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ABSTRACT

The Impact of Early Childbearing on Schooling and Cognitive Skills among Young Women in Madagascar*

Female secondary school attendance has recently increased in Sub-Saharan Africa and so has the risk of becoming pregnant while attending school. Using panel data in Madagascar, we analyze the impact of teenage pregnancy on young women's human capital. We instrument early pregnancy with the young woman's community-level access, and exposure to condoms since age 15. We control for an extensive set of community social and economic infrastructure characteristics to deal with the endogeneity of program placement and conduct several robustness checks to validate our instruments. Early childbearing increases the likelihood of dropping out of school by 42 % and decreases the chances of completing secondary school by 44%. This school-pregnancy related dropout is associated with a reduction of 1.1 standard deviations in Math and French test scores. Delaying the first birth by a year increases the probability of current enrollment by 5% and the test scores by 0.2 standard deviations.

JEL Classification: I25, J13, O15

Keywords: fertility, female education, cognitive skills, instrumental variables, Madagascar

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Introduction

Adolescent pregnancy can have detrimental economic and social consequences. In developing countries, early childbearing is associated not only with health risks such as maternal mortality and low birth weight but also with low school attainment and productivity, and consequently intergenerational transmission of poverty. There is, however, a paucity of empirical evidence that establishes a causal impact of early fertility on young women's human capital formation in developing countries. In Sub-Saharan Africa, pregnancy-related school dropout has increasingly gained prominence, in part due to the recent expansion of female school enrollment in the region. The greater likelihood of girls attending school after puberty has put them at risk of early pregnancy while they are attending school (Lloyd and Mensh, 2008). Girls face complex fertility and schooling decisions with the added constraints of low availability of information on safe sexual practices and limited access to reproductive health services in low-income countries (Chong et al 2013).

This paper investigates whether early childbearing has a causal effect on young women's school attainment and cognitive skills, measured by Math and French test scores, in Madagascar. This country offers an appropriate context for our research question. Female progression to secondary school in Madagascar has rapidly increased from 45% to 69% between 1998 and 2010 (WDI, 2013); however, 32% of girls between 15 and 19 years old have a child or are pregnant for the first time; 48% of women age 18 are mothers or pregnant (Demographic and Health Surveys-DHS, 2009). Indeed, Madagascar is among the top 10 developing countries with teenage pregnancy rates above 20% (Williamson, 2013). This high teenage pregnancy rate occurs in a context of a high fertility rate, which remains at 4.8 children per woman. Moreover, the family planning prevalence in Madagascar is only 29% among women between 15 and 49 years old and there is no access to safe abortion (DHS, 2009).[1]

Fertility decisions can affect women, men and children's welfare through human capital formation. For instance, by delaying pregnancy, women may stay in school longer and their higher education levels might translate into higher human capital outcomes for their children (Schultz, 2007).[2] The challenge of addressing the endogeneity between education and fertility is a result of the possibility that these two are joint decisions; for example, adolescent girls may have strong preferences for education and labor market success and less preference for children.These potential common unobservables in the error terms of the regression equations for both early pregnancy and education will bias the OLS estimates. Using a panel data survey in Madagascar, we use an instrumental variable approach to address this endogeneity issue.

This paper uses a household panel survey in Madagascar that follows a cohort of young men and women ages 21 to 23 in 2012, who were previously interviewed in 2004 when they were between 13 and 16 years old. This seven-year panel survey was designed to capture the transition from adolescence to adulthood and includes detailed socio-economic information at the individual, household and community levels. We also complement the community surveys with the 2001 and 2007 Malagasy community censuses of social and economic infrastructure.

We estimate two sets of models: in the first, we instrument the young woman's early pregnancy with her "access to condoms", defined as the availability of condoms in the community where she lived in 2012. Using the year since condoms were available, in the second set of models, we define the instrument in terms of the young woman's "exposure to condoms," measured by the number

[1] In Madagascar, abortion is illegal. However, some estimates put abortion rates at 1 per 10 live births. Abortion complications are one of the major contributors to maternal death in the country (Sharp et al., 2011).

[2] In developing countries, empirical evidence has shown a positive association between maternal education and children's health (Strauss and Thomas, 1995); however, causality has been less empirically tested with the exception of few studies (Güneş, 2015; Behrman et. al; 2009; and Breirova and Duflo, 2004).

of years during which she has had community-level access to condoms since she was 15 years old. This age cut-off is reasonable since the average age of first birth in our sample is 18.[3] It is worth noting that the condom availability information is reported by community leaders rather than self-reported. Based on the same identification strategy, we also estimate the age of first birth in the first stage using Weibull hazard models which allow us to correct for the right censoring problem of the women's age of first birth in our sample. The hazard model also has the advantage of enabling us to estimate the impact on education outcomes of postponing the first pregnancy by one year. We take advantage of the 2004 panel wave to control in our models for childhood socioeconomic characteristics when the girls were in the age range of 13 to 16 to isolate the effect of pregnancy on schooling from the effect of poverty conditions when women were young adolescents.

The idea behind this identification strategy is that access (exposure) to condoms lowers fertility control costs among young women and affects their schooling decisions through a reduction of early pregnancy rather than through a direct effect.[4] We conduct different robustness checks to support this argument including a placebo test in which access to condoms does not have a statistically significant direct effect on the school outcomes of young men. We use condoms as an instrumental variable for early fertility, instead of other family planning methods such as pills or injectables, because the latter are primarily used to space children within the family rather than to postpone the first birth in Madagascar. In fact, we show that community-level access (availability) to pills does not have a statistically significant effect in reducing early pregnancy in our sample. There are also social norms that discourage girls of high school age from going to family planning

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[3] In the Madagascar 2009 DHS, the median age of sexual initiation is 17 among women ages 15 to 19 and 18 among women ages 20 to 24 There is no information on young women's age of sexual initiation in our survey.

[4] Despite the small effect of family planning on reducing total fertility in developing countries, some empirical evidence has shown that these programs can be more effective among young women (Miller and Singer, 2014).

clinics and seeking contraceptive access from the formal health care establishment. Although our surveys do not have information on the specific channels of condom distribution in the communities of the sample, we know from the 2009 DHS that 40% of condoms are distributed through stores and 20% through pharmacies at the national level; suggesting that condoms are more readily accessible to school girls.[5] The government and NGOs have recently made efforts to increase condom access and use among vulnerable populations to prevent sexually transmitted infections (STIs), the prevalence of which is very high in Madagascar (Glick et al, 2009).[6]

One concern with this identification strategy is the possibility of non-random program placement: condom programs are potentially located in communities where teen pregnancies are the highest or where the population is more inclined to use contraception (Pörtner et al, 2012; Molyneux and Gertler, 2000; Pitt et al; 1993). We lack information on the selection of communities to gain access to condoms. To address this potential issue, we control in our models for an unusually complete set of social and economic infrastructure community variables, both contemporaneous and lagged, which are available in the community surveys of the panel data. We also conduct the following exercises: First, we estimate a linear probability model of access to condoms in 2012, the time of the survey, on 2006 community-level fertility measures and a range of 2012 community covariates. Second, we estimate the same model but instead of fertility measures, we control for variables that capture the size of the population and poverty rates in 2001, a period over 10 years prior to the survey of women used in our study. Third, we investigate if in these models access to condoms is determined by the community-level participation of the major ethnic groups and religious denominations, considered indicators of cultural and/or social norms

[5] In Madagascar, condoms are not distributed in schools. There is no sexual curriculum in the education system.
[6] The low HIV/AIDS prevalence in Madagascar despite a high prevalence of STIs (one of the highest in Sub-Saharan Africa), relatively high rate of sexual partner change, and early sexual initiation is considered an anomaly, but still a threat for public health (Sharp and Kruse, 2011).

and preferences over family planning. We do not find any evidence of non-random program placement in any of these exercises. Furthermore, these results are consistent with a placebo test where access to condoms does not have a statistically significant effect on young women's height, a measure of long term socioeconomic status. Finally, we also conduct a sensitivity analysis, following Conley et al. (2012) methodology, which shows that the IV results are robust to plausible deviations from the exclusion restriction assumption.

Our findings show that teenage pregnancy has a negative causal effect on schooling attainment and cognitive skills among young women in Madagascar. Our instrumental variable results show that early childbearing increases a young woman's likelihood of dropping out of school by 42%. Furthermore, it decreases her chances of completing lower secondary school (i.e., completing more than 9 years of education) by 44%. These findings suggest that schooling and pregnancy are *mutually exclusive* which is consistent with the Malagasy context where pregnant girls are expelled from school *de facto* and *not de jure*.[7] We also find that this early departure from school due to pregnancy has a detrimental impact on young women's cognitive skills: teenage pregnancy decreases by 1.1 a young woman's standardized scores in Math and French. This magnitude is comparable to the effect of secondary school attainment on test scores in our cohort sample.[8]Consistently, the results from the hazard models suggest that postponing the first birth by one year has comparable gains in school attainment and cognitive skills: delaying the first birth by a year increases the probability of current enrollment by 5% and the Math and French test scores by 0.2 standard deviations. These findings indicate that not only the prevention but also the delay

[7] Empirical evidence for other African countries has shown that schooling and fertility are non-compatible, see Duflo et al. (2014) and Ozier (2011) for the case of Kenya and Baird et al. (2011) for the case of Malawi.

[8] Most of the empirical evidence find little evidence on the effects of schooling on tests scores in Africa; nevertheless, Ozier (2011) finds positive effects of secondary schooling on test scores, labor market and fertility outcomes in Kenya.

of the first birth increases youth female human capital.

Unlike in developing countries, the socioeconomic effects of teenage pregnancy in the United States (U.S.) have been extensively researched. A series of empirical strategies have been used to identify causal impacts and to deal with the systematic differences between mothers and non-mothers. These strategies include employing sibling fixed effects to compare teen mothers to their childless sisters (Geronimus and Korenman, 1992), natural experiments that use miscarriages as an instrument of early fertility (Hotz, McElroy and Sanders, 2005; Ashcraft and Lang, 2006; Fletcher and Wolfe, 2009) as well as other instrumental variables for early fertility such as age of menarche, abortion, and contraception rates (Ribar, 1994 and Keplinger et al. 1999), and propensity score matching methods within the school attended to construct an appropriate counterfactual group for teenage mothers (Levine and Painter, 2003). There is no consensus over whether teenage pregnancy has a causal effect on poor school attainment, labor market outcomes, and the probability of being a welfare assistance recipient. Except for Keplinger et al (1999), most studies in the U.S. have found that the impact of adolescent pregnancy on these outcomes is smaller than the one implied by OLS regressions and is sometimes not statistically significant.[9]

In the context of developing countries, to the best of our knowledge, there are very few studies that rigorously establish a causal relationship of early pregnancy on young women's human capital outcomes.[10] Azevedo et al. (2012) use data on miscarriages as an instrument for the timing of pregnancy in Mexico and find that a younger age of first birth does not have adverse effects on

[9] For a discussion of recent empirical studies, see Fletcher and Wolfe (2009) and Kane et al. (2013). Most recently, Lang and Russell (2013) find negative effects of teenage motherhood on schooling before abortion and contraception were available in the US.

[10] A related study is Field and Ambrus (2008) which finds a negative effect of adolescent marriage on schooling using age of menarche as an instrumental variable for the age of marriage in Bangladesh. In this context, young women's schooling is restricted by marriage; pregnancy comes after marriage. This is different from Madagascar and other African countries where out wedlock pregnancy is important; about 25% of girls who are mothers are not married in our survey.

either education or employment. In contrast, Arceo et al. (2012), using propensity score matching to construct a counterfactual group for the young mothers, find that teenage pregnancy decreases years of schooling in Mexico. Employing the same methodology, Ranchod et al. (2011) find that high school completion in South Africa is driven more by socioeconomic conditions than by early pregnancy.

Our paper, therefore, contributes to the limited empirical evidence of the impact of early childbearing on socioeconomic outcomes in developing countries, particularly in Sub-Saharan Africa. Our study is the first to show empirical evidence in a low-income and high-fertility country, in contrast to the aforementioned studies that have addressed this question in middle-income countries where, for example, social attitudes to teenage pregnancy and institutions to help young women and their families cope with a teenage birth may be more developed. Second, to our knowledge there is no empirical evidence for the effect of teenage pregnancy on cognitive skills; we not only analyze the effect of teen pregnancy on the extensive margin of education (i.e., being a school dropout) but also on the intensive margin (i.e., Math and French test scores). There are a few cross-sectional studies in South Africa that have shown a negative association between test scores performance and fertility (Thomas, 1999) or the initiation of sexual activity (Marletto, et al 2008), but these studies have not established a causal effect of early pregnancy on cognitive skills. Third, using young women's access/exposure to condoms as an instrumental variable (IV) rather than propensity score and miscarriages allows us to infer the potential economic consequences of population policies that aim to decrease young women's costs to control fertility in low-income countries.

Indeed, our findings show that during the transition from adolescence to adulthood, reducing early childbearing or delaying the age of first birth generates substantial gains in education and cognitive skills among young women in Madagascar. Therefore, access to family planning and sexual reproductive health services for young women can not only prevent poor pregnancy outcomes but can also potentially enhance young women's education opportunities and increase their accumulation of human capital.

The reminder of this paper is organized as follows. Section 2 describes the panel data set and the context of Madagascar. Section 3 presents the empirical methodology using access and exposure to condoms as instrumental variables, and includes the results of the hazard models used to measure the impact of age of first birth on school outcomes. Section 4 discusses the results and robustness checks, while the last section concludes and discusses policy implications.

II. Data Description and Context

This paper uses data from the 2011-12 Madagascar Life Course Transition of Young Adults Survey which re-interviewed a cohort of 1749 young adults, 859 of them women, who were 21–23 years old at the time of the survey. This cohort was first surveyed in the 2004 *Enquête sur la Progression Scolaire à Madagascar* (EPSPAM) when they were 13-16 years old. In the last round of the survey, 1,800 households were re-visited from 2004 in 73 communities across all regions in Madagascar.[11]This panel tracked around 90% of the cohort members and has therefore a very small attrition rate compared to other panels in Sub-Sahara Africa, especially given the seven year time that has elapsed between survey rounds.

The 2012 survey, designed to capture the transition from adolescence to adulthood, gathered detailed socioeconomic information of the cohort members, their spouses, and the households in

[11] The 2004 ESPAM survey defined a community as the catchment area for a primary school. These communities were chosen based on a school-based sampling frame that covered all regions in Madagascar. For further description of the 2004 survey and sampling strategy, see Glick et al., (2009).

which they reside at the time of survey. The survey collected detailed retrospective event histories on the cohort members regarding schooling, fertility, employment, marriage, and health as well as on the range of economic and life-course events and experiences going back to 2004. In particular, the 2012 data include young adults' cognitive tests measured through short questionnaires in Math and written French. The Math tests had an oral and a written part, so illiterate members were also given a test.[12] These numeracy and literacy tests were administered to all cohort members at their place of residence, even if they were not attending school at the time of the survey. To have a comparable measure of achievement, the tests were identical for all the individuals regardless of their school attainment, starting with basic questions and progressively more complicated tasks. As in 2012, the 2004 survey contained tests for both Math and French. Some common items were included in both the 2011/12 and 2003/4 tests to facilitate comparisons across surveys; however, in 2004 cognitive tests were only administered to 794 cohort members.

The 2011–12 survey also questioned community leaders, teachers, and health personnel as to the availability of social and economic infrastructure and services at the community level, including information on family planning services, as well as the date that these services first became available in the community. We complement this information at the community level with the 2001 and 2007 commune censuses, which feature a wide range of information about all villages in Madagascar, including information on basic public services and infrastructure.[13]

We lack information on how condoms programs were placed among the communities in the sample. In Madagascar, Family Planning (FP) programs were introduced in the 1967s by

[12] The Cronbach's alpha test for internal consistency ranges from 0.82 to 0.92 in the Match and French tests. A value higher than 0.8 confirms the reliability of the tests to capture differences between more and less knowledgeable young individuals.

[13] We merged the household surveys to each commune census using the community identifier. More information about the commune censuses is available at http://www.ilo.cornell.edu/ilo/data.html

Fianakaviana Sambatra (FISA), a pioneer organization affiliated with the International Planned Parenthood (IPPF), but it was not only until the early 1990s that the Government incorporated these programs as part of the population and development policy. In 2003, the Government leveraged the FP interventions by creating a Ministry of Health and Family Planning and by coordinating efforts with other stakeholders in the health sector. Since 2007, the Malagasy government as well as the private sector have rapidly increased these services through the expansion of community health worker programs in the rural areas, free consultation and products as well as establishment of awareness campaigns. Most of the funding and procurement for the family planning products have come from donors such as UNFPA, USAID, and the World Bank (Sharp et al 2011).

For the 2012 sample of 859 female cohort members aged 21 to 23, we have detailed fertility and education history information as well as cognitive test scores. Table 1 shows that 54% (466) of the women in the sample have given birth to at least one child; we call this group of women *"ever mothers".* We refer to their female counterparts in the cohort who have not yet given birth as *"non-mothers"*. In our sample, the average age of first birth is 18 years (standard deviation 2.12) which is consistent with 2009 DHS national level data. Interestingly, we also find that 25 % of the *ever-mothers* are not married suggesting that out-of-wedlock early pregnancy is not negligible in Madagascar.

Table 1 also shows substantial differences in schooling and cognitive performance between these two groups. While 34% of the *non-mothers* still attend school, only 3% of the *ever-mothers* are enrolled.

<< Insert Table 1 here>>

We calculate the difference between the age of awareness of conception and age of dropping out of school and classify the young women of our sample according to the timing of their fertility and education decisions (See Figure 1). We find that almost 24% of the sample, or 46% of the young mothers, became pregnant while they were in school.[14] In contrast, 30% of the girls dropped out of school but had not become pregnant at least through the time of the survey. Also, it is noteworthy that 27% of the young women drop out earlier than their first birth, indicating that there is no overlap between their fertility and education decisions. Finally, we also observe that only 16% of the girls are still attending school at the time of the survey and are *non-mothers*. A very negligible proportion of the sample (2%) are *ever- mothers* and currently enrolled in school, suggesting that young women face difficulty in continuing education once they have their first child.[15]

<<Insert Figure 1 here>>

These patterns are consistent with the years of education completed among the two groups as shown in Table 1. While the group of *ever-mothers* completed 6.2 years of schooling, the corresponding figure for *non–mothers* is 9.25 years. This difference is reflected in the data on their progression through school. Among the group of *ever-mothers,* only 5% completed upper secondary, whereas this percentage is almost 5 times larger among the *non-mothers*. Also, 17% of the women who have not yet had their first birth have some university education while this percentage among young mothers is less than 2%.

[14] Given that we have an exact date of birth for the women's children but not a calendar of their pregnancy, we calculate the age of awareness of conception as the age of the first birth minus eight months of pregnancy.
[15] In field work visits, different stakeholders in the education sector pointed out the fact that school girls who get pregnant are socially pressured, and sometimes by the school principal, to leave the school to avoid a reputational cost for the school. Also, in Madagascar there is no law or regulation in the education sector to address the problem of pregnancy-related school-dropouts, although the issue is recognized by the authorities.

Additionally, we report in Table 1 that the *non-mothers* have on average better performance in the 2012 Math and French test scores, compared to the *ever-mothers*. This is a reflection, in part, of the fact that the former group stays in school longer. The share of young women in the upper quintiles of the Math and French test scores distribution is far greater for those who are not yet mothers in 2012 than for those women who have given birth by 2012 (see Figure 2).

<<Insert Figure 2 here>>

Regarding the use of family planning among the young women in our cohort, the data show that 31% of them use at least one method of contraception (modern and/or traditional). As Table 2 shows, a larger group of family planning users exists among the "*ever mothers*" compared to the "*non-mothers".* This is consistent with the fact that almost 40% of women in Madagascar use family planning for the first time only after they already have at least one child (DHS, 2009). Among the family planning users in our survey, 37% have primary school, 38% have lower secondary, and the rest have upper secondary or higher education. There is no evidence of a positive correlation between young women's level of education and their use of family planning in our sample. In terms of access to family planning services, defined as the existence of these services in the community where the young woman lives, Table 2 shows that the group of *non-mothers* have higher access to family planning services, specifically, to pills and condoms, than the group of *ever-mothers*.

<< Insert Table 2 here>>

III. Empirical Strategy

Fertility and education decisions might be endogenous; i.e., omitted variables such as ability, motivation, or preferences can be correlated with these two decisions. This endogeneity represents an issue in that selection into "treatment" (i.e., *ever-mothers*) and "control" (i.e., *non-mothers*) groups is not random, and thus, OLS estimates of the early childbearing impact on schooling and cognitive skills might be biased. To address this issue and exploit the available information in our Malagasy survey, we use young women's access and exposure to condoms at the community level as an Instrumental Variables (IV) for early childbearing. Access is defined as the availability of condoms in the community where the young woman lives and exposure as the number of years for which the young woman has had community-level access to condoms since she was 15 years old. We use condoms, rather than another family planning method, as an IV for young woman's first birth for the following reasons. First, condoms are considered a key policy target employed to prevent sexual transmitted infections (STIs) and pregnancy among young women (Chong et al 2013). Second, while injectables, pills, and condoms are widely known to women in Madagascar,[16] the first two are more common among women who already have children; thus, pills and injectables are primarily used to space children within the family rather than to postpone the first birth. In fact, 38% of women use family planning for the first time only after they have already at least one child (DHS, 2009).[17] Consistently, condoms are more commonly used by single women compared to married women in Madagascar (Glick et al., 2009). Third, in contrast to pills and injectables, condoms are not perceived as having negative secondary health effects.[18] Using

[16] According to the 2009 DHS, 87.9% of women have heard of pills, 89% of injectables and 85% of condoms.
[17] Moreover, 11% of women used family planning for the first time only after they have already 4 or more children (DHS, 2009).
[18] According to 2009 DHS, 18% of women aged 15-49 who are in a relationship do not use family planning due to the potential secondary effects, while in the case of condoms, no negative health effects are expected.

condoms as an instrumental variable avoids the problem of accounting for social norms and misconceptions about the use of contraception. Fourth, as expressed by NGO workers and government agents during our field work visits (2012), school girls face the stigma of going to family planning centers to get injections or pills, whereas condoms are more easily accessible in this target population. Although we lack information on the condom distribution among the communities in the sample, according to the 2009 DHS 40% of condoms are distributed through stores and 20% through pharmacies at the national level.

The IV approach involves estimating a two-stage model of the following form:

$$Y_i = a + \beta' EverMother_i + \pi' Age_i + \rho' X_i + \theta' C_i + u_i$$

$$EverMother_i = \mu + \tau' Age_i + \delta' Zi + \gamma' X_i + \varphi' C_i + v_i$$

where $\boldsymbol{Y_i}$ represents distinct educational outcomes for a young woman $\boldsymbol{i}$ in 2012: i) current enrollment, ii) years of schooling, iii) a dummy variable for completing secondary school (i.e., having 9 or more years of education), and iv) standardized French and Math test scores.[19] Age_i is a set of dummies for women's age cohort, X_i is a vector of women's parents' socioeconomic variables, and C_i is a vector of extensive community variables to control for the potential endogeneity placement of condoms, as explained in more detail later. We restrict the estimation to those girls who quit school at an age greater than 13 years or older, thus excluding 10% of the total 859 women in the sample.[20] We do so to guarantee that girls are attending school at the minimum age at which they might be at the risk of pregnancy. Table 3 includes a summary statistics of the variables used in the estimation.

[19] Standardized scores are constructed by subtracting the mean and dividing by the standard deviation of the sample.

[20] We choose the age of 13 years because, according to Walker et al. (2011), this is the median age that girls dropped out of school in Madagascar in 2004.

We estimate two sets of models. In the first, the instrumental variable $\boldsymbol{Z_i}$**,** is a dummy variable for whether the young woman has "access to condoms" in the community where she lives. It is worth noting that access is not a self-reported measure since this question in the survey was answered by community leaders.[21] Also, as mentioned earlier, condoms are not distributed in schools. Therefore, we are not concerned that young women are receiving condoms while attending school. In addition, condoms are free or their price is heavily subsidized by the government or NGOs, therefore, price is not a factor defining access to this family planning method. Indeed, the 2009 DHS data show that among women ages 15 to 49 who are not currently using family planning, only 0.2% of them indicate the high price of family planning as a reason for not using these contraception methods in in the future.[22]

<< Insert Table 3 here >>

Given that we have information on the specific year that condoms became available in a particular community, our second set of models uses "exposure to condoms" as an IV. Exposure is defined as the number of years that a girl has had access to condoms at the community level since she was 15 years old. In our sample of communities, the median year that condom distribution started is 2000 and the average years of exposure since girls were 15 years old is 4.8. This age cut-off seems reasonable, not only because reproductive health programs by NGOs and government focus on young people 15 years and older, but also because the median age of sexual initiation among

[21] The exact wording of the related questions to the community leader is: "Can the residents obtain condoms in the village? Since when (year) these are available?

[22] The DHS data listed distance as a separate reason for not using modern contraception.

Malagasy women is 17.4 (DHS, 2009) [23] and the average age of first birth in our sample is 18.[24] We estimate 2-SLS models and IV-probits for binary dependent variables outcomes when instrumenting with exposure to condoms.[25]

In both equations, we control for young women cohort's age dummies, A_i. We also include $\boldsymbol{X_i}$, a set of young women's parents' socioeconomic variables: a dummy for whether the parents were alive at the time of survey (2012),[26] parents' education, and an asset index constructed from the earlier round of the survey in 2004, when the women were on average 15 years old.[27] These variables are important since other studies in the region (see for example, Ranchod et al. 2011) indicate that girls' educational attainment is driven more by socioeconomic conditions than by early pregnancy. Also, the inclusion of the asset index and parents' education is relevant given their importance as determinants of cognitive skills and school dropout behavior in Madagascar (Glick et al., 2009 and Walker et al., 2011). These childhood socioeconomic characteristics allow us to isolate the effect of pregnancy on schooling from the effect of poverty conditions when the girls were in the age range of 13 to 16.

One concern with the IV strategy outlined above is that access to condoms might be related to the level of social infrastructure and public services provision at the community level. This

[23]According to the 2009 DHS, the median age of sexual initiation is 17 among women ages 15 to 19 and 18 among women ages 20 to 24.
[24] As a robustness check, we also estimate our IV models with different measures of exposure, since age 10 and since the young woman's birth year. Although these instruments are negatively correlated with the likelihood of pregnancy, the F-statistics of the first stage with these instruments are lower than the corresponding statistic using exposure since age 15 (See table 6). For the school dropout and secondary progression outcomes, the F-stat using exposure since age 10 is 6.46 and since the birth year is 3.5. For the standardized scores, using exposure since age 10 the F-stat is 7.18 and since birth year is 4.29. Models are upon request.
[25]Lineal IV Models (2-SLS) using exposure to condoms are available upon request. These models indicate similar results as IV probit models.
[26]We also try alternative specifications of the dummy variable for whether the parents were alive in 2012. We tried a dummy variable for whether the parents were alive at the young woman's age of 15. We did not find a different statistical effect from the 2012 variable in the models.
[27]The asset index was created by using ownership of durable goods such as radio, TV, refrigerators, and bicycles, motorcycles, or cars as well as the source of drinking water and toilet facilities of the dwelling. For details on asset construction, see Glick et al. (2009).

potential for a non-random placement of family planning programs has been discussed recently by Pörtner et al. (2012) and earlier on by Molyneux and Gertler (2000) and Pitt et al. (1993). Condoms might be potentially located in communities where teen pregnancies are highest or, conversely, where the population is more inclined to use contraception. This might have large indirect effects on young women's joint fertility and education decisions (Angeles et al., 2005; Pörtner et al., 2012).

To address this issue and given that we lack information on the selection of communities to gain access to condoms, we include in the equations 1 and 2 above the variable *Ci,* an extensive set of social and economic infrastructure variables that allows us to identify the effect of access to condoms (exposure to condoms) conditional to these variables. We use variables from the 2012 community survey and the 2007 commune census to control for access (defined as the availability in the community) to upper secondary school (lycee), district hospital health center (CHD1), and community health center (CSB2), as well as for access to electricity, piped water, weekly market, and paved roads. Furthermore, we control for time-varying community covariates by including access to secondary school, electricity, and a community health center (CSB2) when the girl was 10 years old. From the 2001 community census, a period when our cohort members were young children, we include a remoteness index created using factor analysis and information on community distances to the main social infrastructure services and transportation.[28]In combination, these control variables from multiple points in time of the young women's life-course allow us to uncover some of the unobservable characteristics at the community level that might be related to access to condoms. The inclusion of these time-varying community variables avoids

[28]The remoteness index includes health services, banks, post offices, schools, taxis, courts, markets, inputs, extension services, and veterinarians as well as access to national and provincial roads, utilities, media and other markets and several measures of access to transport.

implementing IV fixed effects models at the community level.

In addition to controlling for C_i in our models, we check for potential non-random placement of condoms by estimating a linear probability model where we predict the probability that a community has access to condoms at the time of survey not only as a function of the community variables described earlier, but also as a function of two different 2006 fertility variables at the community level: number of births and number of women who died during or immediately after delivery. This last variable can be a good proxy of adolescent pregnancy since maternal mortality is higher among young women (Williamson, 2013). This fertility information comes from the 2007 commune census.[29]Table 4 shows that the 2006 fertility variables are not statistically significant and their coefficient are very small, suggesting that condoms are not placed where teen and/or total fertility is higher. None of the other community covariates are statistically significant either. Therefore, we fail to reject the hypothesis of random placement.[30]Furthermore, we estimate the same linear probability model of access to condoms but instead of 2006 fertility, we control for population and poverty rates from the 2001 community census, around 10 years before the 2012 survey and again when the women in our sample were pre-teens. We are able to conduct this exercise for 71 of our 73 communities in the 2012 survey. Table 4 shows that none of these covariates are statistically significant, indicating that there is no evidence for any non-random placement[31]. We also tried to instrument early pregnancy separately with the 2001 remoteness index and the access to CSB2 to test if the effect of access to condoms upon fertility was driven

[29]The 2006 number of births (number of women who died during or after delivery) information is only available for 68 (66) of the 73 communities included in our sample.

[30]We find consistent results when estimating the model with a fertility variable from the 2004 wave of the panel defined as the number of children ages 0 to 5 at the community level.

[31]Similarly, we estimate linear probability models of access to family planning services on the 2006 fertility and 2001 population and poverty controls as well as the other community variables. We do not find evidence of a non-random program placement. Models are available upon request.

by other community characteristics, but we did not find any statistical evidence to support that hypothesis.[32]

We also investigate whether access to condoms is a function of other non-economic characteristics that relate to community-level cultural and/or social norms and preferences over the use of family planning. We use ethnicity and religion as indicators of these characteristics; however, we are aware that these variables will not capture all the other unobservable community-level preferences and norms that might affect placement. Table 4 shows the linear probability models of access to condoms controlling for: a) the participation of the major ethnic groups Merina, Betsileo and Betsiminsarse from the 2001 community census and b) the 2012 participation of the main religious groups: Catholic, Protestant and Traditional.[33] The results indicate that ethnicity and religion do not have a statistically significant effect on the availability of condoms at the community level, further supporting that there is no evidence of non-random program placement.

<<Insert Table 4 here >>

A final point that must be addressed is that identification of the IV model requires a strong correlation between "access to condoms" (or "exposure to condoms") and the endogenous variable *ever-mother*. Table 5 shows the results of the first stage regression using access to condoms with and without the set of control variables described earlier. Table 6 presents the same results, but this time using the instrument "exposure to condoms". We observe in Table 5 that having access

[32]Models are not shown but are available from the authors.

[33]The ethnic variables are rough estimations from the focus groups interviewed in the 2001 community census. Ethnic data are not collected in the national census. The participation of the religious denominations at the community level was calculated using the head household's religion collected in the 2012 household survey; there is no information on the participation of religious groups in the 2001 and 2007 census.

to condoms at the community level, without controlling for any of the covariates, decreases by 26% the probability of being a mother, a finding that is significant at the 1% level (F-stat=38.75). Once we include the complete set of household and community control variables (column 5) this effect decreases to 18%, but it is still statistically significant at the same level (p-value =0.001) with an F-stat of 11.36, which is above the Staiger and Stock criteria for weak instruments.

<<Insert Table 5 here >>

Similarly, Table 6 indicates that having one extra year of exposure to condoms at the community level since the age of 15 decreases the probability of having children by 3.7% when no covariates are included in the estimation. This result is statistically significant at the 1% level (F-stat=44.2.). Once we control for the full set of variables, this estimate decreases to 2.3%, but remains statistically significant at the 1% level (p-value =0.001) with an F-stat value of 11.84. These F-statistics do not indicate a problem of weak instruments. This measure of exposure is consistent with the results of access to condoms, since 2.3% multiplied by the median exposure (4.8) is approximately equal to the point estimate of the access to condoms (18%). It should be noted that the effect of "access to condoms" and "exposure to condoms" on the endogenous variables does not significantly change in magnitude once we control by the 2012 and time-varying community variables and regional dummy variables. This robustness of the magnitude supports the hypothesis that there is no strong relationship between the access to condoms and the social infrastructure at the community level. For the rest of the results, we keep the complete set of control variables found in column 5 of both Tables 5 and 6.

In the results presented in table 5 and 6 above, we do not cluster the standard errors at the community level. We have reasons both for and against doing so, given the size of our sample. Although the endogenous variable *ever-mother* varies at the individual level, access to condoms varies at the community level. Therefore, fertility decisions of women living in the same community might be correlated. If this is the case, clustering will correct the implied underestimation of the standard errors (Bertrand et al., 2004). On the other hand, our sample includes 73 communities (above the critical level of 50 to cluster) but in each community, we have less than 5% of the total sample and the distribution of individuals across communities is unbalanced. Rogers (1993) shows that in these cases, clustering can do more harm than good.[34] Table 1.A of the appendix shows the first stage of the models using clustered standard errors controlling for all the individual, household, and community variables. The F-stat decreases to 8.16 and 7.11 for access and exposure to condoms, respectively.[35]These F-stat magnitudes are under the rule of thumb for weak instruments; however, because the models are just-identified, the weak instrument bias towards OLS is not present (Angrist and Pischke, 2008). Also, Table 3.A shows the results of the second stage of the IV models using clustered standard errors. The statistically significance is only compromised in the case of standardized scores of Math; however, our main results are robust to this more conservative scenario.[36]

<<Insert Table 6 here>>

[34]Indeed, we have 3 clusters with 2 individuals each. We estimate our models without these clusters and the results are robust to this exclusion.
[35]In these first stages, the point estimates of ‘access to condoms’ and ‘exposure to condoms’ are statistically significant at the 1% level, respectively; in each regression, the p-values are 0.006 and 0.008.
[36]Our results are robust to the estimation of the two stage models using IV-GMM and IV LIML suggesting that there is not a weak instrument problem, these model results are available upon request.

Hazard Models-Predicting the Age of First Birth

Using the same identification strategy, we estimate in the first stage a Weibull hazard model in which failure occurs when the young woman has her first child. This hazard model addresses the issue of right censoring since almost half of the young women in our sample have not yet had their first birth: for these women, we only know that age at first birth is at least as high as the current age. Thus, estimating the age at first birth can be done by modeling duration (years) until the first birth:

$$h_j(t) = h_o(t)\exp\{\delta' Age_j + \beta' Z_j + \alpha' X_j + \rho' C_j\}$$

where the hazard rate $h(t)$ is the probability of having the first birth at time (or age) t conditional on not having a child until t, Age_j is the birth cohort dummies, Z_j is the exposure to condoms, and X_j and C_j are, respectively, the household and community characteristics described earlier. The term h_o is the baseline hazard that in a Weibull distribution is defined by: $ho(t) = pt^{p-1}$.[37]We choose this parameterization because in our sample, we expect that the probability of having the first child increases with age (p > 1).[38] The Weibull model allows us to calculate an expected predicted survival time; that is, an expected "predicted age of first birth-*PredAFB*",[39] which we use in the second stage to predict the school outcomes:

$$Y_i = a + \beta PredAFB_i + \pi' Age_i + \rho' X_i + \theta' C_i + u_i$$

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[37]We reject the test of proportionality for the Cox hazard, which suggests a parametric hazard model.

[38]Examples of using the Weibull distribution to model the age of sexual initiation in Africa include Glick and Sahn (2009).

[39] The expected mean age of first birth; i.e., the expected value of the survival time is given by :
$\text{PredAFB} = \int_0^\infty S(t|X_j)$ where $S()$ is the survival function of the Weibull Distribution .

where *Yi* corresponds to the different school outcomes previously analyzed. Table 7 shows the hazard ratios for the main covariates using exposure to condoms.[40] We obtain the same qualitative results as when modeling the probability of *ever-mother*. Figure 3 shows the predicted hazard function after estimating the Weibull model that controls for access to condoms and the rest of covariates described earlier.[41] We observe that young women in communities where there is access to condoms have a lower risk of being pregnant, which confirms the validity of our identification strategy. Following our earlier discussion on the sensitivity of results to clustering, we present in Table 7 the results without clustering; however, assumptions on the standard errors do not affect the predicted age of first birth. Therefore, clustering or lack of clustering will only affect the significance level of the parameters of interest in the second stage.[42]

<<Insert Figure 3 here>>

As a robustness check, we estimate the Weibull hazard models changing the duration time from the age of 12 to the time of first birth or to the age in 2012 for the right-censored observations. The expected predicted age of first birth does not change significantly under this specification and neither do the second stage results. (See Table 5 in the appendix).[43]

<< Insert Table 7 here>>

[40] Results using access to condoms are qualitatively similar. We keep the specification with exposure to condoms since this instrumental variable is more appropriate for a duration model.
[41] A similar pattern is observed when using Kaplan Meier estimates by access to condoms.
[42] We have single-spell continuous hazard models; one spell corresponds to one woman. Thus, the clustering issue has the same nature as the IV lineal models.
[43] Furthermore, we also estimate the hazard models with gamma distribution instead of Weibull, and the results of the second stage model are qualitatively similar.

IV. Results and Discussion

Table 8 reports the OLS and IV estimates of the early childbearing effect on young women's: i) current enrolment, ii) years of education, and iii) completion of lower secondary school, using a dummy variable for whether a young girl has completed 9 or more years of education. These outcomes are measured in the last wave of the survey (2012) and among the girls who drop out from school at an age greater than 13. We present the OLS and IV models using both instrument variables, "access to condoms" and "exposure to condoms since age 15". We present in Table 8 the average marginal effects for the binary outcomes, estimated from the IV probit models.

The OLS results indicate that having a child decreases the probability of being currently enrolled in school at the time of the survey by 27%. This estimate increases to 42% in both specifications of the IV model at the 5% significance level using "access to condoms" and at the 1% level in the IV-probit model using "exposure to condoms".[44] Although the estimates are larger in the IV specification than in the OLS model, this difference is not statistically significant.[45] Compared to the sample mean, this marginal decrease translates into a drop from 19% to 11% in current enrollment. These findings suggest that there is a high opportunity cost in terms of forgone schooling for the girls who get pregnant. They also suggest that schooling and pregnancy are non-compatible or mutually exclusive, as has been shown in other African contexts such as Kenya (Duflo et al., 2014, Ozier, 2011) and Malawi (Baird et al., 2011). In Madagascar, pregnant girls

[44] To validate our results on the school dropout outcome, we construct woman–year panel data using the age of dropping out of school and the age of first birth to analyze the effect of *"ever-mother"* on current enrollment using a woman fixed effects specification. This estimation allows us to control for all a young woman's unobserved time-invariant characteristics that might affect education and fertility decisions simultaneously. In this model (results not shown), early childbearing increases the likelihood of dropping out of school by 22%, which is in line with our OLS and IV estimates.

[45]We are not able to reject the null hypothesis of exogeneity under the Hausman and Durbin Watson test using access to condoms as an IV. Nevertheless, the difference between OLS coefficient and the average marginal coefficient from the IV model with exposure to condoms is statistically different.

are commonly expelled from school *de facto* but there is no regulation justifying this practice. On the other hand, these results differ from those reported by Ranchod et al. (2011) in South Africa. Although the authors find that teenage pregnancy statistically increases school dropout[46] by 16% at age 20 or 22, they find smaller or negligible effects on high school graduation in South Africa. Teenage pregnancy decreases high school graduation only by 5.9% by age 20 and 2.7% by age 22, and this latter effect is no longer statistically significant. This suggests that teen mothers can "catch up" in education, reflecting the possibility of policies facilitating their return to school.

<<Insert Table 8 here>>

Table 8 also indicates that adolescent motherhood decreases by 2 the number of years of education under the OLS model and between 2.1 and 2.4 years under both IV specifications; however, these later point estimates are not statistically significant. The magnitude of this effect is larger than the one found by Arceo et al. (2012) in Mexico who, using propensity score matching, find that teenage pregnancy decreases school attainment by 1.2 years. As described earlier, the difference in the distribution of years of schooling between *non-mothers* and *ever-mothers* is larger when girls are going through the secondary school cycle. This difference is supported by our empirical models. Having a child decreases the probability of completing lower secondary school by 25% under the OLS estimation, 44% when 'exposure to condoms' is used as an IV, and 48% when the IV is 'access to condoms'. The IV point estimates are statistically significant at the 5% and 1% level, respectively. Compared with the sample mean, the IV estimate of the marginal effect of early childbearing implies a decrease from 50% to 28% in the completion of lower secondary school.

[46]Ranchod et al. (2011) defined dropout as a dummy variable that takes value of 1 if the girl has not been enrolled at any point before completion of high school.

We plot in Figure 4 the impact of early childbearing during the progression through secondary school, i.e., from having five years or more of schooling to having 13 years or more.[47] The figure indicates that the most adverse effect of early childbearing occurs when the young women are in the lower secondary school cycle (i.e., having 7 to 9 years or more of education). This effect of childbearing is attenuated in the upper cycle of the secondary school.

<<Insert Figure 4 here>>

We observe in Table 8 that the OLS estimations underestimate the effect of the teenage pregnancy on school outcomes. If the OLS estimates have a causal interpretation, then IV and OLS do not estimate the same parameter. In particular, if the response to treatment (in this case, teen fertility) is heterogeneous, then OLS captures a variance-weighted response while IV captures the response for those young women whose treatment status was affected by the instrument; i.e., local average treatment effect-LATE- (Imbens and Angrist, 1994). Our findings are consistent with those of Keplinger et al. (1999) who, using a large set of variables on the costs to control fertility (i.e., contraception prevalence, abortion rates, etc.) in the US context, also find that the IV estimates of teenage fertility on educational attainment and labor market outcomes are larger than the OLS estimates.[48] Their result differs from other studies in the US that have found that the OLS results overestimate the effect of teenage pregnancy.[49] Indeed, in light of Keplinger et al. (1999), our interpretation of the higher estimates is that they reflect the marginal impact of early childbearing on schooling outcomes for that portion of the sample of young women whose fertility decisions

[47]These results correspond to the IV probit models but similar results are obtained from the models using access to condoms.
48Using the reforms of abortion in 1970 as an IV, Angrist & Evans (2000) also find that the IV estimates of the impact of teenage pregnancy on school outcomes is larger than OLS estimates among the black young women.
49See for example Fletcher and Wolf (2009).

have been affected by the variation in the access (or exposure) to condoms. Larger IV estimates might suggest that those young mothers on the margin; i.e., those girls who face higher costs of condom access and who would have avoided early childbearing had these costs been lower, experience larger human capital losses than the average young mother.[50] The bias between OLS and IV estimates might be determined by the heterogeneity of the unobserved costs and benefits of the treatment (Ebestein, 2009).[51] Our sample is too small to estimate heterogeneous effects and characterize which subgroups of the sample are more affected by access and exposure to condoms. It is possible that girls who have higher opportunity costs of dropping out from school, i.e., are more "able and/or motivated" to keep studying, at the same time, might be more likely to engage in casual sex, and therefore, more likely to use condoms. These girls' costs of early childbearing are between those who will never have a child (never takers) and those who will always have a child (always takers). The relative importance of always takers and never takers is unclear and in theory, the LATE can either overestimate or underestimate the average parameter (Ebenstein, 2009).

A. Impact on Cognitive Skills

We explore whether the pregnancy-related school dropout has an impact on young women's cognitive skills, measured by French and Math test scores in 2012. Table 9 shows that, under the OLS specification, early childbearing is associated with a loss in the order of 0.37 and 0.43 in Math and French standardized test scores, respectively. These OLS estimates are statistically

50This explanation is similar to the credit constraints argument that the empirical evidence has used to explain why the IV estimations of the returns to schooling are larger than the OLS (Card, 2001).

51Ebenstein (2009), using a sex-preference instrument for fertility, shows that the same IV has different results on labor force participation depending on the context. He shows that in the US, OLS overestimates the IV parameter while in Taiwan, the opposite happens. The author uses a conceptual framework to show that the difference in results is due to variation in the unobservable heterogeneity of benefits and costs; for example, in Taiwan, sex preferences are stronger than the US.

significant at the 1% level. Once we account for endogeneity and instrument fertility with “access to condoms”, this effect increases to 1.13 and 1.14, respectively, for Math and French at the 5% statistical significance level. Using “exposure to condoms” as an IV, adolescent motherhood decreases by 1.49 and 1.56 the standardized test scores in Math and French, respectively, at the 1% statistical significance level. The differences between the OLS and IV results are statistically different indicating that endogeneity does have a considerable effect on the magnitude of the adolescent pregnancy impact on cognitive ability.[52]

<<Insert Table 9 here>>

This loss in girls’ cognitive ability due to pregnancy plausibly depends on how long girls have been in school. In fact, there is empirical evidence from Kenya suggesting that completing secondary school has substantial impacts on vocabulary and reasoning tests in adulthood (Ozier, 2011). We estimate OLS models of the effect of highest grade attained on the standardized test scores in Math and French using the entire cohort sample, men and women aged 21 to 23, and controlling for the same individual, household and community characteristics used in the earlier IV estimations. We are aware of the potential endogeneity of school attainment and cognitive skills, given that there might be some unobservables that simultaneously affect the grade completed and the cognitive ability such as parental preferences.[53] Nevertheless, we do this exercise to compare the magnitude of the average effect of school attainment (highest grade attained) on the standardized test scores with our estimates of early pregnancy. Having completed

[52]We reject the exogeneity null hypothesis with Hausman and Durbin Watson tests at the 5% significance level.
[53]Glick and Sahn (2009) do not reject the exogeneity of school attainment in a similar data of children 14–17 years old in Senegal. Also, Glick and Sahn (2009) found similar effects of grade attainment on test scores in different specifications including the selection into schools, suggesting that this endogeneity bias should not be a concern.

lower secondary (i.e., 9 years or more of schooling) increases the standardized test scores in Math and French between 0.9 and 1.25 among young men and women in the sample (see Table A.4 in appendix). The longer the stay in school, the larger the effect: having completed upper secondary school increases by 1.5 the standardized test scores in Math and French. This association of school attainment and test scores is statistically significant at the 1% level. Similar results are found when we estimate these OLS models only in the male sample. These point estimates are in the order of magnitude of the former IV results, suggesting that the effect of early childbearing on cognitive skills is capturing the shorter stay in school due to pregnancy. Indeed, this hypothesis is consistent with prior results of Glick et al. (2011) that show a strong correlation between school attainment and test scores in Madagascar using the 2004 round of our survey.[54]

We also explore whether the effect of adolescent motherhood on the 2012 tests scores is related to earlier test score performance. We do so because it is possible that girls with previous lower scores are less motivated to stay in school and thus deliberately decide to get pregnant. To test this hypothesis, following the framework of value-added models for tests scores (Todd and Wolpin, 2003), we estimate the effect of the 2004 scores on the 2012 scores with and without the variable *ever-mother* controlling for the same set of independent covariates used in the IV estimations. Given that we only have 2004 test scores data for half of the women in the sample, we could not use "access or exposure to condoms" as an instrument of fertility. The results of this exercise are shown in Table A.4 of the appendix. We observe that the effect of the 2004 standardized tests scores on the 2012 standardized test scores in Math and French do not change significantly when

[54]Glick et al. (2009) find that among children aged 14–16 years old attending (or have attended) grades 8 to 9 increases the standardized test scores in written Math by 0.8 and 1.4 standard deviations in an OLS model and a school fixed effects model, respectively.

including *ever-mother*.[55] Although we acknowledge the limitations in addressing the endogeneity of fertility in these estimations, the results suggest that early childbearing has an impact on the 2012 test scores in Math and French independent of the 2004 performance, at least for this portion of the women's sample.

B. Age of First Birth and Schooling

As explained in the empirical methodology section, the Weibull hazard model allows us to calculate a predicted mean age of first birth for all schoolgirls who drop out after age 13.[56] Table 10 summarizes the effect of this "predicted age of first birth" on the school outcomes previously analyzed in the IV models. We observe that a 1-year delay in the first birth increases the probability of current enrollment by 5.6% and the probability of completing lower secondary school by 8.4%. Regarding the test scores, postponing the first birth by 1 year increases the standardized test scores in Math and French by 0.19 and 0.21 standard deviations, respectively.

These findings of the survival models are consistent with our two-stage models' results. Consider an average girl from our sample who gets pregnant in school and has accumulated 7 years of education. If she has the option of postponing her first birth by at least 5 years, under the assumption of no grade repetition, she would be 40% more likely to complete at least lower secondary school. Similarly, if she can improve her standardized tests scores in Math and French by 0.2 each year of school attainment for the 5 years of delaying childbirth, she would have a return of gaining around 1 standard deviation in her tests scores. This result is a very close estimate to the effect of *ever-mother* on cognitive skills using the IV models presented earlier.

[55]The marginal increase in the R^2 of the regression that includes "ever- mother" implies that the fertility variable adds information to the value-added models.
[56]Similar results are obtained when we use predicted median age of first birth.

<<Insert Table 10 here>>

C. Robustness Checks

To validate our hypothesis that access to condoms should only affect young women's schooling outcomes through the avoidance of their first birth and not through other alternative channels; we estimate the reduced form of access to condoms on the school outcomes of young men in the same age cohort. If this placebo test is valid, we should expect that the direct effect of access to condoms on male's education outcomes is not statistically significant.We construct a similar sample of young men aged 22 on average and who drop out of school after age 13. In this sample, we control for the same set of individual, household, and community characteristics included in the IV models. Table 11 shows that the effect of "access to condoms" on the young men's current enrollment, years of education, completion of lower secondary school, and test scores. Compared to the same reduced form for young women, the point estimate of "access to condoms" on the male schooling outcomes are much smaller in magnitude and not statistically significant.

<<Insert Table 11 here>>

We also conduct a falsification exercise using the young women's height, a proxy of cumulative socio-economic and nutritional status.[57] Although some of the variables included in our models will affect young women's height and early pregnancy, access/exposure to condoms should not have a direct effect on young women's height. Using the same specification of our main models,

[57]Empirical evidence has shown that height is associated with better nutritional and economic conditions in utero and early childhood (see for example; Strauss and Thomas, 2007)

Table 12 shows that the coefficients of access and exposure to condoms on young women height are quite close to zero and not statistically significant.

<<Insert Table 12 here>>

In addition to the condom program placement checks that we presented earlier in the empirical section, we also estimate our IV models controlling for the two different measures of 2006 fertility at the community level: number of births and number of women who died during or after child delivery. Table 13 shows the OLS and IV models for the current enrollment and the standardized scores of Math and French outcomes controlling for these 2006 fertility variables and the rest of individual, household, and community covariates.[58] The effect of *ever-mother* on these school outcomes is robust to the inclusion of the 2006 fertility variables. We also conduct the same exercise but controlling separately for the 2001 population, poverty and ethnic variables as well as for the 2012 religious participation at the community level (Tables A.6 and A.7 show the results for the ethnic variables and catholic participation full results are upon request). Our main OLS/IV results are robust to the inclusion of all of these variables supporting that there is no evidence for any non-random program placement of condoms among the communities in our sample.

<<Insert Table 13 here >>

[58]These models were also estimated for years of schooling and completion of lower secondary school and the results are robust to the 2006 fertility controls.

As explained earlier, we use condoms as an instrumental variable because, unlike other modern contraceptive methods in Madagascar, they are more likely to be used to prevent the first birth than to space children. We corroborate this fact in our data by estimating the first stage of our IV models using access to pills (defined as the availability of this contraception method in the community where the young woman lived in 2012) instead of access to condoms. We include the same individual, household and community covariates as in the specifications of Table 5. We find that the F-stat of the first stage that uses access to pills is much lower (F-stat=1.1) than the correspondent statistic when using access to condoms (F-stat=11) (Table 14). This result suggests that teenage pregnancy is more highly correlated with access to condoms than with access to pills. We repeat the same exercise using access to family planning services, which refers to any reproductive health services available in the community, and we also find that the F-stat is about three times lower than the corresponding statistic using access to condoms. Consistently, we also find that the results of the earlier models of *ever-mother* on the school outcomes, that use access/exposure to condoms as an IV, are robust to the inclusion of access to pills as an additional explanatory variable.[59]

<<Insert Table 14 here>>

Finally, we conduct a sensitivity analysis of our IV estimates to potential deviations from the exclusion restriction following the local-to-zero approximation method proposed by Conley et al. (2012). This approach consists in adding the instrument to the second stage equation of the 2SLS model in order to analyze to what extent the IV main results (i.e.; inference on $\boldsymbol{\beta}$) are robust to

[59] These models are upon request.

deviations from the perfect exclusion restriction (γ=0). In our case this involves estimating the following:

$$Y_i = a + \boldsymbol{\beta}' EverMother_i + \boldsymbol{\gamma} AccCond + \pi' Age_i + \rho' X_i + \theta' C_i + u_i$$

The uncertainty about γ is based on adjusting the 2SLS asymptotic variance matrix by including a term that measures the extent to which the exogeneity assumption is erroneous.[60] The magnitude of this uncertainty is based on prior information about the OLS reduced form estimates of the school outcomes on access to condoms. We assume that γ is distributed N (0, δ^2) where δ is the x % of the reduced form impact. We allow x to vary from 0 to 100% and construct 95% confidence intervals for β.[61] Figure A.1 in the appendix summarizes the results for the main outcomes. Our IV results on the effect of early childbearing on currently enrollment, progression to secondary school and test scores are statistically significant as long as we assume values of δ from zero to strictly lower than 40% of the reduced form coefficients. Given that we lack information on how condoms can have a direct effect on young women's school outcomes, except for their effect through the early fertility reduction, this sensitivity analysis suggests that our results are robust to potentially mild and moderate deviations from the exclusion restriction.

V. Conclusions

Empirical evidence on the economic consequences of adolescent pregnancy is scarce in developing countries, particularly in Sub-Saharan Africa. We contribute to this literature by addressing whether early childbearing causally affects school dropout and cognitive skills among young

[60] For further explanations of this method see pages 263-264 in Conley et al (2012).
[61] These estimations are implemented using the Stata code "plausexog" by Damien Clark downloadable via ssc install plauseox and which is based on the Conley et al (2012) methodology.

women in Madagascar, a low-income, high-fertility country. Using a panel data survey combined with community censuses, we address the endogeneity between fertility and education decisions by instrumenting young women's access to condoms at the community level, and their exposure to condoms since age 15. We control for an extensive set of covariates at the community level to account for the potential endogeneity of program placement and present a large number of robustness checks that strengthen our conclusions.

Our findings show a detrimental impact of teenage pregnancy on young women's human capital in Madagascar. Young women's early childbearing increases their likelihood of dropping out of school by 42% and decreases their chances of completing lower secondary school (i.e., 9 years of more of schooling) by 44%. These findings suggest that early pregnancy and schooling are mutually exclusive in Madagascar.

Furthermore, this school-pregnancy related dropout is associated with a decrease in the standardized test scores in Math and French in the order of 1.1 to 1.5 standard deviations. This magnitude is comparable to the effect of secondary school attainment on test scores, suggesting that the shortened stay in school due to pregnancy has detrimental effects on cognitive skills. These results on cognition are a unique contribution to the empirical literature in developing countries. We also obtain consistent results when we model the age of first birth using hazard models in the first stage. Delaying a young women's first birth by a year increases her probability of current enrollment by 5%, her likelihood of completing secondary school by 8%, and her test scores in Math and French by 0.2 standard deviations.

We need to bear in mind that the estimation of fertility impacts on socioeconomic outcomes depends on the identifying instrument employed, since there is heterogeneity in individual responses to the specific chosen instrument. In other words, the effect estimated from variation in a policy variable represents a specific local average treatment effect (LATE) of modifying the fertility of certain population groups (Shultz, 2007).[62] Therefore, our instrumental variable results are applicable to the sample of young girls whose childbearing decisions are induced by the access (exposure) to condoms, which probably is not representative of the average young school girl in Madagascar. However, it is also the case that these girls in our sample have higher opportunity costs when getting pregnant.

Our results underline the potential role for policies that can prevent early childbearing and those that allow teen mothers to catch up with their education to enhance young women's human capital investment. In particular, the results from our instrumental variable approach suggest that reproductive health and family planning policies that lower the costs of postponing the first birth among young women can have human capital gains beyond the prevention of poor pregnancy outcomes, such as risks of maternal health and low birth weight. This evidence is consistent with findings from a large family planning program in Colombia that enabled young women to postpone their first birth, thus allowing them to increase their years of education and labor participation in the formal sector (Miller, 2010).

More broadly, there is an ongoing debate on the effectiveness of reproductive health policies in developing countries, particularly concerning whether access to family planning policies reduces total fertility and improves socio-economic outcomes (Canning and Schultz, 2012). In this context, our findings suggest that, regardless of any effect on total fertility, the timing of postponing the first birth is crucial to increasing women's education and human capital. However, further research should analyze if this reduction in teen fertility translates into reduced fertility over a woman's

[62] This limitation of the IV estimation is also common to studies that use natural experiments such as miscarriages to identify the effects of teenage pregnancy. By comparing teenage mothers to those girls who have had a miscarriage, causal effect concerns only the atypical subsample of the relevant population (Keplinger et al., 1999).

lifetime as well as into improvements in her and their families' long- term economic outcomes. For instance, improved human capital in young women can also be translated into better health and education outcomes for their children, breaking the cycle of intergenerational poverty transmission. Therefore, policies that aim to reduce teenage pregnancy may impact not only young women's economic opportunities but those of their children.

Further research on the effectiveness and impact of reproductive health and family planning policies is timely in Sub-Saharan African countries, such as Madagascar, since they are facing a demographic dividend: the number of young people aged 12–24 is larger than ever, representing a unique opportunity to reap the benefits of enhancing young women's human capital.

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TABLES AND FIGURES

Table 1-Education and Cognitive Performance for Mothers and Non Mothers

	Non Mothers	Ever Mothers	All
2012 Education variables			
% School Enrollment	34.00	3.27	17.39
Years of Education	9.25	6.20	7.60
	(3.74)	(3.18)	(3.77)
% Some Primary school	13.74	29.18	22.12
% Completed Primary	10.69	18.67	15.02
% Some Lower Secondary	9.67	19.96	15.25
% Completed Lower Secondary	14.25	14.81	14.55
% Some Upper Secondary	10.18	7.51	8.73
% Completed Upper Secondary	23.41	4.94	13.39
% Some University	17.56	1.93	9.08
Cognitive skills			
2012 Math Test Score	16.43	11.78	13.97
	(8.12)	(7.10)	(7.94)
2012 French Test Score	12.28	7.92	9.98
	(6.22)	(5.75)	(6.35)
No. of Observations	393	466	859

Notes: Standard deviations in parentheses. Girls without any education represent 1.86 % of the sample. This percentage is not shown in Table 1.Differences in the education outcomes reported in the table between ever-mothers and non-mothers are statistically significant at 1%.

Table 2-Family Planning Access and Use among Young Women

	Non Mothers	Ever Mothers	All
% Family Planning Use	18.07	42.27	31.2
% 2012 FP services access	91.09	80.9	85.56
% 2012 Pill access	83.21	73.61	78
% 2012 Condom access	84.48	69.1	76.1
N	393	466	859

Note: Differences in the Family Planning outcomes reported in Table 2 between non-mothers and ever-mothers are statistically significant at the 1% level.

Table 3-Summary Statistics of the Variables included the IV Models

	N	Mean	Std. Dev
Dependent Variables			
Ever- Mother (Y=1)	778	0.526	0.500
Current Enrollment (Y=1)	778	0.189	0.392
Years of Schooling	778	8.076	3.577
Z Scores of French	703	0.076	0.985
Z Scores of Math	712	0.074	0.981
Parents' variables			
Asset Index 2004	758	0.106	0.997
Mother is alive (Y=1)	778	0.905	0.294
Father alive(Y=1)	778	0.823	0.382
Mother 's years of education	774	4.903	3.578
Father's year of education	774	5.598	3.944
Community variables at the time of the survey			
Community health Center (CSB2)	778	0.636	0.481
Community Hospital (CHD1)	778	0.135	0.342
Upper Secondary (Y=1)	778	0.614	0.487
Piped Water (Y=1)	778	0.554	0.497
Access to weekly market (Y=1)	778	0.614	0.487
Access to paved road all year(Y=1)	778	0.422	0.494
Urban Indicator	778	0.289	0.454
Community variables at 10 years old			
Electricity at 10 years old	778	0.490	0.500
Upper Secondary at 10 years old	778	0.413	0.493
CSB2 at 10 years old	778	0.541	0.499
Electricity at 10 years old	778	0.276	0.447
Remoteness index 2001	778	2.377	1.345

Notes: Dummies for age cohort and regions are not shown. These summary statistics are for the estimation sample which excludes girls who drop out of school at an age younger than 13. This group represents 10% of the female cohort members.

Table 4: Linear Probability Models of Access to Condoms on Socioeconomic Characteristics at the Community Level

Dependent Variable: Access to Condoms

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Urban (Yes =1)	0.226	0.170	0.0828	0.0363	0.109	0.111	0.105
	[0.242]	[0.241]	[0.256]	[0.252]	[0.255]	[0.247]	[0.247]
Electricity (Y=1)	0.137	0.133	0.126	0.155	0.188*	0.201*	0.173
	[0.0989]	[0.107]	[0.110]	[0.131]	[0.0991]	[0.103]	[0.104]
Piped Water (yes=1)	0.105	0.106	0.174*	0.183	0.140	0.140	0.106
	[0.0956]	[0.0970]	[0.104]	[0.121]	[0.110]	[0.112]	[0.122]
Upper Secondary (Yes =1)	0.0242	0.0116	0.0539	0.0336	-0.0476	-0.0547	-0.0410
	[0.151]	[0.149]	[0.148]	[0.146]	[0.149]	[0.150]	[0.152]
Community Health Center (CSB2)	0.321	0.318	0.300	0.237	0.228	0.227	0.220
	[0.207]	[0.204]	[0.205]	[0.206]	[0.215]	[0.210]	[0.209]
Hospital -CHD1 (Y=1)	0.134	0.119	0.165	0.172	0.216	0.209	0.212
	[0.120]	[0.114]	[0.132]	[0.119]	[0.136]	[0.131]	[0.133]
Access to weekly market	0.158	0.124	0.0717	0.108	0.181	0.177	0.187
	[0.137]	[0.131]	[0.140]	[0.124]	[0.124]	[0.124]	[0.123]
Access to Paved Road	0.119	0.151	0.122	0.103	0.0416	0.0346	0.0591
	[0.114]	[0.118]	[0.118]	[0.127]	[0.127]	[0.126]	[0.135]
2001 Remoteness Index	-0.0243	-0.0259	-0.0135	-0.00788	-0.0237	-0.0296	-0.00787
	[0.0520]	[0.0565]	[0.0550]	[0.0509]	[0.0554]	[0.0548]	[0.0599]
No Cyclones 2002-11	-0.0455	-0.0329	-0.0216	-0.0282	0.00662	0.00436	-0.000278
	[0.0571]	[0.0579]	[0.0566]	[0.0590]	[0.0516]	[0.0516]	[0.0546]
2006 No. of Births	-0.0000277						
	[0.0000310]						
2006 No. of Women dead after/immediately after child delivery		0.00144					
		[0.00921]					

2001 Community Variables							
Log Population			0.0157				
			[0.0726]				
Percentage of Poor People			-0.00190				
			[0.00236]				
Merina Ethnic Group(%)				0.00155			
				[0.00619]			
Betsileo Ethnic Group (%)				0.00298			
				[0.00245]			
Betsimisaraka Ethnic (%)				0.00220			
				[0.00309]			
2012 Religious Groups							
Participation Catholic					0.182		
					[0.352]		
Participation Protestant						0.0148	
						[0.304]	
Participation traditional							-0.280
							[0.373]
N	68	66	71	71	73	73	73
adj. R-sq	0.158	0.154	0.125	0.133	0.130	0.123	0.135

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively. Robust Standard errors reported in parentheses. Regional dummies are not shown

Table 5-First Stage Using Access to Condoms as an IV

Dependent Variable: Ever-Mother

	(1)	(2)	(3)	(4)	(5)
Condom Access (Y=1)	**-0.262*****	**-0.193*****	**-0.199*****	**-0.182*****	**-0.179*****
	[0.0395]	**[0.0441]**	**[0.0497]**	**[0.0514]**	**[0.0530]**
2004 Asset Index		-0.0529***	-0.0440*	-0.0171	-0.0122
		[0.0203]	[0.0241]	[0.0261]	[0.0273]
Mother is alive (Y=1)		-0.0496	-0.0386	-0.0417	-0.0390
		[0.0628]	[0.0616]	[0.0610]	[0.0610]
Father is alive (Y=1)		-0.00782	-0.0187	-0.0255	-0.0188
		[0.0452]	[0.0449]	[0.0449]	[0.0453]
Mother's years of education		-0.0141**	-0.0147**	-0.0155**	-0.0147**
		[0.00601]	[0.00602]	[0.00600]	[0.00605]
Father's years of education		0.00000143	0.00152	0.00107	0.000587
		[0.00572]	[0.00571]	[0.00563]	[0.00567]
Community health Center (CSB2)			0.0579	0.0494	0.0808
			[0.0482]	[0.0744]	[0.0888]
Community Hospital (CHD1)			-0.0353	0.00540	-0.000210
			[0.0528]	[0.0539]	[0.0577]
Upper Secondary (y=1)			-0.105**	-0.0890	-0.0965
			[0.0449]	[0.0594]	[0.0642]
Piped Water (Y=1)			0.0751*	0.0832**	0.0951**
			[0.0398]	[0.0417]	[0.0438]
Access to weekly market (Y=1)			-0.0666	-0.0903*	-0.104**
			[0.0443]	[0.0466]	[0.0481]
Access to paved road all year(Y=1)			0.0551	0.0581	0.0683
			[0.0411]	[0.0443]	[0.0460]
Access to Electricity (Y=1)			0.00814	0.0738	0.0597
			[0.0475]	[0.0524]	[0.0585]
Upper Secondary at 10 years old				0.0288	0.0486
				[0.0630]	[0.0705]
CSB2 at 10 years old				-0.0288	-0.0276
				[0.0648]	[0.0660]
Electricity at 10 years old				-0.208***	-0.222***
				[0.0647]	[0.0761]
Remoteness index 2001				0.00177	-0.00527
				[0.0201]	[0.0207]
Urban					0.0135
					[0.108]
Regional dummies					Y
N	778	750	750	750	750
F-stat First Stage	**38.7516**	**19.2553**	**16.0394**	**12.4651**	**11.3694**
R-sq	0.0719	0.0969	0.1181	0.1312	0.136

Notes: Robust standard errors in brackets * p < 0.10, ** p < 0.05 *** p < 0.01

All the models (1–5) include cohort age dummies. Model 5 includes the Regional dummy variables not shown

Table 6-First Stage Using Exposure to Condoms as an IV

Dependent Variable: Ever- Mother

	(1)	(2)	(3)	(4)	(5)
Condom Exposure 15 yrs	**-0.0368*****	**-0.0277*****	**-0.0257*****	**-0.0230*****	**-0.0234*****
	[0.00553]	**[0.00606]**	**[0.00640]**	**[0.00659]**	**[0.00680]**
2004 Asset Index		-0.0515**	-0.0448*	-0.0186	-0.0135
		[0.0203]	[0.0239]	[0.0258]	[0.0270]
Mother is alive (Y=1)		-0.0533	-0.0412	-0.0432	-0.0408
		[0.0632]	[0.0621]	[0.0614]	[0.0614]
Father is alive (Y=1)		-0.0119	-0.0229	-0.0291	-0.0219
		[0.0454]	[0.0451]	[0.0450]	[0.0453]
Mother's years of education		-0.0146**	-0.0149**	-0.0156***	-0.0147**
		[0.00603]	[0.00606]	[0.00605]	[0.00610]
Father's years of education		-0.000134	0.00124	0.000876	0.000345
		[0.00574]	[0.00574]	[0.00567]	[0.00571]
Community health Center (CSB2)			0.0386	0.0343	0.0745
			[0.0468]	[0.0742]	[0.0888]
Community Hospital (CHD1)			-0.0373	0.00325	-0.00206
			[0.0528]	[0.0540]	[0.0577]
Upper Secondary (Y=1)			-0.0945**	-0.0828	-0.0903
			[0.0450]	[0.0599]	[0.0649]
Piped Water (Y=1)			0.0647	0.0715*	0.0854**
			[0.0393]	[0.0408]	[0.0428]
Access to weekly market (Y=1)			-0.0759*	-0.0959**	-0.112**
			[0.0441]	[0.0465]	[0.0477]
Access to paved road all year(Y=1)			0.0444	0.0501	0.0607
			[0.0409]	[0.0443]	[0.0460]
Access to Electricity (Y=1)			-0.000436	0.0658	0.0509
			[0.0471]	[0.0523]	[0.0583]
Upper Secondary at 10 years old				0.0381	0.0559
				[0.0629]	[0.0700]
CSB2 at 10 years old				-0.0301	-0.0295
				[0.0651]	[0.0662]
Electricity at 10 years old				-0.204***	-0.223***
				[0.0641]	[0.0743]
Remoteness index 2001				0.00537	-0.00277
				[0.0199]	[0.0205]
Urban (Y=1)					0.0251
					[0.106]
Regional Dummies					Y
N	778	750	750	750	750
F-stat First Stage	**44.2365**	**20.8813**	**16.143**	**12.2032**	**11.8428**
R-sq	0.0719	0.0988	0.1178	0.1307	0.1365

Notes: Standard errors in brackets * p < 0.10, ** p < 0.05 *** p<0.01"

All the models (1–5) include cohort age dummies. Model 5 includes the Regional dummy variables not shown

Table 7-First Stage for Age of First Birth

	Hazard ratio	Robust Standard error	z	P>|z|
Condom Exposure 15 years	0.94	0.019	-3.11	0.002
2004 Asset Index	0.92	0.083	-0.88	0.376
Mother is alive (Y=1)	0.87	0.164	-0.73	0.464
Father is alive (Y=1)	0.91	0.130	-0.65	0.513
Mother's years of education	0.95	0.019	-2.63	0.009
Father's years of education	1.00	0.018	-0.2	0.842
Community Health Center (CSB2)	1.36	0.392	1.07	0.286
Community Hospital (CHD1)	0.94	0.178	-0.32	0.752
Upper Secondary (Y=1)	0.75	0.157	-1.38	0.168
Piped Water (Y=1)	1.30	0.182	1.87	0.062
Access to weekly market (Y=1)	0.69	0.106	-2.4	0.016
Access to paved road all year (Y=1)	1.16	0.165	1.05	0.295
Electricity(Y=1)	1.16	0.206	0.82	0.41
Upper Secondary at 10 years old	1.14	0.270	0.54	0.587
CSB2 at 10 years old	0.87	0.181	-0.66	0.506
Electricity at 10 years old	0.46	0.117	-3.05	0.002
Remoteness index 2001	0.95	0.056	-0.95	0.341
Urban	1.19	0.396	0.53	0.593

No of Observations = 750 ; Wald Chi2(27)= 113.62, p =7.14 (std. error 0.22)
Notes: Age Cohort and regional dummies not shown. Hazard ratios less than 1 decrease the risk of failure (ever-mother).

Table 8-Impact of Early Childbearing on School Attainment

		(1)	(2)	(3)
		OLS	IV- 2sls Access to condoms	IV Exposure to Condoms /a
Panel A : Dependent Variable				
Current Enrolled	Ever _mother	-0.275***	-0.428**	-0.427***
		[0.0270]	[0.189]	(0.126)
	F-stat		11.36	11.84
	N	750	750	750
Panel B : Dependent Variable				
Years of Education	Ever-Mother	-2.029***	-2.172	-2.400
		[0.201]	[1.460]	[1.487]
	F-stat		11.36	11.84
	N	750	750	750
Panel C : Dependent Variable				
Completed 9 Years of school	Ever-Mother	-0.259***	-0.486**	-0.445***
(Lower Secondary School)		[0.0326]	[0.243]	(0.055)
	F-stat		11.36	11.84
	N	750	750	750

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. (a) Models with IV-Exposure to condoms in Panel A and Panel C are estimated with IV-probits. For these models, the Ever-Mother coefficient is the average marginal effect and standard errors are calculated with the delta method. All the models include age cohort dummies, parents' education, dummies for whether parents were alive at the time of survey (2012), 2004 asset index, the extensive social infrastructure variables at the community level described in section III as well as regional dummies

Table 9-Impact of Early Childbearing on Cognitive Skills

		(1) OLS	(2) IV- 2sls Access to condoms	(3) IV-2SLS Exposure to Condoms
Panel A : Dependent Variable				
Standardized Math Score	Ever-mother	-0.371***	-1.136**	-1.495***
		[0.0637]	[0.532]	[0.570]
	F-stat		12.37	12.269
	R-Square	0.414	0.2789	0.121
	N	688	688	688
Panel A : Dependent Variable				
Standardized Score French	Ever-mother	-0.429***	-1.142**	-1.569***
		[0.0611]	[0.515]	[0.567]
	F-stat		12.83	12.11
	R-Square	0.479	0.361	0.178
	N	679	679	679

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. Standardized test scores are calculated by subtracting the mean and dividing by the standard deviation. All the models include age cohort dummies, parents' education, dummies for whether parents were alive at the time of survey (2012), 2004 asset index, and extensive social infrastructure variables at the community level described in section III as well as regional dummies.

Table 10-Effect of Predicted Age of First Birth on School Outcomes

	Current Enrollment	9 or more Years of Schooling	Z-Score French	Z-Score Math
	(1)	(2)	(3)	(4)
Predicted Age First Birth (Mean)	0.056**	0.084**	0.190***	0.211***
	[0.026]	[0.030]	[0.0614]	[0.0642]
N	750	750	688	679

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. Age of First Birth was predicted after estimation of Weibull models in the first stage. Models (1) and (2) are estimated with probit models. Coefficients are average marginal effects All the models include the individual, household, and community control variables described in section III.

Table 11-Reduced Form of Access to Condoms on Male and Female School Outcomes

Dependent Variables		Current Enrollment	Years of Schooling	Completed Lower Secondary	Z-Score French	Z-Score Math
Outcomes for Young Men	Access to Condoms	-0.00512	0.0567	0.0352	0.121	0.0863
		[0.0341]	[0.475]	[0.0676]	[0.151]	[0.141]
	Adj -R^2	0.129	0.371	0.379	0.311	0.250
	N	723	723	723	664	675
Outcomes for Young Women	Access to Condoms	0.0765**	0.388	0.0869*	0.233**	0.224**
		[0.0332]	[0.281]	[0.0448]	[0.0959]	[0.0920]
	Adj -R^2	0.162	0.436	0.420	0.363	0.286
	N	750	750	679	688	750

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust Standard errors reported in parentheses. All the models include the individual, household, and community control variables described in section III.

Table 12-Reduced Form of Young Women's Height on Access/Exposure to Condoms

Dependent Variable: Young Women's Height	(1)	(2)
Access to Condoms	-0.00228	
	[0.00439]	
Exposure to Condoms since age 15		0.0000439
		[0.000563]
N	741	741
adj. R-sq	0.068	0.067

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively. Robust Standard errors reported in parentheses. Young Women's Height is in natural logarithms All the models include the individual, household and community control variables described in section III.

Table 13-Robustness Check: OLS and IV Models including 2006 Fertility Variables

Panel A: OLS and IV Models Controlling for 2006 Number of Births at the Community Level

	Current Enrollment		Standardized Score of Math		Standardized score of French	
	OLS	IV -Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms
Ever-Mother	-0.275***	-0.443**	-0.371***	-1.077**	-0.428***	-1.205**
	[0.0270]	[0.186]	[0.0637]	[0.492]	[0.0611]	[0.487]
2006 No. of Births	-0.00000270	-0.00000448	0.0000396	0.0000358	0.0000256	0.0000195
	[0.0000150]	[0.0000149]	[0.0000286]	[0.0000308]	[0.0000288]	[0.0000335]
Missing No. of births	0.00777	0.00977	-0.0311	-0.0251	0.0464	0.0610
	[0.0619]	[0.0614]	[0.122]	[0.136]	[0.113]	[0.131]
N	750	750	688	688	679	679

Panel B: OLS and IV Models Controlling for 2006 Maternal Mortality at the Community Level

	Current Enrollment		Standardized Score of Math		Standardized Score of French	
	OLS	IV -Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms
Ever-Mother	-0.274***	-0.370**	-0.372***	-0.998**	-0.430***	-1.183**
	[0.0270]	[0.188]	[0.0634]	[0.500]	[0.0611]	[0.512]
2006 No. of Women dead during/after child delivery	0.000864	0.000347	-0.0110	-0.0136*	-0.00332	-0.00721
	[0.00350]	[0.00362]	[0.00686]	[0.00782]	[0.00693]	[0.00847]
Missing	-0.0529	-0.0497	-0.199*	-0.174	-0.0268	0.00635
	[0.0462]	[0.0467]	[0.111]	[0.116]	[0.111]	[0.121]
N	750	750	688	688	679	679

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust Standard errors reported in parentheses. Standardized test scores are calculated by subtracting the mean and dividing by the standard deviation. All the models include the individual, household and community control variables described in section III.

Table 14- First Stage of Ever Mother on Access to Pills and Family Planning Services

	Access to Condoms	Access Pills	Access to Family Planning Services
Ever-Mother	-0.179***	-0.0530	-0.120*
	[0.0530]	[0.0478]	[0.0625]
F-stat	11.36	1.22	3.66
N	750	750	750
adj. R-sq	0.104	0.091	0.094

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively. Robust standard errors reported in parentheses. All the models include the individual, household and community control variables of column 5 specification in Tables 5 and 6.

Figure 1. Timing of School Dropout and First Pregnancy

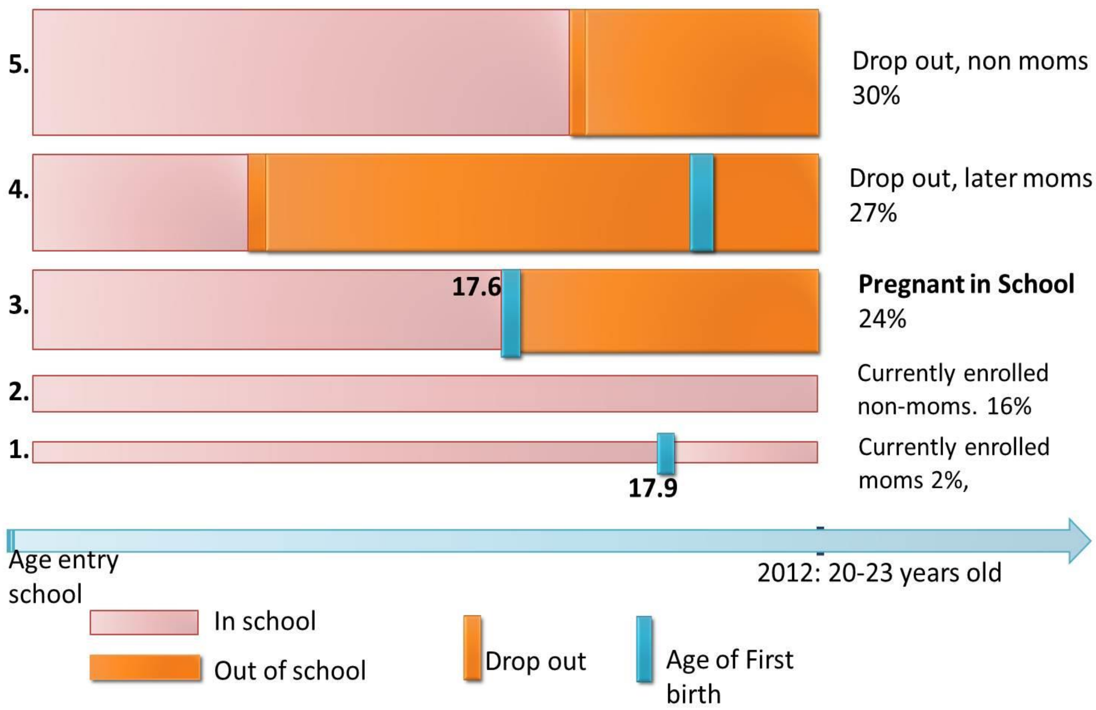
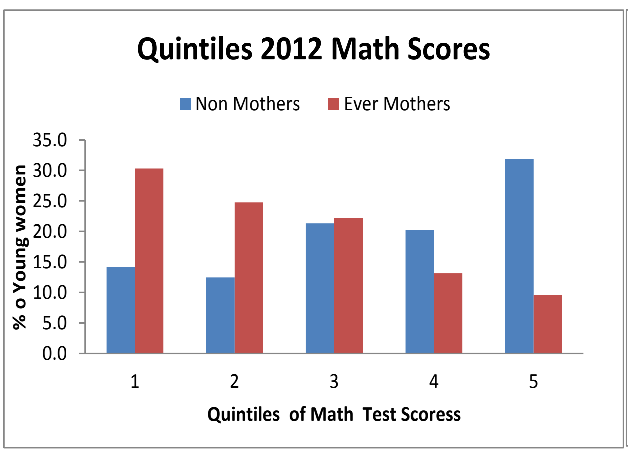


Figure 2 - Quintiles of Math and French Test Scores for Non-Mothers and Ever-Mothers



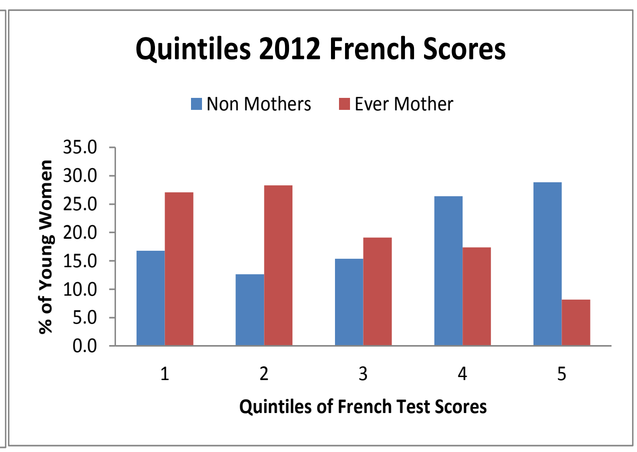
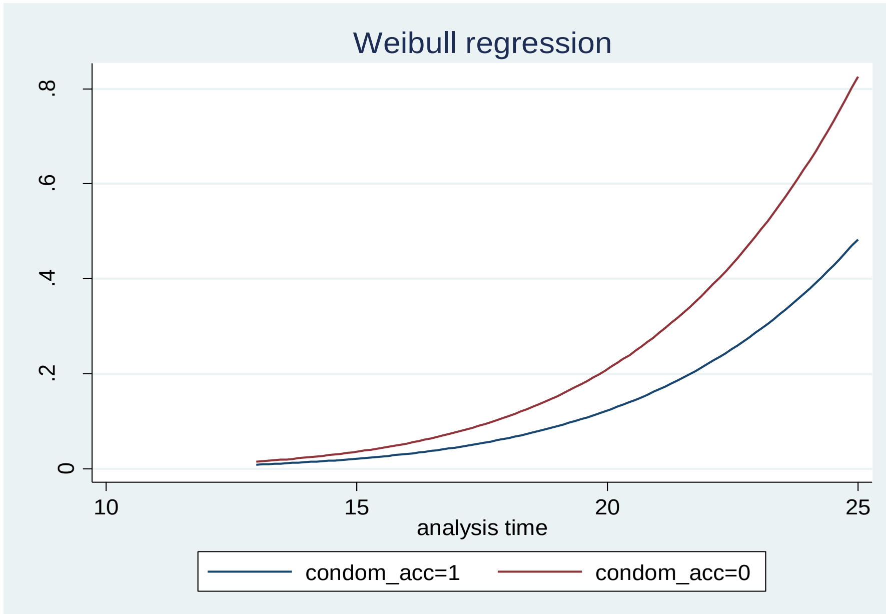
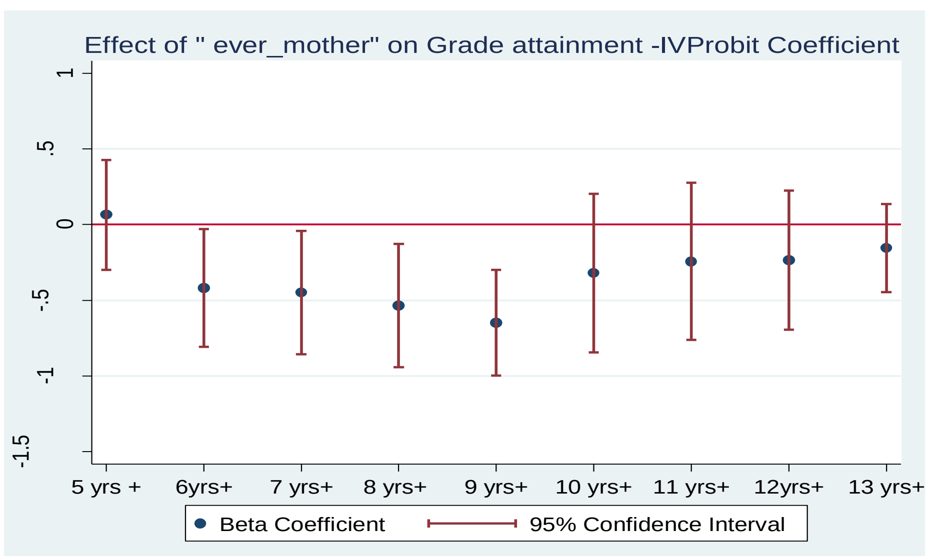


Figure 3- Weibull Regression of the Age of First Birth



Note: This is the predicted hazard function by access to condoms after estimating the Weibull model which controlls by the individual, household and community covariates

Figure 4- Early Childbearing Effect on Grade Attainment



Notes: Beta Coefficient corresponds to the average marginal effect of the IV-probit models. Models include individual, household and community control variables

APPENDIX

Table A.1-First Stage using Clustered Standard Errors

	Ever mother	Ever Mother
Condom Access	-0.179***	
	[0.0626]	
Condom Exposure_15 years		-0.0234***
		[0.00864]
Asset Index 2004	-0.0122	-0.0135
	[0.0270]	[0.0267]
Mother is alive (Y=1)	-0.0390	-0.0408
	[0.0586]	[0.0588]
Father is alive (Y=1)	-0.0188	-0.0219
	[0.0414]	[0.0404]
Mother's years of education	-0.0147***	-0.0147***
	[0.00544]	[0.00554]
Father's years of education	0.000587	0.000345
	[0.00609]	[0.00615]
Community health Center (CSB2)	0.0808	0.0745
	[0.0998]	[0.101]
Community Hospital (CHD1)	-0.000210	-0.00206
	[0.0556]	[0.0564]
Upper Secondary (Y=1)	-0.0965	-0.0903
	[0.0621]	[0.0653]
Piped Water (Y=1)	0.0951*	0.0854*
	[0.0498]	[0.0462]
Access to weekly market (Y=1)	-0.104**	-0.112**
	[0.0468]	[0.0454]
Access to paved road all year(Y=1)	0.0683	0.0607
	[0.0491]	[0.0491]
Electricity(Y=1)	0.0597	0.0509
	[0.0544]	[0.0549]
Upper Secondary at 10 years old	0.0486	0.0559
	[0.0696]	[0.0712]
CSB2 at 10 years old	-0.0276	-0.0295
	[0.0666]	[0.0659]
Electricity at 10 years old	-0.222***	-0.223***
	[0.0826]	[0.0741]
Remoteness index 2001	-0.00527	-0.00277
	[0.0186]	[0.0178]
Urban (Y=1)	0.0135	0.0251
	[0.112]	[0.103]
N	750	750
First Stage	8.1618	7.3442
R-sq	0.136	0.1365

Notes: * p<0.10, ** p<0.05, *** p<0.01" Robust clustered standard errors in brackets. Models include cohort age and regional dummies not shown.

Table A.2-IV Results of the Effect of Ever-Mother on 2012 School Outcomes Clustering Standard Errors

	(1)	(2)	(3)
2012 School Outcomes	OLS	IV- Access to condoms	IV -Exposure to condoms
Current Enrollment	-0.275***	-0.428**	-0.427***
Std. error	[0.0277]	[0.208]	(0.126)
Completed Lower Secondary	-0.259***	-0.486*	-0.445***
Std. error	[0.0336]	[0.272]	(0.064)
Years of Schooling	-2.029***	-2.172	-2.400
Std. error	[0.193]	[1.925]	[1.786]
Z-Score Math	-0.371***	-1.136*	-1.495**
Std. error	[0.0722]	[0.650]	[0.709]
Z-Score French	-0.429***	-1.142	-1.569**
Std. error	[0.0765]	[0.745]	[0.755]

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Clustered Robust Standard errors reported in parentheses. All the models include the individual, household, and community control variables described in section III. In Column 3, binary outcomes are estimated using IV-probit models and the standard errors calculated with delta method.

Table A.3-School Attainment and 2012 Standardized Scores of French and Math

	All Sample		Male	
	z-Score Math	**z-Score French**	**z-Score Math**	**z-Score French**
Complete Primary (5 years sch.)	0.345***	0.306***	0.351***	0.289***
	[0.0616]	[0.0584]	[0.0839]	[0.0797]
Some College (6-8 years-sch.)	0.853***	0.769***	0.952***	0.905***
	[0.0649]	[0.0608]	[0.0895]	[0.0830]
Complete College (9 years sch.)	0.987***	0.984***	0.979***	1.066***
	[0.0656]	[0.0616]	[0.0864]	[0.0809]
Some Lycee (10-11 years sch.)	1.254***	1.353***	1.262***	1.421***
	[0.0756]	[0.0694]	[0.0995]	[0.0936]
Complete Lycee (12 years sch.)	1.574***	1.620***	1.637***	1.715***
	[0.0691]	[0.0624]	[0.0928]	[0.0802]
Superior (12 and more years sch.)	1.964***	1.956***	2.131***	2.042***
	[0.0845]	[0.0738]	[0.127]	[0.105]
N	1363	1343	675	664
adj. R-sq	0.574	0.658	0.592	0.679

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust Standard errors reported in parentheses. Individuals included in the sample dropped out from school at ages older than 13. All the models include the individual, household, and community control variables described in section III.

Table A.4- 2004 Test Scores Effects on 2012 Test Scores in Math and French

	2012 Z-Score Math		2012 Z-Score French	
	(1)	(2)	(1)	(2)
2004 Z-Score Math	0.190***	0.186***		
	[0.0491]	[0.0525]		
2004 Z-Score French			0.222***	0.206***
			[0.0494]	[0.0474]
Ever-Mother		-0.309***		-0.329***
		[0.0847]		[0.0794]
N	402	402	390	390
Adj. R^2	0.381	0.401	0.455	0.479

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors reported in parentheses. Women included in the sample dropped out from school at ages older than 13. The 2012 and 2004 z-scores are the standardized test scores with mean 0 and standard deviation of 1. All the models include the individual, household, and community control variables described in section III.

Table A.5-Effect of Predicted Age of First Birth on School Outcomes Changing Origin at 12 years old

Panel A: First Stage Age of First Birth

	Hazard ratio	Robust Standard error	z	P>|z|
Condom Exposure 15 years	0.940	0.018	-3.29	0.001

Notes: p =2.58 (std. error 0.117); No of observations 750; Wald Chi2= 114. All the models include the individual, household, and community control variables described in Table 7.

Panel B: Second Stage School Outcomes

	Current Enrollment	9 or more Yrs of Schooling	Z-Score French	Z-Score Math
	(1)	(2)	(3)	(4)
Predicted Age First Birth (Mean)	0.043**	0.064***	0.127***	0.156***
	[0.02]	[0.024]	[0.0476]	[0.0489]
N	750	750	688	679

Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors. Models (1) and (2) are estimated with probit models, thus coefficients are average marginal effects and standard errors calculated by delta method. All the models include the individual, household, and community control variables described in section III.

Table A.6-Robustness Check: OLS and IV Models controlling for 2001 Ethnicity Main Groups

	Current Enrolment		**Completed 9 Years or more of Schooling**		**Standardized Score of Math**		**Standardized Score of French**	
	OLS	IV -Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms
Ever Mother	-0.281***	-0.419**	-0.255***	-0.627**	-0.385***	-1.296**	-0.451***	-1.524***
	[0.0273]	[0.195]	[0.0327]	[0.257]	[0.0639]	[0.551]	[0.0617]	[0.548]
2001 Ethnic Groups(Est .% of the population)								
Merina	-0.00334*	-0.00344*	-0.00859***	-0.00886***	-0.0176***	-0.0199***	-0.0121**	-0.0139**
	[0.00181]	[0.00185]	[0.00233]	[0.00246]	[0.00455]	[0.00545]	[0.00488]	[0.00575]
Betsileo	-0.000433	-0.000626	0.00152**	0.000993	0.00328**	0.00201	-0.000687	-0.00197
	[0.000665]	[0.000725]	[0.000767]	[0.000883]	[0.00155]	[0.00194]	[0.00142]	[0.00180]
Betsimisaraka	-0.000844	-0.000911	0.000575	0.000392	-0.00575***	-0.00635***	-0.00278	-0.00373
	[0.000834]	[0.000851]	[0.00105]	[0.00118]	[0.00200]	[0.00237]	[0.00194]	[0.00248]
N	730	730	730	730	669	669	660	660
adj. R-sq	0.273	0.246	0.362	0.235	0.415	0.216	0.471	0.193

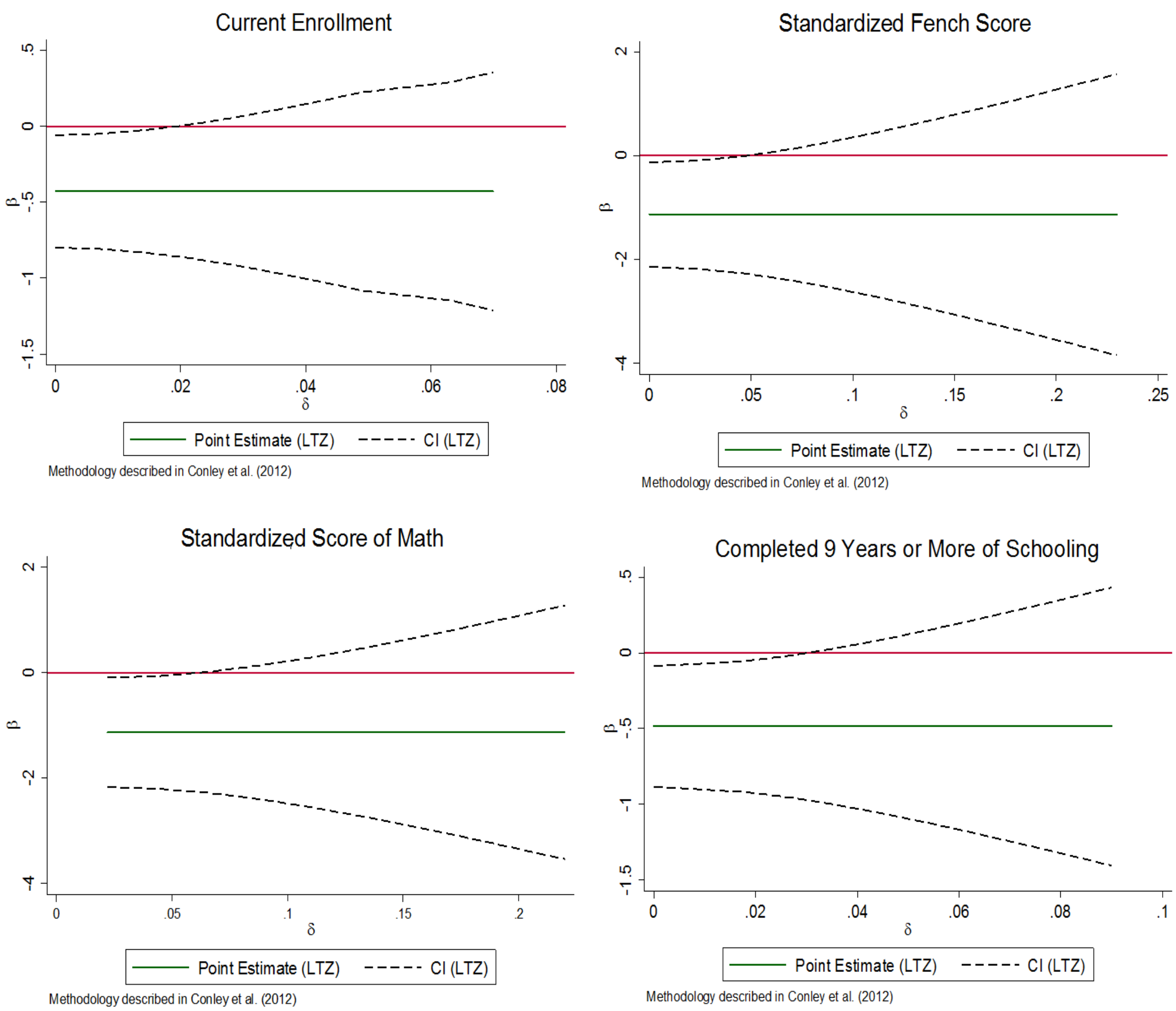
Notes: ***, **, *: significant at 1%, 5%, and 10% levels, respectively. Robust standard errors in parenthesis. Standardized test scores are calculated by subtracting the mean and dividing by the standard deviation. All the models include the individual, household, and community control variables described in section III.

Table A.7 -Robustness Check: OLS and IV Models controlling for 2012 Catholic Participation

	Current Enrolment		Completed 9 Years or more of Schooling		Standardized Score of Math		Standardized Score of French	
	OLS	IV Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms	OLS	IV -Access to condoms
Ever mother	-0.276***	-0.432**	-0.260***	-0.490**	-0.375***	-1.160**	-0.431***	-1.138**
	[0.0270]	[0.189]	[0.0325]	[0.243]	[0.0638]	[0.532]	[0.0609]	[0.504]
2012 Catholic (%)	0.124*	0.138*	0.146	0.166*	0.325*	0.403*	0.478***	0.508**
	[0.0666]	[0.0726]	[0.0915]	[0.0963]	[0.192]	[0.223]	[0.182]	[0.209]
N	750	750	750	750	688	688	679	679
adj. R-sq	0.269	0.234	0.345	0.297	0.393	0.244	0.463	0.342

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively. Robust Standard errors reported in parentheses. Standardized test scores are calculated by subtracting the mean and dividing by the standard deviation. All the models include the individual, household, and community control variables described in section III.

Figure A.1-Robustness Checks: Local-to-Zero Approximation Bounds for School Outcomes using Access to Condoms as an IV



Notes: The 95% confidence intervals are constructed with the-Local-to-Zero Approximation (LTZ) method proposed by Conley et al (2012). We assume that γ is distributed N (0, δ^2) where δ is a percentage from 0 to 100% of the reduced form impacts. IV models include the same control variables described in Table 8 and 9. The STATA code ‘plausexog’ by Damian Clarke (downloadable via ssc install plausexog) was used to estimate these results.