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Abstract

Using multiple births as an Instrumental Variable (IV) for family size and data for 43 developing countries, I find evidence that a shock in fertility has a cost for a family as a whole. Mothers are more likely to live under less stable family arrangements and they are more likely to use contraceptives. Children are less likely to receive some vaccines, attend school, live their mother and there is an increase in odds of mortality. The analysis by level of development reveals the cost of fertility comes from those countries with lower level of development.

Keywords: Fertility, Health, Education, Family Arrangements, Developing Countries.

JEL classification: J11, J12, J13, J18, O15.

Resumen

Utilizando nacimientos múltiples como variable instrumental (IV) para el tamaño de la familia y datos para 43 países en vías de desarrollo, se encuentra evidencia de que un incremento en el número de niños tiene un costo para toda familia en su conjunto. Las madres son más propensas a vivir en estructuras familiares menos estables, como también, a usar anticonceptivos. Los niños en dichas familias son menos propensos a recibir algunas vacunas, a asistir a la escuela, vivir con sus madres y para alguna de las muestras, se observa un aumento en la mortalidad infantil. El análisis por nivel de desarrollo revela que el costo de la fertilidad proviene de aquellos países con menores niveles de desarrollo.

Palabras claves: Fertilidad, Salud, Educación, Estructura Familiar, Países en vías de Desarrollo.

Códigos JEL: J11, J12, J13, J18, O15.

1 Introduction

In this paper by using a sample of 43 developing countries I study the impact of fertility not only on children but also on the complete family. Indeed, an integral understanding of the impact of fertility on the complete household as well as the knowledge of degree of freedom of families to allocated resources is required when trying to understand the recent findings which cast doubt on the impact of family size on children wellbeing.

Although Rosenzweig and Wolpin (1980) support a negative impact of number of births on child's education for India, thirty years later, new evidence is less supportive of a tradeoff between family size and child quality as proposed by Becker's Quantity & Quality model [Becker and Lewis (1973); and Becker and Tomes (1976)]. Specifically, Black, Devereux and Salvanes (2005), using multiple births as a source of variation in family size and administrative data for Norway, find no impact of number of siblings on educational attainments. Angrist, Lavy and Schlosser (2010), also using multiple births (for some of the samples) as a source of variation in family size and census data matched with administrative data for Israel, do not find evidence of a quantity-quality trade-off across samples.

Angrist, Lavy, and Schlosser (2010) suggest four factors explaining this "absence of causal link" between fertility and long-term outcomes. First, parents might make use of perfect capital markets to support child investment independently of current resource constraints. Second, parents facing a shift in family size adjust "on margins other than quality inputs" or "marginally irrelevant inputs." That is, parents who experience an increase in the number of children over a desired quantity will first reduce investment in those inputs with lower return on final child wellbeing and therefore minimize the final impact on children. Third, welfare and public spending help families that are exposed to an unexpected increase in family size. Finally, it might be the case that there are gains in family size due to social interaction.

Empirically, and consistent with these hypotheses, Caceres-Delpiano (2006) and Conley and Glauber (2006), estimate a negative and significant impact of number of children on the probability of attending a private school for the United States. Caceres-Delpiano (2004) finds a positive impact on the probability that a child would share the bedroom for the US as well. Both school type and sharing bedroom are probably investment margins with a lower return on child wellbeing than completed years of education, for example. In fact, Cáceres-Delpiano (2006) does not find an impact on the probability of repeating a grade or years of education, which are margins closer to final wellbeing. Finally, consistent with the idea of public funds helping individuals stressed because of a shock in fertility, Cáceres-Delpiano and Simonsen (2010) find that, for the United States, an increase in family size increases the likelihood of welfare participation and the use of Medicaid.

Moreover, implicitly in the previous hypotheses is the active role of other household members (parents) to buffer an expected change in fertility. Empirically, nevertheless, the impact of family size on other members of the household has focused primarily on its impact on mothers' labor force participation. To the best of my knowledge, Cáceres-Delpiano and Simonsen (2010) is one of the few studies focusing on other dimensions and other household members. Specifically, Cáceres-Delpiano and Simonsen (2010), using US census data and the National Health Interview Survey, investigate the effect of family size on a variety of measures of well-being and demonstrate that additional children increases the likelihood of mothers suffering from high blood pressure as well as increasing the propensity to smoke and the risk of obesity, among other outcomes.

Therefore, this paper advances the literature in three important ways. First, using Demographic Health Survey (DHS) data for 43 developing countries and the event of multiple births at different parities as a source of variation in family size, I provide evidence of the impact of family size not only on child outcomes but also among other members in the household. Second, by using data from developing countries, I am able to study a sample of families for whom family planning policies should have a higher return[1] since these families have fewer margins out of child investment;[2] they are more likely to face an incomplete capital market, and; lack the support of welfare institutions. All these factors not only increase the likelihood that a shock in family size reaches child´s wellbeing but also the likelihood that other household members are affected. In fact, a hypothesis based on fewer degrees of freedom in developing countries when facing a shock in fertility is consistent with earlier evidence for India supporting a trade-off [Rosenzweig and Wolpin (1980)] versus the latest evidence using data for developed countries such as Israel [Angrist, Lavy and Schlosser (2010)], Norway [Black, Devereux and Salvanes (2005)] or the US [Cáceres-Delpiano (2006)]. Finally, exploiting disparity in levels of development among the countries in the sample, I provide evidence about the heterogeneity in the impact of fertility across different levels of development. Thus, by focusing the analysis on less developed countries, first, I am able to not only to study a sample of families for whom family planning policies should have the higher return but also families with fewer margins out of child investment. Specifically, I study the impact of fertility on family arrangements, acceptance of violence, and contraceptive behavior.[3] Finally, I look at the effect of number of children on children outcomes measured by children's vaccinations, years of education, grade retention, the likelihood of attending school, mortality and the probability of living in the same household than their mother.

The results of the investigation reveal that there is a positive return of caring for family size in the context of developing countries. Using multiple births as an Instrumental Variable (IV) for family size, I find evidence that a shock in fertility has a cost for a family as a whole. First, we observe that an increase in family size is associated with an increase in the incidence of unstable family arrangements, measured by an increase in the likelihood that a mother holding a non-traditional role (being the head of the household or not the spouse of the household head), decreases the likelihood of being married and decreases the likelihood that the mother's spouse (partner) lives in the same household. For outcomes

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1. This suggested higher return in developing countries goes beyond an increase in child investment. At the macro level, a reduction in fertility in a context of fixed capital and a decreasing return in labor will increase labor productivity. Also, a transition to regimes with lower fertility and lower mortality implies a demographic change with a higher proportion of the population in ages with higher saving rates (Schultz, 2007).

2. In developing countries, families have lower levels of income (wealth), so the marginal utility of income is high and families work long hours for low wages. Since the marginal utility of wealth is high in developing countries, parents are not "able" to cut back on work to raise children, at least in earlier parities, so children get little time and, relative to smaller families, get less market derived goods. For example, families just above starvation will have both parents working full-time. As such, a new child is essentially a negative wealth shock so the marginal utility of wealth must rise. However, since families cannot work more, they can only consume less; that is, "feed" each person less. This will not only lower child "quality" but the amount of resources allocated to other members in the household. In a developed country, parents have some leisure. If leisure and childrearing are close substitutes, then an extra child might lead parents to substitute out of leisure into childrearing. In case time and goods are substitutes in child production they might substitute out of child rearing goods, which to some extent might mitigate the effects on adult consumption and perhaps on adult labor.

3. The use of contraceptives not only captures the impact on forgone utility in adults but also constitutes a first line investment to prevent the spread of a shock in family size on other children, not only by reducing the chance of an additional child but also reducing the uncertainty of family size.

directly associated to mothers' wellbeing, I first find that an upward shift in the number of children increases the likelihood of accepting violence for some of the samples. Second, for the variables characterizing contraceptive behavior, I find that an increase in fertility raises the time between intercourses and increases the use of contraceptives, sterilization among them. For children's outcomes, the findings reveal that more children in a family decrease the likelihood of a completed vaccination schedule, increase the odds of child mortality, reduce the probability of attending school and we observe a reduction in the likelihood of living in the same household than their mother. The analysis by level of development of the countries reveals an important degree of heterogeneity. While the impact on outcomes measuring family arrangements and children wellbeing is driven for countries with a lower level of income, the impact on a mother's acceptance of violence comes from those countries in the middle part of the distribution. Finally, the impact on contraceptive behavior shows a different type of heterogeneity. At all levels of development, mothers change their contraceptive behavior. Nevertheless, at higher levels of development, the use of contraceptive alternatives such as sterilization is preferred, while in regions with a lower level of development, the alternatives used are spacing of intercourse, abstinence and withdrawal.

The paper is structured as follows. In Section 2, the empirical specification and identification strategy are presented. Section 3 details the data used in the analysis, the criteria applied to the construction of samples and outcomes in the investigation. In Section 4 the results are presented and Section 5 concludes.

2 Empirical Methodology and Identification

The following expression corresponds to the specification of interest in the analysis,

$$y_{ict}^{s} = \rho_{tc}^{s} + \pi_{a}^{s} + \theta_{e}^{s} + \delta_{U}^{s} + \gamma^{s} n_{ict}^{s} + \varepsilon_{ict,}^{s} \qquad \text{(E1)}$$

where y_{ict}^{s} represents an specific outcome for a mother or child i, who lives in country c, at year t, and belongs to a sample s[4]; n_{ict}^{s} represents family size and; the terms π_{a}^{s}, θ_{e}^{s} and δ_{U}^{s} are fixed effects by age, educations and urban status of the mother, respectively. Finally, the term δ_{U}^{s} is a fixed effect for year and country.[5]

The impact of family size on mother's or children's outcomes is measured by γ^{s}. As a profuse literature has documented, OLS estimates of equation (E1) may be subject to an omitted variable bias since the $\mathrm{cov}(\mathrm{n_i}, \varepsilon_\mathrm{i})$ is not zero[6] (Shultz, 2007). Therefore, statistical inference based on OLS will provide an inconsistent estimate of γ^{s}. In order to address this omitted variable bias and how it has been done in previous studies (Black, Devereux and Salvanes, 2005; Caceres-Delpiano, 2006; Angrist, Lavy, and Schlosser, 2010 and; Caceres-Delpiano and Simonsen, 2011), I use multiple births as a source of variation in family size. Specifically, I define $\mathrm{mb_S}$ as the binary instrument, multiple births, that takes a value equal to one for a family (mother) with a multiple birth in the s birth and zero otherwise. Specifically, in the analysis three sub-samples are defined according to the value of s. The first sub-sample consists of mothers with one or more births (1+) whose instrument is $\mathrm{mb1}$, the second one, families with two or more children (2+) whose instrument is $\mathrm{mb2}$, and finally, mothers with three or more births (3+) whose instrument is $\mathrm{mb3}$.

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4. The economic foundation for equation (E1) can be contextualized using the notation from the treatment literature. The population of interest, s, is represented by a family with an endowment of s births at a specific moment t. For this sample of families we are interested in the treatment, n^{s}, which for the sake of simplicity in the exposition, is defined as a dummy variable taking the value of one in case a mother goes for an additional child (birth) over s, and zero otherwise. Given this treatment, we can define two counterfactuals for an specific outcome; Y_0 as the outcome for a woman who does not receive the treatment, that is, in case she decides for a family size of s ($n^{s} = 0$) and; Y_1 as the outcome for an individual who receives the treatment, or in other words, decides for a family size bigger than s ($n^{s} = 1$). Then for each individual we can define ($Y_1 - Y_0$) as the treatment effect associated with an increase in family size beyond s. This treatment can vary among families with different values for a set covariates, X. Specifically, each of these counterfactuals can be expressed as, $Y_v = \mu_v(X) + U_v$ with $v = 0,1$. Then, it may be the case that controlling for X the treatment effect, ($Y_1 - Y_0$), is the same for all families (homogeneous treatment effect given $\underline{X}$). Nevertheless, more realistic mothers (children) vary in their response to the increase in family size even after controlling for the observed covariates and the impact of family size cannot any longer be summarized by a scalar but for a distribution. Often economists focus on some mean of the distribution of ($Y_1 - Y_0$) and use a regression framework to interpret the data [Heckman, Urzua and Vytlacil (2006)]. Specifically, using switching regression framework we can represent the observed outcome according to the following regression model, $Y^{s} = n^{s}Y_1 + (1 - n^{s})Y_0 = \alpha^{s} + \gamma^{s}n^{s} + \varepsilon^{s}$, $\alpha^{s} = \mu_0$, $\gamma^{s} = Y_1 - Y_0 = \mu_1 - \mu_0 + U_1 - U_0$, $\varepsilon^{s} = U_0$, and for the sake of simplicity in the exposition other covariates, X, are left implicit. In this framework, the impact of family size on mother's (child's) outcomes is measured by γ^{s}.

5. Introducing fixed effects at year-country level is identical to allow fixed effects at survey level. There has been a continuous update in the survey design and fixed effects at the survey level control for these updates.

6. Fertility and family resource allocation are determined jointly and simultaneously within a lifetime household decision-making framework; thus we expect that unobserved economic constraints on the family and parent's preferences will impact on fertility decisions and other lifetime household behaviors. Specifically, in the empirical literature studying the impact of fertility (on children, mother's labor force participation and family structure) special stress has been given to an abstract concept of "ability" or, in a model like Browm and Flinn (2006, 2010), to the variable measuring "marriage value." Although it seems that there is some agreement about some of these factors behind the endogeneity of number of children, defining the sign of the bias associated to this omitted variable problem, is a much harder task. Specifically, this bias will depend on the model that the researcher has in mind and therefore the potential unobserved factors that are correlated with fertility and the selected outcomes.

Whether or not the occurrence of multiple births is an appropriate instrument depends on the legitimacy of two well-known assumptions. First, the correlation between multiple births and family size is different from zero. This assumption implies that there should be enough correlation between multiple births and family size, so an average difference in family size exists and can be measured properly. Women who experience a multiple birth have some ability to adjust their subsequent fertility. For example, a mother that would like four children may simply quit having children if on her third birth she delivers twins. This is particularly problematic when working with developing countries, given the higher observed fertility. Nevertheless, heterogeneity in the ideal number of children ensures that at least for some individuals, multiple births produce a shift in family size even at lower margins of family size. I show in the following section that multiple births, in fact, shift mother's number of children upward for all subsamples.

The second assumption, non-testable, is no correlation between the instrument and the error term in the regression. This assumption implies that there should not be a correlation between multiple births and the error term, so that any impact that is observed over the variable of interest should be necessarily attributed to a change in family size. There are two types of twins, the most common of the multiple pregnancies: identical (monozygotic) and fraternal (non-identical, dizygotic). Identical twins occur when a single embryo divides into two embryos. Identical twins have the same genetic makeup and their incidence is equal in all age groups and countries (3.5 per 1000 births). Fraternal twins occur when two separate eggs are fertilized by separate sperms. The occurrence of fraternal twins, unlike identical twins, varies and there are several risk factors that may contribute to increase their incidence[7]. In the existent literature, there are two concerns when using multiple births as instrument for fertility. First, multiple births have a higher incidence among mothers undergoing fertility treatments and among women who come from families with previous incidence of fraternal twins. Nevertheless, given the sample under analysis (developing countries), the average age of the first child and the cost associated with fertility treatments, the use of fertility drugs should not be a concern in my analysis[8]. Also, there is no priori information that women are acting differently based on this hereditary information or that hereditary factors are associated with a particular group of the population.

A second concern raised by Rosenzweig and Zhang (2006) when studying the impact of fertility on child investment refers to the possibility that parents might allocate resources to compensate for (reinforce) an endowment shock. In fact, among twins and higher-order multiple birth children, for example, triplets and quadruplets, rates of low birth weight and infant mortality are 4 to 33 times higher compared to singleton births. Moreover, twins and other higher-order multiple births are more likely to suffer life-long disabilities if they survive (National Vital Statistics Report, 1999). Thus, mothers (parents) might on the one hand react by reallocating resources between household members to compensate for a shock in

7. For the US according to the American Society for Reproductive Medicine, first, the incidence is higher among the Afro-American population. Second, non-identical twin women give birth to twins at a rate of 1 set per 60 births, which is higher than the rate of 1 of every 90 births, at the national level. Fourth, women between 35 to 40 years of age with four or more children are three times more likely to have twins than a woman under 20 without children. Finally, multiple births are more common among women who utilize fertility medication (Martin and Park 1999).

8. Using US Census data for the year 1980 and data from the National Health Interview Survey for the period 1982-1989 (also for the US), I construct the share of children who were twin births by year of births. That fraction is plotted in Figure 1. The share of twins is stable for the period under analysis (with a little more dispersion for the NHIS data due the smaller sample size). Moreover, this proportion of twin births before the penetration of fertility drugs during the early 90's is approximately 1.7% to 1.9% which is practically the same as we found in this current analysis with around 2% of twin births (see, Table 2). Additionally, this proportion is quite close to numbers reported by the US National Vital Statistical Service (NVSS) showing a 1.95% and 1.86% of twin births for the periods 1962-1968 and 1971-1979, respectively.

endowment. This endowment canal would invalidate the exclusion restriction due to an impact of multiple births beyond the channel of fertility. Following Rosenzweig and Zhang (2006), I check the robustness of the findings by controlling for birth weight as measure of child endowment in the regression analysis for children outcomes[9]. Additionally, for mother's outcomes I use auxiliary data constructed from census data for three developing countries to check the robustness of the impact of fertility on different outcomes (the results and discussion are presented in the appendix). Specifically, I use disability status as a proxy for child endowment and I check the sensitivity of the estimates to the inclusion of this variable. The results for these two analyses prove the robustness of the results and they are reported in the appendix.

Moreover, and for the reasons already explained, we expect that children belonging to multiple births were different of the rest of the population. To address this concern, specifically in the analysis of children's outcomes, I keep all children from births prior to the s pregnancy as a unit of observation[10]. That is, for the sample of families with two or more children (2+)[11], I restrict the analysis to the oldest child in the family. Then for samples 3+, the unit of observation will be the two oldest siblings in the family. These children are all from families that planned on having a second (third) child, but may not have banked on having a third (fourth) one. More importantly, by focusing our attention on the older children, I examine children affected by multiple births through family size rather than through other factors directly related to being part of a multiple birth. Specifically, the observational unit in equation (1) when I analyze the impact on children's outcomes will be the older children (siblings) in the household that do not belong to a multiple birth and he (they) has (have) at least one additional sibling at birth s. Nevertheless, when the outcomes are at the family or an adult (mothers) level, I keep one observation per family (mother).

Therefore, despite the fact that the second assumption is non-testable, the random nature of multiple births, the choice of the observational unit under analysis (oldest child in the household that does not belong to a multiple birth when I study the impact on children), the inclusion of other variables that are correlated with the incidence of multiple births such as age of the mother or the mother's education and the analysis of the impact of twinning in a specific birth, *s;* make it more likely that this assumption holds.

The impact of family size as presented in equation (E1), is constant across observations, although this assumption may be unrealistic given the obvious heterogeneity in household's preference, production technology and constraints[12]. Extensive literature on program evaluation has mentioned the importance of addressing this heterogeneity in the

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9. Rosenzweig and Zhang use child's birth weight as a proxy of child endowment. DHS data have information on birth weight only for some of the children (younger than five) in the household and only for some of the country-year samples. This limitation in the sample and the high requirements of data (sample size) faced when using multiple births as source of variation, make this alternative really costly in term of power. Restricting the sample to children younger than five, I get approximately 50% of the sample with missing information about birth weight. Moreover, the lack of information is negatively correlated with mother's education, urban status and level of development of the country. Instead of just restricting the sample to those having information about birth weight, I consider a interaction of birth weight and a dummy variable that reflects if the information on birth weight is missing or not.

10. When estimating equation (E1) for children's outcome, I introduce child's age and gender dummies. Moreover, for the sample of families with three or more births (sample 3+), dummy variables for birth order is also introduced in the specification. Because for sample 2+ I restrict the sample just to the oldest child in the family, we do not need a dummy for birth order.

11. For the same reasons, the analysis for children cannot be done for the sample 1+. The variation in family size due to multiple births happens in the first birth. Therefore, we do not have children born prior to the event of multiple births.

12. The use of the concept of heterogeneity as synonymous with selection is often observed in the empirical literature. Here we make reference to the fact that the parameter γ^s cannot be summarized by scalar rather with a complete distribution (Heckman, Urzua and Vytlacil, 2006).

impact of a specific "treatment". Heckman (1997) calls attention to the role of the heterogeneity and the sensitivity of IV to assumptions about how individuals internalize this heterogeneity in their decisions of being part of the treated group (i.e. the selection of family size). Imbens and Angrist (1994) have shown that IV estimates can be interpreted as a "Local Average Treatment Effects" (LATE) in a setting with heterogeneity in the impacts and individuals whose actions take this heterogeneity into account[13]. In this case, IV identifies the impact of an increase in family size for those families that have had more children than they otherwise would have, due to multiple births. Angrist, Lavy, and Schlosser (2010) show that in the specific case of using the event of multiple births as an instrument, and due to its the perfect compliance[14], the LATE can be interpreted as an Average Treatment Effect on the Non-Treated. That is, the population of compliers is composed by all the mothers who wanted to stay at a specific family size, s, as the ideal number of children, who nevertheless, as a product of multiple births were pushed to a bigger family size, that is the "Non-Treated" at s. Therefore, the instrument identifies an increase in family size for families who sought an "s" pregnancy (child) but received one (twins) or more (triplets, quadruplets, etc.) additional children. In fact, this is the population of individuals that higher values of "s" policy makers have in mind when defining the benefits of family program initiatives.

Although all the countries in our sample can be defined as underdeveloped, we have a great level of heterogeneity among them in terms of development. Moreover as I mentioned in the introduction, there are reasons to expect some level of heterogeneity in the impact of fertility. In fact, the empirical evidence casting doubt about the negative impact of fertility on children's long-term wellbeing is restricted to developed countries such as Israel (Angrist, Lavy, and Schlosser, 2010), or Norway (Black, Devereux and Salvanes, 2005). Thus, by focusing the analysis on less developed countries, first, I am able to not only study a sample of families for whom family planning policies should have the higher return but also families with fewer margins out of child investment. To study the heterogeneity by level of development, I estimate (E1) for different levels of development. Specifically the World Bank Country Classification (WBCC) for the year 2009 is used to define these levels of development[15]. Table1 reports the classification of each country according the WBCC[16]. Using this classification, countries in the sample are defined as "Low Income" (23), "Lower Middle Income" (13) and "Upper Middle Income" (7) without one falling into the category of "High Income."

13. When $\gamma^s$is homogenous, multiple births being a valid instrument (as well as any other valid instrument) will allow us to identify all the relevant parameters such as the ATE, ATT or ATUT since they all are the same (Heckman, Urzua and Vytlacil, 2006). Nevertheless, with γ^s being heterogeneous and individuals sorting in the gains of family size, the interpretation of the parameter estimated with multiple births (or other instruments) is less straight forward.

14. The average treatment effect on the untreated can be expressed as a weighted average of the average treatment on "Never-takers" and the average treatment on "Compliers" (see Angrist and Pischke (2009) for details). The terms of "never-takers" and "compliers" come from the analogy with randomized trials where some experimental subjects comply with the randomly assigned treatment but some do not. Those who do not get "treatment" when randomly assigned to do so are those defined as never-takers. Nevertheless in the specific case of multiple births, mothers (families) who wanted to stay at a specific family size but face a multiple births in that "s" birth cannot avoid being pushed (treated) to a family size bigger than s. Therefore, there are not "never-takers" when using multiple births as a source of variation of family size.

15. Economies are classified according the 2009 GNI per capita. The groups are "low income," $995 or less; "lower middle income," $996-$3,945; "upper middle income," $3,946-$12,195 and; "high income," $12,196 or more.

16. In a previous version of the paper countries were classified by Human Development Index (HDI) or country region and similar results were obtained.

3 Data

The primary data source in the analysis is the Demographic and Health Surveys (DHS)[17]. These surveys are nationally-representative household surveys that provide data for a wide range of monitoring and impact evaluation indicators in the areas of population, health and nutrition. The sample in each country-year is typically a stratified random sample of all non-institutional households[18]. The universe of the survey is mothers who are 15 to 49 years old at the time of the interview. The analysis is restricted to 43 developing countries for which there is an average of two sample years (Table 1). The criterion for selecting these countries and years is based on getting a large enough sample size and ensuring that the key information for constructing the sample and variables were available and consistently measured.

The sample is restricted to those mothers who are between 18 and 45 years old, and who had their first birth between 15 and 35 years of age. By doing so, I focus on women who are in the middle of their childbearing years and who started their reproductive lives neither too early (before 15 years of age) nor extremely late (after 35 years of age). I also restrict the sample to those mothers whose oldest child is under 17 years of age.

The mother's measure of fertility, n_{ict}^{s}, is number of surviving children.[19] This definition of fertility differs from the total number of children living with their parents. In fact, the decision that children live in the same household or turning them over to relatives (or any other third party) can be seen as an outcome of family size which I explore when I analyze the impact on children outcomes.

Following Bronars and Grogger (1994) and Angrist and Evans (1998), multiple births can be identified here by not only exploiting the fact that DHS data reports the year and month of birth for each of the children a woman had but also using the direct information provided in the DHS data on whether a child belongs or not to a multiple birth. Then, in the case of two or more children in the household who belong to a multiple birth, they have the same age, the same month of birth and the same mother, they are defined to be twins (or multiple births). Since multiple births are rare, a large sample is needed in order to have sufficient statistical power; this is provided by combining the different DHS cross sections. Using the algorithm outlined above, I classify 2.05 percent of these children as multiple births, 2.02 percent of which are twins (Table 2).

Three groups of outcomes are included in the analysis: household structure; violence rationalization, mothers' contraceptive behavior, and children's outcomes. While the first group of variables intends to capture the impact on the organization of the household, the second and third groups of variables tries to measure a direct impact on mothers' wellbeing and the fourth group of variables the impact on a traditional measure of child's outcomes.

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17. Source: ICF Macro, 2009. MEASURE DHS http://www.measuredhs.com.

18. Giving this sample design, all regressions in the present analysis incorporate sample weights.

19. In a previous version, children ever born was used as measure of fertility with similar qualitatively results. In this version I choose number of surviving children over children ever born to keep comparability with previous studies such as Angrist, Lavy, and Schlosser (2010) or Black, Devereux and Salvanes (2005). These two studies by using matched administrative data construct fertility based on existing records; therefore the measure of fertility is closer to number of surviving children. I also tried a measure of fertility adjusted by child spacing, and in general, the estimates for all regressions tend to be bigger.

The impact of number of children on family structure is formalized by Brown and Flinn (2006) who demonstrate the simultaneous interaction between child quality and the decision of divorce in a model of the family dynamics. Parents receive utility from child quality; as a result, exogenous increases in child quality, makes divorce more costly. Simultaneously, a reduction in the likelihood of getting divorced motivates a higher investment in child quality. Specifically, to analyze the impact in the household structure in our sample of developing countries, I use four variables to describe household arrangements. The first one, "Married," is a dummy variable taking a value one if a mother reports being married and zero otherwise. Although this measure is informative for western societies, the importance of this institution and its acknowledgement across societies is not the same. In order to have a broader definition, I construct the dummy variable, "Living with someone," which takes a value of one if a mother cohabitates and zero otherwise. Although the previous two variables are useful to know whether mothers report a spouse or partner, these measures could overestimate a "stable" family arrangement if there is some stigma associated with the end of a union. The following two variables attempt to overcome this problem. A third dummy variable, "Spouse at home," takes a value of one if the spouse is physically at home and zero otherwise. Finally, using information about the relationship with the household head, I define the dummy variable, "Non Traditional Role," which takes the value one if a mother is not the spouse of the head of household and zero otherwise. This last variable allows us to capture, first, the impact of fertility on female household headship, which has been associated with higher poverty rates, and also to measure the impact on family arrangements that enable transfer among family members away from the primary family unit.

Two types of variables are used to capture a direct impact of fertility on mothers. First, I use mother's acceptance of violence to mediate conflicts[20] as a measure of female wellbeing[21]. DHS data collect information about five dimensions which might motivate violence against mothers such as burning the food, neglecting children, going out without her husband's (partner's) approval, arguing with her spouse (partner), and refusing sex. I summarize these five dimensions in four dummy variables: "Any Reason" takes a value of one if, for whichever of the situation listed above, the use of violence is justified by a mother, and zero otherwise; "Household Neglect," takes a value of one if the respondent accepts violence if she would have neglected the children or she would have burned the food, and zero otherwise; "Husband Mistreatment" takes a value of one if she would have argued with her husband or she would have gone out without his approval, and zero otherwise, and finally; "Refuse sex" takes a value of one in case she justifies the use of violence when refusing sex, and zero otherwise.

Additionally, in this second group of variables which measure a direct impact on mothers, there are the ones characterizing contraceptive behavior. In fact, number of children, rather than being a deterministic variable fully controlled by parents, cannot be set with

20. A better measure of mother's wellbeing is probably the actual use of domestic violence. Nevertheless, few country-year samples in the DHS data provide this information. Additionally, actual domestic violence is subject to different measurement problems. First, domestic violence is specific to a family arrangement which can be simultaneously affected by fertility decisions. Second, mothers might hide the actual use of violence in the household. Therefore, I use the acceptance of the use of violence as second best since it does not require a partner/husband presence at home and it is less likely that this information would not be revealed.

21. A well documented relationship in the literature is the negative impact of fertility on mothers' labor attachment either in developed countries (Rosenzweig and Wolpin, 1980b; Bronars and Grogger, 1994; Jacobsen, Pearce, and Rosenbloom, 1999; Angrist and Evans, 1998; Hotz, McElroy, and Sanders, 2005) or developing countries (Caceres-Delpiano, 2010). Once women leave the labor market, they accumulate less training and market experience (Schultz, 2007). An increase in fertility will then reduce mothers' outside marriage value, which might reduce not only her bargaining power in the household but also make her more likely to suffer from domestic violence (Stevenson and Wolfers, 2006).

absolute certainty. Individuals control the probability of conception to some degree, with total fertility being a random variable. Michael and Willis (1973) develop a model with these characteristics[22]. By using Michael and Willis' notation, the probability of conception in a specific moment can be represented as $p_i = \beta c_i(1 - e_i^j)$, with β the "intrinsic fecundity," which is defined as the probability of conception from a single unprotected act of coition at a random point during the menstrual cycle, c_i the frequency of coition during the cycle, and e_i^j the reduction in probability of conception associated with the j contraceptive alternative. This expression points out the three channels through which individuals can alter their probability of conception: frequency of coition, use of contraceptives and the type of contraceptive used. Although the survey does not provide direct information about frequency of coition, mothers are asked about the number of days since the last intercourse. I use this variable as an inverse proxy of coition frequency. The second variable I define is a dummy variable, "Ever Use Contraceptive," which takes a value of one if the mother reports that she had used some contraceptive alternative and zero otherwise. Additionally, from the survey we can pin down in specific some of the contraceptive alternatives. In particular, I define the dummy variable "Sterilization," that takes a value of one if a mother has been sterilized and zero otherwise and the dummy variable "Abstinence/Withdrawal" taking a value one in case abstinence or withdrawal are used as a contraceptive options, and zero otherwise.

In a model like Michael and Willis's, a shift in fertility is predicted to produce an increase in the expected mean and therefore an increase in the dispersion of the expected fertility. This rise in the uncertainty in the expected fertility will increase the return associated with the use of contraceptives as a mechanism for reducing the uncertainty. For any ex-ante desired fertility, then, parents will be more likely to use contraceptives as a product of unexpected shock in fertility. Second, parents will be more likely to change to contraceptive alternatives with a lower marginal[23] cost (such as sterilization), everything else being constant, because more potential births will need to be prevented.

The final group of variables in my analysis is the one directly linked to children. In specific, for children outcomes I define three types: health, educational and family arrangement outcomes. First for health variables, I define four health dummies reflecting children's vaccination. DHS Birth Record data provide information about vaccination records for children younger than five years old. In particular I have information about

22. They set the problem in two steps. First, families select the distribution of family size that maximizes individuals' life utility, and in a second step, individuals select the contraception alternative that allows them to reach the desired conception probability at the lowest cost. An essential feature of the process is that the mean and dispersion of children are jointly determined by the choice of conception probability. Moreover, in Michael and Willis's model, for the nature of the process, mean fertility and its dispersion are positively correlated for low values of fertility. "Thus the greater the expected fertility, the greater is the uncertainty about the actual fertility, or greater is the expected deviation between the mean and actual fertility." Families then care not only about the average number of children but also its dispersion. This dispersion can be considered a risk factor which can also affect child quality.

23. In Michael and Willis's model, parents' benefit from the use of a contraceptive choice comes by reaching an "optimal" fertility in the sense that maximizes expected utility and because parents are able to reduce the uncertainty in the expected fertility, since the "optimal" fertility is below the "desired fertility" in a context of perfect and costless fertility control. Regarding the cost size, parents face not only money and time cost, but also forgo pleasure, health and cultural or religious principles when they select a specific contraceptive alternative (Michael and Willis, 1973). Then, parents in order to maximize their expected utility, parents select a specific mean fertility and the contraceptive alternative with the lowest associated cost that allows them to reach that expected fertility. Since contraceptive options differ in their marginal and fixed cost, those options with a relatively low marginal cost (in relation to the fixed cost) will be the ones preferred for those parents who want to reach a lower expected fertility, or in other words, avoid a greater number of potential births. The distinction between fixed and variable (marginal) costs in the model is based on the fact that the first one is not related to the degree of use of a specific contraceptive choice. While the cost of information about a specific contraceptive alternative fit as a fixed cost in the model, cultural or religious pressure when using a specific contraceptive or the forgone pleasure can be seen as a variable cost.

Measles[24], Poliomyelitis[25] (Polio), DPT (Diphtheria, Pertussis and Tetanus) and BCG (Bacillus Calmette-Guérin). Given the differences in the nature of these vaccines, the vaccination process can take more than one dose (Polio and DPT). Considering this information for each of these vaccines, I define a dummy variable to take a value of one if some doses have not been administered[26], and zero otherwise. Given the age restriction in the availability of vaccine information (children younger than five years old) and the restriction to the oldest siblings in the family, I restrict the analysis to the sample 2+ for the variable about vaccine[27]. Also in this group of health outcomes I define for children younger than seven a dummy variable, "death", that takes a value one when a mother reports that child is dead at the time of the survey, and zero otherwise. For educational outcomes, three variables are defined. First, "attend school" which is a dummy variable taking a value one in case a child is reported going to school, and zero otherwise; years of education and; finally a dummy variable that I define as "grade retention" that takes a value one when a child has a reported number of years of education lower than the mode observed in that specific country and age group. Finally, for family arrangements I define the dummy variable that takes a value one when a child is reported as not living in the same household than the mother, and zero otherwise.

The descriptive statistics for the household (mother) and children outcomes, as well as for other covariates in the analysis are presented in Table 3.

24. According to the World Health Organization (WHO), measles is a leading cause of vaccine preventable childhood mortality. In developed countries, most children are immunized against measles by the age of 18 months. The vaccination is generally not given earlier than this because children younger than 18 months usually retain anti-measles (antibodies) transmitted from the mother during pregnancy. A second dose is usually given to children between the ages of four and five, in order to increase rates of immunity. Vaccination rates have been high enough to make measles relatively uncommon. In developing countries, however, measles remains common.

25 The first dose of polio vaccine is given shortly after birth, usually between 1-2 months of age; a second dose is given at 4 months of age. The timing of the third dose depends on the vaccine formulation but should be given between 6–18 months of age. A booster vaccination is given at 4 to 6 years of age, for a total of four doses at or before school entry.

26 For each child I compared the number of doses administered with the mode for each country and age group. In the case that the number of doses is lower than the mode by age and country, I define that a dose has not been administered.

27 The information about vaccines is only available for a universe of children younger than 5 years old which in combination to the constraint of keeping just older siblings restricts the analysis to 20 and 10 percent of the samples 2+ and 3+, respectively. Moreover we have missing information about vaccines for approximately 50% of the sample. Therefore, the availability of information and the restriction in the unit of observation in order to ensure the exclusion restriction have a toll in the sample size to approximately 40 and 10 thousand children for the samples 2+ and 3+, respectively. Then, since the identification for the sample 3+ comes from approximately 30 observations with multiple births, I restrict the analysis of the impact of fertility on vaccine for the sample 2+ with approximately 360 births providing the source of variation in family size.

4 Results

4.1 First Stage. Multiple births and number of children

A (testable) necessary condition to ensure the validity of the instrument refers to the correlation between multiple births and family size so that an average difference in family size exists and can be measured properly. Specifically I estimate the following expression to check the relevance of the instrument,

$$n_{ict}^{s} = \varphi_{tc}^{s} + \vartheta_{a}^{s} + \tau_{e}^{s} + \sigma_{U}^{s} + \pi^{s} mb_{ict}^{s} + \varepsilon_{ict,}^{s} \qquad \text{(E2)}$$

with π^s as the impact of multiple births in the s birth for a woman i who lives in country c, who is observed at time t. The terms φ_{tc}^{s}, ϑ_{a}^{s}, τ_{e}^{s} and σ_{U}^{s} are fixed effects by country-year, mother's age, mother's education and urban status, respectively. The OLS estimates for π^s in equation (E 2), are presented in Table 4. Column 1 for the specification without other controls but country dummies, column 2 for the specification with all controls (equation E 2), and columns 3 to 5 for each of the three samples defined by the level of development of the country when using WBCC (2009). From the first two columns, we observe that the impact of multiple births is robust to the inclusion of other covariates in the model[28]. This finding is important since it reveals that at least based on these observed variables, multiple births are not strongly correlated with other covariates, and the positive impact that we observe on the number of surviving children is not driven by the correlation with the other covariates. Second, across all sub-samples, we observe a positive and statistically significant impact of multiple births (at a 1% significance level). Moreover, the "smallest" F-statistic is over 30, that is, higher than the most conservative critical value for the null hypothesis of weak instrument[29].

The magnitudes reported in Table 4 reveal for the complete sample (column 2) that the event of multiple births increases in approximately 0.3 the number of children for families that experience twining in a first birth and the magnitude goes up to 0.4 more children in the sample of families that experience multiple births in a third pregnancy. Notice too that as we divide the sample according the level of development, a higher impact of multiple births is observed among countries with higher level of income ("Upper Middle Income"), specifically when multiple births happen in a second or third birth (approximately 0.5 more children). This gradient in the impact of multiple births according the birth at which the twining happens and the level of development (income per capita) is not more than the combination of two facts. First, it is more likely that multiple births will increase family size as we get closer (or over) the "desire fertility" and second when families have smaller preferred family size as we observe in countries with higher levels of development (higher income per capita). Compared with previous studies that use the same source of identification, such as Angrist, Lavy, and Schlosser (2010), Caceres-Delpiano (2006), and Angrist and Evans (1998), I find estimates in line with what was reported in those studies, although the analysis is carried out for less developed countries. Angrist, Lavy, and Schlosser (2010), for Israel, find an impact of multiple births that goes from 0.43 to 0.69 depending on the sample considered; Black, Devereux and Salvanes (2005), for Norway, find an impact that goes from 0.67 to 0.817. This similitude in

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28. The same robustness is observed for the sub-samples defined by WBCC. Nevertheless, in order to save space, they have not been included in the table.

29. Stock-Yogo weak ID test critical values for a specification with one endogenous variable and one excluded instrument for a 10%, 15%, 20% maximal IV size are 16.38, 8.96 and 6.66, respectively.

the estimated impact of multiple births, though using less developed countries, is explained by the differences in the period considered in each of these studies and the reported decrease of completed fertility even among less developed regions. The present analysis uses data for years later than 1990 (see Tavle 1), with the year 1972 as the median year of birth for the mothers considered in the analysis. In Angrist, Lavy and Schlosser (2010), the average birth cohort of the mothers for which the impact of multiple births on the number of children is estimated is 1942. Angrist and Evans (1998) use the US census for the year 1980 with mothers born between 1948 and 1960.

4.1.1 GENERAL IMPACT

Following Kling, Liebman and Katz (2007), I start first by drawing general conclusion about the impact of multiple births, and therefore the potential impact of an unexpected increase, based on its impact on summary index for each of the outcome groups. For each outcome group[30], an index Z is defined to be the equally weighted average of z-scores[31] of its components[32]. Then I estimate the following expression,

$$Z = \rho_{tc}^{s} + \pi_{a}^{s} + \theta_{e}^{s} + \delta_{U}^{s} + \alpha^{s} mb_{ict}^{s} + \varepsilon_{ict,}^{s} \qquad \text{(E3)}$$

with the p-values for the null of statistical insignificance of α^{s} being reported from columns 1 to 3 in Table 5.

Secondly, in a similar context of seemingly unrelated equations I estimated the joint impact of multiple births on all outcomes in a group category and I test the joint significance of multiple births. The p-values for the null hypothesis of jointly insignificance are reported in columns 4 to 6 for each of the samples.

Both approaches reported in Table 5 point into the same direction. That is, an increase in family size due to an event of multiple births has an impact on family arrangements, contraceptive behavior, and child's education and health. Nevertheless, for adult's outcomes, this impact comes for an increase in family size in the sample of families with three or more births. For children outcomes, an impact on the selected group of outcomes is observed in both samples but the conclusion depends on the approach used.

4.2 Family Structure

The estimated impacts of number of children on family arrangements are presented in Table 6and Table 7. Table 6 presents OLS and 2SLS estimates for each of the three full samples (1+, 2+ and 3+). Table 7 presents the 2SLS estimates for the analysis of heterogeneity according the level of development.

30. Children outcomes are divided in three groups: health, education and living arrangement. Health compasses variables on vaccination and the probability that a child is dead at the time of the survey. Education groups the variables about years of education, school enrollment and grade retention. Finally, living arrangement is defined just for the variable that capture if a child is living in the same household that the mother. For mothers, I keep the three groups of outcomes defined in the previous section: family arrangements, violence rationalization and contraceptive behavior.

31. The z-score for each outcome is calculated by subtracting the mean for families without multiple births and dividing by the standard deviation of the same group.

32. Family Arrangement: Non-traditional role - spouse at home - married + cohabitation; Violence: Justified Use of Violence (JUV) Household Neglect+ JUV Husband Mistreatment + JUV Refused Sex; Contraceptive Behavior: Ever use of contraceptive + Sterilization + Days since last intercourse + Abstinence /Withdrawal; Health: Death+ Missing BCG+ Missing DPT + Missing Polio + Missing Measles; Education: Years of education + Attending School – Behind and; Living with the mother: living in the same household.

The first thing to notice is the fact that OLS results for the three samples (Table 6) in general support the simple descriptive statistic. That is, OLS estimates reveal that the number of children has a positive impact on marriage stability captured by an increase in the likelihood that the father is living at home, a reduction in the probability that a mother is not the spouse of the head of the household, and also an increase in the likelihood of living with a partner.

When focusing on the 2SLS estimates, first, the usual loss of power associated with instrumental variables is noticeable; there are larger standard errors and fewer statistically significant estimates. Despite this cost in power, important differences can still be learned from 2SLS. First, as we sought in the previous section, the impact of fertility concentrates in the samples 2+ and 3+ without a statistically significant impact on any of the outcomes for the sample of families that experience an unexpected increase in fertility in the first birth[33]. Second, as opposed to OLS estimates, we observe that an increase in family size is associated with unstable arrangements. Specifically, for the samples 2+ and 3+, a shock in the number of children increases the likelihood that a mother will have a role that I define as non-traditional such as the head of the household or other than the spouse of the household head. The magnitude goes from 5 to 8 percentage points for samples 2+ and 3+, which in terms of the sample means corresponds to a 17 and 31 percent, respectively. Moreover, for the sample 3+ 2SLS estimates also reveal that an increase in the number of children decreases the likelihood of being married by 3.4 percentage points and a decrease in the likelihood that the mother's spouse (partner) lives in the same household by approximately 6 percentage points.

Finally, the analysis by level of development in Table 7reveals that a negative impact of family size on family arrangements is driven for those countries with lower levels of development, specifically for the sample of families with 3 or more births.

4.3 Violence and Mother's Contraceptive Behavior

The estimated impact of the number of children on violence rationalization and contraception behavior outcomes are presented from Table 8 to Table 11. Table 8 and Table 9 present the OLS and 2SLS estimates for violence rationalization and contraceptive behavior, respectively. Table 10 and Table 11present the 2SLS estimates for the heterogeneity analysis by level of development for each of these group of outcomes.

First, 2SLS and OLS results in Table 8 reveal (except for OLS estimates in sample 1+) that an increase in the number of children does not have a significant impact on the likelihood that mothers accept violence.

Second, for contraceptive behavior (Table 9) important differences are observed between OLS and 2SLS estimates. Though OLS estimates point out that an upward shift in family size increases the likelihood of having used contraceptives and decrease the frequency of intercourse (for sample 2+ and 3+), the results reveal as well that more children reduce the likelihood that a mother would undergo sterilization (samples 2+ and 3+) or they increase the frequency of intercourse for sample 1+. On the other hand, consistently as whole with Michael and Willis's model, 2SLS not only reveal that an increase in fertility increases the likelihood of having used contraceptive, but also more children increase the time since last

33. In a context of homogenous treatment, this finding is consistent with a non linear impact of fertility. In the more realistic setting of essential heterogeneity in the impact, this finding is also consistent with families with higher preferences for bigger family size who experience this unexpected change in fertility in a second or third birth as the one facing a higher cost associated to fertility.

intercourse and for the sample 2+, I estimate a positive and significant impact on the likelihood of using sterilization[34]. Moreover, for all the statistically significant estimates, the pseudo Durbin-Wu-Hausman test reveals evidence of omitted variable bias when using OLS rather than 2SLS[35].

The heterogeneity analysis by level of development, Table 10 and Table 11, reveals some results that are missed when pooling the countries. First, we observe that an impact on the acceptance of violence is driven for those countries in the middle in the ranking of development. In fact, for some measures of violence rationalization in the sample of countries in the top of the distribution of development (upper middle income), an increase in family size reduces the likelihood of accepting violence. Second, an increase in the number of children increases the likelihood of having used contraceptives for countries in the bottom of the distribution of development, specifically for samples 2+ and 3+. For the sample 3+, in particular, we can observe that more children in the family increases not only in almost 2 percent point the likelihood of sterilization for countries defined as low income but in average increase in three days the spacing between intercourses. Also for the sample 3+, but for the sample of countries defined as low middle income is observed an increase in the use of abstinence or withdrawal as contraceptive technology. Although for the countries in the upper tale of the GNI per capita is not found an increase in the likelihood of ever using contraceptive, a sizeable impact is observed on the likelihood of using sterilization. That is, an increase in the number of children increases in approximately 11 percentage points the likelihood of sterilization for the samples 2+ and 3+. This evidence of a sizeable increase in sterilization together with an insignificant and close to zero impact on the likelihood of ever using contraceptive suggest that the impact of increasing family size for countries defined as upper middle income comes as a substitution toward contraceptive technology with a lower marginal cost, such as sterilization, as it is implied for Michael and Willis's model. Finally, for countries in the lower or upper tale of development is find that family size increase the time between intercourses.

4.4 Children Outcomes

The results for children outcomes are presented in Table 12 and Table 13. Table 12 presents the impact of number of children on child's vaccination[36] and Table 13 the impact on the rest of the outcomes. Each of the tables present in the upper part (panel A) OLS and 2SLS estimates of the impact of the number of children. In the bottom of the table (panel B), is presented the heterogeneity analysis by country's development.

From Table 12 (Panel A), the first thing that we observe is that both OLS and 2SLS estimates reveal that an unexpected change in the number of children increases the likelihood of missing BCG or Measles vaccinations for children in the sample. Nevertheless, 2SLS point estimates are equal to or higher than OLS ones[37]. Specifically, an increase in the number of

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34. For samples 1+ and 3+ we also observe a positive impact on the likelihood of using sterilization as contraceptive method, nevertheless, the loss of precision when using multiple births as source of variation in family size does not allow us to pin down a statistically significant impact.

35. In a framework with heterogeneity in the impact of family size the interpretation of the Durbin–Wu–Hausman test is not straightforward. OLS and 2SLS estimates would measure the impact of family size in different parts of the distribution (Heckman and Vytlacil, 2001).

36. Note again that the analysis for child's vaccination is focused just on the sample of families with two or more births. The reason lies in the fact that the information on vaccination is available just for children younger than five years old, which, added to the fact that we are keeping those children older than a specific birth (second for the sample 2+, and third for the sample 3+) as a unit of observation, it reduces the sample size for sample 3+ considerably

37. However, the Hausman exogeneity test allows us to reject the null hypothesis just for the measles vaccination. However, we should be careful in the interpretation in a context of essential heterogeneity since the causal impact is no longer summarized in one parameter.

children produces an increase in the likelihood of missing the BCG by approximately 6 percentage points, and approximately 7 percentage points for the case of the measles vaccine, which in terms of the sample means are impacts in the range of 50 to 30 percent, respectively. Also in Table 12 (panel A), we observe that the results are robust to the inclusion of birth weight as measure of children endowment.

The heterogeneity analysis by level of development in Table 12 (panel B) reveals that the findings for BCG and measles vaccines are driven by those countries defined as the ones with low income. Specifically, I find that an increase in the number of children is associated with an approximately 12 and 15 percentage points increase in the likelihood of missing BCG or measles, respectively. Therefore, the analysis of the impact of the number of children on vaccine use among children younger than 4 reveals that for the sample of countries with low income, there is a margin of the population for which family program policies have an important return. These countries are those at the earlier stage of development and characterized by high child mortality rates. At those stages of development, there is a high return in the reduction of child mortality by the prevention of infectious diseases (Soares, 2007).

The results for the rest of the outcomes in Table 13 reveal bigger differences between OLS and 2SLS estimates. On the one hand OLS estimates reveal a negative impact of fertility on educational achievements measured by years of education, grade retention, and the likelihood of attending school. On the other hand, contrary to a negative impact of fertility on child wellbeing, OLS estimates also show that an increase in the number of children reduces child mortality and the likelihood that a child is not living with her/his mother.

Now when the endogeneity of fertility is addressed (2SLS estimates), not only a more consistent picture among outcomes but also supporting evidence of a negative impact of fertility is revealed. First, for the sample 3+ I find that an increase in the number of children has a sizeable impact on child mortality. Specifically an increase in the number of surviving children raises in 5 percentage points the likelihood that a child younger than seven is death. Second, there is a reduction of approximately 6.5 percentage points in the likelihood that a child attends school which in terms of the sample means is an approximately 10 percent reduction. Third, for both samples (2+ and 3+), we observe that more children in the family increase the likelihood that older children are not longer living with their mothers. The magnitude of the estimates suggest that an additional child increases in approximately 4 to 3 percentage points likelihood that a child is not longer living in the same household. In terms of the sample means the estimates define an impact of 15 and 10 percent for the samples 2+ and 3+, respectively. Finally, as well as we showed for child vaccination outcomes, the negative impact of fertility on children wellbeing comes from those countries classified as low income or lower middle income. For mortality though a 10 percentage points increase in the likelihood that a child is death is observed for the sample of countries with low income, for the sample of countries defined as lower middle income, a decrease in approximately 5 percentage points is observed.

5 Conclusions

The results of the paper reveal that there is a positive return of caring for family size in the context of developing countries. First, we observe that an increase in family size is associated with an increase in incidences of unstable family arrangements, measured by an increase in the likelihood that a mother holding a non-traditional role (being the head of the household or not the spouse of the household head), a decrease in the likelihood of being married and a decrease in the likelihood that the mother's spouse (partner) lives in the same household. For outcomes directly associated with mothers' wellbeing, I find that more children raises the time between intercourses, increases the use of contraceptives, and for some samples, an increase in the odds of sterilization. For children's outcomes, the findings reveal that more children in a family decrease the likelihood of a completed vaccination schedule, they also increase the odds of child mortality, reduce the probability of attending school and we observe a reduction in the likelihood of living in the same household than their mother. The analysis by level of development of the countries reveals an important degree of heterogeneity. The impact on outcomes measuring family arrangements and children wellbeing are driven for countries with a lower level of income. Finally, the impact on contraceptive behavior shows a different type of heterogeneity. At all levels of development, mothers change their contraceptive behavior. Nevertheless, at higher levels of development, the use of contraceptive alternatives such as sterilization is preferred, while in regions with a lower level of development, the alternatives used are spacing of intercourse, abstinence and withdrawal.

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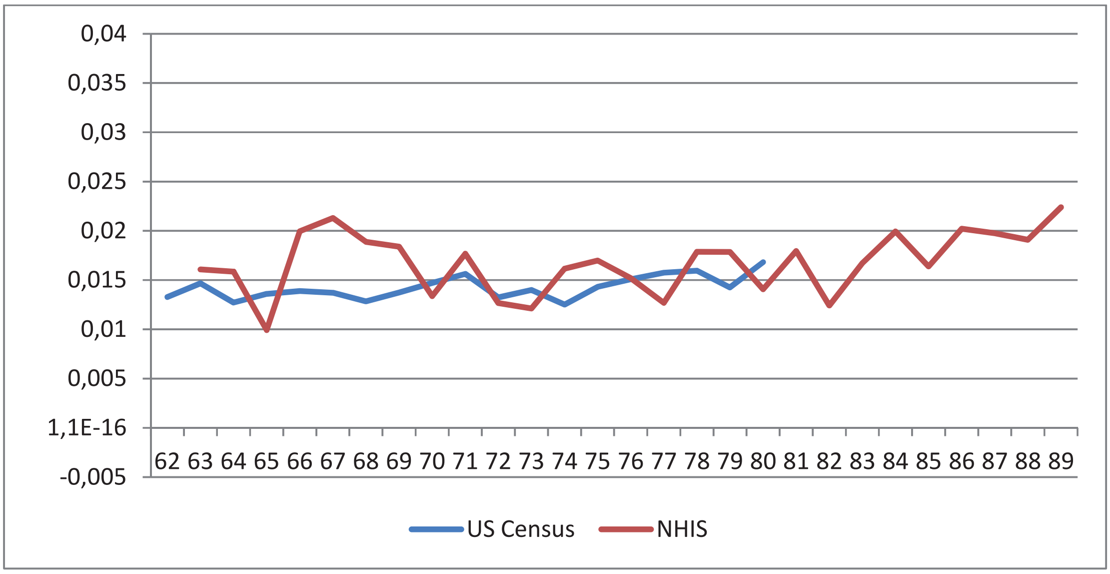

Figure 1

Evolution of the fraction of Twin birth over the total births by year of birth.

Table 1

Countries and Years Considered in the Analysis

	Country	Sample	WB Classification (2009)		Country	Sample	WB Classification (2009)
1	Peru	1996 2000	Upper Middle Income	23	Philippines	1998 2003	Lower Middle Income
2	Guatemala	1995 1998	Lower Middle Income	24	Rwanda	2000 2005	Low Income
3	Colombia	1995 2000 2005	Upper Middle Income	25	Senegal	2005	Lower Middle Income
4	Bolivia	1994 1998 2003	Lower Middle Income	26	Tanzania	1996 1999	Low Income
5	Nicaragua	1998 2001	Lower Middle Income	27	Togo	1998	Low Income
6	Dominican Rep.	1996 1999 2002	Upper Middle Income	28	Zambia	1996 2002	Low Income
7	Brazil	1996	Upper Middle Income	29	Zimbabwe	1994 1999	Low Income
8	Haiti	2000 2005	Low Income	30	Burkina Faso	1999 2003	Low Income
9	Honduras	2005	Lower Middle Income	31	Benin	1996 2001 2006	Low Income
10	Bangladesh	1994 1997 2000	Low Income	32	Comoros	1996	Low Income
11	Cameroon	1998 2004	Lower Middle Income	33	South Africa	1998	Upper Middle Income
12	Car	1995	Low Income	34	Chad	1997 2004	Low Income
13	Ivory Coast	1994 1999	Lower Middle Income	35	Congo	2005	Low Income
14	Ghana	1998 2003	Low Income	36	Mozambique	1997 2003	Low Income
15	Indonesia	1994 1997 2003	Lower Middle Income	37	Cambodia	2000 2005	Low Income
16	Kenya	1998 2003	Low Income	38	Ethiopia	2000 2005	Low Income
17	Madagascar	1997 2004	Low Income	39	Gabon	2000	Upper Middle Income
18	Malawi	2000 2004	Low Income	40	Guinea	1999 2005	Low Income
19	Mali	1996 2001 2006	Low Income	41	Lesotho	2004	Lower Middle Income
20	Namibia	2000	Upper Middle Income	42	Swaziland	2006	Lower Middle Income
21	Niger	1998 2006	Low Income	43	India	1999 2006	Lower Middle Income
22	Nigeria	1999 2003	Lower Middle Income				

The World Bank Classification of countries is based on 2009 GNI per capita. The groups are "low income," \$995 or less; "lower middle income," \$996-\$3,945; "upper middle income," \$3,946-\$12,195 and; "high income," \$12,196 or more.

Table 2

Frequency of Multiple Births. Complete Sample of Children

Type of Birth	Frequency	Percentage
Singletons	1,388,916	97.94
Twins	28,662	2.02
Triplets	480	0.03
Total	1,418,058	100

Table 3

Descriptive Statistics.

	1+	2+	3+
No Household Head Spouse	0.359	0.291	0.245
Spouse at Home	0.729	0.774	0.801
Married	0.729	0.764	0.777
Married or Living with Someone	0.145	0.143	0.143
Justified Use of Violence (JUV)	0.449	0.462	0.481
JUV: Household Neglect	0.369	0.38	0.395
JUV: Husband Mistreatment	0.366	0.377	0.395
JUV: Refuse Sex	0.207	0.218	0.237
Ever Contraceptive	0.781	0.783	0.765
Female Sterilization	0.118	0.152	0.154
Days since Last Intercourse	13.517	13.059	13.139
	[12.592]	[12.431]	[12.456]
Abstinence/Withdrawal	0.072	0.071	0.068
Non BCG Vaccination		0.132	
Non DPT Vaccination		0.309	
Non Polio Vaccination		0.306	
Non Measles Vaccination		0.228	
Death		0.127	0.153
Child’s Years of Education		2.625	2.559
		[2.461]	[2.454]
Grade Retention		0.12	0.128
Attend School		0.647	0.665
Child does not live in the same HH		0.262	0.303
Male Children		0.509	0.504
Child's Age		8.799	9.932
		[4.528]	[4.233]
Mother's Age	28.444	29.554	30.384
	[5.927]	[5.569]	[5.224]
Mother's Years of Education	5.16	4.667	3.951
	[4.685]	[4.533]	[4.223]
Proportion in Urban area	0.393	0.366	0.326
Low Income	0.373	0.397	0.454
Lower Middle Income	0.462	0.455	0.42
Number of Children	2.441	2.896	3.404
	[1.446]	[1.355]	[1.372]

Standard deviation in parentheses. The standard deviation for proportion is not shown.

Table 4

Impact of Multiple Births on Woman's Number of Children

	Unconditional	Conditional	Low Income	Lower Middle Income	Upper Middle Income
	[1]	[2]	[3]	[4]	[5]
1+	0.2322***	0.3125***	0.2468***	0.3257***	0.4430***
	[0.029]	[0.025]	[0.036]	[0.039]	[0.058]
F	63.49	162.2	47.17	70.65	34.63
Obs.		514173	190810	237388	85975
2+	0.4569***	0.4041***	0.3616***	0.3728***	0.6116***
	[0.027]	[0.025]	[0.036]	[0.040]	[0.056]
F	279.99	266.38	101.94	88.22	119.74
Obs.		394214	154761	179110	60343
3+	0.6059***	0.4437***	0.3905***	0.4957***	0.5046***
	[0.030]	[0.028]	[0.036]	[0.051]	[0.086]
F	395.39	255.75	117.95	95.58	57.36
Obs.		264434	118121	110878	35435

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother’s age, mother’s education, urban status, and country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. Stock-Yogo weak ID test critical values for 10%, 15%, 20% maximal IV size are16.38, 8.96 and 6.66, respectively.

Table 5

Overall Intent-to-Treat. Impact of Multiple Births on Selected Outcome Groups. P-values

	KLK			Joint Estimation		
A) Adults	1+	2+	3+	1+	2+	3+
Family Arrangements	0.564	0.031	0.000	0.579	0.122	0.002
Rationalization of Violence	0.295	0.206	0.814	0.755	0.429	0.657
Contraceptive Behavior	0.008	0.012	0.000	0.181	0.021	0.000
B) Children						
Health		0.024	0.764		0.2719	0.065
Education		0.74	0.017		0.618	0.0345
Living in the Same Household		0.044	0.106		0.0441	0.0797

1+, 2+. 3+ stand for the samples with one, two, and three or more births, respectively.
Following Kling, Liebman and Katz (KLK) (2007), columns 1 to 3 present the p-value for the dummy of multiple births in an equation that has as dependent variable an index for each of the outcome groups listed in the first column. Each index is defined to be the equally weighted average of z-scores of its components (the outcome minus the mean of that variable for the families without multiple births over the standard deviation of the variable for families without multiple births). Specifically, Family Arrangement: non-traditional role - spouse at home - married + cohabitation; Violence: Justified Use of Violence (JUV) Household Neglect+ JUV Husband Mistreatment + JUV Refused Sex; Contraceptive Behavior: Ever use of contraceptive + Sterilization + Days since last intercourse + Abstinence /Withdrawal; Health: Death+ Missing BCG+ Missing DPT + Missing Polio + Missing Measles; Education: Years of education + Attending School – Behind and; Living with the mother: living in the same household. Columns 4 to 6 report the p-values of the null joint insignificance of multiple births for the joint estimation of multiple births on all the outcomes in specific category and sample.

Table 6

OLS and 2SLS Estimates of the Impact of Fertility on Different Measures of Family Structure

		No Household Head Spouse	Spouse at Home	Married	Living with Someone
1+	2SLS	0.0249	-0.0361	0.0034	-0.01
		[0.031]	[0.028]	[0.025]	[0.020]
	OLS	-0.0471***	0.0527***	0.0433***	0.0062***
		[0.001]	[0.001]	[0.001]	[0.000]
	p-value	0.0172	0.0008	0.1042	0.417
	Observations	514173			
2+	2SLS	0.0502**	-0.0223	-0.0189	0.0186
		[0.023]	[0.018]	[0.017]	[0.014]
	OLS	-0.0282***	0.0336***	0.0278***	0.0039***
		[0.001]	[0.001]	[0.001]	[0.001]
	p-value	0.0004	0.0021	0.004	0.3037
	Observations	394214			
3+	2SLS	0.0788***	-0.0589***	-0.0336*	0.0166
		[0.022]	[0.020]	[0.017]	[0.014]
	OLS	-0.0191***	0.0250***	0.0212***	0.0026***
		[0.001]	[0.001]	[0.001]	[0.001]
	p-value	0.000	0.000	0.001	0.309
	Observations	264434			

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

Table 7

2SLS Estimates of the Impact of Fertility on Measures of Family Structure by the World Bank Country Classification.

		No Household Head Spouse	Spouse at Home	Married	Living with Someone
1+	Low Income Countries	0.0183	-0.0305	0.0062	-0.0096
		[0.055]	[0.053]	[0.047]	[0.037]
	Lower Middle Income Countries	0.0362	-0.0386	0.006	-0.0313
		[0.047]	[0.038]	[0.033]	[0.021]
	Upper Middle Income Countries	0.0032	-0.055	0.0023	0.0098
		[0.058]	[0.057]	[0.053]	[0.054]
2+	Low Income Countries	0.0995***	-0.0485	-0.0376	0.0232
		[0.038]	[0.030]	[0.027]	[0.022]
	Lower Middle Income Countries	-0.0151	0.0131	0.027	-0.0046
		[0.040]	[0.029]	[0.024]	[0.017]
	Upper Middle Income Countries	0.0209	-0.0136	-0.0475	0.0473
		[0.042]	[0.037]	[0.038]	[0.039]
3+	Low Income Countries	0.0630**	-0.0633**	-0.0542**	0.0416**
		[0.031]	[0.030]	[0.026]	[0.019]
	Lower Middle Income Countries	0.0903**	-0.0497*	-0.0146	-0.0054
		[0.036]	[0.029]	[0.024]	[0.018]
	Upper Middle Income Countries	0.0814	-0.0631	0.0117	-0.0308
		[0.062]	[0.059]	[0.069]	[0.065]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. The World Bank Country Classification defines the economies according the 2009 GNI per capita. The groups are "low income," $995 or less; "lower middle income," $996-$3,945; "upper middle income," $3,946-$12,195 and; "high income," $12,196 or more.

Table 8

OLS and 2SLS Estimates of the Impact of Fertility on Different Measures of Violence Rationalization.

		Justified Use of Violence	Justified Use of Violence: Household Neglect	Justified Use of Violence: Husband Mistreatment	Justified Use of Violence: Refuse Sex
1+	IV	0.0609	0.0366	0.0323	0.0183
		[0.037]	[0.036]	[0.035]	[0.032]
	OLS	0.0028***	0.0002	0.0023**	0.0001
		[0.001]	[0.001]	[0.001]	[0.001]
	p-value	0.1138	0.3099	0.395	0.5747
	Observations		249016		
2+	IV	0.0381	0.0166	0.0424	0.0335
		[0.031]	[0.032]	[0.031]	[0.027]
	OLS	0.0015	-0.0012	0.0012	-0.0007
		[0.001]	[0.001]	[0.001]	[0.001]
	p-value	0.2323	0.5731	0.1849	0.2133
	Observations		193187		
3+	IV	0.0065	0.0038	0.0088	-0.0275
		[0.034]	[0.034]	[0.034]	[0.029]
	OLS	0.0011	-0.0006	0.0007	-0.0004
		[0.001]	[0.001]	[0.001]	[0.001]
	p-value	0.8732	0.8953	0.8098	0.3408
	Observations		131626		

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother’s age, mother’s education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

Table 9

OLS and 2SLS Estimates of the Impact of Fertility on Contraceptive Behavior.

		Ever Using Contraceptive	Female Sterilization	Days since Last Intercourse	Abstinence/Withdrawal
1+	IV	0.0178	0.0181	1.4203*	0.0162
		[0.0258]	[0.018]	[0.815]	[0.016]
	OLS	0.0503***	0.0025***	-0.0628***	0.0019***
		[0.001]	[0.000]	[0.022]	[0.000]
	p-value	0.2069	0.3758	0.0618	0.3774
	Observations	514173	514173	445616	514173
2+	IV	0.0504***	0.0315**	-0.038	0.0096
		[0.018]	[0.015]	[0.595]	[0.012]
	OLS	0.0370***	-0.0105***	0.2001***	0.0008**
		[0.001]	[0.001]	[0.024]	[0.000]
	p-value	0.4571	0.0038	0.6882	0.4687
	Observations	394214	394214	340937	394214
3+	IV	0.0404**	0.0142	2.3494***	0.0097
		[0.020]	[0.014]	[0.614]	[0.013]
	OLS	0.0327***	-0.0174***	0.3571***	0.0011**
		[0.001]	[0.001]	[0.028]	[0.000]
	p-value	0.7028	0.0264	0.001	0.4929
	Observations	264434	264434	231120	264434

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively

Table 10

2SLS Estimates of the Impact of Fertility on Different Measures of Violence Rationalization by the World Bank Country Classification.

		Justified Use of Violence	Justified Use of Violence: Household Neglect	Justified Use of Violence: Husband Mistreatment	Justified Use of Violence: Refuse Sex
1+	Low Income Countries	0.0097	-0.0183	-0.0279	0.0026
		[0.058]	[0.056]	[0.055]	[0.056]
	Lower Middle Income Countries	0.1215**	0.0967*	0.0955*	0.0349
		[0.053]	[0.052]	[0.052]	[0.039]
	Upper Middle Income Countries	-0.0456	-0.0211	0.0282	0.0234
		[0.074]	[0.071]	[0.055]	[0.033]
2+	Low Income Countries	-0.006	-0.0318	-0.0035	0.0077
		[0.039]	[0.041]	[0.040]	[0.038]
	Lower Middle Income Countries	0.1367**	0.1170*	0.1494**	0.0907*
		[0.066]	[0.067]	[0.067]	[0.050]
	Upper Middle Income Countries	-0.0351	-0.0334	-0.0510*	-0.0143
		[0.058]	[0.057]	[0.030]	[0.010]
3+	Low Income Countries	0.0079	0.0224	0.021	-0.0426
		[0.047]	[0.048]	[0.048]	[0.042]
	Lower Middle Income Countries	-0.0078	-0.0383	-0.0113	-0.0044
		[0.052]	[0.051]	[0.051]	[0.041]
	Upper Middle Income Countries	0.0884	0.1195	-0.0197	-0.0277
		[0.161]	[0.173]	[0.082]	[0.031]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. The World Bank Country Classification defines the economies according the 2009 GNI per capita. The groups are "low income," $995 or less; "lower middle income," $996-$3,945; "upper middle income," $3,946-$12,195 and; "high income," $12,196 or more.

Table 11

2SLS Estimates of the Impact of Fertility on Contraceptive Behavior by the World Bank Country Classification.

		Ever Using Contraceptive	Female Sterilization	Days since Last Intercourse	Abstinence/ Withdrawal
1+	Low Income Countries	0.0208	0.0172	1.1364	0.0378
		[0.052]	[0.015]	[1.539]	[0.028]
	Lower Middle Income Countries	0.0306	0.0213	2.8556**	0.0236
		[0.038]	[0.034]	[1.253]	[0.026]
	Upper Middle Income Countries	-0.0129	0.0246	-0.2549	-0.0369
		[0.037]	[0.045]	[1.397]	[0.034]
2+	Low Income Countries	0.0616**	0.0009	0.0678	0.0173
		[0.031]	[0.007]	[0.955]	[0.017]
	Lower Middle Income Countries	0.0758**	0.0296	-0.7006	0.0173
		[0.031]	[0.035]	[1.064]	[0.025]
	Upper Middle Income Countries	-0.0005	0.1122***	0.5256	-0.0112
		[0.023]	[0.038]	[1.052]	[0.023]
3+	Low Income Countries	0.0558*	0.0190*	3.0533***	-0.0112
		[0.032]	[0.010]	[0.937]	[0.016]
	Lower Middle Income Countries	0.0251	-0.0089	1.1614	0.0412*
		[0.031]	[0.031]	[0.931]	[0.023]
	Upper Middle Income Countries	0.04	0.1190**	3.2314*	0.0041
		[0.029]	[0.058]	[1.749]	[0.045]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. The World Bank Country Classification defines the economies according the 2009 GNI per capita. The groups are "low income," $995 or less; "lower middle income," $996-$3,945; "upper middle income," $3,946-$12,195 and; "high income," $12,196 or more.

Table 12

OLS and 2SLS Estimates of the Impact of Fertility on Child Vaccination. Children younger than 5 years old.

		Non BCG	Non DPT	Non Polio	Non Measles
A	IV				
	Without Birth weight	0.0668**	0.043	0.0482	0.0730*
		[0.032]	[0.038]	[0.042]	[0.038]
	With Birth Weight	0.0796**	0.0622	0.0571	0.0889**
		[0.033]	[0.039]	[0.043]	[0.038]
	OLS Estimates	0.0106**	0.0016	0.0055	0.007
		[0.004]	[0.005]	[0.006]	[0.005]
	p-value pseudo Hausman Endogeneity test	0.0786	0.2719	0.3076	0.0758
	Observations	47666	49123	39848	46973
B					
	Low Income Countries	0.1212**	0.0291	0.0547	0.1484**
		[0.059]	[0.059]	[0.069]	[0.066]
	Lower Middle Income Countries	0.0227	0.0124	-0.0158	-0.0247
		[0.051]	[0.071]	[0.072]	[0.065]
	Upper Middle Income Countries	-0.0072	0.0904	0.0816	0.0162
		[0.028]	[0.061]	[0.064]	[0.051]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction, child's age (in months) and child's gender. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. For the sample 3+ since the two oldest children are included, a dummy for birth order is used as covariate.

Table 13

2SLS Estimates of the Impact of Fertility on Child Vaccination by the World Bank Country Classification.

		Death	Children Education	Grade Retention	Attend School	Child is not at Home
A	2+					
	IV	-0.0044	-0.0255	-0.0176	-0.0219	0.0435**
		[0.019]	[0.106]	[0.020]	[0.023]	[0.022]
	OLS	-0.1895***	-0.2100***	0.0147***	-0.0107***	-0.0566***
		[0.002]	[0.006]	[0.001]	[0.001]	[0.001]
	p-value pseudo Hausman Endogeneity test	0.00	0.08	0.11	0.63	0.00
	Observations	162896	112184	205539	108779	391705
	3+					
	IV	0.0507**	-0.1143	-0.0166	-0.0652***	0.0322*
		[0.022]	[0.103]	[0.014]	[0.024]	[0.017]
	OLS	-0.1783***	-0.1844***	0.0129***	-0.0085***	-0.0725***
		[0.001]	[0.005]	[0.001]	[0.001]	[0.001]
	p-value pseudo Hausman Endogeneity test	0.00	0.50	0.03	0.02	0.00
	Observations	78066	79525	145438	72627	260383
	2+					
B	Low Income Countries	-0.0306	-0.1488	0.0098	-0.0408	0.0151
		[0.031]	[0.153]	[0.022]	[0.038]	[0.037]
	Lower Middle Income Countries	0.0326	0.1306	-0.0552	-0.0225	0.0918**
		[0.037]	[0.184]	[0.050]	[0.042]	[0.039]
	Upper Middle Income Countries	-0.0003	-0.0547	-0.0129	0.0208	0.0244
		[0.020]	[0.129]	[0.036]	[0.030]	[0.033]
	3+					
	Low Income Countries	0.1095***	-0.1785	-0.0184	-0.0541	0.0689**
		[0.039]	[0.126]	[0.014]	[0.037]	[0.029]
	Lower Middle Income Countries	-0.0420*	-0.0774	-0.0175	-0.0736**	-0.0155
		[0.023]	[0.167]	[0.027]	[0.035]	[0.022]
	Upper Middle Income Countries	0.054	-0.3141	0.013	-0.0792	0.0273
		[0.061]	[0.364]	[0.051]	[0.055]	[0.041]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction, child's age (in months) and child's gender. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. For the sample 3+ since the two oldest children are included, a dummy for birth order is used as covariate. The World Bank Country Classification defines the economies according the 2009 GNI per capita. The groups are "low income," $995 or less; "lower middle income," $996-$3,945; "upper middle income," $3,946-$12,195 and; "high income," $12,196 or more.

Appendix

Robustness to Child Endowment

A) Colombia, Rwanda and Uganda. Disability Status as measure of Child Endowment

One of the concerns raised by Rosenzweig and Zhang (2006) refers to the possibility that parents might allocate resources to compensate (or reinforce) an endowment shock, which along with a likely impact on health outcomes for children belonging to multiple births, might jeopardize the validity of multiple births as an instrument. This concern about the orthogonality of multiple births is addressed by checking the robustness of the findings to the inclusion of a measure of children's "health" endowment. In particular, the following model is estimated,

$$y_i^s = \alpha^s + \gamma^s C_i^s + \sum_{v=1}^{s} \beta^v D^v + \varepsilon_i^s \qquad \text{(B2)}$$

with a superscript, s, referring to the sample of mothers with s or more births and D^v a dummy variable that takes a value of one when a child is observed in the v birth with a disability and zero otherwise as the proxy for child's endowment. Thus, for the sample of mothers with one or more children, a dummy variable is included for the disability status in the first birth; for the sample of mothers with two or more children, two dummies are included, one for the disability status of the first birth, and one for the second and so on for the samples 3+.

DHS data, however, cannot be used to estimate equation (2) since the disability status (or another measure of endowment) is not available for all children. Therefore in order to provide a sensitivity analysis, I make use of a secondary data sample from the Integrated Public Use Microdata Series (IPUMS), which provides census data information for some developing countries. The data are samples from population censuses from around the world taken since 1960. The variables have been given consistent codes and have been documented to enable cross-national and cross-temporal comparisons. From a total of 111 country-year censuses, only three country-years are considered: Colombia (2005), Rwanda (2002), and Uganda (2002). Unlike the rest of the samples, for these countries and years I am, first, able to construct the instrument (multiple births), because I have the month of birth. Second, I have information about some outcomes similar to the one presented for the analysis with the DHS data. Third, for these samples, mothers are not only asked about the number of children at home but also about the number of children, which is our variable of interest. Finally, I not only have information about the disability status of the members of the household but I am also able to define the origin of the disability for these country-year samples. Specifically, I am able to sort out birth defects from other disabilities. The importance of this distinction resides in the fact that this latter group of disabilities can be confused with other factors affecting directly the outcomes. By using only those disabilities considered to be birth defects, it is less likely that an additional bias will be introduced in the estimation.

The sample is restricted in the same way as with the DHS data. First I keep only individuals living in households as group quarters. Second, I consider mothers who are between 18 and 45 years old, and who had their first birth between 15 and 35 years of age. Nevertheless, unlike the DHS data I have only the information on children living at home in order to construct the information on multiple births. Thus, in order to minimize the error in the instrument, first, I restrict the attention to those families where the number of children living at home matches the reported number of children ever born. Also, differently from the DHS data, due to the fact that we only observe children living at home, I restrict the analysis to families whose oldest child is younger than 7[38].

A final limitation of census data is related to the limited number of outcomes compared to DHS data. Specifically, I am able to define just two groups of variables. The first group of variables as with the DHS data, helps us to measure the impact of family size on family arrangements. In a second group of variables, I analyze the impact of family size on the children outcomes.

For the variables describing family arrangements, four dummy variables are constructed: "Married" takes a value of one if a mother is married and zero otherwise; "Mother's spouse at home" takes a value of one when a member of the household is linked to the mother as a spouse, and zero otherwise; "No Father" takes a value when at least one of the children of a mother does not report a father, and zero otherwise; finally, "Grandparents" takes a value of one if a mother reports living with at least one of her parents, and zero otherwise[39].

For the second group of outcomes, four variables are defined. The first variable, "Years of Education," corresponds to years of education for those children considered in the universe of the question[40]. The second variable, "Grade Retention," is a dummy variable that takes a value of one for those children with a number of years of education below the mode by country and age, and zero otherwise. The third outcome, "Child Work," is a dummy variable taking the value of one if a child is employed[41], and zero otherwise. Finally, the variable, "Child School," is also a dummy variable that takes a value of one if a child is attending school, and zero otherwise[42].

Table B1 presents the results for the robustness check on the inclusion of children's birth disability dummies. The first column for each of the samples presents the specification without the birth disability status for the children in the household. The second column presents the specification when including birth disability status in the specification. The first finding is the robustness and stability of the estimated coefficient when we include the birth disability variables. Although, this finding is not a formal "proof" of the orthogonality of multiple birth, the strong stability of the estimates reduces the concern that the event of multiple births is capturing the effect of other unobserved variables. Second, the results for family arrangements present mixed results. While for sample 1+ is found that number of children increases the likelihood that a mothers reports being married (sample 3+), family size has a positive effect on the probability that a child reports no father at home and a decrease in the likelihood that a child reports the father to be living in the household. Finally, the outcome for

38. Figure 1 graphically presents the share of mothers whose number of surviving children matches the number of children ever born. By restricting the sample to mothers with an oldest child younger than 7, I ensure a more representative sample with almost 80% of the mothers included in the analysis. Nevertheless, this fraction varies considerably across countries. For Colombia, almost 90% fulfill this restriction. However, this fraction is just 63% for Rwanda.

39. Parents of a potential spouse are not used since they are only available when a spouse is present at the time of the census and, therefore, conditional to a specific family arrangement.

40. For Colombia, the universe corresponds to all children 3 years old or older; for Rwanda, 6 years of age or older; for Uganda, 5 years of age or older.

41. The employment status is defined by all individuals older than five years old.

42. The universe is the same as the one for the variables "Years of Education" and "Behind."

children reveals that an increase in family size is in fact associated with an increase in the level of wellbeing of children measured by an increase in the level of education and by a reduction in the likelihood of grade retention measured for the variable behind in sample 1+, and by a reduction in the likelihood that a child would work for sample 3+.

As I did for the DHS analysis, Table B2 divides the sample across country region. For the outcomes related to family arrangements, I find that, consistent with the findings using DHS data, there is a negative impact on family stability among the sample of mothers in these two African countries. Specifically for this sample, we observe that an increase in family size not only increases the likelihood that a mother stays on her own, measured by a decrease in the likelihood that a mother is married, a decrease in the probability that her spouse is at home and that one of her children reports the father in the household, but also that a mother would use the help of other relatives, measured here by an increase in the likelihood that she is living with her parents. On the other hand, for Colombia, with the exception of the likelihood that a child would report no father for sample 3+, and specifically for sample 1+, the estimates reveal that an increase in family size is associated with an increase in the likelihood that a mother would live under a more stable family arrangement. For children outcomes, nevertheless, we do not find evidence of heterogeneity across these two country regions. In fact, for both country regions, it is still observed that an increase in family size has a negative impact on the likelihood that a child would repeat a grade, that is, she/he would be classified as “behind,” and for the two African countries, a negative impact on the likelihood that that child is working is also estimated.

This positive impact on children, nevertheless, might be driven for the restriction of the sample to consider just mothers that experience a shift in family size when the oldest child is “too young” (younger than eight years old) to work and mothers who might want to stay in the labor market would opt for an early enrollment of the children in the formal education system. In order to explore this hypothesis, I repeat the analysis but using families with the oldest child younger than 14 years old instead. Nevertheless, since we restricted the sample to families with the number of surviving children equal to the number of children ever born, I end up with a more selected sample. Figure 1 presents the share of families, for each of the countries in the analysis, whose number of surviving children matches the number of children ever born. We observe that this last restriction to ensure the quality of the instrument, combined with restriction on the age of the oldest child, leaves us with an extremely selected sample for Rwanda and Uganda when setting the age of the oldest child younger than 14 years of age. Therefore, I restrict this last analysis to Colombia since I am still able to consider more than 80% of the mothers in the analysis. The results are presented in Table B3. Although a positive impact on years of education is still found for sample 2+, the estimates for sample 3+ reveal, first, that an increase in family size produces an increase in the likelihood that a child suffered from grade retention. Second, when dividing the sample according to birth order for sample 3+, we find that a negative on human capital accumulation is driven by the oldest child in the family. Specifically, for the oldest child, we observe a reduction in more than a quarter of a year of education and an increase of approximately 8 percentage points.

B) DHS Data. Birth Weight as Measure of Child’s Endowment

The information about birth weight is available just for the sample of children younger than five years old in DHS data. Given this restriction I must center the robustness check on families with the oldest child been younger than five (since we need birth weight for all children in the household). Moreover, the distribution of missing values is not random (even among families with children younger than five). Those observations with missing information for birth weight are more likely to be older mothers, more likely living in rural areas, and living in countries with lower level of income per capita.

Then instead of just constraining to non-missing, I estimate the following expression:

$$y_i^s = \alpha^s + \gamma^s C_i^s + \sum_{v=1}^{s} \beta^v 1\{BW\ not\ missing\} BW^v + \varepsilon_i^s$$

With BW^v as the birth weight for the child born in a v-th birth and 1{*} is a logic statement taking a value one when "*" is true, and zero otherwise. The estimates of gamma are presented in the following two tables.

The results of the analysis are presented in Table B4 and Table B5. First, by restricting the sample to families with the oldest child younger than five years old it is noticeable the loss of power with few of the estimates being statistically significant. Nevertheless, comparing the estimates without (unconditional) and those conditional on birth weight, we observe that are practically the same. Therefore, this analysis together with the robustness check done including birth disability when using census data for Colombia, Rwanda and Uganda, reduce our concern that the findings are driven by the reallocation of resources due to an endowments shock.

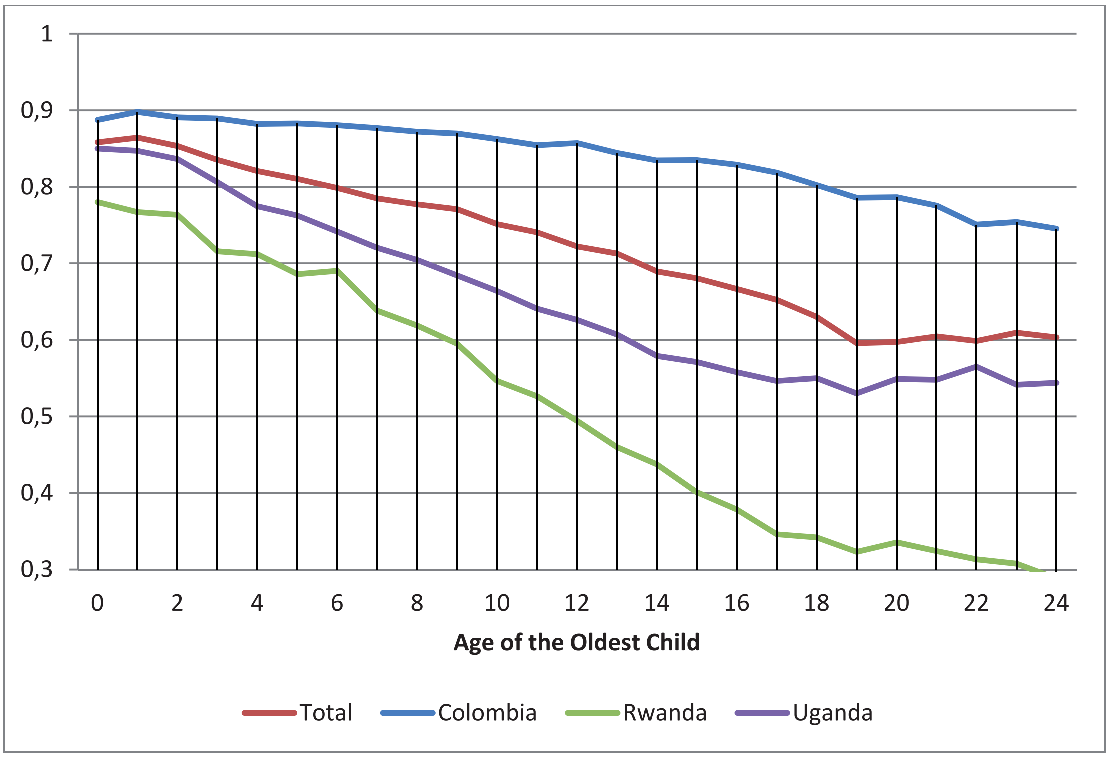

Figure B1: Fraction of Mothers with a Number of Surviving Children equal to the Number of Children Ever born by Age of her Oldest Child.

Table B1. Robustness Check to the Inclusion of Birth Disability Dummies. 2SLS estimates of the Impact of Fertility on Selected Outcomes.*{Sample Means}*

		1+			2+			3+	
Mother Married	*{0.77}*	0.0249*	0.0250*	*{0.85}*	-0.0107	-0.0107	*{0.89}*	-0.0298	-0.03
		[0.014]	[0.014]		[0.017]	[0.017]		[0.025]	[0.025]
Mother Spouse at Home	*{0.69}*	0.0176	0.0177	*{0.78}*	-0.0044	-0.0044	*{0.82}*	-0.0566*	-0.0575*
		[0.016]	[0.016]		[0.022]	[0.022]		[0.033]	[0.033]
Child reports No father	*{0.29}*	-0.0178	-0.0179	*{0.21}*	0.009	0.0089	*{0.17}*	0.0530*	0.0535*
		[0.015]	[0.015]		[0.021]	[0.021]		[0.031]	[0.031]
Grandparents at Home	*{0.16}*	0.0114	0.0114	*{0.09}*	-0.0026	-0.0022	*{0.06}*	0.0252	0.0248
		[0.014]	[0.014]		[0.016]	[0.016]		[0.025]	[0.025]
Years of Education				*{2.87}*	0.0690**	0.0693**	*{2.39}*	-0.0092	-0.0052
					[0.034]	[0.034]		[0.038]	[0.037]
Behind				*{0.27}*	-0.0296**	-0.0295**	*{0.31}*	0.0191	0.0166
					[0.013]	[0.013]		[0.019]	[0.019]
Attend School				*{0.84}*	-0.0023	-0.003	*{0.81}*	-0.0313	-0.0283
					[0.029]	[0.029]		[0.038]	[0.038]
Child Labor				*{0.02}*	0.0071	0.0075	*{0.03}*	-0.0227***	-0.0223***
					[0.010]	[0.010]		[0.004]	[0.004]
Birth Disability			X			X			X

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Other covariates in the model, additionally to birth disability dummies, are dummy variables by country of residence, urban status, mother’s educational attainments and squared polynomials in mother's age and age of the oldest child in the family. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

Table B2. Robustness Check to the Inclusion of Birth Disability Dummies. 2SLS estimates of the Impact of Fertility on Selected Outcomes by Country Region.

	Colombia			Uganda & Rwanda		
	1+	2+	3+	1+	2+	3+
Mother Married	0.0586***	0.004	-0.0959	-0.0368***	-0.0316	0.01
	[0.019]	[0.026]	[0.061]	[0.014]	[0.021]	[0.018]
Mother Spouse at Home	0.0621***	0.0148	-0.098	-0.0628***	-0.0322	-0.0329
	[0.021]	[0.032]	[0.072]	[0.017]	[0.027]	[0.032]
Child reports No father	-0.0520**	-0.0029	0.1274*	0.0420***	0.027	0.0085
	[0.021]	[0.031]	[0.071]	[0.016]	[0.025]	[0.029]
Grandparents at Home	-0.0006	-0.0287	0.0681	0.0333***	0.0336**	-0.0009
	[0.020]	[0.024]	[0.062]	[0.011]	[0.017]	[0.014]
Years of Education		0.067	-0.0061		0.0599	-0.0107
		[0.043]	[0.055]		[0.049]	[0.045]
Behind		-0.0228*	0.0202		-0.0681**	0.0057
		[0.013]	[0.023]		[0.030]	[0.030]
Attend School		-0.0086	-0.041		0.0157	-0.0059
		[0.036]	[0.057]		[0.043]	[0.044]
Child Labor		0.0065	-0.0097		0.0078	-0.0332***
		[0.008]	[0.008]		[0.024]	[0.004]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates in the model are dummy variables for birth disability, dummy variables for country of residence (when proceed), urban status, mother’s educational attainments and squared polynomials in mother's age and age of the oldest child in the family. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

Table B3. 2SLS estimates of the Impact of Fertility on Selected Outcomes for Colombia. Mothers whose Oldest Child is younger than 14 years old.

	2+	3+		
		All	1st Child	2nd Child
Years of Education	0.0991*	-0.1016	-0.2861***	0.1075
	[0.058]	[0.106]	[0.109]	[0.141]
Behind	-0.0329	0.0718**	0.0875**	0.0561
	[0.023]	[0.030]	[0.042]	[0.041]
Attend School	-0.0114	-0.0099	-0.0222	0.0075
	[0.014]	[0.023]	[0.033]	[0.031]
Child Labor	0.0008	-0.0004	0.0009	-0.0027
	[0.004]	[0.005]	[0.008]	[0.006]

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates in the model are dummy variables for birth disability, dummy variables for country of residence (when proceed), urban status, mother’s educational attainments and squared polynomials in mother's age and age of the oldest child in the family. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

Table B4. Sensitivity Analysis. Robustness Check to the Inclusion of Birth Weight. Children Outcomes

		Non BCG Vaccination	Non DPT Vaccination	Non Polio Vaccination	Non Measles Vaccination	Death	Child is not at Home
2+	Conditional on Birth Weight	0.0769**	0.0577	0.0553	0.0853**	-0.0002	0.0201
		[0.032]	[0.038]	[0.043]	[0.038]	[0.024]	[0.029]
	Unconditional	0.0668**	0.043	0.0482	0.0730*	-0.0035	0.0175
		[0.032]	[0.038]	[0.042]	[0.038]	[0.024]	[0.029]
		47666	49123	39848	46973	81242	81242
3+	Conditional on Birth Weight	-0.0183	0.0135	-0.0186	0.0264	0.0415	0.0665**
		[0.033]	[0.041]	[0.041]	[0.038]	[0.028]	[0.032]
	Unconditional	-0.0207	0.0113	-0.0177	0.0235	0.041	0.0661**
		[0.033]	[0.040]	[0.040]	[0.038]	[0.027]	[0.032]
		50372	53449	41811	49626	88382	88382

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, country-year interaction, child's age (in months) and child's gender. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively. For the sample 3+ since the two oldest children are included, a dummy for birth order is used as covariate.

Table B5. Sensitivity Analysis. Robustness Check to the Inclusion of Birth Weight. Mother's Outcomes

	No Household Head Spouse	Spouse at Home	Married	Married or Living with Someone	Ever Contraceptive	Female Sterilization	Days since Last Intercourse	Abstinence
Conditional on Birth Weight	0.1161*	-0.0416	-0.0467	0.0453	0.0094	0.0117	2.8818	-0.0142
	[0.068]	[0.057]	[0.047]	[0.041]	[0.053]	[0.034]	[2.049]	[0.022]
Unconditional	0.1171*	-0.0432	-0.0475	0.0438	0.009	0.0221	3.0136	-0.0187
	[0.066]	[0.055]	[0.046]	[0.039]	[0.051]	[0.032]	[1.966]	[0.021]
	28729	28729	28729	28729	28729	28729	26571	28729

Robust standard errors in parentheses; * significant at 10 percent; ** significant at 5 percent; *** significant at 1 percent. Covariates are dummy variables for mother's age, mother's education, urban status, and country-year interaction. 1+, 2+, and 3+ stand for the samples of families with one, two, and three or more births, respectively.

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