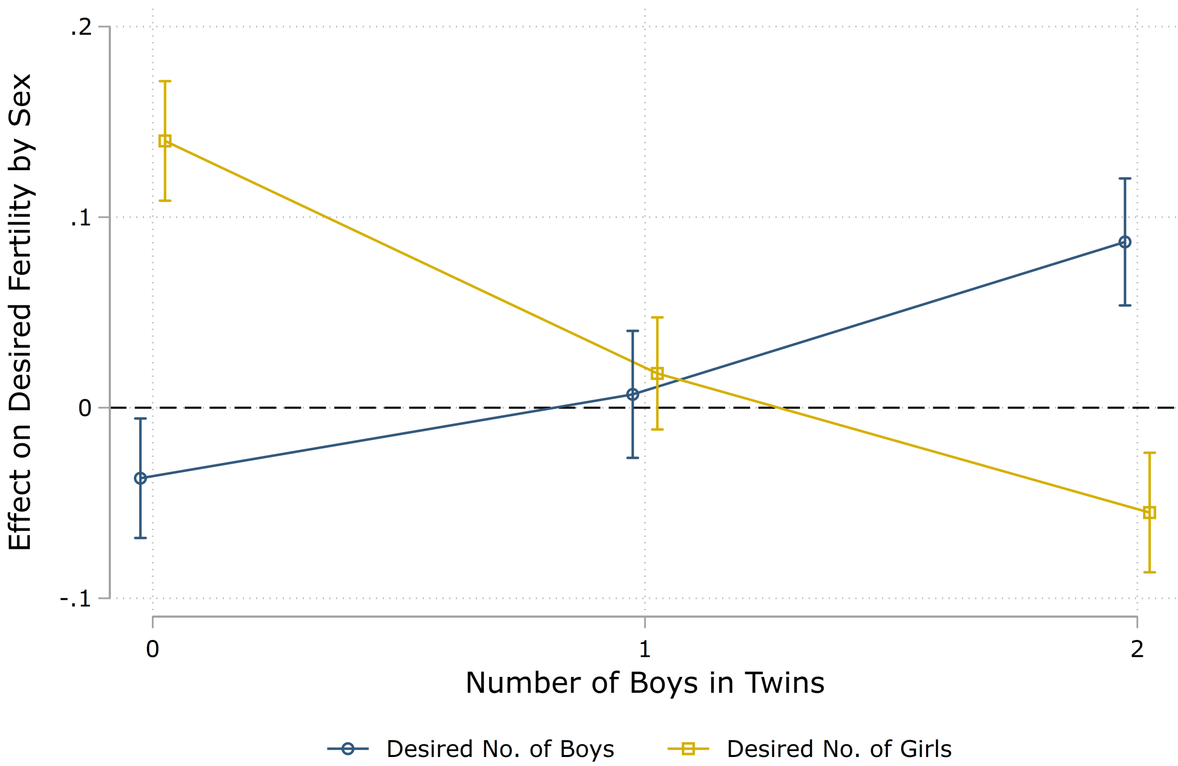


(c) Neighborhood Parity at Age 30



Notes: The figure shows heterogeneity in the two-stage least squares coefficient at different margins. In Panel (a) the results are report for by by education level of the respondent. Primary indicates at least some years of primary education. Same for Secondary and Higher. Panel (b) shows results by the wealth quintile of the respondent's household. Wealth is approximated by the demographic and health survey using the ownership of assets and is not a total valuation of the household wealth of the individual. Fianlly, Panel (c) estimates results by neighborhood parity. Neighborhood parity is computed as the leave out mean fertility of women in the same primary sampling unit at the age of 30. This serves as proxy for whether the neighborhood is a high fertility one or a low fertility one. All estimates control for education (except panel (a)), age, rural residence and country X survey round fixed effects. 95% confidence intervals plotted using standard errors clustered at the primary sampling unit.

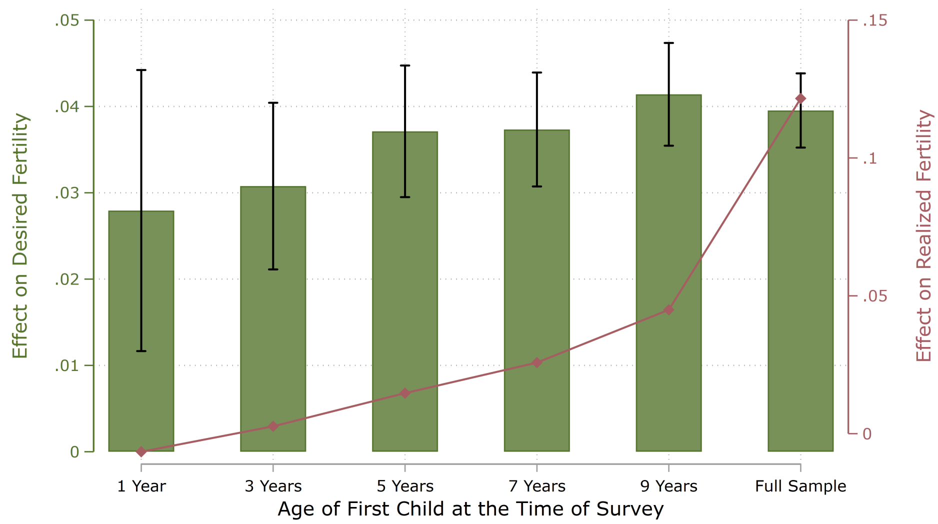
Figure 6: Changes in Desired Sex-Mix by Sex-mix of the Twins



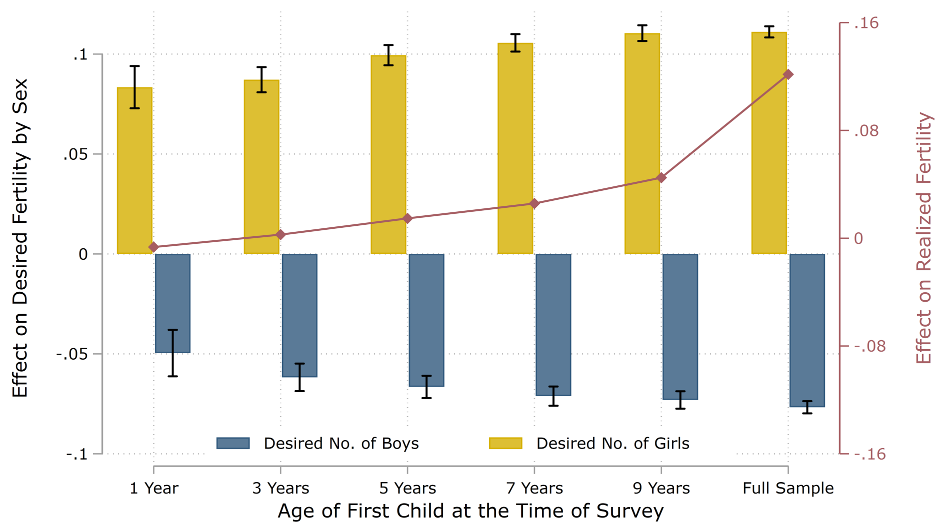
Notes: The figure shows the effect of having twins of different sex-mix on the stated desired fertility by sex. Having zero boys in twins implies both were girls and having 2 implies both were boys, while 1 implies 1 girl and 1 boy. All estimates control for education, age, rural residence and country X survey round fixed effects. 95% confidence intervals plotted using standard errors clustered at the primary sampling unit.

Figure 7: Effect of First Born Girl on Desired Fertility by Age of First Child

(a) Total Desired Fertility



(b) Desired Number of Boys and Girls



Notes: The bars in the figures shows the effect of having a first-born girl on desired fertility (panel (a)) and desired number of girls and boys (panel (b)) by age of the first child. The line in both panel shows the corresponding effect on realized fertility. All estimates control for education, age, rural residence and country X survey round fixed effects. 95% confidence intervals plotted using standard errors clustered at the primary sampling unit.

Tables

Table 1: Descriptive Statistics by Nature of First Birth

	Girl (1)	Boy (2)	Diff (1) - (2)	Twin (3)	Single (4)	Diff (3) - (4)
Rural	0.62	0.62	-0.00	0.57	0.62	-0.05***
Mother's Age at First Birth	20.44	20.42	0.02***	21.76	20.42	1.34***
Age of First Child	13.10	13.28	-0.18***	11.92	13.20	-1.28***
Mother's Education						
None	0.32	0.32	-0.01***	0.27	0.32	-0.05***
Some or Complete Primary	0.28	0.27	0.01***	0.26	0.28	-0.01***
Some Secondary or Higher	0.40	0.40	0.00	0.46	0.40	0.06***
Wealth Quintile: Poorest	0.19	0.19	0.00***	0.15	0.19	-0.03***
Wealth Quintile: Poor	0.20	0.20	0.00	0.18	0.20	-0.02***
Wealth Quintile: Middle	0.20	0.20	-0.00	0.19	0.20	-0.01***
Wealth Quintile: Richer	0.21	0.21	-0.00	0.22	0.21	0.01***
Wealth Quintile: Richest	0.20	0.20	-0.00***	0.25	0.20	0.05***

Notes: Sample includes only women who had at least one birth at the time of the survey. Survey weights used to compute all means. Wealth index was available for only 150 survey rounds out of the total 230 used for the other variables. Standard errors to compute differences are clustered at the primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.

Table 2: First Stage: Both the instruments cause fertility to increase

	Fertility at the time of survey		
	(1)	(2)	(3)
First birth were twins	0.664***		0.685***
	(0.013)		(0.013)
First birth was female		0.127***	0.131***
		(0.002)	(0.002)
N	3,371,836	3,371,836	3,371,836

Notes: All regressions control for age, education level, rural residence and country by survey round fixed effects. Standard errors shown in parantheses are clustered at the level of primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.

Table 3: Main Results: Effect of Realized Fertility on Desired Fertility

	OLS	**Reduced Form**		**2SLS**		
	(1)	(2)	(3)	(4)	(5)	(6)
Realized Fertility	0.267***			0.147***	0.296***	0.230***
	(0.001)			(0.020)	(0.016)	(0.012)
Instruments:						
First birth were twins		0.098***		X		X
		(0.014)				
First birth was female			0.038***		X	X
			(0.002)			
N	3,371,836	3,371,836	3,371,836	3,371,836	3,371,836	3,371,836

Notes: All regressions control for age, education level, rural residence and country by survey round fixed effects. Standard errors shown in parantheses are clustered at the level of primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.

Table 4: Main Results: Effect of Realized Fertility on Desired Fertility by Region

	First Stage (1)	Reduced Form (2)	IV (2SLS) (3)	N (4)
Panel A: Twins				
Central Asia	0.603***	0.144*	0.239*	30,237
	(0.095)	(0.085)	(0.133)	
Latin America & Caribbean	0.611***	0.146***	0.239***	468,023
	(0.032)	(0.032)	(0.051)	
North Africa West Asia	0.414***	0.109***	0.264***	215,035
	(0.031)	(0.029)	(0.069)	
South & Southeast Asia	0.664***	0.042***	0.063***	1,678,675
	(0.014)	(0.011)	(0.017)	
Sub-Saharan Africa	0.695***	0.094***	0.135***	973,045
	(0.019)	(0.024)	(0.034)	
Panel B: First female				
Central Asia	0.096***	0.037**	0.388***	30,237
	(0.015)	(0.016)	(0.150)	
Latin America & Caribbean	-0.000	0.006	-13.636	468,023
	(0.005)	(0.005)	(156.218)	
North Africa West Asia	0.157***	0.043***	0.273***	215,035
	(0.007)	(0.006)	(0.040)	
South & Southeast Asia	0.226***	0.059***	0.259***	1,678,675
	(0.002)	(0.002)	(0.007)	
Sub-Saharan Africa	0.006	0.011**	2.054	973,045
	(0.004)	(0.005)	(1.416)	

Notes: All regressions control for age, education level, rural residence and country by survey round fixed effects. Standard errors shown in parantheses are clustered at the level of primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.

Table 5: Effect on Desired Fertility by Sex

	Desired Fertility by Sex		
	Boys	Girls	Either
	(1)	(2)	(3)
First birth were twins	0.021**	0.033***	0.039***
	(0.010)	(0.009)	(0.013)
First birth was female	-0.077***	0.111***	0.005**
	(0.002)	(0.001)	(0.002)
N	3,129,020	3,129,020	3,129,020

Notes: This table breaks down the desired fertility into the desired number of boys, girls or either sex and shows the reduced form results on each of them of the two instruments. All regressions control for age, education level, rural residence and country by survey round fixed effects. Standard errors shown in parentheses are clustered at the level of primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.

Appendix

Table A1: Sample Distribution by Countries

Country	Number of	Sample Share		Population Share	
	Survey Rounds	Unweighted	Weighted	Sample	Global
India	5	35.5	36.0	33.1	17.8
Indonesia	6	4.9	5.1	6.5	3.5
Peru	5	4.2	4.0	0.7	0.4
Colombia	5	3.2	3.1	1.3	0.7
Bangladesh	5	2.8	2.8	3.9	2.1
Egypt	5	2.5	2.5	2.4	1.3
Nigeria	5	2.4	2.4	4.8	2.6
Philippines	6	1.8	1.8	2.6	1.4
Malawi	4	1.7	1.7	0.4	0.2
Dominican Republic	5	1.7	1.6	0.2	0.1
Senegal	4	1.6	1.5	0.4	0.2
Rwanda	5	1.4	1.4	0.4	0.2
Jordan	5	1.4	1.4	0.2	0.1
Benin	5	1.3	1.3	0.4	0.2
Cambodia	3	1.3	1.3	0.4	0.2
Zambia	6	1.3	1.3	0.4	0.2
Nepal	5	1.2	1.2	0.7	0.4
Madagascar	5	1.2	1.2	0.7	0.4
Mali	5	1.2	1.2	0.6	0.3
Tanzania	5	1.1	1.2	1.5	0.8
Uganda	5	1.1	1.1	1.1	0.6
Bolivia	3	1.1	1.1	0.4	0.2

Table A1: Sample Distribution by Countries

Country	Number of	Sample Share		Population Share	
	Survey Rounds	Unweighted	Weighted	Sample	Global
Ethiopia	3	1.0	1.0	2.8	1.5
Haiti	5	1.0	1.0	0.2	0.1
Pakistan	4	1.0	0.9	5.2	2.8
Cameroon	5	0.9	0.9	0.6	0.3
Burkina Faso	4	0.9	0.9	0.6	0.3
Honduras	2	0.9	0.9	0.2	0.1
Sierra Leone	3	0.8	0.8	0.2	0.1
Zimbabwe	5	0.8	0.8	0.4	0.2
Guatemala	2	0.8	0.8	0.4	0.2
Turkey	5	0.8	0.8	2.0	1.1
Kenya	4	0.8	0.8	1.3	0.7
Mozambique	3	0.8	0.8	0.7	0.4
Niger	4	0.7	0.7	0.6	0.3
Guinea	4	0.7	0.7	0.4	0.2
Namibia	4	0.6	0.6	0.0	0.0
Ghana	5	0.6	0.6	0.7	0.4
Chad	3	0.6	0.6	0.4	0.2
Congo Democratic Republic	2	0.6	0.6	2.0	1.1
Nicaragua	2	0.5	0.5	0.2	0.1
Liberia	3	0.5	0.5	0.2	0.1
Burundi	2	0.5	0.5	0.4	0.2
Armenia	3	0.5	0.5	0.0	0.0
Cote d'Ivoire	2	0.4	0.4	0.6	0.3

Table A1: Sample Distribution by Countries

Country	Number of	Sample Share		Population Share	
	Survey Rounds	Unweighted	Weighted	Sample	Global
Lesotho	3	0.4	0.4	0.0	0.0
Timor-Leste	2	0.4	0.4	0.0	0.0
South Africa	2	0.4	0.4	1.5	0.8
Tajikistan	2	0.4	0.4	0.2	0.1
Gambia	2	0.4	0.4	0.0	0.0
Morocco	2	0.4	0.4	0.9	0.5
Congo	2	0.4	0.4	0.2	0.1
Togo	2	0.4	0.4	0.2	0.1
Brazil	2	0.4	0.4	5.2	2.8
Albania	2	0.4	0.3	0.0	0.0
Angola	1	0.3	0.3	0.7	0.4
Vietnam	1	0.3	0.3	2.4	1.3
Maldives	2	0.3	0.3	0.0	0.0
Gabon	2	0.3	0.3	0.0	0.0
Papua New Guinea	1	0.3	0.3	0.2	0.1
Kyrgyz Republic	2	0.2	0.2	0.2	0.1
Mauritania	1	0.2	0.2	0.2	0.1
Myanmar	1	0.2	0.2	1.3	0.7
Kazakhstan	1	0.2	0.2	0.4	0.2
Azerbaijan	1	0.2	0.2	0.2	0.1
Ukraine	1	0.1	0.1	1.1	0.6
Comoros	2	0.1	0.1	0.0	0.0
Central African Republic	1	0.1	0.1	0.2	0.1

Table A1: Sample Distribution by Countries

Country	Number of	Sample Share		Population Share	
	Survey Rounds	Unweighted	Weighted	Sample	Global
Yemen	1	0.1	0.1	0.7	0.4
Eswatini	1	0.1	0.1	0.0	0.0
Paraguay	1	0.1	0.1	0.2	0.1
Guyana	1	0.1	0.1	0.0	0.0
Uzbekistan	1	0.1	0.1	0.7	0.4
Sao Tome and Principe	1	0.1	0.1	0.0	0.0
Total	–	–	–	–	**53.7**

Notes: Column (1) list the total number of DHS survey rounds used of respective countries. Columns (2) and (3) show the share of observations from each country without and with the sample weights respectively. Columns (4) and (5) give the population share of each country within the sample and overall. Comparing columns (4) and (3) indicate that the countries ahve similar weight as per their population.

Table A2: Sample Sensitivity: Effect of Realized Fertility on Desired Fertility for Different Geographical Samples

	Twins			**First Female**			
	FS (1)	RF (2)	IV (3)	FS (4)	RF (5)	IV (6)	*N* (7)
Full Sample	0.659***	0.080***	0.122***	0.128***	0.037***	0.291***	3,374,329
	(0.011)	(0.011)	(0.017)	(0.002)	(0.002)	(0.013)	
India Sample	0.632***	0.025**	0.040**	0.293***	0.078***	0.268***	1,197,440
	(0.016)	(0.012)	(0.019)	(0.002)	(0.002)	(0.006)	
Non-India Sample	0.649***	0.094***	0.144***	0.030***	0.012***	0.397***	2,176,889
	(0.013)	(0.015)	(0.023)	(0.002)	(0.003)	(0.083)	
Contains Wealth Data	0.631***	0.072***	0.114***	0.145***	0.043***	0.296***	2,626,528
	(0.012)	(0.012)	(0.019)	(0.002)	(0.002)	(0.013)	
Contains Wealth Data	0.640***	0.078***	0.122***	0.142***	0.041***	0.289***	2,626,528
(*Controlling for wealth*)	(0.012)	(0.012)	(0.019)	(0.002)	(0.002)	(0.013)	

Notes: Columns (1) and (4) show the effect of the corresponding instrument on realized fertility, (2) and (5) on desired fertility, whereas columns (3) and (6) show the IC estimate for the causal effect of realized fertility on desired fertility. All regressions control for age, education level, rural residence and country by survey round fixed effects. The last row also additionally control for wealth. Standard errors shown in parentheses are clustered at the level of primary sampling unit. ***p<0.01, **p<0.05, *p<0.10.