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Abstract

Female secondary school attendance has recently increased in Sub-Saharan Africa; however, the higher likelihood of attending school after puberty has put girls at risk of becoming pregnant while attending school. Using a panel survey designed to capture the transition from adolescence to early adulthood, we analyze whether teenage pregnancy contributes to lower school attainment and cognitive skills among young women in Madagascar. We address the endogeneity between fertility and education decisions by instrumenting early pregnancy with the young woman's access to condoms at the community level, and her exposure to condoms since she was 15 years old. We control for an extensive set of community social infrastructure characteristics to deal with the endogeneity of program placement. Our instrumental variable results show that having a child increases by 42% the likelihood of dropping out of school and decreases the chances of completing lower secondary school by 44%. This school-pregnancy related dropout is associated with a reduction of 1.1 standard deviations in the Math and French test scores. These results are consistent with hazard model estimations: 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.

Key words: Fertility, Female Education, Cognitive Skills, Instrumental Variables, Madagascar

JEL codes: I25, J13, O15

1. 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 death 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 for girls to attend 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 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 has rapidly increased from 45% to 69% between 1998 and 2010 in Madagascar (WDI, 2012); 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 (DHS, 2009).¹ Indeed, Madagascar is among the top 10 developing countries with teenage pregnancy rates above 20% (UNFPA, 2013). Moreover, family planning prevalence in Madagascar is only 29% among women between 15 and 49 years old and there is no access to safe abortion.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, young girls may have strong preferences for education and labor market success and therefore less preference for children. Using a panel data survey designed to capture the transition from adolescence to adulthood, we use an instrumental variable approach to address this endogeneity. 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 lives; and in the second, we define the instrument in terms of "exposure to condoms", measured by the number of years during which the young woman 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 18³. Using the same identification strategy, we also estimate the age of first birth in the first stage using Weibull hazard models. This specification allows us to correct for the right censoring problem of women in our sample. The hazard also has the advantage of enabling us to estimate the impact on education of postponing the first pregnancy by one year.

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 the reduction of early pregnancy rather than through a direct effect. We show different robustness checks to

¹ The total fertility rate is still at 4.8 children per women according to the 2008/09 Demographic Health Survey (DHS).

² In Madagascar abortion is illegal. However, some estimates of abortion rates are at 1 per 10 live births. Abortion complications are one of the major contributors to maternal death in the country (Sharp et al., 2011).

³ The age of sexual initiation among Malagasy women is 17.4 (DHS,2009)

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. Additionally, we show that there is no evidence to support any non-random program placement of condoms. The reason we use condoms as an instrumental variable for early fertility, instead of other family planning methods such as pills or injectables, is that the latter are primarily used to space children within the family rather to postpone the first birth. There are also social norms that discourage girls of high school age from going to family planning clinics and seeking contraceptive access from the formal health care establishment. This is in contrast with condoms which are readily accessible among school girls; 40% of condom distribution is done through stores and 20% through pharmacies (DHS, 2009). Additionally, condoms are also a policy target employed to prevent Sexually Transmitted Infections (STIs) which prevalence is very high in Madagascar. In recent years, there has been an effort from the government and NGOs to increase condoms access and use among vulnerable populations (Glick et al, 2009).⁴

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 (Portner et al, 2012; Molyneux et al, 2000). To address this potential issue, we control in our models for an unusually complete set of social infrastructure community variables, both contemporaneous and lagged, which are available in the community surveys of the panel survey. Additionally, we estimate a linear probability model of the access to condoms at the time of survey on a range of community covariates as well as variables that capture the size of the population and poverty rates in 2001, a period over 10 years before the survey of the women used in our study. Also, our IV results are robust to the inclusion of 2006 fertility variables. We do not find any evidence of non-random program placement. Furthermore, we also control in our models for childhood socioeconomic characteristics when the girls were in the age range of 13 to 15 in order to isolate the effect of pregnancy from the effect of poverty conditions when women were young adolescents.

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 the likelihood of dropping out of school by 42%. Also, it decreases the 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 *non-compatible*, a result that is consistent with other empirical evidence in African contexts.⁵ 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 the standardized scores of Math and French. Consistently, the results from the hazard models suggest that postponing first birth by one year has comparable gains in school attainment and cognitive skills.

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 include employing sibling fixed effects which compares 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

⁴ The low HIV/AIDS prevalence in Madagascar despite a high prevalence of STIs (one of the highest in Sub-Saharan Africa), relative 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).

⁵ See Duflo et al (2012) and Ozier (2011) for empirical evidence in Kenya and Baird et al (2011) for Malawi.

menarche, abortion and contraception rates (Ribar, 1994 and Keplinger et al. 1999) and propensity score matching methods within 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 of the 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 sometimes is not statistically significant.⁶

In the context of developing countries, to the best of our knowledge, there are very few studies that rigorously establish a causal relationship between early pregnancy and school outcomes. Azevedo et al. (2012) use data on miscarriages as instrument for the timing of pregnancy in Mexico and find that a younger age of first birth does not have adverse effects either on education or on employment. In contrast, Arceo et al (2012), using a propensity score matching to construct a counterfactual group for the young mothers, find that teenage pregnancy decreases the 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 of the effect of teenage pregnancy on cognitive skills. There are few cross-sectional studies in South Africa that have shown an association between test scores performance and fertility (Thomas, 1999) or the initiation of sexual activity (Marletto, 2008), but they have not established a causal effect of early pregnancy on cognitive skills. Third, using 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 not only can prevent poor pregnancy outcomes but also can have a potential role in enhancing young women's education opportunities and increase their accumulation of human capital.

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, including the results of the hazard models to measure the impact of age of first birth on the school outcomes. Section 4 discusses the results, while the last section concludes and discusses policy implications.

⁶ For a discussion of the recent empirical studies see Fletcher and Wolfe (2009)

2. Data description and Context

The Madagascar Life Course Transition of Young Adults Survey 2011-12 re-interviewed a cohort of 1749 young adults, 859 of them women, who were 21-23 years old at the time of the survey. The survey gathered detailed socioeconomic information on them, their spouses, and the households in which they reside at the time of survey, as well as their communities. The survey also collected detailed retrospective event histories on the cohort members regarding schooling, fertility, employment, marriage, health as well as on the range of economic and life-course events, and experiences going back to 2004 in Madagascar, the year in which the cohort members were last surveyed in the *Enquête sur la Progression Scolaire à Madagascar* (EPSPAM) survey.⁷ This 2012 data include tests of cognitive skills in Math and French collected for all the cohort members even if they were not attending school at the time of the survey. The 2011-12 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 since these services were available in the community. We complement the information at the community level with the 2001 and 2007 commune censuses that feature a wide range of information about all the villages in Madagascar, including information on the basic public services and infrastructure.

For the 2012 sample of 859 women cohort members between 21 to 23 year old, we have detailed fertility and education history information, including test scores from 2012. Some descriptive statistics on these women's education are summarized in Table 1. We observe 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 call "*Non-Mothers*" their female counterparts in the cohort who have not yet given birth. In our sample, the average age of first birth is 18 years (standard deviation 2.12).

⁷ Around 90% of the 2004 cohort members were followed in 2012. This attrition rate (around 10%) is very small compared to other panels in Sub-Saharan Africa.

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

	Non Mothers	Ever Mothers	All
<i>2012 Education variables</i>			
% School Enrollment	34.00	3.27	17.39
Years of Education	9.25 (3.74)	6.20 (3.18)	7.60 (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
<i>Cognitive skills</i>			
2012 Math Test Score	16.43 (8.12)	11.78 (7.10)	13.97 (7.94)
2012 French Test Score	12.28 (6.22)	7.92 (5.75)	9.98 (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 the table 1.

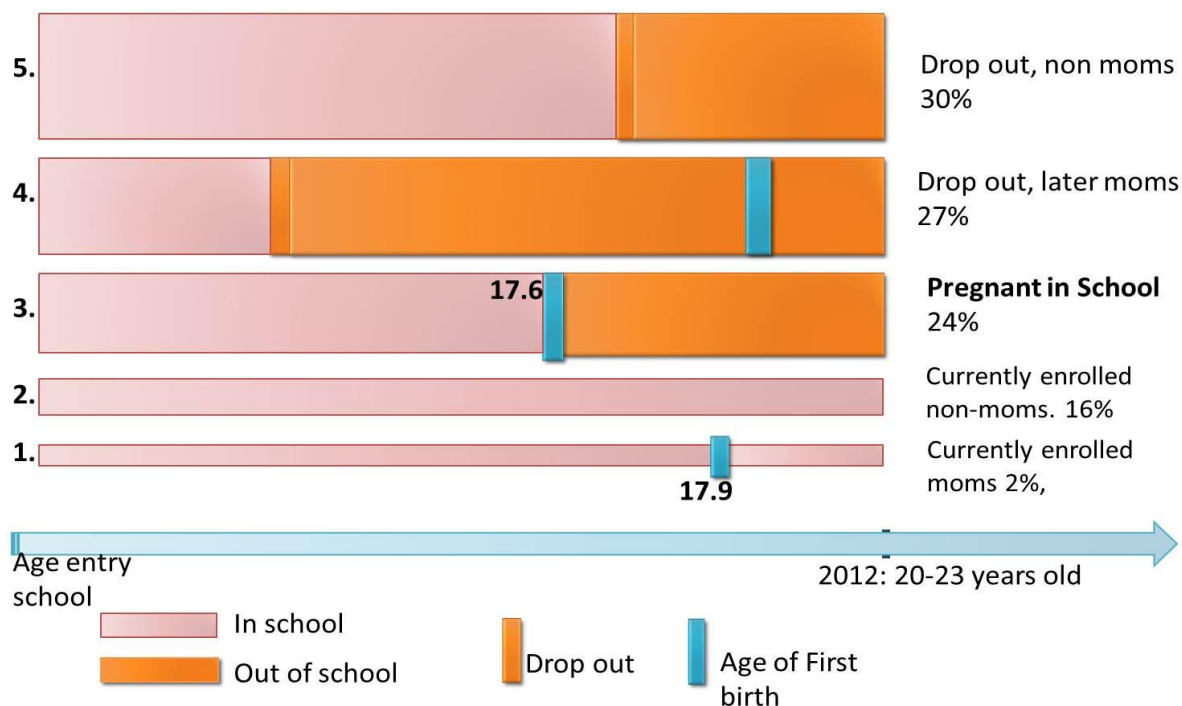
Differences among groups statistically significant at 1%

Table 1 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. We calculate the difference between the age of awareness of conception and age of dropping out of school, and classify the young women according to the timing of these two decisions of fertility and education (See graph 1). We find that almost 24% of the sample, or 46% of the young mothers got pregnant while they were in school.⁸ In contrast, 30% of the girls drop out of school but they do not get pregnant at least until the time of the survey. Also, it is noteworthy that 27% of the young women drop out much sooner than their first birth, indicating that there is no overlapping 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

⁸ Given that we have an exact women’s children date of birth 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.

enrolled in school which suggests the difficulty of continuing education once the young women have their first child.⁹

Graph 1. School enrollment, dropping out and pregnancy

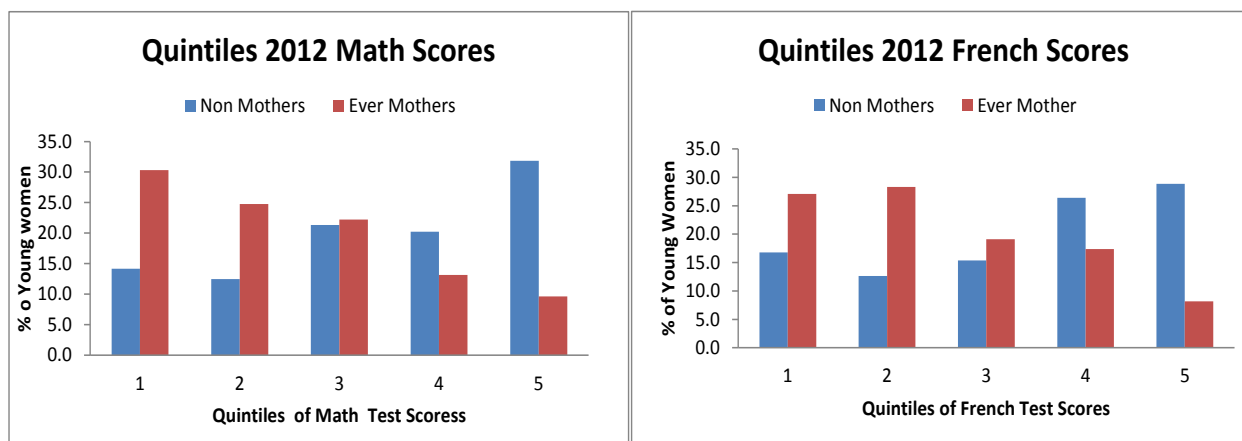


These patterns are consistent with the years of education completed among the two groups as shown in Table 1. While the group of *ever-mothers* completed 6.2 years of schooling, the corresponding graph for *non-mothers* is 9.25. This difference is reflected in the data on the progression through school. Among the group of *ever-mothers*, only 5% completed upper secondary while 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 negligible.

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 Graph 2).

⁹ In field work visits, different stakeholders in the education sector pointed out the fact that school girls who get pregnant are socially and sometimes pressured 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 school-dropout, although the issue is recognized by the authorities.

Graph 2



Regarding the use of family planning among the young women in our cohort, the data shows that 31% of them use at least one method of contraception (modern and/or traditional). As Table 2 shows, there is a larger group of family planning users 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 when they have already at least one child (DHS, 2009). Among the family planning users, 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 the young women’s level 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 more access to family planning services, specifically, to pills and condoms than the group of *ever-mothers*.

Table 2 Access and Family Planning 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 pills access	83.21	73.61	78
% 2012 Condom access	84.48	69.1	76.1
N	393	466	859

Note: The differences between non-mother and ever mothers on the FP variables of the table are statistically significant at 1% level.

In the next section we describe the identification strategy we employ to study the impact of early childbearing on school attainment and cognitive skills among young women in Madagascar.

3. Empirical Strategy

Fertility and education decisions might be endogenous; i.e omitted variables such as ability, and motivation can be correlated with these two decisions. Therefore, OLS estimations of the early childbearing impact on schooling and cognitive skills might be biased. The ideal experiment to analyze this impact would be to randomly assign pregnancies among girls and compare their educational outcomes after girls have given birth. This is an impractical and unethical research design. To address this endogeneity issue and exploiting the available information in the survey, we use the young woman’s access and exposure to condoms at the community level as an

Instrumental Variables (IV) for her early childbearing. Access is defined as the availability of condoms in the community where the young woman lives.

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,¹⁰ 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 when they have already at least one child (DHS, 2009)¹¹. Consistently, condoms are more used by single than married women in Madagascar (Glick et al, 2009). Third, in contrast to pills and injectables, condoms are not perceived to have negative secondary health effects.¹² Using 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 have the stigma of going to family planning centers to get the injections or pills, whereas condoms are more easily accessible in this target population; 40% of them are available in stores and 20% in pharmacies (DHS, 2009).¹³ The IV approach involves estimating a two-stage model of the following form:

$$Y_i = a + \beta'EverMother_i + \pi'Age_i + \rho'X_i + \theta'C_i + u_i \quad (1)$$

$$EverMother_i = \mu + \tau'Age_i + \delta'Z_i + \gamma'X_i + \varphi'C_i + v_i \quad (2)$$

Where Y_i represents distinct educational outcomes 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.¹⁴ 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 potential placement endogeneity of condoms, as we explain 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 sample¹⁵. 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.

¹⁰ According to the 2009 DHS, 87.9% of women have heard of pills, 89% of injectables and 85% of condoms

¹¹ Moreover, 11% of women used family planning for the first time when they have already 4 children or more.(DHS, 2009)

¹² According to 2009 DHS, 18% of the women, aged 15-49, who are in union do not use family planning due to the potential secondary effects, while in the case of condoms, no negative health effects are expected.

¹³ We also tried our models with access to pills since this information was also collected in our data. The F-stat of the first stage was only 2 consistent with the reasons why condoms are better instrument for first pregnancy.

¹⁴ The standardized scores are constructed by subtracting the mean and dividing by the standard deviation of the sample

¹⁵ We choose the age of 13 years because, according to Walker et al. (2011), this is the median age that girls drop out of school in Madagascar in 2004.

Table 3 Summary Statistics of the Variables in the IV Models

	N	Mean	Std Dev
<i>Dependent Variables</i>			
Ever_mother_d (Y=1)	778	0.526	0.500
Current Enrolment (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
<i>Parents' variables</i>			
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 educaiton	774	4.903	3.578
Father's year of educaiton	774	5.598	3.944
<i>Community variables at the time of the survey</i>			
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
<i>Community variables at 10 years old</i>			
Electricity at 10 yrs old	778	0.490	0.500
Upper Secondary at 10 yrs old	778	0.413	0.493
CSB2 at 10 yrs old	778	0.541	0.499
Electricity at 10 yrs old	778	0.276	0.447
Remotness index 2001	778	2.377	1.345

Notes: Not shown dummies for cohort age and regions

We estimate two sets of models. In the first, the instrumental variable 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. 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.¹⁶ Given that we have information on the specific year that condoms were available in a particular community, in our second set of models, we use the “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

¹⁶ According to the USAID sources, the price of a box containing 8 condoms is 400 ariary (0.15 USD)

seems reasonable, not only because reproductive health programs of NGOs and government focus on young people starting at 15 years and older, but also because the median age of sexual initiation among Malagasy women is 17.4 (DHS, 2009) and the average age of first birth in our sample is 18.¹⁷ We estimate 2-SLS models and IV-probits for binary dependent variables outcomes when instrumenting with the exposure to condoms.¹⁸

In both equations, we control for young women cohort's age dummies, A_i . We also include X_i , a set of young women's parents control variables: a dummy for whether the parents were alive or not by the time of survey (2012)¹⁹, parents' education, and an asset index constructed from the earlier round of the survey in 2004, when the women were on average 15 years of age.²⁰ 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 in Madagascar (Glick et al., 2009 and Walker et al., 2011).

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 potential for a non-random placement of the condoms has been discussed by Portner et al. (2012) and Molyneux et al. (2000). 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; Glick et al. 2011; Portner et al. 2012). To address this issue, we include in the equations 1 and 2 above the variable C_i , an extensive set of social 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, district hospital health center (CHD1), community health center (CSB2), electricity, piped water, weekly market and paved roads. Furthermore, we control for time varying community covariates by including access to secondary school, electricity and community health center (CSB2) when the girl was 10 years old. From the 2001 community census, we include a remoteness index which is created using factor analysis and information on community distances to the main social infrastructure services and transportation.²¹ In combination, these control variables allow us to uncover some of the unobservable characteristics

¹⁷ As a robustness check, we also estimate our IV models with a different measure of exposure; i.e since age 10 and 12. Although these instruments are negatively correlated with the likelihood of pregnancy, the F-statistics of the first stage are lower than the one of the exposure since age 15. Models are upon request.

¹⁸ Lineal IV Models (2-SLS) using exposure to condoms are available upon request. These indicate similar results than IV probit models

¹⁹ We also try some specification with the time varying variable of the parents alive at age of and 15 but they did not have a different statistically effect than the 2012 parent alive variable in the models

²⁰ The asset index was created by using ownership of durable goods such as radio, TV, refrigerator and bicycle motorcycle or car as well as the source of drinking water and toilet facilities of the dwelling. For details on the asset construction see Glick et al. (2012) and Sahn and Stifel (2003)

²¹ The remote 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.

at the community level that might be related to the access to condoms. The inclusion of these community variables avoids 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. The covariates we use are the community variables described earlier, in addition to the population and poverty variables from the 2001 community census. We are able to do this exercise for 71 of our 73 communities in 2012 survey. Table 4 shows that none of these covariates are statistically significant; therefore, we fail to reject the hypothesis of a random placement. Similarly, we did not find evidence of a non-random placement for family planning service access (column 2, table 4). We also tried to instrument early pregnancy separately with the remoteness index and the access to CSB2 to test if the access to condoms effect on fertility was driven by other characteristics of the communities, but we did not find any statistical evidence to support that hypothesis (models not shown).

Table 4 Linear Probability Models for Access to Condoms and Family Planning Services

	Access to Condoms	Access to Family Planning
Urban (Yes =1)	0.0828 [0.256]	0.0837 [0.216]
Electricity (Y=1)	0.126 [0.110]	0.0483 [0.0826]
Piped Water (yes=1)	0.174* [0.104]	0.0968 [0.0902]
Upper Secondary (Yes =1)	0.0539 [0.148]	0.00632 [0.109]
Community Health Center (CSB2)	0.300 [0.205]	0.110 [0.180]
Hospital -CHD1 (Y=1)	0.165 [0.132]	0.152 [0.0935]
2001 Remotness Index	-0.0135 [0.0550]	0.00616 [0.0355]
Access to weekly market	0.0717 [0.140]	0.0551 [0.130]
Access to Paved Road	0.122 [0.118]	0.0230 [0.0828]
No Cyclones 2002-11	-0.0216 [0.0566]	0.0406 [0.0429]
2001 Log Population	0.0157 [0.0726]	-0.00726 [0.0672]
2001 % Poor people	-0.00190 [0.00236]	-0.00231 [0.00183]
N	71	71
F(17, 53)	1.84	1.2
Prob > F	0.0471	0.02953
R-squared	0.2783	0.3373

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively.

Robust Standard errors reported in parentheses.

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 of “exposure to condoms”. We observe in Table 5 that having access to condoms at the community level, without controlling for any of the covariates, decreases by 26% the probability of being a mother, at the 1% statistical significance 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, above the Staiger and Stock criteria for weak instruments.

Table 5 First Stage using access to condoms as an IV

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

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 change significantly 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.

Table 6 First Stage using exposure to condoms as an IV

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

In the results presented in table 5 and 6 above, we do not cluster the standard errors at the community level. We have reasons in favor and against to do 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 good²². We show in table 1.A of the appendix 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, respectively²³. 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, 2009). Also, Table 3.A shows the results of the second stage of the IV models using clustered standard errors. The statistical significance is only compromised in the case of standardized scores of Math; however, our main results are robust to this more conservative scenario. Furthermore, our results are robust to the estimation of the two stage models using IV-GMM and IV LIML suggesting that there is not weak instrument problem.²⁴

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 is the birth cohort dummies, Z is the exposure to condoms, 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: $h_o(t) = pt^{p-1}$.²⁵ We choose this parameterization because in our sample we expect that the probability of having the first child increases with age ($p > 1$).²⁶ The Weibull model allows us to calculate an expected predicted survival time; that is, an expected “predicted age of first birth- $PredAFB$ ”²⁷ which we use in the second stage to predict the school outcomes:

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

²² Indeed, we have 3 clusters with 2 individuals each. We estimate our models without these clusters and the results are robust to this exclusion.

²³ 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

²⁴ The results of IV-GMM and LIML are upon request.

²⁵ We reject the test of proportionality for the Cox hazard which suggests a parametric hazard model.

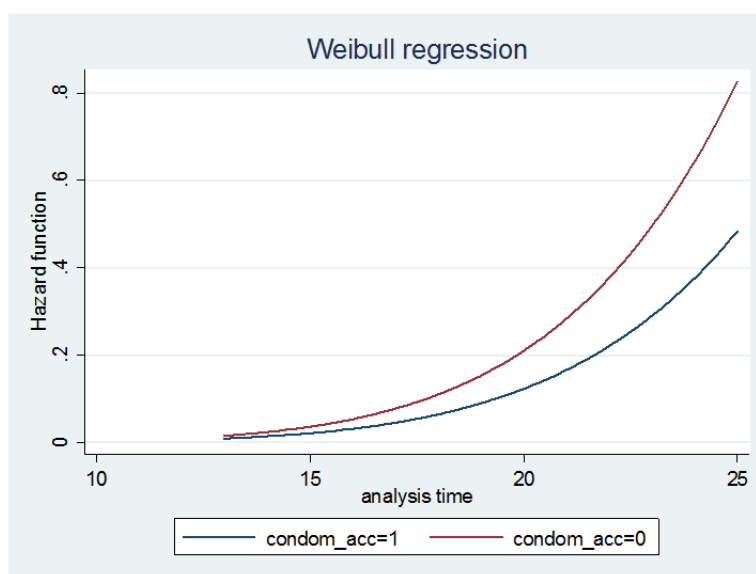
²⁶ Examples of using the Weibull distribution to model the age of sexual initiation in Africa include Glick and Sahn (2008).

²⁷ The expected mean age of first birth; i.e., the expected value of the survival time is given by :

$$PredAFB = \int_0^{\infty} S(t|X_j) \text{ where } S() \text{ is the survival function of the Weibull Distribution.}$$

Where Y_i corresponds to the different school outcomes previously analyzed. Table 7 shows the hazard ratios for the main covariates using exposure to condoms.²⁸ We obtain the same qualitative results as when modeling the probability of “ever mother”. Graph 3 shows the predicted hazard function after estimating the Weibull model that controls for access to condoms and the rest of covariates described earlier.²⁹ 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 not will only affect the significance level of the parameters of interest in the second stage.³⁰

Graph 3



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

²⁸ 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.

²⁹ Similar pattern is observed when using Kaplan Meier estimates by access to condoms.

³⁰ 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.

Table 7 : First stage for Age of first Birth

	Hazard ratio	Robust Standard error	z	P> z
Condom Exposure 15 yrs	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 yrs old	1.14	0.270	0.54	0.587
CSB2 at 10 yrs old	0.87	0.181	-0.66	0.506
Electricity at 10 yrs old	0.46	0.117	-3.05	0.002
Remotness index 2001	0.95	0.056	-0.95	0.341
Urban	1.19	0.396	0.53	0.593
p =7.14 (std error 0.22)				
No of Observations = 750 ; Wald Chi2(27)= 113.62				

Notes: Age Cohort and regional dummies not shown

Hazard ratios less than 1 decrease the risk of failure (ever mother) and opposite happens

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).³¹

4. Results and Discussion

Table 8 reports the OLS and IV estimates of the early childbearing effect on: 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,

³¹ Furthermore, we also estimate the hazard models with gamma distribution instead of Weibull and the results of the second stage model are qualitatively similar.

“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.

Table 8 : Impact of Early Childbearing on School Attainment

		(1)	(2)	(3)
		OLS	IV- 2sls Access to condoms	IV Exposure to Condoms /a
<i>Panel A : Dependent Variable</i>				
Current Enrolled	Ever _mother	-0.275*** [0.0270]	-0.428** [0.189]	-0.427*** (0.126)
	Fstat		11.36	11.84
	N	750	750	750
<i>Panel B : Dependent Variable</i>				
Years of Education	Ever _Mother	-2.029*** [0.201]	-2.172 [1.460]	-2.400 [1.487]
	Fstat		11.36	11.84
	N	750	750	750
<i>Panel C : Dependent Variable</i>				
Completed 9 Years of school (Lower Secondary School)	Ever _Mother	-0.259*** [0.0326]	-0.486** [0.243]	-0.445*** (0.055)
	Fstat		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, 2004 asset index, and extensive social infrastructure variables at the community level as well regional dummies

The OLS results indicate that having a child decreases by 27% the probability of being currently enrolled in school at the time of the survey. 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”.³² Although the estimates are larger in the IV specification than in the OLS model, this difference is not statistically significant.³³ Compared to the sample mean, this marginal decrease translates into a drop from 19% to 11% in the 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-

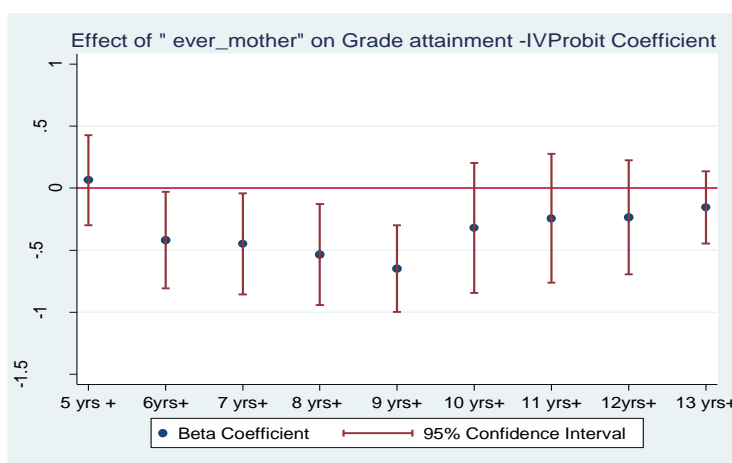
³² To validate our results on school dropout, we construct a woman-year panel data using the age of dropping out of school and the age of first birth in order to analyze the effect of “ever mother” on current enrollment using a woman fixed effects specification. This estimation allows controlling for all the young woman’s unobserved time invariant characteristics that might affect education and fertility decisions simultaneously. In this model (results not shown), early childbearing increases by 22% the likelihood of dropping out of school which is in line with our OLS and IV estimates.

³³ We are not able to reject the null hypothesis of exogeneity under the Hausmann and Durbin Watson tests.

compatible or mutually exclusive as it has been shown in other African contexts, such as Kenya (Duflo et al 2012, Ozier 2011) and Malawi (Baird et al, 2011). In Madagascar, pregnant girls are commonly expelled from school *de facto* but there is no regulation justifying this practice. On the other hand, these results are different from those reported by Ranchod et al (2011) in South Africa. Although the authors find that teenage pregnancy statistically increases the school dropout³⁴ by 16% at age 20 or 22, they find smaller or negligible effects on high school graduation. 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.

Table 8 also indicates that adolescent motherhood decreases by 2 the years of education under the OLS model and between 2.1 and 2.4 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. Using propensity score matching, the authors find that, in the long run, teenage pregnancy decreases by 1.2 the years of schooling. As we 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 two 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. We plot in graph 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.³⁵ In the graph, we observe 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.

Graph 4



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

³⁴ 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.

³⁵ These results correspond to the IV probit models but similar results are obtained from the models using access to condoms.

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, 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- (Angrist and Evans, 2000).³⁶ Our findings are consistent with 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, also find that the IV estimates of teenage fertility on educational attainment and labor market outcomes are larger than the OLS estimates context.³⁷ Their result differs from other studies in the US that have found that the OLS results overestimate the effect of teenage pregnancy.³⁸ 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 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.³⁹ The bias between the OLS and the IV might be determined by the heterogeneity of the unobserved costs and benefits of the treatment (Ebenstein, 2009).⁴⁰ It is possible that girls who have higher opportunity costs of dropping out from school, i.e., they 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).

4.1 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 the Math and French standardized test scores, respectively. These OLS estimates are statistically significant at the 1% level. Once we account for the endogeneity and instrument fertility with “access to condoms”, this effect increases to 1.13 and 1.142, respectively, for Math and French at the 5% of statistical significance level. Using “exposure to condoms” as an IV, adolescent

³⁶ Our sample is small enough to estimate heterogeneous effects and characterize which subgroups of the sample are being more affected by access and exposure to condoms.

³⁷ Using as an IV the reforms of abortion in 1970, 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.

³⁸ See for example Fletcher and Wolf (2009).

³⁹ This 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).

⁴⁰ Ebenstein (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, the 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.

motherhood decreases by 1.49 and 1.56 the standardized test scores of Math and French, respectively, at the 1% of statistical significance level. The difference between the OLS and IV results are statistically different indicating that the endogeneity does have a considerable effect on the magnitude of the adolescent pregnancy impact on cognitive ability⁴¹.

Table 9 : Impact of Early Childbearing on Cognitive Skills

		(1)	(2)	(3)
		OLS	IV- 2sls Access to condoms	IV-2SLS Exposure to Condoms
<i>Panel A : Dependent Variable</i>				
Standardized Math Score	Ever _mother	-0.371*** [0.0637]	-1.136** [0.532]	-1.495*** [0.570]
	Fstat		12.37	12.269
	R- Square	0.414	0.2789	0.121
	N	688	688	688
<i>Panel A : Dependent Variable</i>				
Standardized Score French	ever _mother	-0.429*** [0.0611]	-1.142** [0.515]	-1.569*** [0.567]
	Fstat		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, 2004 asset index, and extensive social infrastructure variables at the community level as well as regional dummies

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 in 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 of 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 the school attainment and cognitive skills, given that there might be some unobservables that affect simultaneously the grade completed and the cognitive ability such as parental preferences.⁴² 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 lower secondary (i.e., 9 years or more of schooling) increases the standardized test scores of 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

⁴¹ We reject the exogeneity null hypothesis with Hausman and Durbin Watson tests at the 5% significance level.

⁴² Glick and Shan (2009) do not reject the exogeneity of school attainment in a similar data of children 14 -17 years old in Senegal. Also, Glick et al (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.

school increases by 1.5 the standardized test scores of 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. (2009) that show a strong correlation of school attainment and test scores in Madagascar using the 2004 round of our survey.⁴³

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 decide to get pregnant. In order to test this hypothesis, following the framework of value-added models for tests scores (Todd et al. 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.5 of the appendix. We observe that the effect of the 2004 standardized tests scores on the 2012 standardized test scores of Math and French do not change significantly when including “*ever_mother*”.⁴⁴ Although we acknowledge the limitation in addressing the endogeneity of fertility in these estimations, the results suggest that early childbearing has an impact on the 2012 test scores of Math and French independent of the 2004 performance, at least in this portion of the women’s sample.

4.2 Survival Analysis Results

As explained in the empirical methodology section, the Weibull hazard model allows us to calculate a predicted mean age of first birth for all the school girls who drop out after age 13.⁴⁵ 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 delaying by 1 year 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 by 1 year the first birth increases by 0.19 and 0.21 the standardized test scores of Math and French, respectively.

⁴³ Glick et al (2009) find that, among children aged 14 -16 years old, attending (or have attended) grade 8 to 9 increases by 0.8 to 1.4 the standardized test scores of written Math in an OLS model and a school fixed effect model, respectively.

⁴⁴ 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

⁴⁵ Similar results are obtained when we use predicted median age of first birth.

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

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

Notes: ***, **, *: significant at 1%, 5%, and 10% levels respectively. Robust Standard errors
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

These findings of the survival models are consistent with our two-stage models results. Consider an average girl of 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% likelier to complete at least lower secondary school. Similarly, if she can improve by 0.2 the standardized tests scores of Math and French each year of school attainment after 5 years of delaying the childbirth, she would have a return of around 1 standard deviation in her tests scores. This result is a very close estimate to the effect of “ever mother” on the cognitive skills using the IV models presented earlier.

The paper results allow us to establish a detrimental and causal effect of teenage pregnancy on young women’s human capital in Madagascar, deviating from the findings of Azevedo et al. (2012) in Mexico and Ranchod et al. (2011) in South Africa. 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 the individual responses to the specific chosen instrument. In other words, the effect estimated from variation in a policy variable represents a *specific LATE* of modifying the fertility of certain groups in the population (Shultz, 2007).⁴⁶ Therefore, our IV results are limited 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, these girls have higher opportunity costs when getting pregnant.

4.3 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.

⁴⁶ 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).

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

<i>Dependent Variables</i>		Current Enrolment	Years of Schooling	Completed Lower Secondary	Z-Score French	Z-Score Math
<i>Panel A:</i>						
Outcomes for Young Men	Access to Condoms	-0.00512 [0.0341]	0.0567 [0.475]	0.0352 [0.0676]	0.121 [0.151]	0.0863 [0.141]
	Adj -R ²	0.129	0.371	0.379	0.311	0.250
	N	723	723	723	664	675
<i>Panel B :</i>						
Outcomes for Young Women	Access to Condoms	0.0765** [0.0332]	0.388 [0.281]	0.0869* [0.0448]	0.233** [0.0959]	0.224** [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

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 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.

In addition to the condom program placement checks that we present earlier in the empirical section, we also estimate our IV models controlling for two different measures of 2006 fertility at the community level: number of births and number of women who died during or after child delivery. This last variable can be a good proxy of adolescent pregnancy since maternal mortality is higher among young women. This fertility information comes from the 2007 community census and it is only available for 69 of 73 communities included in our sample. Table 12 shows the OLS and IV models for the current enrollment and the standardized scores of Math and French outcomes including these 2006 fertility variables and the rest of individual, household and community covariates⁴⁷. The effect of “ever mother” on these school outcomes is robust to the inclusion of these 2006 fertility variables supporting our finding that there is no evidence for any non-random program placement.⁴⁸

⁴⁷ 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.

⁴⁸Consistently, these 2006 fertility variables are not statistically significant in a model of access to condoms on community characteristics.

5. Conclusions

Empirical evidence on the economic consequences of adolescent pregnancy is scarce in developing countries, particularly in Sub-Saharan Africa. We contribute to this gap in the literature by addressing whether early childbearing affects school dropout and cognitive skills among young women in Madagascar, a low-income and high-fertility country. Using a panel data survey combined with community censuses, we address the endogeneity between fertility and education decisions by instrumenting the young woman's access to condoms at the community level, and her exposure to condoms since she was 15 years old. We control for a complete set of covariates at the community level to account for the potential endogeneity of program placement. Our findings point out a detrimental and causal effect of teenage pregnancy on young women's human capital in Madagascar. Our IV results indicate that young women's early childbearing increases by 42% their likelihood of dropping out of school and decreases by 44% their chances of completing lower secondary school (i.e., 9 years of more of schooling). 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 of 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 the 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 the first birth by a year increases the probability of current enrollment by 5%, the likelihood of completing secondary school by 8% and the test scores of Math and French by 0.2 standard deviations.

Our results underline the potential role of policies that can prevent early childbearing and those that allow teen mothers to catch up with their education, in enhancing 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. 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 on 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 the total fertility, the timing of postponing the first birth is crucial to increase women's education and human capital. However, further research should analyze if this reduction in teen fertility is translated in a woman's lifetime fertility reduction as well as improvement in her and their families' economic outcomes. For instance, young women's larger human capital can also be translated into better health and education outcomes of their children, breaking potential channels of intergenerational transmission of poverty. Therefore, these policies that aim to reduce teenage pregnancy will impact not only young women's economic opportunities but those of their children.

Further research on the effectiveness of reproductive health and family planning policies is timely in Sub-Saharan Africa 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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World Bank (2013) World Development Indicators

APPENDIX

Table A.1 First Stage Using Clustered standard Errors

	"ever_mother"	"ever_mother"
Condom Access	-0.179***	
	[0.0626]	
Condom Exposure_15 yrs		-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 yrs old	0.0486	0.0559
	[0.0696]	[0.0712]
CSB2 at 10 yrs old	-0.0276	-0.0295
	[0.0666]	[0.0659]
Electricity at 10 yrs old	-0.222***	-0.223***
	[0.0826]	[0.0741]
Remotness 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 Enrolment std error	-0.275*** [0.0277]	-0.428** [0.208]	-0.427*** (0.126)
Compl. Lower Second School std error	-0.259*** [0.0336]	-0.486* [0.272]	-0.445*** (0.064)
Years of Schooling std error	-2.029*** [0.193]	-2.172 [1.925]	-2.400 [1.786]
Zscore Math std error	-0.371*** [0.0722]	-1.136* [0.650]	-1.495** [0.709]
Zscore French std error	-0.429*** [0.0765]	-1.142 [0.745]	-1.569** [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

In Column 3, binary outcomes are estimated using IV-probit models

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 yrs sch)	0.345*** [0.0616]	0.306*** [0.0584]	0.351*** [0.0839]	0.289*** [0.0797]
Some College (6-8 yrs-sch)	0.853*** [0.0649]	0.769*** [0.0608]	0.952*** [0.0895]	0.905*** [0.0830]
Complete College (9 yrs sch)	0.987*** [0.0656]	0.984*** [0.0616]	0.979*** [0.0864]	1.066*** [0.0809]
Some Lycee (10-11 yrs sch)	1.254*** [0.0756]	1.353*** [0.0694]	1.262*** [0.0995]	1.421*** [0.0936]
Complete Lycee (12 yrs sch)	1.574*** [0.0691]	1.620*** [0.0624]	1.637*** [0.0928]	1.715*** [0.0802]
Superior (12 and more)	1.964*** [0.0845]	1.956*** [0.0738]	2.131*** [0.127]	2.042*** [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 dropout from school at age older than 13. All the models include the individual, household and community control variables

Table A.4 2004 Test Scores Effects on 2012 Test scores of Math and French

	2012 Z-Score Math		2012 Z-Score French	
	(1)	(2)	(1)	(2)
2004 Z-score Math	0.190*** [0.0491]	0.186*** [0.0525]		
2004 Z-Score French			0.222*** [0.0494]	0.206*** [0.0474]
Ever_mother		-0.309*** [0.0847]		-0.329*** [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 dropout from school at age older than 13. 2012 and 2004 z-scores are the standardized scores with mean 0 and standard deviation of 1. All the models include the individual, household and community control variables

**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 yrs	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

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** [0.02]	0.064*** [0.024]	0.127*** [0.0476]	0.156*** [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 deltha method .All the models include the individual, household and community control variables