working paper
2020-20

Examining the Impact of Early Childbearing on Education, Literacy, and Labor-Market Outcomes in Four African Countries

Ronelle Burger
Agnès Zabsonré
Vaqar Ahmed
Mitzie Conchada
Ana Lucia Kassouf

April 2020

PAGE
policy analysis on growth and employment
IDRC CRDI
pep
UKaid

Examining the Impact of Early Childbearing on Education, Literacy, and Labor-Market Outcomes in Four African Countries

Abstract

We examined the impact of early childbearing on education, literacy, and labor-market outcomes of women in four African countries, using Demographic and Health Survey datasets. Cognizant of the endogeneity in this relationship, we identified the effect of teenage motherhood with individual respondents' age at menarche. We employed 2SLS models to compare women with early childbearing to their counterparts who bore children later in life. Aligned with the findings for developed countries, we found that earlier childbearing had a large, negative, and significant marginal effect on literacy and educational attainment. We found no robust evidence that teenage motherhood had a significant or large direct impact on labor-market prospects, but we present evidence of an indirect pathway via literacy.

Authors

Ronelle Burger
Professor, Economics Department
Stellenbosch University, South Africa
rburger@sun.ac.za

Mitzie Conchada
Associate Professor, School of Economics
De La Salle University, Philippines
mitzie.conchada@dlsu.edu.ph

Agnès Zabsonré
Assistant Professor, Department of Economics and Management
Université Nazi Boni, Burkina Faso
zabagnes@yahoo.fr

Ana Lucia Kassouf
Professor, Department of Economics
University of Sao Paulo, Brazil
anakassouf@usp.br

Vaqar Ahmed
Joint Executive Director
Sustainable Development Policy Institute
Pakistan
vaqar@sdpi.org

Acknowledgements

This research work was carried out with financial and scientific support from the Partnership for Economic Policy (PEP) (www.pep-net.org) with funding from the Department for International Development (DFID) of the United Kingdom (or UK Aid), and the Government of Canada through the International Development Research Center (IDRC).

Table of contents

List of tables

List of figures

I. Background

Every year approximately sixteen million teenage girls in developing countries give birth (United Nations Population Fund, 2015; Neal, Matthews & Frost, 2012). Early childbearing is a developing country problem but is also overwhelmingly an African problem with African countries having the highest rates of teenage pregnancies worldwide (Yakubu & Salisu, 2018).

About 95% of teenage mothers reside in developing countries, yet only a handful of studies have examined the impact of early childbearing on women in developing countries (United Nations Population Fund, 2013). The lack of evidence on early childbearing in developing countries is a serious weakness because it constrains the design of appropriate local policies and interventions to discourage teenage motherhood.

The studies on the predictors of teenage motherhood in developing countries found that early childbearing has a consistent and robust association with at least three factors: vulnerability, low education, and lack of contraception use (Pradhan, Wynter & Fisher, 2015). We contribute to this literature by carefully examining the causal links between these factors in four African countries.

The link between teenage motherhood and vulnerability is of particular interest because teenage motherhood tends to conspire with vulnerability to function as a gendered poverty trap, enhancing the likelihood that women at the bottom of the income distribution will become stuck in poverty and find it difficult to achieve their full potential. The gendered dimension of this problem relates to social norms about gender that affect many crucial decisions, including control of reproductive choices and traditional childrearing roles. In most cases, teenage fathers bear a disproportionately small share of the child-raising responsibilities, allowing them to continue their education without disruption and with minimal impact on their labor-market earnings.

The gender question needs to be viewed through the lens of intersecting or overlapping vulnerabilities: an adolescent mother is, by definition, a young woman, but we also know that adolescent mothers are more likely to be from lower socioeconomic strata. Thus, even before becoming pregnant, a large share of teenage mothers face three

intersecting vulnerabilities: being women, being young, and being poor. Our analysis addressed how these vulnerability dimensions intersected with the likelihood of adolescent motherhood and how poverty affected teenage mothers' prospects.

We were aware of the limitations of our approach in a context in which gendered norms about schooling and labor-market outcomes were so biased that they may have served as a binding constraint and prevented us from observing the impact of adolescent motherhood. If young girls were generally discouraged from completing high school and if the market for paid work favored men, gender discrimination may have overshadowed any further bias or disadvantage faced by teenage mothers. In the reduced-form models presented in this paper, however, social norms did not feature explicitly but were part of ethnic, religious, and country dummies.

The cross-country approach can also help us understand to what extent—at least for this sample of African countries—experience with early childbearing and education was shared or unique across countries. This is vital information for global and national advocacy efforts and policymaking.

1.1 What We Know about Early Childbearing in Developing Countries

Despite widespread concern about the impact of adolescent motherhood on poverty alleviation, equity, and social mobility in developing countries, a relatively small number of papers have attempted to estimate the causal impact of teenage motherhood on education or labor-market outcomes in developing countries—or, specifically, in African countries.

Herrera-Almanza and Sahn (in press) examined the impact of early childbearing on labor-market outcomes in Madagascar using a panel survey. Their instrument for early childbearing was community-level access to condoms after controlling for socioeconomic circumstances. The authors found that early childbearing decreased the likelihood of completing school and increased the likelihood of dropping out of school. Early childbearing also affected performance on standardized tests in mathematics and French.

Ardington, Menendez, and Mutevedzi (2014) used a panel dataset from a rural district in South Africa to show that teen fertility affected educational attainment. They employed a mother fixed effects to control for individual heterogeneity, thus comparing sisters against one another. They found that early-teen mothers, who had their first child before the age of 17, had a year less education compared to their counterparts who waited until they were 20 to have their first child. They did not find evidence of selection into teenage pregnancy based on pre-pregnancy differences in school performance or household characteristics. They reported that teen mothers were less likely to report condom use and more likely to have older partners compared to other adolescents with the same age at first intercourse.

Marchetta and Sahn (2015) studied how young women in Senegal made decisions about their education, their age at marriage, childbearing, and entry into the labor market. To achieve this, they estimated a recursive four-equation simultaneous equation model, using the Household Survey on Education and Welfare. They use a sisters fixed effect to address concerns about unobserved heterogeneity. They found that women with more years of completed education were more likely to delay marriage. In Senegal, they also found that the delay of the first birth worked via the delay of marriage.

To the best of our knowledge, only one previous study has considered the impact of early childbearing on labor-market outcomes in more than one developing country. Azevedo et al. (2012)[1] examined early childbearing in Latin America and the Caribbean and found that it was associated with vulnerability and lack of opportunities and that it contributed to a gendered poverty trap in the region. Their work was descriptive and did not attempt to derive a causal impact.

[1] Other cross-country evidence from developing countries has been provided by Aguero and Marks (2008, 2011) and Caceres-Delpiano (2012). However, these studies did not focus on early childbearing but rather on the relationship between fertility decisions and women's labor participation. Jensen and Thornton (2003) conducted another cross-country analysis based on developing countries, but they looked at the association between early marriage and women's education and well-being in general. As in our case, all these cross-country analyses have used data from nationally representative demographic and health surveys (DHS).

1.2 Mechanisms Influencing Teenage Fertility and Schooling Decisions

Typically, models of teenage-fertility decisions describe fertility decisions as a rational choice, drawing on the seminal work of Becker (1993) on the economics of fertility (e.g., Ribar, 1994; Klepinger, Lundberg & Plotnick, 1999; Hotz, McElroy & Sanderset, 2005). For instance, Ribar (1994) viewed teenage motherhood as the consequence of a sequence of important choices about sex, contraception, and abortion. Using a utility maximization framework, teenagers' decisions about fertility amounted to balancing various anticipated costs and benefits, including those associated with having a child, continued schooling, and labor-market prospects. In most such models, the preferred age for having a first child was affected largely by the underlying valuation of additional years of education. Having a child increased the opportunity cost of attending school; in most societies, the burden of childcare is still carried disproportionately by women.

While such analytical models have tended to acknowledge the role of chance through such factors as the likelihood of conception, fecundity, and miscarriage, the assumption is usually still that the teenage girl has considerable agency in navigating her life path. These assumptions often do not align with the experiences of teenage girls in developing countries where arranged marriages, coercive sexual encounters, and repressive gender norms may severely constrain the choices of teenage girls, influencing their reproductive rights, their schooling decisions, and their likelihood of finding lucrative employment.

Child or teen marriage is an extreme but apt illustration of such restrictive social norms. The early transition to adult responsibilities robs children of their childhood. As Nour pointed out in 2006, "Child marriage is a human rights violation that prevents girls from obtaining an education, enjoying optimal health, bonding with others their own age, maturing, and ultimately choosing their own life partners" (1644). Field and Ambrus (2008) showed that early marriage had a significant negative impact on the health and economic outcomes of women in Bangladesh. As expected, child or teen marriages are more prevalent in societies with conservative gender norms and are associated with higher levels of gender inequality (Raj et al., 2009). In regions where child marriage is the norm, teenage childbearing is five to ten times higher. Globally, nine in ten adolescent pregnancies occur

in teen brides (World Health Organisation, 2008). While it is acknowledged that teen pregnancies and teen marriages are entangled, the focus of this research was teen pregnancy.

II. Identifying the Causal Impact of Teenage Motherhood

The causal mechanisms linking early childbearing, educational attainment, and labor-market outcomes are complicated to disentangle. We identified three avenues through which endogeneity could distort the results of an analysis on the impact of early childbearing, and suggest a potential solution.

2.1 Endogeneity Concerns

For educational attainment, literacy, and paid work, unobserved heterogeneity would be expected to cause a downward bias in OLS estimates, while measurement error and misreporting would cause an upward bias in OLS estimates under traditional assumptions of classical measurement error.

2.1.1 Individual Motivation and Aspirations As Unobserved Heterogeneity

The fertility decisions of teenage girls are influenced by their anticipated labor-market returns to investment in education, which would reflect their perceived ability, motivation, confidence, and labor-market aspirations (Rosenzweig & Wolpin, 1980; Heath, 2017; Guo et al., 2018). If a teenager did not expect to gain much from school and thought she would not do well in the remunerated labor market, then leaving school early may not have appeared to be a large loss. Empirical evidence has also supported this analytical concern: infrequent contraceptive use among teenagers is correlated not only with a lack of knowledge about and access to contraception but also with poor performance in school and low career aspirations (Brooks-Gunn & Furstenberg, 1989; Sneed et al., 2001). As the result of this unobserved heterogeneity, concerns arose regarding endogeneity in

estimating the impact of teenage fertility on educational and labor-market outcomes. We expected this unobserved heterogeneity to manifest as a downward bias in OLS estimates.

2.1.2 Shorter Decision Horizons and Risk-Taking As Unobserved Heterogeneity

Findings from behavioral economics have shown that teenagers often make short-sighted or risky decisions because they live in the moment and heavily discount the future (Gruber, 2001; Oreopoulos, 2007). Short-sighted, sensation-seeking, and egocentric decision making increases the likelihood of risky or reckless sexual behavior and early school drop-out (Arnett, 1992). Unprotected teenage sex remains prevalent in developing countries, despite the increasing availability and awareness of contraception and the harsh consequences of early childbearing for young women (Chandra-Mouli et al., 2014). We had no variable that could capture a teenager's tendency to engage in risky or reckless behavior, which could have been an important source of unobserved heterogeneity that influenced the likelihood of having unprotected sex, dropping out of school, and making short-sighted decisions that influenced labor-market prospects. This source of endogeneity would lead to a downward bias in the OLS estimates of the impact of teenage motherhood on literacy, education, and labor-market outcomes.

2.1.3 Inaccurate Reporting As a Result of Social Stigma

As the result of social stigma related to teenage pregnancy and because the survey was administered in-person by a field worker, measurement error may have played a role. Teenage motherhood may thus have been underreported, which would have been difficult to detect or verify during the day when the children living in the household were often not at home. This would have led to an upward bias in the OLS estimates under the assumption of classical measurement error.

2.2 Identification Strategy and Model Specification

Hotz, McElroy, and Sanders (2005) and Hotz, Mullin, and Sanders (1997) estimated the causal impact of early childbearing on mothers' social prospects and long-term outcomes, using miscarriage as an instrument. They acknowledged that miscarriage was a combination of random and non-random events, but they were able to control for the

influence of non-random factors such as drinking, smoking, and early contraception, which enabled them to estimate lower and upper bounds on causal impact. This work was extended by Reinhold and Woutersen (2010), who found that such bounds were wide but informative, with the upper bound remaining consistently well below the OLS estimate.

Abortions have also been proposed as an IV, but Ashcraft, Fernandez-Val, and Lang (2013), Lang and Weinstein (2015), and Fletcher and Wolfe (2009) argued that the loss of a pregnancy was non-random in places where abortions were available and widely practiced. However, it has been suggested that including socioeconomic status variables and community fixed-effects could control this channel of influence.

Other reports have used a mother fixed effect to capture unobserved heterogeneity shared by siblings (Ardington et al., 2014: Marchetta & Sahn, 2016) but, because aspirations and motivation can differ substantially among siblings, it is not clear that this approach has addressed endogeneity concerns.

To take sources of endogeneity that could bias our results into account, we proposed to estimate the impact of teenage motherhood on years of education, literacy, and labor-market outcomes by using a two-stage least squares (2SLS) approach with age at menarche as our IV. Formally, our empirical strategy is given by

$$\mathrm{y_i} = \delta + \beta_1 \mathrm{TM_i} + \beta_2' \mathrm{X_i} + \mathrm{u_i} \quad (1)$$

$$\mathrm{TM_i} = \eta + \theta_1' \mathrm{X_i} + \theta_2' \mathrm{Z_i} + \varepsilon_i, \quad (2)$$

where i refers to the individual, β_1 is the parameter of interest, and **δ** and **η** are the constant terms of the model. y is the outcome variable and refers either to years of education, literacy or the labor market outcome. TM is the endogenous variable and is defined as the number of years prior to 18 that the individual had her first child. The error terms are uu and $\varepsilon.\varepsilon$. We assumed that (u, ε) were zero-mean but correlated, that is, $cov(u, \varepsilon) \neq 0$. In the case in which y is$y$ a binary variable, for instance, when y refers to literacy or the labor market outcome, u is supposed to be heteroskedastic. We also assume that (u, ε) are independent of (X, Z). The covariates Z are the excluded exogenous regressors which contain the instrument. Given that TM is a continuous variable, Equations 1 and 2 are simply estimated by 2SLS, ignoring the binary nature of y. This estimation yields consistent estimators for $(\delta, \beta_1, \beta_2')$.

Instrumentation with age at menarche has been widely used and more credible than the IVs discussed earlier. Ribar (1994) and Klepinger, Lundberg, and Plotnick (1999) relied on age at menarche as an instrument to analyze the effects of early childbearing on educational attainment. The credibility of survey information on age at menarche has been strengthened by papers showing that women reliably recall their first period, with reproducibility of self-reported menarche at two different points in time classified as moderate to strong (Bosetti et al., 2001; Freedman et al., 2002; Dorn et al., 2013; Lundblad & Jacobsen, 2017). Field and Ambrus (2008) and Sunder (2016) both used the age at menarche as an instrument for age at first marriage in Bangladesh and Uganda, respectively. Based on a cohort study from the U.S., Kane et al. (2013) employed age at menarche in addition with other instruments (for instance, abortion rates, physician availability, public funding, etc.) to identify the causal effect of teen childbearing on educational attainment. Performing a test that over-identified restrictions, they showed that their instruments were valid. More recently, Huang et al. (2019) proposed age at menarche as an instrument for adolescent sexual intercourse to examine its effect on years of education.

The correlation between age at menarche and teenage motherhood is well-established. Earlier age at menarche implies a greater number of fertile teenage years and thus a greater risk of becoming pregnant as a teenager. Lower age at menarche affects the age at first pregnancy and first marriage (Aryal, 2007; Dunbar et al., 2008; Sekhri & Debnath, 2014). Additionally, Ajah et al. (2015) and Glynn et al. (2010) showed a positive relationship between age at menarche and first sexual intercourse in Nigeria and Malawi, respectively. Ajah et al. (2015) reported that, in Nigeria, girls who reached menarche before 13 were more likely to report being sexually active than those who became fertile after 14.

Our data set showed that the age at menarche had a very strong relationship to our endogenous variable. See Appendix Figure 1A for the kernel-weighted local polynomial smoothing graph that compares the relationship between the likelihood of teenage motherhood and age at menarche (here defined as years prior to 18 that the individual reported experiencing menarche). For the sake of transparency, we also include the kernel density graphs for the age at menarche for each country (Appendix Figure 1B).

The medical literature has shown that age at menarche is largely determined by genetic factors (Jahanfar, Lye & Krishnarajah, 2013; Szwed et al., 2013; Ameade & Garti 2016). Twin studies have found that age at menarche is largely determined by genetic factors with Kaprio et al. (1995) attributing only 26% of the variation in age at menarche to unique environmental factors. Meyer et al. (1991) also found a relatively modest role for environmental factors. The evidence of a relationship between genetics and age at menarche has been further strengthened by work such as that of Chunyan et al. (2010) who traced variations in age at menarche to specific genes.

Evidence also exists for the role of environmental factors, however. Some workers have found that age at menarche is affected by body size, nutrition, stress, and health (see Kaplowitz et al., 2001; Opare-Addo et al., 2012; and Pierce, Kuh & Hardy, 2012, among others). The literature on correlates at menarche has mostly been based on cross-sectional data for a specific country, region, or community, and it is therefore not surprising that systematic reviews have concluded that few consistent findings can be found. Kelly et al. (2017) analyzed an eleven-year longitudinal study of almost 20,000 households in the UK and confirmed that ethnicity and social disadvantage were important predictors of early age at menarche. They found that this effect operated among the poor via higher psychosocial stress and adiposity while it worked via higher levels of material disadvantage and adiposity for ethnic minority groups.

We estimated the impact of teenage motherhood on what Geronimus and Korenman (1992) called secondary and primary outcomes. They defined secondary outcomes as instruments for achieving material well-being, whereas primary outcomes were indicators of material well-being. Using these definitions, two of our outcomes (years of education and literacy), could be categorized as secondary outcomes while paid work was a primary outcome. Teenage pregnancy could thus have had both an indirect (operating via education and literacy) and direct effect on labor-market outcomes.

Years of education and paid employment were both self-reported. Literacy was a binary variable based on a reading test, coded as a 1 in cases in which the woman was assessed to read with ease and 0 if she could not read at all or found it very difficult to read. We included paid work rather than any work because we wanted to exclude unpaid

informal agricultural work (which is very prevalent among women in these countries) given that it provides little security, social mobility, or career prospects.

We erred on the side of parsimony, opting for simple reduced form IV models with controls for age, urban location, religious affiliation, and ethnicity.

We included teenage motherhood as the number of years prior to 18 that a respondent had her first child. We opted for this approach because we expected a greater adverse impact when a girl's childhood was truncated at the age of 14 than when it happened at 17. A 17-year old would be more mature and closer to school completion. Indeed, Ardington et al. (2014) showed that, in rural South Africa, teenage mothers who had their first child very early faced an increased risk of school drop-out (compared to other teenage mothers).

III. Demographic and Health Surveys

The Demographic and Health Surveys (DHS) Program has been widely used across a range of developing countries, and one of advantage of using these data is that they are comparable over countries and over time because of the development of standard questionnaires (and written descriptions explaining why certain questions or sections are included). Typically, a country is asked to adopt the model questionnaire in its entirety but can add questions of particular interest. Questions in the model can also be deleted if they are irrelevant in a particular country.

DHS are nationally representative population-based surveys with large sample sizes (usually between 5,000 and 30,000 households). There are three core questionnaires in DHS surveys: a household questionnaire, a women's questionnaire, and a men's questionnaire. The women's questionnaire is administered to a subsample of women aged 15 to 49 and contains questions on employment status, birth history, current and future contraceptive use, fertility preferences, and socioeconomic and marital status.

As a result of our reliance on the age at menarche for instrumentation, we included only the DHS surveys of African countries for which the age at menarche was available. We also excluded surveys that did not allow us to create the required controls for our models.

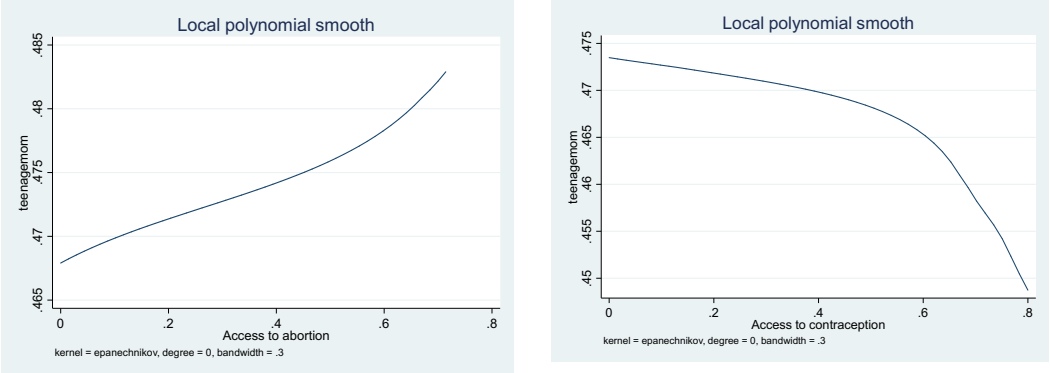
This left us with datasets for four African countries: Cameroon 1991, Uganda 2000, Ghana 1998, and Gabon 2000. We excluded women younger than 25 because two of the key outcomes, labor market outcomes and completion of high school, would not be fully determined prior to age 25.

IV. Correlates of Teen Motherhood

It is clear that teen mothers are different from women who have children later in life. Appendix Table 3 shows that the likelihood of being a teenage mother was significantly higher among those who were poor (0.49 vs. 0.46). The parents of teenage mothers also have fewer years of education (5.6 vs. 6.1 years). We found that women who had children early in their lives were significantly less likely to have ever worked (0.59 vs. 0.65) or to be currently engaged in paid work (0.74 vs. 0.77). Teenage mothers tended to have fewer years of education (4.31 vs. 5.45), and there was only a small likelihood that they could read with ease (0.45 vs. 0.52).

The patterns were, however, much starker for childbearing before the age of 16. It clearly matters how early childbearing occurs: Education outcomes were considerably worse when childbearing occurred before age 16: on average, teenage mothers had 4.7 years of education, while child mothers (young women who first gave birth before age 16) had 3.6 years of education (vs. 5.5 years of education for other mothers). Also, half of teenage mothers but only 38% of child mothers (vs. 52% of other mothers) could read with ease. The gaps were less stark for labor-market outcomes: while 60% of women who first gave birth between 16 and 18 (teenage mothers) were currently engaged in paid work, 58% of child mothers were engaged in paid work (vs. 65% for other mothers).

Fig 1. Local polynomial comparing the likelihood of teenage motherhood over local access to abortions and contraception.



Notes: Access to abortions was defined as the share of women in a stratum who reported that they had ever had an abortion. Access to contraception was defined as the share of women in a stratum who were currently using modern contraception methods.

As expected, variables such as contraception and teen sexual activity related to teenage motherhood as shown in Figure 1. Note the truncated x-axis, though, suggesting that the slope is flatter than it appears here. It should also be noted that it is not clear that we should pay much attention to the stronger downward sloping part of the contraception-teenage mother curve given that the estimates here are based on a very small number of observations.

We did not include these variables in our causal models because they were endogenous. The kernel-weighted local polynomial smoothing graph above shows that there was a negative relationship between local access to contraception and teenage motherhood. Our implementation of local access to contraception was estimated by the share of women in a stratum who said they were currently using modern contraception methods, so it also incorporates acceptability. One of the difficulties, of course, was that this measure was reliant on the demand for contraception, which was derived from the demand for sex without reproductive consequences. Access to abortions was measured in a similar way: the share of women in a stratum who reported never having had an abortion. Figure 1 shows that, contrary to expectations, local access to abortions appeared to have a positive relationship to teenage motherhood. This could be attributable to the relationship of both these variables to higher levels of unprotected sex and pregnancies.

Fig 2. Local polynomial comparing the likelihood of teenage motherhood by the average years of sexual activity before 18 vs. average post-menarche years of sexual activity before 18.

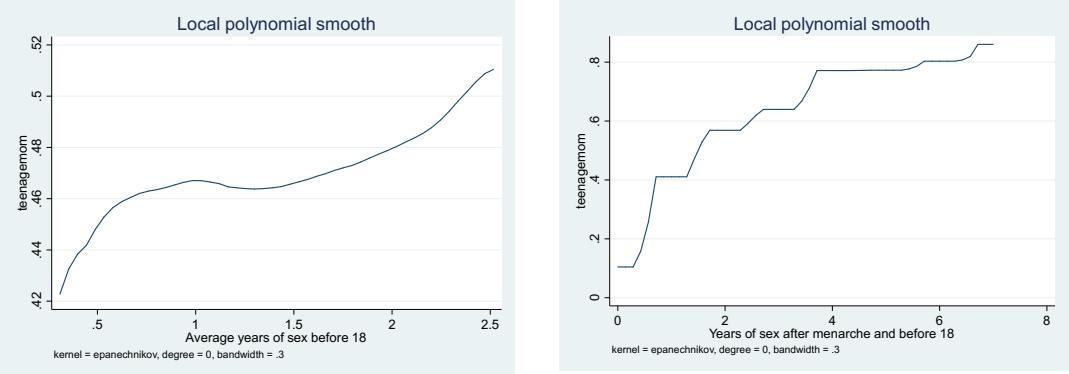


Fig 3. Local polynomial comparing the likelihood of teenage motherhood by years at menarche before 18, for vulnerable vs. non-vulnerable subgroups.

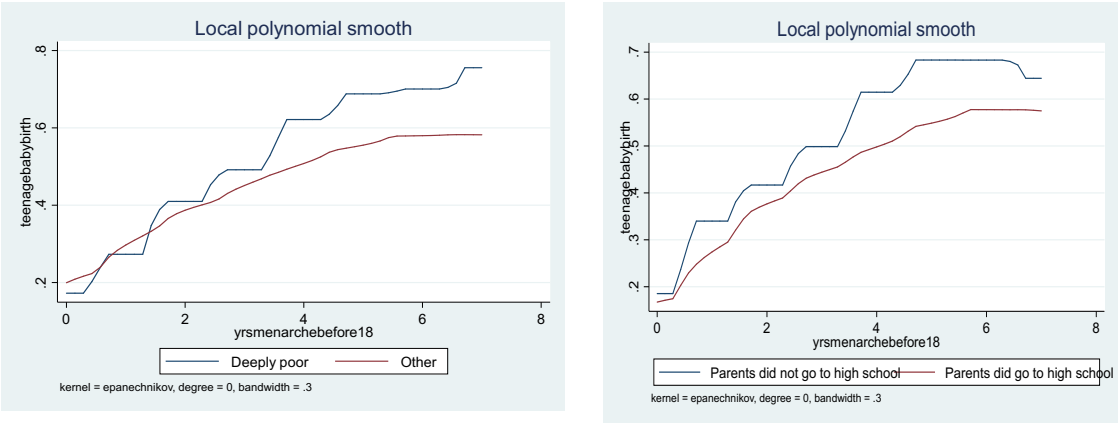
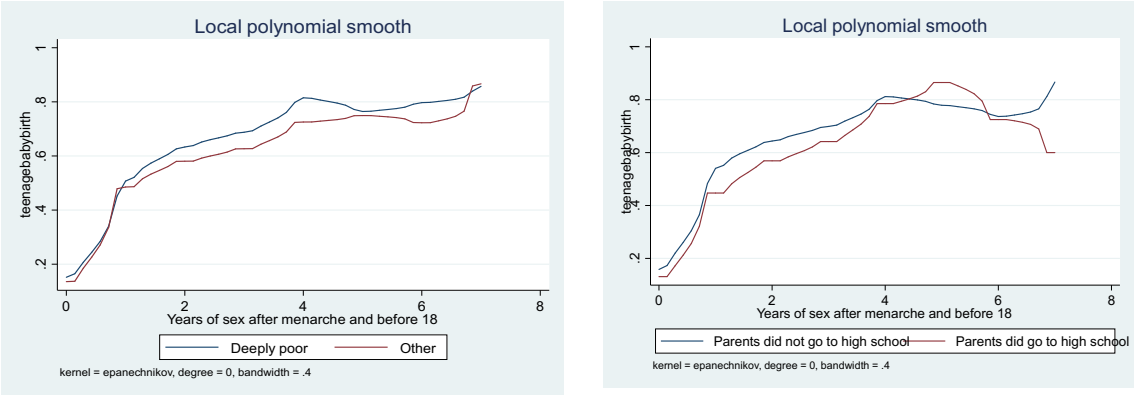


Fig 4. Local polynomial comparing the likelihood of teenage motherhood by (post-menarche) sexually active years before 18, for vulnerable vs. non-vulnerable subgroups.



Note: Deep poverty was categorized as the bottom 20% of households as defined based on a poverty index composed of ownership of radio, TV, refrigerator, bicycle, car, and phone as well as floor material, sanitation, piped water, and information on access to electricity and homeownership. The index was weighted based on a multiple-correspondence analysis.

Figure 2 shows that years of teen sexual activity had a strong relationship to teenage motherhood. Figures 3 and 4 suggest that teen sexual activity may mediate observed relationships to teenage motherhood, including its relationship to poverty and lower parental education (see Figure 3). Once we added teen sexual activity to the age-of-menarche variable (i.e., to capture sexual activity before 18 but after menarche), little evidence emerged of a residual impact of poverty or parental education on the likelihood that young women of reproductive age would become pregnant (see Figure 4), which suggest access to contraception and abortions may not vary much along these dimensions.

Our descriptive analysis also suggested that early marriage was important. Early marriage and childbearing were both associated with a transition in which a child became a caregiver and took up the responsibility of looking after her own household. These additional responsibilities often interfered with further investments in education and career. Moreover, early marriage has been shown to be an important enabler and predictor of early childbearing (World Health Organisation, 2008; Mmari & Sabherwal, 2013). There were, however, many important differences as well, including the parental consent required for teen marriage, and thus we expected separate mechanisms to determine early childbearing outside of a teen marriage and early childbearing within a teen marriage.

The literature acknowledges that teen marriage and teen childbearing are intertwined. First, in terms of prevalence, it is important to note that, while there was a fair overlap between teen brides and teen mothers (38% of total), a noteworthy share of non-overlapping cases also emerged: 35% of teen brides were not teen mothers, and 20% of teen mothers were not teen brides. Overall, there were far more cases in which teen brides did not have children (21% of total) than unmarried teen mothers (8%).

Table 1 below explores this issue further by examining the reasons provided for leaving school. Unfortunately, the question was only included in the Gabon questionnaire. Gabon was a somewhat atypical case because it was the only country in our sample in which unmarried teen mothers (26% of total) were more common than teen brides without children (14%). Accordingly, it was unsurprising to see that, in Gabon, 43% of young women under 25 reported leaving left school because they were pregnant, while only 3% of women reported leaving school because they got married. Thirty-six percent of women reported that they left school as the result of family circumstances or financial constraints.

Table 1: Reason Women Stopped Attending School, Gabon

Pregnancy	42.58
Marriage	3.01
Need to look after children	2.06
Family needs help	2.89
Could not afford school	30.81
Need to earn money	2.10
Graduated	0.64
Did not like school	6.27
School not accessible	1.20
Health problems	8.45

Notes: N = 832

Table 2: Years of Education vs. Marital Status and Motherhood at 18, by Country

	Married at 18, with children	Married at 18, no children	Unmarried, with children	Unmarried, without children	Total
Cameroon	2.07	2.17	5.93	5.83	3.01
Ghana	4.44	4.80	5.01	6.08	5.24
Gabon	5.97	6.14	7.43	8.06	6.94
Uganda	3.13	3.42	5.10	5.44	3.95
Full sample	3.76	3.95	6.57	6.29	7.92

Table 2 shows a comparison between the average number of years of education for women who were teen brides, but not teenage mothers, and women who experienced the reverse—that is, they were teen mothers, but not teen brides. Although selection issues were admittedly at play here, it was interesting to compare the educational attainment of these two categories. The table shows that teen brides tended to have fewer years of education with respect to teen mothers. As expected, teens who were both brides and mothers had the lowest educational attainment, while women who were neither teen brides nor teen mothers had the most years of education.

As the result of our interest in the complicated relationship between teenage motherhood and teenage marriage, we supplemented our teen motherhood models with a set of models that examined the impact of teen marriage on education and labor-market prospects. As proposed by Field and Ambrus (2008), we used the age at menarche as an instrument for early marriage. These results appear in the Appendix. Appendix Table 4 shows that teenage marriage had an impact on education of a similar order of magnitude to that of teenage motherhood.

4.1 Impact of Early Childbearing on Years of Education and Literacy

Table 3 below shows the marginal effects of years of teenage motherhood on literacy and years of education for the OLS and 2SLS models. The negative coefficient on teenage motherhood was significant in both the OLS and the IV models but was larger for OLS regressions than for the IV (-0.258 vs. -0.828; -0.021 vs. -0.106). Plausibly, many different sources of bias may have been present, but, because these effects would have worked in opposite directions, they cancelled each other out. The larger IV coefficient would be aligned with a dominant role for the measurement-error formulation of the endogeneity problem.

Table 3: Impact of Teenage Motherhood on Years of Education and Literacy

Second stage	OLS Years of education	IV Years of education	OLS Literacy	IV Literacy
Years of teenage motherhood	-0.258*** (0.019)	-0.828*** (0.108)	-0.021*** (0.002)	-0.106*** (0.014)
Woman's age	-0.078*** (0.006)	-0.075*** (0.006)	-0.007*** (0.0007)	-0.007*** (0.0007)
Urban	1.012*** (0.154)	0.961*** (0.161)	0.129*** (0.020)	0.122*** (0.021)
Cluster average for parental education	0.515*** (0.023)	0.488*** (0.023)	0.046*** (0.003)	0.042*** (0.003)
Observations	11491	11491	11491	11491
First stage for IV				
Years at menarche before 18				0.219*** (0.013)
Woman's age				0.003 (0.003)
Urban				-0.089 (0.070)
Cluster average for parental education				-0.041*** (0.101)
Partial R-squared of excluded instruments				0.0451
Cragg-Donald F-stat				543.23
Anderson stat				530.78

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. The age variable was continuous. Standard errors were adjusted for clustering. * p<0.10, ** p<0.05, *** <0.01. Standard errors are shown in parentheses.

The instrument was significant and had the expected positive coefficient. The low p-value of 0.000 across the various weak instruments tests suggested that we could reject the hypothesis of weak instruments. The causal effect was large: An additional year of teenage

motherhood was associated with the loss of almost a year of education (0.828) and an eleven-percentage-point decrease in the likelihood of being able to read with ease.

The covariates had the expected signs and were consistent across the three models: average parental education of the cluster, urban location, and being Christian were associated with higher education and literacy. Older women were less likely to have higher education and literacy. The country marginal effects were large and significant showing different experiences among the countries.

4.2 Impact of Early Childbearing on Paid Work

Table 4 shows the marginal effects of the 2SLS model for paid work. Years of teenage motherhood had no causal impact on paid work, but we found a significant coefficient on literacy, showing that the impact of (instrumented) teenage motherhood on paid employment worked indirectly via literacy. The diagnostics showed no concern regarding weak instruments and are summarized below.

Table 4: Impact of Teenage Motherhood on Paid Work

Second stage	OLS (without education controls)	IV (without education controls)	OLS (with education controls)	IV (with education controls)
Years of teenage motherhood	0.002 (0.003)	0.011 (0.014)	0.006* (0.003)	0.023 (0.147)
Woman's age	0.006*** (0.0007)	0.006*** (0.0007)	0.007*** (0.0007)	0.007*** (0.0007)
Urban	0.056*** (0.016)	0.058*** (0.016)	0.027* (0.016)	0.028* (0.016)
Literacy			0.005 (0.017)	0.004 (0.017)
Years of education			0.011*** (0.0022)	0.013*** (0.003)
Observations	11491	11491	11491	11491
First stage for IV				
Years at menarche before 18		0.220*** (0.013)		0.207*** (0.013)
Woman's age		0.003 (0.003)		-0.003 (0.003)
Urban		-0.208*** (0.060)		-0.033 (0.624)
Literacy				0.100* (0.603)
Years of education				-0.080*** (0.008)
Partial R-squared of excluded instruments		0.0457		0.0407

Cragg-Donald stat	549.97	487.50
Anderson stat	537.21	477.45

Notes: All models included fixed effects for religious affiliation, country and ethnic group membership. The age variable was continuous. Standard errors were adjusted for clustering. * p<0.10, ** p<0.05, *** <0.01. Standard errors are shown in parentheses.

Is Teenage Motherhood a Heavier Burden on Vulnerable Women?

Our concerns about vulnerability and intersectionality prompted us to consider whether teenage pregnancy had a larger effect on vulnerable subgroups in which the average parent in the cluster had not completed primary school. We also considered whether our results varied by age cohort, comparing women 25-34 with women aged 35-49. Table 7 below shows that communities with lower human capital and cohorts of younger women carried a heavier burden.

Table 5: Impact of Years of Teenage Motherhood, Comparing Vulnerable Groups and Age Cohorts

	Education		Literacy	Paid work
Full sample	-0.828***	-0.106***	0.011	
	(0.108)	(0.014)	(0.014)	
More vulnerable	-0.986***	-0.121***	0.008	
	(0.135)	(0.019)	(0.180)	
Less vulnerable	-0.449***	-0.066***	0.018	
	(0.157)	(0.017)	(0.022)	
Older than 34	-0.678***	-0.091***	0.009	
	(0.147)	(0.021)	(0.202)	
Younger than 35	-0.878***	-0.110***	0.032**	
	(0.134)	(0.016)	(0.182)	

Notes: For ease of comparison, this table shows only the coefficients on the instrumented-years-of-teenage-motherhood variable. All models included fixed effects for religious affiliation, country, and ethnic group membership. The age variable was continuous. Standard errors were adjusted for clustering. A cluster was defined as vulnerable if the average parent did not complete primary school (fewer than 7 years of education). * p<0.10 ** p<0.05 *** <0.01. Standard errors are shown in parentheses.

V. Critically assessing the Identification Strategy

Exogeneity assumptions ae not directly testable. Instead, they need to be motivated by compelling analytical arguments and empirical evidence refuting hypothetical pathways that could cause the instrument to be correlated with unobserved errors. We know that, while the age at menarche is largely determined by genetic factors, there is evidence of a

relationship with body size, nutrition, cognitive development and stress. It offers some reassurance that empirical relationships in the literature show that these factors will cause bias will dilute the strength of our results. We designed our model identification strategy based on studies that have shown that ethnicity and social disadvantage capture the most prominent social-environmental variations in age at menarche that also influence teenage motherhood. Realizing that this may not convince all readers, we however proceeded to critical examine our identification strategy with falsification testing sensitivity analysis (and robustness tests.

As a falsification test, we applied our IV model to the impact of teenage pregnancy on completion of primary school. Given that only approximately a quarter of girls had their first period before 14, we expected instrumented teenage motherhood to have a much-diluted effect (if any) on primary-school completion. As expected, our falsification test showed that years of teenage motherhood had a substantially diminished (but significant) coefficient of -0.075 in a model of primary-school completion (vs. -0.868 for years of education).

We examined the impact of relaxing the assumption of perfect exogeneity, employing a method proposed by Nevo and Rosen (2012) to estimate alternative upper and lower bounds for estimates. We opted for this method over Conley, Hansen and Rossi (2012) because we had better information about the direction of the potential bias than about the size of the correlation.

Nevo and Rosen (2012) propose to replace the instrument-validity assumption with two others: i) that the correlation of the instrument and the error term were in the same direction as the correlation between the endogenous variable and the error term; and ii) that the instrument was less endogenous than the instrumented endogenous variable. The ii) assumption is plausible and not testable. Because the correlation between the endogenous variable and our IV was positive, only upper bounds were estimated under the default assumptions. Estimates for the imperfect IV bound estimates were -0.126 and -0.02 for the education and literacy coefficients respectively, which are much smaller than the initial estimates but still negative.

We explored the sensitivity of the findings by examining the impact of including additional covariates. The medical literature has provided evidence that age at menarche is

significantly affected by such factors as body size, nutrition, stress, and disease (see, among others, Kaplowitz et al., 2001; Opare-Addo et al., 2012; and Pierce, Kuh & Hardy, 2012). As the result of data availability, we concentrated this analysis on weight, height, hemoglobin level, and anemia status. As suggested by recent clinical literature (Milligen et al., 2014; Vulser et al., 2016), a strong association exists among depression, stress, and anemia. Hence, hemoglobin level and anemia status can be used as proxies for stress. We had height and weight information from the Gabon, Ghana, and Uganda DHSs, but hemoglobin level and anemia status only for Uganda. The findings are reported in Appendix Tables 5 to 8 and show that the results were robust to the inclusion of these variables.

VI. Conclusion

The level of teenage motherhood varied across countries was high, with almost half of respondents reporting that they given birth to their first child before they were 19. Furthermore, our work showed that early childbearing had a significant and sizeable impact on years of education and literacy and, via this avenue, plausibly also on labor-market prospects, which may contribute to a gendered poverty trap. These effects may effectively undo and counter much of the progress made by programs to promote gender equity in schooling, attainment, and outcomes. Ensuring safe and affordable access to contraception and raising awareness of the social acceptability of contraception among sexually active teenagers would be an important first step, but a broader set of policies and reforms are required to effectively respond to this problem.

Appropriate policy solutions would vary across countries. Our results held for the pooled sample of four African countries but, as expected, we also found considerable differences by country in how early childbearing affected women's lives.

It appears sensible to hypothesize that progressive social norms and the impact of teenage motherhood on education and labor-market outcomes may be presented with an inverted U-shaped curve: Societies tend to move toward more progressive gender norms and, if this were represented on the horizontal x-axis, we would expect severely restrictive initial social norms to offer women so few options that discerning any impact of early

childbearing on education and labor-market outcomes would be difficult. All women face severe discrimination that prevents school completion and fair labor-market participation. As a society develops and becomes more open and fair and more appreciative of the importance of women's education, then the impact of teenage pregnancies may start to show in educational attainment. Similarly, as a society starts to prioritize women's education sufficiently to create effective support mechanisms and solutions to enable women to study while caring for a baby, the observable effect of teenage motherhood on education may become very small or disappear but, in this case, for reasons that are entirely different from those in the earlier development stages of misogyny. Given global evidence, it is likely that the impact of early childbearing on labor-market outcomes would be more persistent than its impact on education.

It is difficult to measure the impact of gender norms because they are often so pervasive that not enough variation exists within a country to estimate their effect. Very high levels of discrimination may mask the impact of teenage motherhood, with little difference in education and labor-market outcomes of teenage mothers and other mothers or women. In that event, one could, in principle, resort to comparing the education and labor-market outcomes of teenage mothers with those of the biological fathers—if these data were available; in our case, they were not. Alternatively, a cross-country comparison of developing countries representing a range of gender norms may be a useful avenue to better understand the role of such higher, macro-level constraints.

On another point, our analysis demonstrated the usefulness of including the age at menarche in household surveys. Sommer (2013) showed that very few household surveys have included the age at menarche in their questionnaires and argued that, given the public health importance of this variable and the clear evidence of its credibility and reliability, more surveys should include it. This would have given us access to more data to examine the problem of teenage motherhood in developing countries and facilitate the inclusion of more countries in future DHS analyses of the adverse outcomes of teenage motherhood.

References

Aguero, J. and Marks, M. (2008). Motherhood and Female Labour Force Participation: Evidence from Infertility Shocks. American Economic Review, 98(2), 500-504.

Aguero, J. and Marks, M. (2011). Motherhood and Female Labour Supply in the Developing World: Evidence from Infertility Shocks. Journal of Human Resources, 46(4), 800-826.

Altonji, J.G., Elder, T.E and Taber, C.R (2005). An Evaluation of instrumental Variable Strategies for Estimating the Effects of Catholic Schooling. The Journal of Human Resources, 40, 791-821.

Ameade, E.P.K. and Garti, H. A. (2016) Age at Menarche and Factors That Influence It: A Study among Female University Students in Tamale, Northern Ghana. PlosOne 11(5), n.p.

Ardington, C., Menendez, A. and Mutevedzi, T. (2014). Early Childbearing, Human Capital Attainment, and Mortality Risk: Evidence from a Longitudinal Demographic Surveillance Area in Rural Kwazulu-Natal, South Africa. Economic Development and Cultural Change, 281-317.

Arnett, J. (1992). Reckless Behavior in Adolescence: A Developmental Perspective. Developmental Review, 12, 339-373.

Aryal, T. R. (2007). Age at First Marriage in Nepal: Differentials and Determinants. Journal of Biosocial Science, 39(5), n.p.

Ashcraft, A., Fernandez-Val, I., and Lang, K. (2013). The Consequences of Teenage Childbearing: Consistent Estimates When Abortion Makes Miscarriage Non-Random. Economic Journal, 123, 875-905.

Azevedo, J. P., Favara, M., Haddock, S. E., Lopez-Calva, L. F., Muller, M. and Perova, E. (2012). Teenage Pregnancy and Opportunities in Latin America and Caribbean. Washington DC: World Bank. Available at http://hdl.handle.net/10986/16978.

Becker, G. (1993). Human Capital: A Theoretical and Empirical Analysis, with Special Reference to Education. Chicago, IL: University of Chicago Press.

Bosetti, C., Tavani, A., Negri, E., Trichopoulos, D. and La Vecchia, C. (2001). Reliability of Data on Medical Conditions, Menstrual and Reproductive History Provided By Hospital Controls. Journal of Clinical Epidemiology, 54(9), 902-906.

Brooks-Gunn J., and Furstenberg, Jr, F. F. (1989). Adolescent Sexual Behavior. American Psychologist. 44(2), 249-257.

Caceres-Delpiano, J. (2012). Can We Still Learn Something from the Relationship Between Fertility and Mother's Employment? Evidence from Developing Countries. Demography, 49, 151-174.

Chandra-Mouli, V., McCarraher, D. R., Phillips, S. J., Williamson, N. E. and Hainsworth, G. (2014). Contraception for Adolescents in Low and Middle Income Countries: Needs, Barriers, and Access. Reproductive Health, 11(1), n.p.

Clarke, D. and Matta, B. (2018). Practical Considerations for Questionable IVs. The Stata Journal, 18(3), 663-691.

Conley, T.G., Hansen, C.B. and Rossi, P.E. (2012). Plausibly Exogenous. Review of Economics and Statistics, 94(1), 260-272.

Dorn, L.D., Sontag-Padilla, L. M., Pabst, S., Tissot, A., Susman, E.J., and Eccles, J. (2013). Longitudinal Reliability of Self-Reported Age at Menarche in Adolescent Girls: Variability Across Time and Setting. Developmental Psychology, 49(6), 1187-1193.

Dunbar, J., Sheeder, J., Lezotte, D., Dabelea, D., Stevens-Simon. C. (2008). Age at Menarche and First Pregnancy among Psychosocially at-Risk Adolescents. American Journal of Public Health, 98(10), 1822-1824.

Field, E. and Ambrus, A. (2008). Early Marriage, Age of Menarche, and Female Schooling Attainment in Bangladesh. Journal of Political Economy, 116(5), 881-930

Fletcher, J. M. and Wolfe, B. (2009). Education and Labour Market Consequences of Teenage Childbearing: Evidence Using the Timing of Pregnancy—Outcomes and Community Fixed Effects. Journal of Human Resources 44(2), 303-325.

Freedman, D. S., Khan, L. K., Serdula, M. K., Dietz, W. H., Srinivasan, S.R. and Berenson, G.S. (2002). Relation of Age at Menarche to Race, Time Period, and Anthropometric Dimensions: the Bogalusa Heart Study. Pediatrics, 110(4), E43.

Geronimus, A.T. and Sanders, K. (1992). The Socioeconomic Consequences of Teen Childbearing Reconsidered. The Quarterly Journal of Economics, 107(4):1187-1214.

Glynn, J.R., Kayuni, N., Floyd, S., Banda, E., and Francis-Chizororo, M. (2010). Age at Menarche, Schooling, and Sexual Debut in Northern Malawi. PlosOne, 5(12), n.p.

Gruber, J. (2001). Risky Behavior among Youths: An Economic Analysis. In J. Gruber, Ed., Risky Behavior among Youths: An Economic Analysis. Chicago, IL: University of

Guo, R., Li, H., Yi, J. and Zhang, J. (2018). Fertility, Household Structure, and Parental Labour Supply: Evidence from China. Journal of Comparative Economics, 46, 145-156.

Huang, J., Groot, W., Sessions, J. and Y. Tseng (2019). Age of Menarche, Adolescent Sexual Intercourse and Schooling Attainment of Women. Oxford Bulletin and Statistics, 81(4), 0305-9049

Herrera-Almanza, C. and Sahn, D. E. (in press). Early Childbearing, School Attainment, and Cognitive Skills: Evidence from Madagascar. Demography.

Heath, R. (2017). Fertility at Work: Children and Women's Labour Market Outcomes in Urban Ghana. Journal of Development Economics, 126, 190-2014

Hotz, V.J., McElroy, S.W., and Sanders, S.G. (2005). Teenage Childbearing and Its Life Cycle Consequences: Exploiting A Natural Experiment. Journal of Human Resources 40(3), 683-715.

Hotz, V.J., Mullin, C.H., and Sanders, S.G. (1997). Bounding Causal Effects Using Data from A Contaminated Natural Experiment: Analysing the Effects of Teenage Childbearing. Review of Economic Studies, 64(4), 575-603.

Jahanfar, S., Lye, M.-S., and Krishnarajah, I. (2013). Genetic and Environmental Effects on Age at Menarche, and Its Relationship with Reproductive Health in Twins. Indian Journal of Human Genetics, 19(2), 245-250.

Jensen, R. and Thornton, R. (2003). Early Female Marriage in the Developing. Gender and Development, 11(2), 9-19

Kane, J., Morgan, P., Harris, K., and Guilkey, K. (2013). The Educational Consequences of Teen Childbearing. Demography, 50(6), 2129-2150.

Kaprio, J., Rimpelä A., Winter T., Viken R. J., Rimpelä, M. and Rose R. J. (1995). Common Genetic Influences on BMI and Age at Menarche. Human Biology, 67(5), 739-53.

Kaplowitz, P. B., Slora, E. J., Wasserman, R.C., Pedlow, S. E., and Herman-Giddens, M. E. (2001). Earlier Onset of Puberty in Girls: Relation to Increased Body Mass Index and Race. Pediatrics 108, 347-353.

Kelly, Y., Zilanawala, A., Sacker, A., Hiatt, R., and Viner, R. (2017). Early Puberty in 11-Year-Old Girls: Millennium Cohort Study Findings. Archives of Disease in Childhood, 102(3), 232-237.

Klepinger, D., Lundberg, S., and Plotnick, R. (1999). How Does Adolescent Fertility Affect the Human Capital and Wages of Young Women? The Journal of Human Resources, 421-449.

Lang, K. and Weinstein, R. (2015). The Consequences of Teenage Childbearing Before Roe v. Wade. American Economic Journal: Applied Economics, 7(4), 169-197.

Lundblad, M.W. and Jacobsen, B.K. (2017). The Reproducibility of Self-Reported Age at Menarche: The Tromsø Study. BMC Women's Health, 17, 62.

Marchetta, F. and D. Sahn (2015). The Role of Education and Family Background in Marriage, Childbearing, and Labour Market Participation in Senegal. Economic Development and Cultural Change, 64(2), 369-403.

Meyer, J.M., Eaves, L. J., Heath, A. C., and Martin, N. F. (1991). Estimating Genetic Influences on the Age-at-Menarche: A Survival Analysis Approach. American Journal of Medical Genetics, 39(2), 148-154.

Milligen, B. A., Vogelzangs, N., Smit, J. H., and Penninx, B. W. (2014). Hemoglobin Levels in Persons with Depressive and/or Anxiety Disorders. Journal of Psychosomatic Research, 76, 317-321

Mmari, K. and Sabherwal, S. (2013). A Review of Risk and Protective Factors for Adolescent Sexual and Reproductive Health in Developing Countries: An Update. Journal of Adolescent Health, 53(5), 562-572. Available at doi: 10.1016/j.jadohealth.2013.07.018.

Neal, D. (1997). The Effects of Catholic Secondary Schooling on Educational Achievement. Journal of Labor Economics, 15, 98-123.

Neal, S., Matthews, Z., Frost, M., Fogstad, H., Camacho, A.V., and Laski, L. (2012). Childbearing in Adolescents Aged 12-15 Years in Low Resource Countries: A

Neglected Issue. New Estimates from Demographic and Household Surveys in 42 Countries. Acta Obstetrics Gynecology Scandinavia, 91, 1114-1118.

Nevo, A., and Rosen, A. (2012). Identification with Imperfect Instruments. Review of Economics and Statistics, 94, 659-671.

Nour, N. (2006). Health Consequences of Child Marriage in Africa. Emerging Infectious Diseases, 12(11), 1644-1649. Available at doi: 10.3201/eid1211.060510.

Opare-Addo, P.M., Stowe, M., Ankobea-Kokroe, F., and Zheng, T. (2012). Menarcheal and Pubertal Development and Determining Factors among Schoolgirls in Kumasi, Ghana. Journal of Obstetrics and Gynaecology, 32, 159-165.

Oreopoulos, P. (2007). Do Dropouts Drop Out Too Soon? Wealth, Health, and Happiness from Compulsory Schooling. Journal of Public Economics, 91, 2213-2229.

Pierce, M. B., Kuh, D., and Hardy, R. (2012). The Role of BMI Across the Life Course in the Relationship Between Age at Menarche and Diabetes, in A British Birth Cohort. Diabetic Medicine, 29, 600-603.

Pradhan, R., Wynter, K., and Fisher, J. (2015). Factors Associated with Pregnancy among Adolescents in Low-Income and Lower Middle-Income Countries: A Systematic Review. Journal of Epidemiology and Community Health, 69, 918-924.

Raj, A., Saggurti, N., Balaiah, D., and Silverman, J. G. (2009). Prevalence of Child Marriage and Its Effect on Fertility and Fertility-Control Outcomes of Young Women in India: A Cross-Sectional, Observational Study. The Lancet, 373(9678), 1883-1889.

Reinhold, S, and Woutersen, T. (2010). Endogeneity and Imperfect Instruments: Estimating Bounds for the Effect of Early Childbearing on High School Completion, University of Arizona Department of Economics Working Paper. Available at https://www.researchgate.net/publication/228609269.

Ribar, D.C. (1994). Teenage Fertility and High School Completion. The Review of Economics and Statistics, 76(3), 413-425.

Rosenzweig, M. R. and Wolpin, K. I. (1980). Life-Cycle Labour Supply and Fertility: Causal Inference from Household Models. Journal of Political Economy, 88(2), 328-348.

Sekhri, S. and Debnath, S. (2014). Intergenerational Consequences of Early Age Marriages of Girls: Effect on Children's Human Capital. Journal of Development Studies, 50(12): 1670-1686.

Sneed, C. D., Marisky, D. E., Rotherum-Borus, M. J., Ebin, V., Marlotte, C. K., Lyde, M., and Gill, J .K. (2001). "Don't Know" and "Didn't Think Of It": Condom Use at First Intercourse By Latino Adolescents. AIDS Care, 13(3), 303-308.

Sommer, M. (2013). Menarche: A Missing Indicator in Population Health from Low-Income Countries. Public Health Reports, 128(5), 399-401.

Szwed, A., John, A., Czapla, Z., Kosinska, M. (2013). Influence of Socioeconomic Factors on Age at Menarche of Polish Girls. Anthropologischer Anzeiger, 70(4), 455-470

Sunder, N. (2016). Marriage Age, Social Status and Intergenerational Effects in Uganda, Department of Economics, Cornell University. Available at

https://editorialexpress.com/cgi-bin/conference/download.cgi?db_name=IAAE2016&paper_id=578.

United Nations Population Fund (UNFPA) (2013). Motherhood in Childhood: Facing the Challenge of Adolescent Pregnancy. New York: United Nations Population Fund.

United Nations Population Fund (UNFPA) (2015). Girlhood, Not Motherhood: Preventing Adolescent Pregnancy. New York: United Nations Population Fund.

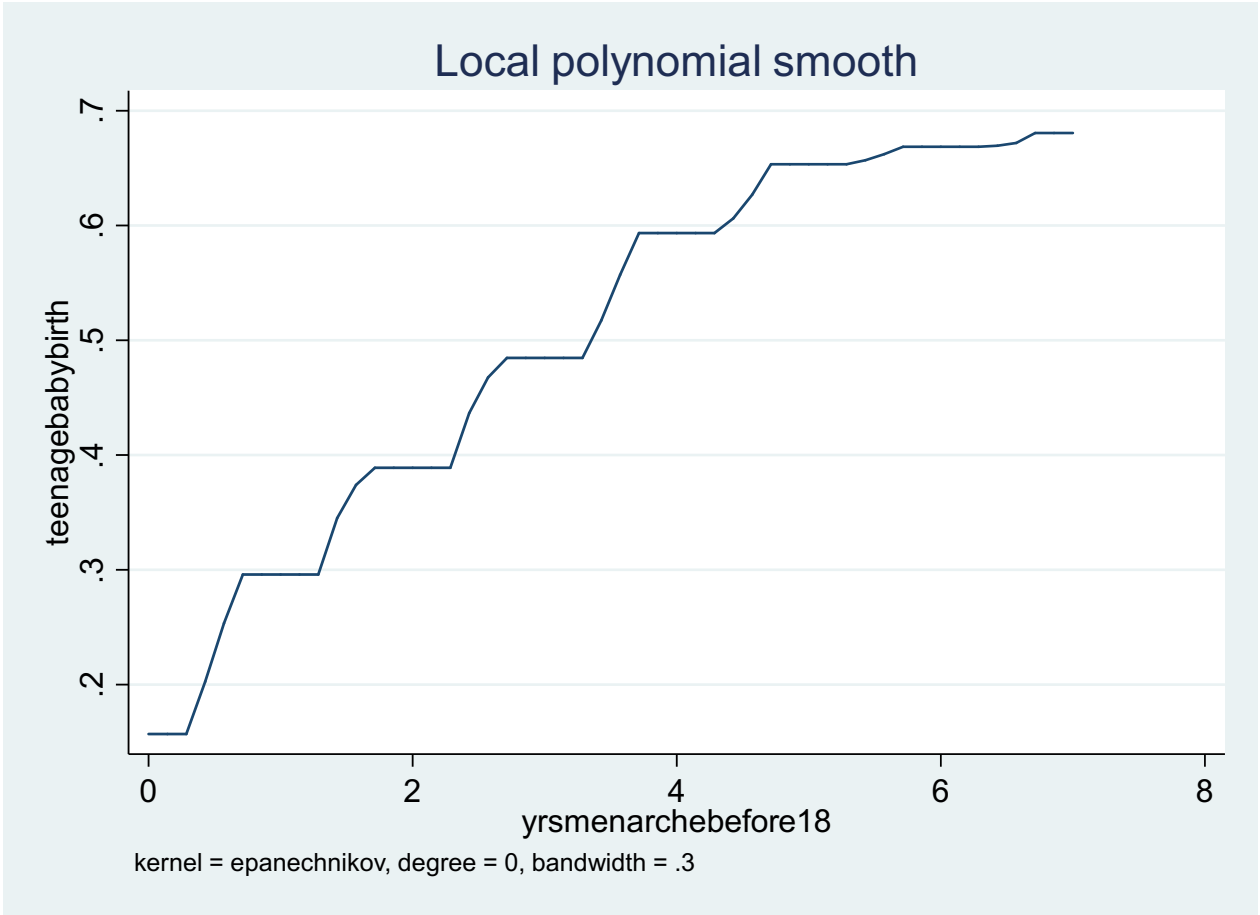
Vulser, H., Wiernik, E., Hoertel, N., Thomas, F., Pannier, B., Czernichow, S., Hanon, O., Simon, T., Simon, J.-M., Danchin, N., Limosin, F., and Lemogne, C. (2016). Association between Depression and Anemia in Otherwise Healthy Adults. Acta Psychiatrica Scandinavica, 134, 150-160.

World Health Organisation (WHO) (2008). Why Is Giving Special Attention to Adolescents Important for Achieving Millennium Development Goal 5? Factsheet. Geneva: World Health Organisation.

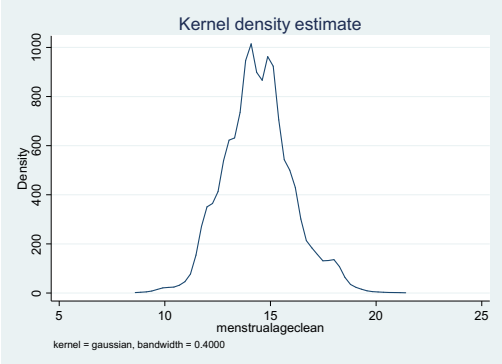
Yakubu, I and Salisu, W.J. (2018). Determinants of Adolescent Pregnancy in Sub-Saharan Africa: A Systematic Review. Reproductive Health, 15(1): 15.

Appendix

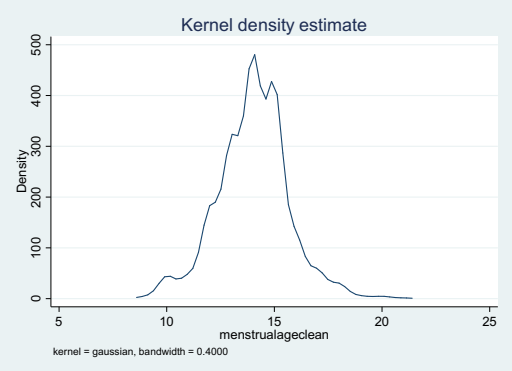
Figure 1A: Local Polynomial Comparing First Period (Years before 18) with Likelihood of Becoming a Teenage Mother



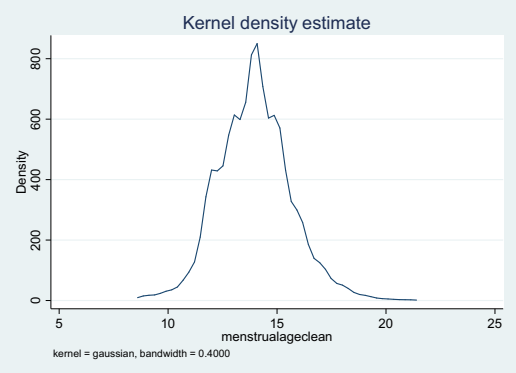
Figures 1B: Kernel Density Graphs for Age at Menarche, Per Country



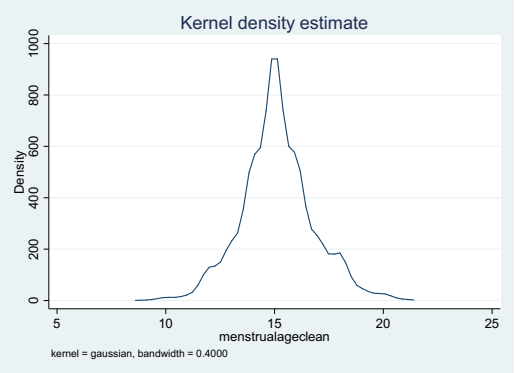
Age at menarche, Uganda



Age at menarche, Cameroon



Age at menarche, Gabon



Age at menarche, Ghana

Appendix Table 1: Means and Proportions for Key Variables

	Mean	S.D.	Min	Max
Teenage motherhood	0.479	0.500	0	1
Years of education	4.945	4.236	0	15
Literacy	0.506	0.500	0	1
Paid work	0.609	0.488	0	1
Works currently	0.764	0.425	0	1
Works currently (excluding work for family)	0.660	0.474	0	1
Woman's age	34.613	6.758	25	49
Urban	0.390	0.488	0	1
Cluster average for parental education	5.991	3.141	0	17
Number of household members	7.048	4.122	1	48
Head of household was a man	0.707	0.455	0	1
Number of children born	5.991	2.661	0	17
Age at first marriage	4.868	4.260	1	18
Years of fertility prior to 18 (menarche)	18.159	1.615	8	40
Years of sex after menarche and before 18	3.579	1.687	0	8
Average years of sex before 18	2.005	0.435	0	8
Access to abortion	1.565	0.122	0.309	2.516
Access to contraception	0.285	0.131	0	0.714

Appendix Table 2: Means and Proportions For Key Variables, By Country

	Cameroon	Uganda	Ghana	Gabon
Teenage motherhood	0.52	0.50	0.34	0.56
Years of education	3.20	4.00	5.23	6.91
Literacy	0.30	0.45	0.45	0.76
Paid work	0.56	0.56	0.82	0.49
Works currently	0.71	0.83	0.89	0.58
Works currently (excluding work for family)	0.58	0.64	0.82	0.57
Woman's age	33.92	34.10	35.49	34.79
Urban	0.40	0.14	0.33	0.77
Cluster average for parental education	3.74	5.68	6.36	7.34
Catholic	0.34	0.42	0.14	0.57
Protestant	0.27	0.41	0.62	0.28
Muslim	0.24	0.11	0.11	0.05
Other	0.00	0.06	0.06	0.02
No religion	0.15	0.00	0.08	0.08
Number of household members	8.97	6.65	5.30	8.22
Head of household was a man	0.87	0.71	0.61	0.70
Number of children born	5.17	5.51	4.22	4.51
Age at first marriage	16.49	17.49	18.81	19.34
First period (years before 18)	3.99	3.59	2.90	4.02
Years of sex after menarche and before 18	2.59	1.97	1.36	2.37
Average years of sex before 18	1.53	1.62	1.48	1.61
Access to abortion	0.31	0.24	0.24	0.38
Access to contraception	0.06	0.21	0.15	0.17
Observations	1546	3404	2782	2716

Appendix Table 3: Comparing Characteristics and Outcomes for Teenage Mothers and Other Mothers

	Other mother	Teenage mother	P-value
Years of education	5.45	4.31	0.00
Literacy	0.52	0.45	0.00
Work	0.65	0.59	0.00
Paid work	0.77	0.74	0.00
Poverty	0.46	0.49	0.01
Cluster average for parental education	6.11	5.64	0.00
Share of husbands in community who support family planning	0.46	0.37	0.00
Age at marriage	19.69	16.42	0.00
First period (years before 18)	3.42	4.28	0.00
Muslim	0.11	0.12	0.07
Urban	0.41	0.41	0.30

Appendix Table 4: Examining the Impact of Teen Marriage on Years of Education, Literacy and Paid Work

	IV Years of education	IV Literacy	IV Paid work
Years of teenage marriage	-0.790***	-0.099***	0.012
Woman's age	-0.071***	-0.006***	0.006***
Urban	0.859***	0.110***	0.061***
Cluster average for parental education	0.446***	0.037***	

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. Age was a continuous variable. Errors are clustered. * p<0.10 ** p<0.05 *** <0.01

Appendix Table 5: Impact of Teenage Motherhood on Years of Education and Literacy, with Control Variables for Weight, Height, and Hemoglobin

	IV Years of education	IV Literacy	IV Years of education	IV Literacy
Years of teenage motherhood	-1.045***	-0.124***	-0.994***	-0.103***
Woman's age	-0.067***	-0.006***	-0.053***	-0.002
Urban	1.009***	0.097***	0.817***	0.080
Cluster average for parental education	0.443***	0.040***	0.658***	0.061***
Weight	0.035***	0.003***	0.037***	0.004***
Height	0.013	-0004	0.005	-0.002
Hemoglobin			0.055	0.010
Observations	5530	5530	2705	2705

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. Age is a continuous variable. Errors are clustered.
* p<0.10 ** p<0.05 *** <0.01

Appendix Table 6: Impact of Teenage Motherhood on Years of Education and Literacy, with Control Variables for BMI and Anemia

	IV Years of education	IV Literacy	IV Years of education	IV Literacy
Years of teenage motherhood	-1.064***	-0.125***	-1.021***	-0.104***
Woman's age	-0.065***	-0.056***	-0.051***	-0.002
Urban	1.049***	0.098***	0.848***	0.081
Cluster average for parental education	0.447***	0.040***	0.658***	0.061***
BMI	0.080***	0.009***	0.090***	0.011***
Anemia			-0.205	-0.043*
Observations	5530	5530	2705	2705

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. Age was a continuous variable. Errors are clustered.
* p<0.10 ** p<0.05 *** <0.01

Appendix Table 7: Impact of Teenage Motherhood on Paid Work, with Control Variables for Weight and Height

	IV (without education controls)	IV (with education controls)
Years of teenage motherhood	-0.002	0.01
Age of mother	0.004***	0.005***
Urban	0.081***	0.048**
Weight	0.003***	0.002***
Height	-0.002*	-0.002*
Literacy		0.03
Years of education		0.010***
Observations	5530	5530

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. Age is

a continuous variable. Errors are clustered.
* p<0.10 ** p<0.05 *** <0.01

Appendix Table 8: Impact of Teenage Motherhood on Paid Work, with Control Variables for BMI and Anemia

	IV (without education controls)	IV (with education controls)
Years of teenage motherhood	0.002	0.027
Woman's age	0.001	0.002
Urban	0.085	0.011
BMI	0.008**	0.005
Anemia	0.021	0.022
Literacy		0.120***
Years of education		0.010*
Observations	2705	2705

Notes: All models included fixed effects for religious affiliation, country, and ethnic group membership. Age is a continuous variable. Errors are clustered.
* p<0.10 ** p<0.05 *** <0.01

Appendix Table 9: Examining the Impact of Teen Pregnancy on Years of Education, Literacy, and Paid Work, with Control Variables for Access to Contraception and Age at First Intercourse

	IV Years of education	IV Literacy	IV Paid work with education controls	IV Paid work without education controls
Years of teenage motherhood	-1.378***	-0.245***	0.036	0.019
Woman's age	-0.072***	-0.006***	0.007***	0.006***
Urban	0.845***	0.113***	0.018	0.041**
Cluster average for parental education	0.451***	0.036***		
Literacy			0.003	
Years of education			0.012***	
Access to contraception	2.819***	0.406***	0.089	0.162**
Community average age at first intercourse (years before 18)	0.118	0.024	-0.013	-0.010
Individual average age at first intercourse (years before 18)	0.408	0.102**	-0.010	-0.006
Constant	3.866***	0.357***	0.339***	0.398***